the Mineralogical Record

Volume 3/Number 2
March/April 1972

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feature articles

departments

EMMONSITE from the Moctezuma mine, Moctezuma, Sonora, Mexico. Strange hair-like crystals described by Richard V. Gaines in "New data on emmonsite, and a second locality for sonoraite" in this issue. The photograph is by Julius Weber.

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editorial matter

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Editorial

ON "ROCK SHOPS"

When you use a *broad brush* you are bound to get some paint where you never intended. The editor is guilty of using a broad brush. In my editorial about mineral dealers (Vol. II, #6) I said that the term rock shop is nearly synonymous with rock junk. The use of the word *nearly* was not enough to prevent injured feelings (see letters). So I hasten to apologize to those dealers whose "rock shops" carry worthwhile mineral specimens. My words were not meant to convey the impression that *all* rock shops are junk stores.

THE RECORD AND THE CALENDAR

I have tried in many ways to make it generally known that the *Mineralogical Record* is running behind the calendar in its appearance. Since it is not really a news magazine this shouldn't make any difference. We have been able to produce a new issue every two months (give or take a week) and we expect to be able to catch up with the calendar eventually. Nevertheless there are still a lot of readers who get nervous when they look at the date on their last issue and judge, from that, that they've missed an issue. It is just great to have our readers look forward so eagerly to each issue but it is frustrating to us to receive a number of letters before mailing time asking what has happened to the magazine.

RENEWALS

As pointed out in my editorial outlining the nature of this publishing venture (Vol. II, #5) we have no large, highly-paid staff to relentlessly track down and badger delinquent subscribers who have not renewed. Our envelope addressing system does not permit including the date when an individual's renewal is due. Billing is prohibitively expensive and time-consuming except, perhaps, after we have whittled the number down to a few percent. We have provided a convenient prepaid envelope for you to use and plenty of reminders that *most* renewals are due. We now must rely upon your willingness to help us by keeping your subscription paid up without our having to pursue you.

A special problem are recipients of gift subscriptions. Have they been told that either the donor will continue the subscription or that they are expected to continue it themselves? Many, I am sure, do not know what to do at renewal time, so they do nothing.

Still another problem are those who started their subscriptions with other than the first issue of a volume. We prefer to have all subscriptions begin with the first issue of a volume so that the renewals will all come due near the first of the year. Subscribers may, if they wish, inquire about converting to this schedule.

THE GLOSSARY TO BE UPDATED

In the September-October 1971 issue we announced the publication of the *Glossary of Mineral Species - 1971,* by Michael Fleischer. This unique publication offers the most complete compilation of accepted mineral names and chemical formulas in existence, and is of great potential benefit to collectors trying to struggle through the nomenclature snarl. Recognizing the utility of the *Glossary,* the American Federation Nomenclature Committee promptly adopted it as an official reference for use with the Uniform Rules in competitive mineral exhibiting.

It is a difficult task to gather such material without incorporating some errors and omitting some entries. In addition, a number of new mineral species have been introduced to the science since the *Glossary* went to press. In order to improve its completeness and enhance its usefulness, we intend to publish corrections and revisions, in this journal, at periodic intervals. Users of the *Glossary* may then enter these changes in the book. We suggest that readers have Xerox copies made of these changes, as they appear, so they be placed within your books without cutting up your copies of the *Mineralogical Record.*

The first set of revisions will appear in Volume III, number 3 (May-June, 1972). If you do not yet have your Glossary we urge you to order now at the special subscriber's rate of $1.00 per copy. Send your orders to "Mineral Glossary", Post Office Box 34027, Bethesda, Maryland 20034.

John S. White, Jr.

HANSEN'S MINERALS

1223 PORT ROYAL, ST. LOUIS, MISSOURI 63141

PRESENTS NEW MINERAL LIST M-1

In lieu of quarterly lists we are planning full page specimen listings in future issues of the Mineralogical Record. Please contact us for specific requirements in minerals, reference material or cut gemstones. Please include a check with your order and postage consideration. Any specimen may be returned for cash or credit if you are not satisfied. Refer to list M-1. See us at the following 1972 shows: Cincinnati, Phoenix, Anaheim, Detroit. Hansen's Minerals, Inc. Dr. Gary R. and Maurine Hansen. Ph. (314) 432-2882. (Showroom: 149 N. Meramec, Clayton, Missouri 63105, Ph. 314-726-2236).

RHODOCHROSITE, American Tunnel, Silverton, Colorado. 5x2x2 in., A fine brilliant pink crystallized stalactite, crystals up to 0.5x0.5 in. **$200.00**

METASTRENGITE. Bull Moose Mine, Custer, South Dakota (SDSM&T Museum Specimen). Several specimens 1x0.5 to 2x2 in. with crystals from 1/32 to 1/16 in. on Barbosalite. **$9.50 - $25.00**

PYROMORPHITE. Hercules Mine, Burke, Idaho. (Single pocket, found 1966). Green single, TN-crystals 8-18mm. x2-4 mm., clean and bright. **$7.50-$12.50 ea.**

WULFENITE. Old Yuma Mine, Arizona. Bright orange TN to sml. miniatures. Mostly twinned crystals 0.5x1 and 0.75x 1.75 in. **$20.00-$40.00 ea.**

COBALITE Cobalt, Ontario, Canada. TN-size. Bright, silver metallic crystal on matrix, rare. Eight specimens at **$10.00 ea.**

ERYTHRITE w. Belovite. Bou Azzer, Morocco. 2.75x2. Bladed deep, rose red crystals up to 3/8 in. grouped on matrix with small pink balls of Belovite. **$115.00**

MANGANITE w. Barite. Ilfeld, Harz, Germany. 2.5x2, White barite matrix with bright terminated manganite crystals to 1/8x3/8 in. displays well. **$110.00**

CROCOITE. Dundas, Tasmania. Several well crystallized groups. 1x1 to 1.75x2. Good color, six specimens available. **$25.00 to $40.00 ea.**

MARCASITE. Frederick der Grosse Mine, Herne, Westphalia, Germany. 2.3x1.8x1.5. A single pocket occurance of stacked, bright octahedral crystals to 3/8x1/2 in. **$60.00**

BOURNONITE on Sphalerite w. Quartz. Felsobanya, Romania. 3x2. Attractive arrangement of 1/4x3/16 in. xls. of bright Bournonite with drusy Quartz. **$65.00**

GRATONITE (Rare), Cerro de Paso, Peru. (Single pocket occurrence, found by G. Rust 1936) Small TN to sml. miniature specimens of crystal groups. Clean, silvery 1/16 to 1/8 in. xls. Very limited supply. **$6.50-$30.00 ea.**

TETRAHEDRITE w. Barite on Pyrite. Cavnic, Romania. 4x2.5. A group of 3/8x 1/2 in. xls. with white blades of Barite. Very clean for this sulfosalt. **$125.00**

AZURITE on Malachite. Dixie Mine, Washington Co., Utah. (Found 1892, with original labels). 3.5x2. A malachite matrix covered with 1/8 to 1/4 in. Azurite balls on reverse side a solid blue botroydial azurite coating. **$65.00**

HESSONITE GARNET. Jeffrey Mine, Ontario, Quebec, Canada. An extremely choice lot collected from the original pocket in 1964. Excellent apricot-orange color. TN-single xls. to sml. groups **$4.50-$30.00,** 2x2 at **$9.50-$95.00.** Cabinet Specimens. **$25.00-$300.00.** Small groups available for jewelry. **$7.50-$20.00**

PYRRHOTITE. Santa Eulalia, Mexico. Perfectly formed crystals up to 2 in. long. Available in TN to 2x2 size. Excellent specimens. **$8.50 to $30.00**

WITHERITE. Gaskin Mine, Pope Co., Ill. A very nice selection of clean, white 1x1; 2x2 and several cabinet specimens. Elongated barrel-shaped crystals, many dld. terminated at **$4.00-$6.00; $7.50-$15.00** and **$15.00-$60.00**

APATITE (Green). Minas de Panasqueira, Portugal. Four excellent specimens. 2.5x2.5x1.5, two large intersecting crystals **$265.00;** 1.8x1.5 with three 0.5 in crystals on arsenopyrite; 3.2.3 in., flattened crystals with siderite **$150.00;** 3x2.3 in. an excellent group of crystals **$200.00**

FLUORITE (Yellow). Ft. Wayne, Indiana. A fine selection of pale yellow, brilliant single crystals and small matrix specimens, very similar to Cumberland, England. TN. **$5.00-$15.00;** miniature **$10.00-20.00;** cabinet **$15.00-$25.00**

LIBETHENITE. Castle Dome Mine, Gila Co., Arizona (Dana) 1.5x1.3x1. A group of approx. 10-1/8 in. deep green rosettes of micro-crystals on matrix. **$40.00**

DOLOMITE. Eugi, Navarra, Spain. Two large intersecting rhombohedrons. Very clean, translucent to transparent, gray to clear. 3x2.5 in. **$115.00.** Four other specimens at **$65.00, $70.00, $75.00** and **$120.00**

ARAGONITE. Minglanilla, Cuenca, Spain. Lot A. 9-specimens. Pseudo-hexagonal twinned crystals, with penetration twinning at terminations; pale to deep violet color, approx. 1.5x1.5 in. **$15.00 ea.** Lot B. Similar to above, without twinning at terminations. Extremely clean, violet hexagonal prisms up to 1.5 in. long x 0.75 to 1.0 in. diameter. **$7.50 ea.**

ARSENOPYRITE. Santa Eulalia, Mexico. Brilliant, silver, diamond shaped crystals. (Cf. Mineralogical Record 2 (6), 248), TN. **$6.00-35.00.** Miniature **$30.00-$50.00.** 2x3. **$40.00-$50.00.** (Limited supply).
Several TN and miniatures exhibiting an epitaxial pyrite overgrowth. **$20.00-$40.00**

REALGAR. Nagyag, Romania. 6x2. 7x 1.5 in. A very old specimen with short, prismatic deep red realgar crystals and horizontal sections on a matrix of deep black sphalerite-tetrahedrite. Very fine for this old European Locality. **$135.00**

VIVIANITE. Blackbird Mine, Cobalt, Idaho. 6x3x2.5. A fine cabinet specimen with 70% of the face encrusted with blue-violet crystals up to 0.8x0.8 in., displays well on natural base. **$125.00**

GALENA. St. Joseph Lead District, Missouri. This is the most brilliant cubic galena we have seen from any location, a true patent finish. Individual crystals from 0.5x0.5 to 4x3 in., matrix and crystal group specimens. All are superb show specimens. Priced at **$10.00** to **$200.00** dependent on crystal size (A fine cabinet size crystal at approximately **$45.00**).

SIEGENITE. St. Joseph Lead District, Missouri. A rare cobalt nickel sulfide with brilliant crystals up to 1/8 in., the finest quality material reported. TN, miniature, cabinet and museum specimens available. **$15.00-$40.00; $50.00-$165.00; $175.00-$300.00** and **$600.00-$800.00** (X-Ray fluorescence and powder data availabe, very limited supply as it was a one pocket occurrence).

ADAMITE. Mina Ojuela, Mapimi, Mexico. From the superb pocket mined during 1970. A very choice selection of bright yellow to yellow-green material available in TN to cabinet specimens, many of the specimens carry National Museum (Smithsonian) labels. Material of this quality is very scarce. **$5.00** to **$75.00** Please give us size and price requirement.

TSUMEB, S.W. Africa. We have just purchased a superb collection of approximately 500 specimens from this classic locality. The collection is very heavy in TN's and miniatures.

SMITHSONITE. (Rare green), botryoidal and crystallized. TN. **$8.00-30.00;** 2x2. **$25.00-$50.00;** cabinet specimens. **$60.00-$165.00.** Other colors available Clear, cream, pink at comparable prices.

CERUSSITE. These are very clean specimens. Thick, single and sixling. Crystals in miniature **$45.00-$100.00** to small cabinet specimens. **$65.00-$400.00**

DIOPTASE. Excellent green color and crystal form, some with calcite TN **$8.00-$20.00;** 2x2 **$20.00-$45.00;** cabinet specimens **$60.00-$450.00.** One choice museum specimen. **$1,100.00**

AZURITE. Deep blue blocky crystals on limonite. TN to cabinet specimens. **$15.00-$135.00**

TARNOWITZITE. Plumbian aragonite. Clean white single crystals and small groups with tan colored terminations. TN. **$4.00-$6.00.** Miniature. **$7.50-$15.00.**

WILLEMITE. Vitreous, blue-green botyroidal crystals. Exceptional for this rare mineral. Miniature. **$30.00-$45.00.** Two cabinet specimens. **$85.00** and **$135.00**

FRIENDS OF MINERALOGY

by Joel E. Arem

"ON THE MOVE"

FM is 2 years old. It was born at a time when interest in minerals was at a high point unmatched in history and is growing as this interest increases still further. Its conception occurred amidst a major shifting of attitudes in the very structure of American amateur-professional mineralogy. The smoke of debate has now cleared somewhat, revealing an arena of activity that involves all aspects of the science and hobby of mineralogy. FM is on the move.

The past year has been extremely valuable in shaping opinion of what the needs are of both amateur and professional mineralogists. All this meditation and discussion has solidified the concept of what FM is and what it should be doing. This concept was given fresh life at the FM meeting on Feb. 11, 1972, at the Desert Inn, Tucson, Arizona.

Several FM activities in the past year have been quite successful. Guidelines for future work have been established by the following major committees. *Mineral Locality Preservation* (Davis Lapham): A data sheet for describing localities is now being tested in Pennsylvania. Many problems have to be solved, but effort is being expended and useful ideas are emerging. *Educational Exhibits* (Robert W. Jones): The guidelines for exhibiting have now been revised twice (benefiting from experience at several shows) and a final form is ready for distribution. The judging criteria have also been modified and strengthened. It was decided at the Tucson meeting that exhibiting should be considered one facet of a larger FM activity involving educational aspects of mineralogy. The broader function would include lectures, traveling exhibits and writing, perhaps even correspondence courses.

Educational Uses of Minerals (Raymond Grant): Proposals regarding mineral uses were made in the *Record,* Vol. I, 132. A trial program to assess the needs of schools and sources of material had a poor response. Nevertheless, a great need is evident in this area. In some elementary and secondary schools earth science is taught without a single specimen of a rock, mineral or fossil. Introductory mineral-and-rock sets need to be developed. A major step forward may lie in bringing FM activities to the attention of potentially interested schools: a decentralized, locally-active FM can do this far more effectively than a solely-national organization.

FM Field Trips (Joel E. Arem): An FM-sponsored trip to the Pine Creek mine, Bishop, California resulted in the recovery of many fine laumontite specimens. Groups and single crystals have been sent (at their request) to over 15 museums and universities, and the overall experiment in collector-mining company relations can be deemed a success. Additional trips are anticipated; FM-collected specimens may be ideal prizes for educational exhibit competitions and mineral auctions for the benefit of the *Mineralogical Record.* Guidelines are currently being developed within the Mineral Preservation Committee based on this experience.

Special Project (Arthur Montgomery): The Philadelphia Academy of Natural Sciences has agreed to let FM advise on the renovation of the Academy collection. This significant and historic assemblage has been somewhat neglected, but under FM guidance it will be reorganized, updated, and gradually put to better display and scientific use. This project, which may take as much as 5 years to complete, could become a showcase for successful FM collection preservation activities.

Auditing Committee (Mike Kokinos): The past year has seen a growing financial base for FM operations. A total of over $1200 resides in the treasury, and should give needed leverage to advance many projects and activities.

Nominating Committee (John Medici): A slate for election of 2 new Executive Committee members was not augmented by floor nominations, so it stands as: Richard Thomssen, Neal Yedlin, Wayne Leicht and Davis Lapham. Two of these will be elected for 3-year terms in a ballot of all FM members. These two will replace the two current 1-year term members of the Excutive Committee, Robert W. Jones and Mary Mrose.

Organization (Richard Bideaux): Articles of Incorporation and ByLaws are being reviewed by the Executive Committee. Tax exempt status will be sought.

Friends of Mineralogy has clearly not been idle in the past year. But in spite of some success and enthusiasm, FM has not managed to reach and bring into membership many people whose attitudes and interests coincide with those of FM. Furthermore, many existing FM members had not found means to participate actively in FM activities. Many who could not come to Tucson feel the need for a more locally-active organization with which to affiliate.

In light of these vital needs, action suggested by the Executive Committee was unanimously approved at the Tucson meeting. FM has been reorganized on a regional basis. The Executive Committee and national officers will provide an essential decision making function, and will coordinate activity taking place primarily at a local level. In this way many more people can become truly active in FM projects and committees, and much more can be accomplished. Along with decentralization must come two additional changes.

A local organization needs people to operate efficiently, so FM urges its members to actively seek those who are interested in promoting the stated FM goals (see *Record,* Vol. II, 92) and urge them to join. Ideally, many subscribers to the *Record* who are seriously interested in minerals will recognize and grasp the opportunity to truly advance their hobby and science through participation in projects that have proven themselves beneficial. Dues have been fixed at $5 per year, per person. These funds enable activation of many projects, and cover the postal and considerable miscellaneous expenses that are expected in a communications-oriented group.

A second necessity for FM is the creation of long-range projects. To this end guidelines have been finalized and are ready for distribution. Three major areas of interest have been chosen for the main thrust of FM work. These are: Educational aspects of mineralogy; Locality registration and specimen preservation; *Mineralogical Record* promotion and distribution.

Each region (see adjoining map) is semi-autonomous and will have its own Director (these are listed below, except for region 1 where a Director is still needed). Each region has its own Secretary/Treasurer and committee chairman. In every region members will be sought for committee work - as many FM members as possible should be involved in these. New FM members can immediately find an activity on which they may work, and will be able to join a group of people already locally active. Initiative is recommended in FM projects. If someone has a good project in mind, he should be allowed to pursue it under the guidance of a standing FM committee. Every FM member should register his interests with his regional director. Committee work will provide a major incentive for membership, since FM activities will thus become visible and accessible.

Each region will have its own problems, and will have to find unique ways of solving them - the challenge certainly exists. No fixed rules will be established governing operation of regions, except where activities reflect on the national organization (the Executive Committee is expected to clarify these issues). And most important, the regional FM structure will allow individuals to participate to whatever extent they wish.

All new members will be processed through the National Secretary. Dues money will be sent to the national Treasurer where they will become available to individual regions, to cover expenses, as approved by the Executive Committee. A questionnaire to be filled out by every new member will provide enough basic information about the members to allow FM to put him in touch with others in FM who may have similar interests. A copy of the questionnaire will go to the Secretary of the region in which the member lives, to still further improve communications potential.

Regional committees will operate autonomously, but will coordinate their activities through the National Committee chairmen. Ideas generated by individuals in any region, at any time, can immediately be sent to the other regional committees. In this way good ideas will reach all interested people, with minimal time lag. After comments from the regions have been received, the National chairmen can then distill the original idea into working guidelines or suggestions to be used in all FM regions. This type of information and suggestion exchange will characterize FM activities in general.

continued on page 88

the state of the art - crystal growth

by K. Nassau

Bell Telephone Laboratories, Incorporated • Murry Hill, New Jersey

PART II

Synthetic Minerals That Have Been Grown

In the following section a listing is given of some 70 minerals which have been grown in the laboratory or in the factory. This list includes materials grown by the author, reported in the literature, or otherwise noted. No attempt has been made to give references because the field is growing so rapidly and a literature search (see Part I) should be made if further information is required (please do *not* contact the author for this). This listing is not meant to be inclusive; both common and rare synthetic minerals are listed, as well as both those available commercially and those one would have to grow oneself. Inclusion in this list generally implies that crystals at least 1/8 inch in size have been grown, but the absence of a listing has no particular significance. The crystal growth techniques will be discussed in detail in Part III of this series. The order follows (with a number of exceptions), the Hey arrangement M. H. Hey, *Chemical Index of Minerals,* 1955).

Fig. 1 **— Moissanite crystals - largest is 1 inch in diameter.**

A. *Elements*

Metals and semi-metals such as *copper, silver, gold, tin,* and *bismuth,* can be readily grown by most of the melt techniques. The Bridgman and Czochralski techniques are the preferred methods and the size of the crystal boules is limited only by the size of the apparatus. In the case of bismuth rapid solidification of the melt with a large supercooling can lead to dendritic forms, and somewhat slower growth can give hopper shaped crystals of great beauty. With reduced supercooling and slower growth ordinary crystals are obtained. During electrolysis (e.g. electrolytic silver plating) crystals can also form.

Sulphur crystals in the α-form can be grown in inch size by the slow evaporation of a carbon disulphide solution. High purity *tellurium* ingots as purchased frequently consist of single crystals formed during solidification.

Diamond crystals are prepared commercially by the high pressure technique. Any form of carbon can be used (even peanut butter!) and a small amount of solvent such as chromium or iron metal is usually added. The actual growth mechanism is probably a flux zone. Crystals up to 1 carat (0.2 gm) in size have been made, both colorless and colored.

B. Carbides

Moissanite (SiC) has been reported in meteorites but is known as carborundum when it is made by the electric arc reaction of carbon and silica for abrasive use. This is done on a large scale, and 1 inch diameter crystals of SiC are sometimes an incidental by-product, Fig. 1. Crystals have also been grown in the laboratory, but the presence of many different polytypes and the high temperatures involved makes it difficult to control the process. Both vapor growth (sublimation) and solution growth (using silicon as the solvent) have been employed. Colors range from a light tan, via deep green, to black.

Cohenite (Fe_3C) found in meteorites and known as cementite in metallurgy has been crystallized by flux electrolysis.

C. Sulfides

Greenockite (CdS) is a semiconductor used in camera photocells, exposure meters, etc. It is available commercially in single crystals of inch size and can be grown in a number of ways, including melt, hydrothermal, and vapor phase techniques. In Fig. 2 are shown a number of small greenockite crystals grown at about 1000° C by sublimitation in a gas stream.

Cinnabar (HgS) has been grown hydrothermally in 1/2 inch size crystals and also from a sodium sulfide - sulfur flux. Sulfides which can be grown by vapor techniques include *bismuthinite* (Bi_2S_3) and *stibnite* (Sb_2S_3); a cluster of the latter was shown in Fig. 6, Part I.

Fig. 2 — Vapor grown greenockite crystals.

D. Oxides

Bromellite (BeO) and *zincite* (ZnO) have been grown as single crystals hydrothermally, from the flux, and from the vapor phase. Both form hexagonal prisms with one end terminated by the pyramid and are perfectly clear and colorless when pure. Hydrothermal zincite is shown in Fig. 4.

Periclase (MgO) is often formed in inch size crystals during the decomposition of magnesite when firebricks are being made. Smaller crystals have also been made in laboratory furnaces by using a carbon arc to melt a puddle of MgO within a pile of the material and letting it solidify. Colored crystals are formed by the addition of impurities: red by Co, blue by Ti, and various shades of tan to green by Fe, Ni, or Cr.

Corundum (Al_2O_3) is probably the best-known synthetic, being used as a gemstone, in watch bearings, as laser crystals, etc. The first synthetic crystals were those of Fremy and Verneuil (about 1890) shown in Fig. 5 (grown from a complex mixture probably by a vapor transport mechanism within a semi-solid flux mass). These were followed shortly by the flame fusion growth, a technique invented by some unknown person in Geneva in 1886, Fig. 6, and independently re-invented in a somewhat different form by Verneuil in 1891-1892. More recently the flux-technique (Fig. 7), the hydrothermal technique (Fig. 3), and Czochralski pulling have all been used. The last of these has produced boules over 1 inch in diameter and several feet in length. Detailed investigations of the early history, of "reconstructed" or Geneva ruby, of the life of Professor Verneuil, as well as a description of the current state of ruby synthesis have recently been published: K. Nassau and R. Crowningshield, "The Synthesis of Ruby," *Lapidary Journal* **23,** 114-119; 313-314 and 334-338; 440-446; and 621 (1969); K. Nassau, "Reconstructed or Geneva Ruby," *J. Cryst. Growth* **5,** 338-344 (1969); K. Nassau and J. Nassau, "Dr. A. V. L. Verneuil and the Synthesis of Ruby and Sapphire, *Lapidary Journal* **24,** 1284-1296; 1442-1447; 1532-1542 (1970).

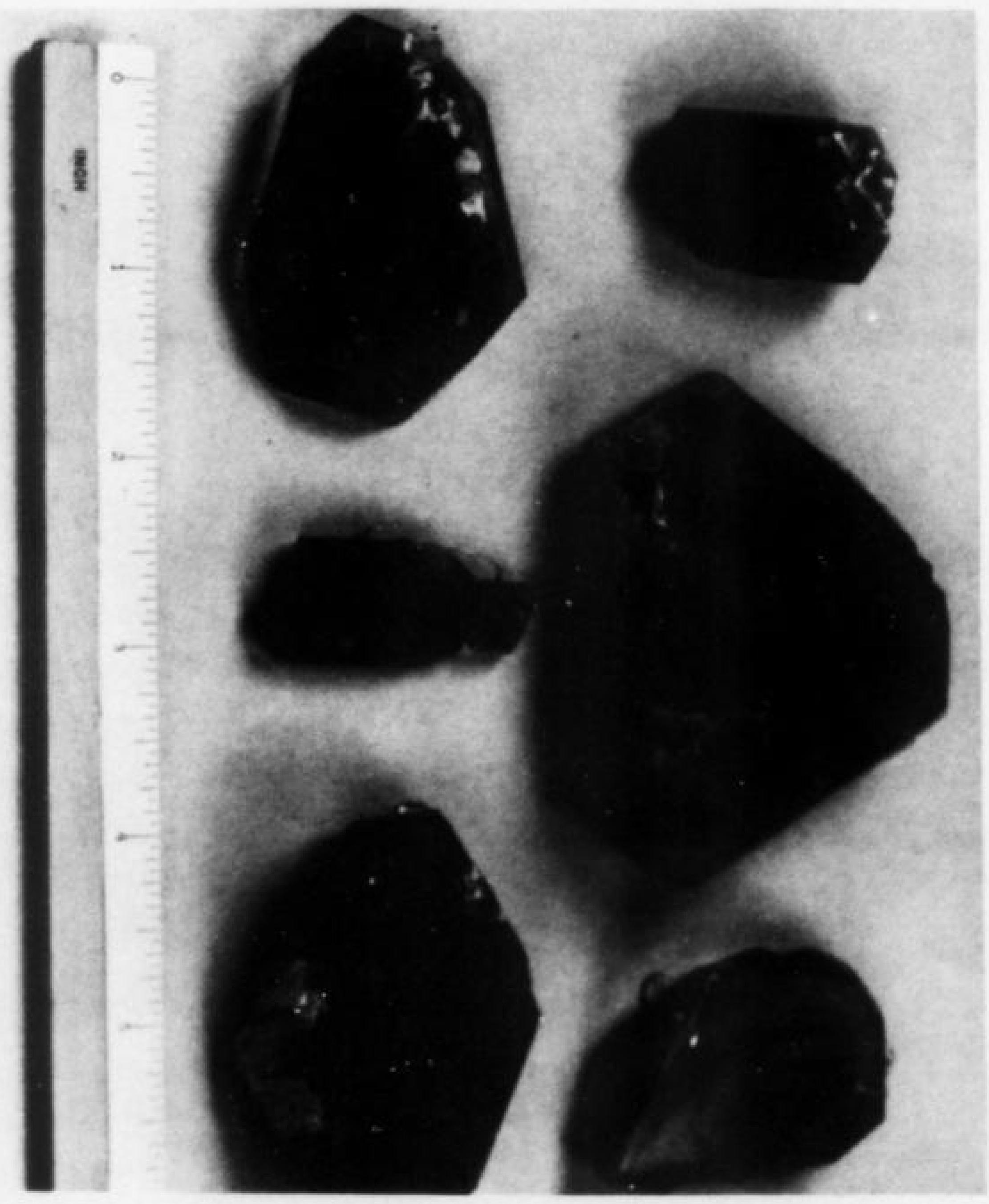


***Fig. 3* — Hydrothermally grown ruby crystals.**

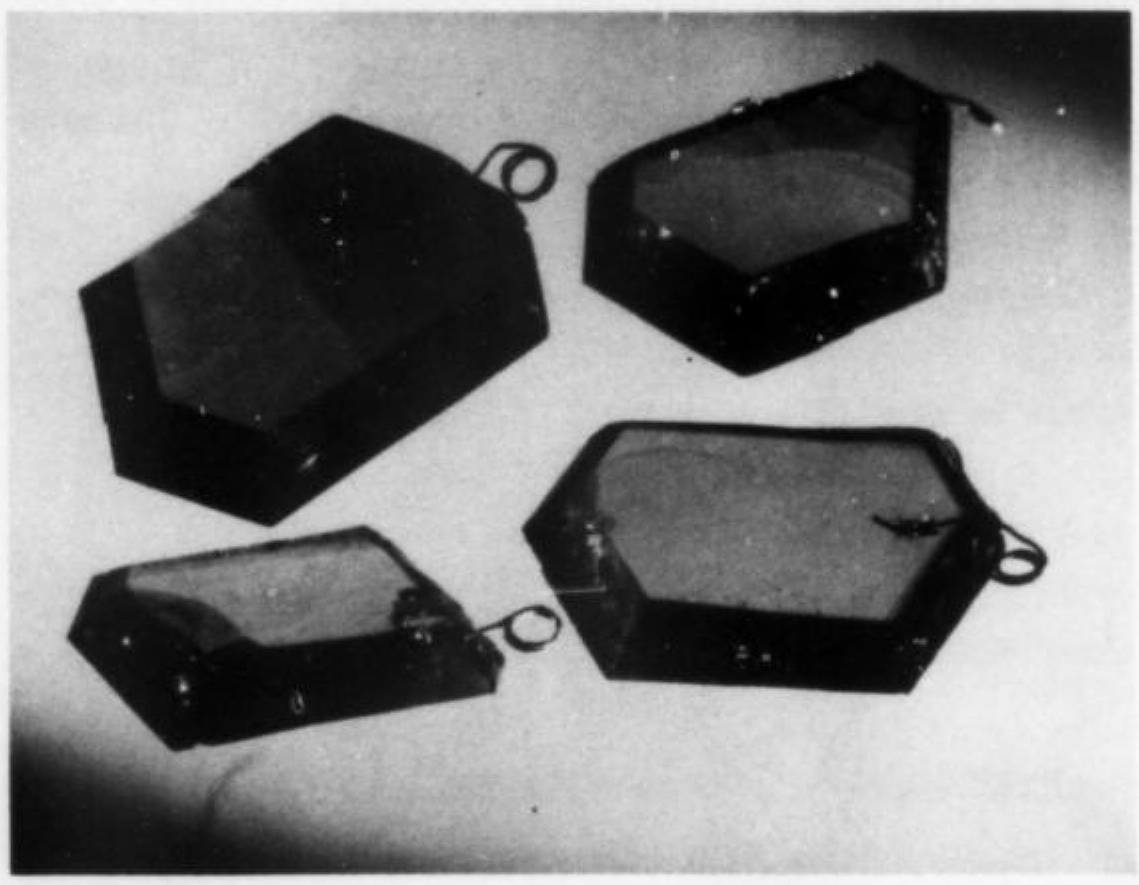


***Fig. 4* — Hydrothermally grown zincite; largest is 1 1/2 inches across.**

***Fig. 5* — Fremy and Verneuil rubies, grown about 1890; largest cluster is 1/4 inch in size.**

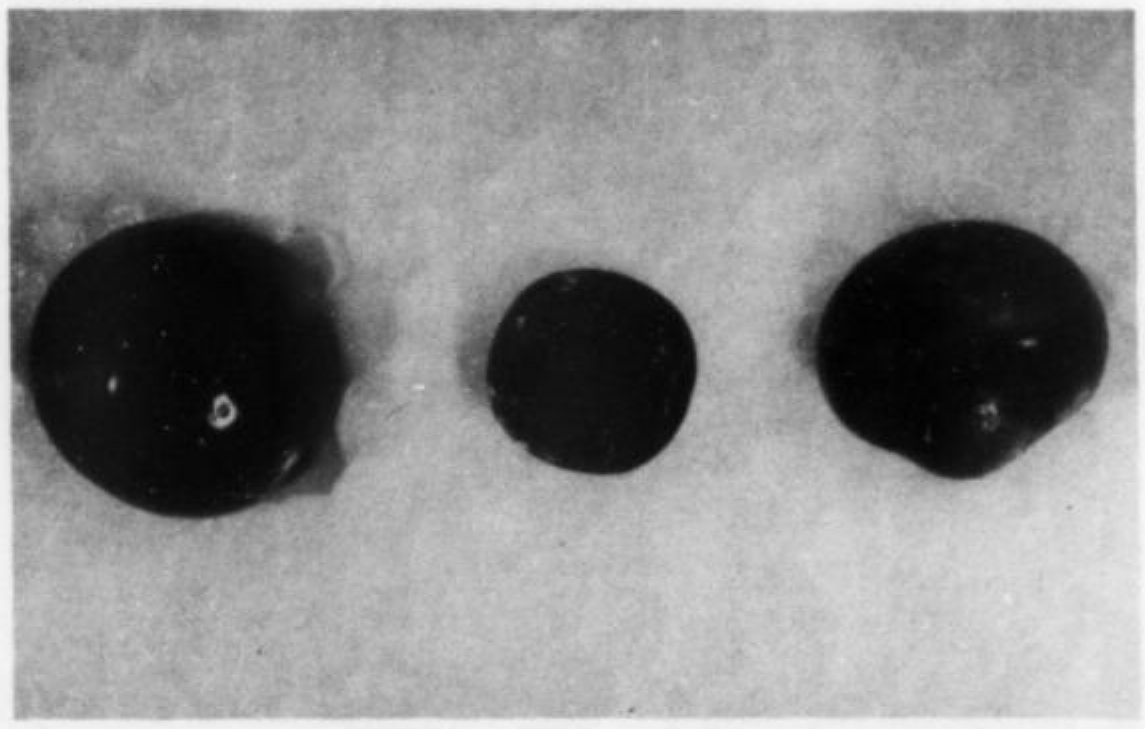


***Fig. 6* — "Geneva" flame fusion grown rubies, about 1886; crystals about 3/8 inch across.**

Fig. 7 — Flux grown ruby cluster: 1 inch diameter.

Many colors can be obtained by the addition of impurities: the *ruby* red by Cr, the *sapphire* blue by Fe and Ti, padparadschah orange by Cr plus Mg, green by Co or Cu, yellow by Ni, and so on. The addition of vanadium produces "alexandrite colored corundum" which gives a color change somewhat similar to that of alexandrite (see below under alexandrite). *Star ruby* and *star sapphires* are made by the addition of a small amount of titanium oxide; after growth in the usual Verneuil fashion annealing at about 1300° C produces precipitation of small needles of TiO_2 to give the asteriated product.

