the Mineralogical Record

Volume Five Number Two

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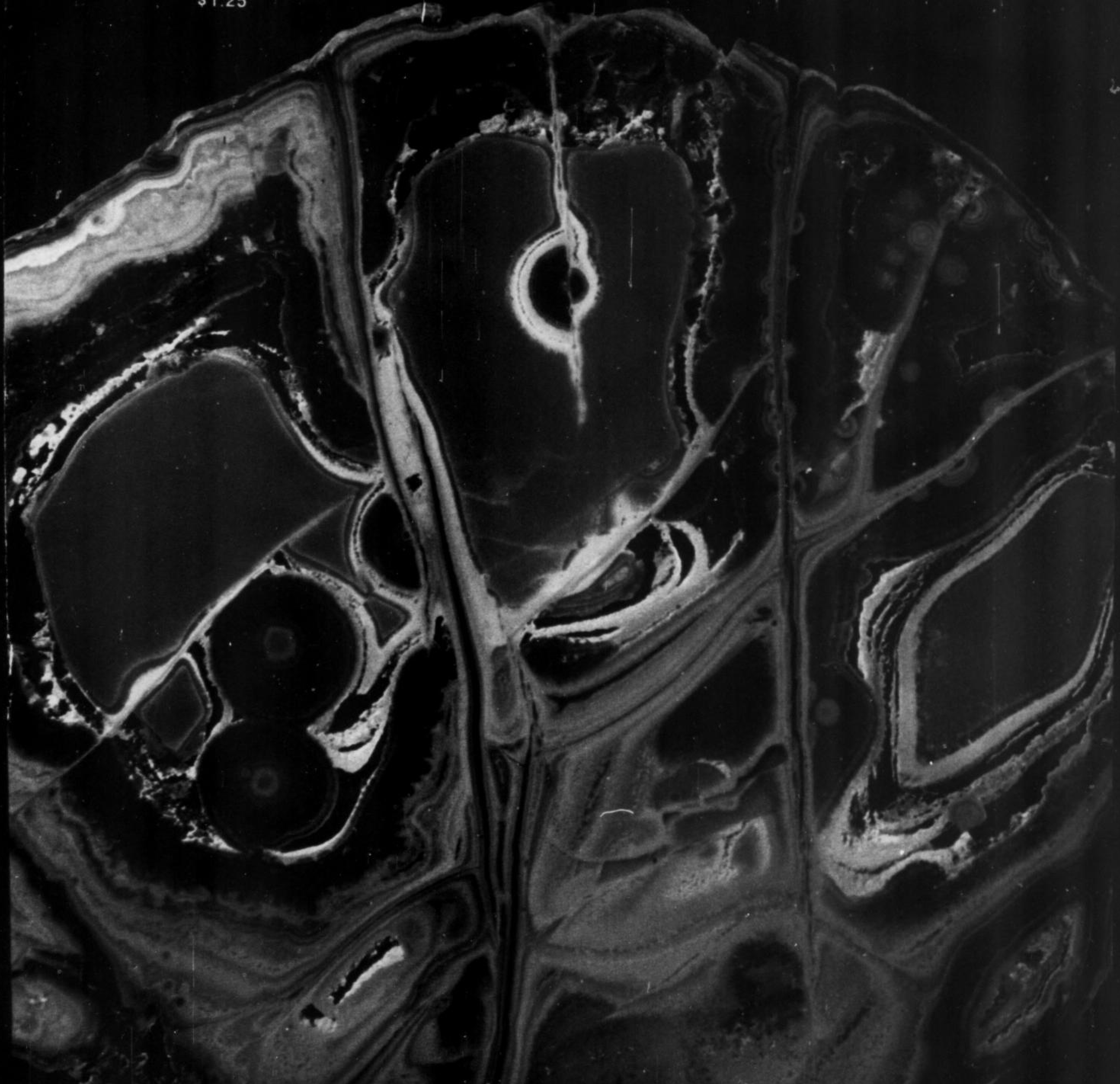

the Mineralogical Record

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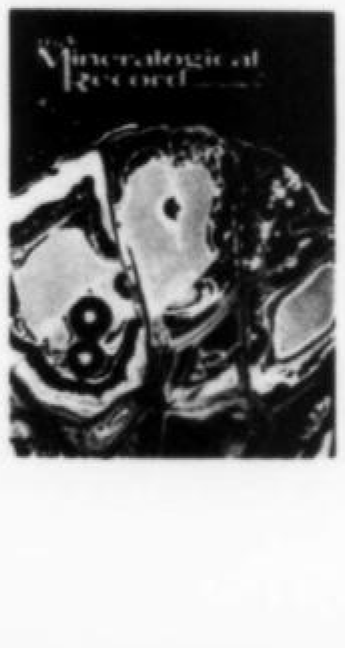


Detail of polished nodule half of variscite and associated alteration phosphates from Fairfield, Utah (Montgomery-Over collection). Secondary minerals in the order of their formation from the primary variscite (green), as clarified by E. S. Larsen, 3rd (*Amer. Min.*, **27**, 281-300, 350-372, 441-451, 1942), are: crandallite (yellow to white bands and areas veining and surrounding segmented variscite relics); wardite (bluish layers and eyes encircling and spotting variscite segments); millisite (whitish bands encircling and partly interlayered agate-like with wardite); gordonite (gray to pale-lavender lath-like crystals occupying solution cavities, especially at top center and to right, between variscite and wardite). *Photo by Lee Boltin.*

Editorial

A Nomenclature Guide For Collectors

I suppose there have always been certain terms used in reference to minerals that were more or less local and restricted in their use to relatively small groups of collectors and dealers. The last ten years have witnessed such an extreme increase in the mobility of both dealers and collectors that many of these terms are now gaining wide circulation. It is not unusual, anymore, for west coast dealers to participate in mineral shows in the east. A large number of dedicated collectors make the annual circuit of the half-dozen or so major mineral shows in this country. Many of these shows draw increasingly large numbers of visitors from Europe, in addition to a significant number from Canada and Mexico. American dealers are now even taking part in shows in Europe. Communications are, therefore, at an all-time high, so it occurred to me that it might be desirable to review some of the descriptive terms that have come into general use from diverse sources. The following are some of the terms that I have been able to come up with after a very limited survey among the dealer, collector and curator friends I've had an opportunity to consult. This list is by no means exhaustive and the terms, most certainly, are not all restricted to mineral collectors and dealers.

It is here emphasized that the majority of these terms circulate among those who are primarily interested in display type crystal specimens.

ASSOCIATION — Two or more species on the same specimen. An otherwise ordinary specimen may be highly regarded because it combines several species not usually found together. *1. Boy, what an association!*

ATTACHMENT — Damage appearing on a display specimen that is not the product of carelessness. *Attachments* are points where the specimen was *attached* to matrix or to the opposite side of a pocket. Some collectors scorn all such damage but there are those who tolerate *attachments* while refusing to accept damage due to careless handling.

BARKER — See under "dog".

BIZARRE — A descriptive term for an exceptionally fine specimen, either because of its overall sculptural qualities, its crystal size and perfection, or its heretofore unique association.

BRICKBAT — See under "heavy".

BRUISE — Damage to a crystal that detracts from its appeal. A *bruise* is readily observed without magnification at arm's length. *Bruises* are generally considered unattractive so that *bruised* specimens are less desirable than *unbruised* ones, a fact commonly reflected in the prices a dealer assigns to his specimens. Synonymy: chippie.

CHIPPIE — See under "bruise".

DECORATOR SPECIMEN — A specimen that is large but so ugly that it could be sold only as a decorator object in a residence, bank, etc. The term carries the implication that the purchaser is not a mineral collector and would never purchase the specimen if he were.

DING — Damage to a crystal that detracts from its appeal. A *ding* is visible at very close inspection without magnification. There is no truth to the expression "five dings make a bruise". This would, perhaps, be true if the *dings* were clustered at one point but they could just as well be scattered all over the specimen.

DOG — An unattractive specimen. The term usually carries the connotation of large size, with the attendant implication that someone else (usually the seller) believes that the specimen is beautiful. Synonymy: barker, doorstop.

DOORSTOP — See under "dog".

FLAT — A shallow cardboard box commonly used for storing and transporting minerals. Often specimens are sold "by the *flat*", or one hears of the "*flat* price" being so much per box. From *beerflat.*

Continued on Page 54

Editorial, Continued from Page 52

FLOATER — A single complete crystal or crystal group having no discernible point of attachment, as though it grew *floating* in a fluid medium. Single crystal collectors are particularly fond of *floaters*.

GAUDY DOG — A very conspicuous specimen which, on first glance, appears superb but is actually a dog.

GRUNGE — A collective term for a number of specimens that are all, more or less, dogs. The term is used to refer to a group of specimens rather than a single piece for which "dog" would suffice. Synonymy: schlock.

HEAVY — A very fine specimen; superior material but not extraordinary. Very good commercial specimen. Not, however, one of the best ever found of a given species. Synonymy: brickbat, winner.

HIGHGRADING — A practice encountered in buying specimens. One *highgrades* when he buys a selection of top specimens out of an offering of many specimens. Many dealers will charge a higher unit price when their stock is *highgraded* than they would if the buyer would take the entire lot.

KEEPER — A specimen that is not available for purchase or exchange.

KEYSTONE — A wholesale price, half of the price on the label.

LOADED — A descriptive term for a specimen that is priced as high as one would assume it could be and still be expected to sell. There is no room left for a mark-up. Contrast with "sleeper".

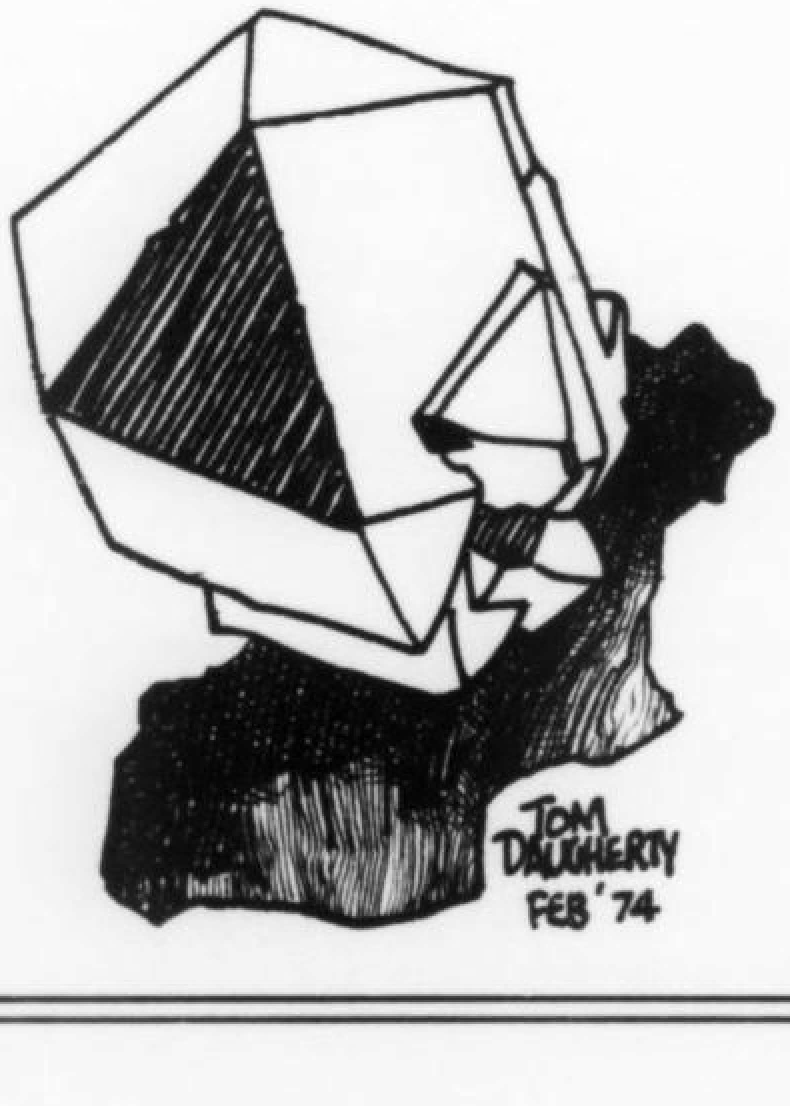
MALLARD — A customer who is a big spender.

MIND-BLOWER — An extraordinary specimen. The type of specimen that would be described as bizarre. Synonymy: red-hot, smoker, world-beater, museum piece (in part).

MUSEUM PIECE — A somewhat archaic term for a very fine specimen. It has undergone a subtle change in meaning. Today, many use the term to mean large and dramatic specimens suitable for display but not necessarily exceptionally fine or valuable. See under "mind-blower".

REPAIRED — A descriptive term for a specimen that has suffered breakage and been glued back together. Except for the *repair* the specimen is in its original condition. *Repairs* may consist of reassembling broken crystals, reattaching crystals to their actual matrix, and rejoining two or more pieces of matrix. Many collectors will identify *repaired* specimens on their labels. *Repaired* specimens are not the same as created specimens. In the latter case crystals are joined to other crystals or matrix to which they were not formerly naturally attached.

ROCKHOUND — A mineral hobbyist who cares little for the study of mineralogy. *Rockhounds* enjoy minerals as wondrous things to behold, they like to go out and dig minerals, and they may perhaps cut and polish them, but they really are not interested in learning much,



if anything, about them. From the German *steinhund* (or vice versa?).

SCHLOCK — See under "grunge".

SILVER PICKING — The practice of purchasing minerals, as opposed to digging them personally or trading for them, is called *silver picking.*

SLEEPER — A specimen that is underpriced or underappreciated so that it is acquired at a cost well below its real value is a *sleeper.* Contrast "loaded".

SMOKER — Variant of "red-hot", see under "mind-blower".

TAILGATE — Originally, to sell specimens from the back (tailgate of a truck) in the parking lot. Now, any extra-show selling.

WILBER — The category of least visible damage to a crystal. A *Wilber* is not readily discernible unless examined under magnification (not to exceed 10X). A relatively small number of collectors allow *Wilbers* to influence their decision when trying to decide upon a specimen purchase. The name comes from David P. Wilber, collector and dealer of Carson City, Nevada.

WINNER — See under "heavy".

WORLD-BEATER — See under "mind-blower".

There have been some other terms mentioned but I cannot escape the conclusion that these were motivated by a large measure of cynicism. For example, the following translation of dealer's descriptive terms was offered:

fine = poorest quality
choice = good study material
extra fine = shows some crystal faces

Another wag defined "pre-show selling" as any sale occurring between the close of a show and the packing and removal of the stock. The explanation is that this is the only interval between shows that is clearly in the *pre*-show category. I feel that these definitions border on insincerity and, as such, are probably not deserving of being included.

It is hoped that the readers of the *Record* may have some terms to add. Suggestions for additions to this "Glossary" are invited.

John S. White, Jr.

FM friends of mineralogy

ANNUAL MEETING

Arthur Montgomery, FM Column Editor

The annual meeting of Friends of Mineralogy, Inc., was held at 4 p.m. on Saturday, Feb. 9, 1974, at the Tucson Community Center, Tucson, Arizona. The meeting was well attended by a large number of members and guests.

Retiring president Dick Bideaux presided. He reminded members that annual tax-deductible dues of $5.00 were due on Feb. 1, 1974, and were to be paid by April 30, 1974. All members not yet paid up in their own Regions, and wishing to retain membership in good standing, should send dues payments at once to FM treasurer: "Wayne C. Leicht, P.O. Box 2514, Costa Mesa, CA 92626."

The treasurer's annual report was read, and its acceptance approved. There was a cash balance, on Jan. 31, 1974, of $3,526.70.

The most important business consisted of nominations for and elections to the Board of Directors, to fill vacancies created by the expiring terms of six directors: Joel E. Arem, Richard A. Bideaux, Herbert V. Corbett, Robert J. King, A. L. McGuinness, Arthur Montgomery. Eight candidates were nominated and elected: Joel E. Arem, Raymond W. Grant, David E. Jensen, Robert W. Jones, Dona Lee Leicht, A. L. McGuinness, H. Earl Pemberton, Abel Selburn.

Among new business, Gerhard Muehle, of Region 10, spoke for an FM project to compile a loose-leaf card index of handy reference data on new minerals. Paul B. Moore, MSA representative on the FM board of directors, discussed the Muehle project, and also asked members for suggestions on means of effecting closer cooperation between MSA and FM.

A meeting of the board of directors came right after the annual membership meeting, with Dick Bideaux presiding as chairman. The most important action was the election of officers. Nominees on the slate presented by the nominating committee, consisting of Dick Bideaux and Arthur Montgomery were: for president, H. Earl Pemberton; vice-president, Raymond W. Grant; secretary Dona Lee Leicht; treasurer, Wayne C. Leicht. Joel E. Arem was nominated as a second candidate for president. Earl Pemberton was elected president by a majority vote, followed by the election of the three other slate candidates.

Some background on the newly elected officers may be appropriate: Earl Pemberton, well known for writing and research on the minerals of California, has been a vital force in FM since its inception and chiefly responsible for its recent incorporation and tax-deductible status; Ray Grant, one of FM's founders, has been a key figure in Region 3 and a long-time researcher on Pennsylvania minerals at Lafayette College; Dona and Wayne Leicht, while continuing in their indispensable national secretary-and-treasurer services, have played central roles, as secretary-treasurer and regional coordinator, in the activities of Region 14.

With president Pemberton presiding, these actions were approved by the Board: letters of appreciation to go to the retiring president and directors for their dedicated services; funding, equal to that expended by MSA and not exceeding $500, of costs of the joint MSA-FM symposia held during the Tucson Show; authorization to each FM Region to withdraw funds up to one-half of the dues collected in its Region without special directors' approval;' consideration to be given to the means of selection of new Regional Coordinators and the possible need for redefining some Regional boundaries to better reflect membership numbers and activity.

Official appointments since the directors' meeting have included: Delbert L. Oswald, active in Region 3, as Historian; Gerhard Muehle as chairman of an ad hoc committee to prepare a pilot issue of a loose-leaf card index of data on new minerals; an executive committee, consisting of Ray Grant, Wayne Leicht, David Jensen and Earl Pemberton, with Dick Bideaux as a past-president *ex officio* member. David Jensen, of Region 2 and long active in amateur mineralogy, is the current president of the Eastern Federation of Mineralogical and Lapidary Societies.

An Abridgement, approved by the president, of the official Secretary's Minutes of the annual meeting follows:

ANNUAL MEETING OF FRIENDS OF MINERALOGY, INC.

Held at 4 p.m., Saturday, Feb. 9, 1974, at Tucson Community Center, Tucson, Arizona.

President Richard A. Bideaux called the annual membership meeting to order at 4:15 p.m. Members were reminded that dues, now tax-deductible, were due on Feb. 1, 1974, and should be paid by April 30, 1974. The treasurer will send a dues notice to all members not in attendance.

Executive committee decisions during the year, subject to Board of Directors' approval were:

(1) FM would co-sponsor a joint winter meeting with the Mineralogical Society of America (MSA) to be held in conjunction with the Tucson Gem and Mineral Show. FM would make an expenditure equal to that of MSA, not to exceed $500, to fund the event. Approval by the directors was sought on this through a mail ballot; of the responses received, all were affirmative.

(2) Authorization that one-half of dues collected from each Region

can be drawn without Board approval. It was suggested further that the most active Regions might be entitled to a still larger allocation.

(3) The boundaries of some Regions may need to be redrawn to better reflect areas of concentration of members.

(4) The treasurer will be bonded, and was given authorization to consult with a professional accountant (CPA) as to meeting tax obligations in the State of California, under whose laws FM is incorporated.

(5) H. Earl Pemberton, of Santa Monica, California, was asked to serve as FM Parliamentarian.

The president read the treasurer's report for the fiscal year, Feb. 1, 1973, to Jan. 31, 1974. The balance on hand as of Jan. 31, 1974, was $3,526.70. A major disbursement item was a donation of $2,159.35 to the **Mineralogical Record** to pay for educational color plates requested by FM. A motion that the treasurer's report be accepted, carried unanimously.

New Business:

Gerhard Muehle, Region 10, proposed as a possible FM project, the compilation of a loose-leaf card index containing all pertinent data on new minerals.

Paul B. Moore, MSA representative to the Board, discussed the pros and cons of the Muehle proposal. He also asked for suggestions from members on strengthening cooperation between MSA and FM. Nominations to and elections of the board of directors came next. Six directors were to be elected to fill vacancies created by the expiring terms of Joel E. Arem, Richard A. Bideaux, Herbert V. Corbett, Robert J. King, A. L. McGuinness, Arthur Montgomery. The nominating committee of Richard Bideaux and Arthur Montgomery proposed a slate of four candidates: Raymond W. Grant, Robert W. Jones, Dona Lee Leicht and H. Earl Pemberton. Four more candidates, Joel E. Arem, David E. Jensen, A. L. McGuinness and Abel Selburn, were nominated from the floor. After nominations were closed, all eight nominees were elected unanimously to serve three-year terms on the board of directors.

Richard Bideaux made some concluding remarks about his past year as president, then adjourned the meeting at 5:05 p.m.

BOARD OF DIRECTORS MEETING
OF
FRIENDS OF MINERALOGY, INC.

Held at 5:15 p.m., Feb. 9, 1974, Tucson Community Center, Tucson, Ariz..

In accordance with the By-Laws, a Board of Directors meeting was scheduled immediately after the annual membership meeting. The chairman of the nominating committee, Richard Bideaux, presided. Directors present were: Joel Arem, Raymond Grant, David Jensen, Wayne Leicht, Dona Leicht, Barbara Frank Muntyan, William D. Panczner, Earl Pemberton, Abel Selburn and Charles L. Towle. A quorum was determined to be present.

The first order of business was the election of FM officers for the fiscal year, Feb. 1, 1974, to Jan. 31, 1975. Nominees on the slate submitted by the nominating committee were: for president, H. Earl Pemberton; vice-president, Raymond W. Grant; secretary, Dona Lee Leicht; treasurer, Wayne C. Leicht. A motion that this slate be accepted was approved. The floor was then opened to nominations; and Joel Arem was nominated as a second candidate for president. Earl Pemberton was elected president by a majority ballot vote, followed by the election of the three other slate nominees for officers.

With president Pemberton presiding, the following actions were taken: letters of appreciation were to go to the retiring president and directors; approval of funding, equal to that of MSA and not to exceed $500, of the current joint FM-MSA meeting held during the Tucson Show; authorization to each FM Region to withdraw funds up to one-half of the dues collected in its Region without formal Board approval; consideration to be given to the means of selection of regional coordinators, with Raymond Grant charged to investigate this, as well as to the possible need for changing some regional boundaries to more equably reflect membership population and activity.

The meeting was adjourned at 5:45 p.m.

Respectfully submitted,
Dona Lee Leicht, Secretary

TREASURER'S REPORT, FRIENDS OF MINERALOGY, FEB. 1, 1973 - JAN 31, 1974

Summary

Cash Balance, Feb. 1, 1973		$3,080.38
Receipts		4,580.20
	Total	$7,660.58
Disbursements		4,133.79
Cash Balance, Jan. 31, 1974		$3,526.70

Itemized receipts and disbursements — Feb. 1, 1973 - Jan. 31, 1974:

Receipts

Dues (438 paid-up members)[2]		$2,255.00
Special gifts and contributions		2,190.70
Overpayments on current dues		9.00
Auction proceeds from Region 14		120.00
"Minerals of Pennsylvania" book orders sent in with dues		5.50
	Total	$4,580.20

Disbursements

Donation to **Mineralogical Record**[3]		$2,159.35
Educational awards and expenses		308.06
Incorporation expenses		69.75
Executive Committee expenses (other than National Secretary-Treasurer)		84.03
National Secretary-Treasurer expenses (includes $392.82 for Name Badges)		644.29
Regional Expenses		848.66
Refunds for overpayments on dues		9.00
"Minerals of Pennsylvania" book - paid to Region 3		5.50
Special charges (uncollected dues, bank charges)		5.15
	Total	$4,133.79

[1] Held in Special Account #103-002 at Security Pacific National Bank, Harbor and Wilson, Costa Mesa, Calif. 92626

[2] Includes payments on old and advance dues.

[3] To fund educational color plates requested by FM.

