the Mineralogical Record

Volume Four/Number Two

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affiliated with the Friends of Mineralogy

editor & publisher

John S. White, Jr.
Division of Mineralogy
The Smithsonian Institution

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editorial matter

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RHODOCHROSITE on quartz from Trepča, Serbia, Yugoslavia. The upright crystal is about 1 cm long. *Photograph by Werner Lieber.*

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Editorial

Educational Exhibits

Nearly two years ago this editorial page carried a discussion of new attempts at producing educational exhibits for mineral shows. While early efforts left much to be desired, the exercise of patience in waiting for really outstanding exhibits was urged. It was thought that a good set of guidelines would emerge, but very slowly, as the product of the trial and error system.

It is with disappointment that I report that these guidelines do not appear to be emerging at all. It is true that a small number of fine educational displays have appeared, but the quality of most of the entries has not been worthy of the project. I recently participated in the judging of educational displays at a show and I must say the array was disheartening. This has been my reaction at many other shows as well.

The problem of judging is made difficult because sponsors haven't really made up their minds yet as to what category of viewer the exhibits should be aimed. In my mind there are but one or two appropriate targets for mineral shows – the first-time visitor and the novice collector. Most of the so-called "educational" displays I have seen are more likely to kill any budding interest, either because the subject matter is too complex and detailed or just too dull. One of the worst offenders was a tiered case showing about 25 or 30 specimens from a well-known locality. Under each was a label giving the name of a mineral, yet in nearly every case the specimen was massive and unspectacular and contained two or more minerals. Hence the viewer could not even be expected to know which of the phases the label referred to! Further, the main case label did not truly represent the contents of the display. It read something like "Paragenesis of the minerals ..." etc. Of course the specimens did not elucidate the paragenesis and, worse, the term paragenesis was not even defined. There was absolutely nothing educational about that exhibit and even experienced collectors in love with the locality would not have given the case more than a passing glance.

To a lesser degree this criticism applies to the majority of the remaining displays I have seen entered in the educational category.

So perhaps the time has come for the sponsors of this competition to confront this problem and try to do something about it. Let me emphasize here, as I did in my earlier editorial on this subject (Vol. II, p. 99), that I am not urging formulation of "uniform rules" to achieve this end. I think it can be done by taking two important steps. The first is making a clear statement as to what sort of people the displays are to be directed toward. Hopefully these will be the people mentioned above – the non-collectors and novices. The second step is to enumerate the principle factors which make an exhibit educational for the intended audience. Of these factors one is of paramount importance – the subject must be *simple,* so that a viewer can grasp it in just a few minutes. Some labels are essential but the viewer cannot be expected to stand in front of the case and read several pages of text. The specimens must illustrate the subject very well but a small number of them will probably work more effectively than a large number.

This brings to mind an exhibit where the purpose was to illustrate that metals come from ores made up of minerals. At least 30 specimens of ore minerals were shown along with samples of refined metals from such ores. How much more effective it would have been to show a photo of a copper mine (for example), several copper ore specimens from that mine, a model or drawing of a smelter and a sample of refined copper metal with a series of brief labels to lead the viewer from the mine to the metal in a logical progression.

Some may argue that there are only a limited number of such elementary topics and many exhibitors would use the same ones. This is no problem. It would be a fine thing to see the same subject approached in a half dozen different ways. Such competition would really encourage the exhibitor to experiment with novel treatments instead of being satisfied with a token effort. Out of this kind of competition real progress could be made. In fact, I encourage the sponsors to select a specific topic for one show and *require* all entrants to treat that topic. Think how fascinating it would be to see a group of exhibitors take on a subject such as "How varying conditions during crystal growth affect the nature of the crystals" or something completely nontechnical such as "What makes one specimen more esthetic than another."

John S. White Jr.

10TH ANNUAL NEW ENGLAND GEM AND MINERAL SHOW – MORE THAN A LITTLE DIFFERENT!

The 10th Annual New England Gem and Mineral Show will be held Saturday and Sunday, June 16-17. As before, the Show is situated on the Topsfield Fairgrounds which offers excellent facilities. Dealer's booths, competitive and noncompetitive exhibits, movies, lectures, games, and demonstrations are held in the various buildings. This is one of the oldest fairgrounds in the United States, there are acres of *free* parking available just off scenic and historic U. S. Route 1 in Topsfield, Massachusetts.

The mineral show is hosted annually by The Northshore Rock and Mineral Club, and members have been planning two days of continuous entertainment. Lectures by Pete J. Dunn (Smithsonian), crystal growing and lapidary demonstrations, a field trip, and special geological exhibits are just some of the activities planned.

The New England Show encourages educational mineral exhibits in both the competitive and noncompetitive classes. The younger members of the club have a special earth science project each year which attracts a great deal of interest.

A building is set aside for swappers providing free tables and allowing mineral collectors and micromounters to show their trading material in a congenial setting.

A snack bar will serve delicious home-style during the day, and a special supper will be held on Saturday night.

There is no admission charge, no parking fee, and no charge for traders. For two days mineral collectors from all over the Northeast get together to enjoy their hobby, show and compare fine mineral specimens, and talk about their plans for the coming collecting season.

RICHARD M. PEARL ACQUIRES *EARTH SCIENCE DIGEST*

Ownership of *Earth Science* magazine and Earth Science Publishing Company, Inc. has been acquired by Richard M. Pearl, professor of geology at Colorado College, Colorado Springs.

Established in 1946 in Omaha as a monthly with the name *Earth Science Digest*, the magazine is now issued bimonthly in pocket format. Its chief interest is popular geology, emphasizing features and special departments rather than current news. Educational articles will be stressed.

Prof. Pearl is serving as editor-in-chief, Mignon W. Pearl as assistant editor, and Elizabeth Shafer as associate editor. The new address is Earth Science, P.O. Box 1815, Colorado Springs, Colorado 80901.

FRIENDS OF MINERALOGY

by Joel E. Arem

FM MEETING — Tucson, Arizona, 1973

Friends of Mineralogy had its annual meeting in Tucson, Arizona on February 10, 1973. This particular meeting was significant in that it was the first official meeting of a fully incorporated organization.

FM was registered and approved as a Tax-Exempt Corporation in the State of California on January 26, 1973. According to the papers, signed by the Secretary of the State of California, FM is exempt from state taxes. Federal tax-exempt status has been applied for, and is hoped for shortly. These legal steps were carried out largely through the efforts of Earl Pemberton, Wayne Leicht and Mike Kokinos.

The Tucson meeting was attended by more than 150 people, including a number of guests. There was considerable excitement and a feeling of accomplishment and anticipation in the group. FM membership has tripled since the 1972 meeting. Many projects have been launched; several have achieved considerable success. There was little doubt in the meeting room of the Tucson Community Center that those present were witnessing the first steps of what has become a strong and active nationwide organization, working for the advancement of mineralogical education and conservation.

The Constitution and By-Laws of FM (to be published soon in the *Mineralogical Record*) were approved by a pro-tem Executive Committee. The By-Laws provide for the annual election by all FM members of a national Board of Directors with up to 25 members. The Board would elect officers of FM at the annual meeting, from among their own ranks. The current system of regionalization was established a year ago for convenience in operating FM. Regional Directors are not provided for in the Constitution and By-Laws, but those formerly acting as Regional Directors are now Regional Coordinators. They continue to be responsible for guiding the day-to-day activities of FM, on a localized level.