By a slight variation of the flux process corundum crystals will grow in the vapor space above the crucible. The habit of these crystals is quite unusual: they are lozenge-shaped, up to more than 1 inch across, but the thickness is only about 5 microns (one five-thousandth of one inch). Such crystals are quite flexible.

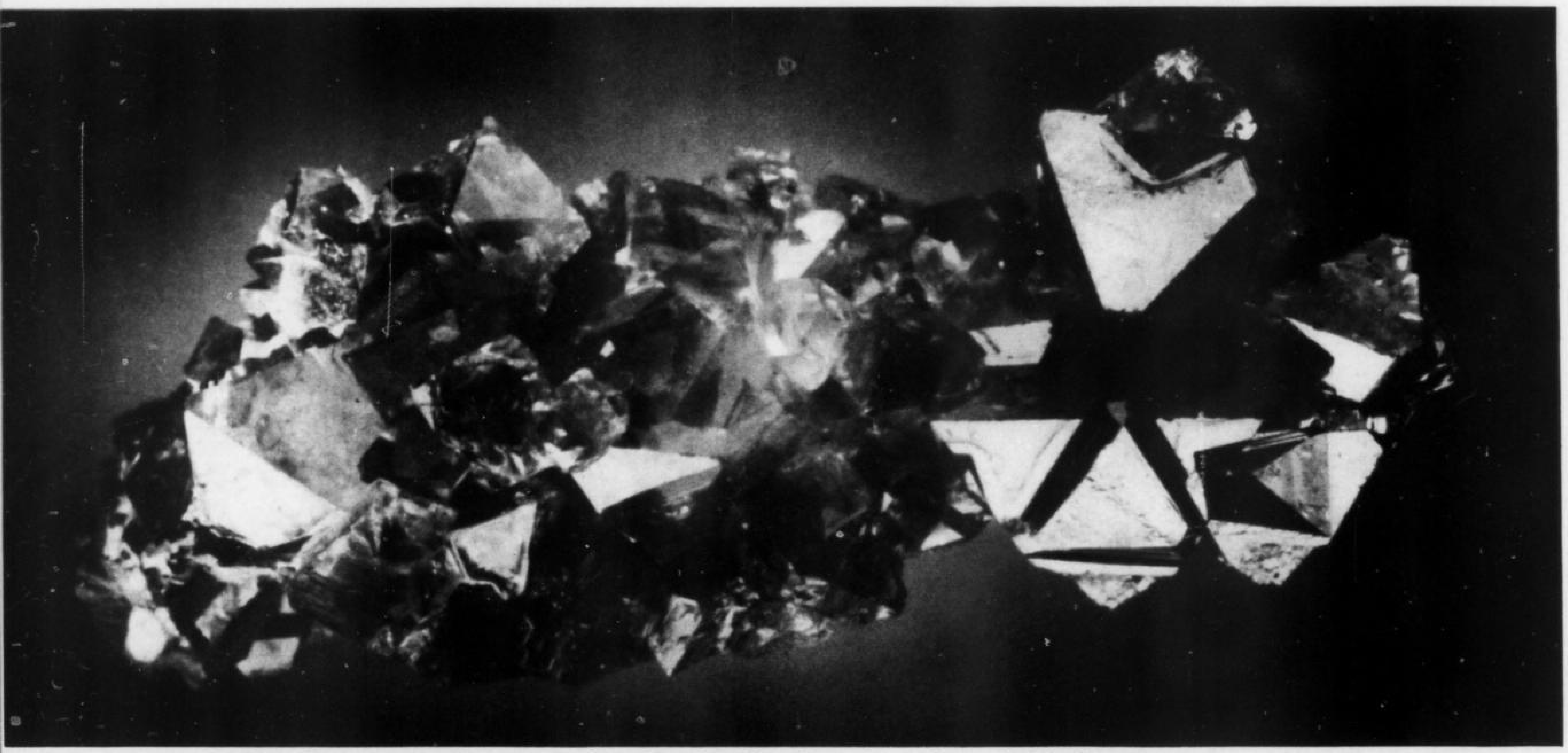


***Fig. 8* — Flux grown gahnite crystals, colored red by chromium; cluster is 2 inches across.**

Quartz (SiO_2) is grown in large crystals by the hydrothermal technique. These are used in crystal clocks, electrical oscillators, filters, etc. Since the seeds are usually cut almost perpendicular to the c-axis, the crystals are dominated by pebble-like c-surfaces, which are however not c-faces. If given enough growth time, such crystals do yield completely faceted forms, not unlike naturally occurring quartz crystals.

Rutile (TiO_2) is grown by the Verneuil technique in inch size boules and has also been grown from the flux. The crystals are a pale yellow color when pure, but a deep blue when heated in a reducing environment. Crystals with Fe added are brown. *Paratellurite* (TeO_2) is grown in large boules by Czochralski pulling. Oxides which have been grown from the vapor phase include *baddeleyite* (ZrO_2) and *cassiterite* (SnO_2).

Ice (H_2O) is a readily grown mineral which is easily forgotten. Bridgman, zone, Czochralski, and vapor techniques have been used. Careful control of the temperature gradients is important to ensure that the density maxium near 4°C does not produce unexpected convection flow patterns in the melt. Such work is best performed in a walk-in freezer.

A large group of complex oxides having the spinel structure and general formula AB_2O_4, where A are divalent and B trivalent ions have been grown in the laboratory for investigative purposes. These include *spinel* ($MgAl_2O_4$), *gahnite* ($ZnAl_2O_4$), *trevorite* ($NiFe_2O_4$), and *magnetite* (Fe_3O_4 or $Fe^2 + Fe_2^3 + O_4$). All of these are grown from the flux in the form of octahedra. The iron-containing ones are black and magnetic. Spinel and gahnite are colorless if pure, red with Cr added, blue with Co, and green with Ni. A cluster of gahnite crystals is shown in Fig. 8, and trevorite in Fig. 9. Spinel as grown by the Verneuil technique for gemstone use is usually much richer in aluminum content then the formula $MgAl_2O_4$ indicates, i.e., it is intermediate between spinel and corundum. Trevorite and magnetite have also been grown by the Verneuil technique as well as by flux electrolysis.

Chrysoberyl ($BeAl_2O_4$) is named *alexandrite* when chromium is present in the rare specimen having the correct concentration to show the alexandrite color change effect: red under incandescent light and green in daylight or under a fluorescent (not ultraviolet) light. This must not be confused with "alexandrite colored synthetic corundum," which is $Al_2O_3 + V$ and which shows a somewhat similar effect. Both chrysoberyl and alexandrite have been grown from the flux in very small crystals. If the commercial or scientific interest justified the effort, synthetic

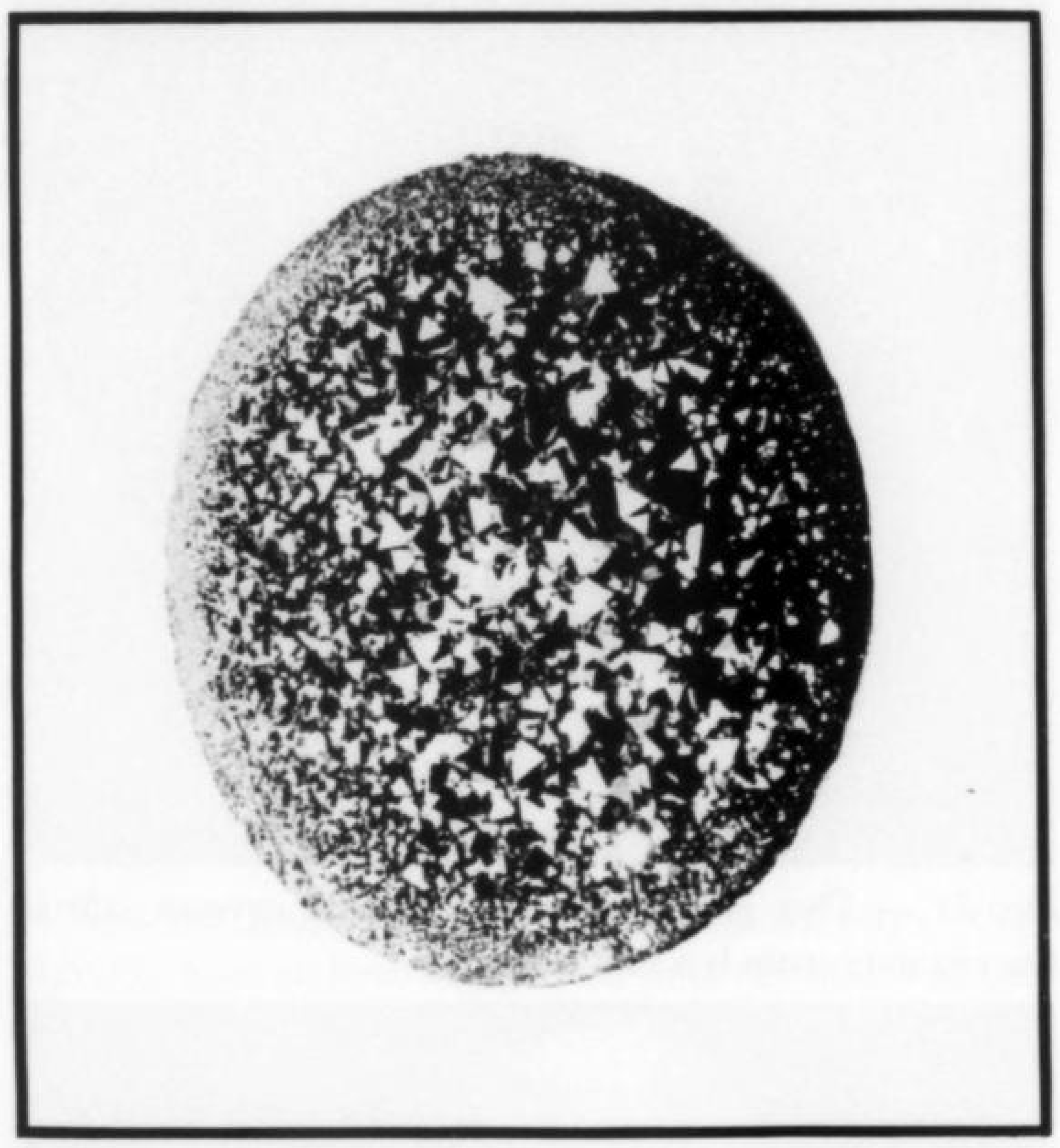


Fig. 9 — **Cluster of black trevorite crystals; specimen is 4 inches in diameter**

alexandrite crystals large enough for jewelry use could almost certainly be grown. In the absence of such a demand however the synthetic crystals will remain essentially unavailable. This is of course also true of many of the other examples cited here.

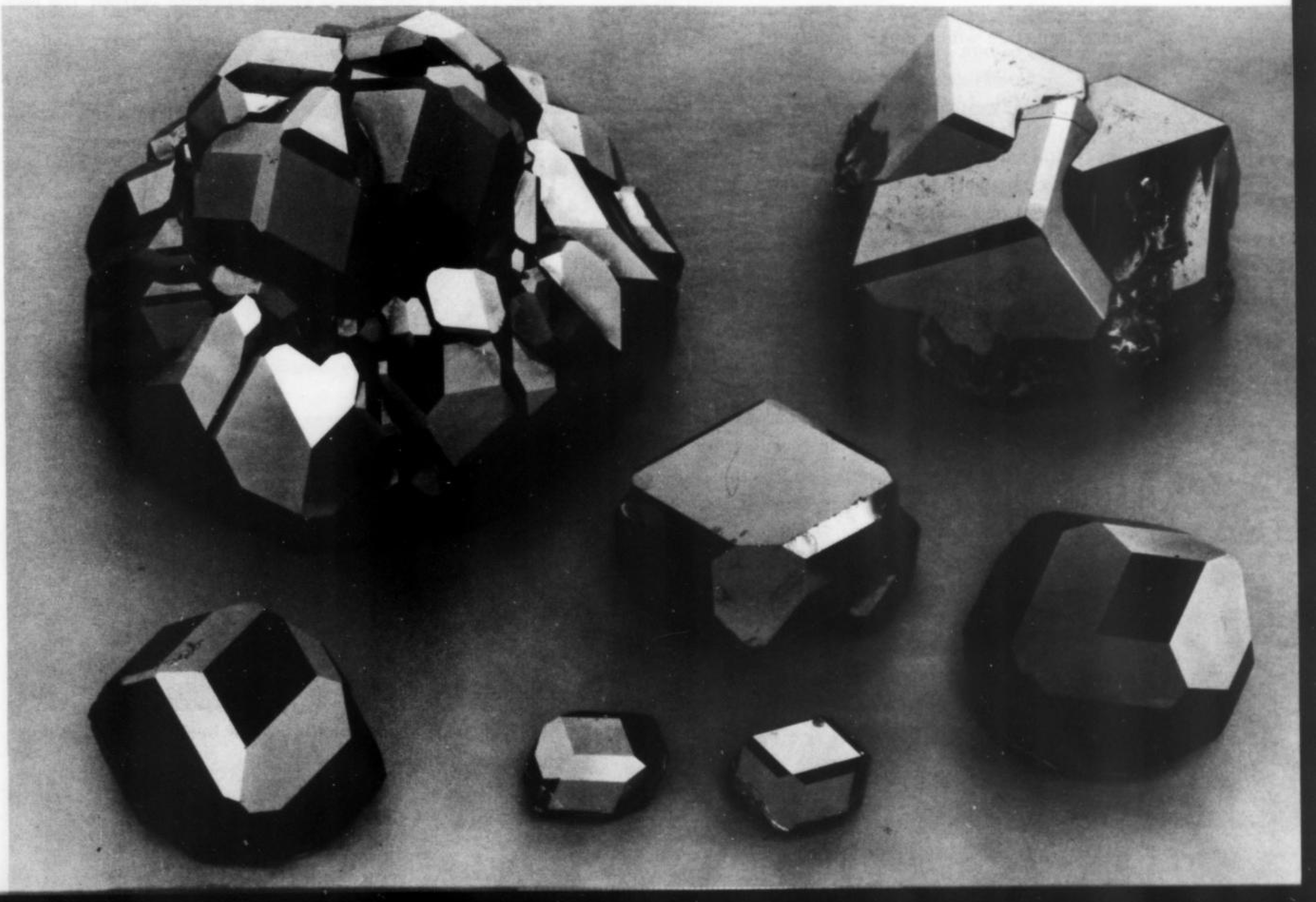
There is a large group of synthetic *garnet* structure materials based on the composition $Y_3Al_5O_{12}$. This is related to the ordinary garnets, e.g., grossular $Ca_3Al_2Si_3O_{12}$, by the simultaneous substitution of Y^{3+} for Ca^{2+} and Al^{3+} for Si^{4+}; this maintains electroneutrality and eliminates silicon. By similar substitutions a whole series of rare earth garnets can be made:

$Y_3Al_5O_{12}$	- yttrium aluminum garnet	- "YAG"
$Y_3Fe_5O_{12}$	- yttrium iron garnet	- "YIG"
$Gd_3Ga_5O_{12}$	- gadolinium gallium garnet	- "GdGaG"
$Nd_3Ga_5O_{12}$	- neodymium gallium garnet	- "NdGaG"

and so on. This type of substitution does occur in nature, resulting in the rare earth containing minerals yttergarnet (Hey #14.8.13) and emildine (Hey #16.13.8).

These "garnets" can all be grown from the flux to yield inch size crystals of the usual dodecahedron (110) and trapezohedron (211) garnet habit, Fig. 10. Both hydrothermal and vapor phase techniques have also been used. Iron-free rare earth garnets can also be grown by Czochralski pulling from the melt in foot long boules. If they contain iron, the rare earth garnets provide useful magnetic materials. YAG and GdGaG, for example, are colorless and become green with Co or Cr addition, blue with Co plus Si, purple with Nd, red with Mn, yellow with Ti, and so on. YAG-Nd is a good laser material. A detailed account of these rare earth garnets has been given (K. Nassau, "Synthetic Garnets," *Lapidary Journal* **25**, 100-102 and 108-112 (1971).

Fig. 10 — **Black, magnetic yttrium iron garnet crystals, grown from the flux.**



When $Y_3Fe_5O_{12}$ is grown from lead-containing fluxes a relatively small change in growth conditions will result in large crystals of *magnetoplumbite* ($PbFe_{12}O_{19}$). A group of these crystals is shown in Fig. 11.

E. *Halides, Carbonates, Borates, Nitrates, Sulfates, Chromates*

A number of halides such as *halite* (NaCl), *sylvite* (KCl), and *fluorite* (CaF_2) are readily crystallized from the melt. These materials are used to make lenses, prisms, and windows for specialized optical instruments. Commercial growth is performed on an extremely large scale: 20-lb crystals grown by the Czochralski or Bridgman techniques are common and half-ton size crystals of this type have been reported.

Both fluorite and crystals in the mixed fluorite (CaF_2) - yttrium fluoride (YF_3) system such as the minerals *yttrofluorite* $(Ca,Y)F_{2-3}$, *cerofluorite* $(Ca,Ce)F_{2-3}$, and also *tysonite* $(Ce,La)F_3$ type fluorides have been extensively investigated for use in laser research, the latter systems particularly intensively in Russia. Impurities added for this use include neodymium (purple), uranium (red), and divalent samarium (green). Czochralski, Bridgman, or zone growth are most frequently employed to yield larger than inch size crystals.

Nantockite (CuCl) has been grown by several techniques, including from solution in concentrated hydrochloric acid, from the gel, by the Bridgman technique, and from fluxes such as KCl, including the flux zone technique. The growth is complicated by a wurtzite-sphalerite type phase transition which makes it difficult to obtain quality crystals.

Chlorargyrite (AgCl) and *bromargyrite* (AgBr) have been grown in inch size crystals from the melt. To obtain thin crystal sheets several inches across a drop of melt can be squeezed between polished glass plates and permitted to solidify from one point outwards.

The mineral *boracite* ($Mg_3B_7O_{13}Cl$) and a number of related compounds have been grown by a complex vapor phase transport - reaction in 1/8" size crystals, Fig. 12. *Bellingerite*, $3Cu(IO_3)_2\bullet 2H_2O$ has been grown from water and nitric acid solution, Fig. 13.

Several techniques have been used to grow single crystals of *calcite* ($CaCO_3$). By the addition of other low melting carbonates as solvents, the vapor pressure of CO_2 over the molten $CaCO_3$ can be lowered to less than one atmosphere. In this manner calcite has been crystallized in an atmosphere of carbon dioxide by using the traveling solvent zone technique with added Li_2CO_3 to lower the melting point to 662° C. The hydrothermal technique has also been used for calcite. By reacting calcium and carbonate containing solutions in a gel, small crystals of the three polymorphs *calcite, aragonite,* and *vaterite* are formed simultaneously - clearly not an equilibrium process! *Gypsum* ($CaSO_4\bullet 2H_2O$) has also been grown by reaction of its components in a gel.

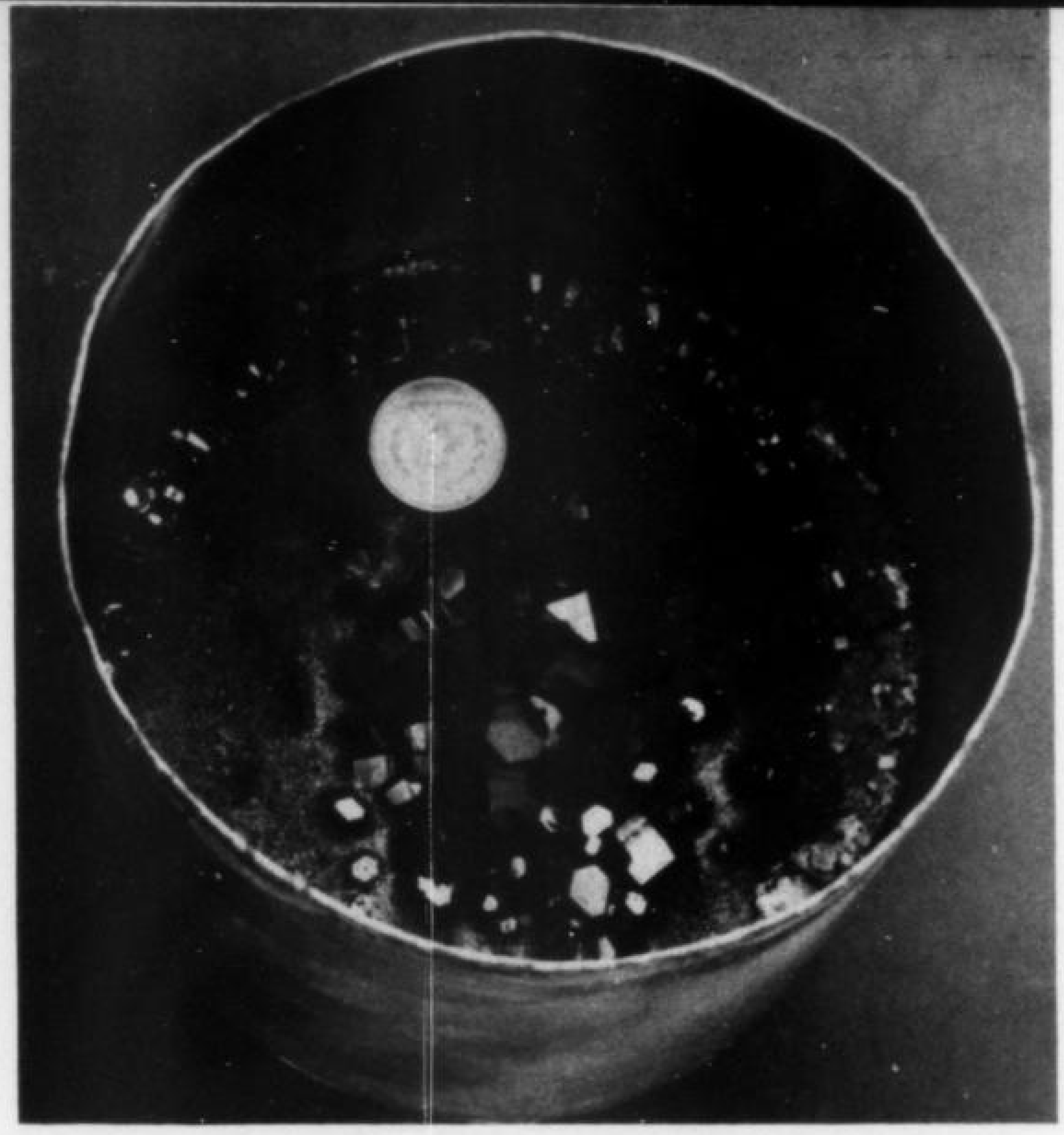


Fig. 11 **— Flux grown magneto-plumbite crystals still in the crucible; coin is a half dollar.**

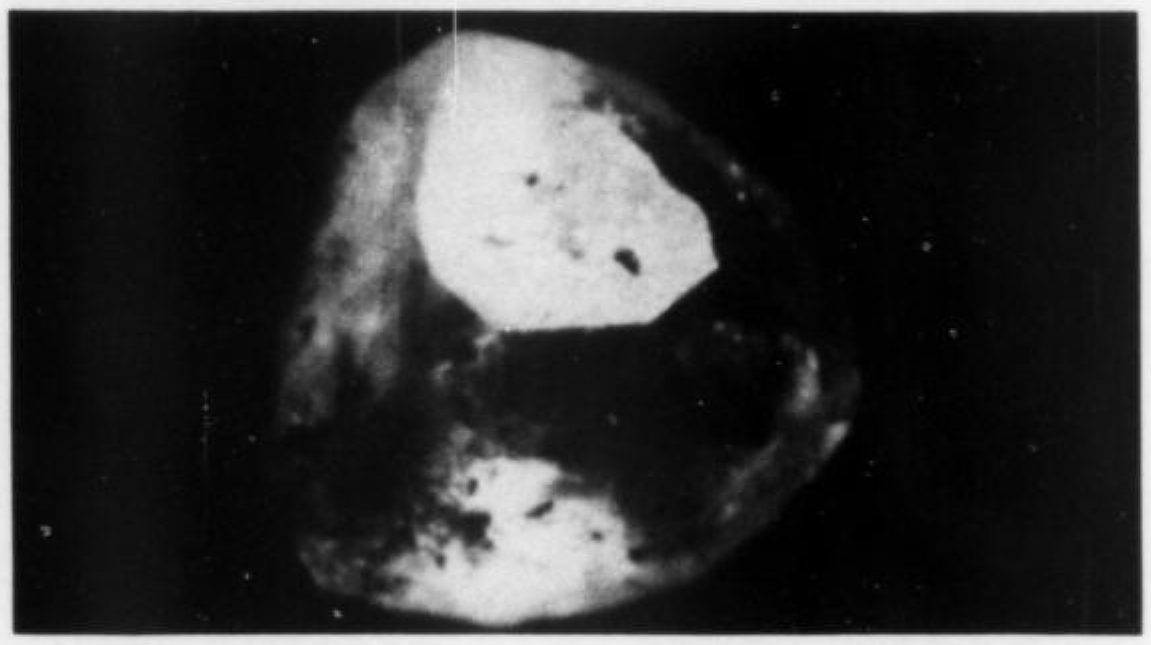


Fig. 12 **— Vapor phase grown boracite crystal; 1/8 inch diameter.**

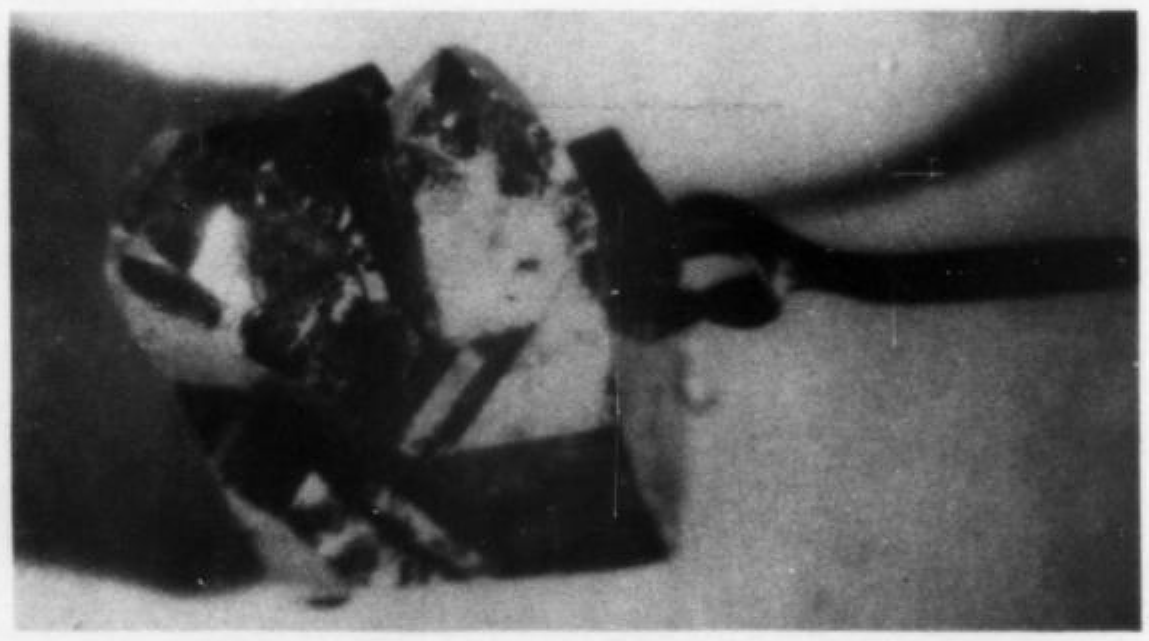


Fig. 13 **— Solution grown bellingerite crystal; 1/4 inch across.**

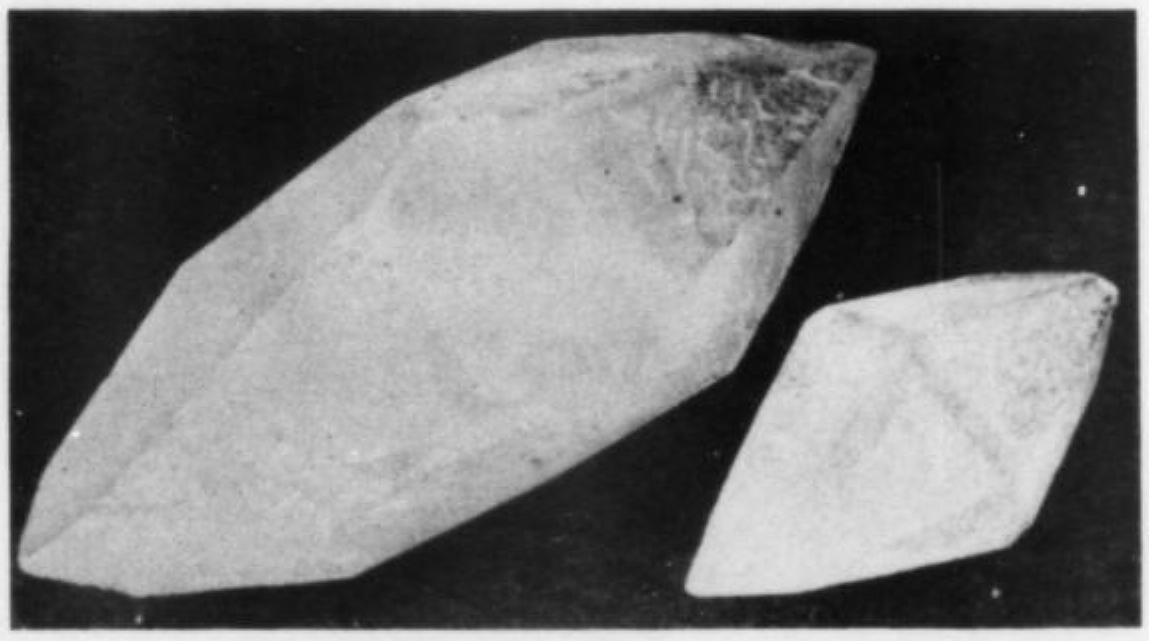


Fig. 14 **— Hydrothermally grown berlinite; large crystal is 1 inch long.**

A number of minerals in this group are soluble in water and can be grown by evaporation or temperature change of the saturated solution. This includes, as examples, *halite* (NaCl), *sylvite* (KCl), *natron* ($Na_2CO_3 \bullet 10H_2O$), *mirabilite* ($Na_2SO_4 \bullet 10H_2O$-Glauber's salt), *chalcanthite* ($CuSO_4 \bullet 5H_2O$ - blue vitriol), *epsomite* ($MgSO_4 \bullet 7H_2O$ - Epsom salt) and *crocoite* ($PbCrO_4$).

F.Silicates

As the largest group among minerals, surprisingly little synthetic work has been done here. One reason is that silicates tend to give very viscous melts which solidify to form glasses (such as *lechatelierite* - silica glass; or emerald glass). Most silicates are chemically complicated, and most crystal growth efforts so far have been concentrated on chemically simple systems.

Phenakite (Be_2SiO_4), *zircon* ($ZrSiO_4$), and *beryl* ($Be_3 Al_2Si_6O_{18}$ have all been crystallized from the flux. The last of these in the form of emerald ($Be_3Al_2Si_6O_{18}Cr$), is a commercially sold synthetic gemstone in two forms. Grown from the lithium molybdate flux (e.g., the Chatham and Gilson products) it is free of water, whereas the acid-mineralizer hydrothermal product (e.g., Linde) contains water. Natural emerald is slightly different from the latter, containing both water and also alkali and water in associated form, as shown by its infrared spectrum ("The Characteristics of Beryl and Emerald by Visible and Infrared Absorption Spectroscopy," D. L. Wood and K. Nassau, *American Mineralogist* **53,** 777-800, 1968). The growth of emerald crystals by the Verneuil and high pressure techniques has also been reported, but the crystals were very small and successful repetition of the work does not seem to have been reported.

The growth of *forsterite* (Mg_2SiO_4) crystals has been reported by the Czochralski technique of pulling from the melt at 1900° C in air.

Much work has been devoted to the synthesis of mica. *Fluorphlogopite* ($KMg_3AlSi_3O_{10}F_2$) has been prepared in large iron pots by what is essentially Bridgman - type solidification. Crystal sheets up to 1 ft across have sometimes been found in the polycrystalline mass obtained, but the process does not appear to be controllable in the form used.

Sodalite ($Na_4Al_3Si_3O_{12}Cl$) and its varieties, such as *hackmanite* which contains some sulfur, can be photochromic and have been grown by the hydrothermal technique for use in devices employing this property.