Wayne C. Leicht, Treasurer

BOARD OF DIRECTORS, EFFECTIVE, FEBRUARY 9, 1974

To Serve One Year (1974)

Martin L. Anné, 509 Maple St., Wrightsville, PA 17368
Barbara Frank Muntyan, 6978 Wapiti Drive, Boulder, CO 80301
Charles L. Towle, 4621 E. Don Jose Drive, Tucson, AZ 85718
Neal Yedlin, 129 Englewood Drive, New Haven, CT 06515

To Serve Two Years (1974 and 1975)

Millard M. Groben, Route 1, Box 16, Coos Bay, OR 97420
Wayne C. Leicht, P.O. Box 2514, Costa Mesa, CA 92626
William D. Panczner, 1405 Arden Ave., Clearwater, FL 33515
Richard M. Pearl, Colorado College, Colorado Springs, CO 80903
Mike Ridding, 608 Besserer St., Ottawa, Ontario, Canada
Willard L. Roberts, 628 Harter Dr., Rapid City, SD 57701

To Serve Three Years (1974, 1975 and 1976)

Joel E. Arem, 6451 Fairborn Terrace, New Carrollton, MD 20784
Raymond W. Grant, 120 Parker Ave., Easton, PA 18042
David E. Jensen, 199 East Brook Rd., Pittsford, NY 14534
Robert W. Jones, 3520 N. Rose Circle Drive, Scottsdale, AZ 85251
Dona Lee Leicht, P.O. Box 2514, Costa Mesa, CA 92626
A. L. McGuinness, 4305 Camden Ave., San Mateo, CA 94403
H. Earl Pemberton, 1638 Hill St., Santa Monica, CA 90405
Abel Selburn, 24700 Northwestern Hgwy, Suite 410, Southfield, MI 48075

Non-Voting Representatives for 1974

Mineral Museums Advisory Council:
D. Vincent Manson, 73 Lincoln Terrace, Harrington Park, NJ 07640

Mineralogical Society of America:
Paul B. Moore, Geophysical Sciences, Un. of Chicago, Chicago IL 60637

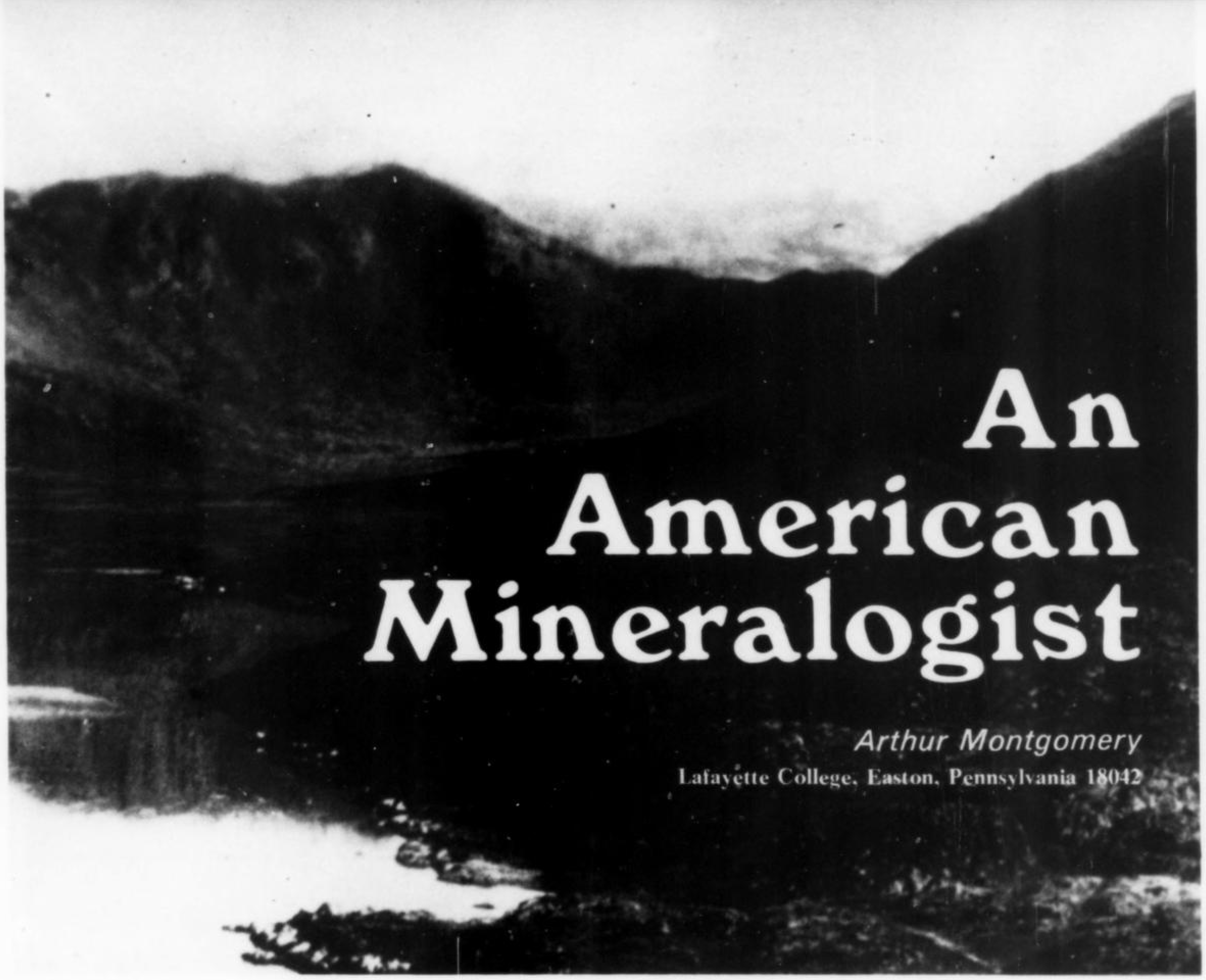
American Federation of Mineralogical Societies:
(to be appointed)

Officers: **President,** H. Earl Pemberton
Vice-President, Raymond W. Grant
Secretary, Dona Lee Leicht
Treasurer, Wayne C. Leicht

Executive Committee: Raymond W. Grant
David E. Jensen
Wayne C. Leicht
H. Earl Pemberton
R. A. Bideaux, ex officio

Historian: Delbert L. Oswald, 9396 Doral Circle, Pittsburg, PA 15237

All news and material relating to FM, for Record publication, should be sent to Dr. Arthur Montgomery at: Dept. of Geology, Lafayette College, Easton, PA 18042



An American Mineralogist

Arthur Montgomery
Lafayette College, Easton, Pennsylvania 18042

Part III

EXPEDITION TO GREENLAND

In the late spring of 1923 Gordon set off on his second major collecting expedition. Its destination was the Julianehaab region at the southwesterly tip of Greenland. From boyhood he had had an irrepressible desire to visit that far-off part of the arctic in search of the rare and beautifully-crystallized minerals collected there many years before by Danish mineralogists. In fact, when still in his early teens, he and his friend, Harry Trudell, had entertained a scheme for purchasing an old boat to use in waters along the southwesterly Greenland coast, if they could once get there. What encouraged that youthful project, and helped make possible Gordon's later trip, were the facilities of the Pennsylvania Salt Company and the location of its headquarters in Philadelphia. For a number of years its ships had been transporting cryolite ore from the mine at Ivigtut in southwesterly Greenland to Philadelphia. Cryolite, an aluminum-rich sodium-fluoride mineral, was used extensively at that time as a flux in the production of aluminum metal from its ores. The cryolite-bearing ships plying between Greenland and Philadelphia offered a unique opportunity to anyone wishing to collect minerals in the Julianehaab region, not many miles distant from Ivigtut.

Permission had to be secured from the Danish government for such a collecting expedition. Apparently no special difficulties were encountered, and the Academy curator would be allowed to carry back home anything he could collect. He was going alone. He would travel to Europe first, visit mineral museums in Paris, Brussels and London, then take a small Norwegian ship from Newcastle to Ivigtut in early summer. At Ivigtut he planned to hire a motorboat and enlist the services of a crew of native Greenlanders; spend several months collecting in the Julianehaab district, especially around the notable locality of Narsarsuk; then, hopefully, get back to Ivigtut with his specimens in time to board, in late summer or early fall, an ore-bearing ship in its voyage from the mine to Philadelphia.

The story of the Greenland trip was published in the Academy *Year Book* of 1924 (p. 3-12) and is reprinted here in full. Gordon's spelling of most locality names in this account differs slightly from the present correct versions, chiefly *ss* and *q* instead of his *s* and *k*, appearing on the accompanying sketch map (Fig. 1). Permission to copy and use this map was kindly granted by Geodetic Institute, Copenhagen.

The second Vaux-Academy mineralogical expedition: the Julianehaab district of Greenland

The many expeditions of the past have done much to reveal the geology of the land bordering the inland ice of Greenland. Of exceptional interest is the Julianehaab district, between Cape Desolation and Cape Farewell, where are situated the Igaliko and Ilimausak batholiths, *which present unusual geological features, as well as affording many rare minerals.*

Through the courtesy of the Danish Government, and the Pennsylvania Salt Company, the Academy was enabled, during the past year, to send the writer to the Julianehaab district of Greenland for the purpose of collecting minerals. For some time previous to leaving America, active preparation was made to secure on adequate outfit—camping equipment, tent, food, tools, and gasoline. The food was packed in tin cases which fitted snugly into wooden boxes with thumb-screw lids. Each box contained sufficient food for one week, excepting that the meat and biscuits were in separate cases, and when emptied, they were used for packing specimens. The total outfit of 29 cases was shipped to England early in June, and there transferred to the Norwegian steamer "Lom," Captain, Julius Mayer.

After four weeks spent in visiting the mineralogical laboratories and examining collections in Paris, Brussels, London, and Oxford, the writer joined the vessel at Newcastle-on-Tyne. On Sunday, July 1, the "Lom" left Newcastle, at 11:30 A.M. Twenty-seven hours later she passed through the Pentland Firth, between Scotland and the Shetland Islands, into the Atlantic. For several days the sea was rough, after which it became remarkably calm, and we enjoyed fine weather. The approach to Greenland was heralded by cold winds and fog. On Sunday the sea was filled with fantastically carved masses of ice through which the "Lom" made its way slowly. The vessel finally turned southward along the margin of the pack and thence around Cape Farewell, the position of which could only be guessed at. That night was spent in dodging great icebergs, some of which we passed so closely as to be able to hear the waves beating against their sides.

The fog persisted until Tuesday morning, when the lifting of the clouds showed us to be just off Cape Desolation (Nunarsuit). Many icebergs gleamed in the sun about the ship, contrasting brilliantly with the dark blue water of the strait, and the rugged brown mountainous coast. In the distance was Umanak, marking the approach to the Arsuk fiord, and behind it the peak of Kingnait. In the evening the "Lom" anchored in the fiord, just beyond the village of Arsuk, proceeding to Ivigtut the next morning. Close to the shore of the fiord is the famous cryolite mine, a unique pegmatite deposit composed of cryolite, cryolithionite, siderite, quartz, galena, and chalcopyrite,

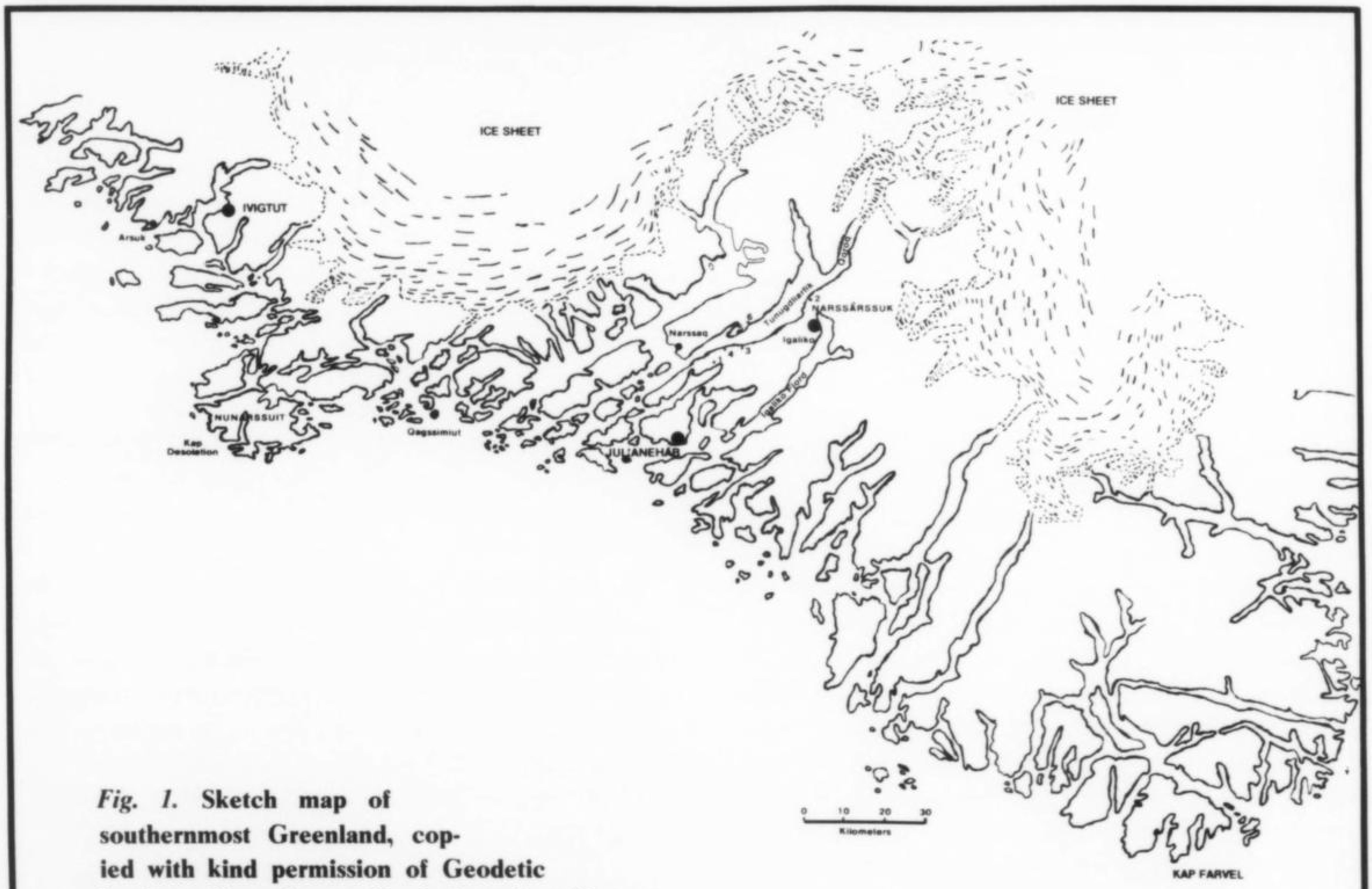


Fig. 1. **Sketch map of southernmost Greenland, copied with kind permission of Geodetic Institute, Copenhagen. Gordon's main collecting sites, with their present correct name spellings on the map differing slightly from his versions, are shown approximately at: 1(head of Kangerdluarssuk fjord); 2(Narssârssuk); 3(Tuperssuatsiaq); 4(Naujakasik); 5(Nunarssuatsiaq); 6(Tugtup agtakôrfia).**

Fig. 2. **Ivigtut in 1923. Open pit of cryolite mine close to shore and surrounded by houses. Gordon photo. From ANSP Year Book, 1924, p. 3-12.**

with secondary thomsenolite, pachnolite, gearksutite, and ralstonite.

Arrangements were made to leave immediately for Julianehaab in the Kontrollør's motor-boat, the "Else". Everything was stowed on the boat, and accompanied by a kayakman, the "Else" left at 1 P.M., Wednesday. The warm sunny weather of the inner fiord was soon replaced by the cold cloudiness of the outer fiords and skerries. The way was quite tortuous, now we passed down wide and deep fiords, elsewhere were small connecting channels passable only at high tide. Occasionally we obtained fine views of the Inland Ice, or of glaciers debouching at the heads of the fiords, which were frequently filled with great icebergs. In the evening my companions brought out a loaf of dark bread, and a kerosene stove, over which they cooked a pot of coffee; afterwards all but the steerman huddled about the boat in sleep.

At midnight the boat reached Kagsimiut, a small group of huts dimly seen clustered on the rocks. In the distance gleamed the Inland Ice, over which the sky exhibited a ruddy glow by its reflection. A pilot was now added to the already numerous crew of the boat. At eight o'clock the next morning the "Else" turned into the harbor of Julianehaab, with its 450 inhabitants, the second largest village in Greenland — a veritable metropolis.

The Julianehaab district is underlain by Precambrian granite, with an area of red sandstone with interbedded flows, presumably of Devonian age.[1] *Intrusive in these basement rocks are two large nepheline-syenite batholiths. The northern one, cut by the Korok fiord, consists of foyaite with a margin of augite-syenite, in which is situated the mineral locality Narsarsuk. Thirty-five kilometers to the southwestward is the Ilimausak batholith, cut by the Tunugdliarfik and Kangerdluarsuk fiords. Remnants of the roof of the batholith exist as caps on Ilimausak and the Hatten. The nepheline-syenitic magma differentiated into a series of rare rocks, which form a stratified complex, beautifully exposed along the fiords. On the north side of Tunugdliarfik, this series comprises from the bottom upward: lujavrite, naujaite, sodalite-foyaite, pulaskite, quartz-syenite, and arfvedsonite-granite. At the head of the Kangerdluarsuk, a similar series is revealed; and in addition another type, the kakortokites, exposed as a series of red, black, and white bands on the plateau of Kringlerne. Many pegmatites of aegirite, arfvedsonite, feldspar, nephelite, eudialyte, rinkite, sodalite, and steenstrupine, occur in the naujaite.*

It was planned to establish the first camp at the head of the Kangerdluarsuk; a later one on the plateau of Nar-

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[1] Now known to be Precambrian.

***Fig. 3.* Julianehaab in 1923. Gordon photo. From ANSP Year Book, 1924, p. 3-12.**

sarsuk; followed by camps at various points on the Tunugdliarfik.

*Late in the afternoon of July 14th, we reached the head of the Kangerdluarsuk, a magnificent amphitheatre which has been likened to the Monzoni in the Tyrol. A camp site was selected on the north side of the fiord, near a brook. Directly opposite, in the east, was the serrated mountain Kidtlavat — The Comb, behind the lower Laxefaeld. Southward were the twin peaks of Iviangusat rising above the plateau of Kringlerne. Grayish slopes formed the northern part of the fiord, while in the northwest, behind the camp, the side of Nunasarnausak rose precipitously above the water. In the vicinity of the camp was a scanty vegetation consisting of copses of dwarf birch (*Betula nana*), and willow (*Salix glauca*), with blooms of the arctic poppy (*Papaver nudicaule*), the blue willow herb (*Chamaenerion latifolium*), and the yellow saxifrage (*Leptasea aizoides*).*

The writer's staff consisted of two loyal Greenlanders: Peter Hansen of Arsuk, the interpreter, and John Kielsen, of Julianehaab, the kayakman. John furnished the camp with salmon from the Laxe Elv, and halibut from the fiord, which he skillfully caught with a two-pronged spear. It was decided to begin work the first day on Kekertausak, a small island near the western shore, about a kilometer from the camp. At 5:30 A.M., the camp was up and stirring about. The clouds were hanging close to the sides of Kidtlavat and Iviangusat, but the sun was already well up in the sky. After breakfast — oatmeal, pancakes, biscuits, and coffee, the tools were placed in the boat, and we slowly rowed down the fiord.

*The shore of the island is formed of low, grayish-green cliffs of naujaite, a beautiful, variegated coarse-grained rock, composed of large crystals of black arfvedsonite, greenish orthoclase and nepheline, and reddish eudialyte, all enclosing great numbers of small sodalite crystals. The low tide revealed a prolific growth of seaweeds in which were many mussels (*Mytilus edulis*), and small gastropods (*Littorina urdis, *and* L. palliata*). The rocks were encrusted with barnacles, while in the clear waters of the Kangerdluarsuk, many jellyfishes were swimming about. On the south side of the island is a pegmatite, best exposed at low tide. Work was immediately begun on the vein with sledge hammers, revealing crystals of arfvedsonite, eudialyte, nephelite, aegirite, rinkite, and natrolite. Late in the afternoon John returned from the Laxe Elv on the opposite side of the fiord with fourteen salmon. Evening presented a scene of great calm. The setting sun lit up the peaks of Kidtlavat and Iviangusat. All was still, save the rushing waters of the brook and the occasional boom of two stranded icebergs, as they broke up under the influence of the waves and tide.*

In the days that followed, the operations were transferred to the pegmatite veins in the shore cliffs northwest of the Lille Elv, and the steep talus slopes (screes) between the Lille Elv and Nunasarnausak, where much steenstrupine and eudialyte were obtained. The weather continued remarkably fine and clear; there were many days without a cloud in the sky. The only annoyance were the myriads of mosquitoes and small flies, necessitating wearing head nets most of the time. Excursions were made up the Lille Elv and the Laxe Elv; to Niakornarsuk, and Iviangusat. At the end of three weeks our finds were carefully packed in moss preparatory to moving. On August 1st. Dr. Erik Bay-Schmith arrived in his motor-boat, the "Poul-Erik," and we left for Igaliko. At Julainehaab, the next day, everything was transferred to the motor-boat "Bjørn". Soon after turning into the Igaliko fiord, several whales were met, rather alarming the Greenlanders by their antics as they swam in front of the boat. Occasionally a seal bobbed its head above the water.

Late in the afternoon, Igaliko, the garden spot of Greenland, was reached. Most of the population, numbering about seventy, were engaged in haymaking in the tiny fields in front of the sandstone cliffs. The houses were low stone structures, with flat roofs often covered with luxurious growths of daisies. A small herd of cows completed a picture, most unusual for Greenland, and to be found duplicated only at Narsak. Many old Norse ruins can be seen in this vicinity. Twenty-two men and women were engaged to carry the equipment and supplies to Narsarsuk, about eight kilometers to the north. The boxes were slung on their backs, and carried by means of tump lines. From the head of the fiord the route lay northward across a gravelly alluvial plain, traversed by a small river. About five kilometers from Igaliko, an escarpment 300 meters high is reached, on top of which, near the foot of Igdlerfigsalik, Narsarsuk is situated.

The tents were pitched between high rocks, close to the site of the proposed excavations. While the coast of Greenland has a barren and forbidding aspect, the high rugged mountains of the interior, the wide and deep fiords, the glaciers at their heads, and the Inland Ice, present magnificent vistas that truly beggar description. To the southward of the camp could be discerned Igaliko, nestling in front of the red sandstone cliffs near the head of the Igaliko fiord, directly opposite the dark mountainous mass of Ig-

Fig. 4. **Mineral collecting at Narsarsuk. Native workers and shallow pits are visible at right. Gordon photo. From ANSP Year Book, 1924, p. 3-12.**

Fig. 5. **View from Narsarsuk collecting area toward northeast showing Korok (Qoroq) fjord and glacier. Gordon photo. From ANSP Year Book, 1924, p. 3-12.**

anek. Just to the north a field of huge icebergs marked the junction of the Korok fiord to the Tunugdliarfik. Their source, the Korok glacier, was but a short distance away. Below the camp was the wide, blue Tunugdliarfik, whose sinuous course could be seen from Brattahlid, the site of the farm of Erik the Red (discoverer of Greenland), past the reddish palisades of Musartut, to the distant Ilimausak. Farther to the west was the Sermilik glacier and the Inland Ice, beyond which the sun would set, its last rays reddening the peaks of Igdlerfigsalik behind the camp. The Igaliko batholith is a large body of nepheline-syenite, forming an intrusive mass in Precambrian and Devonian sandstone. At the western margin is an area of augite-syenite, a barren, gravelly plateau — Narsarsuk. Numerous coarse pegmatites of aegirite and feldspar occur in the augite-syenite, often containing small cavities, lined with rare minerals. Such cavities may occur also in the augite-syenite.

The operations at Narsarsuk consisted of digging holes and trenches over the small area in which the rare minerals occur. Some fifty holes were dug by the staff, augmented to eight Greenlanders, exposing about sixteen small pockets which produced a variety of minerals including albite, orthoclase, aegirite, epididymite, catapleiite, parisite, ancylite, elpidite, zircon, natrolite, astrophyllite, taeniolite, chalcolamprite, crocidolite, and quartz.

Fresh salmon and halibut were brought daily from the fiord at Igaliko. The Greenlander's diet is far from elaborate, consisting of boiled fish, black bread, and coffee which is roasted in a pan over a birch fire, and ground with a rock. On the night of August 14th a violent föhn wind began to blow. At 3 A.M. all were called out to reinforce the tents with additional rope and rocks. Toward noon of the 15th the wind abated enough to continue work.

August 20th dawned a fine, clear day, and an ascent of Igdlerfigsalik was decided upon. Accompanied by a Greenlander, Andres Egede of Igaliko, the writer left the camp at 7:40 A.M. The climb was an easy one, although progress was at times slow owing to the loose nature of the rocks of the slopes. The crest between the two peaks was soon reached, and at 11:15 A.M., we stood on the summit. Search was made for the records of Steenstrup and Brunn, who ascended the mountain in 1888 and 1894, but their cache could not be found.

A magnificent panorama is revealed at the summit. Far below were the fiords of Igaliko, Kangerdluarsuk, and Tunugdliarfik. In the dim distance was Davis Strait, seen from Nunarsuit (Cape Desolation) to the maze of mountains overhung with heavy clouds, behind Cape Farewell. To the eastward, the Inland Ice, a great white desert, stretched away to the distant nunataks of the east coast of Greenland. To the north and west, the Inland Ice sends glaciers into the Korok and Sermilik fiords, which are filled with many icebergs. In the southwest the mountains Kidtlavat, Nunasarnausak, Nunasarnak, and Ilimausak, appeared as bluish masses in the haze of the noon sun. At 1:40 P.M., we left the summit, reaching the camp at 4 o'clock.

On August 23rd, twenty men and women arrived to carry the equipment and boxes of food and specimens to the foot of the plateau, preparatory to moving to Tupersuatsiak, thirty kilometers to the southwest. The staff was reduced to three Greenlanders, Peter Hansen, Jakob Egede, and Henderik Egede, kayakman. At ten o'clock we departed, three women and three men rowing. The trip was leisurely made, and was enlivened by the songs of the Greenlanders, as they slowly rowed down the fiord. The

***Fig. 6.* Gordon with fellow Greenlanders at Narsarsuk camp. From ANSP Year Book, 1924, p. 3-12.**

***Fig. 7.* Gordon by tent at Narsarsuk. From ANSP Year Book, 1924, p. 3-12.**

*cliffs rise precipitously above the smooth waters of the Tunugdliarfik. The ledges and terraces are carpeted with a heath of juniper (*Juniperus siberica*), blueberry (*Vaccinium uliginosum*), and crowberry (*Empetrum nigrum*), with occasional copses of willow and birch. In the afternoon a short stop was made for lunch, which, for the Greenlanders, consisted of a small dried fish similar to a smelt; sodde (*Mallotus villosus*), and blueberries. On the way, Henderik shot several ducks.*

Late in the afternoon the tents were set up at Tupersuatsiak, close to the bay. Many horizontal pegmatites are exposed in the naujaite cliffs, and these produced crystals of aenigmatite and arfvedsonite. Ptarmigans were very abundant; on one occasion Henderik shot thirteen. Stewed ptarmigan with fried sweet potatoes (canned), huckleberries and cream, biscuits and tea, proved a delicious repast at the end of the day, and a welcome change from halibut and salmon.

*On August 26th, a row boat with four women and one man (the steerer) arrived from Narsak, and the camp was moved to Naujakasik farther down the fiord. An excursion was made to South Siorarsuit, where albite and ilvaite occur. The talus slopes below the cliffs of Naujakasik afforded many crystals of eudialyte, steenstrupine, and schizolite, and a few specimens of dahllite and britholite. On the 26th, it began to rain in the evening, after forty days of fine, clear weather. A Greenlander from Narsak brought us a large redfish (*Sebastes marinus*), a species living in the great depths of the fiord, and which, once it accidentally gets to the surface, cannot return.*

The camp at Naujakasik presented a fine view of the eight kilometer section of the Ilimausak batholith. The different layers, lujavrite, naujaite, sodalite-foyaite, and arfvedsonite-granite, and the roof-remnants of porphyry could be very distinctly seen across the fiord. At Tugtup Agtakorfia, the large blocks of naujaite in lujavrite presented a striking appearance. Thirty-five kilometers to the north, Igdlerfigsalik marked the site of the Igaliko batholith.

After several days at Naujakasik, the tents were moved across the fiord to Nunarsuatsiak, a small hill at the foot of Ilimausak. On top of the hill is a very coarse pegmatite with large crystals of arfvedsonite. Along the shore cliffs is a vein of aegirite and natrolite containing many yellow crystals of "erikite," a mixture of monazite and hydronephelite.

It continued to rain until the end of the month. One night a row boat, accompanied by two kayaks, passed up the fiord on a fishing trip, returning late the next night. On September 2nd, the camp was again moved to Tugtup Agtakorfia. A cold wind was blowing from the west, with occasional showers. Search was made along the shore of Igdlunguak for steenstrupine and natrolite.

In the afternoon of September 3rd, the Kaleralik arrived to take us back to Julianehaab. The tents were rolled up for the last time, and at 6 P.M., we left for Narsak. As we passed down the fiord the mountains bulked hugely above the water as dark shadowy masses. In the distance, Igdlerdigsalik, now covered with snow, glowed under the setting sun. In the evening we reached Narsak, a picturesque village lying at the foot of Ilimausak, the two peaks of which are separated by the Narsak glacier. On September 5th, the writer left Julianehaab on the S. S. "Gautatyr," arriving at Ivigtut the next morning. From

Fig. 8. **Greenlanders and Narsarsuk camp. Gordon photo. From ANSP Year Book, 1924, p. 3-12.**

Ivigtut an excursion was made to the glacier at the head of the Arsuk fiord, in the motor-boat "Tertia," accompanied by Engenior Sven Oxcar Corp, and Doctor Skat Illum. A stop was made at Ekaluit, to gather specimens from the nepheline-syenite dike. At many points rills and waterfalls coursed down the precipitous walls of the fiord. The blueberry leaves were now assuming a scarlet hue, vividly coloring the patches of vegetation on the ledges of the cliffs. About noon the "Tertia" anchored in the lee of the glacier, which presented a blue wall about 20 meters high. From a moraine at the side we could climb up to the surface to photograph the seracs.