Regional Coordinators in many cases will also be National Directors, but do not have to be. The current Regional Directors (of 1972) were put on a slate to serve on the Board of Directors, in positions with tenure of 1, 2 or 3 years. It was felt that those with the responsibilities for the daily operation of FM should also have the authority befitting the job. Regional Coordinators will, in future years, be elected locally, but for the present the 1972 Directors have agreed to serve as an initial governing body. The members present at the meeting voted unanimously to adopt the proposed slate of Directors for the National Board. These, along with the officers elected by the Board and the Regional Coordinators, are listed below.

FM officers will serve for a 1-year term. In addition, the Constitution and By-Laws provide for liaison positions with the American Federation of Mineralogical Societies (AFMS) and the Mineralogical Society of America (MSA). Those serving in liaison positions will be non-voting members of the National Board of Directors. The 1973 representatives are:
D. Jerome Fisher - MSA   Katherine Steinbrenner - AFMS
The FM liaison with the newly-formed Mineral Museums Advisory Council (MMAC) is D. Vincent Manson.

A letter was received recently from R. J. King of the Geology Dept., the University of Leicester, England. Mr. King and 31 others have formed a society in England to be known as the Russell Society, whose membership desired affiliation with FM. Since there is no provision in the FM Constitution for Corporate membership, Mr. King was invited to form and head Region 16 (England) and accept individual memberships. This region has now been formed and is growing. It will serve as a model for future non-USA chapters of FM.

A membership list has been prepared, largely through the efforts of Wayne and Dona Leicht. Copies were available for distribution at the meeting, with the remainder to be mailed to all members. Discussion concerning publication of the membership list in the *Record* resulted in a negative vote of those present. The membership list will therefore not be published, but instead will be distributed solely by FM.

The Treasurer's report was submitted by Arthur Montgomery (who could not be present at the meeting). Dues will be used for operating expenses and for special projects that require national coordination. Funds for Regional expenses will be available on request of the national treasury of FM, dispensed according to the value of the project to FM and the availability of funds. Donations to FM, however, in order to qualify as tax-exempt, must be given to the National organization.

Several FM committees have been active and productive in the past year.

Educational Exhibits: Bob Jones, the national Chairman of this committee, has all but worked himself out of a job.

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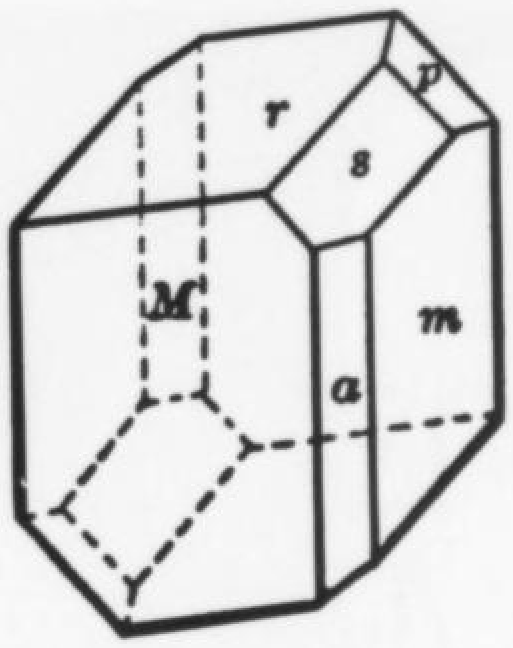
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What's New in Minerals?

by John S. White Jr.

MAINE TOURMALINE

This story I have been reluctant to write because I have been promised an article about the discovery and I don't want to steal any thunder. However, most other hobby journals have carried stories about it, and many of these are so loaded with *mis*information that I feel compelled to at least comment briefly on what has to be one of the most exciting mineral discoveries in the northeastern U. S. in a long, long time.

The varied reports such as "the greatest gem discovery ever made in the United States", "value ... estimated at one million dollars", "90% of the stones are gem quality", "uncut values are from $6.00 - $8.00 per carat", and "the treasure trove contains several large chunks of pure flawless tourmaline worth fifty to one hundred thousand dollars", are based upon very sketchy examination of the materials taken out of the pockets. At the time these were mined it was necessary to remove all of the contents of the pockets as quickly as possible, so everything was placed in boxes and sacks, uncleaned, and immediately put in secure storage.

This writer examined a small sampling, at random, of the findings which consisted mostly of elbaite. The great preponderance of material appeared to be "logs" of watermelon crystals in broken sections. The cores were a deep raspberry red with a bright green rind. There were a great number of pieces approximately two inches in diameter and from two to six inches in length. There were also a great number of "pencils" and broken pieces of smaller crystals. A major part of the smaller crystals were rather transparent bright-green in color. I was shown a large terminated (on one end only) green crystals that measured 13 1/2 inches in length and about 4 1/2 inches in diameter. It was translucent, not gemmy.

The prospects of fitting many of the broken sections together seem rather dim but at least one series was found to fit and the length of the reconstructed crystal was 21 inches! It must be pointed out that the breaking of the crystals occurred prior to the discovery, it was not the result of careless mining. Many of the broken sections show some rehealing on the break surface. In some cases rehealing makes it impossible to put the crystals back together. Growth over the fracture surface means that formerly adjacent pieces no longer fit together.

The first pocket was encountered in August, 1972, but it was not too spectacular. However, it led to a series of larger ones containing better crystals. Some seven pockets in all were mined prior to sealing the mine for the winter. The owners report that in one day they removed a half ton of tourmaline crystals. This was not, of course, a typical day's haul. Fred Hartman is credited with making the find. As of the Fall of 1972 he was in partnership with Dale Swett and Dean McCrillis.

Very little of the newly discovered elbaite has found its way to the market yet as the owners are still cleaning and sorting. A small amount has been released through a dealer in Winthrop, Maine. The gem potential is still unknown but lovely rubellites and light emerald-green gems have been faceted. At the time when all of the extravagant claims were being made (not by the owners) not one piece had been faceted. There will be a significant number of cabinet specimens of terminated, mostly green, crystals. Matrix specimens are very few but I have seen a few plates of brilliant grey-white, tabular albite (cleavelandite) crystals with bicolored elbaites lying flat across the crystals. Most of these are thin small pencils. There will, no doubt, be an abundance of thin slabs cut across the

The succession of pockets that produced the large quantity of tourmaline at Plumbago Mountain, Maine in 1972. The contents of the pockets were placed in the toy wagon which was then pulled up the ramp to a dump where it was rough-sorted and sacked or boxed.

The sacks and boxes of uncleaned material were placed in the shovel of this bulldozer which carried them up a steep incline where they were transferred to a truck.

watermelon types. A few rare phosphates have also been found.

The locality is the old Nevel gem pit on Plumbago Mountain, not far from the town of Newry, a name long associated with tourmaline and other pegmatite minerals. The mine is posted against trespassing and various security measures are in force.

We are looking forward to a detailed article by Mr. McCrillis in the near future to be published in the *Record*.

NATROLITE – NEW JERSEY

A recent find of natrolite in New Jersey has created quite a stir, and justifiably so. Large sharp terminated crystals, many of them transparent and some doubly terminated, were collected in large numbers. Some single crystals exceeded seven inches in length but most averaged from one to three inches, with the average thickness being about 5/8 inch, but the largest of the crystals reach one inch on an edge in cross section.