G. *Phosphates, Tungstates, Molybdates*

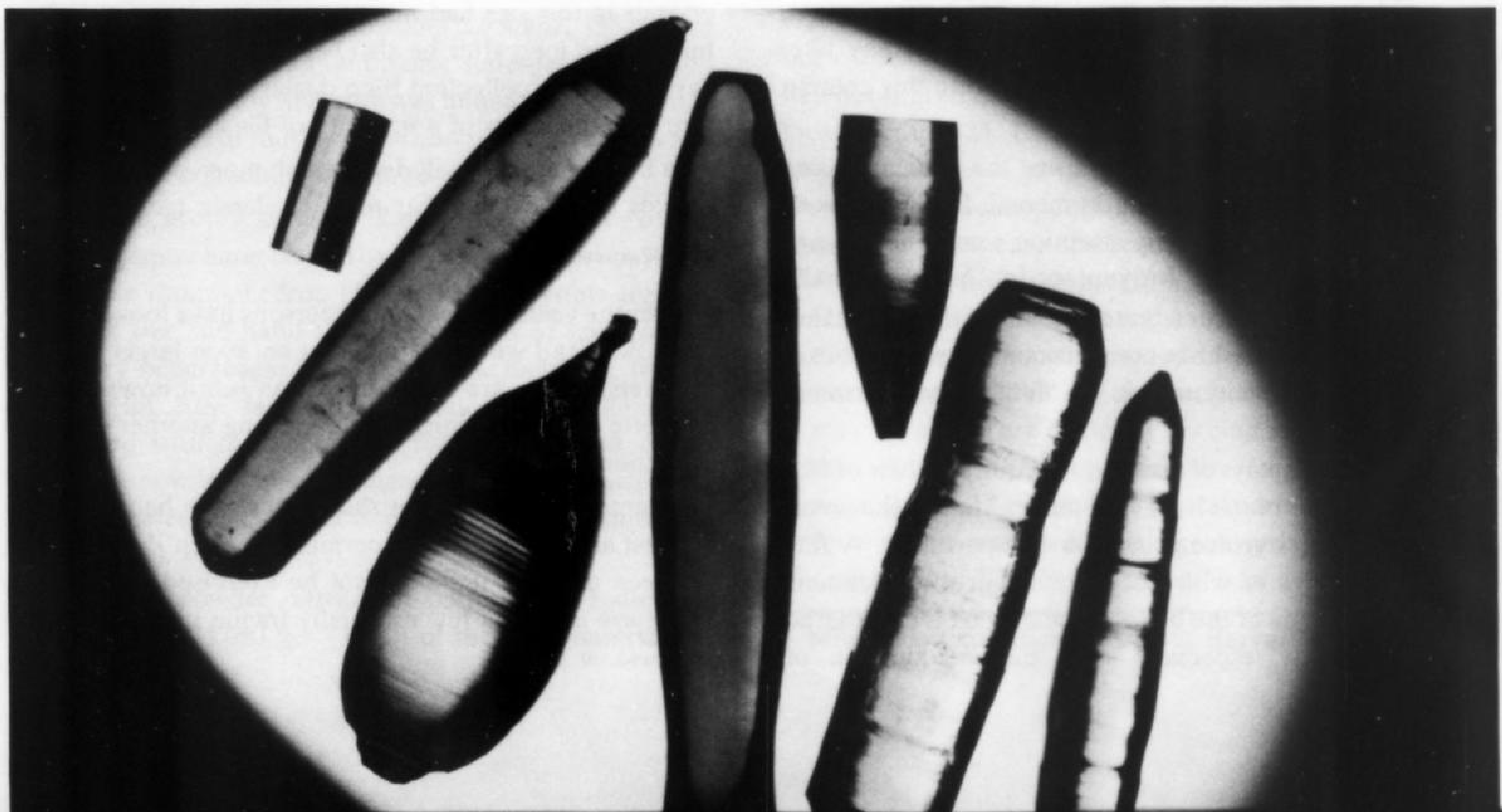
The rare mineral *berlinite* ($AlPO_4$) has been grown hydrothermally in inch size crystals, Fig. 14. The conditions of growth, morphology, etc. are essentially identical to those of quartz, and this relationship can be understood on the basis of coupled substitution: starting with $2SiO_2$, one Si^{4+} is replaced by Al^{3+} while the other is replaced by P^{5+}, thus maintaining charge neutrality in $AlPO_4$ while retaining the quartz structure.

Chlorapatite ($Ca_5(PO_4)_3Cl$) functions as a laser material when Nd is added in small amounts and has been grown by the Czochralski technique of pulling from the melt.

A group of tungstates and molybdates can be grown by the Czochralski technique; this includes *wulfenite* ($PbMoO_4$), *powellite* ($CaMoO_4$), *scheelite* ($CaWO_4$), and *sanmartinite* ($ZnWO_4$), Fig. 15. Crystals up to 1 inch in diameter and more than 1 ft in length are readily grown. Colors obtainable with scheelite, for example, are purple (with added Nd), yellow (Cr or Tb), green (Cr plus Y), yellow to brown (U or Eu^{2+}), pink (Er), and so on; a number of these function as laser materials. These tungstates and molybdates have also been grown from the flux, and in the case of scheelite, small crystals have also been obtained both hydrothermally and by reaction in a gel.

Part III, the conclusion, will appear in the next issue.

Fig. 15 — **Czochralski grown crystals; left to right two powellites, two wulfenites, a sanmartinite, two scheelites; largest crystal is 3 inches long.**



THE COLLECTOR

by Richard A. Bideaux

In a recent column I suggested that readers might like to submit effective display techniques. Following this month's column is a note from Dr. G. Wesley Pedlow, Jr. in reply, concerning his technique for display of thumbnail-size crystals and groups. The accompanying photograph shows this technique to be a pleasing one.

Thumbnail-sized (t/n) specimens are a particular love of this writer. Formally, these are specimens which will fit into a 1" cube, but do not require magnification for their appreciation. They share some of the advantages of micromounts, which do require magnification. Highly perfect specimens of a wide variety of species are somewhat more available than in larger sizes, and they are far more conservative of space. In general they are less dear than larger specimens, but they are increasing in cost as their popularity increases. Many people are collecting them along with larger and smaller sizes, a few devoting their collecting efforts entirely to this size. The largest collection I have heard of is about 1300 pieces. Several dealers specialize in them and there have been, and are, magazine columns devoted exclusively to their collection.

About the only thing I don't like about them is their name. "Museum", "cabinet", "miniature" and even "micromount" somehow seem to have more class. If any like-minded reader can propose a good substitute this column will assist in publicizing it.

The term derives, of course, from the specimen size approximating that of a human thumbnail. I don't know its origin, but it first came to my attention sometime prior to 1950, when competition for juniors in "half-thumbnail" boxes began at the Arizona State Fair under the late Arthur Flagg's direction. These are compartmented wooden boxes of 25 specimen capacity, versus the "full" 50 compartment box.

Competitive displays of that period required labels of like size inside the lid of the box, with the specimens shown on cotton and later styrofoam in each compartment. A few brave souls innovated with labels, then later the specimens themselves, outside of the boxes. Now the box is considered passé for display, especially since the introduction of individually labelled acrylic plastic boxes. The techniques of Dr. Pedlow and others would seem even another step forward. His bases fit into the plastic boxes for storage between displays.

The favored specimen size in the beginning was around 1/2", probably because of the necessity of exhibition in 1" compartments. This left sufficient space around the specimens to show them off properly. With individual mounts this is no longer a necessity, and most of the finest collections presently being built contain primarily specimens right up to the 1" cube limitation. Due to sheer size (if this can be said of something so small) these do make a more impressive showing.

My own collection of t/n's began before there was any general interest in this size. Our main collection is housed in Ward's Unit-Basis trays, the smallest of which is about 1 1/2" x 1". These take up undue drawer space for 1/2" pieces, so I decided to gather them all together into a t/n box. As a result of seeing these formerly scattered crystals, all of a size, and with an appeal entirely their own, further t/n's were selectively sought.

Even the largest older collections seem to contain few specimens in this size. Apparently they were beneath the notice of collectors, and probably dealers as well; or larger sizes were as easily obtained. The ones that were kept were unusual and of quite high quality. I have had the impression they were kept because they were too cute to pass over. Because they were often not considered really essential to the collection, they were exchanged rather easily.

On one occasion I recall, David New, then with the Scott Williams Mineral Company (perhaps the best mineral business ever conducted), asked why I was buying a 1/2" clear blue German boracite crystal. A collection of fine crystals in this size had not come to his attention before, but not too long after he also began to collect them. This gave a suitable collection for a dealer not wanting to interfere with the wants of a majority of his customers.

In later columns I will delve much more deeply into the species and localities that provide classic t/n specimens.

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Over the years, a great many persons have looked at our collection, and we have looked at an even larger number of others. There are a few unwritten (until now) rules of etiquette to keep in mind while viewing another's private collection.

Foremost, the specimens should never be handled without first asking the owner's permission. Even if permission has been granted, it should not be exercised in all cases. There are usually a few especially fragile pieces that only

continued on page 92

Willemite From the Andover Iron Mine,

ANDOVER, NEW JERSEY[1]

by David K. Cook

Department of Geological Sciences, Harvard University · Cambridge, Massachusetts

Introduction

Mention of the mineral name willemite almost invariably brings to mind the occurrence of this mineral at the zinc mines of Franklin, New Jersey. Only at Franklin does willemite occur in mineable quantities and, because of this, many minor occurrences of the mineral have been overlooked or forgotten for many years (Pough, 1940). This is the case with the occurrence of willemite at the Andover iron mine at Andover, New Jersey.

A new find of willemite at the Andover iron mine, Andover, New Jersey

The major purpose of this paper is to reinstate Andover as a valid occurrence of willemite. This is possible due to a recent find of the mineral at the Andover iron mine.

The Andover iron mine, abandoned many years ago, was the largest hematite producing mine in New Jersey. It was worked extensively before the Revolutionary War and ore was smelted at the Andover furnace, built in 1763. During the war, the Continental Congress took possession of the mine and used it to supply iron and steel to the Army. After the war, the mine was abandoned but was reopened in 1847, by the Trenton Iron Company. In 1848, the first railroad in New Jersey was built between the mine and Old Andover, now Waterloo. Between 1847 and 1854, 120,000 tons of ore were mined. The mine was again closed in 1863. It is located 12 miles southwest of Franklin, in Sussex County. The area is in the New Jersey Highlands which is mostly underlain by Precambrian crystalline rocks, with a few down-faulted blocks of Paleozoic rocks.

The magnetite ore body was a pyrometasomatic replacement of Precambrian age (Sims and Leonard, 1952). The hematite deposits formed by intense supergene alteration of the magnetite. Only hematite was mined due to its much higher grade. It is in this hematite cap that the veinlets and small cavities containing willemite occur.

Willemite occurs as small (2mm), light yellow to red-orange crystals characterized by the hexagonal prism $(11\bar{2}0)$ and obtuse rhombohedron $(0\bar{1}12)$. These crystals are very similar in size and habit to those present at most of the secondary occurrences of the mineral, including that at Sterling Hill, New Jersey (the so-called "betawillemite"). Associated with the willemite crystals are small quartz crystals, a powdery black manganese oxide, massive willemite, sphalerite, chalcocite, coatings of malachite and white to pink calcite.

The X-ray powder diffraction pattern and indices of refraction ($\omega = 1.690$, $\epsilon = 1.720$) of the new material are identical to those of type willemite from Belgium. Spectrographic analysis confirms Zn and Si to be the major elements present and also indicates the presence of Cu, As, Ge, Be, Mn, and Al in minor amounts and Fe, Pb, Ag, Bi, B, Cr, Ti, Ni and Mg in traces amounts. When exposed to short-wave ultraviolet radiation, Andover willemite fluoresces orange to green and phosphoresces a bright yellow-orange. In long-wave radiation, it fluoresces faint pink and phosphoresces a very faint pink. This fluorescence is identical to that of the so-called "beta-willemite" from Sterling Hill, but unlike that of willemite from other localities. The variations in the fluoresecence of willemite are probably the result of complex interactions of the many minor and trace elements which are present in varying amounts.

The new find of willemite at the Andover iron mine is unlike that described by Kitchell (1855). His mention of large garnet crystals as an associated mineral indicates that his material may have come from the nearby Sulphur Hill mine at which large garnet crystals are known to occur.

A brief history of the occurrence of willemite in New Jersey.

Willemite was named by the French mathematician and mineralogist, Armand Levy (1830), after William I, King of the Netherlands. The mineral was found at Moresnet, Belgium as tiny transparent and colorless to yellowish and reddish brown cyrstals characterized by the hexagonal prism $(11\bar{2}0)$ and obtuse rhombohedron $(0\bar{1}12)$. The mineral was present in very small quantities and was secondary in origin.

Eight years earlier, John Torrey (1822), an early American naturalist and mineralogist, first described the same mineral from Franklin, New Jersey under the name of "siliceous oxide of zinc". He also metioned that a Dr. Langstaff had discovered the mineral many years earlier at the same location. In 1824, Lardner Vanuxem and W. H. Keating, an important team in early Franklin mineralogy, gave the first accurate description and two analyses of willemite, again under the name of siliceous oxide or silicate of zinc. The following are excerpts from this description:

> "It presents itself in the form of concretions or grains, also in amorphous masses, and likewise in crystals. The concretions (which are the most common manner in which it exists) are evidently nothing more than the product of a disturbed crystallization: for every grade between them and the perfect crystals are observable. The form of the crystals is a hexagonal prism with dihedral terminations. The faces and angles of the prism are gen-

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[1] Mineral contribution, No. 485, Harvard University.

> erally well defined, but it is extremely rare to find the pyramids well determined. The specific gravity of this mineral if 3.89 to 4.: it forms a jelly with strong acids, and is infusible by the blowpipe.
>
> The color of the siliceous oxide of zinc varies from a light greenish yellow (which is the purest) to a deep flesh red; it also occurs inclining to a green, brown, gray and even to a black color, all of which are owing to variable admixtures of franklinite, garnet, pyroxene, etc. The colors are dull and dirty; most of the crystals are covered with a brown ochrey coating. In transparency it exhibits every degree, from the highly translucent to the opaque; the most translucent is the light greenish-yellow variety, which is the kind that exists in grains, and is most abundant.
>
> The associates of the siliceous oxide of zinc are, at Sterling, the franklinite, the red zinc ore, the dysluite, carbonate of lime, and mica; at Franklin, the garnet, pyroxene, etc.”

In 1832, Shepard presented an incorrect description of silicate of zinc from Sterling Hill and named the mineral troostite. The identity of troostite and willemite was shown by analyses presented in 1849 by H. R. Herman, a German mineralogist and chemist. The name troostite is still used locally in a varietal sense for the dark manganiferous varieties, especially the large reddish-brown crystals from Sterling Hill.

Later, willemite was mined as one of the primary ore minerals of zinc at both Franklin and Sterling Hill where it is associated with franklinite, zincite, tephroite and calcite. This assemblage of minerals is presently being mined only at Sterling Hill due to the closing of the Franklin mine in 1954.

Willemite of secondary origin has been reported from Sterling Hill and was named “beta-willemite” by L. H. Bauer due to its unusual fluorescence.* However, the Sterling Hill material has been shown to be identical with type willemite by X-ray diffraction techniques.

The first mention of willemite from Andover, New Jersey was made by Kitchell in 1855. His description was as follows:

> “....From the frequent association with it (garnet) of willemite, or silicate of zinc, and or hydrated sesquioxide of manganese in fine powder, filling cavities, and from its apparently considerable weight, it is suspected to be highly manganiferous or zinciferous, or both, and an analsis will be made to determine the point. The specimens of garnet collected include masses a foot or more in diameter, covered with crystals of various sizes, and forming exceedingly fine specimens. The willemite, which occurs in hexagonal prisms, generally of a greyish color, but sometimes nearly white among the garnet crystals, is a very rare mineral species, of which I can find but one known European locality, and but two others on this side of the Atlantic, both of which are in New Jersey, namely, Mine Hill and Sterling Hill, in Sussex.”

This description was repeated by the State geologist of New Jersey, George H. Cook (1868), in his famous volume *The Geology of New Jersey.* In the catalog of C. A. Canfield (1889), a famous collector of Franklin minerals whose collection is now at the Smithsonian Institution in Washington D.C., willemite is noted as occurring in long slender crystals from Andover. The last mention of a willemite occurrence in New Jersey other than at Franklin or Sterling Hill was made in 1910 by W. S. Bayley, who lists willemite as one of the insoluble constituents of the limestone at the Sulphur Hill mine. Surprisingly, the occurrence of willemite at Andover has been forgotten for the past 60 years. Pough (1940) described all of the known localities of willemite but failed to mention that at Andover.

ACKNOWLEDGEMENTS

I would like to thank Dr. Clifford Frondel of Harvard University for his help in the acquisition of specimens and his guidance during the writing of this paper. I would also like to thank Al Lord of Franklin, New Jersey who discovered the new willemite from Andover in 1968, Bruce Barr who identified the mineral at Princeton University, and George Michaelson and Jack Baum of Franklin who aided in the acquisition of specimens.

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*Schleede & Gruhl (1923) demonstrated the existence of a synthetic β-form of willemite, having a yellow fluorescence

What's New in Minerals?

Photos by Joel E. Arem

The Tucson Show

There are many ways in which one may measure the success of a mineral show. In this writer's opinion, a mineral show is successful if it attracts lots of minerals and lots of people. The Tucson Show this year locked up even tighter its claim to the title of the world's finest mineral exposition. It surpassed previous shows in all of the areas that bring joy to the hearts of the show sponsors, but it was also a mecca for the mineral collector. Imagine being able to rub elbows with such as Paul Desautels, Peter Embrey, Pierre Bariand, Clifford Frondel, Fred Pough, Dave Jensen, Paul Seel, Vince Manson, John Sinkankas, Neal Yedlin, John Jago, Joachim Folch-Girona, and many others - all under one roof. And what a roof! The Show was moved out of the Fairgrounds this year into the beautiful new Community Center, one of the finest settings yet seen for such an event. But enough of this, let's speak of minerals.

First, a summary of the minerals seen and not seen. The Tucson Show is a good barometer of the specimen situation as many dealers save their best stock, and make special efforts to enhance their stock, for this occasion.

Formerly abundant but drastically less so this year are Mexican amethyst, adamite, and wulfenite (the latter from Los Lamentos). Milarite, buergerite, Charcas and Santa Eulalia calcite. Naica fluorite and gypsum. Lake Jaco idocrase and grossular, hemimorphite, creedite, mimetite, and Santa Cruz schorl are all but gone or disappearing quickly. It is a constant source of amazement to me how fast seemingly endless reserves of various minerals disappear. My spies tell me that more buergerite can be mined but the Mexican suppliers haven't been too excited about buergerite because it never brought particularly good prices. Continuing in a Mexican "vein", danburite has managed to remain available longer than most species, the Naica tennantite-tetrahedrite will probably be with us for some time, and fine new pyrrhotites from Santa Eulalia (mostly singles up to incredible sizes - see back cover of last issue) are available in limited numbers. The choice arsenopyrite crystals from Noche Buena (see this column, Vol. II, #6) are becoming more plentiful and less expensive but this can't last. This just about closes out the Mexican mineral picture. Oh - Chihuahua geodes are still available but at higher prices and, in general, in smaller sizes.

Elsewhere Brazil, as usual, is striving mightily to keep the picture from looking too bleak. Recent mining of lovely green elbaites in huge quantities from the Cruziero mine, Minas Gerais makes possession of a fine specimen a reasonable aspiration for nearly every collector. Available in an array of forms from long thin pencils to sprays of stout crystals, with black tips, attached to quartz crystals, there is a specimen to suit nearly every taste. Eosphorite remains moderately plentiful while deep-colored rose quartz crystal groups appear to have passed their peak.

Fig. 1. Elbaite group, Cruziero mine, Minas Gerais, Brazil. The largest crystal is about seven inches in length. Smithsonian Institution specimen.

Newly mined California elbaites were suddenly available and became the talk of the Show. A rich pocket was mined at the Tourmaline Queen mine in Pala just two weeks before the Tucson Show. The owner, Bill Larson, of Pala Properties, has promised an article for the *Mineralogical Record* about this pocket and its contents. The elbaites are fat, flat-terminated crystals of a rich deep rubellite color with an unusual inky-blue tip. Many were six or more inches in length and up to two inches wide. Smaller crystals tended to be more transparent and showed a greater color range, from pink to blue to green. A limited number were associated with beryl (morganite) crystal clusters and albite (cleavelandite) around their bases. Some of the finer groups consisted of elbaites in random arrangement growing upon large milky quartz crystals.

From the state of Washington came some truly exciting, relatively new material. The brightest red realgar one could hope for comes from Green River Gorge, Franklin, King County, in stubby crystals up to about one inch by 3/4 inch maximum size. These are usually widely scattered over a light-colored matrix making of them rather spectacular display specimens. Also from King County (precise locality not specified) were very fine sceptered quartzes. The narrow shaft is milky white but the broader termination is either amethyst or "strawberry" quartz. The latter derives its color from inclusions of a platy blood-red mineral (probably hematite) in tiny crystals. Upright groups of these scepters are superb display specimens.

Southwest Africa, notably Tsumeb and nearby localities, continues as a prolific supplier. Cerussite, azurite, smithsonite, and dioptase are seen in large numbers and the prices reflect this. They are at their lowest in recent years. It is particularly pleasing to see fine sharp azurite crystals once again on the market. I don't know if this represents a new find or if old stock has just been released.

ANHYDRITE

To depart now from the Tucson Show, let us look at a specimen that is remarkable in all respects. Anhydrite from Mexico is not well-known, I have seen only three or four specimens in all. The Smithsonian has just acquired one of these and it may be the finest anhydrite in captivity (Fig. 2). The locality is Naica, Chihuahua, . The specimen is composed of a subparallel aggregate of columnar crystals forming a roughly rectangular mass measuring 2 by 1 1/2 by 1 inches. The color is a pale sky blue, very similar to that often seen in celestite. The crystals grew on banded sulfide ore consisting of galena, black sphalerite, and pyrite. The anhydrite is encrusted with druses of colorless calcite.

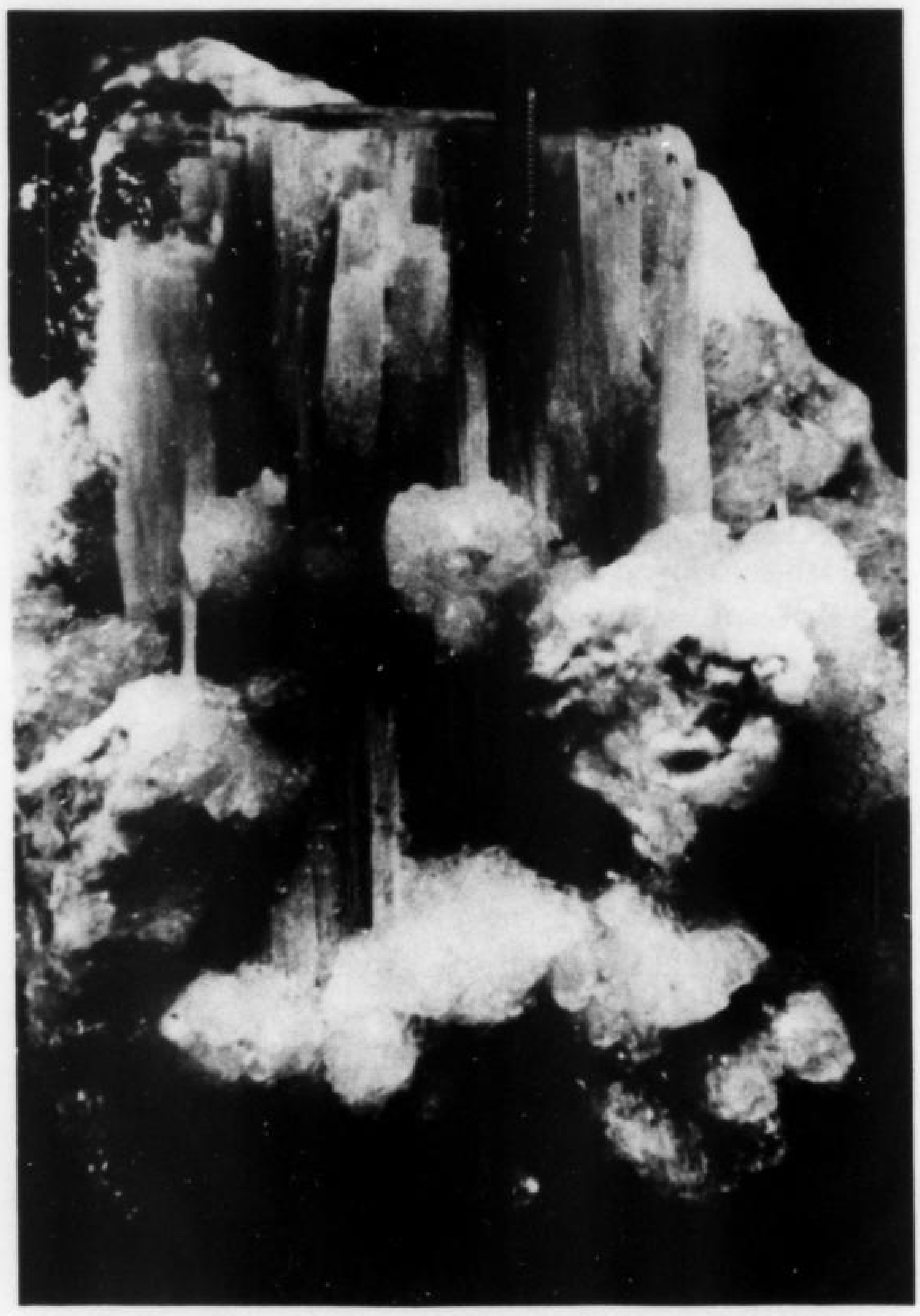

Fig. 2. Anhydrite, Naica, Chihuahua, Mexico. The white crystal druses are calcite. Smithsonian Institution specimen.

NOMENCLATURE

It is no wonder that mineral nomenclature is in such bad shape. It takes only one unfortunate usage of a name in print to launch its immortality. Whether we like "tanzanite" (the name, not the gem) or not, it is here to stay. At least the name has been applied to only one kind of material - blue zoisite. Until recently we could say the same of "alexandrite" but now that may be changed. R. Crowningshield published a paper in *Gems & Gemology* (Vol. 13, 174-177, 1970) entitled "A rare *alexandrite* garnet from Tanzania"(Italics are mine). This was a most unfortunate title choice. If the title had been "A rare alexandrite-like garnet from Tanzania", there would be no problem. But Crowningshield has actually called the garnet alexandrite and now the name alexandrite is no longer uniquely applied. Henceforth when the name is used you will have to specify chrysoberyl or garnet. This is the way new gem names become adopted - someone simply begins to use them. Regrettably there is no international organization to rule on their acceptance for general use. I wonder why the gem people don't establish formal procedures for regulating the gem nomenclature.

PARISITE (AGAIN!)

Another letter has come in about the Montana occurrence of parisite (see Vol. II, p. 231 and Vol. III, p. 14), this from Lanny Ream of Pullman, Washington. I think his letter will be of interest to our readers so most of it is quoted below.

"Last year another graduate student at Washington State University did his Master's Thesis on the Snowbird deposit. I visited the deposit in September of 1971 along with other graduate students and faculty members. The deposit is located in Mineral County on the Montana-Idaho border. Originally it was known as the Snowbird. Now it is owned by the F and S Mining Company of Boise, Idaho and is called the Snowshoe. Most people still call it the Snowbird as that is the name in most of the literature.

It is an unusual pegmatitic body of quartz, calcite, fluorite and ankerite, with minor amounts of parisite and gersdorffite. It is being mined for fluorite. The quartz occurs as an envelope completely enclosing the deposit; crystals are numerous up to 6 meters long. Some small quartz crystals up to 25 cm are clear or smoky. When I was there I got so interested in hunting the quartz I did not collect much parisite.

The parisite is common in crystals up to 6 cm long, but has been found in crystals *up to 24 cm*! Many of the smaller ones are doubly terminated. Unfortunately, as you know, the deposit is highly sheared up, so the crystals are badly fractured. This fracturing has made it difficult to see the cleavage in the fluorite and has emphasized the basal cleavage of the parisite. Large crystals are thus hard to extract from the matrix.

Fluorite in the deposit is massive. We did find a few broken crystals, of poor quality, up to 5 cm on a side."

John S. White, Jr.

The Museum Record

by Paul E. Desautels

To anyone who will listen I've often delivered my stock lecture on the justifications for the existence of museum collections of minerals. These justifications are not particularly difficult to make. However, in this pragmatic age when everything must have a justification, preferably practical, (or else it won't get official support and funds) there is a tendency to justify such collections based on the uses to which they can be put. Most of us recognize as primary among the "use justifications" the mighty two - research and education. Depending on the justifier and the official position of his institution the order may change with education coming first. In my own establishment I have heard the collections described in absolutes as "only a valuable research tool" or as an "instrument for instruction of the public through the exhibits program". Sometime I'd like to address myself in this column to both of these statements. Meanwhile, lets look at some other parts of the picture. My personal feeling is that, unfortunately, most of us are usually afraid to emphasize certain other potent justifications.

For example, let us take the case of the fine collection at Harvard University. The fact that it exists is one of the best reasons for curating and caring for it. Never mind for the moment how it got there or where it is going. It is a magnificent collection and that's all it needs. To neglect, disperse or starve it is as bad as cutting down a magnificent 200 year old tree because it is in the way of a new concrete sidewalk. Maybe one doesn't like either trees or mineral collections but that gives no license to destroy them. True, there aren't too many U. S. mineral collections that have such an aura of greatness, historic development, memorable association with mineralogical personalities and all the other qualities of an important monument - but there are several.

Great collections or not, these and other collections may also be justified for their archival function. Why shouldn't there be a place where unique, unusual, and otherwise important and interesting mineralogical material can go for preservation. If it is important to preserve some threatened species of animal, such as the whale, how much more important to preserve some magnificent specimens of stibnite from Japan. They will most likely never be found again. Certainly they can't reproduce themselves and thus are even more difficult to guard from extinction. There should be a place to put and keep the largest crystal of chrysoberyl ever found or the only preserved piece of native gold from the Schuylkill River in Philadelphia or the finest specimen of crystallized gold found in California. Somebody should be caring for the clinochlore specimen illustrated in *Dana's System of Mineralogy* (6th ed.) and the morganite illustrated on the cover of the *Lapidary Journal* and the Frostburg, Maryland barite crystals described by Waldemar Schaller. The other day I was looking through the suite of gold specimens at the Smithsonian and encountered two that were donated by Teddy Roosevelt. I'm glad somebody had the good sense to keep them even though they are pretty ordinary looking.

Perhaps the least popular justification for a museum mineral collection among present day pedants, scholars and museologists happens to be one which the public at large finds most popular and reasonable. I am referring to its value for entertainment. A paper was read before the

American Historical Association in December 1888 * by George Brown Goode (the man who was charged with developing the U.S. National Museum in the Smithsonian Institution). In it he told of the earliest U.S. public museum established by Charles Willson Peale in 1785. By 1800 it was full of popular attractions. "There were a mammoth's tooth from the Ohio, and a woman's shoe from Canton (China); nests of the kind used to make soup of, and a Chinese fan six feet long; bits of asbestus, belts of wampum, stuffed birds and feathers from the Friendly Islands, scalps, tomahawks, and long lines of portraits of great men of the Revolutionary War. To visit the museum, to wander through the rooms, play upon the organ, examine the rude electrical machine, and have a profile drawn by the physiognomitian, were pleasures from which no stranger to the city ever refrained."

I don't think things have changed very much since Goode's time. Years of contact with hordes of people who come crowding through our museums have thoroughly convinced me that they come to be entertained. They want to be amazed and amused, impressed, intrigued, dismayed or emotionally moved in some way by the things they see. The Hope Diamond is still the strongest drawing card in the Smithsonian's Natural History Museum and, take my word for it, it doesn't do anything or tell you anything more than a piece of bluish glass would do. And yet, it is the Hope Diamond and because of that, millions flock in to see it. People do come to be entertained by the collections and any museum that loses sight of this fact and de-emphasizes the "Oh My!" factor of public museum-going is surely tampering with its life blood.

Please don't misinterpret my remarks as implying that research and education are not prime collection justifications. All I am trying to say is that there is more to it - much more. ∽

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*Museum History and Museums of History, by George Brown Goode, Annual Report of the Smithsonian Institution 1897.

NEW FIND------SCHEELITE CRYSTALS

Pala Properties International, Inc. President, Mr. Edward Swoboda, announced that he was able to obtain a very fine selection of octahedral scheelite crystals from Tong Wha, Korea, on his last around-the-world buying trip. These crystals are from ½ " to 3" maximum dimension and were recently mined from this famous locality. He was also very successful in his other stops in Bolivia and Europe. For further information please contact:

Pala Properties International
P.O. Box 545
Fallbrook, California 92028
714-728-9121

The Evans-Lou Pegmatite, Quebec:

A Unique Yttrium-Niobium-Bismuth-Vanadium Mineral Assemblage

by D. D. Hogarth
University of Ottawa, Canada

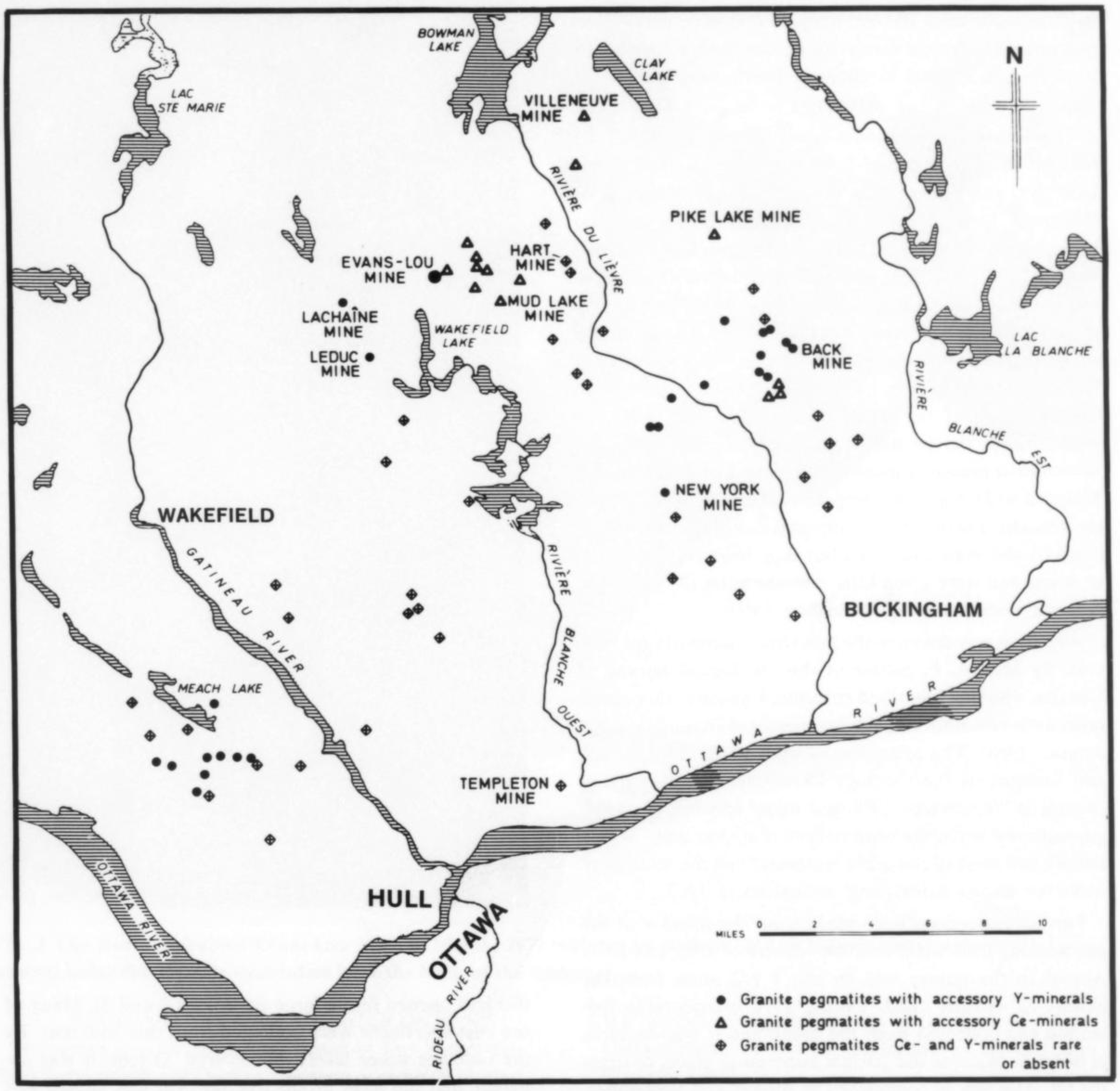

Fig. 1 **Granite pegmatites of the Wakefield-Buckingham region, Quebec.**

INTRODUCTION

Pegmatites are well known sources of primary, rare-element mineral specimens. It is, perhaps, less well known that pegmatites are equally rewarding sources of secondary minerals, some of which may be generated, within a few years after mining, as oxidation products. The secondary minerals commonly appear as dull stains or smears.