Another excursion was made one evening to the village of Arsuk, at the foot of Kingnait, to see the dances. The sun was disappearing behind Umanak when we arrived. The dancing was held in a small, low room. The wooden bed had been folded against the wall, and in the recess thus formed, an inconceivably dirty infant lay against the bedding. A single candle hung from the ceiling, while on the window sill, a blubber lamp glowed feebly. The room was crowded with Greenlanders stepping picturesque old Danish folk dances. The dancing included much stamping and shuffling of the feet, and clapping of the hands, as they whirled about, now forming interweaving circles, then breaking into couples or groups of three, to the spirited and infectious rhythm of music skillfully played on a concertina.

*About midnight we returned to the "Tertia." The night was cold and the sky clear, with here and there a greenish northern light. The motor boat left a phosphorescent wake as it chugged rapidly towards Ivigtut. With the beginning of September, the northern lights (*Aurora borealis*) became a nightly occurrence, usually seen as slowly moving, long, greenish clouds, and occasionally as rapidly moving curtains of greenish, orange, pink, and reddish streamers. The mountains about the fiord abound in ptarmigan, arctic hare and fox. A hunting trip of the Arsuk men to the Sermiliarsuk fiord resulted in the killing of twenty-five reindeer, which proved a delightful addition to the Ivigtut larder. At the end of October, thin ice began to form in the fiords.*

On October 24th, the Norwegian steamer "Skulda," Captain R. Petersen, arrived for a load of cryolite for Philadelphia. The equipment, and thirty cases of specimens were stowed on board, and on October 28th, at 6 A.M. the "Skulda" weighed anchor. A short stop was made at Halifax for coal, and on November 11th, we passed up the Delaware, marking the end of an exceptionally interesting and profitable trip.

In conclusion, the writer desires to express his appreciation and thanks to the following for their kind courtesies and aid: the Danish Government; the Pennsylvania Salt Company; the Cryolith Mine-og Handels Selskabet of Copenhagen, and their officials at Ivigtut: Messrs. N. Jagt, E. Stenor, Mr. and Mrs. Robert Larsen; Kontroller Aage Essemann, of Ivigtut; Mr. and Mrs. O. Hastrup of Julianehaab, Dr. and Mrs. Erik Bay-Schmith; Captain J. Mayer of the "Lom," and Captain R. Petersen of the "Skulda." His indebtedness to the Greenlanders for the success of the expedition is heartily acknowledged."

This narrative of Gordon's Greenland expedition belongs among the great classic stories of mineral collecting. Accurately, but also vividly described are the geological surroundings, the mineral occurrences, the flora and fauna, the scenery and weather, as well as the collecting experiences. There comes through eloquently the young author's deep feeling for the bleakness and harsh beauty of the arctic; his receptivity to everything new and strange around him; the close fellowship with his Greenlander companion-workers; and his unmistakable awareness of taking part in a unique and unforgettable experience.

Gordon's accomplishments during this expedition were truly impressive. Despite the indispensable assistance rendered by the Pennsylvania Salt Company in establishing contacts with local personnel and facilitating the use of mining equipment and boat transportation, the responsibility for everything else was his. He had to locate the more promising sites for collecting, direct the trenching and mining work by unskilled natives, recognize the mineralogical identity and relative scientific importance of the excavated material, make meticulous records of observational and descriptive data on occurrences of all minerals precisely as found in each opened-up pocket, select and pack the best specimens for removal to Ivigtut, keep the crew well fed and satisfied, and maintain the work schedule at a rapid pace. The better specimens, a few of which are kept on display in the Academy Mineral Hall, surely rank among the finest of the rare and beautifully-crystallized species ever to come from this Greenland area. The achievements were those of a twenty-six-year-old collector operating on a shoestring thousands of miles from home. He would go on other far-distant mineral journeys; but none would come up to the challenge, excitement and special flavor of this expedition to the arctic.

COLEMANITE
from the THOMPSON MINE

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INTRODUCTION

A remarkable new find of colemanite, $Ca_2B_6O_{11} \cdot 5H_2O$, was made in the summer and early fall of 1972 at the Thompson mine in Death Valley. Beautiful lustrous crystals of a very blocky habit sometimes exceeding eight inches across were found. There is little doubt that this find will stand as the best ever for colemanite, even though the crystals habit is radically different from both Boron, California, and Kirka, Turkey, material.

HISTORY

The Thompson mine is located in Furnace Creek Wash on the eastern slope of Death Valley two miles northwest of the old borate mining camp of Ryan. It was first claimed by the Pacific Coast Borax Company in about 1915 as the Clara lode. Patent was applied for but, through some now forgotten error, patent was not granted. Pacific Coast Borax Company did not realize this error, began paying taxes on it, and stopped assessment work at that time.

In 1921, Messers, Russell, Monaghan, Barlow, and Hill discovered this title flaw and filed claims on the area as the Boraxo No. 1 and No. 2. A classic court battle ensued (after a couple of physical battles came to naught), and the new claimants were granted title.

During the next few years, the 60 foot Russell shaft was sunk and very limited mining was done. It is not now known just when the 100 foot away Thompson shaft was sunk. The origin of the name Thompson is also unclear. Apparently this shaft represents the early discovery shaft for Pacific Coast Borax.

Having lost the claim in the courts, Pacific Coast Borax Company resorted to buying back the mine. Repurchase was completed in 1935. The courts were not to be kind however, for anti-trust charges were made concerning restriction of trade. The result was a long drawn out court battle in which Pacific Coast Borax was ordered to divest itself of the Thompson in 1945. No buyers could be found however, until 1960, when Kern County Land Company purchased the mine for $200,000.

Kern County Land sunk a new 120-foot shaft and shipped a few thousand tons of colemanite ore in the 60's, the first significant production recorded. The mine became inactive again, and during this period Kern County Land

***Fig. 1.* Boraxo pit #1. Looking from east to west. Colemanite area at the lower edge of the picture to the left of water in the bottom of the pit.**

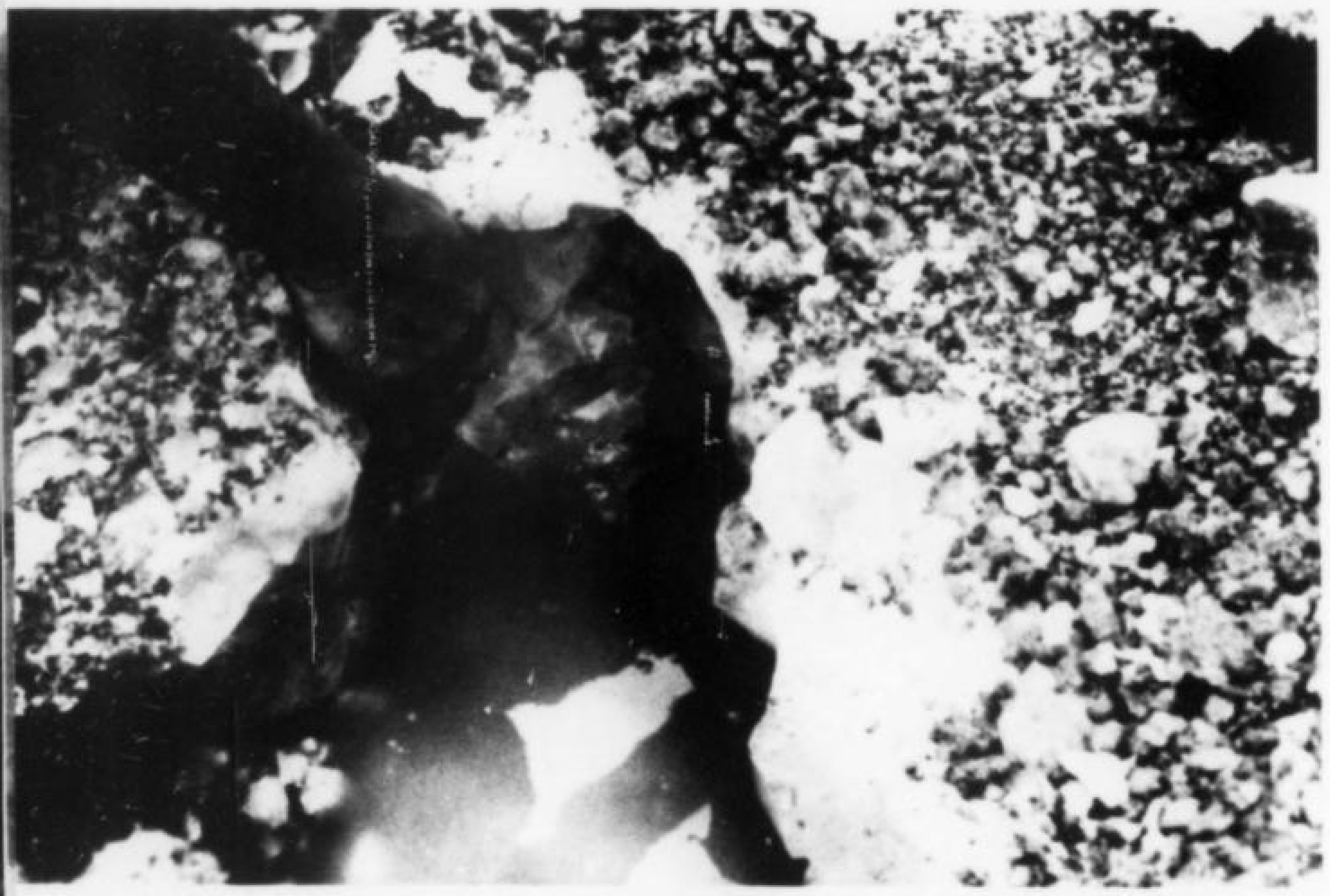


Fig. 2. **One of the water-filled pockets of colemanite in the pit bottom. Note the large crystal size.**

merged into the Tenneco Company. Tenneco reopened the mine in 1971 as an open pit about a 1/4 mile west of the shafts. The Boraxo pit is the current name, although it is still termed the Thompson by most people. (Note: The authors have retained the name Thompson because of long usage. Some recent labels may read "Boraxo Pit No. 1", and older labels "Russell Shaft.")

The first record of mineral collecting at the Thompson was somewhere in the late 20's or early 30's. Harry Gower, Magnus Vonson, and Willard Perkins all collected a few large crystal groups at about a 60-foot depth in the Russell Shaft. Vonson is reported to have collected while hanging from a rope. These few groups, somewhat dull and etched from surface waters, stood as the high water mark for colemanite crystal size and were highly sought after by museums and collectors.

GEOLOGY OF THE THOMPSON

A brief review of the general geology is helpful at this point. The orebody occurs on the northern limb of a tightly-folded, east-west striking fold. The borates are completely altered from ulexite to colemanite in the western half of the deposit, but residual ulexite remains at relatively shallow depth in the eastern half. The borates dip at roughly 70-80 degrees to the south, so the south side is best termed the hanging-wall, and the north side the footwall. The bed is up to 40 feet thick, with 2 to 10 feet of coarsely crystalline material on the footwall and 10 to 30 feet of more massive colemanite overlying it. The coarsely crystalline bed is the only one of interest to this article. Colemanite extends from the surface to about 175 feet of depth, where it thins and feathers out at the bottom. Ore extends for roughly 2,000 feet along strike.

ORIGIN OF COLEMANITE

Most of the significant borate deposits of the world (with the major exception of Inder, Russia) originate from hot springs feeding soluble borates into an undrained basin. The primary borates normally laid down are ulexite ($NaCaB_5O_9 \cdot 8H_2O$) and borax ($Na_2B_4O_7 \cdot 10H_2O$). Ulexite is represented by the greatest number of deposits, borax by the largest deposits. As they are relatively soluble, there had to be protection from weathering, usually by burial.

Colemanite is formed when water is able to percolate through the ulexite deposit. The water, sometimes containing $CaCO_3$, dissolves the sodium borate out, leaving the relatively insoluble calcium borate behind as colemanite, usually with a loss of volume. The ideal conditions for this to happen are found in Death Valley, where massive faulting has exposed numerous deposits to surface waters. Many of these deposits are almost wholly altered to colemanite, with only minor residual ulexite in deeper or less permeable zones.

The extensive faulting and fracturing in the Death Valley area have allowed the leached sodium borate to migrate some distance from its origin. Some is dropped out on contact with calcium as colemanite in minor seams and scattered crystals in lake bed clays downstream from the origin. Some migrated up to 15 miles to form the original "cottonball" ulexite beds on the floor of Death Valley.

This explanation of the origin of colemanite is a bit oversimplified, but should give a feel for what happens. It also should not be construed to mean that all colemanite is found as a secondary mineral. It is quite possible for the borate-charged hot spring water to contact surface water rich in calcium, dropping colemanite as the primary mineral. However, primary colemanite is minor compared to that formed from alteration of ulexite. This is particularly true in regard to crystallized specimens.

THE FIND

No colemanite specimens of consequence came out during the first two years in the new open pit at the Thompson. Some very weathered large crystals were noted along the footwall of the steeply-dipping colemanite beds, but nothing collectable. A superb find of hydroboracite and tunellite in the old underground workings was made during this period. This was the subject of an earlier *Mineralogical Record* article.

In late 1971 a significant thing happened—the pit encountered a heavy water inflow in the bottom at about 140 feet in depth. This was a major problem for the mine, but was later to prove to be the incubator of a fabulous crystal find. The water brought a marked change in the nature of the orebody. Above the water table the clay was dry, hard, light tan-colored, and relatively iron-free. Below the water table, the clay was soft, sticky, almost black colored, with probable microscopic dispersions of iron sulfides (unidentified). An oxide-sulfide zone relationship in a borate deposit is a bit novel, but there it was. The old guideline, "look at the matrix color to tell Boron and Death Valley colemanite apart," no longer held true.

Still, through the spring and early summer of 1972, nothing of note showed up but drusy colemanite. Pit No. 1 was almost mined-out. Stripping was well along the next extension to the east. Finally, in mid-summer, Tenneco finished mining the upper layers of the ore and broke into the thin layers of coarsely crystalline colemanite in the very bottom of the eastern end of Pit No. 1 at about 150 feet of depth.

The authors found out about the find independently. In the summer an explosives salesman brought a large mound of white lustrous crystals up to five inches across to Jim Minette at Boron. Jim and Bob Pederson collected at the mine the following weekend. Two weeks later Gerhard Muehle stopped at the mine and found large crystals in the muck pile. Then the fun began.

While the authors, together with Paul Hartman and Chuck Longshore (the Mine Superintendent), probably did the bulk of the collecting, several others were involved. The management was normally rather generous in allowing people in, although at the last, things got a bit out of hand, and restrictions were placed on collecting.

The first few trips, usually weekends, were really spent learning how to collect the locality properly. The collecting zone was about six feet thick by 150 feet long, dipping at 70 to 90 degrees into the pit bottom. Within the six-foot zone, two very prominent beds about two feet apart and each only a foot or two thick produced by far the bulk of the specimens. The largest crystals and pockets tended to be in the lower bed, although both seams produced superb material. Pocket size varied from a few inches to 6 feet across. It is almost certain that all the pockets were interconnected by at least minor openings as water flowed easily from pocket to pocket.

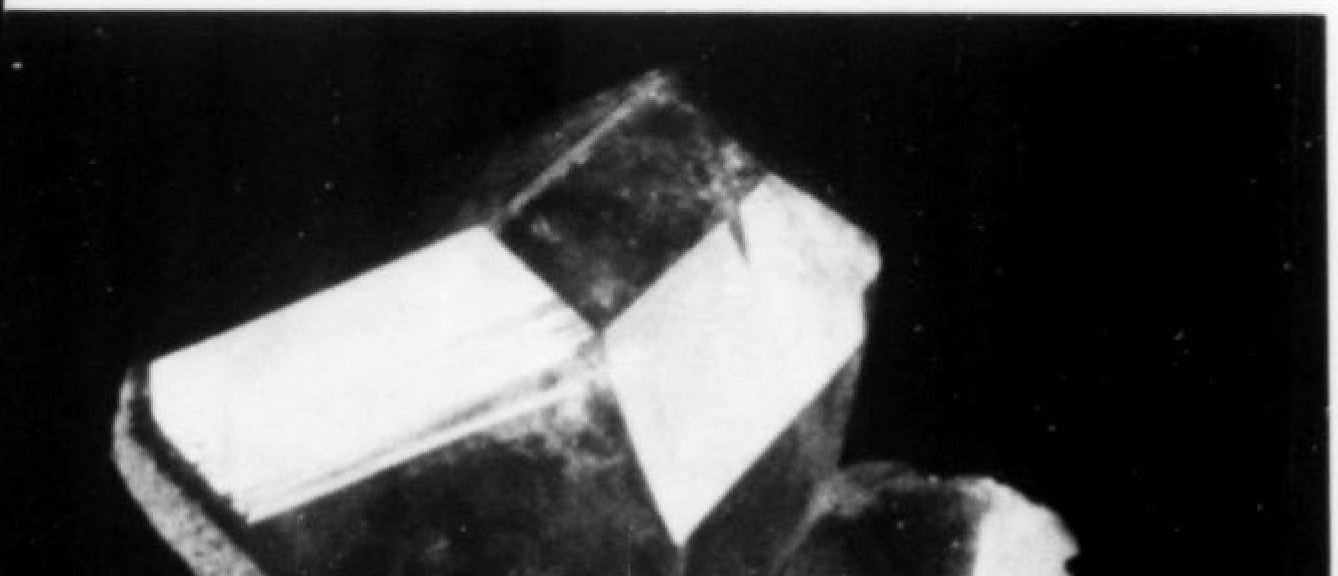


***Fig. 3.* Thompson colemanite. A 1 3/4 inch by 2 1/2 inch golden-hued crystal perched atop a column of white crystals. The Minette collection.**

One very helpful feature was the predictability of pockets. About 30% of each bed was open pockets, and they were distributed along the beds both on the strike and dip at 5 to 10 foot intervals. This simplified collecting somewhat because once a pocket was found, the next one had to be close by.

Earlier it was noted that the water zone was the incubator for the large crystals. The same beds extended from top to bottom of the orebody. Above the water table, the pockets were mud-filled and nearly all crystals were badly etched. Below the water table, the pockets were larger and free of mud; crystals were also larger, extremely clean, and had a fine vitreous to adamantine luster. There is little doubt that active, but very slow crystal growth was in progress when collecting occurred. Considering the large crystal size and the low solubility of calcium borate, the crystals obviously took many thousands of years to form. The lack of evidence of shattering indicates they formed in recent geologic time after faulting and folded ended.

Had the water table been 20 feet lower, little of note would have been found. In the dry Death Valley area, any water at all is unusual. It is not known if the water was stagnant or actually represents a slow flow through Furnace Creek Wash into Death Valley, ten miles to the west and 2.500 feet lower. The absence of any secondary ulexite points to flowing water totally removing the sodium borates.

Initial collecting problems were caused by the mining method. A Caterpillar D-9 ripper-dozer was used to tear out the ore. As the area was below the water table in an area of high clay content, an inspection of the pit floor showed a hopelessly jumbled muddy mess. An occasional decent crystal could be found, but in general the scene was dismal as far as the pit bottom was concerned.

The upper section of the pocket area passed into the east wall, and here much of the collecting time was spent. The pockets were well exposed, clean and dry - and too hard for really good collecting. Some nice "floaters" came out, but it was a beautiful siren tempting the collector to expend hours of work for a few choice pieces.

The real breakthrough came when the D-9 dozed away loose muck from the pit floor and exposed the tops of some fresh pockets. Anything loose was readily removed, but the solid walls, where the largest crystals grew, were usually too hard to work. A chisel merely caused the coarse crystals to fall apart between their intergrowth faces. The management again came to the rescue. They had to rip the area for mining anyway, so the Mine Superintendent had the dozer carefully rip the pocket area—at least as carefully as you can expect from a 50-ton D-9. This was ideal because it cracked the area between the ripper teeth enough to allow proper collecting, yet it did not interfere with mining operations.

***Fig. 4.* A large fine white Thompson colemanite crystal approximately six inches across. Rock Currier collection.**

A realistic estimate is that 10 to 20 percent of all good available specimens were saved when the dozer assisted collecting, as opposed to 2 to 5 percent without the help. Considering everything, the cooperation between Tenneco and collectors was superb and a respectable quantity of specimens was saved.

Collecting reached a peak during October and early November. Just after Thanksgiving, blasting and the start of backfilling brought an effective end to collecting. The bed dips under the pit bottom a short distance before feathering out, but will not be mined.

CRYSTAL DESCRIPTION

A detailed description of the specimens is called for. Generally, the monoclinic crystals ranged in size from 1/2-inch to 8 inches on a side. The most prominent single face is the *c* pinacoid {001}. Single pinacoid faces to 5

TABLE I

Form	Miller Indices	Relative Size	Relative Frequency	Physical Features
c	001	Often largest single face	100%	Very clean, no striations
d	$\bar{1}21$	Very prominent	100%	Clean, Vertical striations
γ	$\bar{1}11$	Prominent (less than d)	95%	Clean, vertical striations
m	110	Prominent	95%	Often coated with secondary growth
β	111	Less prominent	75%	Often coated
α	021	Very small	5%	
κ	011	Very small	5%	
a	100	Small to prominent	10-20%	Almost always found together as beautifully curved composite faces
ν	$\bar{2}21$			
h	$\bar{2}01$			

inches square were noted. The next most prominent faces are a set of domes which, combined with the pinacoid, give a blocky habit. Table I lists commonly observed forms with comments on size, frequency of occurrence, and physical features.

The Colemanite crystal form sketched on Page 350 of *Dana's System Of Mineralogy*, Volume II, Seventh Edition, fits the Thompson habit very well, both as to faces present and relative size. See Figure No. 1.

The curved composite *a-h-v* face was particularly interesting. It was frequently noted, but only rarely developed so that individual faces could be determined. On some exceptional crystals, there were indications of at least three other forms in the curved zone. The *o*{211} form is probably one of these. The other two could not be readily determined. Two enlargements of this zone are shown on Figure No. 2.

The crystal forms in Table II under "rare forms" are usually quite small, and noted on a few specimens or less. Normally, only one or two of the rare faces would be noted on a given specimen. Ten different forms on a given crystal is about the maximum. Chances of finding a new form on a given specimen were really quite good, and many hours were spent looking for them. It should be noted that the number of specimens studied was a small fraction of the total collected. So far 17 forms have been identified, out of a total possible of about 64 known forms for colemanite. No totally new forms were identified.

Orientation of a crystal was not easy at first because most crystals were distorted. However, once the *c* pinacoid was observed to be the only major unstriated face, orientation became easy.

On others, the curved composite *a-h-v* face was a further guide. The perfect (010) cleavage, which is very frequently noted as internal fracturing, was a third good orienting tool.

A significant feature of almost every larger crystal is the presence of two very distinct growth periods. The second growth is about 1/8 inch thick and conforms perfectly to the original crystal habit, but does not always completely cover the first. Bonding between the two layers is weaker than within the regular crystal.

TABLE II

Rarely Observed Crystal Forms

Form	Miller Indices	Relative Size
b	001	Small - noted on two crystals
o	$\bar{2}11$	Possibly fair sized, part of curved area
H	130	Very small, very rare
ι	$\bar{1}01$	Rare
σ	331	Uncommon
ω	131	Very tiny and rare - noted once
κ	311	Very tiny and rare - noted once

Separation of the "cap" was noted where crystals were broken. It is theoretically possible to separate the cap and have a perfect crystal left underneath, with excellent form and only slightly poorer luster.

Crystal color varied from water clear to white, various shades of tan to brown, and grey. The brown coloration is apparently due to slight strontium content in the colemanite. The color was not notable near the outer layers of the crystal. The grey coloration is due to microscopic clay dispersions, again most notable in the outside layer. Another interesting observation is that there appears to be some preferred orientation to the crystals. This is particularly true of the larger crystals in a group. The *c* pinacoid frequently lies on a more-or-less vertical plane. While this is far from universally true, the evidence points to a much greater frequency of occurrence than would be expected from purely random growth. On several larger groups that were very clean and free of secondary growth, it was possible to remember the exact orientation in the pocket. These groups fit the theory well. On others where original orientation was not remembered, secondary growth and frosting aided orientation. Secondary growth is normally on the upper exposed surfaces, because as nucleation of small crystals in a brine occurs, they settle out by gravity on any exposed surface. These comments are based on observation of about thirty specimens from twenty different pockets. This is enough to indicate a possible trend, but short of enough to prove a theory.