The New Jersey trap quarries are famous for radial sprays of delicate crystals of natrolite so this new discovery is a significant departure from form. The following letter is from Roger Sassen, a graduate student in the Department of Geological Sciences, Lehigh University, Bethlehem, Pennsylvania 18015 ...

"I was the first to find the natrolite. Its presence was indicated by a few scattered crystals among bulldozed rubble at the Bound Brook basalt quarry of the Houdaille Company, at Bound Brook, New Jersey. Initial exploration showed the natrolite to be coming from a breccia zone whose contact with the quarry floor was in the form of an ellipsoid approximately four to five feet wide and which was approximately twelve feet long. The find represents what I believe is a steam explosion breccia pipe. I observed successive vertical sections of a similar breccia pipe that occurred several hundred yards from the one described below. This other pipe was in the shape of an inverted, rounded cone and was perhaps twenty-five feet high. Fractures around the pipe suggested a violent origin for the

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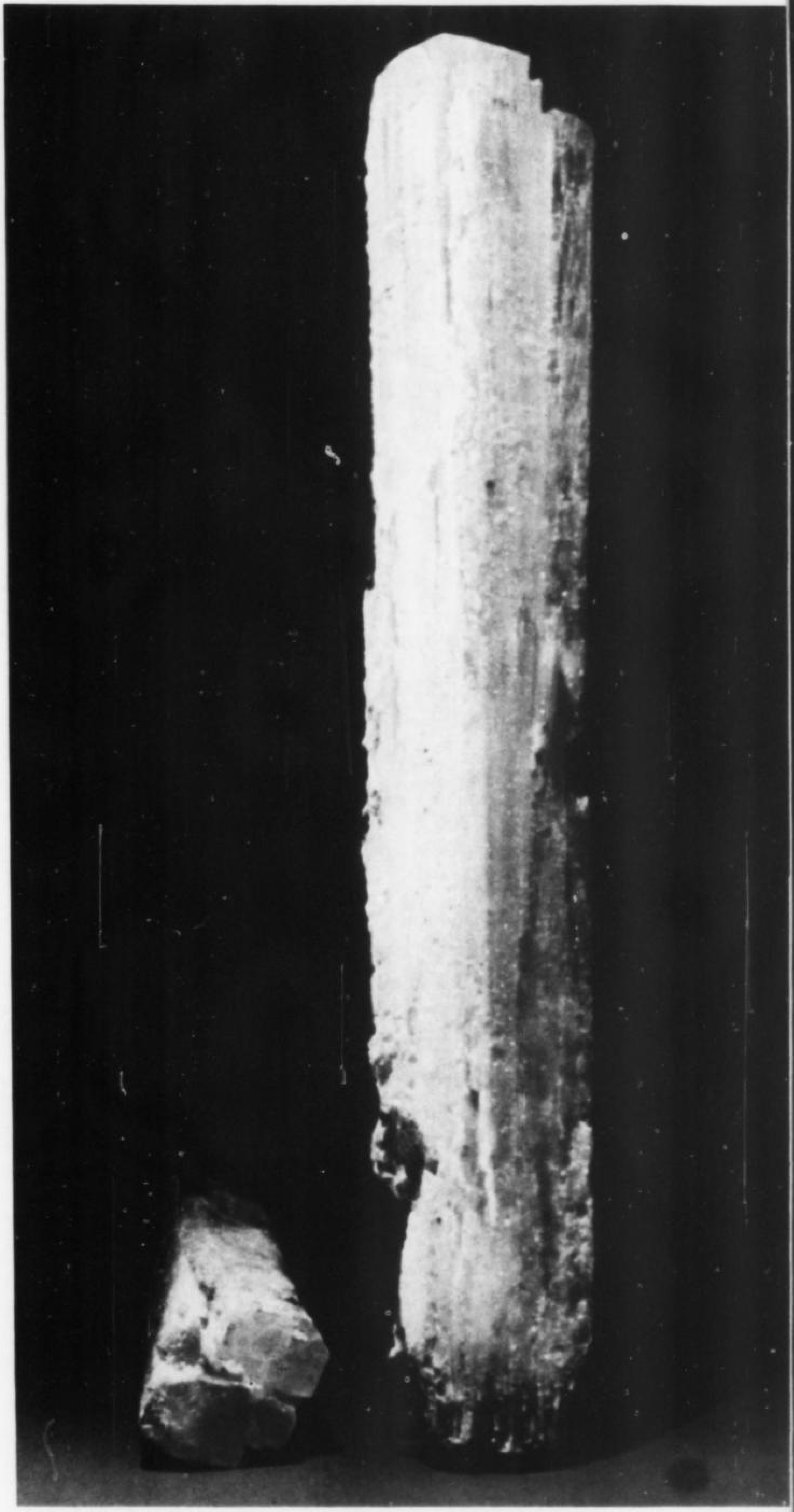

Two very large natrolite crystals from the Bound Brook quarry, here reproduced natural size. Smithsonian Institution specimens. ***Photo by Joel E. Arem.***

TREPČA AND ITS MINERALS

by Werner Lieber
**Baden-Badener-Str. 3,
D-6900 Heidelberg 1, West Germany**

Fig. 1. **Portion of southeast Europe showing the location of Trepča in Serbia, Yugoslavia.**

The locality name *Trepča*,* in Yugoslavia, is very well known to most mineral collectors for its many beautiful mineral specimens and excellent crystal groups of a number of ore minerals and carbonates. The author has seen many thousands of specimens from this exceptional locality and will describe some of the most important species in this paper.

Many collectors believe the name Trepča to be the name of the mine. It is, however, the name of a small river and the narrow valley through which it flows from a nearby mountain (1360 m high) to the Ibar Valley. The correct name of the mine is *Stari Trg*, which means "Old Market Place" and which is also the name of a very small village half a mile from the mine. It is situated about 350 km southeast of Belgrade and 8 km east of the town of Kosovska Mitrovica, in southern Serbia.

Ore was mined from the Fourteenth to the Sixteenth Century, as a very small open pit and old dumps show. However, modern development started in 1925 when Selection Trust London began prospecting in the area. Soon Trepča Mines Ltd. was founded and mining began in 1930 under British direction. Since then, Trepča developed into one of the largest lead-zinc producers in the world.

THE DEPOSIT

The Trepča locality is a good example of a hydro-metasomatic ore deposit which has been implaced at high temperature. A section through the Trepca area shows a recrystallized limestone which is embedded in phyllite schist. During the Tertiary, part Miocene, a dacite pipe was intruded between the schist and limestone. The oval pipe, with dimensions of about 200 by 100 m, is filled with a breccia made up of fragments of all the rocks which were penetrated during the explosive intrusion, and also of trachite, the eruptive equivalent. Later, ore solutions came up and replaced the limestone around the breccia pipe and along the limestone-schist contact. A horizontal section of the 610 m level (Fig. 2) shows that ore was deposited "horseshoe"-like around the pipe.

The deposit is large. The horizontal area of ore measures between 8,000 and 10,000 square meters and appears to become even larger at depth. From core drillings it is known that the body extends down to the 140 m level and is supposed to be as deep as sea level (Fig. 3).