An outstanding example of a pegmatite enriched in minerals of both primary and secondary origin is the Evans-Lou pegmatite about 20 miles north of Hull, Quebec (Fig. 1).

Primary crystals of microcline are up to 5 x 2 feet, allanite up to 4 x 2 feet and hellandite up to 1.8 x 0.4 feet. On the other hand, submicroscopic stains of a yellowish limonitic color, giving goethite or thorogummite X-ray patterns, are abundant. Some canary-yellow stains were beyond the resolution of X-rays and therefore did not yield an X-ray pattern. The contrast of sizes is truly remarkable.

Also notable are the number of minerals that may be found in a single locality. Thus the Evans-Lou pegmatite, which has produced 61 known minerals and 11 unknowns from an excavation 180 feet long, 40 feet wide and 90 feet maximum depth must surely, for its size, rank as one of the most prolific mineral localities in North America.

HISTORY

The Evans-Lou pegmatite was originally quarried for feldspar by B. Winning of Salette, Quebec in 1932. From 1934-1936 the quarry was worked for Mr. Winning by William E. Evans of Perth, Ontario who with his daughter Louise, gave the name to the mine. The mine was reopened in 1938 by Canada Flint and Spar and was worked simultaneously for feldspar and quartz until 1952. During this period the rock was taken from the pit via a road on the south side. In 1956 the pit was drained and worked for Canada Flint and Spar by Rene Larocque of Buckingham, Quebec. Most of the feldspar was taken from near the south end of the pit and loaded onto a ramp by boom. The mine is presently inactive but owned by International Minerals and Chemical Corporation (Canada), Ltd. During the periods of active mining unusual minerals were recognized by the mine operators but they were not identified or saved and were given little consideration (N. B. Davis, personal communication, February, 1969).

Attention was drawn to the mine as a source of rare minerals by Miss A. P. Sabina of the Geological Survey of Canada, who first identified euxenite, kainosite, thorogummite, native bismuth and eulytite (personal communication, August, 1968). The mine dumps were visited by the staff and students of the Geology Department, University of Ottawa in September, 1968 and many specimens of fergusonite and bismutite were collected at that time. Wakefieldite and most of the other minerals from the mine were collected during subsequent excursions in 1968.

Further collections were made from the interior of the pit, working from the ice, in the winters of 1969 and 1970. Access to the quarry was by ski, 1 1/2 miles from the closest all-weather road. During 1970 considerable hellandite was collected from the dump and it was decided, in order to examine the yttrium minerals in place, to drain the pit. This was accomplished in August and September, 1970, with a centrifugal gasoline pump with 2 1/2 inch inlet and outlet. However, owing to mechanical problems combined with an occasional and rather unpredictable labour force, it was necessary to continue pumping for about 6 weeks, with the pit partially refilling during inactive periods. Some 10 feet below initial water level, an undercut appeared on the west side of the quarry and, at 25 feet, this had opened into a large cave (Figs 2 and 3). Many of the best specimens were collected from this undercut. By the time the water level was lowered 33 feet, it was apparent that the most productive horizon was passed and pumping was discontinued.

During the summer and fall collections were made using two rafts: a homemade wooden raft, for loading specimens, towed by a rubber raft. Additional specimens were collected from the ice, three times, during the winter of 1971. The quarry continued to fill duing the winter and, by early May, the water was within two feet of its former level.

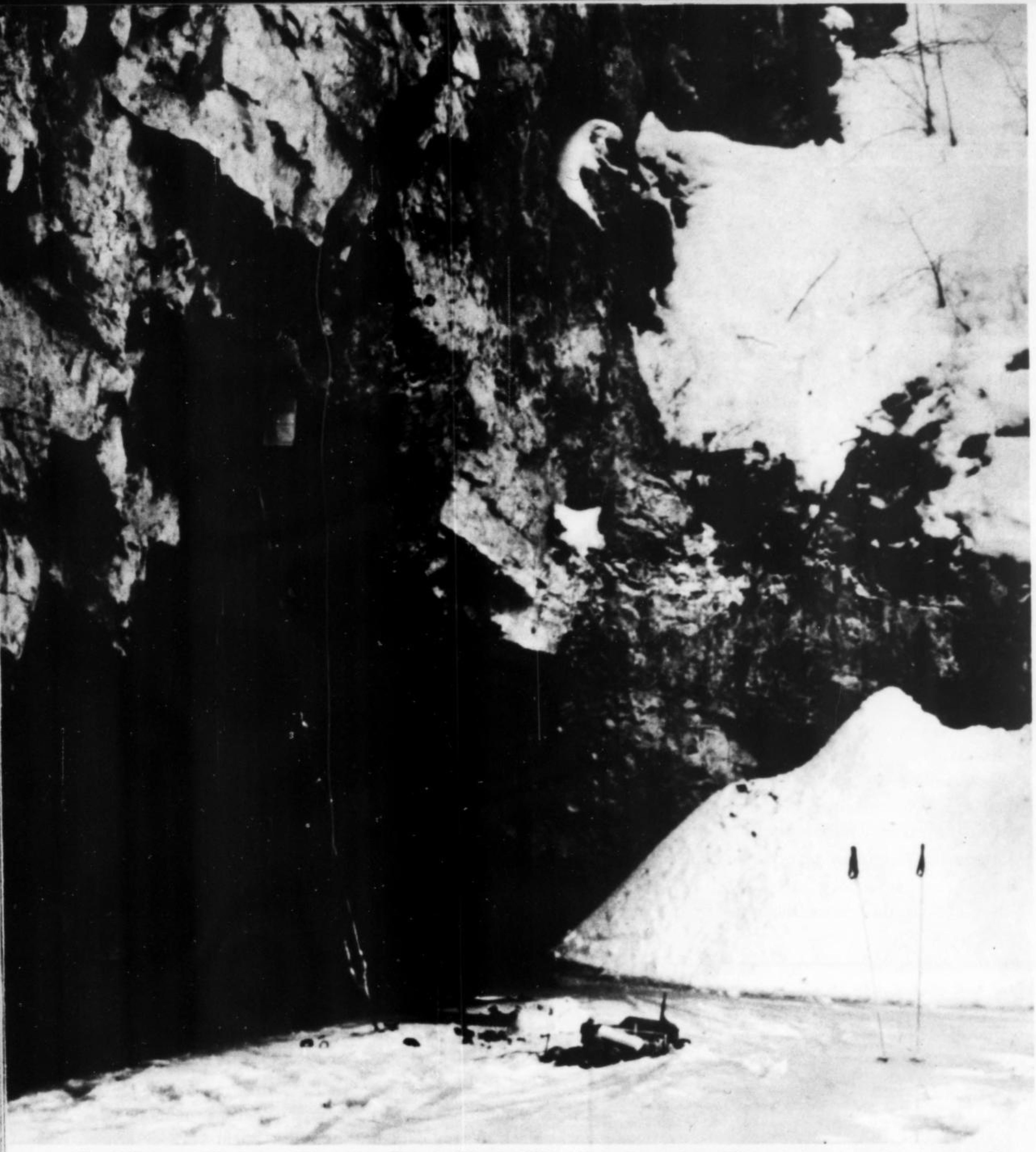

Fig. 2 **The partially drained Evans-Lou Mine in March, 1971 with ice level about 20 feet below normal water level. Large altered hellandite crystals were taken from the back of the undercut.**

REGIONAL SETTING AND GEOLOGY

Numerous granite pegmatites occur in the Wakefield-Buckingham region of Quebec, the main ones being plotted on Fig. 1. Yttrium-bearing pegmatites are well developed and occur in three clusters:

(1) a group near the Lièvre River, characterized by biotite accompanied by euxenite, yttrian thorite or allanite,

(2) three mines near Wakefield Lake characterized by euxenite-fluorite or, in the case of the Evans-Lou mine, by fergusonite-hellandite and

(3) a number of pegmatites west of the Gatineau River characterized by yttrian andradite (Kasowski and Hogarth, 1968).

Cerium-bearing pegmatites are not well developed in the region but are characterized by the monazite-uraninite-muscovite association best shown in the Mud Lake mine.

Pegmatites cut several types of Precambrian metamorphic rock such as marble, calc-silicate rock and biotite gneiss but there is no obvious connection between the mineral assemblage of a pegmatite and its surrounding rock.

The geology of the Evans-Lou mine has been described by Miles, Hogarth and Russell (1971) and need only be briefly mentioned here. Zoned granite pegmatite cuts granitic and calc-silicate rocks. The most interesting minerals in the pegmatite were taken from a giant perthite-quartz zone surrounding a quartz core which is, itself, enveloped by a perthite-plagioclase-quartz zone.

MINERALOGY

An unusual number of minerals have been recovered from the mine. Miles, Hogarth and Russell (1971, pp 399-400) list 51 species. Of this number 5 are bismuth minerals, 3 niobium minerals, 3 uranium minerals and 10 yttrium and thorium minerals. Further research has added the following:

Anthophyllite. Long prismatic crystals in chlorite from calc-silicate rock at the southwest end of the pit.

Bismuthinite. Narrow mantles around native bismuth grains. South end pit.

Brochantite. Green crusts on pyrite. Fragment from dump.

Chalcocite. Partial replacement of pyrite. Fragments from dump.

Chamosite. Fine grained black masses with hellandite. Common.

Jarosite. Yellow crust on quartz. Fragment from dump.

Lokkaite. White fibrous mineral. Normally with tengerite. Common.

Marcasite. Tiny crystals in fault zone. With thorogummite and wakefieldite. Southeast end of pit.

Molybdenite. Tiny foliae on pyrrhotite. Specimen from dump.

Nontronite. Greenish cavity-filling in quartz. Fragment from dump.

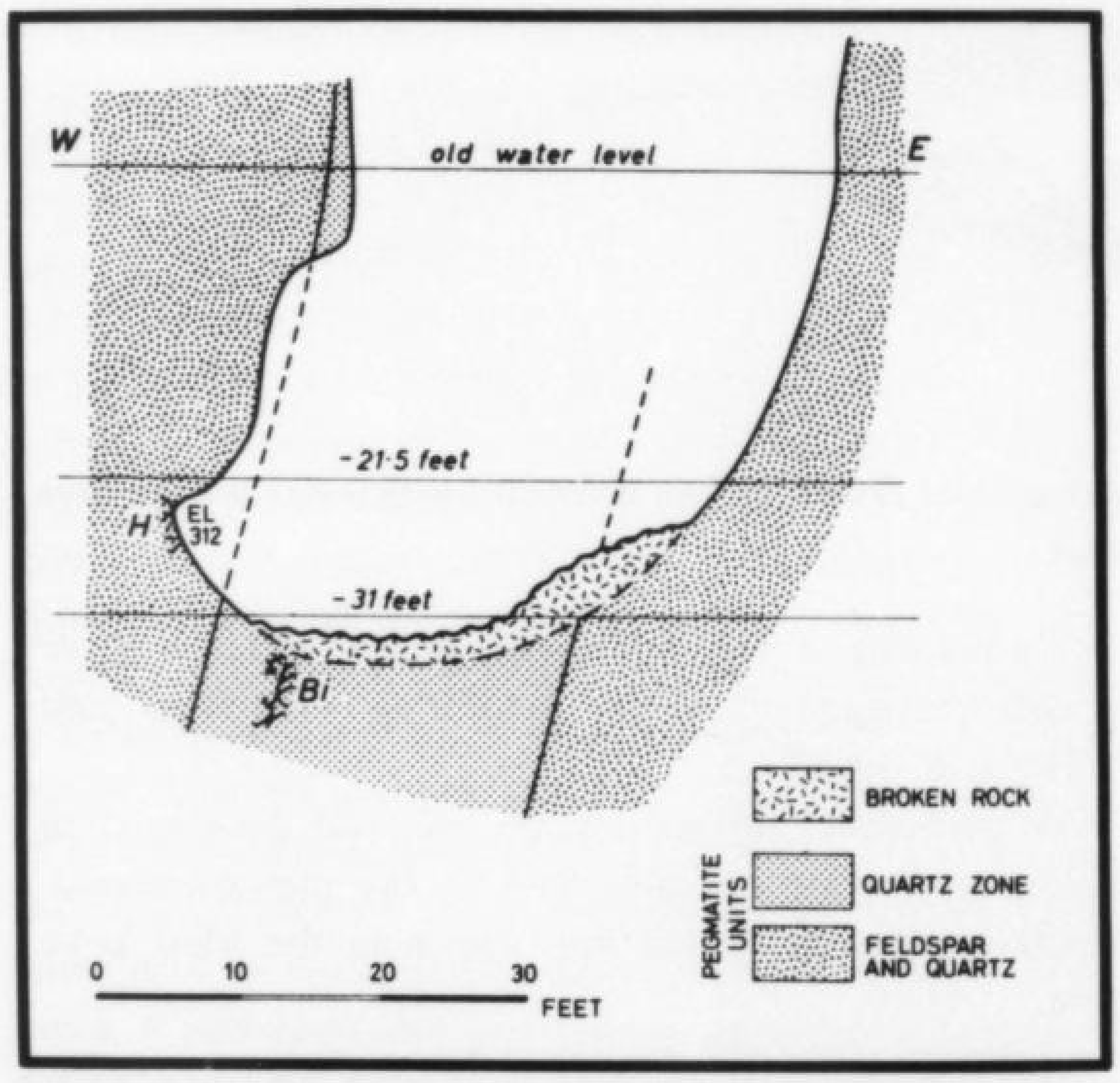

Fig. 4 **Cross section W-E through the southern part of the quarry showing a hellandite location (H), EL-312, and a bismuth location (Bi) projected from location EL-340.**

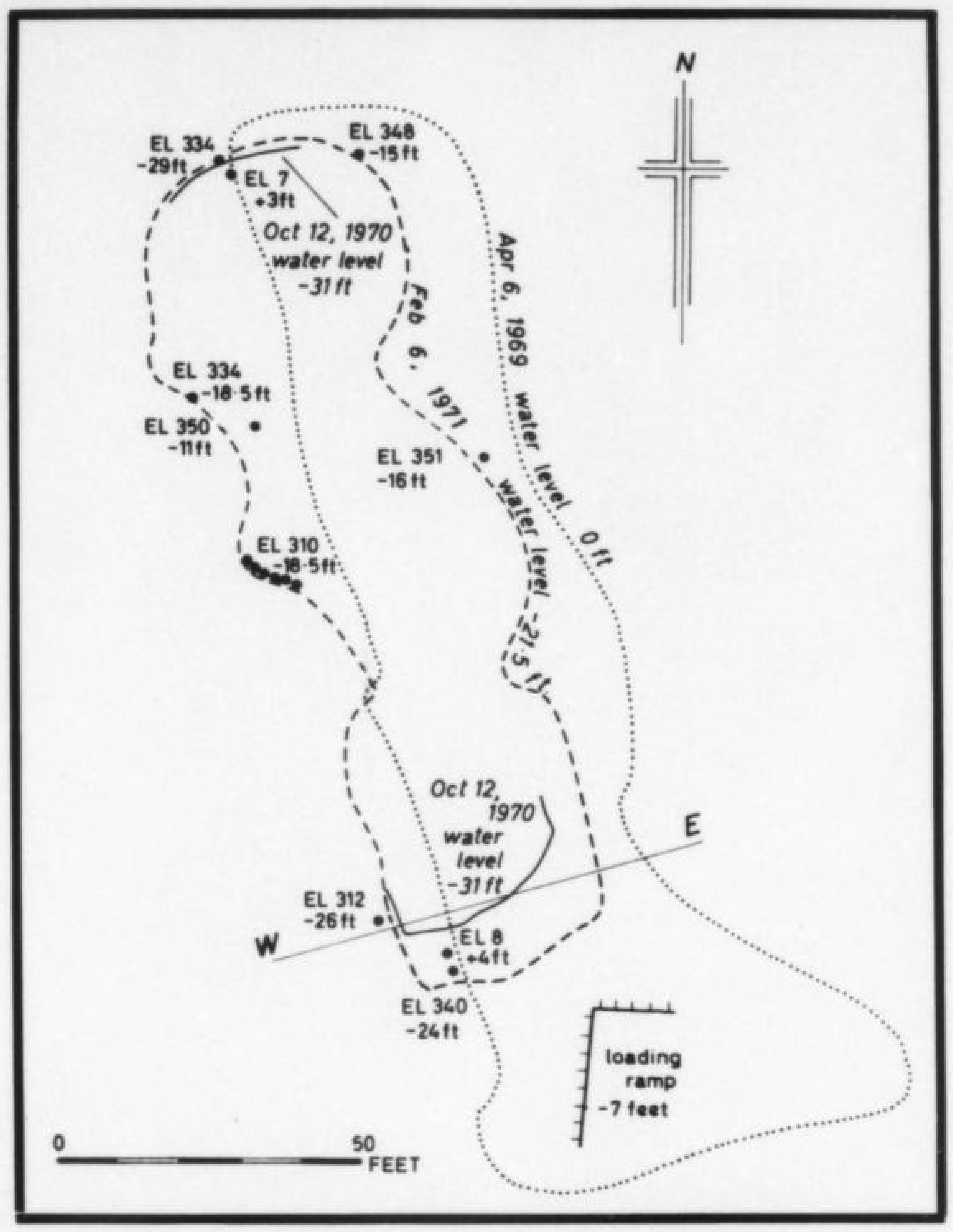

Fig. 3 **Plan of the Evans-Lou Quarry showing three successive water (or ice) levels.**

Yttrium minerals are common in the pegmatite. Examples of mineral associations are quoted in Table 1. Hellandite, $(Ca,Y)_2(Si,B,Al)_3O_8.H_2O$, which was originally found in place as fresh greenish brown crystals on the west or hanging wall side of the pegmatite (Figs. 2 and 4, location EL-312) and as altered white to yellow crystals under the overhang (Figs 2 and 3; locations EL-310 and EL-344 on Fig. 2), was later found as fresh brick-red crystals in the footwall, notably in locations EL-348 and EL-351. Crystals 1 foot long were common. The mineral is described in some detail by Hogarth, Chao and Harris (1972).

Fergusonite, $YNbO_4$, which normally occurs close to hellandite, is another common accessory mineral. It is black to very dark brown with a bright vitreous lustre; $n > 2.0$. The mineral is metamict but is well crystallized to tetragonal fergusonite after heating 2 hours in nitrogen at 700°C and to monoclinic fergusonite after heating 1/2 hour in nitrogen at 1000° C. Some "crystals" contain a few discrete grains of metamict euxenite. Normally fergusonite is ovoid but some of the smaller "crystals" show the tapering habit typical of Madagascar and Norwegian varieties. The size ranges up to a solid mass, 9 inches across, from which a fragment of 7.1 lb. was recovered. An analysis of fresh fergusonite, hand picked from a crushed fragment taken from the dump, is given in Table 2. Compared to most fergusonites this sample is high in CaO but low in FeO and Ta_2O_5. The SiO_2 is probably due to quartz impurities; the B_2O_3 is possibly due to included hellandite.

The yttrium minerals weather readily to a white powder which coats exposed surfaces, fracture openings and cavities. Most of this powder is tengerite, $Y_2(CO_3)_3 \cdot 3H_2O$, which occurs as rosettes or as minute spheres of radiating fibres. Some fibres belong to the new mineral lokkaite - also $Y_2(CO_3)_3 \cdot 3H_2O$ (Perttunen, 1971). Each mineral has similar optical properties (biaxial with indeterminate sign, $\gamma \approx 1.626$), and the two can be distinguished by X-ray only. Somewhat less common is white and yellow, pulverulent, yttrian thorogummite, $(Th,Y)(Si,P)O_4$, which tends to fill cavities.

Kainosite, $Ca_2Y_2Si_4O_{12}CO_3 \cdot H_2O$, is another common secondary mineral. Prisms have a maximum length of about 3 mm and are colorless to pale yellow, sometimes tipped with pink. Crystals occur as subparallel or radiating groups in cavities in quartz and hellandite or as clusters and isolated crystals in hellandite. Most crystals show growth zones and some have a central core of lower birefringence than the rest of the crystal. Using the optical orientation of Pouliot *et al.* (1964, p. 4), $X = c$ (elongation), $Y = b$, $Z = a$, the most common forms are {100}, {010} and {101}. Optical constants are $\alpha = 1.664$, $\beta = 1.685$, $\gamma = 1.689$, $2V_x \approx 45°$. Some kainosite is fine grained (grains < 0.5 mm), granoblastic, brick red in hand specimen and replaces hellandite and yttrian spessartine.

Wakefieldite, YVO_4, which was first found in 1968 by Norman Miles during routine examination of "limonite" stains on fragments from the dump, was later identified from 7 other fragments and from 3 locations, in place, in the quarry. One of the *in situ* locations was discovered, quite by accident, in testing a site for relocation of the pump.

Uranium minerals were commonly found near hellandite. Uraninite, UO_2, cubes attain diameters of 3/4 inch but are usually much smaller. Beta-uranophane is the most common secondary uranium mineral and occurs as packets of subparallel microcrystals.

Bismuth minerals were quite common on the dump but could be located in one place only in the pit (location EL-340, Figs 2 and 4). The location has the distinction of being the only part of the quartz core where rare-element minerals were found. Native bismuth is commonly surrounded by a narrow rim of bismuthinite, Bi_2S_3. Primary bismuth minerals were marked by an abundance of secondary, pulverulent, bismutite, $Bi_2O_2CO_3$, normally intermixed with beyerite, $CaBi_2O_2(CO_3)_2$. The mixture is characterized by pale drab yellow, green or orange colors and high specific gravity (orange-yellow: $G = 7.24 \pm 0.03$; green: $G = 6.02 \pm 0.02$). Eulytite, $Bi_4(SiO_4)_3$, found only on the dump, is white translucent and micro-botryoidal; more rarely in microcrystals (dodecahedra ?).

Elsewhere, rocks with similar mineralogy are rare. For example, the assemblage fergusonite-allanite-thorite (or "thorogummite") - garnet, well developed at the Evans-Lou pegmatite, has been described from a few other occurrences only, such as Rode Ranch, Texas (Ehlman *et al.*, 1964), Iisaka Village, Japan (Wakita *et al.*, 1969), Pyörön-

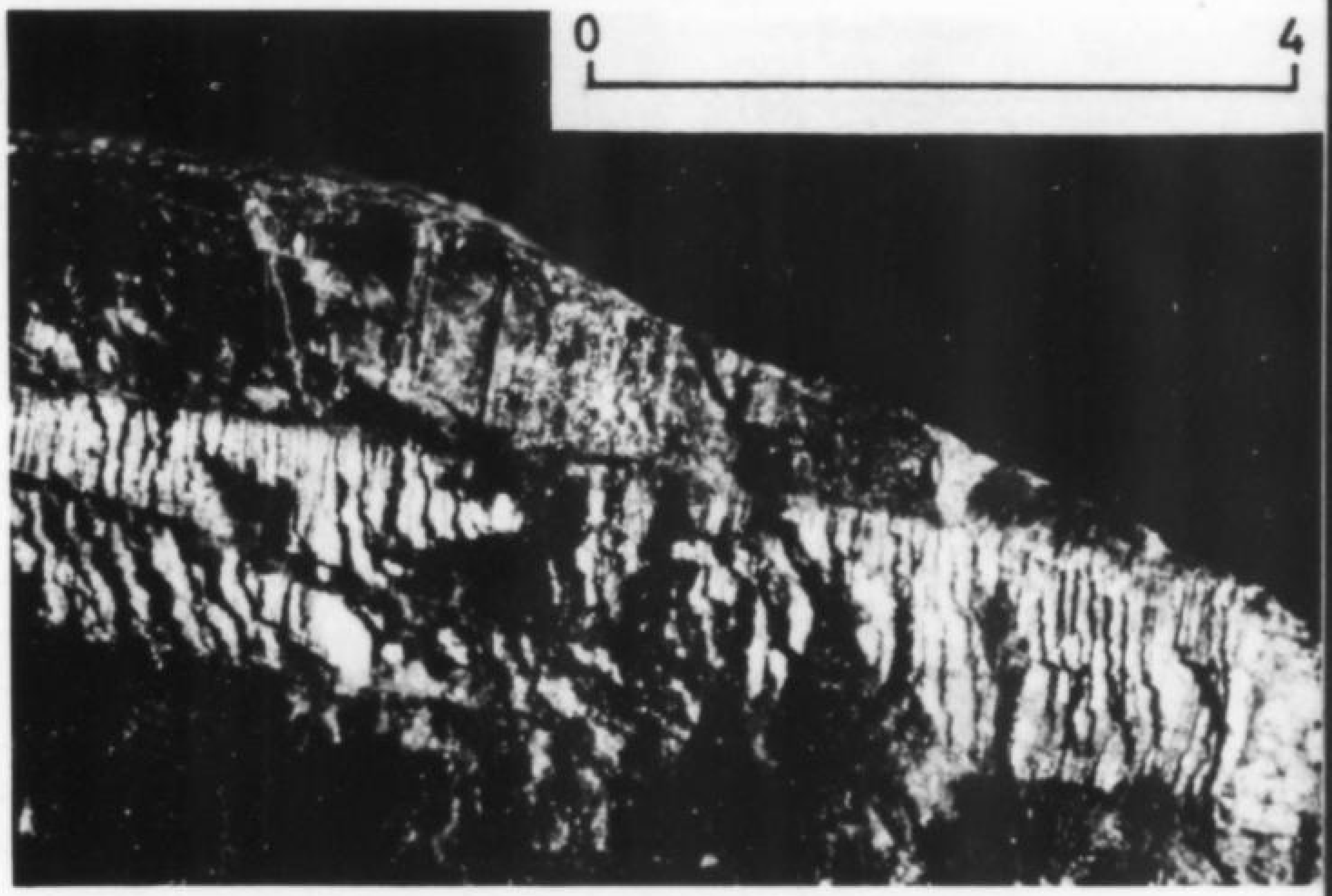

Fig. 5 **Twinned crystals of hellandite $(Ca,Y)_2(Si,B,Al)_3O_8 \cdot H_2O$). Central individual is illuminated by reflection of light from a cleavage surface. Locality EL-348.**

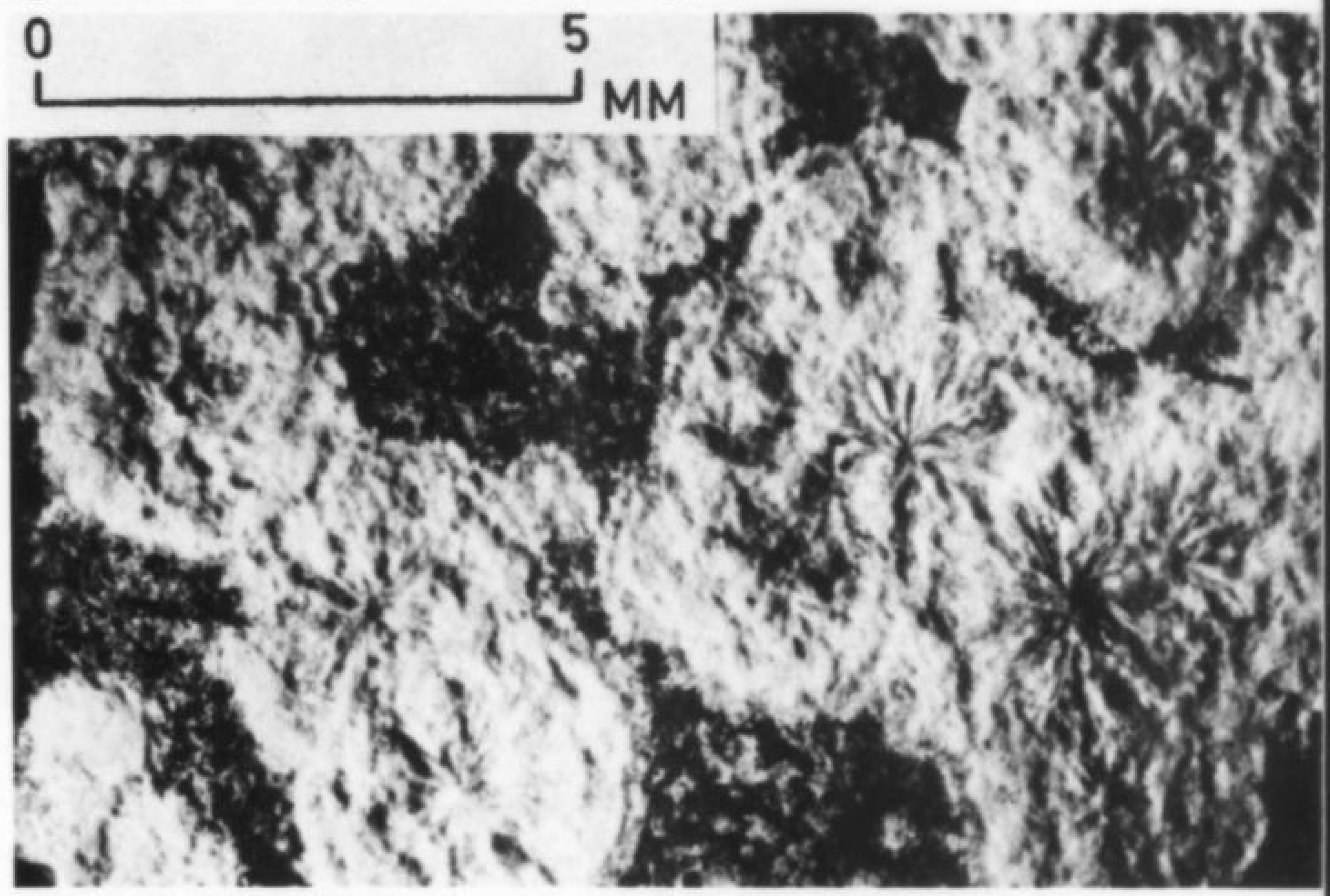

Fig. 6 **White radiating crystals of tengerite and lokkaite (both $(Y,Ca)_2(CO_3)_3 \cdot 3H_2O$) on quartz. Locality EL-344.**