FORMATION IN THE POCKET

The crystals had one feature that greatly assisted collecting. That was the presence of "floaters," ridges, and knobs. Some pockets were merely large crystals solidly in the wall. Those were tempting, but seldom produced good specimens because the solid colemanite background was too hard. In others, loose crystal groups were found laying on the bottom, lightly attached to the clay-mud background,

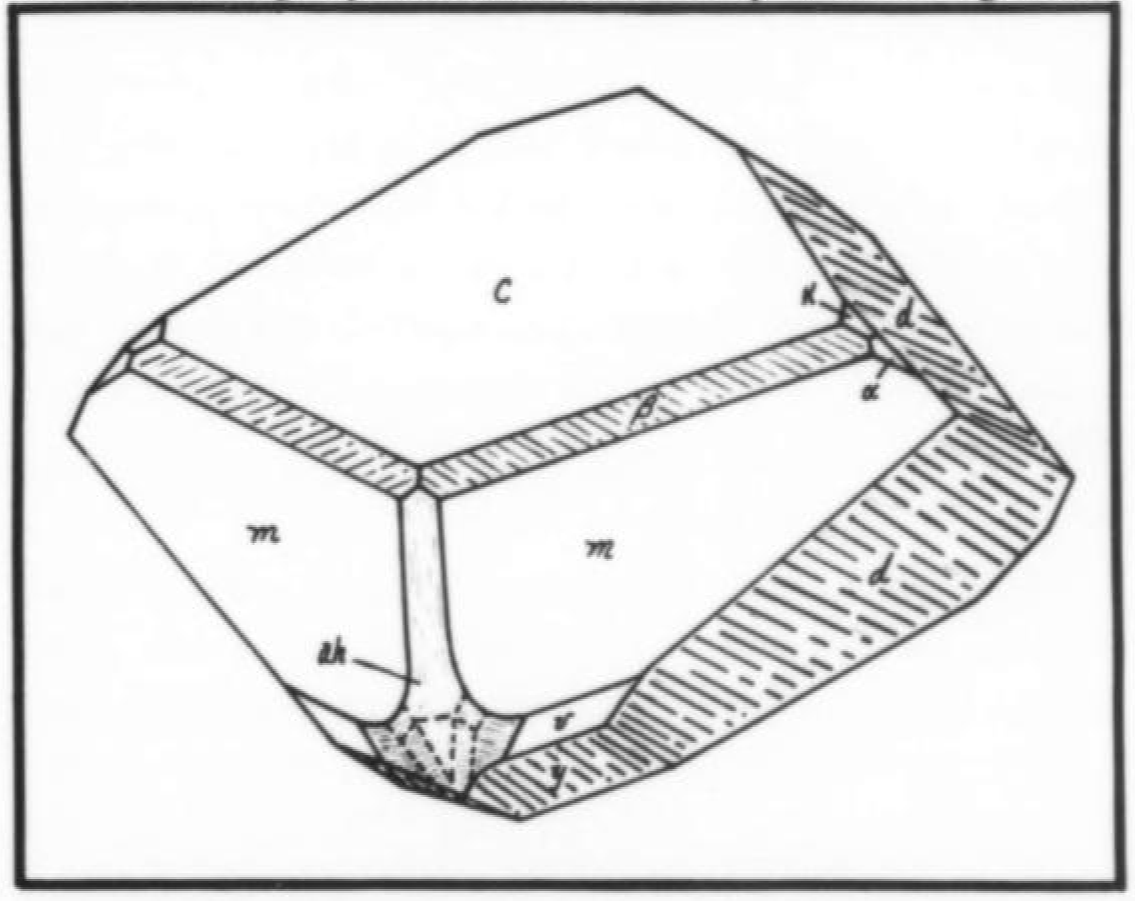


***Fig. 5.* Colemanite, Death Valley. Modified after p. 350, *Dana's System of Mineralogy*, 7th Ed., Vol. 2, showing the *a-h* composite face.**

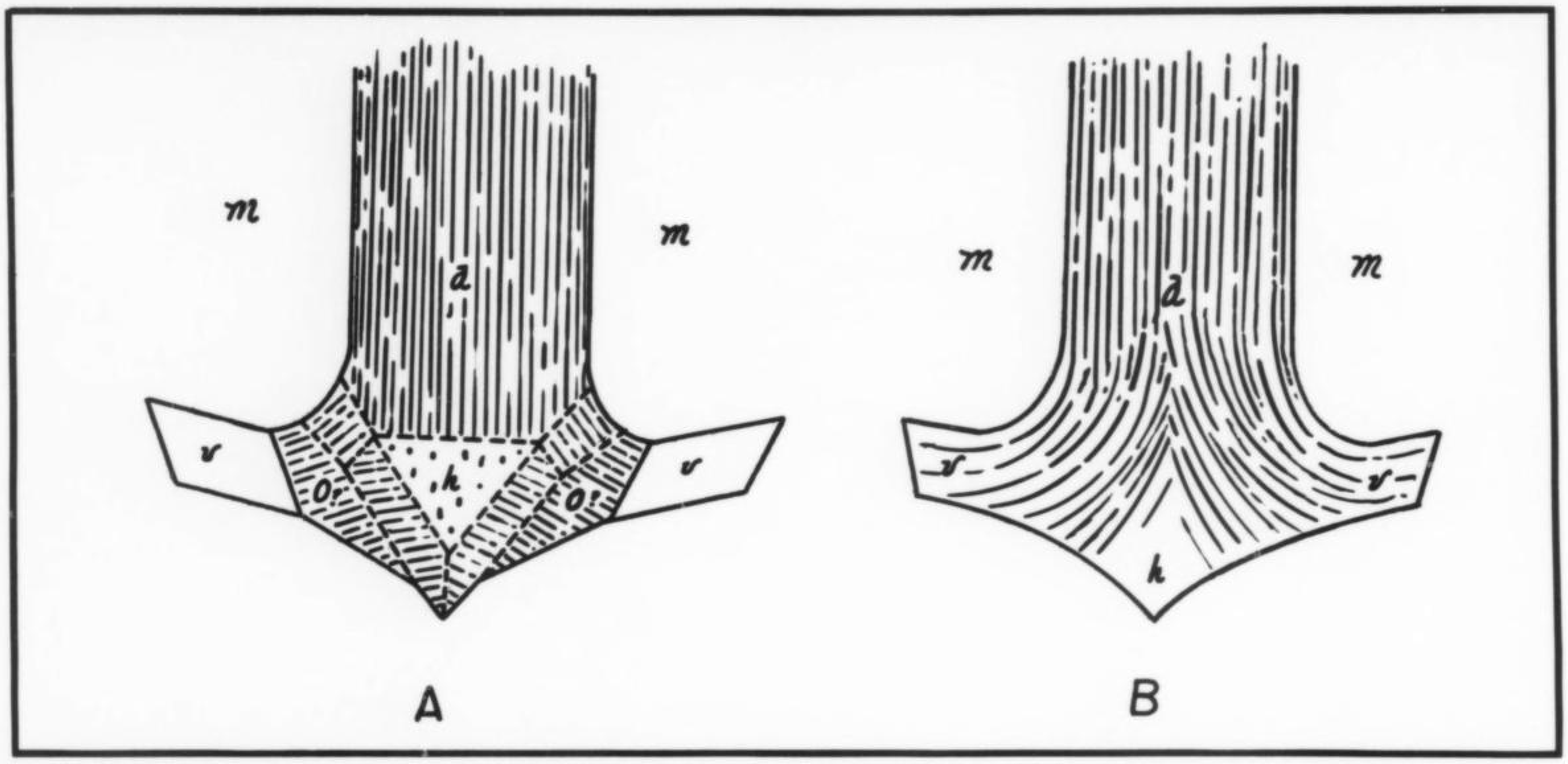


***Fig. 6.* Two enlargements of the *a-h-v* composite face. A. shows an exceptionally well-formed *a-h-v* complex where the *v* faces are individually formed. Dashed lines indicate the approximate edges of faces within the curved surface. B. shows the most commonly found form of the *a-h-v* curved face.**

or projecting as prominent, easily-collected ridges and mounds. Most of the truly fine pieces were of this "floater" type. It is surprising how such heavy specimens could have formed with as little attachment as was evident. One 4 1/2" x 3 1/2" x 2 1/2" single crystal had less than 1/4 square inch of attachment. Mining activity caused many of these to detach and fall to the bottoms of the pockets—fortunately cushioned by water in most cases.

CRYSTAL SIZE

Average crystal size from the find was probably about one inch on an axis. Much larger crystals were quite common though. Many fine groups were taken out with 3 and 4 inch crystals. The largest single crystal actually measured by the authors is about 9 inches square, lying flat in a large group of smaller ones. One of the mine supervisors reported collecting and measuring a broken 13 inch crystal, but it was not clear if this was a true single crystal or a complex group. One collector reported a 12 inch crystal that was broken in mining. This may be, but a similar crystal which the same person claimed was 10 inches square actually measured 6 inches. Probably everyone fell prey to "calibrated eyeball fever," a phenomenon not restricted to fishermen.

ASSOCIATED MINERALS

The only associated mineral of any significance was celestite. Several scattered pockets, always in the upper portion of the footwall beds, had small crystals of celestite coating the colemanite. One pocket had rosettes of pale blue crystals up to one-half inch long. Most were white and much smaller. No celestite was noted in the larger pockets nearest the footwall. There were no ulexite, calcite, or other minerals one would expect in such an environment. The beds directly above the productive footwall zone were composed of typical massive colemanite with small spear-like crystals. Further east, ulexite, hydroboracite, tunellite, and rarer minerals are found, but not in the coarsely crystalline footwall beds.

CHEMICAL STUDY

At the time this was written, only very preliminary chemical and structural studies of the colemanite had been completed. X-ray fluorescence and microprobe work is being done by Wayne Leicht and Ed Saller. Studies of one clear crystal indicated both significant strontium and arsenic. The strontium appears to be uniformly distributed, the arsenic either randomly or layered. Study of a brown crystal indicated four times the strontium as in a colorless crystal. The actual quantity of arsenic and strontium is not known at this time, nor the variation between a large number of samples. No iron was noted in either sample. The work to date is quite limited, but points up some intriguing areas of research. A sample of the brine from the pockets was submitted for analysis. Unfortunately, the results appeared erroneous and incomplete, and it was not possible to get more brine.

COLLECTING VIGNETTES

With any major find, people remember dozens of tales concerning memorable moments. A few are worth recounting here.

The first concerns what is probably the finest single large specimen removed - a magnificent 135-pound 2' x 1' x 1 1/2' mound of white, grey and brown crystrals without blemish. Paul Hartman and Gerhard Muehle were walking along the pit floor when they heard something splash under their feet. They looked down, saw a small hole and started digging. The hole opened into a huge vug, with water about 18 inches to 2 feet down. The big mound was loosely attached to one side, and with a few chisel taps it came loose and slid down into the water. Paul worked his way down into the hole, took a deep breath, went head first into the water and wrapped his arms around it; Gerhard then wrapped his arms around Paul's stomach and hoisted him out. Paul said, "I can't hold it." Gerhard said, "You'll hold it 'til you reach the car, or else!" Paul did. The specimen now resides in the Smithsonian, probably the finest colemanite in existence.

A painful (now laughable) facet of collecting at the Thompson were the cuts received from sharp cleavages. There was, of necessity, a lot of hand removal of debris that fell into the deep pockets. Much of this was in the form of razor-sharp colemanite cleavages. Once, after one of the authors had received a particularly nasty cut, and the area had taken on a vivid red color, the Mine Superintendent commented on the beautiful "Type O" colemanite. The name stuck, and many a jibe about "O" colemanite was made later when anyone cut himself. Gloves were a necessity. Anyone who worked without gloves could expect literally hundreds of tiny slashes, and hands that felt like they had been scalded for several days after. A low pain threshold would have been a real hindrance.

FUTURE

The area of good collecting is now buried with backfill material. Mining of the remaining orebody above the water table to the east will be completed in another year or so, perhaps by the time this is published. The Thompson will be no more. How many times have we heard this before? Defiance and Glove wulfenite: Fairfax, Virginia, apophyllite; ect.—all were superb collecting, prolific but short-lived, as was the Thompson colemanite. All still probably have good material left, but not without major changes in the economics of mining and the specimen market. The remaining Thompson colemanite, probably a 10' x 6' x 100' strip in the bottom of the pit, would require a deep shaft through backfill, and pumps to dewater the area. Someday.

In an earlier *Mineralogical Record* article on hydroboracite (*4*, 1, 21-23) from the old underground workings of the Thompson, certain comments were made regarding the future of that mineral. The access shafts have now been completely destroyed. It has also been learned that the open pit will not be developed in the hydroboracite area. Thus it would appear that this find too will be no more.

The Thompson has produced two remarkable finds so far, does she hold anymore surprises in the remaining short life? We can only hope so.

The authors wish to think Tenneco for their exceptional cooperation and assistance to collectors in saving as much as was possible from the crusher. Particular thanks go to Chuck Longshore, Dave Rau, Jack Cummings, and Clyde Algier, the Tenneco officials who put up with all the antics that collectors are prone to with remarkable calm and good humor.

Since the magnitude of the find became public in November, Tenneco has been flooded with collecting requests. The mine was actually relieved when backfilling covered the area. They have informed us that they can no longer honor requests for collecting except by legitimate scientific institutions.

Special thanks must also go to Dawn Minette, who did the crystal figures and much of the crystallographic work. The photographs are by Gerhard Müehle.

MINERAL NOTES
NEW MINERALS

CAVANSITE

Cavansite and pentagonite, new dimorphous calcium vanadium silicate minerals from Oregon. Lloyd W. Staples, Howard T. Evans Jr., James R. Lindsay

Amer. Mineral., **58**, 405-411, 1973

Cavansite, $Ca(VO)\ (Si_4O_{10}).4\ H_2O$, is a dimorph of pentagonite and occurs as radiating single prismatic crystals .05 mm in diameter and 0.5 to 1.0 mm in length and as spherulitic rosettes. The crystals are orthorhombic with the prism {110} (m) and the dome {101} (d) as the dominant forms. Other observed forms are the pinacoids {100} (a), {010} (b), {001} (c). The color is brilliant greenish blue, the luster is vitreous, and the hardness is approximately 3-4 but could not be determined. There is one good cleavage parallel to (b) {010}. Cavansite is associated with calcite, analcime, thomsonite, heulandite, stilbite, and apophyllite in a brown tuff in a roadcut 2.1 miles by road south of Owyhee Dam and about 1/4 mile north of Gordon Gulch on the east side of the reservior.

Cavansite is also found in veinlets and cavity fillings in the Charles W. Chapman quarry, Goble, Oregon, 0.5 miles west of U.S. Highway 30 on Neer Road. The quarry rock is a vesicular basalt and red tuff breccia. The name cavansite is a mnemonic word chosen from the composition.

Orthorhombic *Pcmn*

		strongest X-ray lines
a = 9.778 Å	α = 1.542	7.964 (100)
b = 13.678 Å	β = 1.544	6.854 (50)
c = 9.601 Å	γ = 1.551	2.779 (25)
Z = 4	Biaxial (+)	3.420 (25)
G (calc.) = 2.33	2V = 52°	3.930 (25)
G (meas.) = 2.21-2.31		6.132 (25)

PENTAGONITE

Cavansite and pentagonite, new dimorphous calcium vanadium silicate minerals from Oregon. Lloyd W. Staples, Howard T. Evans Jr., James R. Lindsay

Amer. Mineral., **58**, 405-411, 1973

Pentagonite, $Ca(VO)\ (Si_4O_{10}).4H_2O$, is a dimorph of cavansite and forms orthorhombic prismatic crystals quite similar in appearance to cavansite. Dominant forms are the prism (m) {110}, the dome (u) {201}, and the pinacoid (c) {00$\bar{1}$}. Less common forms are the pinacoids (c) {001}, and (a) {100}. Pentagonite is nearly always twinned on the prism (m) {110}, generating fiveling twins with a star shaped or pentagonal cross section. The name is for the twinning habit. The color is brilliant greenish blue but less green than cavansite, and the hardness appears to be about 3 to 4 on Mohs scale. Pentagonite is associated with calcite, cavansite, heulandite, stilbite, analcime and apophyllite and is found only at Owyhee Dam.

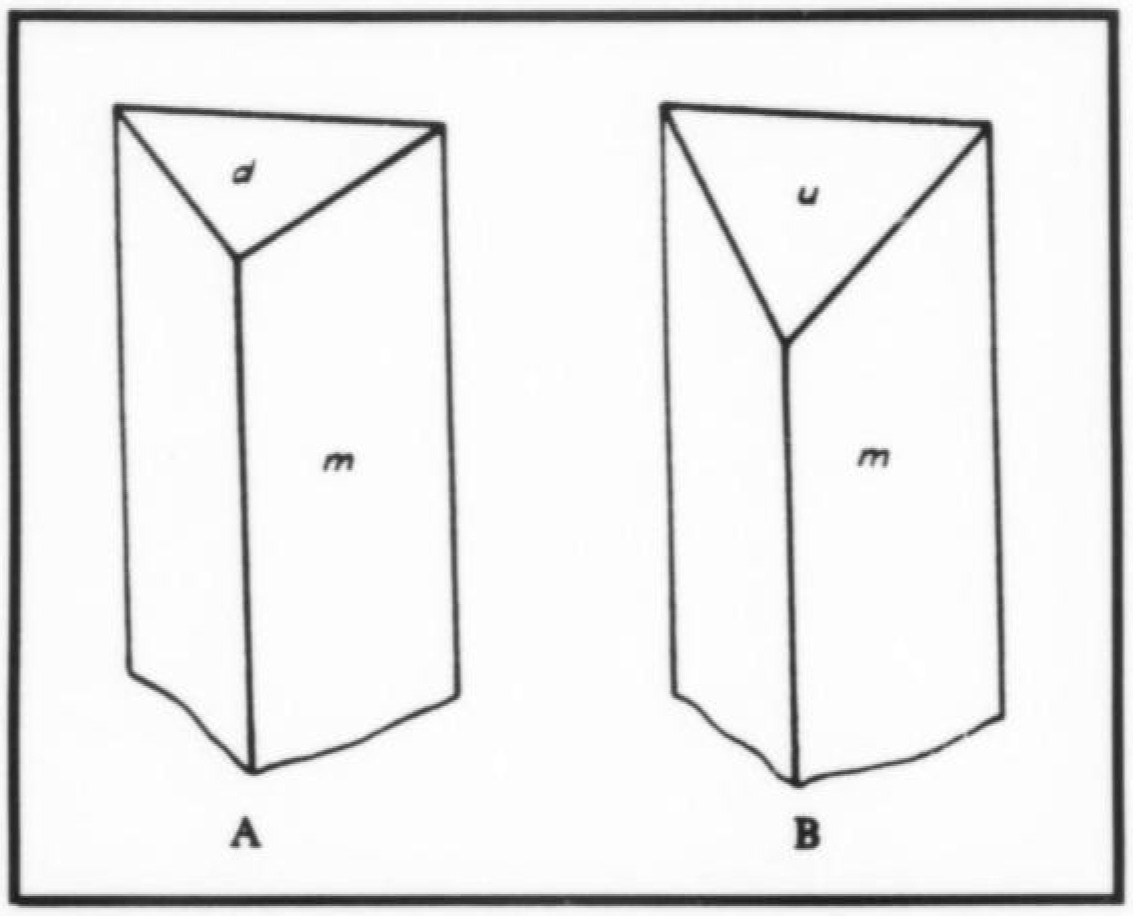


Fig. 1. **Single crystal habit of (A) cavansite, and (B) pentagonite. Forms are:** ***m*** **{110},** ***d*** **{101},** ***u*** **{201}.**

At Owyhee Dam, cavansite and pentagonite have been enclosed by heulandite and analcime which assume a blue color. The sequence of deposition for the minerals at this locality appears to be first, amber calcite followed by cavansite and then pentagonite and heulandite. These are in turn followed by the deposition of stilbite and a second generation of pentagonite. Final minerals in the sequence are calcite and analcime followed by apophyllite. One specimen was found with both cavansite and pentagonite together at Owyhee Dam where the exposure was quite large and the mineral cavansite abundant.

Orthorhombic, *Ccm2*

		strongest X-ray lines
a = 10.298 Å	α = 1.533	6.071 (100)
b = 13.999 Å	β = 1.544	3.920 (100)
c = 8.891 Å	γ = 1.547	3.755 (100)
Z = 4	Biaxial (—)	8.298 (70)
G (calc.) = 2.33	2V = 50°	

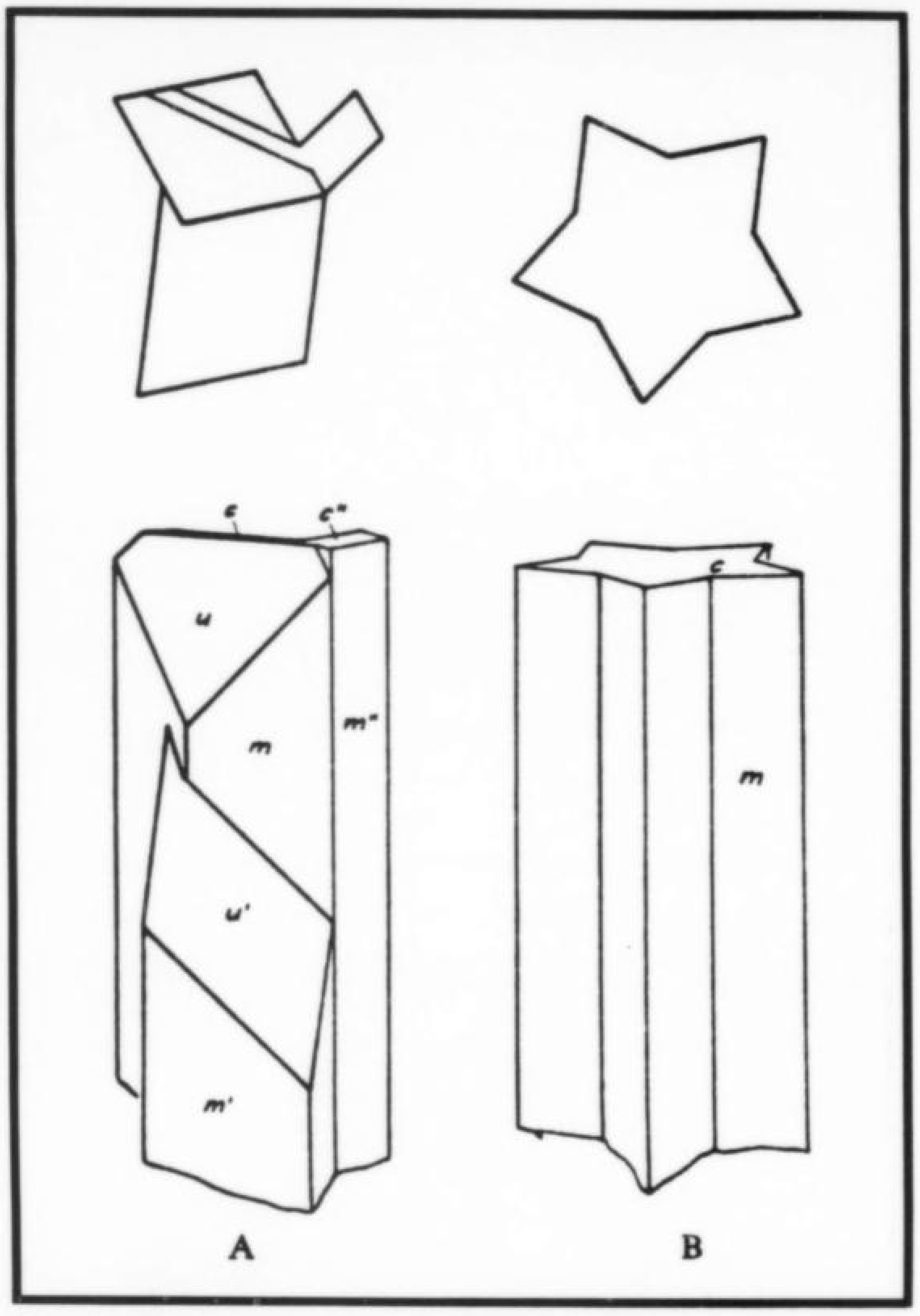


Fig. 2. **Multiple twinned crystal habits of pentagonite. Two types shown are typical bladed habit (A), and idealized blunt habit (B).**

JAMBORITE

Jamborite, a new nickel hydroxide mineral from the Northern Apennines, Italy. N. Morandi and G. Dalrio

Amer. Mineral., **58**, 835-839, 1973

Jamborite, $(Ni^{2+},Ni^{3+},Co,Fe^{2},Fe^{3+})(OH)_2(OH,S,H_2O)$, occurs as aggregates of parallel fibers and lamellae which are pseudomorphs after millerite. It should be noted that the principle symmetry axis is not parallel to the direction of elongation. Some fibers are bent and some are fractured perpendicular to the elongation. Some of the crystals contain internal zones of unaltered millerite. Jamborite is associated with millerite, dolomite and quartz at three localities near Bologna and Modena, Italy. The mineral is insoluble in water but slowly soluble in dilute HC1. It is proposed that the original millerite underwent gradual low temperature hydrothermal alteration and by hydrolysis and subsequent oxidation, jamborite was formed. The name is for John L. Jambor, mineralogist of the Geological Survey of Canada.

Hexagonal

		strongest X-ray lines
a = 3.07 Å	ϵ = 1.602	7.78 (10)
c = 23.3 Å	ω = 1.607	2.592 (6)
G (calc.) = 2.69	uniaxial (−)	1.530 (5)
G (meas.) = 2.67		3.89 (4)
		1.500 (3)

HEYITE

Heyite, $Pb_5Fe_2(VO_4)_2O_4$, a new mineral from Nevada
Sidney A. Williams

Min. Mag., **39**, 65-68, 1973

Heyite, a new lead iron vanadate, occurs in small (less than 0.4 mm) imperfect monoclinic crystals which twin on {110}. The crystals are transparent and have no cleavage. The mineral is brittle and the hardness is 4 on Mohs scale. Forms present are the prism {110} (m), pinacoids {100} (a), {001} (c), and {$\bar{1}$01} (d).

The color is yellow orange, and it has a yellow streak. Heyite dissolves in 1:1 warm HNO_3, but does not react with cold HNO_3. It reacts with 1:1 HC1 to form $PbC1_2$. Heyite is found associated with tungstenian wulfenite, pyromorphite, cerussite, mimetite, shattuckite and chrysocolla in a silicified limestone at the Betty Jo claim near Ely, Nevada. The mineral strongly resembles descloizite under casual observation and is quite similar to brackebushite in its cell dimensions. Only three specimens have been found to date at the Nevada locality. The name is for Dr. Max Hey, eminent British chemist and mineralogist.

Monoclinic $P2_1/m$

		strongest X-ray lines
a = 8.910 Å	α = 2.185	3.248 (100)
b = 6.017 Å	β = 2.219	2.970 (69)
c = 7.734 Å	γ = 2.266	2.767 (61)
β = 111°53′		4.873 (46)
Z = 1		3.674 (35)
G (calc.) = 6.28		
G (meas.) = 6.3		

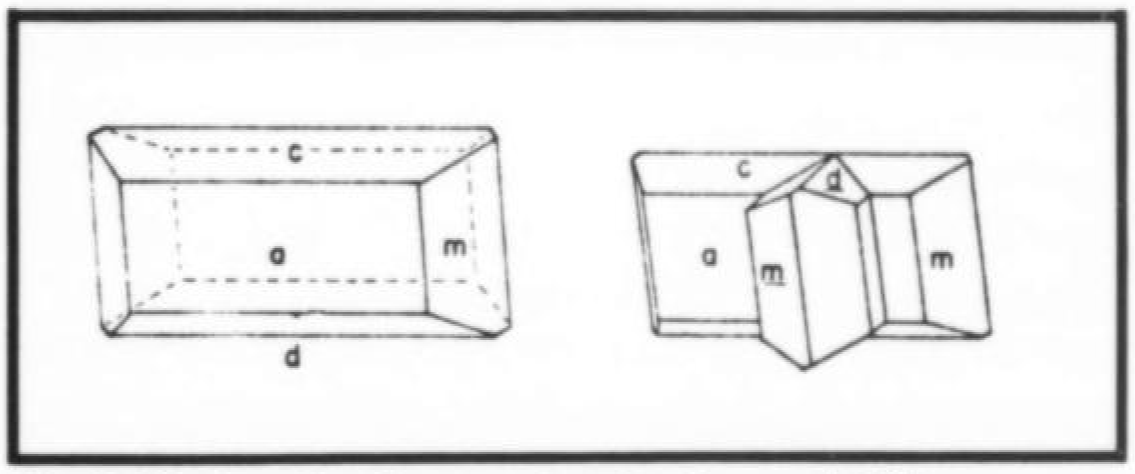


Fig. 3. **Heyite; simple crystal and twin on *m*(110).**

What's New in Minerals?