The raw ore, according to an analysis made in 1948 by the laboratories of the nearby refinery, has the following composition:

iron	31.5 %	∽ 75%
lead	7.1	
zinc	5.5	
copper	0.1	
bismuth	0.009	
silver	0.009	
antimony	trace	
sulfur	28.9	
arsenic	0.5	
silica	12.1	∽ 25%
alumina	2.5	
lime	3.4	
manganese oxide	2.3	
magnesia	0.5	
carbon dioxide	4.6	
	99.0	

This is the composition of the ore only. The amount of carbonates in the ore body is much higher but these are

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* pronounced *trep-tscha*

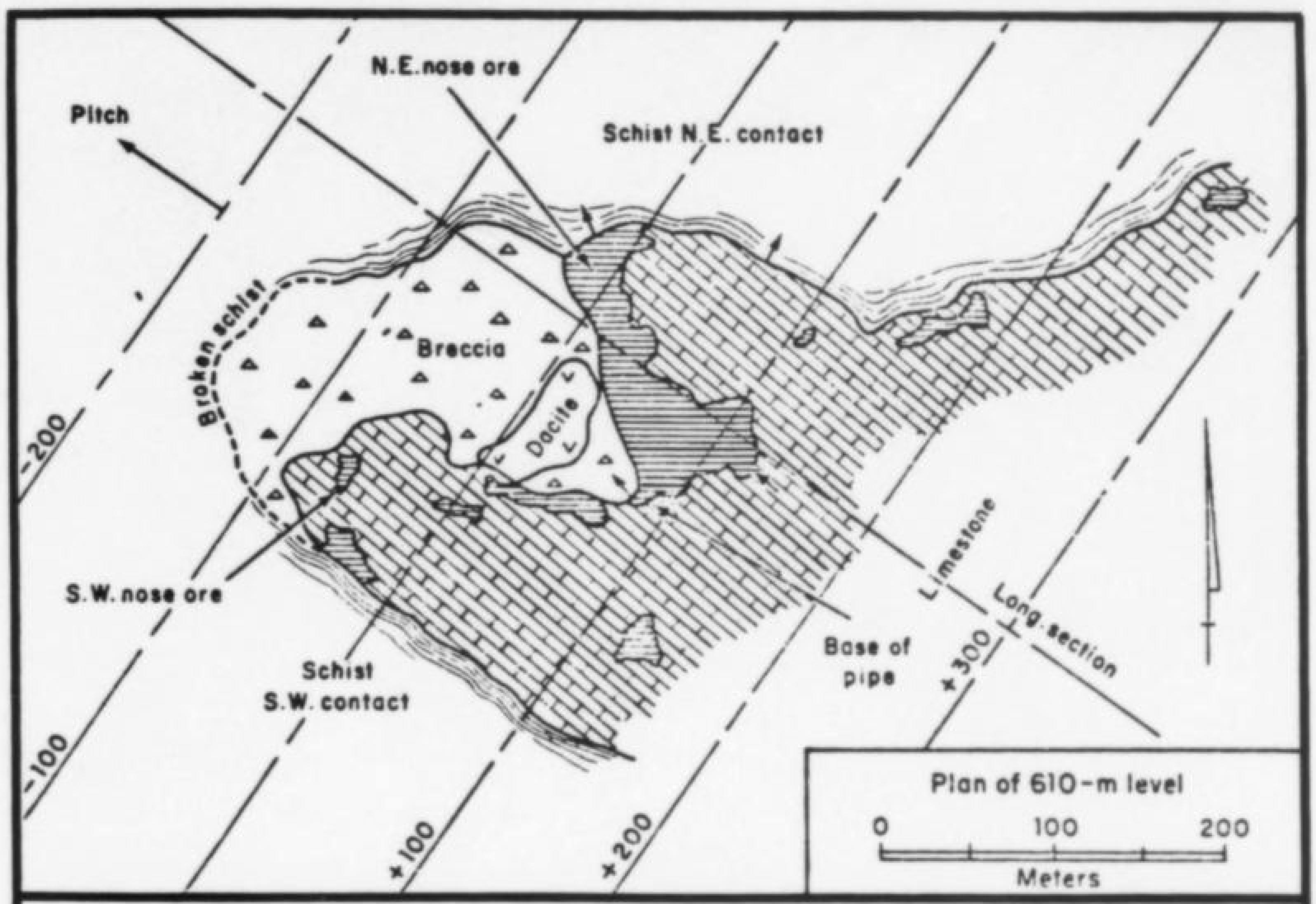

Fig. 2. **Trepča, or Stari Tag, mine, Yugoslavia. Plan of 610 meter level. (After Forgan, 1948).**