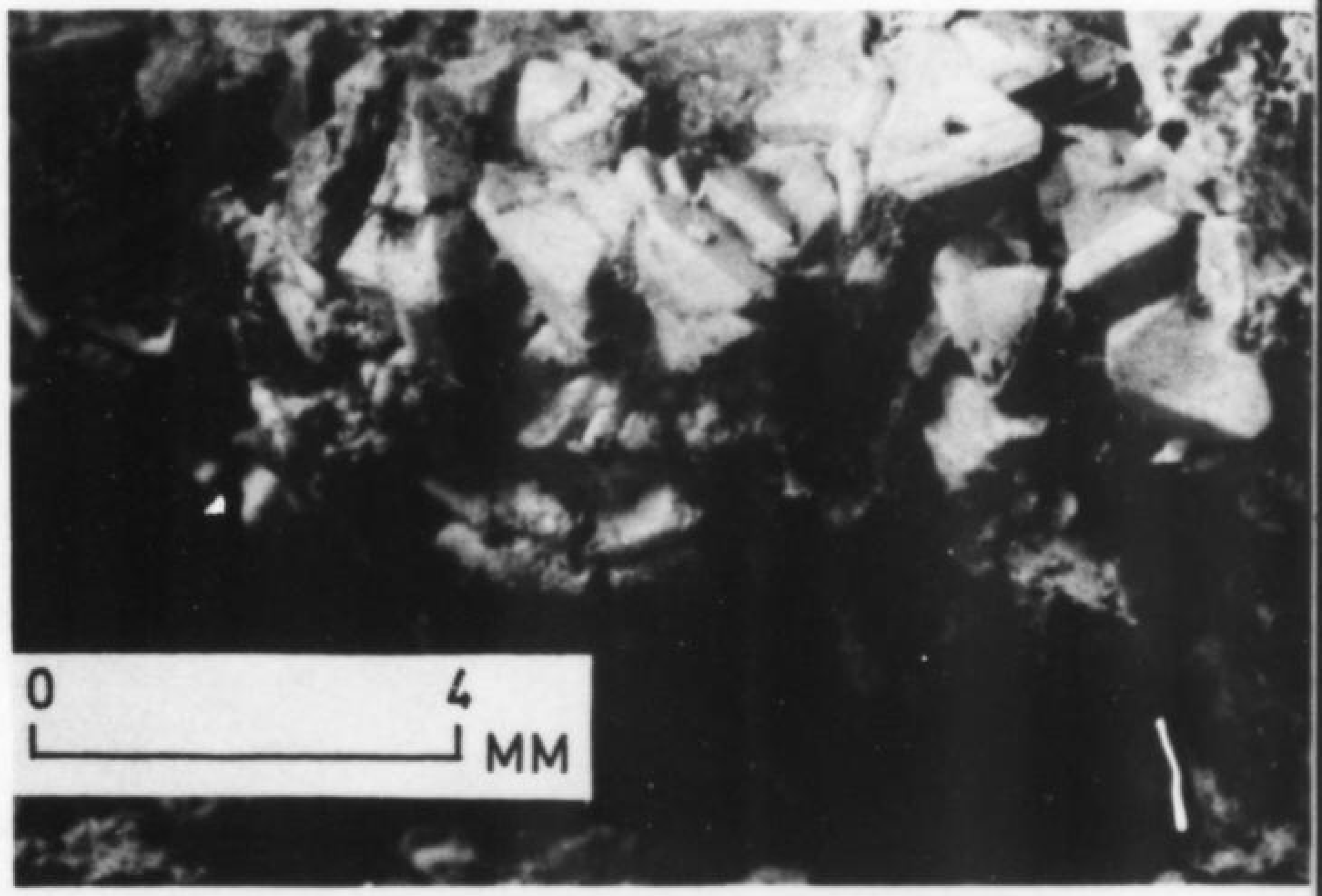

Fig. 7 **Hollow xenotime (YPO_4) crystals in vug. Specimen taken from dump.**

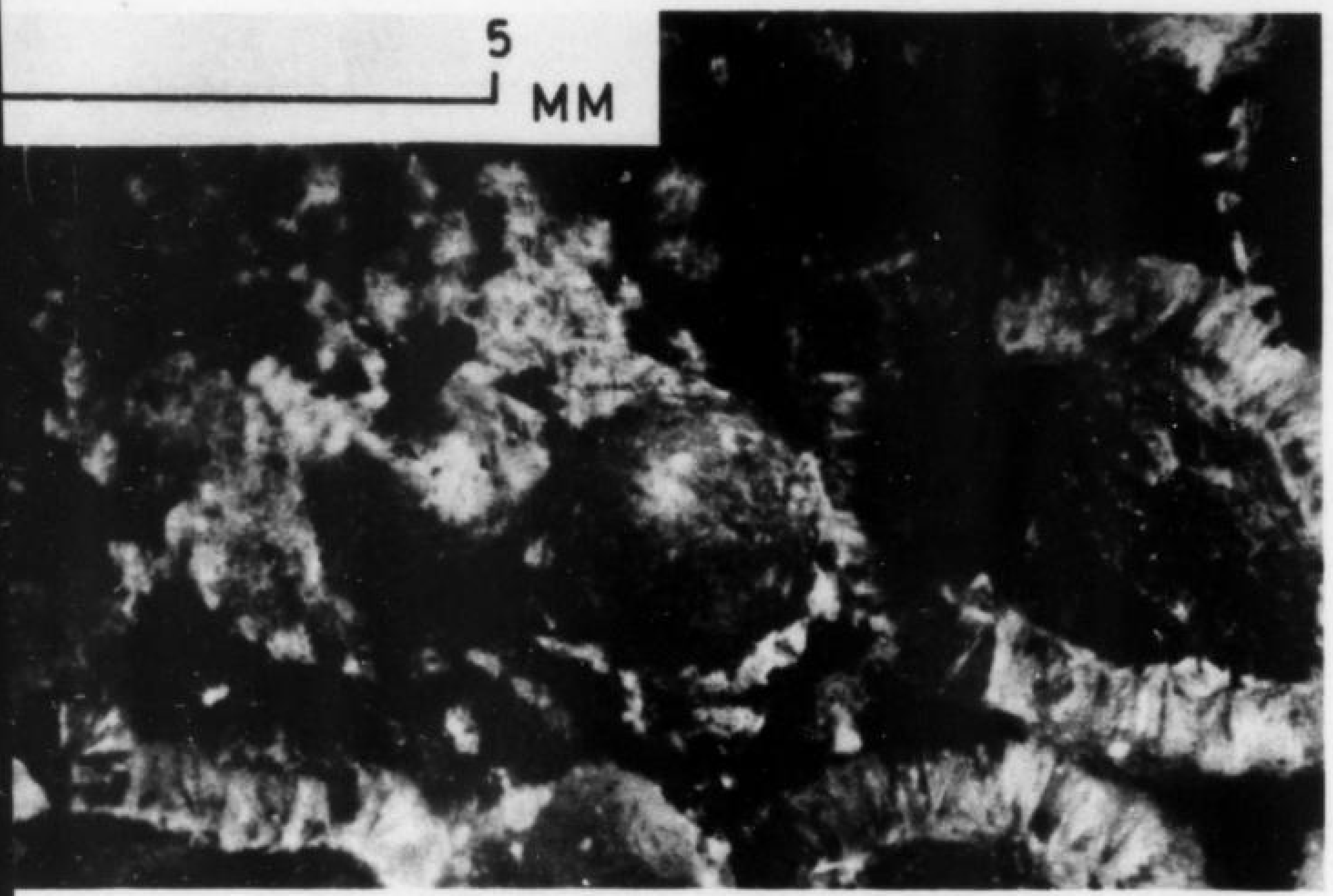

Fig. 8 **Radiating crystals with spherical exteriors of the new yttrium silicate UN-16, growing on smoky quartz and with surfaces dusted with stars of lokkaite. Location EL-344.**

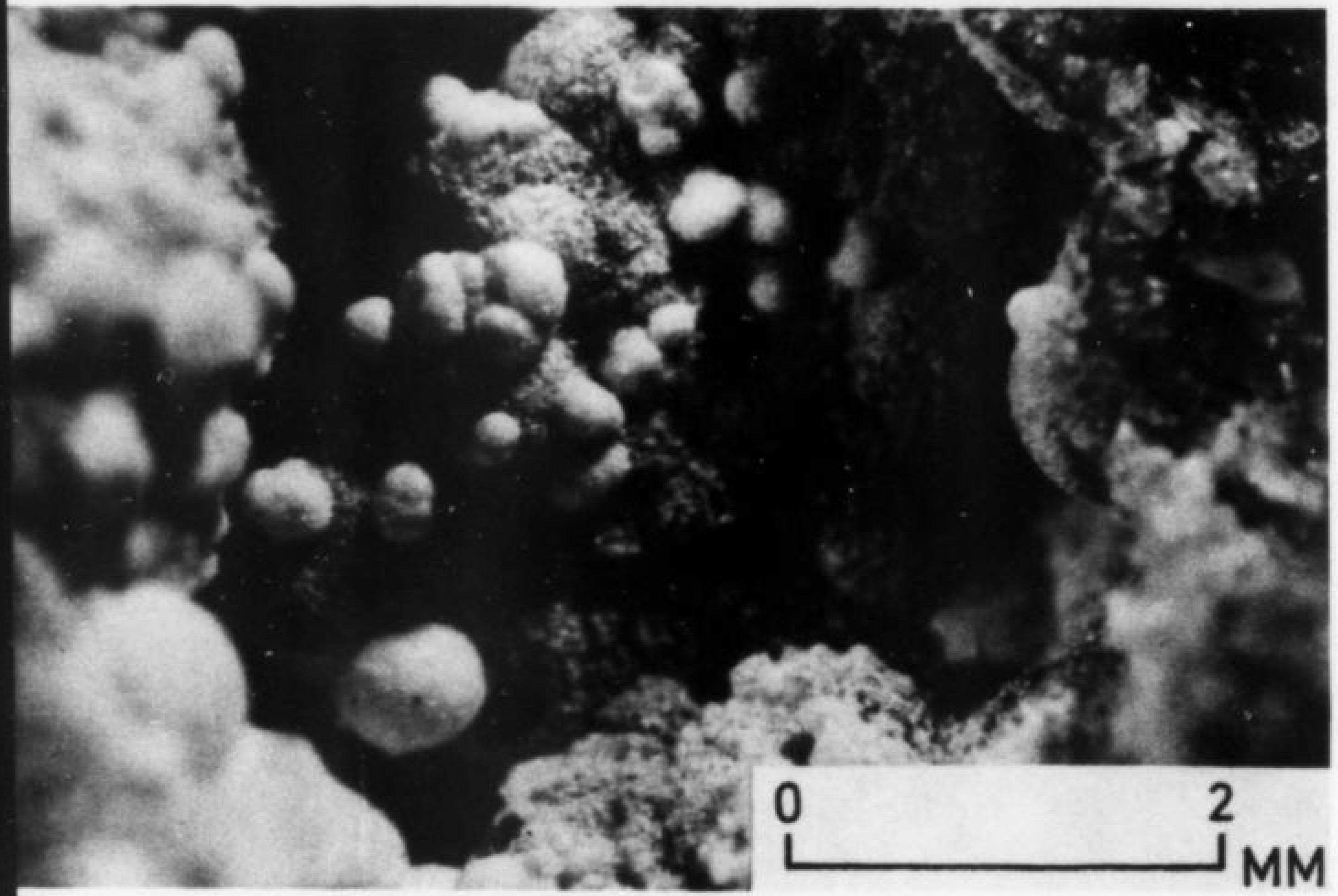

Fig. 9 **Microcavity in UN-16 with surface liberally dusted with tengerite. Location EL-344.**

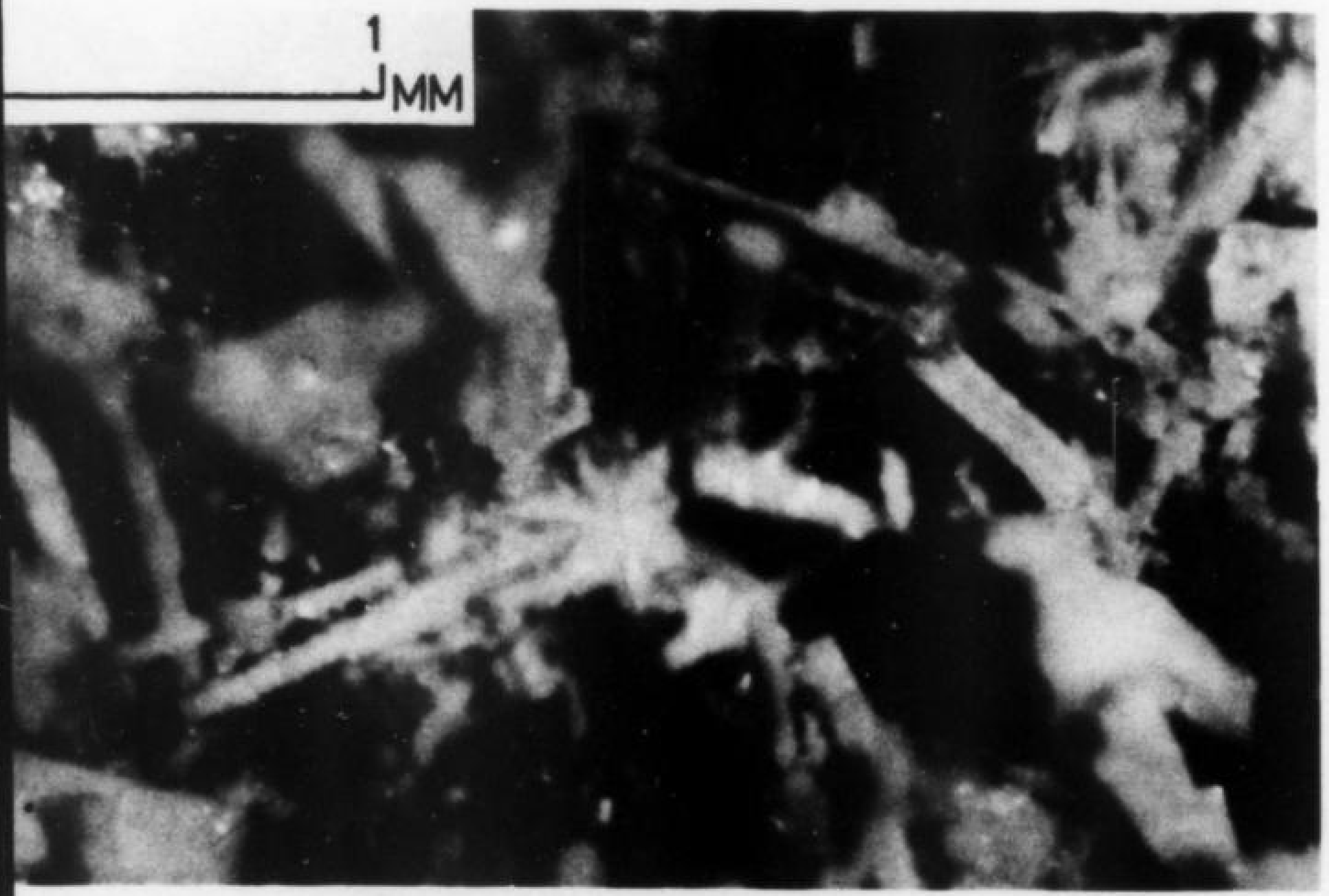

Fig. 10 **Laths of UN-17 ($Mg_yNb_2O_{5+y}$; $y < 3$ - ?) coated with tengerite. Specimen taken from dump.**

maa, Finland (Vorma *et al*.. 1966) and Fiadanana, Malagasy Republic, formerly Madagascar (Lacroix, 1922).

Hellandite was originally described from granite pegmatite at Lindvikskollen, Norway where it occurred with euxenite, allanite and thorite (Brøgger, 1903, 1907; Bjørlykke, 1937) and was later found in the Predazzo granite, Italy with fergusonite, allanite and thorite (Emiliani and Gandolfi, 1965; Gandolfi, 1966). The Evans-Lou pegmatite is the third occurrence on record and the association hellandite-fergusonite-spessartine is described for the first time.

On the other hand, fergusonite itself is not a rare mineral. Traill (1970) notes 10 occurrences in Ontario and Quebec alone. It appears in many yttrium-rich pegmatites and is strongly selective of the heavy lanthanide elements (gadolinium, dysprosium, erbium and ytterbium) as shown in the chemical analysis of fergusonite from the Evans-Lou pegmatite (Table 2).

Table 2. Chemical analysis of fergusonite from the dump of the Evans-Lou mine.

A		*B*	
FeO	0.50	Y	25.7
CaO	4.03	La	0.1
ThO_2	3.63	Ce	0.34
RE_2O_3	40.57	Pr	0.09
TiO_2	0.96	Nd	0.57
Nb_2O_5	41.20	Sm	0.7
Ta_2O_5	0.1	Eu	0.06
Al_2O_3	0.11	Gd	1.6
V_2O_5	0.11	Tb	0.5
MnO	0.19	Dy	3.6
GeO_2	0.06	Ho	1.0
SrO	0.05	Er	3.8
ZrO_2	0.07	Tm	0.5
PbO	0.2	Yb	4.3
UO_2	3.1	Lu	0.4
B_2O_3	0.3		
F	0.1		
Cl	0.08		
SiO_2	5.8		
	101.2		
less O = F+ Cl	0.1		
	101.1		

Analyses by D.S. Russell and colleagues, National Research Council of Canada

A. Nb_2O_5 and above determined by standard analytical procedures

Ta_2O_5 and below determined by mass spectroscopy

B. Rare earth elements determined by mass spectroscopy

Geochemically, the elements yttrium, uranium, niobium, bismuth and vanadium, which give rise to independent minerals at the Evans-Lou pegmatite, are also enriched in granite pegmatites of the Malagasy Republic (Lacroix,

Table 1. Yttrium, uranium, bismuth and copper minerals collected from locations within the Evans-Lou quarry

	EL-7	EL-8	EL-310	El-312	EL-334	EL-340	EL-344	EL-348	EL-350	EL-351
Fergusonite	C*	C	C	C	C		C	C	C	C
Euxenite	r*				r					
Hellandite			C	C			C	C		C
Y-spessartine			r					r		C
Y-apatite		r								
Y-sphene		C								
Y-allanite	r									
Xenotime	r		r	r				r		
Thorogummite		C	C	C			r	r		r
Wakefieldite	r	r								
Kainosite			C	C	C		C			C
Tengerite			C	C	C		C	C		C
Lokkaite			C	C			C	C		C
Doverite			r	r						
Uraninite		r							r	
Beta-uranophane	r								C	
Uranophane		r								
Native bismuth						C				
Bismuthinite						r				
Beyerite						r				
Bismutite						C				
Chalcopyrite										r
Chrysocolla										r
Malachite				r						r
Azurite				r						
Cornubite										?
Unidentified		un-4	UN-16* un-13	un-13 un-16 un-17			UN-16	un-3 un-20		

*C and unidentified minerals in capitals signify common minerals; r and unidentified minerals in lower case signify rare minerals.

1922). Thus a pegmatite at Samiresy has betafite ("samiresite"), euxenite, native bismuth, bismutite ("bismuthosphaerite") and pucherite ($BiVO_4$) and one at Ampangabe has samarskite ("ampangabeite"), columbite, bismuthinite, bismutite and pucherite.

Unknowns: Miles, Hogarth and Russell (1971, p. 400) list 9 unidentified minerals. Three unknowns must be added to this list and one unknown, UN-11, must be deleted because it has been shown to be a variety of UN-16. The three new unknowns have the following X-ray data (spacings of the strongest lines are given in Ångstroms; in parentheses):

UN-20: green mineral in hellandite, location EL-348-6.11 (10), 4.51 (10), 3.18 (8) 3.05 (7), 2.81 (7), 2.75 (7), 2.53 (7b).

UN-21: white crusts on loose fragments in the pit - 6.15 (5), 4.41 (4), 2.73 (8), 2.64 (7), 1.88 (10).

UN-23: shiny black grains in hellandite from the dump - 3.20 (10), 2.94 (5), 2.85 (10), 2.53 (7b), 1.49 (6b).

UN-21 has a similar X-ray pattern to the white tetragonal "tengerite" of Stepanov (1961) and the unidentified carbonate of Verwoerd (1963) but with the 013 (2.73Å) reflection greatly strengthened.

Of the unidentified minerals, UN-4 and UN-16 appear to be the most abundant. UN-4 occurs as an ochre-yellow powder on quartz near hellandite and yields an X-ray pattern with 4 lines only, suggesting a primitive cubic lattice with a = 7.73Å. UN-16 occurs as pale green or colorless radiating columns that have positive elongation with $\gamma = 1.620$. It is shown by X-ray and optical spectroscopy to be essentially a silicate of calcium and yttrium.

ALTERATION

The formation of secondary products was aided by abundant cavities which provided an easy access to ascending thermal solutions and downward percolating groundwater. The downward movement of groundwater is facilitated by the location of the pegmatite on the edge of a hill.

Possible schemes of alteration are presented in Fig. 13. Yttrian sphene is known to alter to quartz and greenish yellow anatase (leucoxene) and perhaps tengerite. The name leucoxene is in keeping with present usage which encompasses fine-grained, dull yellow to brown alteration products of sphene, ilmenite and other titanium minerals (Palache *et al.,* 1944, p. 560) and is favoured over the term xanthitane (Palache *et al.,* 1944, p. 587) which is less commonly used today. Spessartine alters to kainosite which may, in turn, alter to tengerite. Hellandite alters by several paths but mainly to fine-grained, brick-red kainosite (kainosite I) + chamosite, yttrian thorogummite and goethite, followed by snowy white tengerite and lokkaite + prismatic and colorless kainosite (kainosite II). The terms kainosite I and kainosite II are used with genetic connotation only, denoting first and second generation kainosite respectively. The principal alteration of yttrium silicates can be regarded as a progressive carbonatization and hydration with concurrent removal of silica.

Native bismuth alters by carbonatization and hydration, the principal secondary products being bismutite and beyerite. With the widespread alteration of yttrium silicates and native bismuth to corresponding carbonates, it is surprising that calcite is rare (observed in very minor amount associated with tengerite in 3 specimens only) and aragonite non-existant.

Fergusonite is relatively stable but does alter to pink and yellow products rimming the fresh mineral. Presumably these colored borders contain the bulk of the niobium whereas yttrium and uranium are dissolved and reprecipitated in nearby cavities as tengerite and beta-uranophane. In this case the alteration is one of hydration, oxidation and silicification.

Parts of the pegmatite have been brecciated and recemented by quartz. Careful examination of fragments and matrix has suggested that this process took place after the main alteration of sphene and after the formation of fergusonite. On the other hand, brecciation appears to separate kainosite I from kainosite II + tengerite and lokkaite.

The conditions of formation of the secondary minerals are uncertain. Miles, Hogarth and Russell (1971) favor precipitation of wakefieldite and kainosite I from ascending warm alkaline solutions. However, it is certain that at least some of the yttrium, bismuth and copper carbonates and the uranium silicates have formed recently under mildly acidic conditions ($pH<7$). Solution could take place in mildly acidic carbonated groundwaters and deposition when the acidity is lowered (pH increased). This theory is in agreement with present measured pH values: soil on the edge of the pit gave 5.1 and 5.4 (two locations) while water in the pit gave 6.5. It is also possible that some precipitation took place when evaporation led to supersaturation.

The multiplicity of minerals is, therefore, not a chance phenomenom but owes its existence to a chain of unusual circumstances such as:

(1) a pegmatite containing appreciable amounts of copper, yttrium, vanadium, boron, bismuth, uranium, thorium and niobium. A high content of calcium and low contents of sodium and iron favored the generation of hellandite (Hogarth, Chao and Harris, 1972).

(2) alteration aided by a rather permeable rock with steady downward circulation of groundwater,

(3) initial alteration products isolated by brecciation and further alteration of these products impeded by the sealing of openings in the rock by secondary quartz and

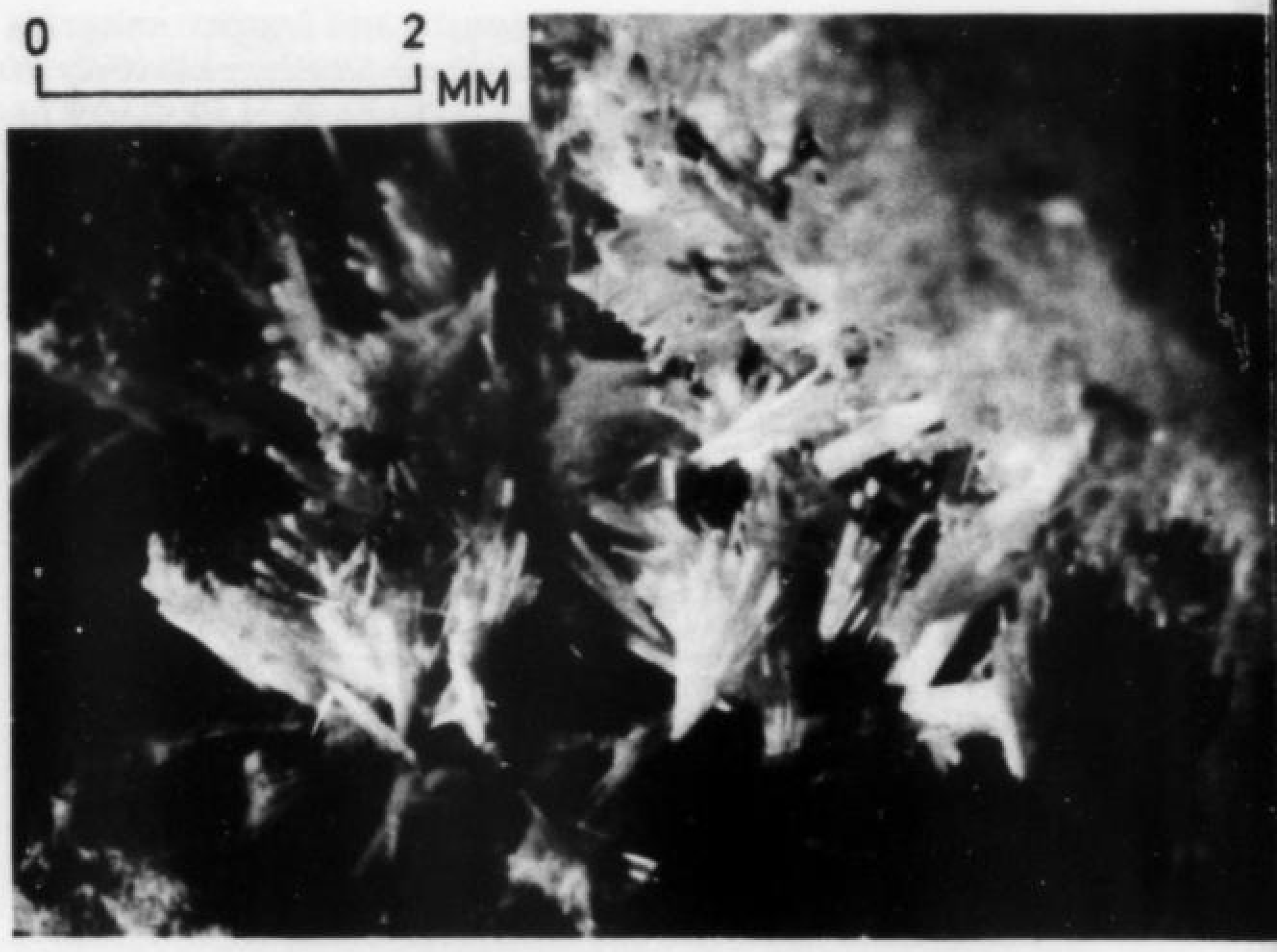

Fig. 11 **Second generation kainosite — $Ca_2Y_2CO_3Si_4O_{12}\bullet H_2O$ ("kainosite II") crystals projecting into a cavity. Specimen taken from dump.**

Fig. 12 **Second generation kainosite ("kainosite II") spray.**

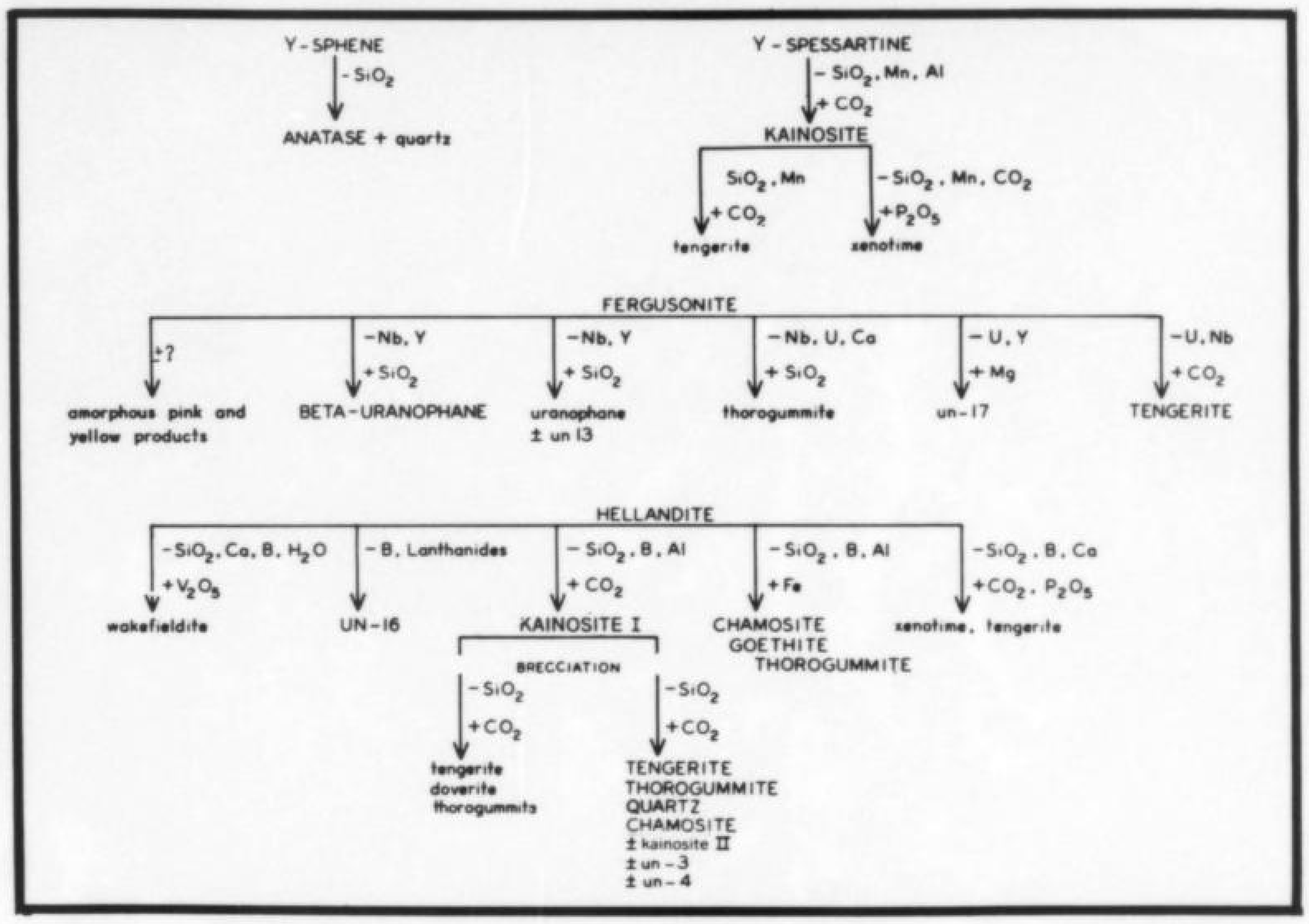

***Fig. 13* Possible scheme of alteration of yttrium minerals. Most common alteration products are shown as capitals. "Tengerite" includes tengerite and lokkaite.**

(4) possible alteration by thermal alkaline solutions followed by weathering under mildly acidic conditions.

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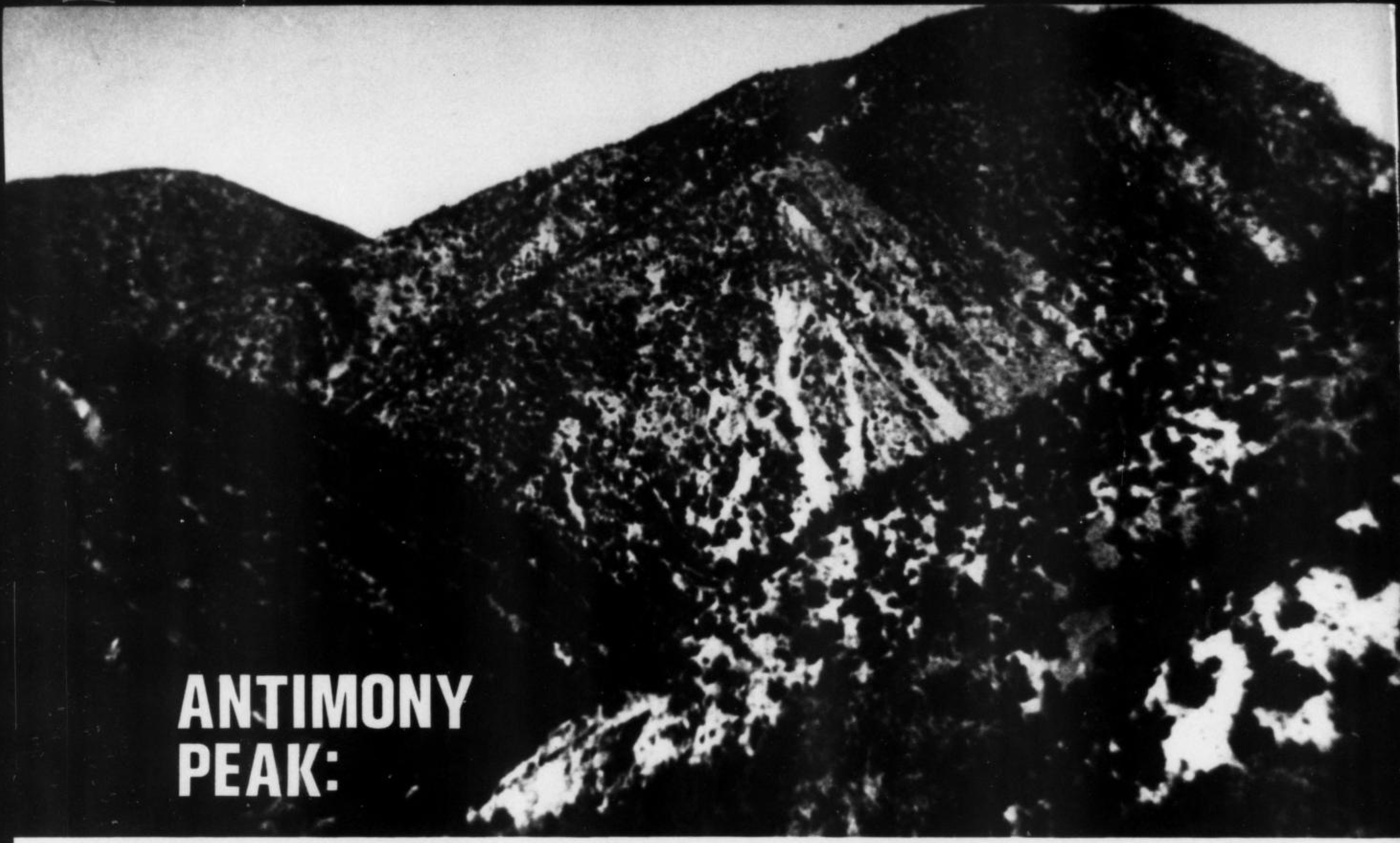


West slope of Antimony Peak seen from old smelter site.

ANTIMONY PEAK:

A Rerun of a Field Trip 110 Years Later

by H. Earl Pemberton
1638 Hill Street • Santa Monica, California 90405

Photos by Charles H. Baines

"A large vein of sulphuret of antimony exists in the granitic rocks at the head of the Tulare Valley, near the pass of San Amedio. It is about eighty miles distant from Los Angeles, by way of the nearest trail, and is most readily reached from the Tejon or Canada de las Uvas."

"The Indians and others had reported the ore to be of silver, speaking of the locality as affording 'mucho plata', and it was also reported that a party of men had been to the locality and reduced some of it in forges and furnaces of rude construction. While in Depot Camp at the Tejon, I made a special visit to the locality, in order to ascertain the true nature of the ore and its composition."

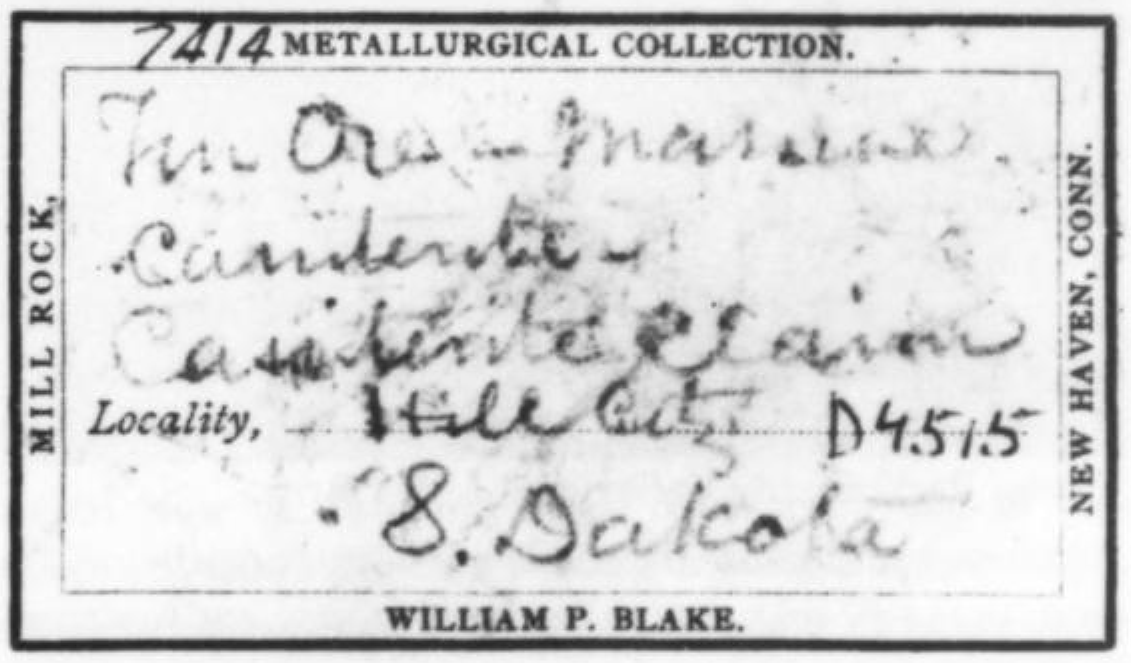
"The general direction of the trail to the mine is from the entrance to the Canada de las Uvas, westward, along the base of the sandstone hills to the third principal canada, through which a stream flows, fringed with cottonwoods. This canada is ascended for eight miles in a direction a few degrees west of south. On approaching the junction between the sandstone and the granite, the trail turns to the west and passes over to another canon, and ascends this to the high granite ridges, where trees and water are abundant. The ruins of a log house, and the forge that has been used to melt the ore, are romantically situated at the lower end of a long but rugged canada, between high and steep granite ridges. The canon and the sides of the mountain are heavily timbered with large fir trees."