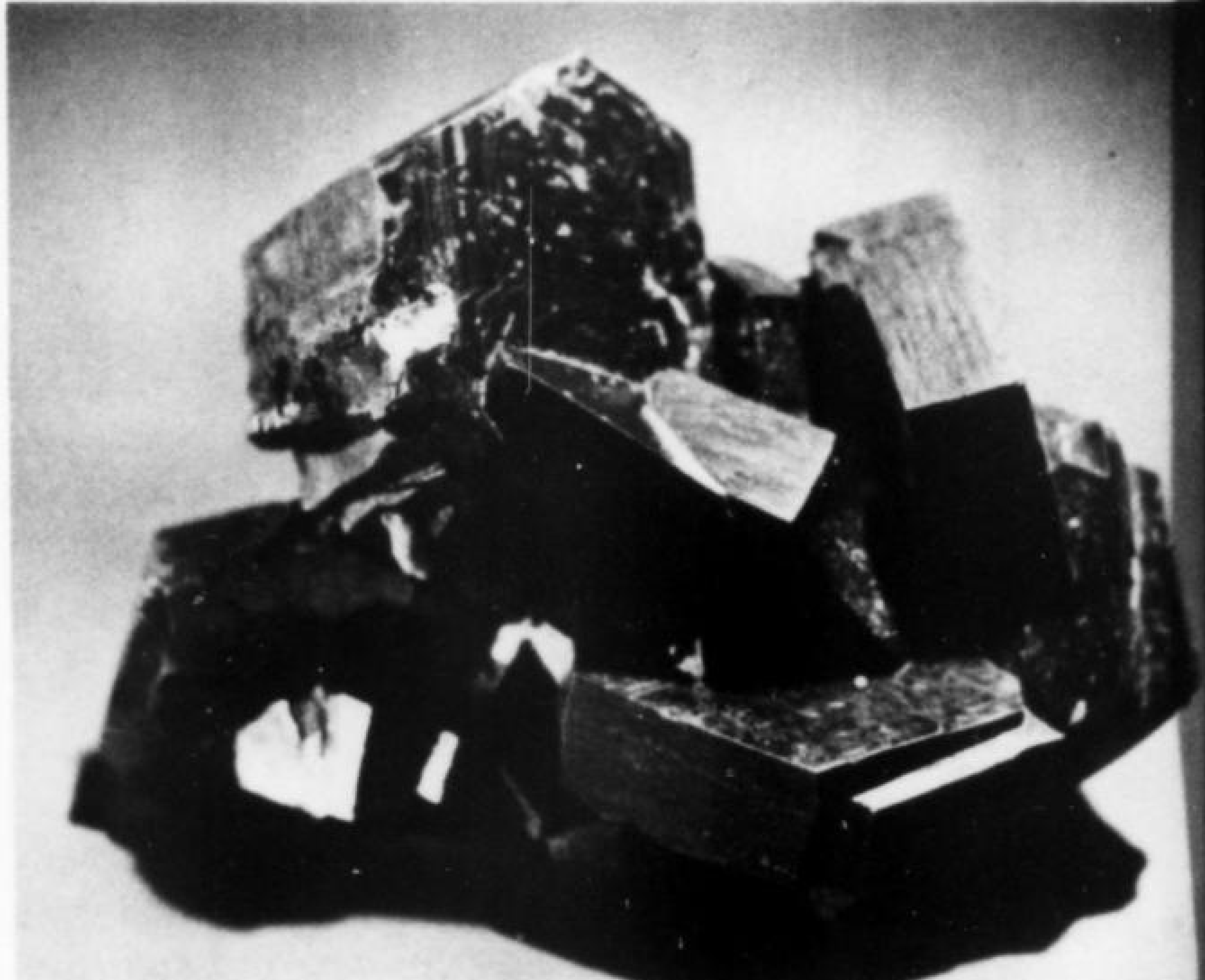
THE TUCSON SHOW

Tucson is a good barometer of what we can expect to see on the market for the balance of the year. This year there was plenty of good material, as always, but a disappointing number of *new finds*. In fact, I am hardpressed to come up with very much in what could be considered a "real new" category. Naturally, everyone was talking about the new cuprite from South West Africa (treated later in this column) but little else created much of a stir. There was, however, a large slug of good solid familiar material such as: colemanite—Death Valley, California; inesite—Hale Creek mine, Trinity County, California; smithsonite—Kelly mine, Magdalena district, New Mexico; wulfenite with mimetite—San Francisco mine, Sonora, Mexico; serandite—Mt. St. Hilaire, Quebec, Canada; grossular—Asbestos, Quebec, Canada; scheelite—Tae wha mine, Chungchongpukdo, Korea; wolframite and apatite—Panasqueira, Portugal; barite—Sterling, Colorado; microcline (amazonite)—Florissant, Colorado; pyrite—Logrono, Ambassaguas, Spain; brazilianite—near Galilea, Minas Gerais, Brazil; eosphorite and rose quartz—Lavra da Ilha pegmatite, Minas Gerais, Brazil; smithsonite, dioptase, and cerussite—Tsumeb, South West Africa; zeolites and associated minerals—Poona, India; artinite—Clear Creek, San Benito County, California; stibnite—Herja, Rumania; vanadinite—Mibladen, Morocco; quartz (amethyst)—Las Vigas, Vera Cruz, Mexico; topaz—Ouro Preto, Minas Gerais, Brazil; and much, much more.

Nevertheless there were some discoveries that rate more than mere mention. Some of these notables include:

Hemimorphite

One of the minerals very much in evidence is hemimorphite, supposed to have come from Magistral, Durango, Mexico. The specimens are composed of masses of compact, radial crystals forming botryoidal coatings about one cm thick. These are a beautiful sky-blue color, very similar to smithsonite from the Kelly mine, New Mexico. A suspicion immediately comes to mind when examining this material and that is that the specimens may actually have come from the 79 mine in Gila County, Arizona. Certainly, the habit, color and matrix match perfectly the 79 mine hemimorphite. The reader is referred to the color photograph in the *Record*, volume 3, p. 270, 1972. This could just as well be a photograph of the "new" material from Mexico. In both cases the matrix is buff-colored and mottled with tiny black spots throughout. If the locality is really the 79 mine, I can understand the misrepresentation. Collecting there has become hazardous due to attempts by the owner to keep collectors out of the mine. In spite of the similarity, however, I have received assurances from dealers handling the specimens that they are convinced of its origin in Mexico. It is also interesting to note that it was first being offered as smithsonite by the suppliers, but its identification has been confirmed by x-ray diffraction.



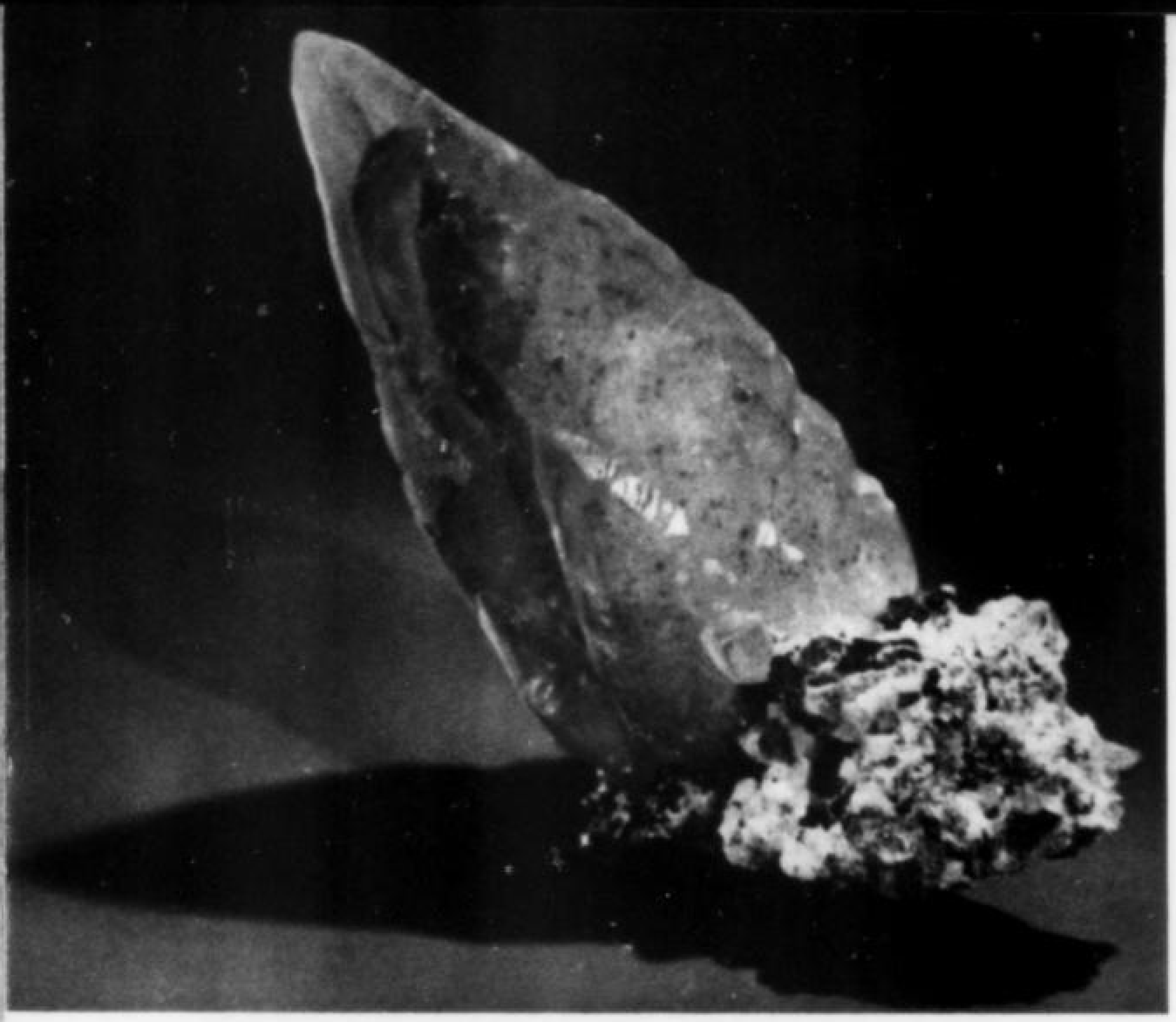
Pyrrhotite—Mexico. 9 x 6 cm. ***Smithsonian specimen.***

Pyrrhotite

This one really is from Mexico, there can be no doubt. Superb crystals and crystal groups of pyrrhotite from Santa Eulalia, Chihuahua, Mexico, were very much in evidence. Several dealers had a good selection. Unlike much of the earlier material, this newer pyrrhotite has a bright and shiny luster on the pinacoid face and moderately sharp, but striated, prism faces. In the past the pyrrhotites from Mexico tended to be dull, as though etched or oxidized. The new crystals are of two different habits, tabular or truncated conical. The tabular crystals come in attractive groups with crystals being about four times as wide as they are thick.

Calcite

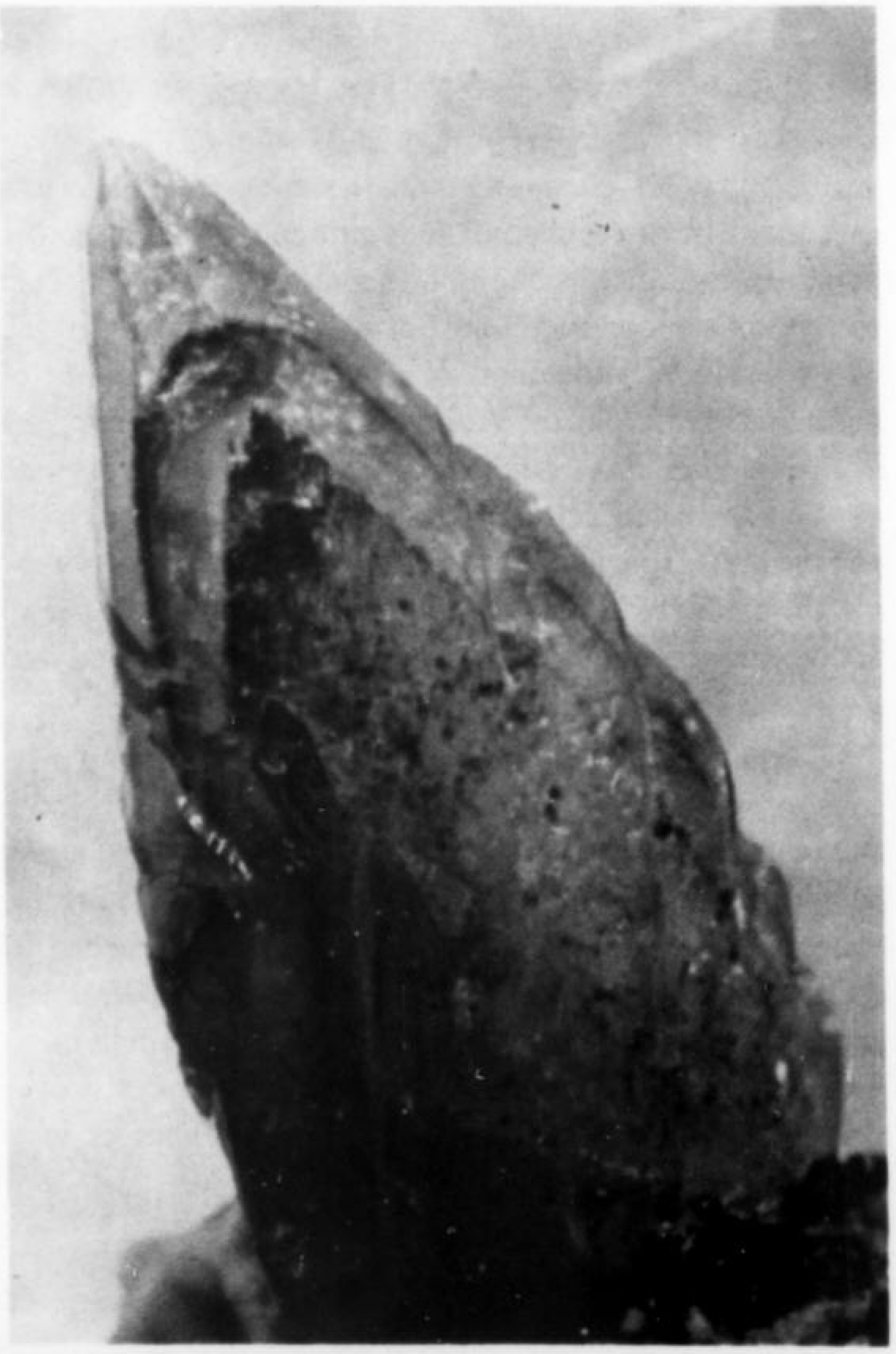
Each year, it seems, the calcite from the St. Joseph lead district, Missouri, puts on a new face, just in time for a major mineral show, This year a large, isolated pocket in



Calcite—Missouri. Crystal is 12 cm long.

a watercourse was encountered prior to the Tucson Show. It was large enough to walk in and was not in the ore-producing part of the mine so, uncharacteristically, there was time to carefully remove its contents over a weekend. The crystals are quite transparent and a delicate golden sherry in color. What makes these so nice is that they all contain several phantoms. The presence of the phantoms is recorded by a dusting of a metallic phase, probably marcasite or pyrite, over several sides of the calcite crystals at intervals during their growth. For some reason the phantom surfaces have an attractive greenish coloration, a pleasant contrast to the color of the calcite. The successive stages of growth are readily observed through the one side of every crystal that didn't get covered by sulfide. The crystals are large, approximately 15 to 20 cm in length, and are attractively attached to a dolomite matrix over which are scattered brilliant small chalcopyrite crystals.

Calcite—Missouri. Note phantoms.



These specimens were very popular at Tucson and the lot has probably been sold out entirely by now.

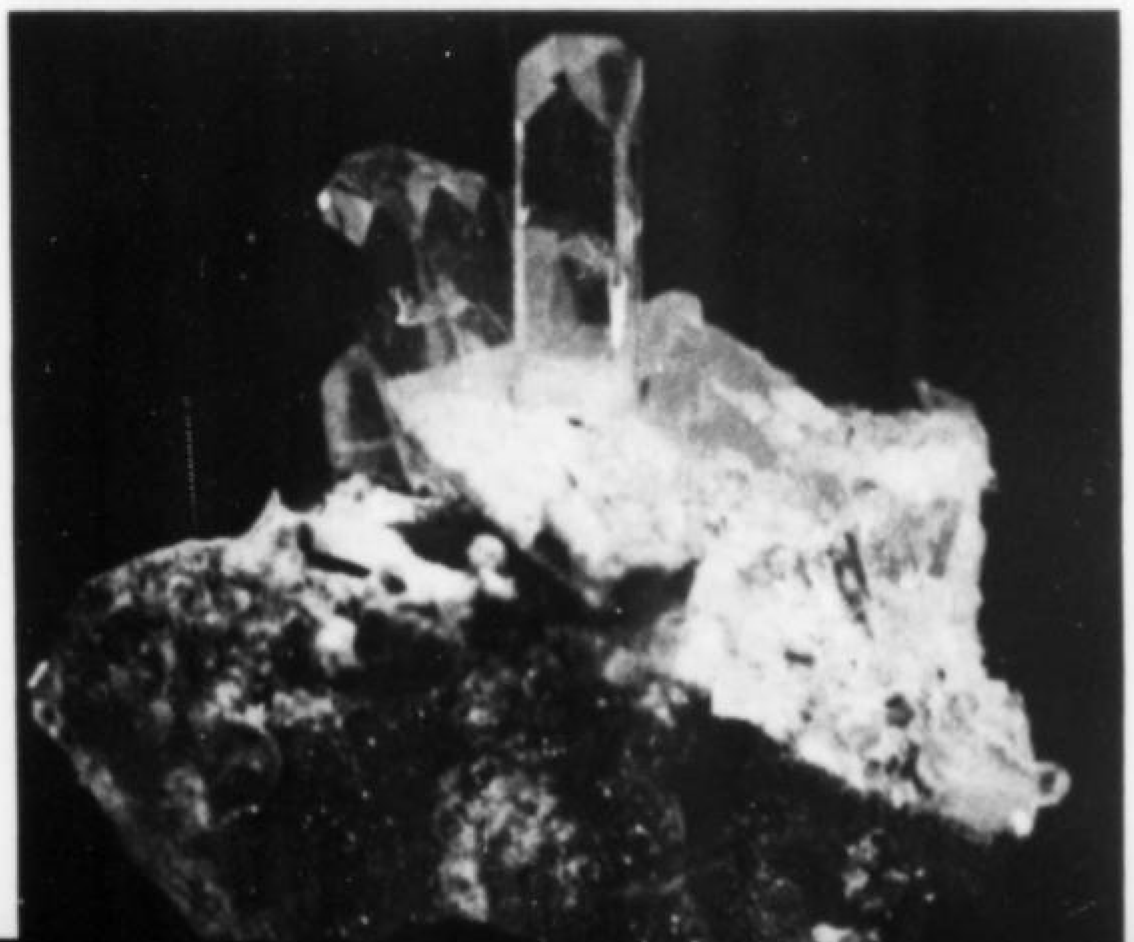
Scholzite—Australia. Crystal sprays are 2 cm long. ***Smithsonian specimen.***

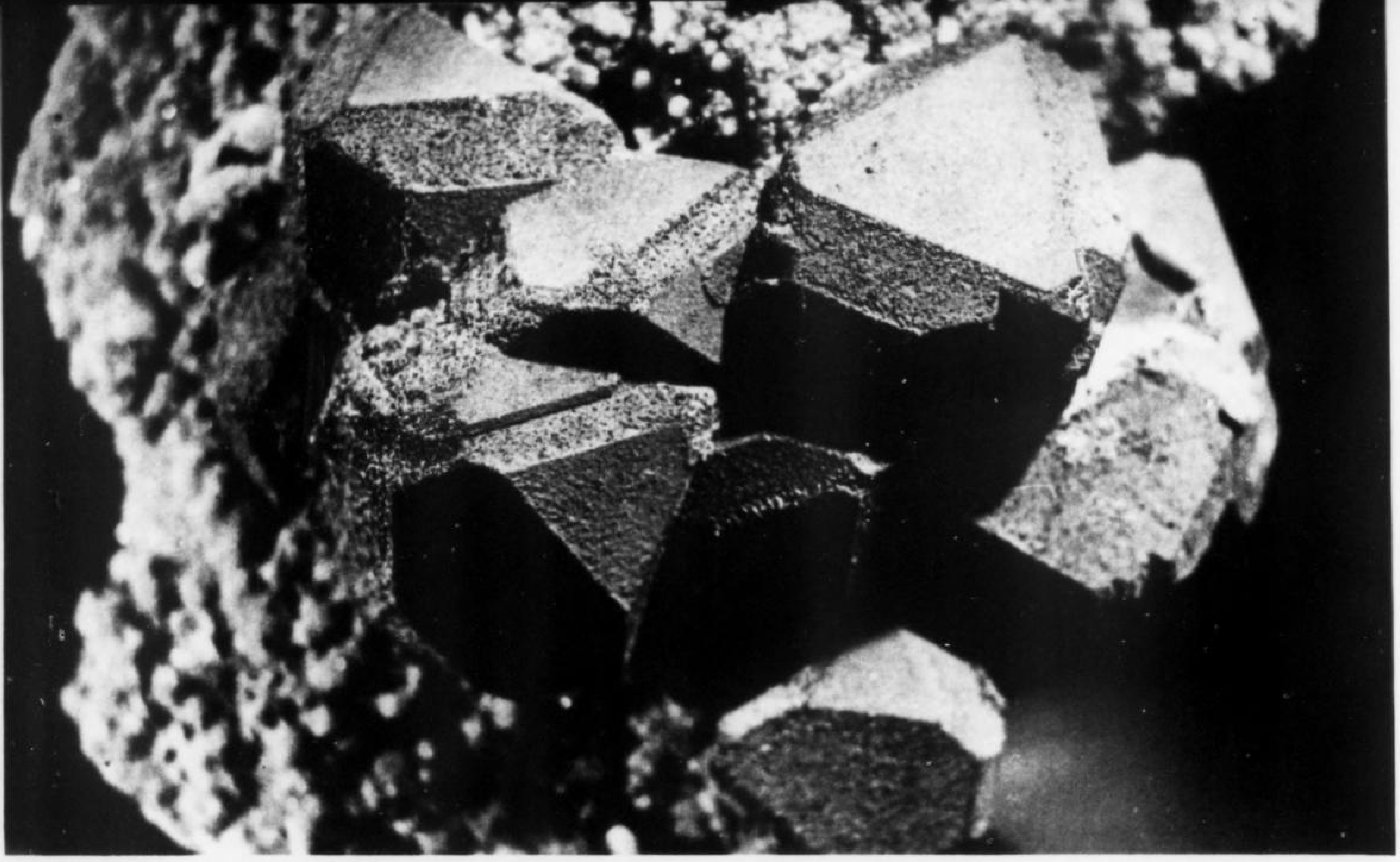
Scholzite

From Australia were very fine specimens of a relatively rare mineral—scholzite—a hydrated calcium zinc phosphate. The scholzite appears in divergent sprays of very delicate, colorless crystals in vuggy, limonitic-looking matrix. The fanlike crystal sprays are commonly as much as 2 cm in length. Associated minerals are few but include what has been identified as collinsite in crusts of interlocking, but distinct, ash-grey crystals. Individual crystals are perfectly developed in the classical broadsword shape, and twinning is not rare.

The locality is Reaphook Hill, near Blinman, Flinders Range, South Australia.

Barite—Colorado. 6 x 5 x 4 cm. ***Smithsonian specimen, donated by Mr. and Mrs. Don Belsher.***





Cuprite — South West Africa. The cluster of crystals is 15 cm across. ***Smithsonian specimen.***

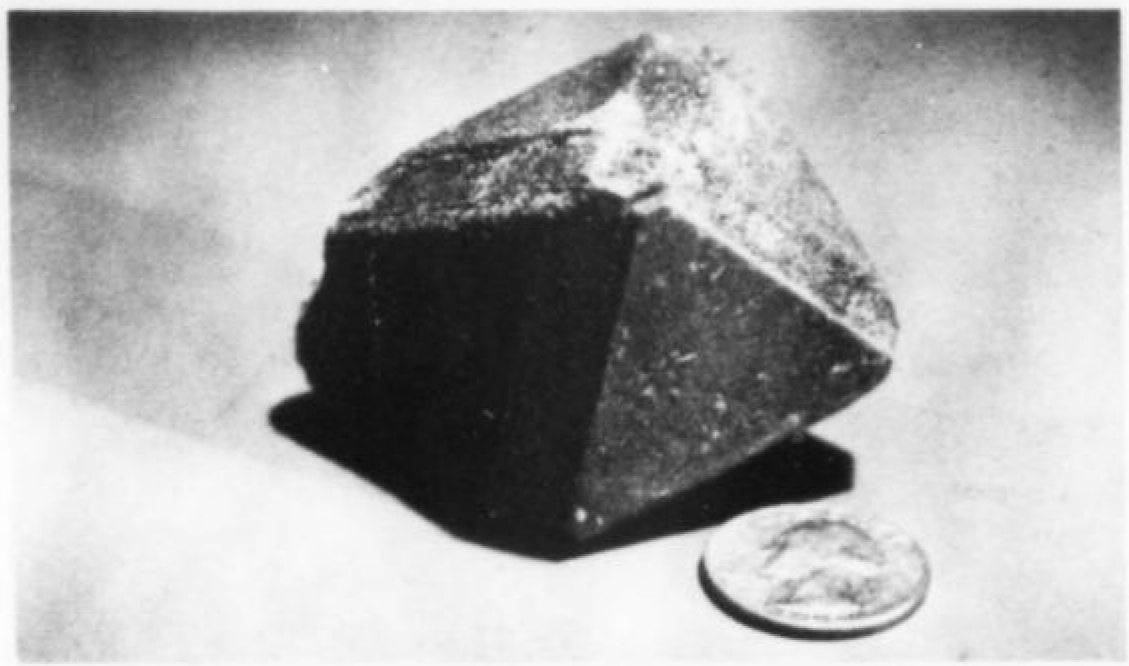
Barite

Not on any dealer's shelves but available for purchase, I am told, were very fine groups of absolutely colorless barite crystals from Grand Junction, Mesa County, Colorado. They are so perfectly flawless that they resemble topaz in clarity and general crystal habit. These are quite unlike any matrix barite specimens I have ever seen. Unfortunately I know very little about the extent or the nature of the occurrence.

Cuprite Supreme

Mother Nature (or Father Nature, if you prefer) has done it again! We've long been accustomed to the idea that cuprite comes only in modest sized crystals. Little wonder then that the new material from South West Africa has caused such a stir among collectors. Would you believe a single crystal some four inches across, and of faceting quality? Not willing to produce such a masterpiece that we would be soured on all other mineral specimens, the Gods who contrive these creations stopped short of what might have been the ultimate of ultimates. The surfaces of the cuprite crystals have been replaced to a depth of about 1 mm by a velvety crust of malachite. Imagine, if you will, crystals of cuprite two inches, more or less, with sharp, dark red and lustrous faces! It would be too much to believe. By the way, for those who wonder what the cuprites would look like if the malachite were removed with hydrochloric acid, its been done and the results are disappointing. The surface became dark red but is pitted and not lustrous.