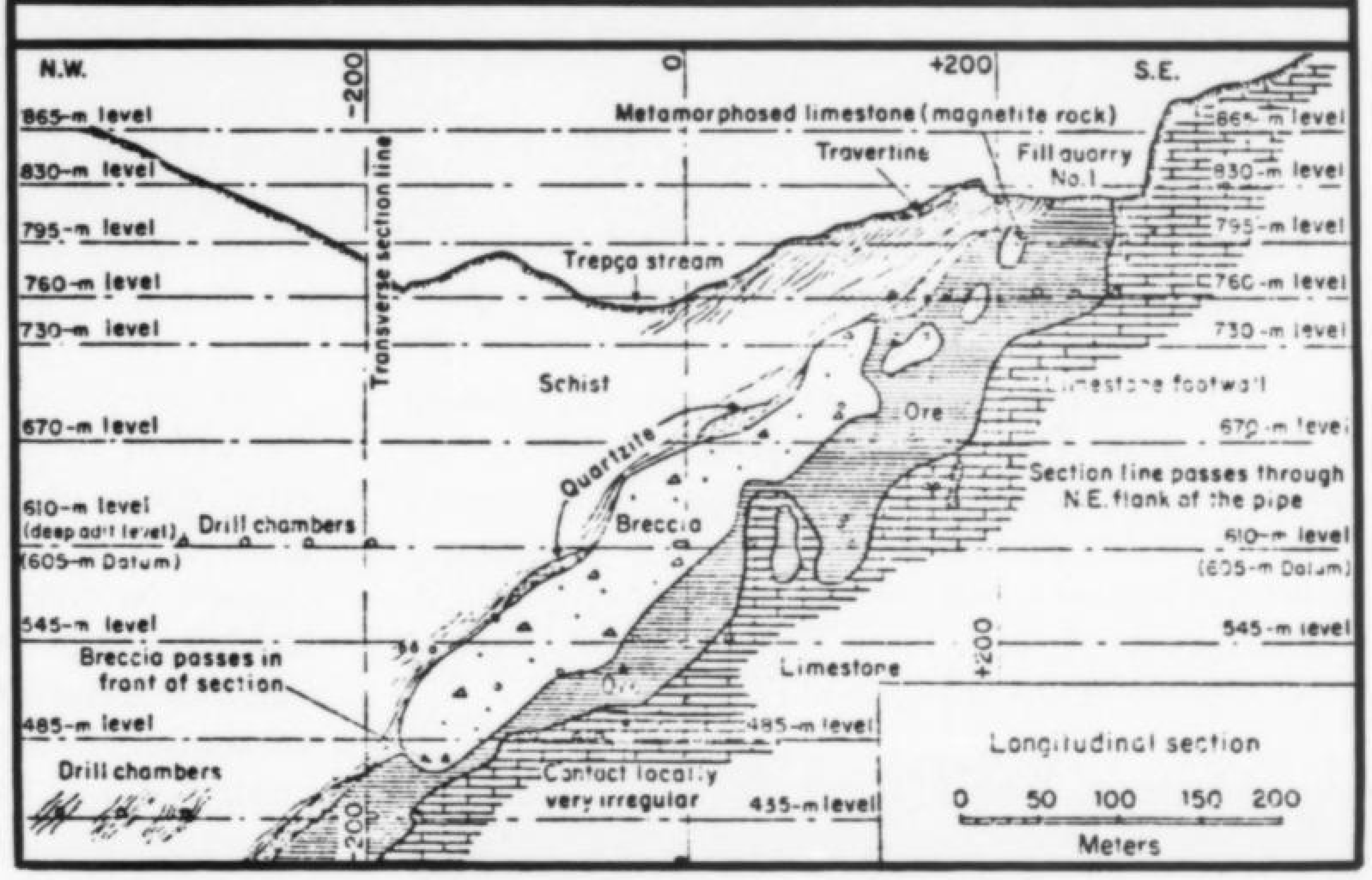

Fig. 3. **Longitudinal section of Trepča mine, Yugoslavia. (After Forgan, 1948).**

not mined. The high amount of silica is not only due to quartz but also to silicate rocks of the contact.

The four principal ore minerals are galena, iron-rich sphalerite, pyrrhotite, and pyrite. All the others, including arsenopyrite, chalcopyrite, bournonite, and boulangerite as well as the accessory minerals quartz, calcite, dolomite, siderite, and rhodochrosite, are subordinate. Actinolite, hedenbergite, ilvaite, andradite, and magnetite are in the skarn which is found in parts of the mine.

THE MINERALS

Although having examined thousands of specimens, the author has never seen any secondary oxidation minerals, such as cerussite, anglesite, smithsonite, hemimorphite, malachite or azurite. Indeed, the oxidation zone of the deposit is very weakly developed because it was covered and protected for a long time by a thick tuff layer. A few oxidized minerals such as limonite, crusts of smithsonite, and small amounts of gypsum can be seen in the old dumps of former mining areas. Vivianite is a rare and interesting mineral which occurred in the upper levels of the ore body.

The minerals mentioned above are usually coarse-grained and intergrown to form a massive mixture. In vugs they occur in euhedral crystals. It is typical that the specimens from Trepča show more than one species on a specimen, mostly three, four or five different minerals, which makes the specimen interesting, colorful and attractive.

Pyrrhotite is one of the most desired minerals of collectors. The amount of this mineral increases with depth, but good crystals are becoming rare. The miners found more fine crystals in the upper levels of the mine, where the vugs were plentiful. The mineral occurs as large hexagonal tabular crystals, sometimes in rosettes. Their size reaches 10 cm across. It is a pity that most of the fresh pyrrhotite crystals are covered with a thin layer of dolomite or other carbonates. Sometimes quartz crystals appear on the hexagonal plates.

Pseudomorphs of pyrite after pyrrhotite are very common. Less common are pseudomorphs of galena after pyrrhotite. Such pseudomorphs are beautiful and character-

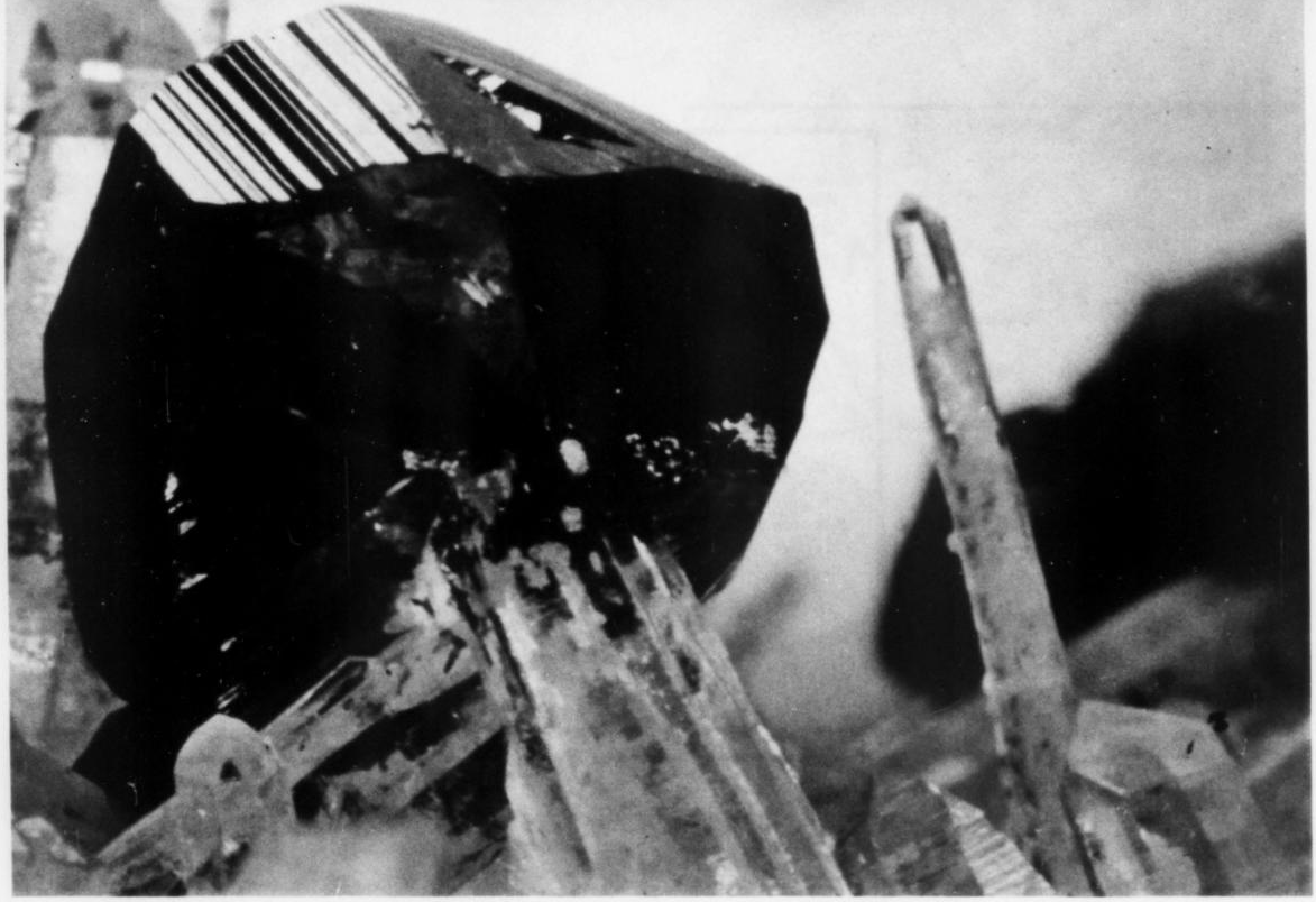

Fig. 4. **Sphalerite, striations visible, with needle-like quartz crystals. Size of the sphalerite crystals is about 5 mm.**

istic for the deposit. The platy crystals are paper thin up to 1.5 cm thick. They also form aggregates which sometimes look like large roses. The pyrite which replaced pyrrhotite is fine-grained, more rarely coarse-grained and sometimes in small crystals which are not perfectly formed. The larger crystals, up to 5 mm, represent a second generation of pyrite on the fine-grained pseudomorph.