"The ore for the supply of the furnaces appears to have been obtained from the numerous transported fragments, mingled with the granite debris brought down the canon by floods. The ascent of this canon was commenced in search of the vein, and I was guided by the numerous boulders of solid ore, which were, in some cases, over one foot in diameter. They were traced up to the foot of a steep and rocky channel, descending the almost precipitous side of the mountain, and it was evident that their souce was at a very considerable elevation above. The blocks of ore were occasionally met with along this channel. One of them was twenty-seven inches long and from sixteen to eighteen wide. The vein was at length found, at an elevation of about 6000 feet above the sea."

"The vein is bounded on both sides by granite, and it appears to extend in a nearly north and south direction. The outcrop is so situated on the face of the cliff that it was hardly possible to give it a full examination; and the greater part of it is so much covered from view by a thick crust of decomposed ore, that the thickness of the vein could not be conveniently measured. I judged, however, that the solid or workable part was from four to ten or twelve feet thick. There certainly is an unusual quantity of ore at this locality, and at some future day it will be worked with profit. . . ."

Such was William P. Blake's story of his trip to Antimony Peak in 1854, as he told it in his "Report of a Geological Reconnaissance in California", published in 1858. Some of the place names he uses are strange today. The valley he called Tulare is today's San Joaquin Valley. The Canada de las Uvas is Grapevine Canyon which is the route of the main highway from Los Angeles to the north. The old Spanish name means "grapevine." Depot Camp at the Tejon was on Tejon Creek where it reaches the valley floor about 14 miles northeast of the mouth of Grapevine Canyon.

From Blake's careful description it is easy to trace his route. The third principal watercourse west of Grapevine Canyon, up which he went, is Salt Creek. This canyon is, moreover, a present day route by road and jeep trail to Antimony Peak from the San Joaquin Valley side. As is so often the case, the trail of yesterday is the route of the highway, the back road, or the jeep trail of today.



7414 METALLURGICAL COLLECTION.

MILL ROCK,

Tin Ore - Massive

Cassiterite -

Cassiterite Claim

Locality, Hill City D4515

S. Dakota

NEW HAVEN, CONN.

WILLIAM P. BLAKE.

William P. Blake was a mineral collector as well as a noted geologist-mineralogist. Label from Richard A. Bideaux collection.

As Blake approached the sandstone-granite contact he turned west on a short branch of Salt Creek. His trail took him over a low ridge to a tributary of Pleito Creek and down this to today's Harris Ranch on Pleito Creek. He then followed Pleito Creek and its west branch to the base of Antimony Peak. As he describes his trip no other route was reasonably possible.

Intrigued by Blake's report of the float in the canyons below the Peak and by later reports of the variety of antimony minerals found at the deposit, we visited the area 110 years after Blake, but by a different route.

Antimony Peak is one of the higher and steeper landmarks in the granitic range rising steeply from the south edge of the San Joaquin Valley. Geologists believe the uplift

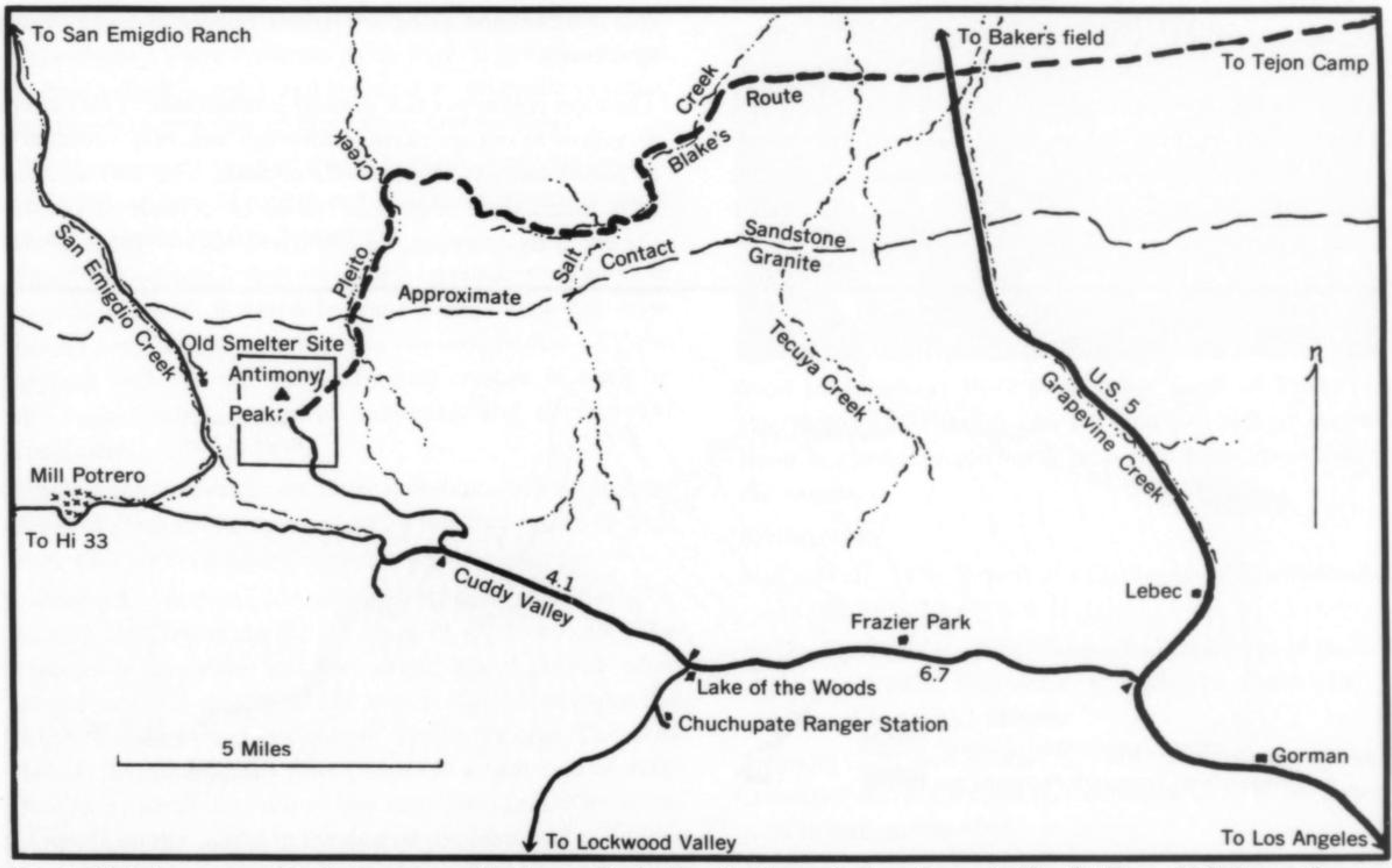


Fig. 1. **Blake's route and today's route to Antimony Peak. Detail of area in box shown in Fig. 3. (From U.S. Forest Service maps of Mt. Pinos and Ojai Districts)**

of the range started about 38 million years ago and continued up to about 1 million years ago, producing the range as we know it today. The range rises as high as 7500 feet (San Emigdio Mt. four miles west of Antimony Peak) and drops sharply to 1500 feet 8 miles to the north. Two miles south of the peaks of the range is the San Andreas fault zone. This zone is the valley followed by the roads shown in Fig. 1 running west from Gorman throuh Frazier Park, Cuddy Valley, and Mill Potrero.

Primitive paintings on the sandstone formations below the Peak suggests that the antimony deposits on Antimony Peak were known to the Indians and historical rumor suggest that the early Jesuit padres did some mining there. But in spite of Blake's glowing account of the value of the deposit there has actually been very little antimony produced there.

The first formal claims were staked sometime between 1872 and 1878. About 1878 the Boushey brothers built a small concentrating plant and smelter in San Emigdio Canyon and started mining the western part of the deposit. Remains of the ore dump and smelter can still be seen in the Canyon. It is reported that 60 tons of antimony were produced in 1882. Later the Anglo-American Association took over the operation and is said to have shipped several carloads of refined ore in 1885. Intermittent mining continued until 1892 when the Kern County Land Co. purchased the property; since then lessees have mined the deposit during two brief periods. One group of lessees mined and shipped five or six carloads of ore during World War I, and in 1941 a lessee shipped five tons of ore.

The above summary of production has been taken from a report of an investigation made by the U.S. Bureau of Mines during 1940 and 1941 (Jermain and Ricker, 1949). That report concludes "it is doubtful, judging by the extent of the old workings, whether the production of metallic antimony reached more than 600 tons since the first recorded production in 1882."

This report by the Bureau of Mines was a clue to the reasons why William Blake found so much float in Pleito Canyon: the rich part of the deposit is on the steep southeast escarpment of the Peak above Pleito Canyon. Fig. 2. taken from the report, shows the shear zone in quartz-diorite, in which the deposit occurs, and the concentrations of ore in that zone. This zone follows roughly the claim pattern shown in Fig. 3, and the richest part of the deposit is on the southeast end of the claim series, directly above the canyon which Blake travelled. So it was to this area that we went in search of the minerals of Antimony Peak.

The route today to the Pleito Canyon float area is from the south and is shown in Figure 1 and in greater detail in Figure 3. From the north edge of the clearing around the cabin shown in Figure 3 you can see the sheer south face of Antimony Peak. On the east side of this sheer face is a brownish scar. The brown is the mineralized zone and below it the richest float area. The road beyond the cabin is only for 4-wheel drive vehicles. 1.3 miles past the cabin is a saddle. Ahead is a very steep trail up Antimony Peak. This leads to the mineralized zone of the north side of the Peak covered by patented claims. There is a very dim trail winding down into the canyon to the east. This is the trail to the area where float up to one foot in diameter may be found. This is where Blake reported it 110 years ago. It is still there.

Most of the float material is massive stibnite. Associated with the stibnite in some cases is native antimony. Small but perfect crystals of stibnite are found in vugs in the massive material and along the quartz border of some of the specimens.

The most common oxide present is stibiconite. This occurs as yellow to orange massive material and very commonly as pseudomorphs after stibnite crystals. The fine acicular tufts which were once believed to be crystals of cervantite are fairly common. Vitaliano and Mason (1952), whose

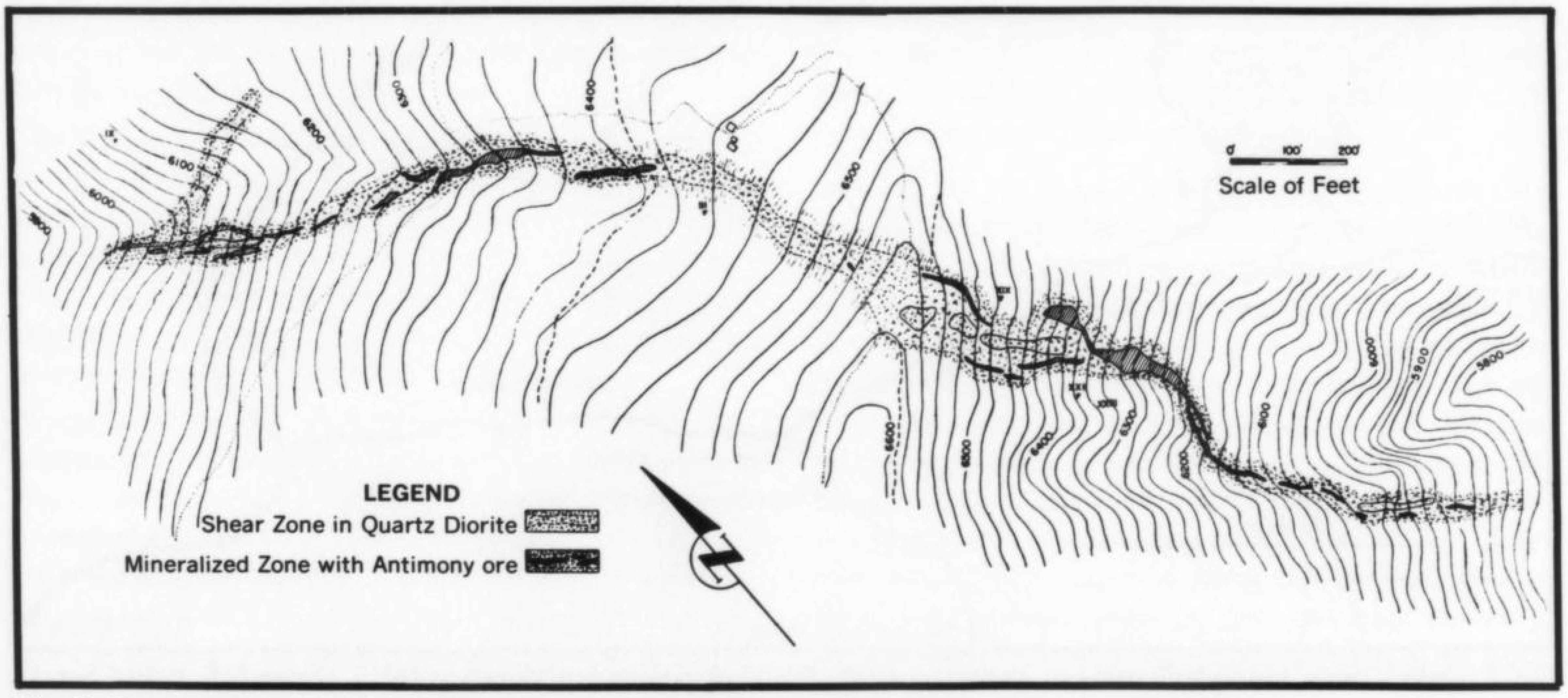


Fig. 2. **Contour map of mineralized zone (Jermain and Ricker, 1949)**

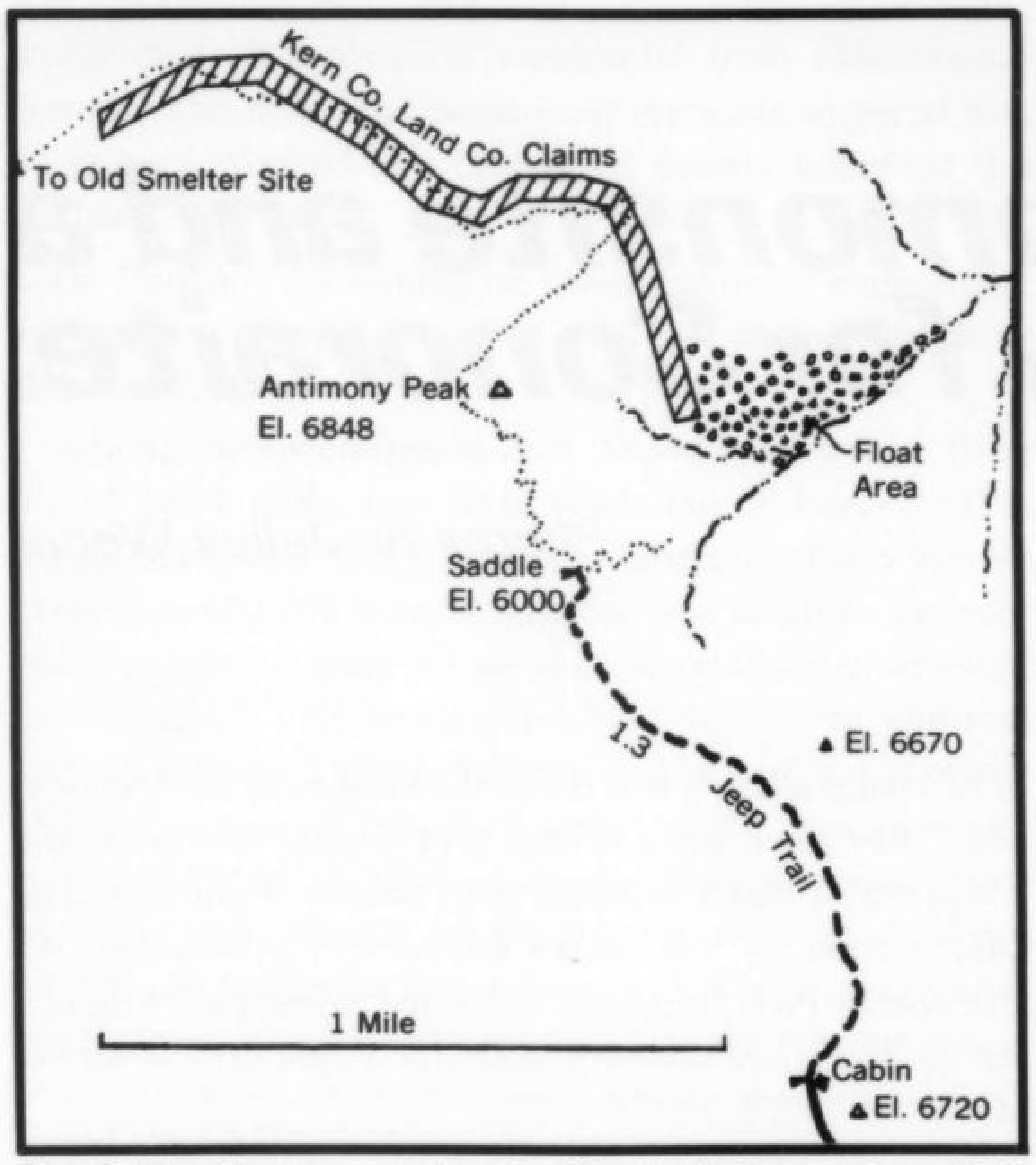


Fig. 3. **Detail of area in box in Fig. 1. (Adapted from U.S. Geological Survey maps of Cuddy Valley and Pleito Hill quadrangles, 1942-43.)**

work suggested that cervantite was identical with stibiconite, described these acicular forms as pseudomorphs of stibiconite after stibnite. A number of specimens of stibnite show that the acicular tuft form of the pseudomorph is due to the splitting of the stibnite crystals during alteration along the very perfect (010) cleavage plane.

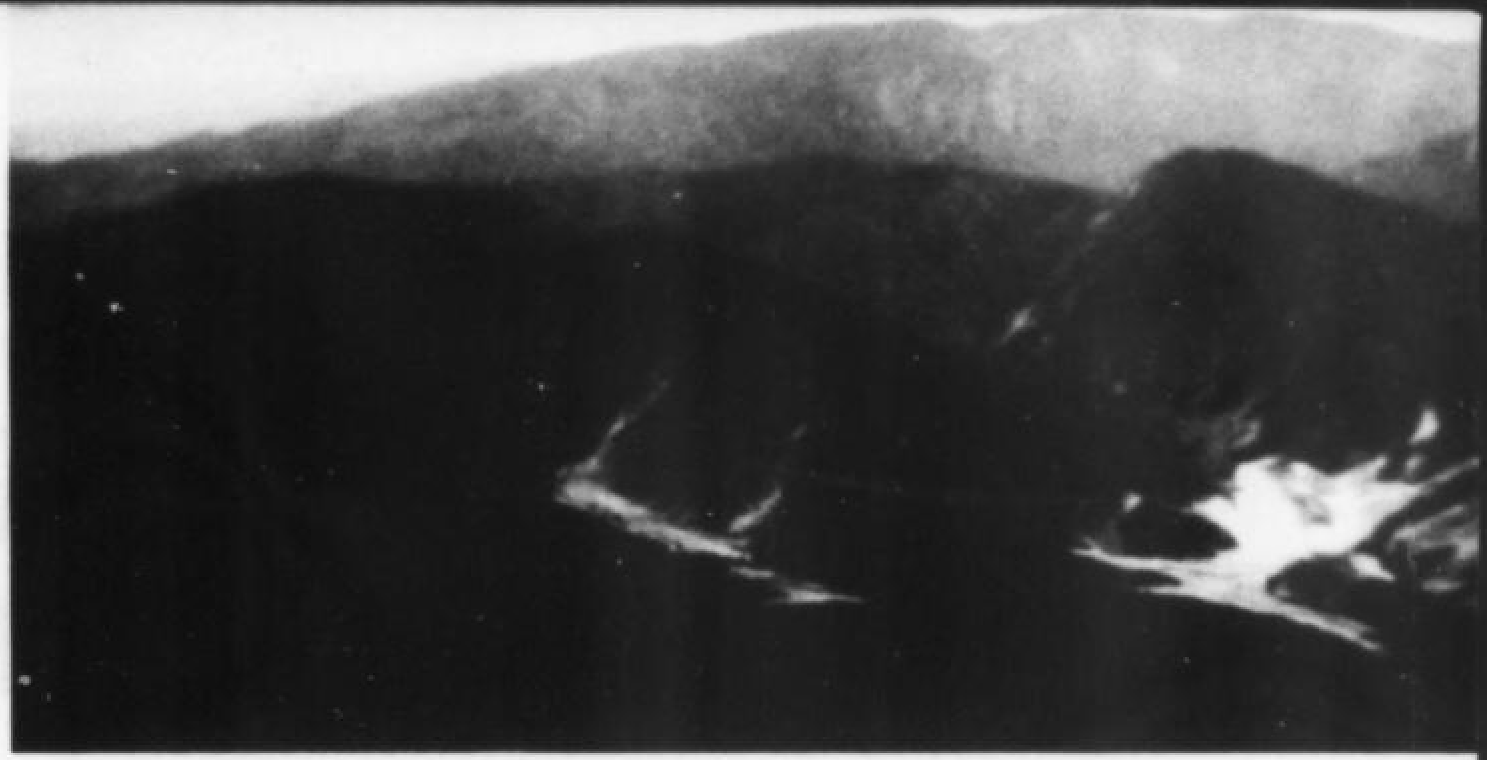
Valentinite is also a common oxide here. It is white, cream or pale yellow in color and is found as prismatic crystals, fan-shaped aggregates of thin plates, and massive.

The Bureau of Mines reported the presence of "red oxides" of antimony here. A bright red coating is found on some of the material but it is hematite.

Small but perfectly formed quartz crystals are found in vugs in the wall material in some cases. They are mentioned here particularly because the association of these crystals with stibnite and valentinite crystals in some of the vugs result in beautiful thumbnail and micromount specimens.

Small sulphur crystals are fairly common on fracture surfaces of some of the material and a few thin seams of gypsum with poorly formed crystals were also found.

One word of warning should be given about this area. Collecting this float is not for the weak of spirit or body. The country is very steep and very rough. Loose granite talus, cloud-burst-cut channels, and heavy vegetation make the trip a very hard and potentially dangerous one. The area below the mineralized zone drops off at the rate of 1000 feet in a lateral distance of less than 2000 feet. The slope down from the saddle at the end of the jeep trail is almost equally steep. And to top it all off the float you may find is just plain heavy.



Aerial view of Antimony Peak from south end of San Joaquin Valley. Peak is pointed mountain upper right. Ridge in background is Mt. Pinos. White area below Antimony Peak is lower reach of Pleito Creek Canyon.

Charlie Baines at old smelter site in San Emigdio Canyon west of Antimony Peak.

View of Antimony Peak from cabin south of Peak. (see Fig. 3) Trail to summit can be seen just left of summit. Road in center of picture is jeep trail from the cabin to the saddle.

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New Data on Emmonsite and a Second Locality for Sonoraite

by Richard V. Gaines

Photos by Julius Weber

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The mineral emmonsite $Fe_2(TeO_3)_3 \cdot 2H_2O$, was first described by Hillebrand in 1885, using material from near Tombstone, Arizona. Subsequently, emmonsite has been described from Cripple Creek, Colorado; near Silver City, New Mexico; at Goldfield, Nevada; at the El Plomo mine, Ojojona district, Honduras, and in some quantity at the Moctezuma mine, Moctezuma, Sonora, Mexico. In spite of the fact of these six published occurrences, and probably others which have not gotten into the literature, the symmetry and cell constants of emmonsite have until now remained indeterminate. On the basis of optics it was clear that it must belong to either the monoclinic system or the triclinic, but beyond this all investigators have come up against the problem of the almost complete lack of measurable crystals, or even of anhedral fragments consisting of a single crystalline individual.

The normal habit of emmonsite is of small mammillary or botryoidal crusts, or of tiny globular aggregates. These consist of radiating crystals of very small size. At the Moctezuma mine still another habit is common, in which hair-like crystals or crystal aggregates, usually curved, form radiating clusters in vugs (see cover). The hairs are usually nearly round, but the smallest ones clearly show apparently prismatic faces; some of these clusters are composed of perfectly straight hairs.

Prof. Charles W. Burnham of Harvard University recently investigated some of these hairs. He concluded that their structure was disordered, and that they consisted of almost randomly oriented crystallites. They produced a few lines like a powder pattern; however, when ground up, they give a normal powder pattern for the mineral. One possible explanation suggested by Prof. Burnham for the lack of correspondence between the external form and the internal sturcture, is that the emmonsite may be pseudomorphous after an earlier hair-like mineral. If true, this would account for the random orientation of the crystallites; however, the lack of evidence in the mine for the earlier presence of another mineral in this form, and the completely fresh, uniform appearance of the emmonsite, seems to preclude such a possibility.

Under the microscope most of the hairs extinct as a unit, in inclined orientation, or sometimes the hairs will extinct in two parts along a line down the center, as though twinned. They show some evidence of mosaic structure, and it is probable that if each hair does consist of multiple crystallites, these at least share sub-parallel orientation. All attempts by Prof. Burnham, and other investigators including the writer, to use such hairs for single crystal studies failed.

They would yield neither the network of points characteristic of a precession photograph, nor even the level lines of a Weissenberg rotation photograph.

Several years ago Prof. C. Douglas Woodhouse provided the author with a number of specimens of ore from the Mohawk mine, Goldfield, Nevada. These specimens all contained emmonsite, mackayite, or the still incompletely characterized mineral blakeite. They had been collected by Prof. Woodhouse, in 1931, at the McGinnity shaft. Study of the specimens revealed two in which there were a few clear, green, axe-shaped crystals which proved to be emmonsite. These crystals were not over 1mm in maximum dimension, and were tightly attached to the matrix; none showed more than four faces, and there was no discernable symmetry.

On the chance that these crystals might prove responsive to single crystal X-ray investigation, one of the specimens was sent to Prof. Dr. Josef Zemann of the Institute of Mineralogy and Crystallography at the University of Vienna. Prof. Zemann and his collaborators have worked very extensively on the structure of tellurim oxy-salts; he turned the problem over to his associate, Dr. Franz Pertlik and after several months, in the words of Prof. Zemann, "Dr. Pertlik from this institute was now - after weeks of nasty work - successful in finding a crystal of emmonsite which gives good X-ray pictures. It is a grain from the material from Goldfield, Nevada".

On the basis of Dr. Pertlik's work, emmonsite is shown to be triclinic. The unit cell constants are:

$a = 7.90 \pm .01$ Å $\qquad \alpha = 96° 44' \pm 10'$
$b = 8.00 \pm .01$ Å $\qquad \beta = 95° 00' \pm 10'$
$c = 7.62 \pm .01$ Å $\qquad \gamma = 84° 28' \pm 10'$

The cell volume is 474.6 Å^3, and the cell contents are $2[Fe_2(TeO_3)_3 \cdot 2H_2O]$. The formula was confirmed by the writer through analysis of emmonsite from Moctezuma, Sonora. The measured density on the same material was 4.549, as compared to a calculated density based on the cell data, of 4.719.

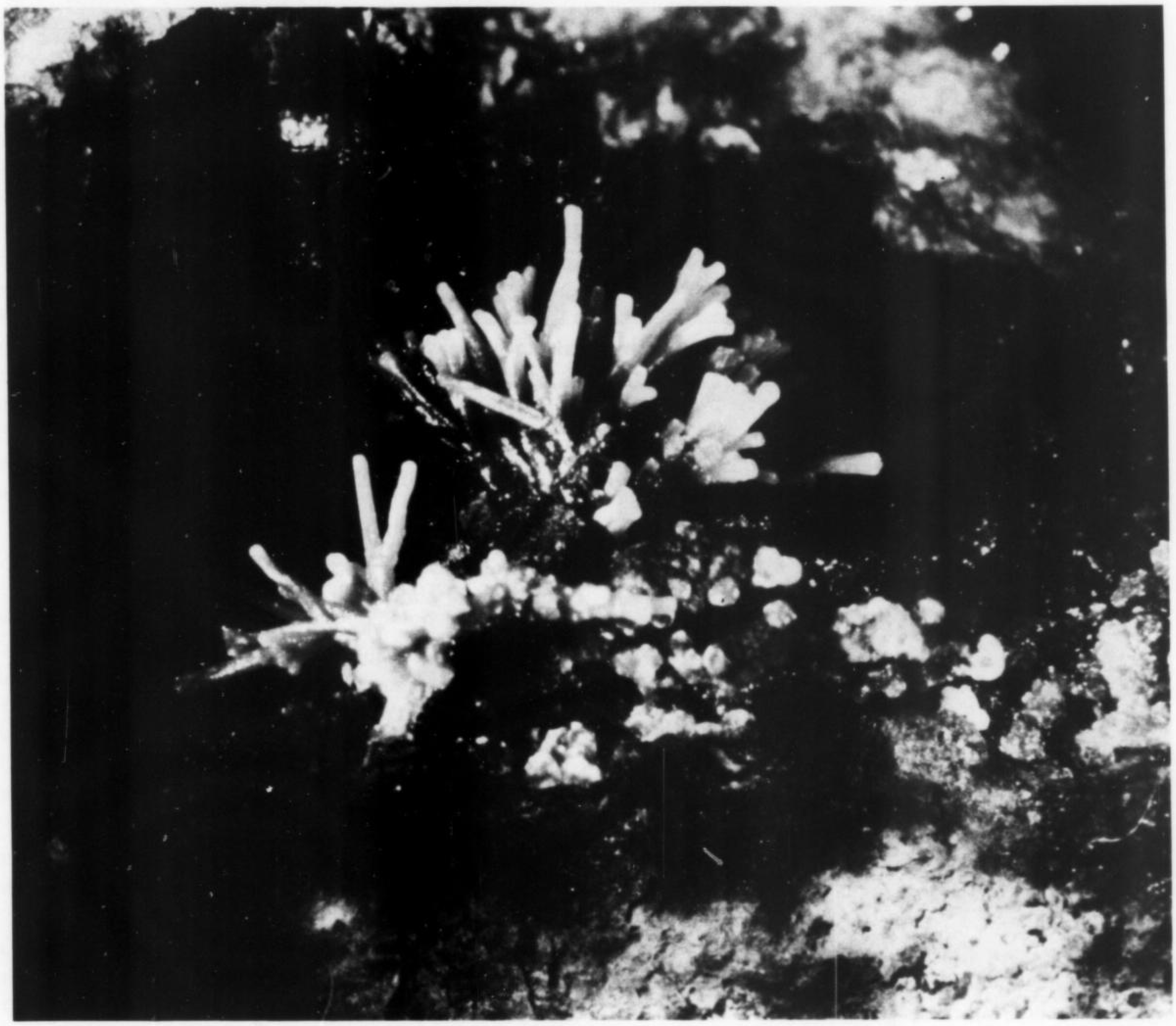
Dr. Pertlik is continuing his investigation of emmonsite, and expects to publish the full structure of the mineral in the near future.

Among the specimens in Prof. Woodhouse's suite from the Mohawk mine, one other is of unusual interest. This is a piece about 2.5 cm x 4 cm of silicified rhyolite porphyry breccia containing several rosettes and fracture surfaces of emmonsite, besides the usual brown staining of limonite or "blakeite". One small vug about 4mm long contains several yellowish green velvety rosettes of a somewhat different aspect; these when tested could be seen to be soft and have good radial structure with pronounced cleavage. The total amount of the mineral probably does not exceed one milligram; enough was sacrificed for a powder photograph, which clearly showed that the mineral is sonoraite. Later on a few more small specks of sonoraite were found elsewhere on the specimen.

The formula of sonoraite was initially thought to be $Fe_2Te_2O_5(OH)_4 \cdot H_2O$. However, determination of the structure by Donnay, Stewart, and Preston has shown that the correct formula is $FeTeO_3(OH) \cdot H_2O$, and there are 8 formula weights per unit cell.

This is only the second locality for sonoraite, and this new specimen is only the fifth specimen of the mineral which has been found at all. The other four are all from the Moctezuma mine in Sonora. One interesting aspect of sonoraite, both at Goldfield and at Moctezuma, is that it is found in intimate association with emmonsite with no clear evidence of order of formation, as though they had formed simultaneously. Since both are hydrous ferric tellurites, it is difficult to understand why two distinct phases should have formed in the same environment. Another characteristic shared by both minerals is the fact that, despite numerous attempts on the part of the author and

Fig. 1 **Emmonsite. Moctezuma mine, Moctezuma, Sonora, Mexico. Radiating cluster of curved, hair-like crystals.**



other mineralogist, it has not been possible to synthesize either mineral, whereas virtually all the other known tellurim oxysalts have been readily synthesizable.