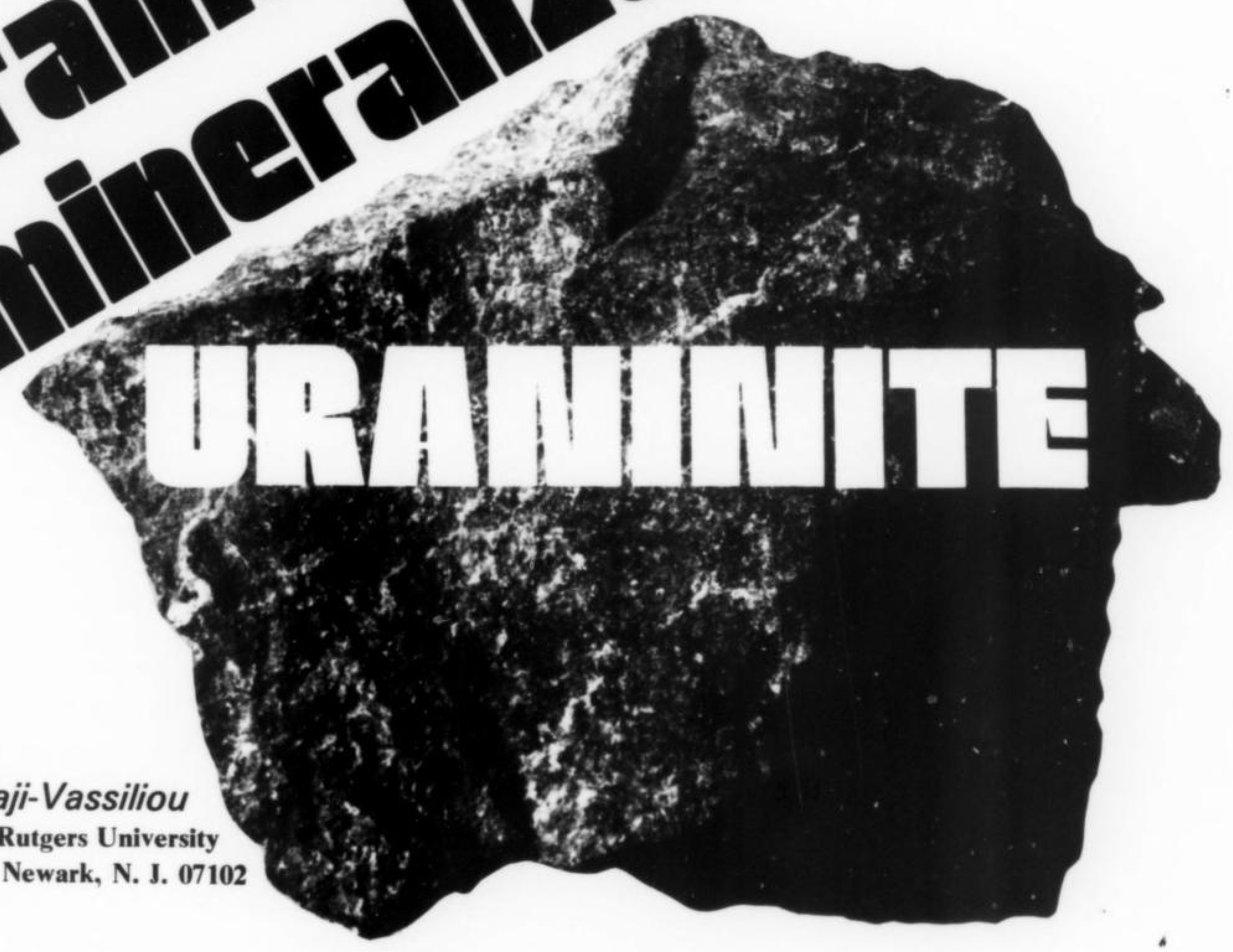
The locality is the Onganja mine, near Seeis, South West Africa, about 68 miles northeast of Windhoek. The Onganja mine is a small one, worked largely with simple hand tools off and on over the last forty years. The ore has been cuprite and malachite compactly encased in calcite. Not until the recent encounter with open cavities have any specimens been recovered. It is difficult to estimate the number of good specimens turned loose on the market as reports are contradictory but it is probably something like a thousand altogether. A relatively small number of these are matrix pieces. While a thousand may seem like a large number, those familiar with the rapid disappearance of good specimen material know it is not a large number and the better specimens will go in a hurry. Even the "scrap" will probably find a ready market because the crystals tend to be gemmy and flawless so much of it will be faceted into cut stones for the collectors of the bizarre.



Cuprite — South West Africa. The longest dimension is 7 cm. ***Smithsonian specimen.***

With one notable exception there are no associated minerals of particular interest. What is reported to be the only one of its kind is a very fine 1.5 cm, umbrella-shaped molybdenite crystal in matrix. This specimen resides in a private collection. Some powder-blue earthy material attached to the underside of a large cuprite crystal gave a diffraction pattern of a mixture of chrysocolla and clay. A small number of specimens of native copper have also been recovered, some of these associated with small cubes of very bright unaltered cuprite of a fine deep-red color.

uranium mineralization—URANINITE



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THE ABUNDANCE OF URANIUM AND ITS MINERALS

Uranium is probably the least common element in the earth (Urey, 1952). Estimates of uranium content in materials of the earth's crust (as tabulated by Klepper and Wyant, 1957, p. 91) indicate that the typical content in several common igneous and sedimentary rocks is of the order of 0.000X percent. However, there are certain abnormally rich rocks and ore deposits whose typical content may be up to 0.1 percent, with maximum content in exploitable deposits often being much higher. These are sandstone-type deposits, uraniferous conglomerates, vein deposits, marine phosphorites, marine black shales, uraniferous lignites or other types of coal, placer deposits, and pegmatites.

In spite of the relative scarcity of uranium, Kostov (1968) lists about 110 minerals that generally contain this metal. This means that about 5 percent of all known minerals may contain uranium as a major component. Uranium is not known in nature as a native element or as a simple sulfide or arsenide. Twenty-one of the minerals are oxides or hydroxides, 26 are phosphates, 13 are titantes and niobates, 12 each are silicates, carbonates, and aresenates, 8 are vanadates, 4 are sulfates, and 2 are selenates (Kostov, 1968). Uranium is also directly associated with organic derivatives (coal and petroleum) forming large urano-organic deposits (Haji-Vassiliou and Kerr, 1973); the form of occurrence of uranium in these associations is not clearly known, and it may involve microscopic uranium minerals disseminated in the organic complexes (Haji-Vassiliou, 1969).

The principal and best known uranium mineral is the oxide uraninite; the term "pitchblende" is often used to denote massive or collomorphous aggregates of uranium oxide. The names of the other uranium minerals are relatively unfamiliar; however, some of these are of great importance as common constituents of large ore deposits, and some are of interest because of specific physical and other characteristics. Notable examples are the silicate coffinite, the vanadates carnotite and tyuyamunite, the complex titanates brannerite and davidite, the phosphates torbernite and autunite, and the carbonate andersonite.

THE IMPORTANCE OF URANIUM AND ITS MINERALS

In the last thirty years, uranium and its chief ore minerals have assumed an important place among the elements and valuable natural compounds. The main reason is the susceptibility of uranium to nuclear fission, and it is responsible for the greatest metal hunt in the history of the world; this hunt for uranium was concentrated in the Colorado Plateau area starting in 1948 and continuing through the 1950's.

The susceptibility of uranium to nuclear fission relates to the discovery that when an atomic particle such as a neutron strikes a uranium nucleus (protons and neutrons), the nucleus grows unstable and splits in two with a release of energy as well as more neutrons. The neutrons released by one fission will then produce further fissions in the form of an intense chain reaction that releases more and more energy. This energy, first demonstrated in the atomic bomb, is now controlled by man and is produced by nuclear-power reactors for generating electricity.

Another reason is the use of uranium isotopes to determine the age of rocks, and it is of scientific rather than economic importance. Uranium has two radioactive isotopes, U235 and U238 which decay or disintegrate spontaneously by emitting high velocity particles, specifically α particles (ionized helium atoms) and β particles (electrons). Uranium 238 (about 140 times as abundant as U235) has been found to disintegrate through the loss of eight α particles (atomic weight 4) and six β particles to a stable isotope of lead with atomic weight 206.

It has also been determined that if we had a mass of U238 at a given time, one-half of the atoms will have decayed to lead 206 in about 4500 million years. Uranium 235, on the other hand, disintegrates to form the stable isotope lead 207, with a half-life of about 700 million years. Besides the lead isotopes, the disintegration of uranium produces several intermediate radioactive daughter products such as radium which was first discovered in uranium ore by the Curies in 1898. Also, helium (α particles) is always found in uranium where it was first discovered.

If a crystal of uraninite formed at a given time, it would be composed of U238 and U235 and it would normally lack Pb206 and Pb207; however, the disintegration of this primary uranium would produce an increasing amount of Pb206 and Pb207 through time. Thus, if we assume that the rate of disintegration is constant, the ratio of Pb206 to U238 (or Pb207 to U235) would be a measure of the time that elapsed since the formation of the uraninite crystal.

URANINITE

General Characteristics — Uraninite, UO_2, is the most important primary mineral of uranium and the chief ore of this metal. Chemical analyses show that uraninite from different localities may contain different amounts of UO_2 and UO_3, corresponding to the oxidation states U^{4+} and U^{6+}, and causing the actual composition of the mineral to lie between UO_2 and U_3O_8. No example exactly corresponding to the ideal formula UO_2 has been found in nature.

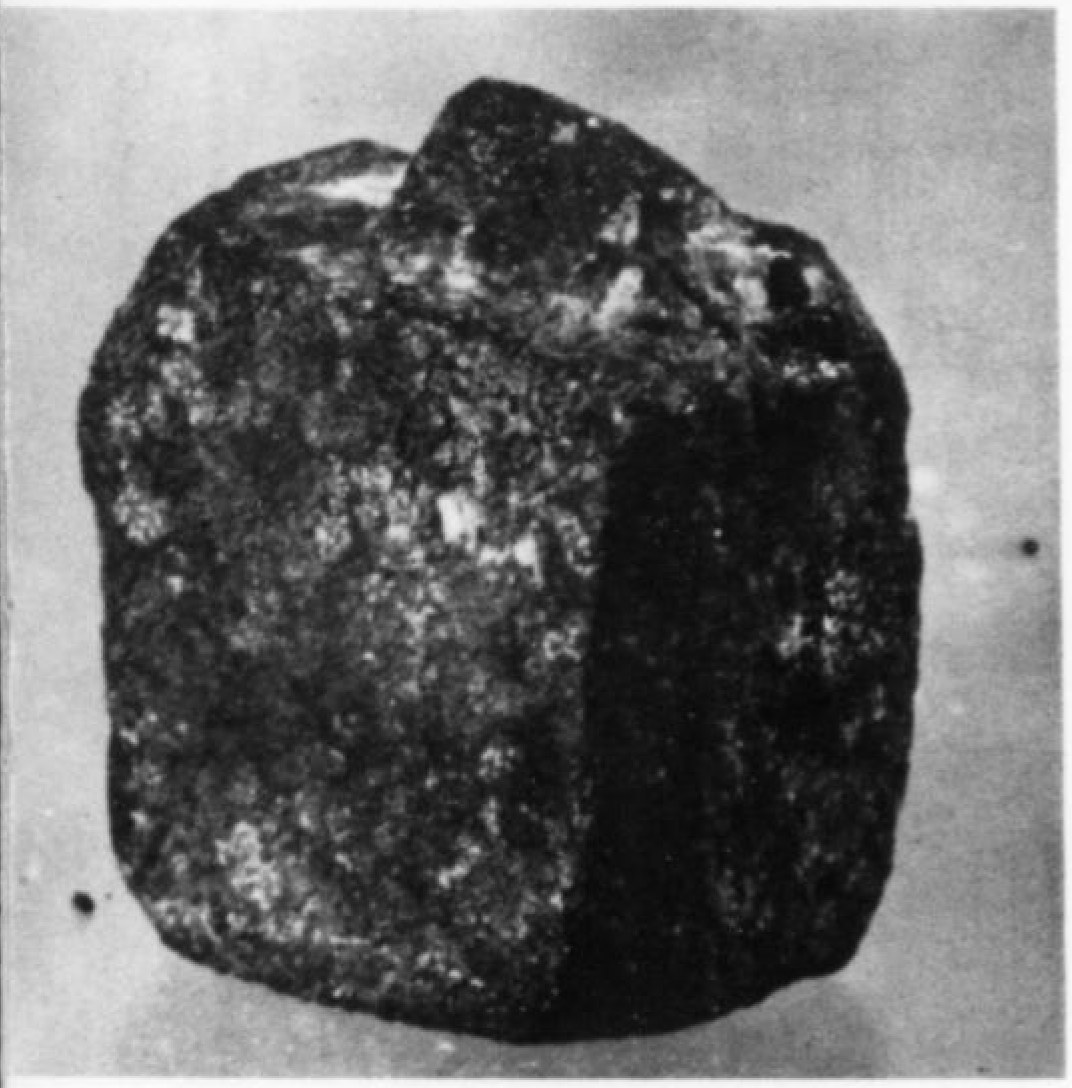
Uraninite is isometric with a fluorite-type structure (face-centered cube) which accounts for its cubic, octahedral or cubo-octahedral crystals (Fig. 1A). However, crystals are rare, and the mineral is more often massive (in veins or as fine disseminations in detrital sediments) or it may be in the form of botryoidal or collomorphous aggregates (Figs. 1B and C); when in the latter form, the mineral is often called "pitchblende", but as Kerr (1950) pointed out, it is not necessarily essential to make the distinction.

Uranium oxide is generally black, and it has a pitchy, submetallic to dull luster. Its range in specific gravity (6.5 to 9.7) reflects its oxidation state and the degree of radioactive decay. Because it is intensely radioactive, even small amounts of this or any other uranium mineral can be detected by Geiger Muller counters or similar radiation detection instruments.

Occurrence — Uraninite has always been considered a characteristic hypogene mineral formed under pegmatitic or hydrothermal conditions. However, since the uranium exploration of the 1950's, several large deposits in the Colorado Plateau and adjoining areas have been generally classified as sedimentary; the solutions responsible for these extensive bedded deposits are generally thought of as low-temperature (ground-water) solutions whose migration was predominantly lateral.

The pegmatitic type is connected with granitic or syenitic rocks and associated with such minerals as zircon, monazite, and tourmaline. Many occurrences of this type are in Canada (Ontario and Saskatchewan), Norway (Saetersdalen), U. S. S. R. (northern Karelia), India (Bengal), Zaire (Katanga), and in regions of Colombia, Brazil, and South Africa. As isolated crystals or as small anhedral masses or veins, uraninite has been found in numerous regions of the United States in association with pegmatites and other igneous rocks. Notable localities include several areas in Connecticut (Middletown, Glastonbery, and Branchville) and other New England states, and North Carolina (Mitchell County). Uraninite crystals up to 11 cm and weighing over 2280 grams were found in pegmatites at Cardiff, Ontario (Kostov, 1968).

The hydrothermal type is represented on the one hand by high temperature hydrothermal vein deposits in association with cassiterite, arsenopyrite, chalcopyrite, pyrite, and other minerals as at Cornwall, England; and on the other hand by medium-temperature hydrothermal veins with Co-Ni-Bi-Ag-As minerals as at Joachimsthal, Czechoslovakia, and Great Bear Lake, Canada. The Shinkolobwe mine in Zaire (formerly the Congo) has been one of the most productive uranium mines, and it represents vein



1a

1b

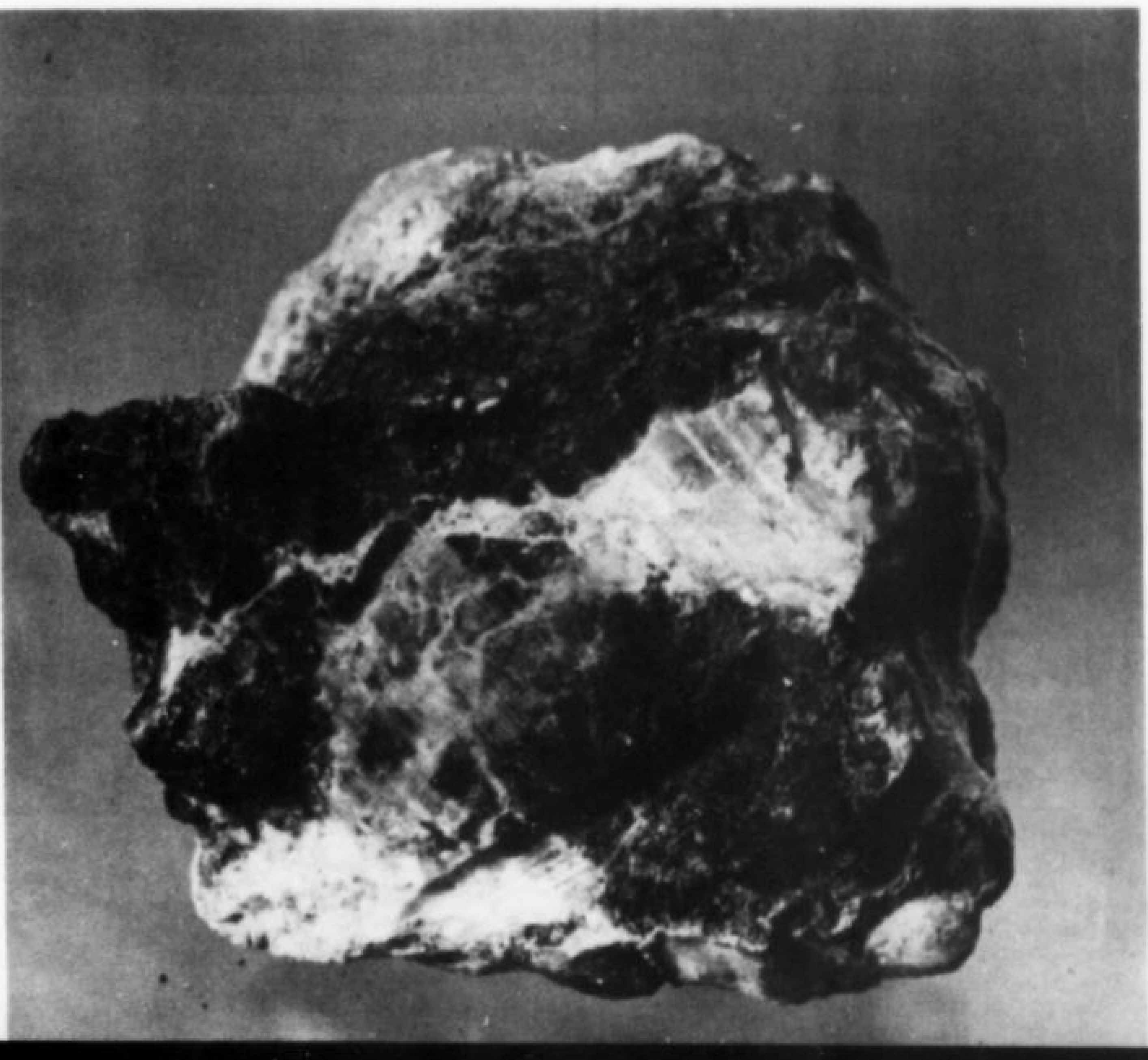
1c

Fig. 1. **A. Intergrown uraninite crystals (approx. 1 cm) from Wilberforce, Ontario. (Crystals kindly provided by Joel Baskin, Middlesex, N. J.)**

B. Massive (vein) uraninite (black) from Big Indian Wash, Utah. (approx. 4 x 2 cm long.)

C. Vein uraninite (black bands) from Joachimsthal, Czechoslovakia. (approx. 4 x 2 cm.)

D. Massive to collomorphous aggregates of uraninite (or pitchblende). Locality unknown. (approx. 4 x 2.5 cm.)



1d

deposits in association with Co and Cu minerals as well as significant amounts of Mo, W, Au, and Pt.

The numerous deposits in the Colorado Plateau area (New Mexico, Utah, Colorado, Arizona) and in Tertiary basins of Wyoming represent the sedimentary occurrences. In these deposits, uraninite and other uranium minerals are generally finely disseminated in sandstones or other detrital sediments. In several cases, the uranium mineralization is intimately associated with organic derivatives forming urano-organic deposits. Similarly, the extensive deposits in the gold-bearing Witwatersrand conglomerates of South Africa have been described as "thucholite" deposits (Liebenberg, 1955) because of the uranium-organic matter association. The name "thucholite" was originally used by Ellsworth (1928) to describe a uraniferous hydrocarbon from Ontario, and it was intended to indicate the principal constituents, i.e. Th-U-C-H-O plus "lite" as an ending. In the sedimentary category may also fall the large deposits in the Blind River area of Ontario where uraninite occurs as detrital grains in Precambrian quartz conglomerates.

Besides sedimentary deposits, the Colorado Plateau area is represented by notable examples of other types of occurrence, especially hydrothermal. These include the Orphan mine, Grand Canyon, Arizona, where the ore occurs in a nearly circular, vertical pipe structure, and is believed to be of hydrothermal origin (Gornitz and Kerr, 1970), and the well known vein deposits of Gilpin County, Colorado.

Unit-Cell Edge Size and its Implications — One of the more interesting and much studied aspects of uraninite mineralogy concerns the variation in the size of its unit cell. Reported cell sizes range from as low as 5.38Å to as high as 5.65Å (Robinson and Sabina, 1955; Wasserstein 1951, 1954; Berman, 1957, Haji-Vassiliou and Kerr, 1970). Berman (1957) showed the frequency distribution of unit cell measurements according to type of origin, indicating a decrease in size from pegmatitic to vein to sedimentary (Fig. 2).

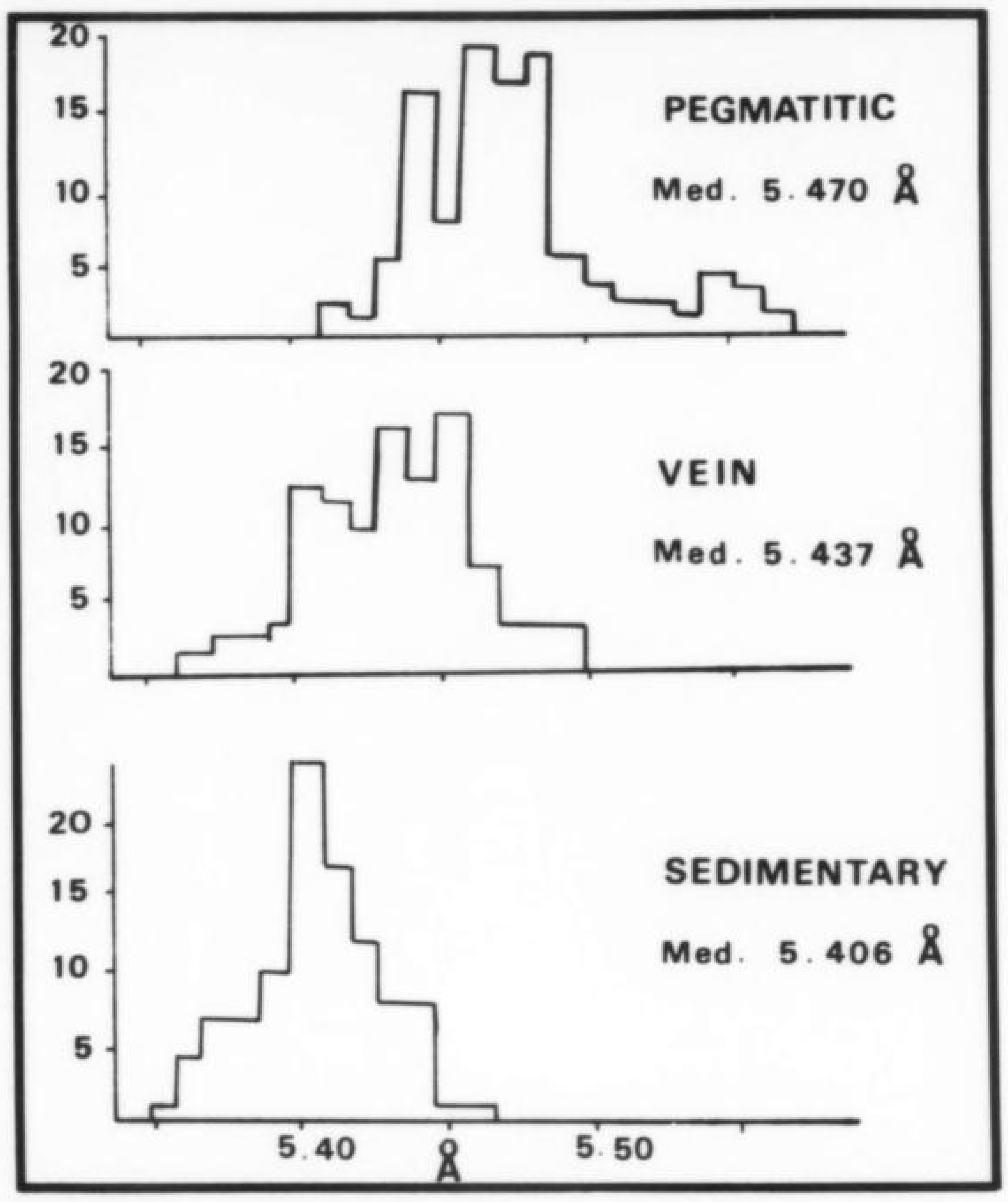


Fig. 2. **Distribution of unit cell sizes in uraninite according to occurrence (Berman, 1957).**

The variation in cell size has been attributed to various causes, the most important of which relate to ionic substitution or, specifically, the replacement of U^{4+} by other cations in the uraninite structure. A typical chemical analy-

Table I. The relationship between unit cell edge size and thorium to rare earth ratio in uraninite of pegmatitic origin.

Sample	Cell Size Å	Th/R. E. ratio	Source
Wilberforce, Ontario	5.486	19.4	A
Elvestad, Norway	5.48	18.04	B
Lac La Ronge, Saskatchewan	5.482	17.4	C
Hale's quarry, Connecticut	5.484	16.52	B
Gustausgruben, Anerod, Norway	5.470	13.9	B
Strickland quarry, Connecticut	5.47	9.25	B
Huggenaskilen, Norway	5.470	4.54	B
Flat Rock mine, North Carolina	5.44	2.8	B
Gordonia, South Africa	5.454	1.1	A
Baringer Hill, Texas	5.43	0.67	D
Spruce Pine, North Carolina	5.431	0.49	A
Sudbury District, Ontario	5.437	0.21	A

Source: A. Berman, 1957
B. Hillebrand, 1891 (in Atia, 1964)
C. Atia, 1964
D. Hidden and Mackintosh, 1889 (in Atia, 1964)

Table II. Cell-edge shortening in uraninite samples exposed to artificial oxidation by heating at the maximum temperature of stability of UO_2 structure.