Fig. 5. **Hillocks on cube face of galena crystal with quartz and ankerite. The galena cube is about 12 mm.**

The paragenesis of three typical specimens: (1) large plates of 10 cm diameter and 3 mm thick with some sphalerite crystals on them all covered with calcite, (2) thin plates of 5 cm diameter, thickly overgrown with rhodochrosite, on which some arsenopyrite and calcite crystals have deposited, (3) very large arsenopyrite crystals on which are a few plates of the pseudomorphs and on these a few sphalerite crystals are partially covered with calcite.

It should be mentioned that many pseudomorphs and other specimens which formerly contained pyrrhotite (and which later changed to pyrite) show cracks due to the volume increase during the change of pyrrhotite to pyrite. These cracks, however, do not weaken the specimens as many of them are filled or covered with a later generation

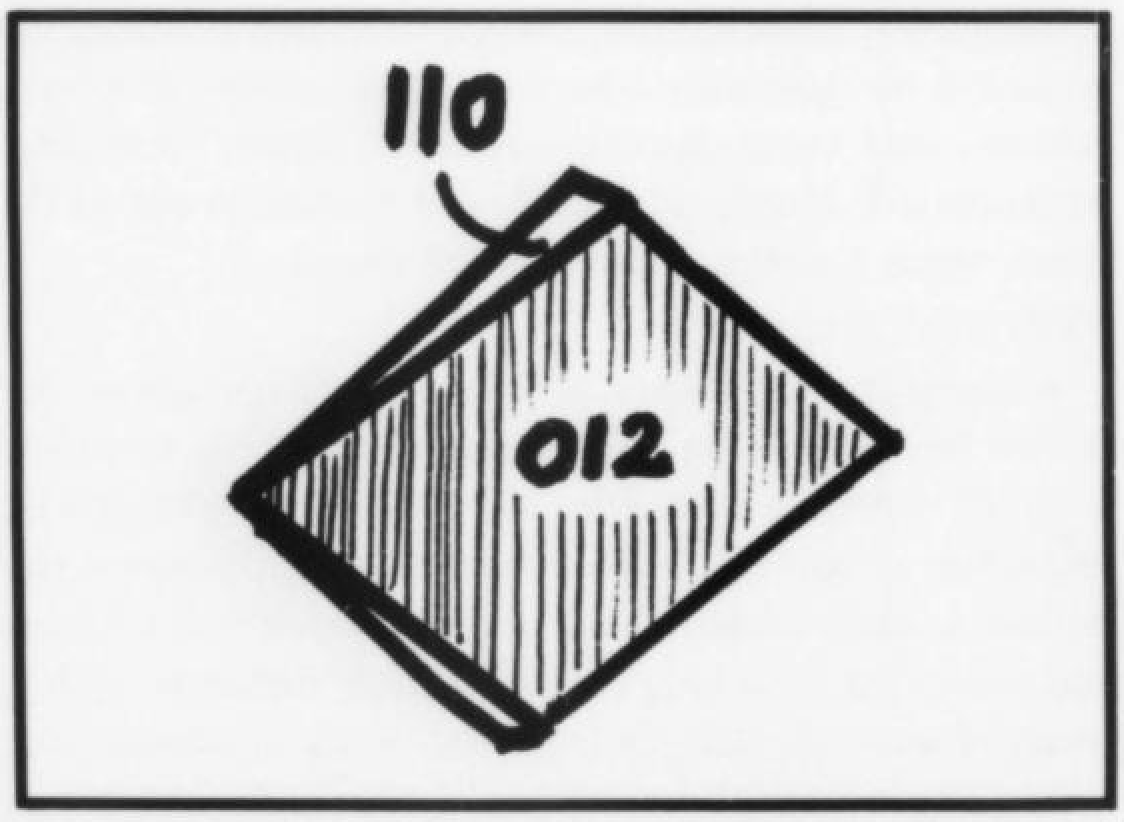

Fig. 6. **Arsenopyrite crystal, flat type with very small and short {110} face.**

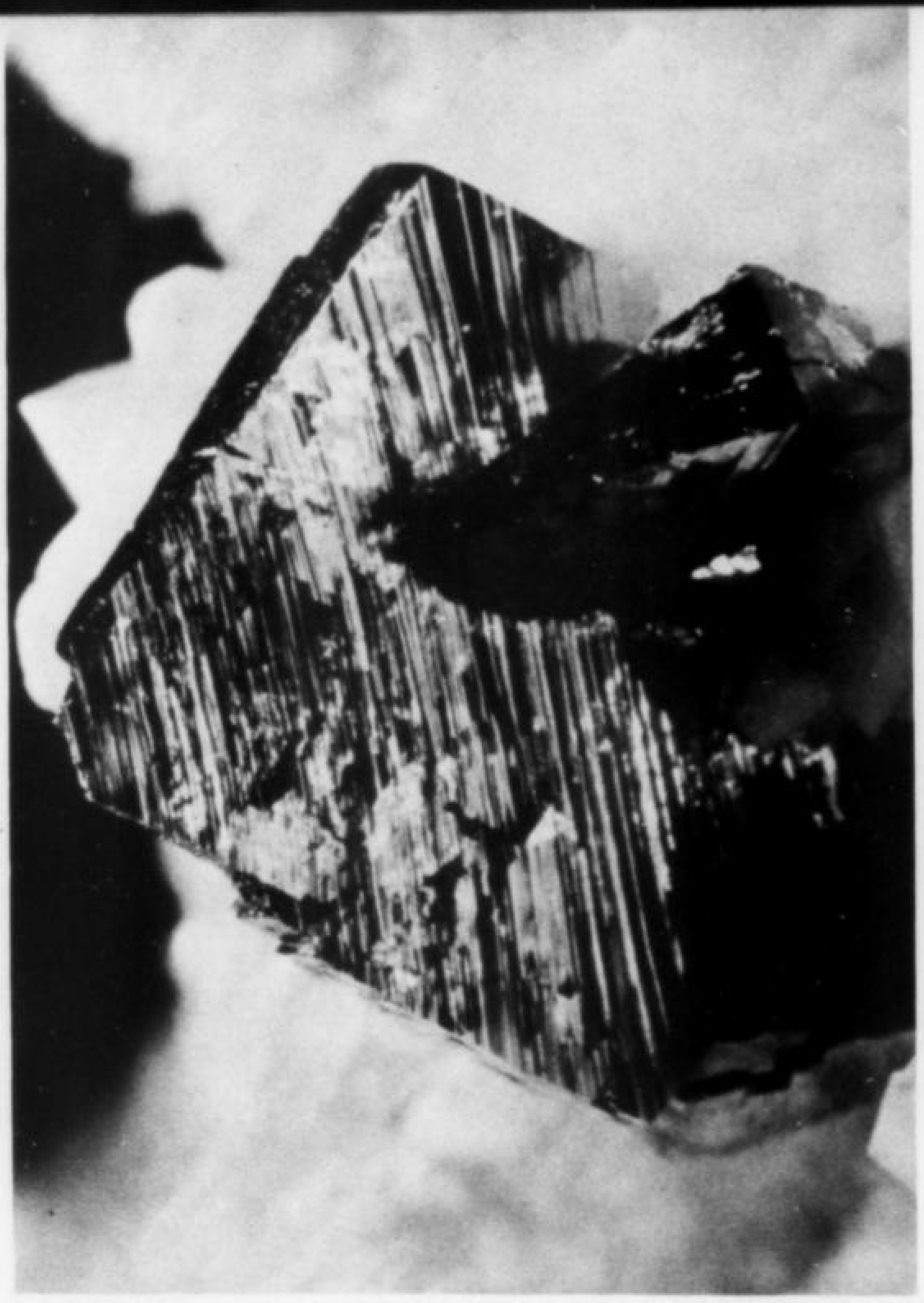

Fig. 7. **Flat type of arsenopyrite crystals on dolomite. The large crystal is about 5 mm.**

of calcite or other carbonates. There is no reason to believe that specimens with cracks will fall apart some time later while in collections. The author has had specimens for 20 years in his collection and never had any problems with them.