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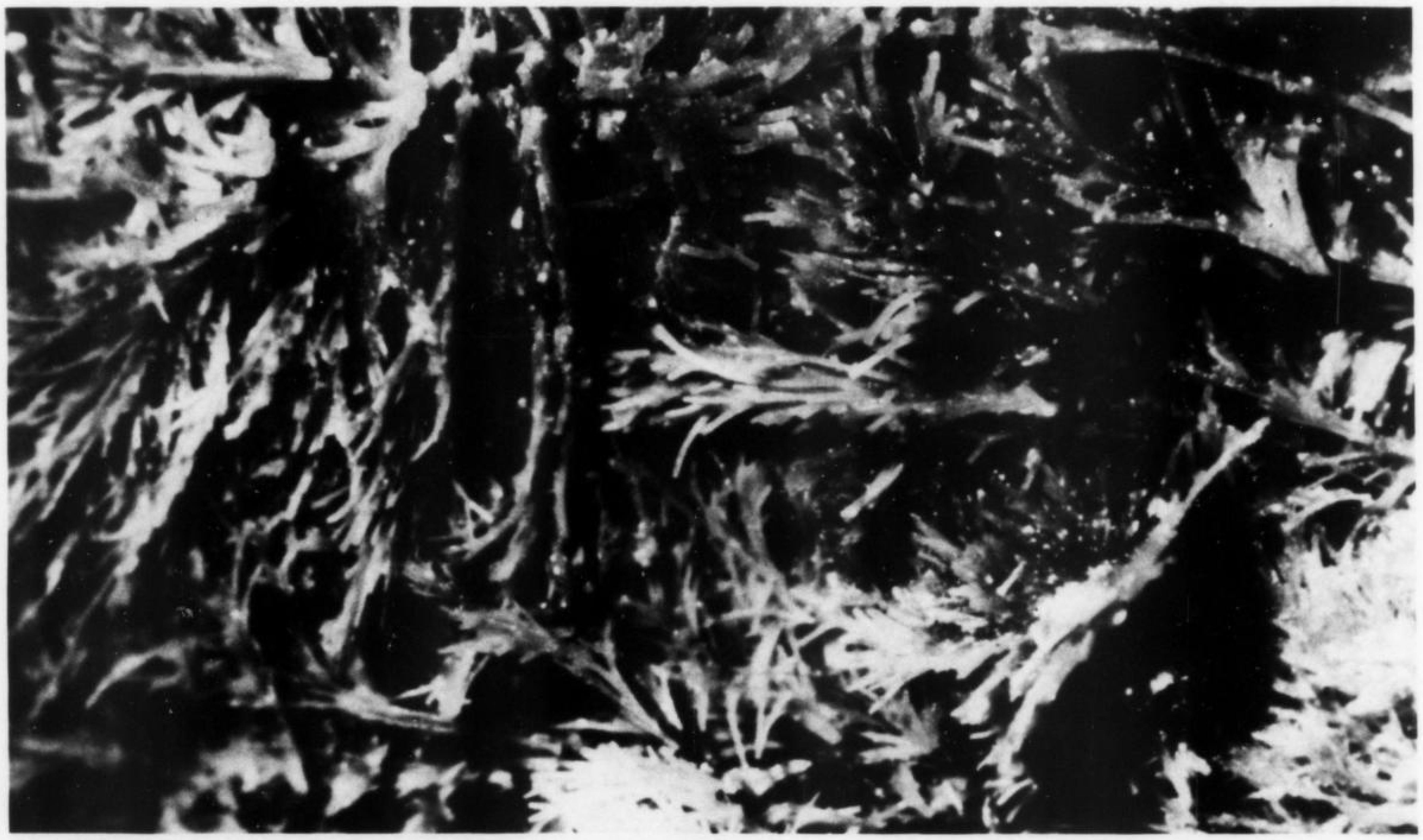


Fig. 2 **Emmonsite. Moctezuma mine, Moctezuma, Sonora, Mexico.**

Fig. 3 **Sonoraite. Mohawk mine, Goldfield, Nevada. The crystal is about 1 mm in length.**

SLIDE COMPETITION WINNER IS JOEL AREM FOR SECOND CONSECUTIVE TIME

The *Mineralogical Record* sponsored a 35 mm slide contest again this year in conjunction with the Tucson Gem and Mineral Show. The winner of the $25.00 cash prize this year, as last, was Joel E. Arem of the Smithsonian Institution. Joel's subject was a group of cinnabar crystals from Hunan, China. There was never any doubt as to the winner as soon as the slide was projected upon the screen. The reaction of the audience was clearly heard as nearly everyone made an audible response to the beauty of the slide. The audience selects the winner by ballot.

To all of those who submitted slides for the competition we extend our sincere thanks. We regret that there can be but one winner. The competition has been greeted with enthusiasm and we eagerly look forward to the third contest next year.

The winning slide, by the way, will be used for the cover of a future issue of the *Mineralogical Record.*

Yedlin on Micromounting

One of the things we noted at the Tucson Show, and on the shelves of numerous wholesalers in the area, was bright, shiny native copper, like a brand new penny, with a marked difference. All the specimens were pitted, evidence of the fact that the copper was cleaned with acid, usually hydrochloric. A pity this, for the value of such specimens is depreciated, both esthetically and monetarily.

The late O. Ivan Lee had researched this problem and had come up with an old time solution. (Pun intended.) You need a fish globe, or some non-porous vessel deep enough to hold sufficient liquid to cover the specimen to be treated. Use 1 part lye (sodium hydroxide), three parts rochelle salts, and twenty parts of distilled water. Combine, place a dowel over the top of the container, and suspend the copper, by a copper wire, into the solution. Shortly, the liquid turns blue. Lift the specimen a few times to determine its status. When bright and shiny, rinse in cold water and you have it. No etching, no pitting, no diminution of the specimen's value. Be sure, before you dip, that the copper is grease-free and uncoated with lacquer or any other preservative. And have a care for your skin and clothing. Lye eats through all kinds of organic matter.

We'd like to tell a story. The Foote Mineral Company is presently operating the mine at Kings Mountain, North Carolina, for lithium, and this gigantic quarry is a prime source of rare specimens for the micromounter. Originally, A.E. Foote was a dealer in mineral specimens in Philadelphia. (We print herewith one of his specimen labels.) Foote published 3 editions of a catalogue of minerals for sale, and these have become collectors' items, for they could well have been used as textbooks of descriptivel mineralogy, so detailed was the information supplied.

Foote was famous throughout the world. There is no major museum that does not count among its exhibits specimens supplied by this dealer.

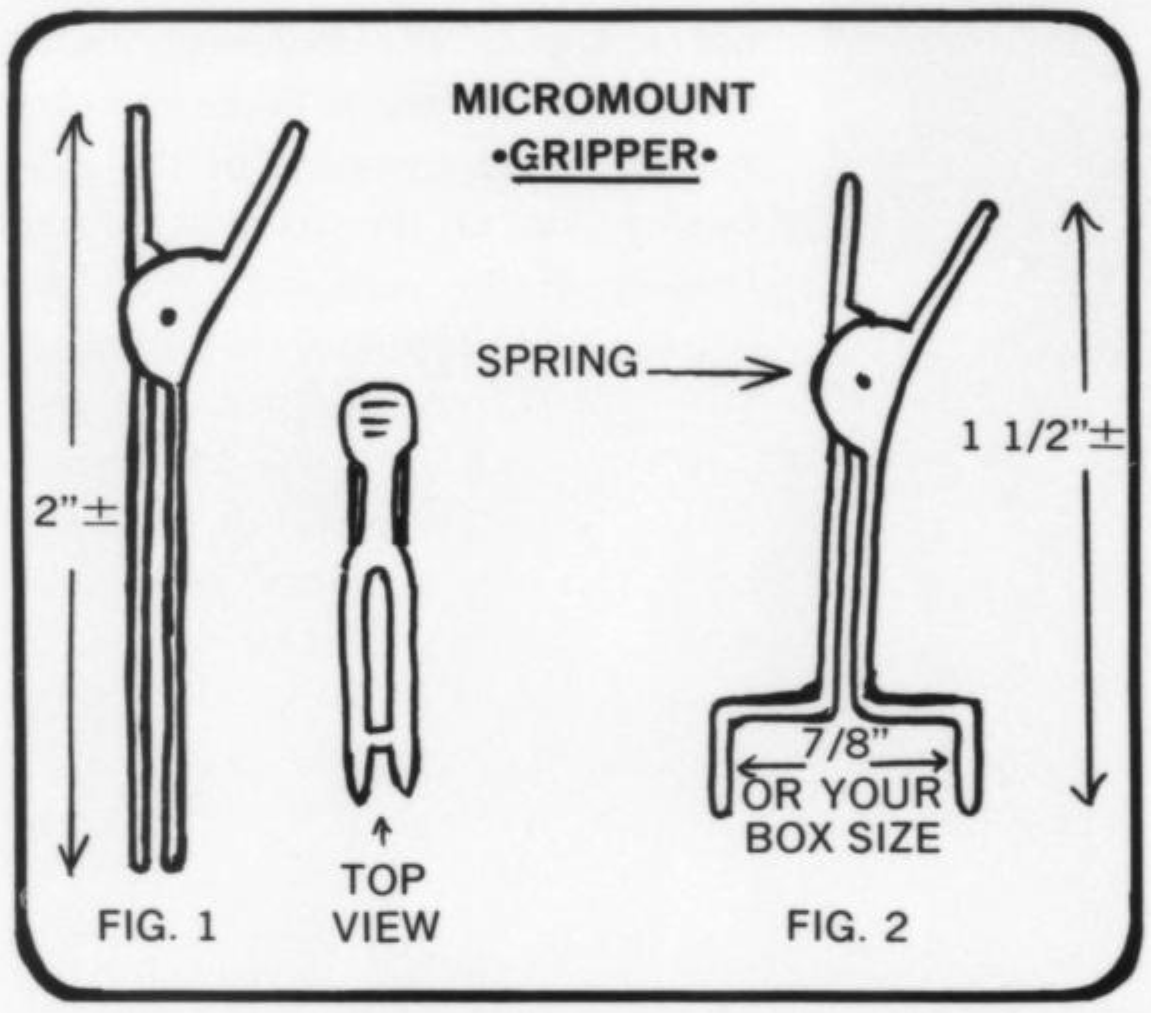
Now let's skip to 1960 or so. Lou Perloff, micromount collector, was an examiner for the National Labor Relations Board, and operated out of Winston-Salem, North Carolina. A hearing was in progress, and one of the parties involved was the Foote Mineral Company. During the course of the conference, and during a rather tense period, Lou brought out one of the old catalogues. The conference ended for the day. No one at Foote had ever known of the existence of the publication nor of the activites of the founder of the company. With the tension thus dissipated a settlement was quickly reached, with but one disastrous result. Lou was not permitted to leave the premises with the book. It now rests among the records of the Company. The present value of the publication? Well, when available, and depending upon condition, it is priced at from 10 to 18 dollars. More than worth it if it abets in settling labor disputes.

Ah, confirmation! In the September - October, 1971 issue of the *Record* we told you of our surmise that *E. S., N.Y.* on micromount boxes indicated that the collector was Ernest Schernikow, erstwhile member of the New York Mineralogical Club, a contemporary of Kunz, Cahn, Ashby and Martin, and in fact, the second president of the organization. From Arthur Roe, of Washington, D.C. come these words: "..........you spoke of Ernest Schernikow. I have 3 specimens he mounted in the old cardboard boxes - cuprite, diaphorite, and miargyrite. These were given to me by Lazard Cahn (cahnite) who knew Schernikow, and who said that Schernikow's collections, both of micro and cabinet specimens, were good ones. Mr. Cahn had an office as mineral dealer in New York City for many years before he retired to Colorado Springs, where I, happily, met him. Mr. Cahn supplied Schernikow with specimens for both his collections, and Schernikow gave Cahn material, both mounted and loose." (Ed. note. The Cahn micromount collection was given to Yale University, where it is used by members of the mineralogy department for reference work.)

It is quite satisfying to get this verification of our surmise. It now firmly establishes the identity of another early worker in the micromount field. We're still seeking infor-

DANA
441 PHILLIPSITE
AND PHAGOLITE
NEAR MELBOURNE
VICTORIA
DR. A. E. FOOTE, PHILADELPHIA.

mation on *C. E. Hanaman, Troy, N.Y.* Oblong paper boxes, Philadelphia type label, good mounts. Recognition, anybody?



Here is a gadget very useful to a collector whose boxes are so packed in a container that he has difficulty in extracting them from the tray or drawer. Some sort of gripper is needed. Pliers are too massive. Fingernails are not always long enough in this age of tension and turmoil. So Will and Gerry Shulman devised a simple tool, inexpensive and functional. Approach your wife (Or, as the advertising people say, "A reasonable facsimile") and obtain from her an aluminum hair clip. New, it looks like Figure 1. Using a pair of pliers bend the tines so that the gadget looks like Figure 2. You're in business. A squeeze it opens. Insert along the sides of the box. Release pressure and it grips the mount, which now can be lifted.

We had occasion to go through a small box of miscellaneous crystals and masses of material from Magnet Cove, Arkansas. This area has some unusual TiO_2, for it has produced rutile, brookite, rutile-brookite paramorphs and pseudomorphs, some with rather startling geniculations. What we found were some "fourlings." These look like wagon wheels, and are composed of 4 sets of twinned crystals, all combined as a single unit, lustrous, striated, geniculated, and beautiful to behold. We've seen some an inch in diameter, but were able to get one that shows up at about 10 X. Look for them at dealers and old collections.

The micromounter forever seeks material. His complaint is that dealers do not give heed to his needs. This is understandable when it is realized the great care that must be exercised in selecting micromount mineral material. It is almost axiomatic that more work is done by a purveyor properly to prepare a dollar item than to ready a fine fifty dollar specimen. So it behooves the collector of micros to fend for himself among the availables.

Now at every show there are displayed for sale some items at fifty cents to a dollar or so. Usually these are small, most are unsuitable, and some are too common or uninteresting. Yet it is from these boxes that we have obtained many fine things. Here are half a hundred, taken from sundry notes we've kept, not complete memos, by any means, but adequate to show that things are available. In some cases we've had to work on the specimens - like etching natrolite to expose neptunite and joaquinite, but for the most part the items were about ready for mounting. No order, just as they appear in our notes.

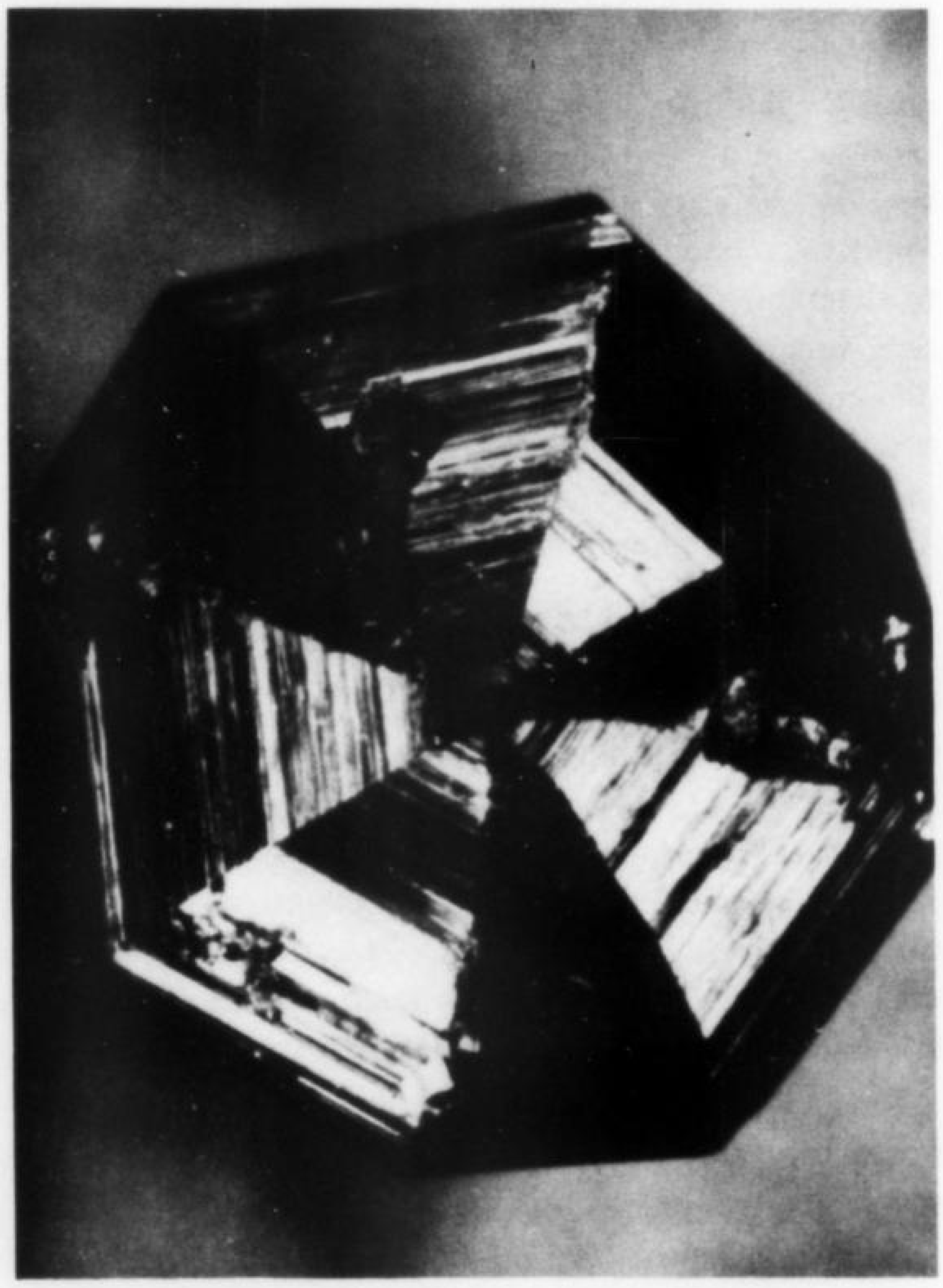
From Mexico: Plattnerite, murdochite, aurichalcite, hydrozincite, descloizite, erythrite, wulfenite, mimetite, danburite, apatite, epidote, adamite, hemimorphite.

From Arizona: Vanadinite, wulfenite, mimetite, copper, copper in gypsum, malachite, azurite, cuprite, dioptase, willemite, aurichalcite, linarite.

From Nevada: Brochantite, realgar, orpiment, olivenite.

From other states: Rhodochrosite, huebnerite, apatite, topaz, realgar, copper, autunite, torbernite, rutile, pyrophyllite, anatase, wavellite, apophyllite, stilbite, heulandite, prehnite, analcime, natrolite, variscite, pyromorphite, neptunite, joaquinite, tourmaline, bertrandite, fluorite, garnets.

Enough? Don't ask what to do after you've acquired a lot such as this. We personally still add quartz and calcite to our melange. No two specimens are alike. A glance through Goldschmidt's *Atlas der Kristallformen* discloses calcite with 2544 form diagrams, quartz with 855, tourma-



Rutile Twin (fourling) — Magnet Cove, Arkansas
Photograph by J. Weber from a specimen in the collection of Neal Yedlin

line 403, sphalerite 183 and wulfenite with an even hundred. And that was over 50 years ago! You've a long way to go, baby, so keep plugging.

A brief note from Dick Thomssen, Tucson, Arizona, anent our phase of the mineralogical hobby, and his conclusions after a dispassionate viewing of a micromount competition. "Judged micromounts at a show recently. I was disappointed at the overall quality. The material was monotonously the same - all recent and local. The inference is a decided lack of depth to the collections behind the exhibits. There seems to be a proliferation of micromounters without any appreciable increase in collections of note. Perhaps this represents a natural stage in the evolution of the specialization...."

Well, we think this is a normal thing, though somewhat deplorable. You begin with the things around you and available. If your intentions are serious you involve yourself in a wider range of study and acquisition. What surprises is the entering into competition of portions of such collections, truly unthinkable in a competition among cabinet specimen collectors. Is it that the quality of the workmanship is taking precedence over the primary item - the specimen? Perhaps Mr. Thomssen's experience was an isolated example. We have seen fine collections in California; Canada; here in the East, the cradle of the hobby; and in Michigan. We have seen, too, collections as described by Dick in all parts of the country. Like other mineral collections, a few are outstanding, many are good, and the rest are amassed by those who enjoy the outdoors, and the social life inherent when birds of a feather assemble.

Buy and use a good mineral book, and please, affix the name and locality directly onto a good specimen. This, too, is a phase of ecology, the preservation of natural species.

Neal Yedlin
129 Englewood Drive
New Haven, Connecticut 06515

Mineralogical Record Idea Adopted

Editorially we complained (Vol. II, no. 3) that the sponsors of mineral shows are not making an attempt to explain to "the man off the street" what a mineral show is all about. Needless to say we are very pleased to see that someone has taken our complaint to heart. The following was printed as a hand-out for a recent show by The Springfield Rock Club, Springfield, Oregon. We are indebted to Mr. Harold M. Dunn, Public Relations Officer, for sending a copy to us. . .

WELCOME TO SPRINGFIELD'S ANNUAL ROCK AND GEM SHOW

To those who may not be very familiar with the procedures and ways of conducting these Shows we offer the following information:

Around the walls of the room are the commercial booths representing Rock Shops from a number of Western cities and communities. This material here on display is for sale. Do not hesitate to ask questions you may have of these experienced people; and enjoy seeing the variety of hobby supplies they have to offer.

Within the individual cases occupying the rest of the room are displays of two types, Competitive and Noncompetitive. Among the latter are choice collections shown by some of the dealers and others by members of the Springfield Rock Club and their guests. A sharing with you of some of the pleasures to be found in the earth sciences hobby.

The Competitive cases are all amateur owned and created. They are developed and arranged under specific rules which are uniform throughout the competitive shows anywhere in the country. Those displayed here are submitted for critical appraisal and a scoring under definite criteria by competant and experienced amateur judges, coming from other clubs.

Exhibitors are ranked by experience. Namely: Novice for the beginner, Advanced, for those with some experience in previous shows, and the Master Class, for those who have a score in previous shows high enough to earn a blue ribbon. This score differs for each group. 70 points is enough for the novice, 80 points for the advanced exhibitor, and 90 points are required for the Master to get a Blue. This Status is shown on the identifying card affixed to each case. Here also is shown the class and division in which a particular display is entered.

A set of Uniform Rules provide a guide for judging and displaying. The Uniform Rules provide a wide range of choice as to the class and division in which a particular display can be entered: Minerals, under B;Lapidary under C and so on. A person wanting to show just cabochons may enter for example, Class CC-l while someone with "thumbnail sized" minerals will enter in BT-1. Only cases in the same group, division and class meet any comparison of scores. Hence competition actually is with the rules, not with other displays.

We hope this information will assist your enjoyment of the Gem Show.

You are invited to attent the regular monthly meeting of the Springfield Rock Club which occurs the first Tuesday of each month, at the American Legion Hall, 8th & C Streets, Springfield. Come join our club and share the participation of a good hobby.

FRIENDS OF MINERALOGY, continued from page 53

A major area of FM activity must be the *Mineralogical Record.* As was pointed out in a previous editorial (Vol. II, 194) we are a long way from seeing the *Record* as a secure and widely enough supported publication. More publicity is vitally needed. People are still attaching notes to their subscriptions, to the effect that they have just seen the *Record* for the first time. Many people live in areas of minimal activity in mineralogy, and this "vacuum" is substantially filled by the *Record*. Such people should be given a better chance to see the magazine. Local libraries are a fruitful, potential source of many subscriptions. Very few local libraries now get the *Record,* because individuals have not approached them and asked them to subscribe. FM decentralization will make such individual local attention possible. All local dealers should be encouraged to display and market the *Record* and the new *Glossary of Mineral Species, (1971)* in their shops and at shows. The *Record* should be represented bya subscription table at every local mineral show. FM, through its members, operating on a widespread local basis, can make all of these things happen.

One of the highlights of the Tucson meeting was a talk by Prof. Clifford Frondel of Harvard University, outlining the past history of mineralogy in the U.S. and some current developments. The M.S.A. (Mineralogical Society of America) is the professional mineralogical society in this country. It began as a forum where all the diverse interests in mineralogical activities could find representation. It has now become a specialized professional society, whose primary aims are highly technical research and new instrumental techniques in the study of minerals. It is clear that a large area of less specialized mineralogical interest remains, but now without a strong organization to support it. Here is the pathway open to FM, if we choose to follow it. Friends of Mineralogy can provide a vital service to both the science and hobby of minerals, by making sure that no important activities are neglected, and that good relations are maintained between amateurs and professional mineralogists. Mineralogy as a whole will benefit greatly from this spirit of cooperation.

One valuable offshoot of FM-related activity thus far is the new Mineral Museums Council. This association of curators is now fully established and is in the process of drafting a Constitution and ByLaws. A first major goal of MMC will be to draft a statement of the needs of mineral science museums, to present to possible sources of support. The President-elect of MMC is Dr. Vincent Manson, American Museum of Natural History, New York; the Secretary/Treasurer is Dr. Joel E. Arem, Smithsonian Institution, Washington, D.C.

FM is on the move. It will go as far as its members take it, and will be as influential and active as the people who constitute its membership. Mineralogical interest is at an all-time high, in both the scientific and collecting areas. The mineral hobbies are among the largest and fastest-growing in the world. It is an ideal time to be excited about minerals, a stimulating time to be involved in new developments. If this appeals to you, and you wish to join collectors, both novices and sophisticates, as well as the most eminent scientists and curators in the world, in furthering mineralogical interest and activity, then now is the time for you to join Friends of Mineralogy.

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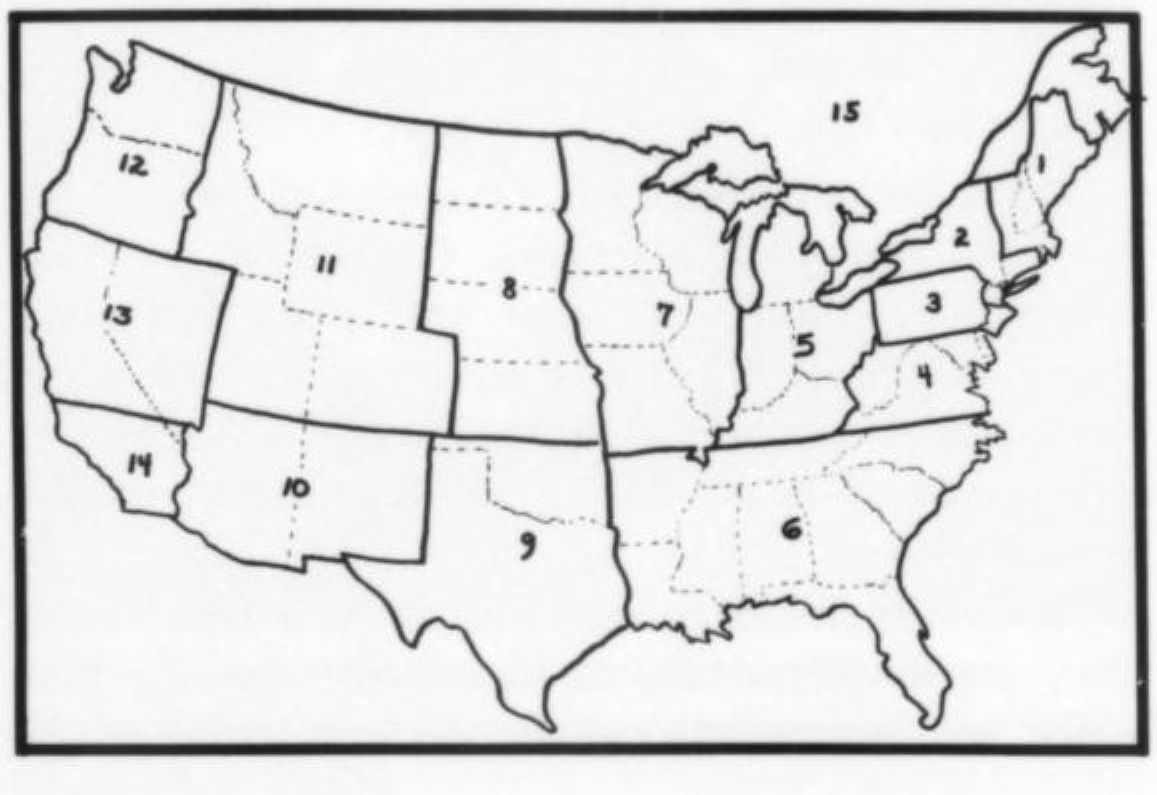

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(*Newly elected, March, 1972)

Yet Another Job For Fido

It isn't enough that dogs are guarding buildings, solving crimes, carrying brandy to lost skiers, and guiding the blind. Man is now making prospectors of them.

In *Geologiska Főreningens Főrhandlingar,* Volume 93, number 547, page 725, 1971, there appeared the article "The Use of Dogs in Prospecting for Sulphide Ores" by Gunnar Nilsson. For four years now the Geological Survey of Sweden has been training dogs to detect sulphide-bearing blocks of rock buried at shallow depths in glacial moraine. The program has been sucessful, and in one case a block was discovered 3 feet below the surface.

As luck would have it, male dogs were found to be more reliable than bitches. Apologies to Woman's Lib! In Nilsson's words "bitches turned out to be rather unreliable in localizing large blocks and tended to concern themselves only with the smaller ones. Male dogs...refused to be intimidated by large blocks." Of the different breeds tried the alsatian worked best.

Some of the dogs became such eager collectors that they "became jealous when the trainer himself found a block and started to hammer it. The dog(s) then showed... ill-humour by barking and being somewhat aggressive towards the trainer."

Now, finally, we know what a true rock*hound* is!

Sphalerite and Associated Minerals
from East Tennessee

by Kent C. Brannock
1701 Dennis Bypass, Apt. 38
Kingsport, Tennessee 37664

Although Tennessee has been a leading producer of zinc for many years, specimens of sphalerite and its associated minerals from the area are found in very few collections and, though quite attractive, are virtually unobtainable from dealers. The state's most important zinc producing area is in east Tennessee in the Mascot-Jefferson City district of Knox and Jefferson Counties. Surface deposits of oxidized zinc ores, consisting mainly of smithsonite and hemimorphite, were discovered in the area in the early 1800's and were mined for some time, beginning around 1854. No mining of these oxidized ores is done at present. Underground mining of sphalerite in the area began in 1913, and has been continuous since then, with numerous mines having been developed.

The geology and stratigraphy of the area, and the genesis of the ores, have been the subject of many publications, too numerous to review here. There is general agreement that many unsolved problems relating to the origin of the zinc ores still exist. These are reviewed and discussed by Oder and Picketts (1961) and in a series of papers in the *Tennessee Division of Geology Report of Investigations* No. 23 (1969).

The sphalerite now mined occurs mostly in brecciated areas of the Kingsport formation and the lower Mascot dolomite of the Knox dolomite group. The brecciation apparently resulted from solution thinning and dolomitization of the Kingsport formation and collapse of the lower portion of the overlying Mascot dolomite. Thus rubble and crackle breccia resulted, and locally the fragments range from subangular to subrounded to rounded. They have been displaced from two to fifty feet. Generally, chert has been deposited in and near the breccia bodies.

The chief minerals of interest to collectors are sphalerite, dolomite and fluorite. Much of the sphalerite is massive and occurs in seam fillings. It is yellow to brown in color having a low iron context (∼0.5%). The most attractive specimens, however, consist of brilliant, complex crystals of sphalerite, brown, greenish-brown and amber in color, and usually accompanied by white to pale-pink saddle-shaped crystals of dolomite. These are found lining vugs or as free "floaters" (3 - 10 cm in size) within vugs. The sphalerite frequently occurs in groups of crystals up to about 2 cm with the individual crystals averaging 3 - 5 mm. The associated dolomite crystals are about 5 - 10 mm. Obviously some brecciation followed the first sphalerite deposition, since some of the sphalerite has been completely rounded prior to dolomite crystallization. In other specimens areas of the sphalerite have been abraded to give a polished or burnished surface. At first glance, these latter specimens appear to have been damaged in the process of being collected; often, however, there is a later growth of sphalerite crystals, usually lighter in color, on the surface of the abraded material. The specimens are also frequently "sanded" with a later coat of very fine-grained dolomite.

Fluorite occurs very rarely in the ore, usually in pale lavender to purple cubes, sometimes enclosing sphalerite, around 5 mm in size. Even more rarely large purple fluorite crystals up to 2.5 cm are found which exhibit a beautiful growth pattern. They are made up of a lineage of multiple, subparallel cubes (slightly curved) stacked on top of each other in what might be described as a "macromosaic"

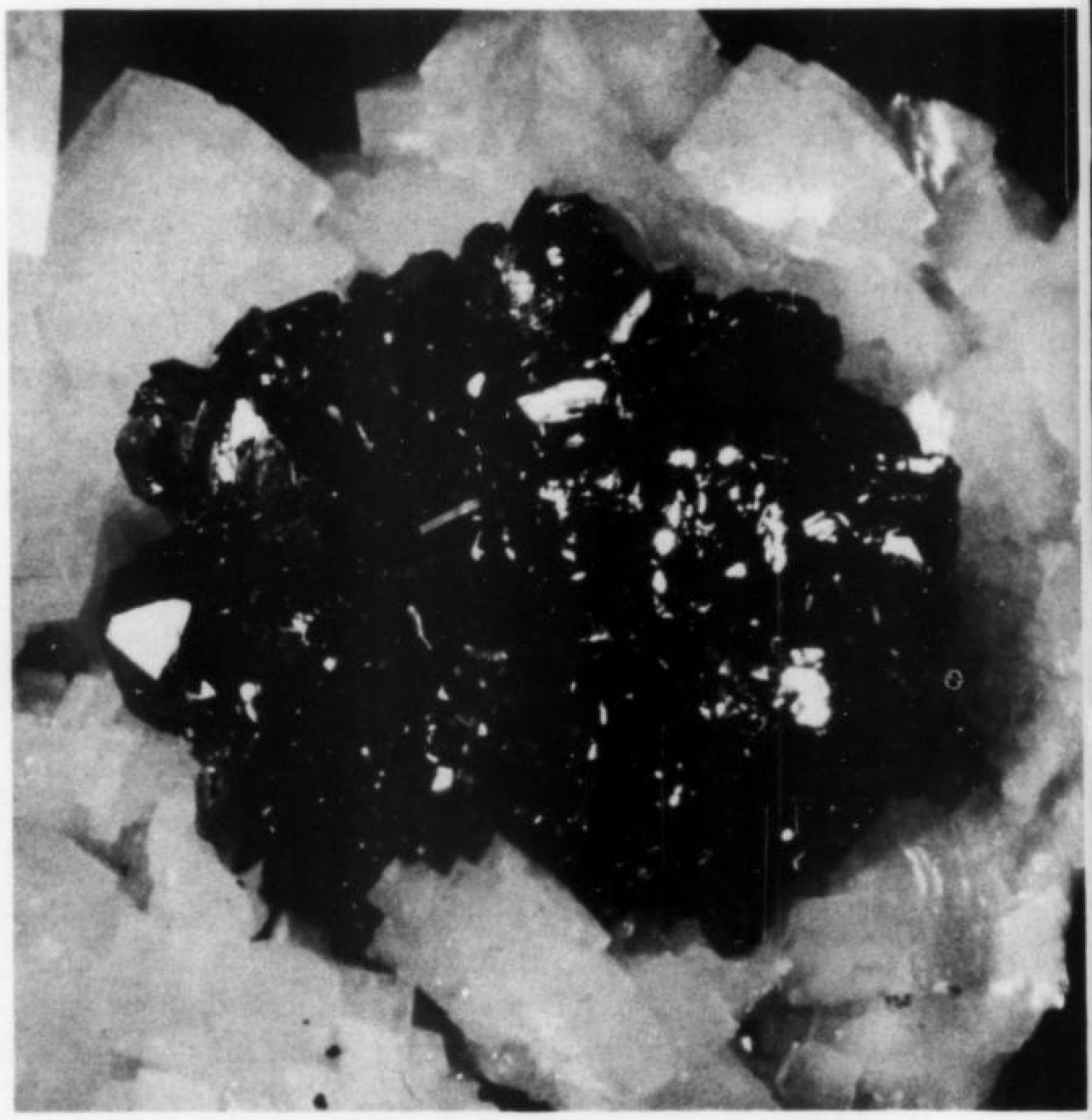


Fig. 1. Sphalerite on dolomite. Photo by Ben Kinkead.

arrangement. Grossly the resulting crystal is a cube with concave faces.