Sample and Origin	Temperature °C	Cell Edge Å	Cell Edge Shortening Å
Pegmatitic			
Hale's quarry, Connecticut**	Unheated	5.484	
	600	5.451	0.033
Baringer Hill, Texas*	Unheated	5.430	
	580	5.400	0.030
North of Santander, Colombia	Unheated	5.445	
	500	5.425	0.020
Spruce Pine, N. Carolina	Unheated	5.419	
	500	5.409	0.010
Vein			
Shinkolobwe, Zaire	Unheated	5.446	
	530	5.425	0.021
Eldorado mine, G. B. L., Canada	Unheated	5.473	
	560	5.458	0.015
Joachimsthal, Czechoslovakia	Unheated	5.400	
	600	5.386	0.014
Richard's mine, Gilpin Co., Colo.	Unheated	5.403	
	550	5.390	0.013
Sedimentary			
Kane Creek, Utah (KC-2)	Unheated	5.421	
	550	5.414	0.007
Mi-Vida mine, Utah (MV-2)	Unheated	5.406	
	600	5.400	0.006
Kane Creek, Utah (KC-1)	Unheated	5.386	
	600	5.382	0.004
N. Alice mine, Lisbon Valley, Utah	Unheated	5.389	
	620	5.386	0.003
Faith mine, Grants, New Mexico	Unheated	5.397	
	550	5.394	0.003
Barbara J#3, Grants, New Mexico	Unheated	5.394	
	620	5.392	0.002
Mi-Vida mine, Utah (MV-1)	Unheated	5.410	
	500	5.408	0.002
Happy Jack mine, Utah	Unheated	5.398	
	485	5.398	--------

* Data from Atia, 1964.
** Data from Berman, 1957.

sis of uraninite shows the presence of varying amounts of UO_2 and UO_3 (reflecting the oxidation of U^{4+} to U^{6+}), with generally small amounts of thorium, rare earths (cerium, yttrium, etc.), and calcium; products of radioactive decay such as lead, radium, and helium are also generally present in small amounts, but other elements such as magnesium, manganese, zirconium, iron, nitrogen, and argon may be also present (Berman, 1957; Kostov, 1968; Hurlbut, Jr., 1971).

Thorium and rare earths are typical associates of pegmatitic uraninite. Substitution of U^{4+}(0.97Å) by Th^{4}_{+}(1.02Å) tends to increase the unit-cell edge size, whereas rare earth substitution (mostly 0.92 - 0.94 Å) tends to decrease it. A survey in the literature indicates that as the ratio of Th/R. E. in uraninite increases so does the unit cell (Table 1). This may be offered as one of the reasons for the relatively larger unit cell of pegmatitic uraninite which may contain up to 20 percent ThO_2.

Perhaps the most important cause for the cell-edge size variations relates to the oxidation state of uraninite — the ratio of UO_2 to UO_3 or how much U^4 (0.97A) has been replaced by U^{6+}(0.80A). Brooker and Nuffield (1952) showed a roughly linear relation between cell-edge size and oxygen coefficient; Sidorenko (1958) confirmed the relation. However, the question as to what principally determines the oxidation state of a uraninite sample is still unanswered. Is it the radioactive disintegration of uranium that causes the oxidation of U^{4+} to U^{6+}? Does the mineral crystallize directly in a more or less oxidized condition depending on the temperature and other environmental conditions? How about the effect of weathering?

In order to examine further the relationship between cell size and oxidation state, uraninite samples representing pegmatitic, vein and sedimentary occurrences were x-rayed and their unit cell dimensions were calculated before and after these samples were exposed to artificial oxidation (Table II). By artificial oxidation is meant the heating of a sample in air (for about two hours) at the maximum temperature of stability of the UO_2 structure. By submitting a sample to differential thermal analysis, one can determine the temperature of the exothermic peak at which the cubic UO_2 structure changes to the orthorhombic structure of U_3O_8; the maximum temperature of stability of the UO_2 structure is taken to be a few degrees below that of the exothermic peak.

Table II shows that artificial oxidation may cause a decrease or shortening in the unit cell dimensions, with the shortening generally increasing from sedimentary to vein to pegmatitic uranite. This may imply that pegmatitic uraninite is generally not as oxidized as vein uraninite, and, in turn, vein uraninite not as oxidized as sedimentary uraninite, perhaps reflecting environmental conditions of deposition that each type of occurrence represents. However, in cases where data are available, the state of oxidation of a sample (its UO_2 to UO_3 ratio) does not always reflect the amount of shortening expected relative to other samples (Table III). For instance, on the one hand, the low UO_2/UO_3 ratio in the pegmatitic Spruce Pine sample may very well account for its relatively low cell shortening; but, on the other hand, vein and sedimentary uraninites show relatively little or no shortening in spite of their relatively high UO_2/UO_3 ratios.

It is believed that ionic substitution in the uraninite structure may be the primary cause for such discrepancies. We have seen how the substitution for thorium and rare earths influences the size of the unit cell (Table I); however, in addition to the change in the cell size, every time that U^{4+} is replaced by another ion, its concentration in the structure relative to U^{6+} is diminished, and the effectiveness of the UO_2 /UO_3 ratio as a measure of the oxidation state is also diminished.

Alberman, Blakey and Anderson (1951) showed that in synthetic material UO_2 can take CaO into solid solution; they also showed that the cell-edge size of UO_2 will vary linearly with the molar fraction of CaO in the structure. Thus, it is understandable that the unit cell of uraninite will shrink, its UO_2/UO_3 ratio (and cell shortening) will decrease as $U^{4+} + 2O^{2-}$ is progressively replaced by $Ca^{2+} + O^{2-}$ plus a vacant oxygen site. Table III shows that the CaO content of most vein and sedimentary uraninites is relatively high. Although specific data are not available, all sedimentary samples in Table II are known to contain relatively high percentages of CaO. The presence of CaO in these samples seems to offer some explanation for their generally smaller cell-edge size and cell-edge shortening relative to their oxidation state.

Finally, the presence of lead (whether radiogenic or otherwise introduced) should cause a cell shortening if Pb^{4+}(0.84Å) substitutes for U^{4+} (0.97Å) in the uraninite structure. Chemical analyses and other evidence strongly indicate that lead does not proxy for uranium in the uraninite structure (Phair and Levine, 1952; Eckelman and Kulp, 1956; Berman, 1957). However, Wasserstein (1951; 1954) suggested that with the radioactive decay of uranium with time, U^{4+} is progressively replaced by radiogenic Pb^{4+} causing a cell shrinkage that may be measured and used to estimate the age of the deposit represented by a sample.

Wasserstein's data showed that, after corrections for thorium substitution and the effects of oxidation and re-

Table III. Cell-edge shortening (through artificial oxidation) in uraninite samples as related to their UO_2 to UO_3 ratio, and their percent content of CaO.

Sample and Origin	Cell Edge Shortening Å	UO_2/UO_3* ratio	CaO* Percent
Pegmatitic			
Hale's quarry, Connecticut	0.033	2.68	0.08
Baringer Hill, Texas	0.030	2.11	0.32
Spruce Pine, N. Carolina	0.010	0.23	0.60
Vein			
Shinkolobwe, Zaire	0.021	1.16	0.58
Eldorado mine, G. B. L., Canada	0.015	1.94	5.10
Joachimsthal, Czechoslovakia	0.014	2.00	4.28
Sedimentary			
Mi-Vida mine, Utah (MV-1)	0.002	1.01	4.40
Happy Jack mine, Utah	None	0.60	N. D.

* Data from Berman, 1957.

Table IV. The cell-edge size and cell-edge shortening (through artificial oxidation) of uraninite samples as related to their absolute ages.

Sample and Origin	Cell-Edge Size Å	Cell-Edge Shortening Å	Age* Millions of Years
Kane Creek, Utah (KC-2)	5.421	0.007	60
Faith mine, Grants, New Mexico	5.397	0.003	153 ± 3
Barbara J#3, Grants, New Mexico	5.394	0.002	154 ± 3
N. Alice mine, Lisbon Valley, Utah	5.389	0.003	197 ± 4
Kane Creek, Utah (KC-1)	5.386	0.004	200

* Ages determined by W. R. Berglof (personal communication) using the Pb207/U235 method.

duction in various types of uraninites, there was a progressive reduction in unit cell size with passing of time; furthermore, he indicated that proof of substitution by lead in the structure is provided by the fact that uraninites with lead have a smaller cell edge than pure uraninites. Hoekstra and Katz (1955) criticized Wasserstein's idea of correlating cell size with age as an oversimplification mainly because of failing to take into account additional factors such as oxidation due to weathering, radiation damage, and the presence of other cations besides thorium (i.e. rare earth and alkaline earth oxides).

Since some of the actual samples used here were dated by William Berglof (personal communication), the relationship between age and cell dimensions (and shortening) is shown in Table IV. The data suggest that the cell-edge size of the various samples does vary roughly with age: the older the sample, the smaller its cell-edge size. Perhaps substitution corrections for thorium and other cations may not be critical because all samples represent the same type of occurrence (sedimentary) in the same general area (Colorado Plateau). However, such substitution corrections together with additional correction factors, especially those relating to the oxidation state of the samples, are believed to be critical and may break down the apparent correlation between cell-edge size and age. This is suggested by the cell-edge shortening of the samples (due to artificial oxidation) which shows no correlation with age (Table IV). The cell-edge shortening is believed to represent a measure of the oxidation state of a sample plus the effect of other factors such as ionic substitution, all of which influence the size of the unit cell.

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Andreas Haji-Vassiliou is Assistant Professor of Geology at Rutgers University and Adjunct Instructor of Geology at Essex County College, New Jersey. He was born at Ora, Larnaca, Cyprus, in 1936. His undergraduate and graduate studies were at Columbia University where he earned his Doctorate in 1969. Dr. Haji-Vassiliou's continuing research interests include the form of occurrence of uranium in urano-organic deposits and the mineralogy of manganese nodules from the Atlantic Ocean.

Yedlin on Micromounting

We've just received (3-18-'74) a 46 page publication entitled *Geology and Mineralogy of Mount St. Hilaire, Quebec.* This has been published by the Worcester (Massachusetts) Mineral Club and is the work of its president, Mrs. Roger (Peg) Marble and those referred to in her two page bibliography and in the acknowledgements. The volume is plastic spiral bound, tastefully done, easily read, with explanatory sketches and line drawings illustrating points of interest. On page 41 Mrs. Marble states: "The purpose ....is not to present a detailed, highly scientific study of St. Hilaire, but....to provide a....fundamental account of the geology and mineralogy which would incorporate all.... the literature and original work done on St. Hilaire. It has been written with the average non-professional mineral collector in mind...."

This has been done. The volume includes the following chapter headings: "Geology of St. Hilaire; Mineralogy of De-Mix and Poudrette Quarries; Descriptive Mineralogy; Mineral Descriptions; Geochemistry of St. Hilaire and related Nepheline Syenite Intrusions; Comparison of St. Hilaire with other Famous Syenite Locations; Conclusions; References; Addenda."

Without delving into the book for review purposes at this time, we feel it is of value for both the cabinet collector and micromounter. It supplies needed information to the serious visitor to the quarry, familiarizes him with the locality and its mineralogical areas, and discusses the availability of the various species. We recommend it highly as a practical guide, as an aid to learning the minerals at the locality, and as a recognition piece for those who are fortunate enough to study the minerals of this great collecting area. It is available from the Worcester Mineral Club, 24 Duxbury Drive, Holden, Massachusetts 01520. The price is four dollars.

Our question anent crocoite, pyromorphite, vauquelinite from Tasmania and Russia (*Mineralogical Record. Vol. IV No. 5*) was partially answered by a note from John B. Thigpen, 1418 Pike Street, Golden, Colorado 80401, who supplied us with some fabulous micromount material from the Australian locality, including several types of crocoite, pyromorphite, dundasite, cerussite, cassiterite and arsenopyrite. His letters and labels detail a great deal of information concerning the Dundas area and we'll try to convey the data with a combination of quotes and conclusions. Thigpen writes: "I spent most of the year 1971 in the area as a geologist in a mineral exploration program (by the way Dundas is no more, not even a building left; nearest town is Zeeham, about 6 miles away). It so happened that our exploration area covered the sites of the old mines at Dundas, so I got to know them well. I am a mineral collector—a somewhat rare thing with working geologists—specializing in m/m, t/n and miniatures of the rare, better crystallized minerals, so my stay in the Dundas area was very rewarding. The pyromorphite-crocoite combination is common at one of the old mines, and crocoite-dundasite-minor cerussite-very minor pyromorphite combinations at another. The old mines were very active in the period 1890-1915, and little, if any, mining activity has occurred since. The old workings are poorly accessible and moderately to very dangerous. The best geological reference to the Dundas area is that of A. H. Blisset, 1962, *Geological Survey Explanatory Report, One Mile Geological Map Series, ZEEHAN:* Tasmania Department of Mines."

In a further letter Thigpen notes: "Most of the crocoite on the market and in collections is from the Adelaide mine, but further crocoite potential is rather limited at that specific locality. That does not mean that the potential of the surrounding area is affected. At last report the operator of Adelaide was prospecting around the area for additional specimen material. The overall specimen probabilities are good, but the climate is generally so miserable that many of them will remain in the ground.

"I have found no specimens of, nor reference to, vauquelinite at the Dundas area, but it appears that further study may lead to identification of other species. Most mineralogical studies on a professional level were done around the turn of the century when the mines were in operation. Several rare species were found then that cannot be found now, mainly due to inaccessible workings."

Let's see, from his notes to me on his specimens we can generate some data concerning the various mines. Five are listed. We have material from each of them.

Adelaide mine: Produced most of the crocoite on the market and in collections. Crocoite crystals rarely terminated. Dundasite from here, too. Other rarities produced in the past. Has been under mineral lease for specimen collecting. Future of crocoite not optimistic. Some large specimens, up to 4 to 6 inch crystal prisms, have been found.

Kapi mine: Abundant crocoite, dundasite, cerussite, pyromorphite (in small pockets). Crocoite is mostly very fine acicular, with good to poor terminations, good micromount material. Dundasite varies from acicular tufts to dense mats of fibrous crystals. Cerussite varies from rare minute well formed crystals to good larger ones on massive cerussite. Some of yellow color, "chromiferous". Pyromorphite rare, especially in association with crocoite. It appears that the crocoite is still forming, as seen on the walls of the old mine workings.

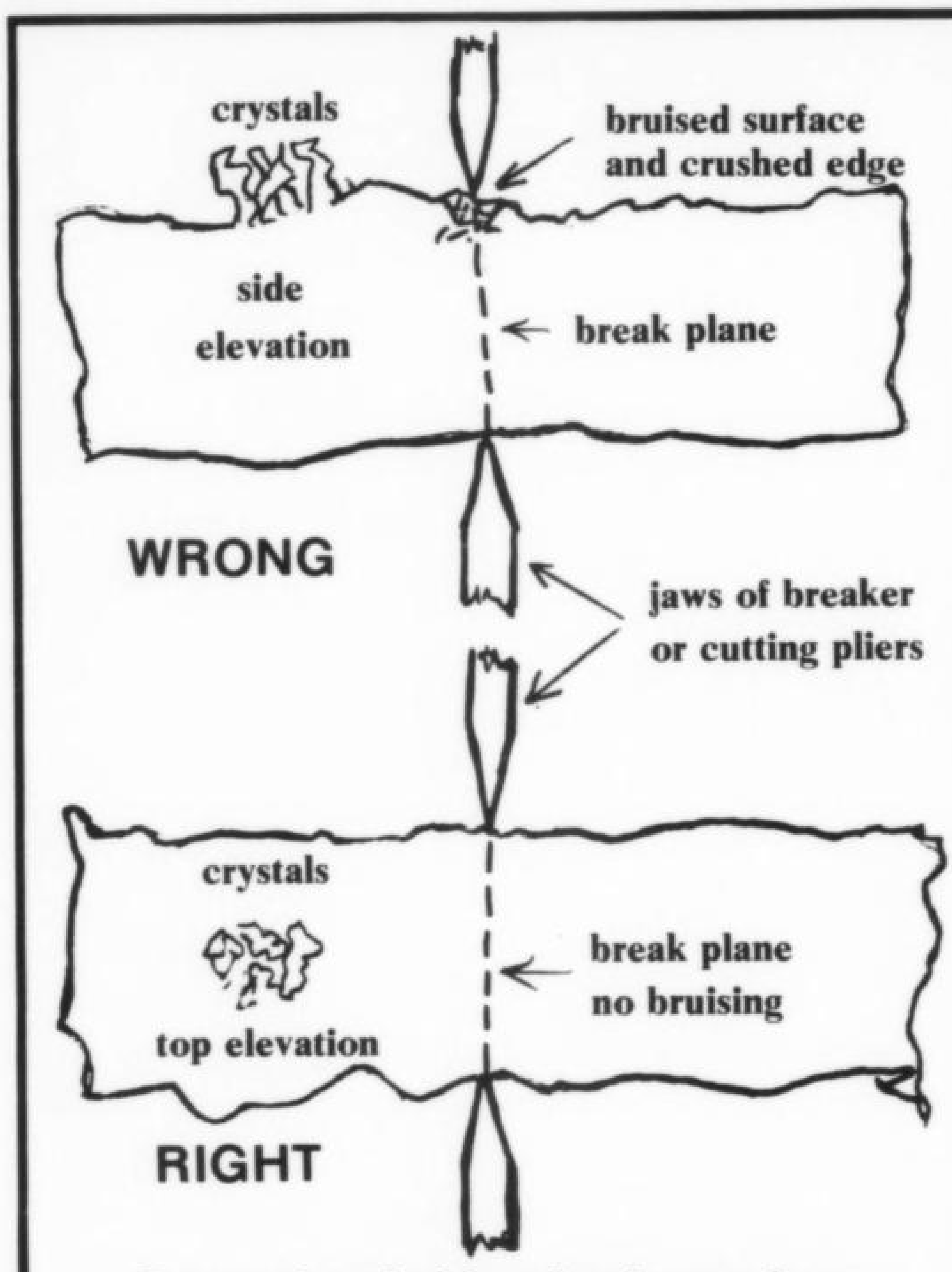
Platt mine: Abundant crocoite-pyromorphite in one small pocket. Usually terminated. Acicular crystals to more equant form with modified terminations. Excellent for micromounts.

Razorback mine: Brown and tan transparent small cassiterite prisms, on a matrix of crystals of arsenopyrite.

Red Lead mine: Minor crocoite, mostly massive but with occasional terminated crystals in cavities. Most underground workings inaccessible.

West Comet mine: Crocoite found in relatively minor quantities of small crystals, some excellent for micromounts.

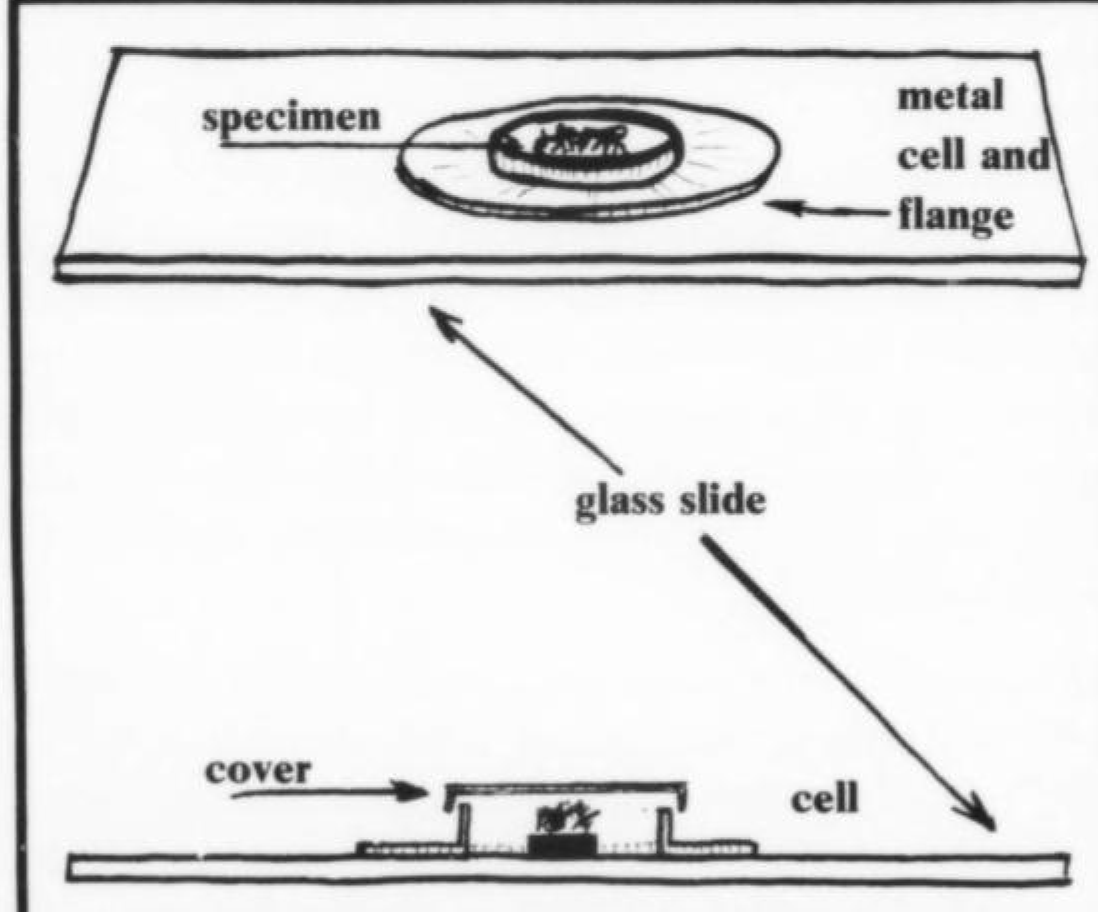
Thigpen concludes, "I have a good supply of most of these minerals in micromounts to miniatures. I am a novice at exchanging but would give it a try. I would be interested in rare, showy, well crystallized m/ms and t/ns from worldwide areas. No particular species restrictions; my collection is somewhat weak in eastern United States minerals." So go to it, but be certain that "Measure for Measure" is the rule.



Suggested method for trimming specimens

We missed the Pacific Micromount Conference this year. Tucson, too. First of many. But Juanita Curtis acted as our deputy and reported in 5 pages of long, yellow legal paper. We'll brief her notes: New meeting place, Ramada Inn, Santa Monica...Excellent accomodations. Members and guests took up floors 6, 7, 8 and part of 9...plenty of parking....new light cords and fixtures—no shorts or hot wires...81 microscopes of all types from Greenoughs to the latest zooms...175 people registered...no changing of rooms or leaving scopes and tables to attend the speakers...lights were not up to the quality of the microscopes—publicity needed on what a good light will disclose about our specimens...large crowd Friday night for the introductory talk, with a talking, questioning and answering bunch...subject of the meeting was oxides....Bill Wise the first speaker. Fine job, as he does every year at this meeting ...Paul Desautels Saturday A.M. and he did an excellent job as he always does...Dr. Slikla fine, but he knows too much and wants to impart it all to us at once...Dr. Jahns was last and his talk was the finish to the oxides...Al Valenti, program chairman, did a beautiful job...something new this year. Bill Wise brought some of the new western zeolites. He expected perhaps 15 people to remain after the meeting, but about 75 stayed to participate...Wise and Jahns stressed the importance of the m/m hobby because we look, see and record everything about minerals.. attendance from 9 states and Canada...off-hour slide programs (we missed you and Perloff) by Vi. Frazier, a fine first attempt; by Kay Robertson; Willard Perkins; and Bob Curtis...*The Mineral Index to Localities* we're doing was very well received and new material is coming in regularly —thanks for your contributions of Laurium, Greece, and the Strickland quarry in Connecticut...the give-away table was loaded as usual, with western zeolites in the fore... everyone had mounted stuff for trading...I had two good sessions for beginning micromounters...Bob's (Curtis) shots have graced the covers of a number of magazines, but he says he won't be content until he makes the center triple fold....!" Thank you, Juanita.

Some notes and memos of interest: Rocky Mountain



Pierce's cell for opaque objects—June, 1876

Micromounters will convene at the 7th annual gem and mineral show on Saturday, May 19th, 1974, at the Adams County fairgrounds, Denver, Colorado. Communicate with C. E. Withers, 10485 West 13th Place, Lakewood, Colorado 80215. Hatfield Goudey, 1145 West 31st Avenue, San Mateo, California 94403, has issued a new catalogue. No charge, but please send twenty cents for postage. (This applies to and for everyone when an inquiry is being made. We've a hungry mailbox.) W. D. Christianson, 200 Napier Street, Barrie, Ontario, has just published a price list of micromount material, number 3, containing 385 items, with a great many Mt. St. Hilaire minerals included. Kümineral, 1, ch August Vilbert, 1218 Grand-Saconnex, Geneva, Switzerland, a dealer who sent a list of micromounts for sale, 26 of them, from the Alps, including such things as anatase, axinite, brookite, bastnaesite, dufrenoysite, gadolinite, milarite, rathite and synchisite. List free, but if you want an extended catalogue of large minerals, world wide, send a dollar, refundable. Dieter Haas, BRD (6740) Landau/Pf, Westring 22, West Germany, wants to swap German material. And Robert Cobben, 70 Estes Sreet, Lakewood, Colorado 80226 needs New England phosphates and St. Hilaire material. He has for exchange South Dakota and Colorado specimens.

Paul Seel came across an item in the *American Journal of Microscopy*, dated June, 1876. Called "Pierce's Cell for Opaque Objects", it was used by micromounters before the advent of paper boxes. The article reads, "Opaque objects have always troubled microscopists. If covered with glass it is difficult to see them clearly; if mounted in an exposed condition they are liable to injury, and if placed in a deep cell, so as to be protected, it becomes impossible to illuminate them. Professor Pierce has devised a new mode of mounting, shown in the accompanying figures. A metallic cell, having a broad flange like the brim of a hat, is cemented to a regular glass slide. To this cell is fitted a cap, which covers and protects. The object may be fastened to the glass or raised by means of a disc of any needed thickness. Protection and easy access and thus afforded..." Most interesting. The first mounts made by Rakestraw and others were on glass slides, with raised cells where needed, but then sealed with cover glass, optically clear. We have one of the Pierce type in our collection. It was done by Amos P. Brown, Nicetown, Philadelphia, Pennsylvania, and is of loose crystals of garnet. Dated 1891. A gift of Dr. Ed. Zukauckas of Moorestown, New Jersey, an ardent and skilled collector. We didn't know the contrivance was a Pierce invention; we don't even know who Pierce was.

Checking the collection of an advanced micromounter recently we noted some annoying bruises at the edges of the matrix. The crystals at the center were perfect, and were not affected by the crushed rock a quarter inch away, except esthetically. We know how it came about and suggest a remedy. The sketches herewith tell it in detail.

Let's see, we've just ascertained the whereabouts of the mineral collections of the late Gunnar Bjareby, a great student of minerals and their environments. We'd known of their disposal in the midwest, but got the precise information from Russell MacFall recently. The micromount collection was acquired by Professor J. V. Smith of the University of Chicago, presently president of the Mineralogical Association of America. All the other minerals, catalogued and in miscellaneous status, were purchased by Glenn D. Commons, of Aurora, Illinois. Both in good hands. In fact, Paul Moore researched this material extensively in his study of the phosphate minerals, and it was from this source that he discovered the mineral bjarebyite.

Buy and use a good mineral book.