Sphalerite is exceptionally beautiful because of the fine crystal forms and high luster. The crystals are extremely large, reaching 10 cm across. The predominant habit is the octahedron, but there are also other forms and frequent twins. The sphalerites are all black and contain up to 18% iron. They occur with quartz, calcite and arsenopyrite crystals. A typical paragenesis is sphalerite on which arsenopyrite has grown, covered with quartz and calcite.

Galena occurs as a combination of cubes and octahedrons. Small crystals show only the octahedron and have a silvery luster. They sit on carbonates and mostly under boulangerite. Larger crystals up to 5 cm across are usually grey. Hillocks can be seen on cube faces (Fig. 5). The edges are never sharp but usually rounded as though melted. Galena occurs with sphalerite, chalcopyrite, carbonates and quartz.

Pyrite is very common but usually in small crystals with imperfect development. Cubes of 5 cm are rare. Small crystals show combinations of cubes with pyritohedrons. Pyrite as pseudomorphs has been mentioned.

Arsenopyrite is a late mineral in vugs and shows a variety of habits. Usually the crystals are short prismatic and small (1 cm). They are on pyrite and sphalerite, often covered with calcite. Typical paragenesis is arsenopyrite on sphalerite, covered with rhodochrosite, the latter also covered with calcite. More rare are flat tabular crystals. The author has seen only three specimens with crystals as shown in the drawing (Fig. 6). They usually occur on poorly crystallized carbonates, and sometimes on small dolomite crystals.

Fig. 8. **Small elongated arsenopyrite crystal sitting on a small galena octahedron which is on quartz. The galena is about 3 mm.**

Long prismatic crystals up to 5 cm in length are rare too, occurring on massive ore with rhodochrosite sometimes covered with boulangerite. Elongated, but very small,