Small quartz crystals and brilliant, colorless calcite crystals are found rarely in the ore. Of little interest to collectors are, roughly in order of decreasing abundance, pyrite, hematite, marcasite, barite and galena. Occasionally, thin, yellow coatings of greenockite are observed, and the author has seen a few specimens of lustrous druses of hemimorphite crystals.

The specimens described and figured in this report are from one of the mines within a few miles of Jefferson City, Jefferson County.

The paragenetic sequence of mineralization has not been studied in detail, but it is obvious that several overlapping periods of crystallization of the major minerals in the ore occurred.

Since all of the present mining is underground, collecting is not allowed at any of the mines, and few specimens see the light of day. They are available in limited quantities from a few miners who occasionally retrieve specimens, however the demand far exceeds the supply.

References

Oder, C. R. L., and J. E. Ricketts (1961), Geology of the Mascot-Jefferson City zinc district, Tennessee, *State of Tennessee, Division of Geology, Rpt of Investigations,* no. 12, 29 p.

(1969) Papers on the stratigraphy and mine geology of the Kingsport and Mascot formations (lower Ordovician) of east Tennessee, *State of Tennessee, Division of Geology, Rpt of Investigations,* no. 23, 90 p. Included in this report are the following papers:

Harris, L. D., Kingsport formation and Mascot dolomite (lower Ordovician) of east Tennessee.

Fagan, J. M., Geology of the Lost Creek barite mine.

McCormick, J. E., L. L. Evans, R. A. Palmer, F. D. Rasnick, K.C. Quarles, W.V. Mellon and B.G. Riner, Geology of the American Zinc Company's Young mine.

Hathaway, D. J., Mine geology of the New Market Zinc Company mine at New Market.

Crawford, J., R. E. Fulwiler and H. W. Miller, Mine geology of the New Jersey Zinc Company's Jefferson City mine.

Hill. W. T., Mine geology of the New Jersey Zinc Company's Flat Gap mine at Treadway in the Copper Ridge district.

Readers interested in a series of technical papers relating to the ore deposits of this region are referred to Economic Geology, *Vol. 66, August, 1971, 695-805. This special issue contains fourteen papers that were first presented at a symposium sponsored by The Society of Economic Geologists, the University of Tennessee Department of Geology, and the Tennessee Division of Geology, in Knoxville, Tennessee on March 27-29, 1969. Ed.*

Fig. 2. Curved dolomite crystals with sphalerite. Photo by Ben Kinkead.

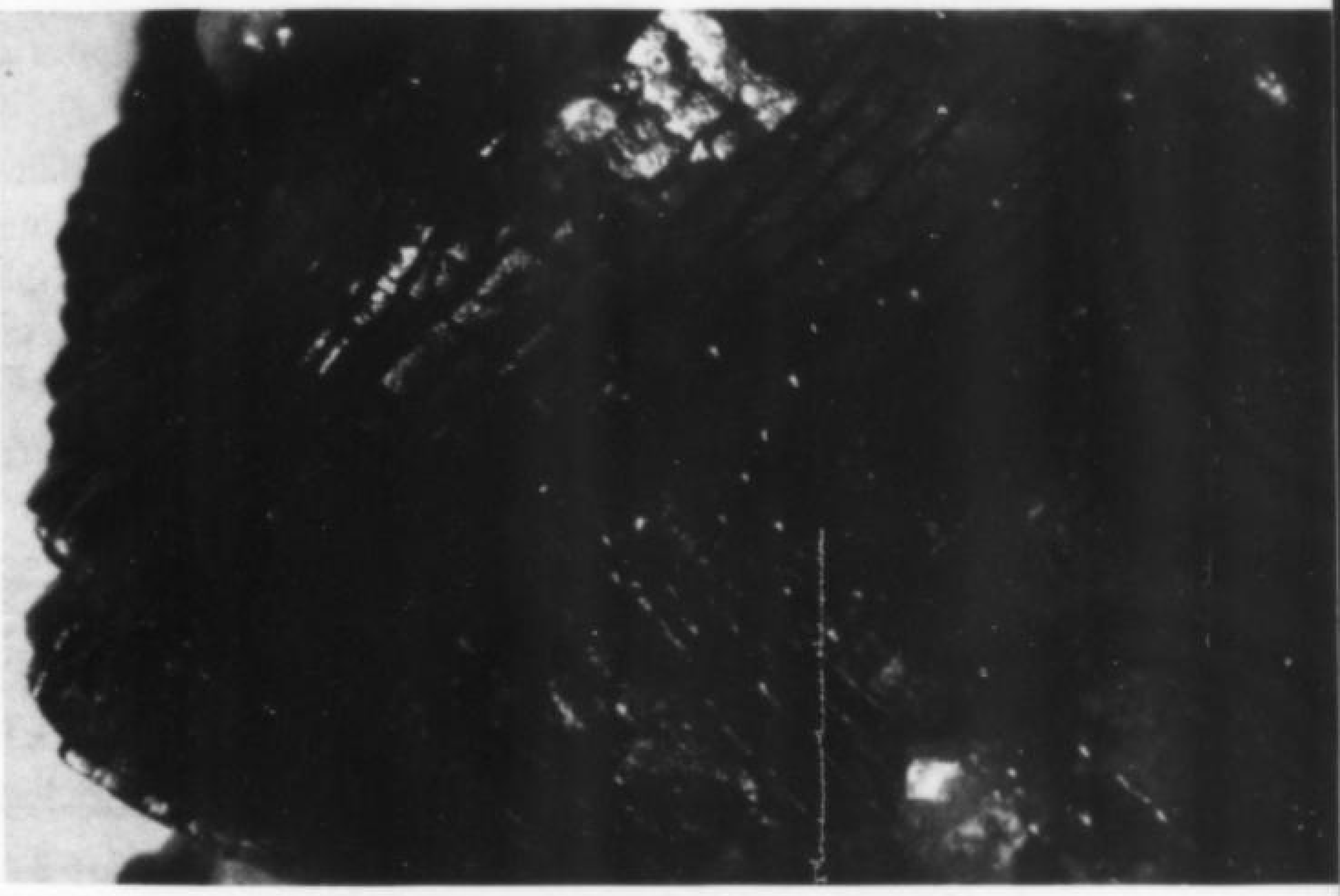


Fig. 3. Fluorite exhibiting the subparallel stacking of cubes. Photo by Ben Kinkead.

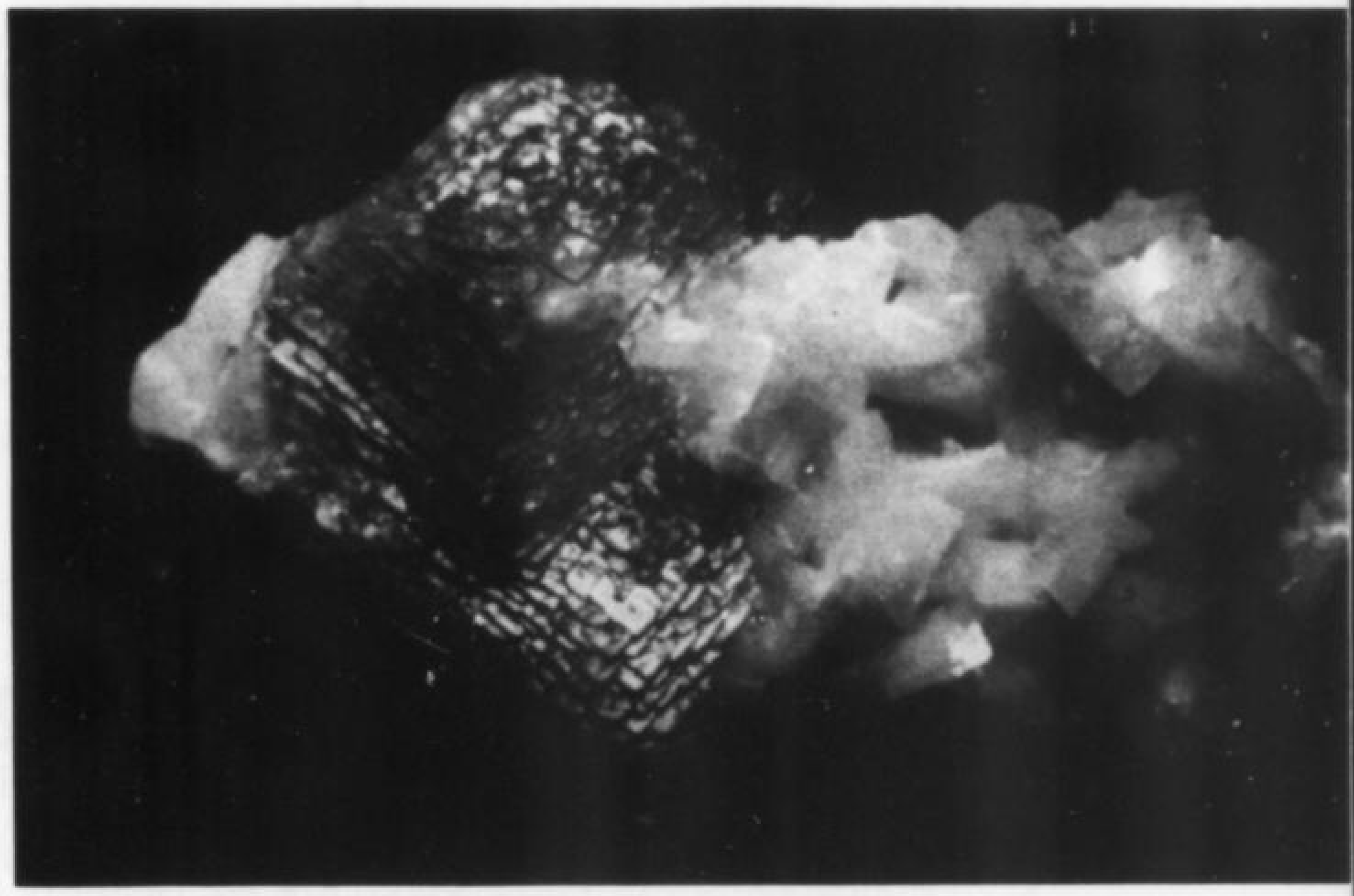
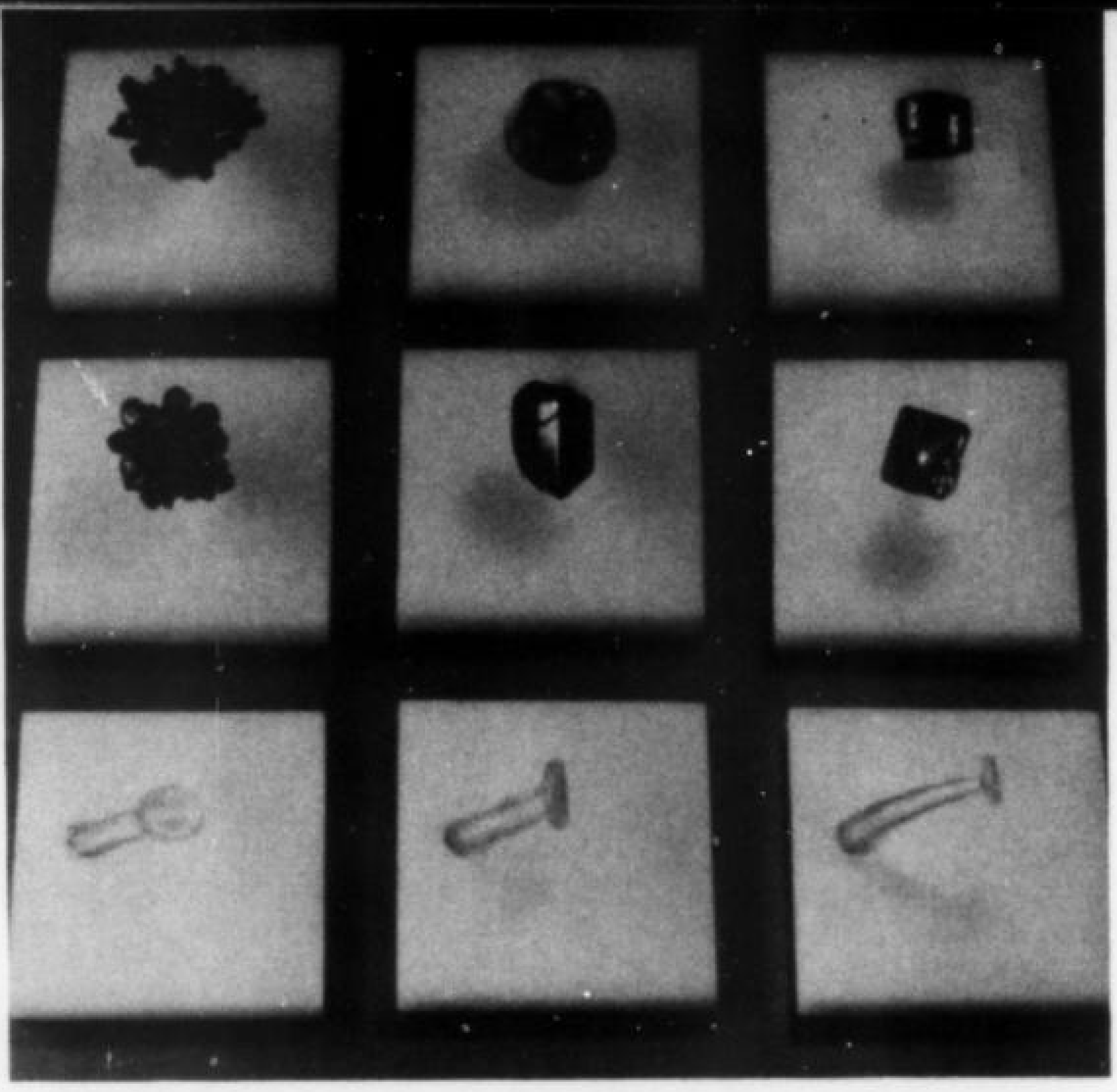


Fig. 4. Fluorite, a different view of the specimen shown in Fig. 3, with dolomite. Photo by Ben Kinkead.



Top Row: Eosphorite (Brazil), Smithsonite (New Mexico), Bixbyite (Utah).
Middle: Gratonite (Peru), Realgar (Washington), Diamond (Africa).
Bottom: Types of mounts used on above specimens.

THE COLLECTOR, continued from page 62

the owner should handle at all, since the exact places to pick them up and the pressure they will bear are apparent only on long familiarity. It can be considered a courtesy to hand them back to their owner for replacement, so that they may be best turned for later display. In the case of a tight fit in a drawer or tray this will be a necessity.

For collections stored in drawers, the drawer immediately under that being viewed should be pulled halfway out to provide support. It is all too easy to overestimate the length or stability of a drawer, even with stops, and have a serious accident.

Comments that a better piece has been seen elsewhere should not be made unless invited. The rule of saying nothing unless it is complimentary should be followed. Corrections of identifications of species or localities should be made as an obligation to the science, but only if you are absolutely certain.

A major violation of hospitality is to make an outright offer to buy a specimen in a collection being viewed. Even a comment such as "If you ever decide to dispose of that piece, I'd be interested" can be borderline, depending on circumstances.

A related very touchy area is when the owner makes an offer of a gift of a specimen in the collection. This is certainly a sign of high regard. However, unless the recipient intends to include the offered specimen in his own collection, the offer should be turned down. This may well be for reasons of duplication or space, rather than not wanting to incur an obligation or outright rejection, so the offerer should not become offended.

These rules apply primarily among private collectors. We lately heard a quote of the late Sam Gordon, curator of the Philadelphia Academy of Natural Sciences, to the effect of "take everything that is offered, and ask for more"-but that is one of the things that a curator is paid to do.

VARIATIONS ON SMALL MINERAL MOUNTS —

G. Wesley Pedlow, Jr., Ph.D.

Some years ago I was impressed by the display of a large octahedral diamond at the Smithsonian Institution. It was placed at the end of a gracefully curved glass or plastic rod so that it seemed to float in space. More recently, at a mineral show in Pennsylvania, Mrs. Paul Seel displayed a fine collection of thumbnail specimens mounted on opaque, white, non-reflecting plastic bases. Mrs. Seel very kindly explained to me that they were white Plexiglas and were sanded on fine sandpaper to remove the gloss. At the 1972 Tucson Show, Mrs. Mildred Schupp also had an excellent thumbnail exhibit mounted on similar bases. These were translucent giving the effect of ground glass.

Using a combination of the above ideas I have mounted many thumbnail specimens and I am very pleased with the results, particularly with doubly terminated and other single crystals. I have always felt that commonly used Styrofoam, because of its coarseness and many reflections, detracts from small specimens.

My only contribution to the art may be seen in the foreground of the accompanying photograph. The plastic rods used are 1/8 inch in diameter and the ends were flattened by pressing them against the heating unit of an electric range set at low heat. They can be flattened at any angle desired to match the specimen. The rod at the lower right was held close to a very hot unit and spun in the fingers until soft and then drawn out like taffy to taper the rod. While pulling the soft rod it can be simultaneously bent to obtain the curved effect.

The bases are drilled with a 9/64 inch drill at the proper angle and the rods cemented in place with household cement. I use clear General Electric or Dow-Corning silicone sealant for gluing the specimens to the flattened end of the rod. This rubber-like material has the difficulty of being hard to remove from porous or rough specimens if the mounting is later changed.

To keep the mounts from rattling in the thumbnail box I glued a 1/2 inch square of the hook portion of Velcro to the bottom of the mount and a matching piece of looped Velcro inside the bottom of the box. Velcro is a fabric type of zipper obtainable at sewing centers. It is easy to remove the mount from the box for display. If an additional piece of the looped Velcro is glued to the showcase it will keep the specimens in place in spite of considerable vibration.

It all sounds tedious, but I think that my average time per specimen was not more than five minutes when a number of mounts were made at one sitting. I believe it is worth the effort.

Three-sixteenth inch plastic sheet was sawed to the proper size with a fine toothed circular saw designed for plastic use. The individual squares were quickly sanded on 3M Wet-or-Dri sandpaper laid flat on a table and wet with plenty of water. The edges were also sanded to remove saw marks. Acrylite and Plexiglas are trade names for cast acrylic sheet plastic of the type used.

To the Editor

Rock Shops

Dear Sir:

The undersigned did not appreciate your gratuitous slap at "Rock Shops" in your editorial of the November-December issue of your magazine. In speaking of dealers and especially new dealers in the mineral hobby you say "new dealers of this type pop up like weeds in a garden, especially around western tourist traps situated near mining areas. *Most give fair warning to the wary by putting up signs which read 'Rock Shop', a term nearly synonymous with rock junk."*

Granted what you say may be true of some rock shops but it is unfair and I believe more often untrue to say "Rock Shop" is synonymous with "rock junk", or nearly so. Many rock shops don't even claim to stock mineral specimens—they do have cutting materials and specimen material - still rocks. Others have, besides such rocks, gem materials, both cabochon and faceting, carving material, gemstone and rock jewelry with gemstone and rock oddities — all of which are of interest to rockhounds and many of the tourist public, if not mineral collectors.

Mineral collecting to me is only one facet of the Rock and Mineral hobby, in which some dealers specialize. Other dealers try and stock something to interest all Rock and Minerals hobbyists including mineral specimens and thereby attract a wider clientele.

I have been an active part time Rock Shop proprietor for over 12 years. I really enjoy nice mineral specimens myself and over the years have acquired or purchased numerous desirable specimens — but I can never seem to keep them, some customers always want them and being in business I can hardly refuse to sell them — I still run a Rock Shop. Seldom are my really good specimens labeled — I know where they came from (at least where suppliers said they came from), neither are they priced — the price depends on how badly I want the specimen — if someone else wants it that many dollars worth he can have it. I also stock and sell rocks, cutting materials, gem material equipment, etc. I run a "Rock Shop", and most mineral hobbyists enjoy looking over the stuff I have in my shop, even though I am able to keep only a very few really good mineral specimens in stock.

G. Kent Burson
Tekoa, Washington

P.S. Anyway I renew my subscription herewith.

Dear Sir:

We have enjoyed *The Mineralogical Record* since its inception and have persuaded several other mineral collectors to subscribe...

On the whole your editorial, "Mineral Dealers" (Nov-Dec '71), was a very perceptive discussion of the subject of mineral distribution. However, there was a line of thought in it to which we take strong exception.

We own a general rock shop, off the tourist route, stocking rocks, minerals, made-up jewelry, lapidary supplies and equipment, silverworking supplies, books and mountings. We box nearly all our minerals, labeled with name, chemical formula and origin. They range from educational specimens to unique museum pieces, at least one of which will eventually be donated to the Smithsonian. We donate much time, labor and material to educating and encouraging youth groups in learning the rudiments of geology and mineralogy. We are members of the American Gem and Mineral Suppliers Association and of Registered Lapidary Dealers.

Some shops do carry much junk and have specimens "buried under years of grime." But there are shops which, while carrying tourist souvenirs, also display excellent mineral specimens and beautiful decorator pieces, all fully labeled.

Full-service rock shops meet legitimate needs as well as find it "necessary to stock a wide variety of sizes and quality in each of the minerals. The sale of tumbled jewelry and cabochon-cut and faceted gem material" as well as of other supplies and equipment not only keeps "many dealers in business" but accomodates numerous categories of artists, craftsmen and hobbyists other than mineral collectors.

Your blanket categorizing of rock shops as being synonymous with *"rock junk"* and to be avoided reflects a narrow viewpoint. You are performing a grave disservice to many mineral dealers who are of the type you supported in your editorial and who are personally serious collectors, but who also have other interests and operate broader-scope businesses, hoping to "make a living at it." Many of us are helping promote and develop the field of mineral collecting through deliberate personal programs.

Stanley C. Dalbec
Ridgecrest, California

Dear Sir:

There is one criticism that I would like to make conserning your Editorial in the November/December 1971 issue. Taken as a whole, the article is very well stated and will help collectors understand better the position of the mineral dealer. However, I belive you have done many reputable and knowledgeable mineral dealers a disservice by equating the words "rock shop" with "rock junk". No doubt there are many cases where this is true, but did you mean to imply that this is true of nearly all establishments which have the words "rock shop" in their business name? If so, I am sure you have alienated a very large number of dealers who do have neatly displayed, properly labeled and priced specimens, but who also happen to have the words "rock shop" as a part of their business title.

I would appreciate it if you would clarify your position on this in a future issue. Thank you, and my good wishes for a successful continuation of your publication.

Thomas H. Webb
Linville, Norht Carolina

Dear Sir:

Your editorial "Mineral Dealers" appearing in the final 1971 issue of *Mineralogical Record* is a classic. It is accurate, comprehensive and perceptive to an unusual degree. So well-defined is the current state and structure of U.S. mineral specimen selling that a reader in 2071 perusing the editorial pages of the *Record*, Volume 2, Number 6 could garner a keen historical slant on the economics of specimen sales as it exists in our time.

Through your exposition, I have gained a sharper insight into the interrelation of miners, mineral wholesalers and dealers.

Thank you for the unexpected values you place within the pages of your publication.

Jack Halpern
San Francisco, California

Labels on specimens

Dear Sir:

I'd like to be one of the first to join Yedlin's latest crusade: PASTE A

LABEL ON THE SPECIMEN (Vol. 2, #6). My work with the mineral collections in Pratt Museum has convinced me of the wisdon of affixing labels directly to specimens.

The locality is the most vital piece of information accompanying any specimen. It allows the geologist to place his observations, made on a particular specimen, in the context of a specific geological environment which may, in turn, lead to a further understanding of earth processes. also, knowing the locality, anyone, the geologist or the collector, can return to the original site in search of more specimens.

Specimens have a tendency to stray from their labels and catalogues can be lost. There are many good, numbered specimens with indeterminable localities at Amherst because a catalogue (the Hitchcock collection) was lost before 1871. Labels pasted directly onto the specimens would have insured to this day their maximum usefulness.

Dr. A. E. Foote of Philadelphia, the famous mineral dealer, was particularly faithful in affixing a small printed label to his specimens. Pratt Museum's finest specimen, a five inch matrix group of wulfenite crystals, from the Red Cloud mine, still bears such a label after fifty-six years. It is inconspicuous and, I believe, adds historical interest to the specimen.

It would be interesting to read the opinions of other readers: collectors, curators, and dealers.

Carl A. Francis
Pratt Museum
Amherst College
Amherst, Massachusetts

My opinion is that microfilming makes the fear of catalog loss unnecessary. Pasted-on labels make washing a specimen, especially in an ultrasonic cleaner, very difficult. I've washed off more than one A. E. Foote label. Ed.

So there, Mr. Marcus!

Dear Sir:

When I recived my *Mineralogical Record,* Vol. 2, No. 6 (have them all from Vol. 1, No. 1), I did the usual and started by reading the Editorial and on through. Then I came to Letters to the Editor and read the letter from Mr. Philip Marcus, Wheaton, Maryland.

To offset his criticism, let me say the *Mineralogical Record*, as composed, suits me exactly. I wanted a mineral magazine, without lapidary or paleontology. Since I subscribe to *Rocks and Minerals* (would not be without it) and also *Earth Science,* these both cover my wants in those departments. For text books I have *Dana's Textbook of Mineralogy,* Dr. Pough, Dr. Pearl, Mr. Sinkankas and Mr. Desautels' *Mineral Kingdom.* I learn everything I need to know about my minerals, which were acquired about 50% by exchanging all over the country, 25% collected in the field and 25% gifts and purchases. It might sound as though they are mediocre but they are not. In fact, some are rare and superb.

I want you to know one customer is satisfied and maybe Mr. Marcus should broaden his reading.

Naomi McGregor
Oceanport, New Jersey

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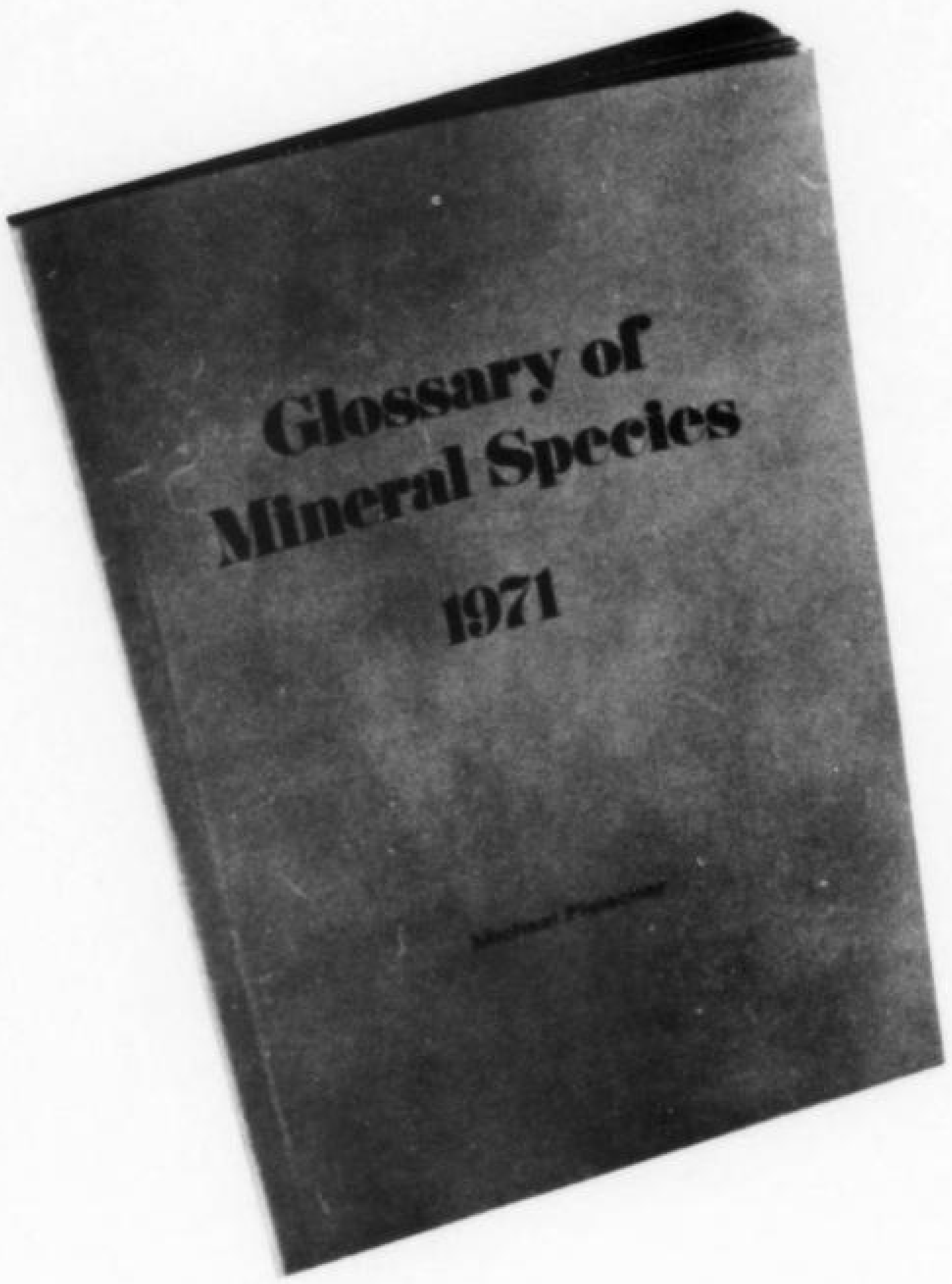

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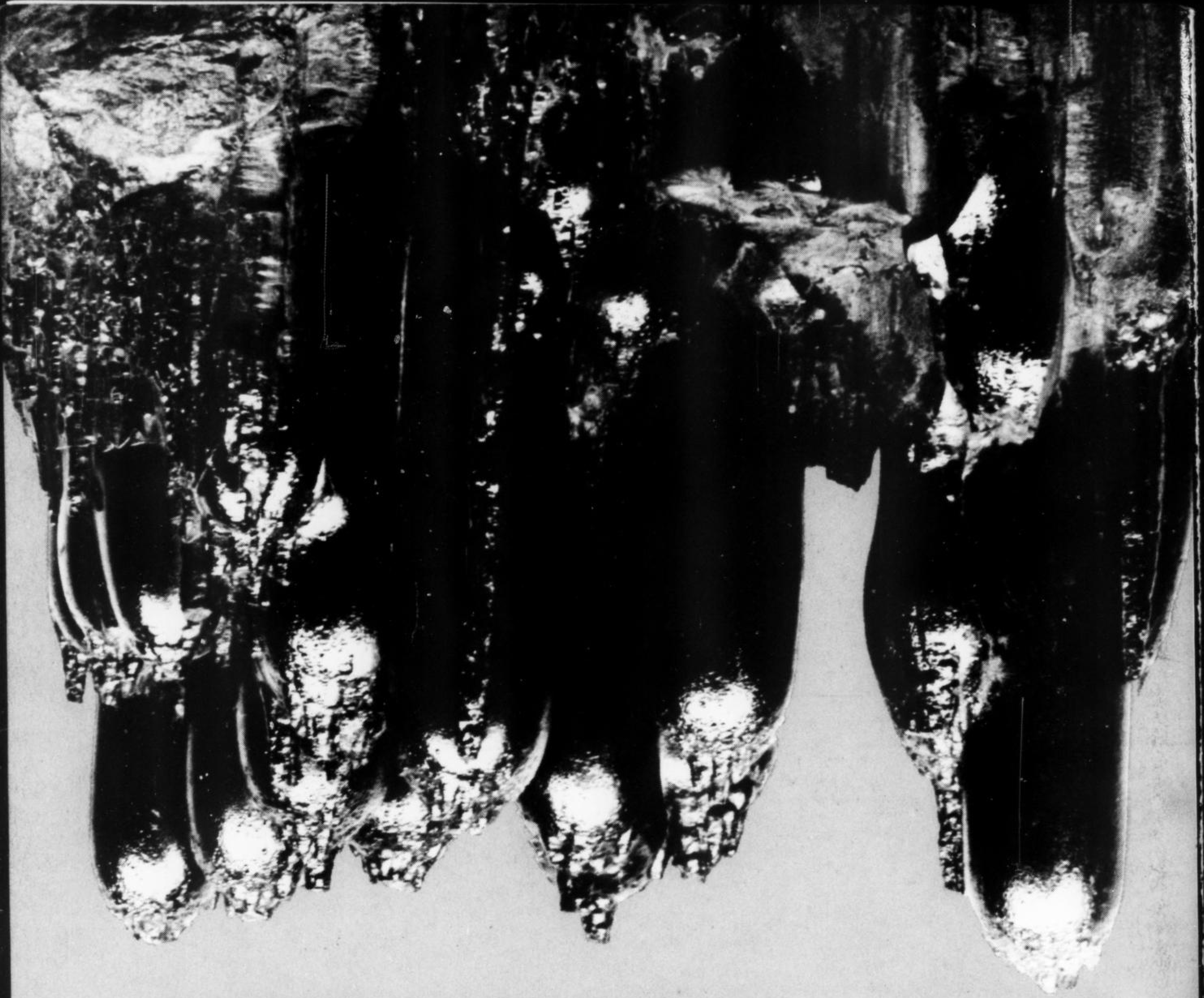

Stalactitic "limonite" from Salisbury, Connecticut, newly acquired by the Pratt Museum, Amherst College, Amherst, Massachusetts. The specimen measures seven inches across the base.

The photograph was supplied by Carl Francis, Assistant Curator, Pratt Museum.