Neal Yedlin
129 Englewood Drive
New Haven, Connecticut 06515

The Record Bookshelf

***Minerals of the St. Lawrence Valley,* by George W. Robinson and Schuyler W. Alverson, Privately published, 42 pp., 29 photographs, ($2.50) (Copies available in Potsdam stores or from Mr. Schuyler Alverson at 38 Pierrepont Avenue, Potsdam, New York.**

Here is an excellent guide to the many mineral localities in the St. Lawrence Valley of upstate New York. Its first pages discuss the rock types in a knowledgeable manner, followed by a brief treatment of the local economic mineral deposits. Some remarks on the modes of mineral occurrence conclude the introductory material.

The real value of the guide lies in the twenty-five full-page descriptions of collecting localities which include such famous sites as the Rossie lead mines, the Sterling mine at Antwerp (millerite), and the Pierrepont (schorl) tourmaline locality. Four categories: geology, minerals, directions, and notes make an easy format for the narrative remarks which display obvious familiarity with each locality and its minerals. Directions are so precise that the accompanying sketch maps are almost unnecessary. The notes recommending specific tools and suggesting appropriate courtesies and cautions are thoughtful and helpful. Unfortunately, the twenty-nine black and white photographs did not reproduce well and hence add very little.

An additional fifteen localtites are listed with sketch maps giving an impressive total of forty localities included. Notice is also given of closed or exhausted localities.

Field guides are a perennial problem for collectors. So often the money would be better spent on a single good specimen. Despite the lack of a table of contents or index, which is a genuine nuisance, this guide is well worth the price ($2.50) because it is complete enough, specific enough, and sufficiently imbued with a sense of history to serve not only as a field guide but also as a handbook to the minerals of this famous region.

Carl A. Francis

***A Guide to Mineral Collecting at Ouray, Colorado,* by Ervan F. Kushner, published by Ervan F. Kushner, Books, 5 Colt Street, Paterson, New Jersey 07505, 1972, 77 pages (2nd ed.). ($3.00)**

The first edition of this fine little book was rapidly depleted, prompting the preparation of a revised and enlarged second edition. It is a general guide to the history, geology and mineralogy of a famous mining camp: Ouray, Colorado. In format the *Guide* is somewhat novel, with certain similarities to U.S. Geological Survey Professional Papers. A large fold-out map pinpoints the major mines in the Ouray district. The minerals are each given a paragraph or two, with a simple description and an indication of Ouray locations where each was found. The rock formations in the district are all described in some detail, a rarely found and useful addition in a collector's guidebook.

The major asset of this book is the extensive historical treatment it provides. Many of the photographs are from the Denver Public Library collection and show the mining camps in their heyday. Kushner has also included an extensive glossary, which provides information about geological, mining and mineralogical terms.

The size and printing quality of the *Guide* are commensurate with more expensive publications, although some of the mineral photographs suffer from small format (all are in black and white).

Kushner's book differs somewhat from the average guide, in that it does not stress the occurrence of fine mineral specimens. This is logical, since the district has been worked for many years and good specimens are uncommon. The book remains useful, however, because it recognizes this fact and places emphasis on the historical interest of Ouray, as well as the geological features. Thus, a collector may find only bits and scraps of specimens, but still comes away with an appreciation of the former glory of Ouray. With the *Guide to Mineral Collecting in Ouray* a visit to the old mines and dumps becomes a historical voyage, rich with the color and excitement of former bonanza days. Thus, the book can never become useless, inaccurate or out of date, a comment difficult to make about most other field guides.

Joel E. Arem

Tsumeb, a Historical Sketch. **by G. Sohnge, published by the Committee of the S. W. A. Scientific Society, Postfach 67, Windhoek, South West Africa, 92 pp., 5 figures (including maps) and 32 photographs (1967).**

(This publication was brought to the attention of the editor by Prosper J. Williams, who has some copies for sale for $4. His address is 270 Sutherland Drive, Toronto 17, Canada)

This is primarily a history and not a mineralogy book.

Mathew Rogers, a geologist who in 1892-93 visited Tsumeb (then called Soomep, and before that Sumeb and Otjisume) at the request of the South West Africa Company, wrote in his report to the Company: "I ... have visited various countries of the world, inspecting mines, mineral outcrops, and prospecting for minerals; have been associated with the minerals gold, silver, tin, copper, and lead; but in the whole of my experience, I have never seen such a sight as was presented before my view at Soomep, and I very much doubt if I shall see such another in any other locality ... The outcrop is in a valley, formed by gradually sloping hills. As if the subterranean forces had made one sudden and special effort to force an entrance through the crust of the earth, a large rent is made. This rent has been filled in probably by aqueous solutions with minerals, having as its chief matrix quartz. In this instance the minerals, as far as can be seen, are different ores of copper and lead. In process of time ... the surrounding ... rock(s) have been removed, leaving the fissure vein standing in an inclined position corresponding to the lay of the strata — in some places being 40 feet in height — with the green and blue colors of chrysocolla covering it ... it is difficult to determine its real width ... I will only say that on first seeing such a grand and prominent outcrop I could scarcely conceal my astonishment and delight ..."

The discovery and first use of the Tsumeb ore body is not recorded; probably over a thousand years ago, Bushmen of the Otavi Upland showed the green outcrop of malachite ore to a wandering Bergdama tribesman, who knew how to smelt copper from the carbonate ore. There is evidence that the ores have been mined (and smelted) in the area for hundreds of years. The first written record of mineral deposits in South West Africa is probably in the diary of Sir Francis Galton, who camped at Otjikoto lake, twelve miles west of Tsumeb, on 26 May, 1851. There he met various groups of Bushmen and Ovambo transporting copper ore to Amboland. A few years later, another expedition met Ovambo men, each carrying 90-pound baskets of ore (in addition to their food and water) 150 miles from the Otavi valley to their destination.

This remarkable booklet, "... not a history but a sketch, compiled in spare time over a span of ten years", gives a colorful account of the trials and tribulations encountered by a determined group of miners, engineers, laborers, and others to bring the ores from one of the world's richest mineral deposits, 400 miles from the sea, to the outside world. Mr. Sohnge, who "... positively hated history at school", has searched dusty company records, diaries, old newspapers, and talked with scores of old-timers to record the story of mining in this area from earliest times to 1966. The difficulties overcome in mining were numerous: too little water on the surface but rather too much in the mine; human and animal diseases; insect pests, both flying and crawling; native hostility; wars; drastic declines in world-wide prices of metals; fires; and other man-made and natural calamities. That they succeed is attested by the fact that by June 30, 1966, the Tsumeb mine produced 12.46 million short tons of ore containing 665,700 tons of copper, 1,818,800 tons of lead, 730,500 tons of zinc and, as by-products, many million pounds of cadmium, silver, and germanium. At least as much and probably more remained in the ground (in 1966), and mining is continuing. The "sketch" is enhanced by figures, maps, and photographs, the latter showing the mine and town in various stages of development; ox carts, autos and trains; and other memorabilia.

A list of about ninety minerals found in the Tsumeb mine (as of 1966) is given, including ten new minerals discovered there. Several additional new minerals were not fully studied or named at that time.

Occasionally the writing is vague or unclear (where was that 150-mile trek of basket-carried ore, referred to above, going?), and the fold-out map is difficult to read; these are but minor flaws in a generally well-written and readable work.

It is impossible to close this review without quoting an incident related by the author; it is but one illustration of the incidental and often colorful detail with which the volume abounds, although this one relates only most indirectly to mineralogy. When a great celebration was held in 1914 in Windhoek, the Tsumeb band was officially invited to play. "Like most great artists some of the members ... were highly strung. During a practice ... at the Minen Hotel the tuba player lost his temper when the B-trumpeter repeatedly squeaked out the wrong notes; with one great swing he sank the tuba deep over his colleague's head. The manoevre was so well executed that the instrument could not be lifted without breaking the trumpeter's nose, and a tinsmith had to be called to cut open the giant brass horn. It is said that all damages were squared off the same evening by lavish rounds of beer."

Happy reading!

Arthur Roe

The World's Finest Minerals and Crystals, by Peter Bancroft. The Viking Press Inc., 625 Madison Avenue, New York, N. Y. 10022, (1973). 176 pages, 78 full-page color plates, hard cover, 9-1/2 x 11-1/2 inches, ($28.50).

Upon reading the title, one might think that Dr. Bancroft has a lot of nerve to appoint himself judge of the world's finest specimens. What he actually did was to enlist the help of no less than 58 experts to make the selections. His panel of judges and consultants reads like a *Who's Who* of collecting and curating. Still, you might ask, how can *anyone* agree on the one finest example of a mineral when there are so many and such varied pieces to choose from? Beauty is in the eye of the beholder, is it not? Many choices are therefore bound to be controversial but this in itself is an appealing aspect. Consider the interesting conversations, comparisons and competitions that are sure to result. Collectors now have a reference point against which to measure new discoveries and old "sleepers".

With so many new discoveries constantly being made, such a book does seem doomed to partial obsolescence almost before it is published. David Wilbur's new golden topaz, for instance, is probably superior to the one pictured in this book. But the book is a sort of bench mark in time, recording the 78 specimens as the best known examples of their type as of 1972. And certainly the great majority of these pieces will remain unchallenged for many decades, if not forever.

The short text and plate captions are all written in a highly knowledgable and non-technical style. Dr. Bancroft's thoughts and research on localities, collectors, collecting, and the associated history make interesting and easy reading. Each specimen is carefully documented as to size, locality, history, and present location and curator. Supplementary information on other localities and other fine specimens is also included.

The photography is the work of 19 professional photographers including Earl Lewis (Los Angeles), Peter Green and Frank Greenaway (London), and Karl Hartmann (West Germany). Each piece was photographed primarily for accuracy of rendition; no trick shots or exotic lighting techniques were employed, and the specimens usually fill most of the plates in a full-face orientation. Artistically the photography ranges from barely adequate to excellent; a few photographs seem underlit or have backgrounds which are too dark, but only one plate (the brazilianite by Nelly Bariand) has a serious focus problem. The print quality is excellent, and even the dust jacket photograph (Bancroft's fantastic Alma rhodochrosite) is perfect for framing!

The specimens themselves are mind-boggling. Imagine a 12-inch cerussite crystal, in a group, on matrix! Other beauties include a 2-inch twinned silver crystal, a 3-inch twinned phosphophyllite, a nearly 2-inch, twinned, Hunan cinnabar crystal on matrix with four others, and a 4.3-inch terminated crocoite crystal on matrix, all exceptionally lustrous and undamaged. There is also a Red Cloud wulfenite that defies description, and the fabulous 253 carat (uncut) Oppenheimer diamond! But of course *every* piece is incredible; the color and spectacular beauty of the specimens as a whole is almost overwhelming.

Although rather expensive, the book does *not* seem grossly overpriced considering the unique content, high print and binding quality, and the great expense of compilation (which involved a period of nearly a decade and a half-million miles of travel by the author). This is a book to be savored, like a very old brandy on a winter night. Excluding the heavy reference works, *The World's Finest Minerals and Crystals* is probably the world's finest mineral book, thereby joining, in a way, its own elite subject matter.

Wendell E. Wilson

***Grundwissen in Mineralogie, Teil 2: Aufbaukursus, Kristallographie*, by E. Nickel; 301 pp., 141 figs., 4 plates, 20 titles. Ott Verlag Thun, 1973. Price not given.**

This is the second book of a series of three written by Professor Nickel of the University of Fribourg in Switzerland. *Teil 1* (published 1971) entitled *Grundkursus* (basic course) I have not seen, but evidently covers the fundamentals of crystallography, mineralogy, and petrology in a single volume; *Teil 3*, entitled *Petrographie*, is scheduled for publication at the end of 1973.

The purpose of this series, as stated on the dust jacket, is to serve both for an independent study course, presumably for the serious amateur mineralogist, and as a textbook for university students. The present book evidently builds upon the basic material provided in Teil 1, and covers all aspects of crystallography – morphology, optics, atomic structure, and crystal chemistry. Its level is approximately that of a standard U.S. university text in this field. It parallels a number of excellent German texts. It appears to me that it is much too difficult foran independent study course for any amateur without at least some university training in related subjects. As a textbook for a university course, with the addition of laboratory work, it is probably satisfactory. However, the subject matter of crystallography is standardized, and has been for a long time; hence it is difficult for an author to show much originality in this field. In other words, if you need a crystallography textbook in German, Professor Nickel's book will probably fill your needs, but it has no marked advantages over the other standard works in this field.

Brian Mason

***Cornwall's Old Mines*, by H. V. Williams; 46 pages with 13 photographs and 10 drawings and engravings. Published by Tor Mark Press, D. Stratford Barton, Ltd., Trethellan House, St. Aubyn's Road, Truro, Cornwall, England. Twenty pence: date of publication not shown (this booklet is one of a series of forty-odd publications about Cornwall).**

This is not a book about minerals – indeed, few are even named – but rather about the rise and fall of mining in Cornwall, and the hundreds of mines, large and small, that produced millions of dollars worth of tin, copper, and lead, although the latter was never of great economic importance there. The chapter headings give a concise idea of the book's coverage: Early mining and streaming; Copper mining; From copper to tin; A typical mine and its workings; The depressions; The old mining districts; Lead mining in Cornwall; Some historic copper mines; Some famous tin mines; Tin mining today; What to see now; Some books to read.

This booklet gives the reader a good picture of old mining customs. Legend has it that the Phoenicians bartered for Cornish tin long before the Romans obtained it there. The first tin was obtained by "streaming" – washing the ore out from alluvial deposits. Vein mining did not begin until some time in the Middle Ages. Tin was the only metal sought from Cornwall until about 1700, when copper mining became inportant.

The first horizontal shafts were in the coastal regions, where the "adit" could be driven in at a slightly upward slope, thus draining the mine. When vertical shafts were necessary, there began an unceasing battle between Cornishmen and water. The Cornishmen usually won with the aid of a great variety of pumps. "Cornish engineers, following Boulton and Watt's day, exercised their inventive skills with pumping engines over a long period, and after something like forty years had evolved a machine which was without equal for raising water from great depth at low cost." The foundries making these pumps became famous, and supplied machines throughout the world. The enormous 144 inch engines used to drain part of the Dutch polders in the 1840's were of Cornish manufacture.

By 1750 copper mining had become important; during the first half of the nineteenth century Cornwall was the chief supplier of copper to the world. About 1865, however, many of the mines had "bottomed out", and Cornish copper was largely replaced in the world market by more abundant and cheaper ore from South Australia, the Keweenaw peninsula in the United States, Chile later, and still later Africa.

In 1860 an important discovery was made in the Dolcoath mine (which had been a large copper producer since the early 1700's): rich tin ore deposits were found at the bottom of the mine. This discovery paid off for a number of mines that found "... deep tin beneath shallow copper", and tin mining again became profitable for a time.

Some of the copper mines were quite deep. "The men climbed ladders in and out of the mine, continuing to do so even to depths of more than 1500 feet, without this being regarded as anything extraordinary." In a few of the larger mines, man-engines were used; these worked like a pump rod, rising and falling regularly in the shaft with the men making use of its upward (or downward) motion to ride on it in a succession of stages.

The copper ore was prepared by hand in "... primitive open-sided wooden structures — where balmaidens hammered the pieces to a manageable size and cast away any valueless rock adhering. Barrowed thence to a group of equally sturdy females armed with large but light flat-faced hammers, the ore was cobbed and stored in piles ... ready for sale. Samplers from the copper ore companies... then assayed the ore and bid for it at the ticketings which, briefly, might be likened to auction sales but with the bid-prices entered on tickets."

There is an exhaustive listing of mines opened, closed, and opened again as prices and foreign sources of copper and tin waxed and waned. At the book's end is a list of places where remains of old tin buildings can still be seen, the names of the few still operating, and a list of more extensive publications about mining in Cornwall. In this booklet the reader does get a good concise introduction to the history of mining there; a map of Cornwall would have added interest and enjoyment to the discussion.

Arthur Roe

X-ray Data for Minerals, J.J. Finney, Gobel Volker, and Henry Briceno, Colorado School of Mines, Golden., 1974, plastic binding 188 pps.

This is a very current index to published x-ray powder diffraction data for minerals. It covers the literature, including Russian, thoroughly and is not burdened with data for organic and synthetic compounds. Each entry consists of the mineral name but without the formula, the d-spacing of the three strongest lines with their relative intensities, and a literature reference. The data is tabulated in four sections: alphabetic list of minerals, minerals listed by three strongest lines, ore and associated minerals by three strongest lines, and an alphabetic listing of ore and associated minerals. Data on the ore minerals are incorporated in the general listings. The separate sections on ore and associated minerals are intended as an added convenience. There are multiple listings for many minerals, which reflect variations in chemical composition. Unfortunately species are listed only by the strongest line, not cross indexed by three strongest lines. When two or more lines are reported to have one hundred percent intensity, the mineral is listed under the one with greatest d-spacing.

X-ray data for minerals is intended to be an index to powder diffraction data and as such has proven useful to this reviewer during routine mineral identification. A copy may be obtained by addressing an inquiry to:

Professor J.J. Finney
Geology Department
Colorado School of Mines
Golden, Colorado 80401

Carl Francis

To the Editor

FLOWERS OF THE MINERAL KINGDOM

Dear Sir:

I was glad to find the new issue of the *Record* waiting for me on my return from a recent trip to Bancroft. For a moment I could easily have thought I was getting a copy of Burpee's seed catalog with a newly developed flower on the cover (Vol. 4, No. 4). In fact I think that I did have the thought I was seeing a flower, for just a fleeting moment. This is perhaps not too far off, after all, with one of the chapters in *The Mineral Kingdom* being "Flowers of the Kingdom".

W. Seward Mariner
New London, New Hampshire

Dear Sir:

After subscribing to the *Mineralogical Record* since its inception I was delighted with the cover of your last issue. For the first time I recognized the material pictured — Dandelion. Marvelous! May I suggest for future covers, Magnolia grandiflora, Eckianthus companulata, etc.

I will suggest to the American Horticultural Society that they include a rock or two on their cover as a reciprocal gesture of good will.

E. L. Hogarth, Jr.
Jarrettsville, Maryland

Mr. Hogarth, alas, is not a mineral collector. He subscribes out of loyalty to a life long friendship with the editor. Ed.

MORE ON QUALITY MINERALS

Dear Sir:

The last two issues suggested that the *Mineralogical Record* is catering less to the collector than to the professional (semi or pseudo) mineralogist. I, for one, would hate to see *Mineralogical Record* become a third rate technical journal rather than a first-rate mineral collector's (enthusiast's) publication.

What has happened to "What's New in Minerals?", "Museum Record", and articles (with good photos) of *general* interest? Let's have less "Epitaxial Overgrowths ..." and more quality minerals.

Harold H. Freedman
Newton Center, Massachusetts

FROM THE NETHERLANDS

Dear Sir:

As a professional mineralogist I must say that I really have been impressed by your magazine because I have been confronted with many other aspects of mineralogy besides the scientific one which is the only one in professional journals.

I believe that you have accomplished the difficult task of bridging the wide gap between amateurs and professionals.

Currently I am giving a course of mineralogy (15 evenings) to a group of about 80 amateurs. It is the first time in the Netherlands that a university mineral collection has been put at the disposal of amateurs.

The greatest difficulty is the inhomogeneity of the group: "Dana collectors" and persons really interested in the problems of mineralogy; but all have a common goal: to hear more about minerals. I believe that it is a duty of professional mineralogists to come out of their ivory tower and let the amateurs participate in the knowledge they have acquired.

E. A. J. Burke
Institute of Earth Sciences
Free University, Amsterdam

TOO MUCH PHOTOGRAPHY

Dear Sir,

I wish to convey my displeasure concerning a recent addition to the *Mineralogical Record*. I am referring to the column entitled The Photographic Record. I consider this column to be a waste of space in a magazine devoted to minerals. This is not to disparage the photographic or literary talents of Mr. Wilson which are considerable. There is a sufficiency of articles on photography in the abundant photo magazines for those with an interest in photography. There are too few publications dedicated to minerals and mineral collecting to justify space for a column on photography in the *Mineralogical Record*.

The editor commented in an early issue (vol. 1, #4, p. 134) that lapidary articles would not be featured in the *Record* because they are adequately covered by several other publications. This viewpoint is a very sound one with which I fully agree. I think the judgement should be applied just as strongly to the inclusion of a column on photography. Granted, there might be need for a special article on mineral photography and the unique problems it presents. This is still no excuse for a regular column on photography in the only excellent mineral publication available to collectors. Every time I see a column on photography in the *Record*, I cringe, because I know there will be that much less on minerals in the issue.

Pete J. Dunn
Lanham, Maryland

the Mineralogical Record

ON COLLECTING IN FRANCE

Dear Sir:

With reference to the article by M. Santoni on the mines of Chessy, France, (*Min. Rec.*, 1971, **2**, 69-72) I would like to add some up to date information and a few comments.

First of all, I would disagree with his opening statement that "France is not a richly mineralized country." From my experience, France is as richly mineralized as any other part of Europe dominated by the Hercynian, and France has the added bonus of a part of the Alpine orogenic belt with its "Alpine Type Vein" mineralization.

Last summer, my wife and I spent our holiday in the vicinity of Cap Garonne, a locality of note, on the south coast of France, and on our return journey we decided to stop for a couple of nights and visit the museum at Lyon. Whilst reading Monsieur Santoni's article, my wife noticed that Chessy was only 20 miles away and, consulting the map, we found, in fact, the distance was only 20 kilometres. As the museum is only open in the afternoons, it was obvious that we should visit Chessy in the morning.

The Chessy dumps are immediately adjacent to the road on the west side of the village but "private" notices are very prominent. The mine is now leased by the Societe d'Enterprises des Carieres et Mines de l'Estereie, whose offices are situated at Sain Bel, and access to the dumps is forbidden to collectors. This information was offered by a man supervising some sort of mineral processing plant on the dumps. A visit to the company offices at Sain Bel elicited the same story. The manager informed me that because so many mineralogists and rockhounds were visiting the locality (sometimes by the coach-load) and because there are open shafts among the dumps, the company was not prepared to accept responsibility and they had decided to prohibit access completely. It is sad to record the closure of yet another locality.

However, the manager gave me permission to wander round the pyrite mine across the road from the offices, the Mine de Saint Gobain. This mine, on the west side of route D24E, just north of the village of St. Pierre, is no longer working. The headframe of the Perret Shaft forms a prominent feature in the valley and the whole mine site is covered with a dusting of fine grained golden pyrite. The dumps are most uninteresting.

The mine worked a deposit of finely granular pyrite in the Brevenne Green Schists. The pyrite was used for the manufacture of sulphuric acid and from its opening in 1872 to its closure in 1972, the mine produced 18 million tonnes of pyrite with a density of 4.5, which occupied 4 million cubic metres. These statistics were given by the manager.

In the afternoon, we visited Lyon natural history museum to find the re-organization mentioned by Monsieur Santoni completed. In the main hall there is a systematic display housed in 10 double sided vertical cases. This is an unpretensious collection of cabinet sized specimens with a few larger (museum size) specimens interjected to give dimension to the displays. The quality of the specimens is generally good but seldom exceptional. The display is most useful for the locality information it gives. French and other European localities are well represented and the most strongly represented area is Oisan with all its quartz, adularia, axinite, anatase etc. etc. There are six large Chessy azurites in the carbonate section. One specimen struck us as rather amusing; a small, somewhat poor specimen of caledonite labelled "Caledonite, Caledonia, Scotland."

In a circular gallery above the entrance hall we found the main Chessy display. It is in a large wall case and consists of 18 specimens of azurite from 3 x 4 to 12 x 15, showing the various forms and habits; nodules, geodes, botryoidal masses with malachite and crystal groups. However, this case also contains 15 large Sicilian sulphurs which spoil the display completely. The colour contrast between bright yellow and dark blue is somewhat overpowering.

Be that as it may, I think for anyone driving past Lyon on the auto-route in the afternoon, a visit to the museum would be worthwhile.

And please, don't take Monsieur Santoni too seriously. There are lots of minerals in France, not to mention superb food and wine.

Roger S. Harker
36 Oxford Street
Leicester, England

THE COLOR ISSUE

We are pleased that we were able to offer our readers color photographs inside the magazine with the last issue. Once again, as with the first color issue (Volume 3, number 6), this was made possible through the very generous support from Randolph S. Rothschild, of Baltimore, Maryland.

Randy has been an avid micromounter and active member of the Baltimore Mineral Society for many years. He is the compiler of the *International Directory of Micromounters*, the 7th biennial edition of which will be published this coming September by the Maryland Academy of Sciences, of which the Society is a section.

We regret that the *Mineralogical Record* cannot carry color in each issue, our financial situation does not permit it. In fact, were it not for Randy, there would be none at all. Those who enjoy this relief from black and white should be grateful to him. Thus, a public "thank you Randy" is here offered.

Specimen Requests

Dear Sir:

I am interested in acquiring specimens suitable for the determination of the elastic coefficients of single crystal feldspars at high pressures. Of particular interest are Sanidine ($KAlSi_3O_8$) and members of the Plagioclase Series: Albite to Anorthite ($NaAlSi_3O_8$ — $CaAl_2Si_2O_8$). Samples must be fairly large monocrystals (3" x 3" x 2") as free of cracks, other than cleavage, and inclusions as possible. Twin lamellae are ubiquitous to plagioclase, and cannot be avoided. All donated specimens not used in the study will be returned to their donors. All assistance will be gratefully acknowledged.

Richard L. Carlson
Department of Geological Sciences
University of Washington
Seattle, Washington 98195

Dear Sir:

Since you like to help people researching minerals and used to run a specimen request column, I thought you might have a corner to print this.

I am studying phase relations in the pyrrhotite field, where a confusing number of integral and non-integral superstructures have been reported for natural specimens. It is an interesting crystallographic problem how some 18 different structures occur in $Fe_{.875-1.00}S$. I believe there are more than these and that all are composition and temperature related in a predictable way. I am using electron microscopy and some x-rays so all I need are small (not more than a gram) chips and pieces of pyrrhotite from any locality. These could merely be dropped into an envelope and mailed. Any help you could give would be greatly appreciated.

Larry Pierce
Dept. of Geochemistry
Arizona State University
Tempe, Arizona 85281

Dear Sir:

I would like to obtain some photographs of, or to view, some specimens of EPIDOTE, QUARTZ, SCHEELITE, GARNET, etc. from the Greenhorn Mountains, Kern County, California. I have written a small report on material I collected but I would like to expand my report for possible future publication.

Bill Hawes, Jr.
6612 Cedarcrest
Bakersfield, California 93308

DIRECTORY OF MICROMOUNTERS, 7TH EDITION, TO APPEAR IN SEPTEMBER

The International *Directory of Micromounters* is published biennially by the Baltimore Mineral Society, a section of the Maryland Academy of Sciences, at the time of its annual Micromount Symposium in September.

The price of each copy of the seventh edition will be 60¢; by mail, $1.00. Anyone who wishes to have a copy mailed to him or her this coming September is invited to send a check or money order for one or more than one copy to: Randolph S. Rothschild, 2909 Woodvalley Drive, Baltimore, Maryland 21208.

Please send any new or different information as soon as possible to the above address so that it may be incorporated in the new (seventh) edition.

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