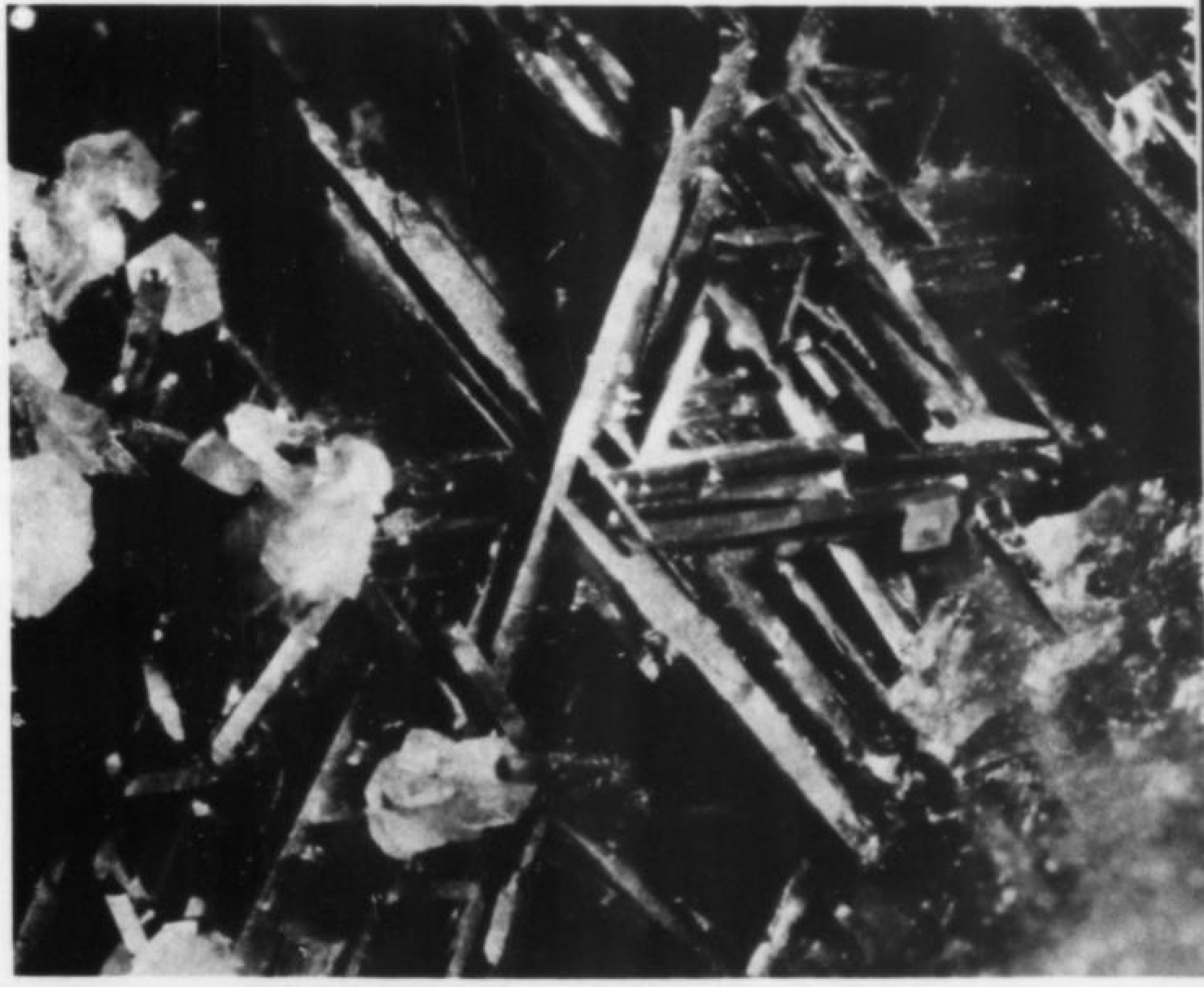

Fig. 9. **Arsenopyrite twin. The "star" is about 5 mm in diameter.**

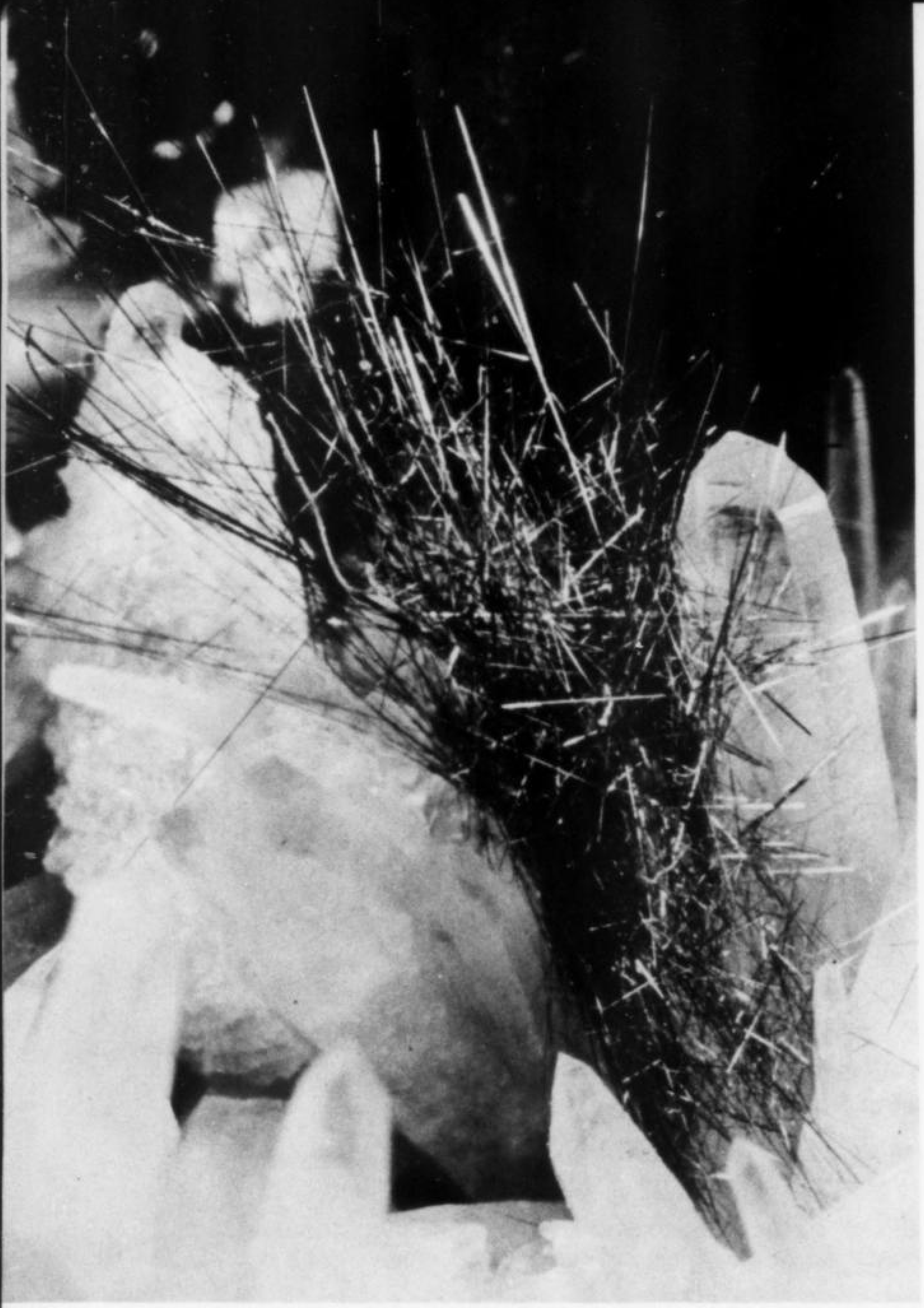

Fig. 10. **Boulangerite needles on rhodochrosite and quartz. The longest needle is about 12 mm.**

crystals as a secondary growth are also found on small dolomite crystals, sometimes with stalactitic rhodochrosite covered with calcite. They may be associated with small quartz crystals.

Of particular interest are the twins. In comparison with the number of arsenopyrite specimens, the twins are rare. They may form a simple cross similar to staurolite, and more rarely they form stars of three crystals as shown in Fig. 8.

Arsenopyrite is abundant in the deposit but, as can be seen from the chemical analysis of the ore, arsenic is subordinate.

Chalcopyrite is rare and does not form any good sharp crystals.

Boulangerite from this locality was called "plumosite" by the miners and some early collectors but x-ray studies have shown that this material is truly boulangerite. It occurs as thin needles and hairs up to 30 cm sometimes hanging out of vugs. It is the youngest ore mineral. While it is usually found implanted upon rhodochrosite, it is also found on pyrite and galena and sometimes as inclusions in calcite crystals.

Fig. 11. **Vivianite on dolomite and ankerite. The vivianite is nearly transparent and is 12 mm in length.**

Bournonite crystals are very rare. The author has seen only two specimens. They form multiple twins like cogwheels of at least 5 mm.

The most important accessory minerals are calcite, dolomite, siderite, ankerite, rhodochrosite and quartz. *Vivianite* is extremely rare and appears not only in the upper levels but also down to the 375 m horizon. It is found in fine crystals up to 7 cm and shows a deep green color. The medium size of the crystals is about 1 cm.

Calcite usually occurs covering the ore minerals. It also forms fine crystals of flat rhombohedrons which may be white, transparent, or black, the latter because of a high boulangerite content.

Dolomite forms very large crystals of the usual rhombohedron. The size is usually 1 cm but there are crystals up to several kilos in weight. *Ankerite*, with different amounts of manganese and magnesium, occurs in small saddle-shaped crystals.

Rhodochrosite is common and forms crystals with an average size of 5 mm. The color is not as red and pink as Colorado rhodochrosites, it is more brown, even grey and dirty appearing. Pink rhodochrosites are rare but are found in small aggregates. Larger crystals grow together or on sphalerite and arsenopyrite. Both calcite and rhodochrosite are found as stalactites at Trepča.

Quartz is abundant in crystals from millimeter size up to 30 cm individuals. Some of these are thin needles which may impale the fingers if the collector is not careful. Double-terminated crystals, scepter crystals (Fig. 12), club-like crystals, forms of the Alpine type, white and clear, make the groups showy and beautiful.

Trepča is one of the great mineral locations because it produces extremely beautiful specimens in quantity. The finest crystal groups were mined during the time from 1930-1940. Many of them can be seen in the British Museum (Natural History). The deeper the mining operations go, however, the rarer the vugs become. Let us hope that Trepča will continue to produce more and interesting material for the collectors.

Fig. 9.

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(Note: "Stantrg", written this way in the paper cited above, should be Stari Trg)

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Note: All photographs are by the author.

***Fig. 12.* Scepter quartz, about 12 mm.**

Recent Work on the Minerals of Franklin and Sterling Hill, New Jersey[1]

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The Franklin-Sterling Hill area in Sussex County, New Jersey, never ceases to provide specimens of mineralogical interest. Well over 400 articles have been written concerning the more than 230 species now recognized from the area. Although countless collectors have visited the mineral dumps at Franklin over the years, unusual and interesting specimens are still to be found. All that is necessary are care, hard work and a knowledge of what has been found in the past and what one is looking for.

The recent opening and expansion of the Trotter dump collecting area has greatly improved the prospects for interesting discoveries. The Trotter shaft has yielded many mineral treasures including giant rhodonite and gahnite crystals and gemmy willemite. At a depth of 340 feet, a segregation of nickel ores was encountered which consisted of chloanthite, niccolite, desaulesite, yellow sphalerite and purple fluorite. These minerals and many others may be encountered by the ambitious collector who is good with a pick and shovel. Exhibits of minerals which have been found at the Trotter dump may be seen at the Franklin Mineral Museum located on Evans Road between the Buckwheat dump and the Buckwheat open pit, and at the Gerstmann Museum located at 14 Walsh Road in Franklin. Both of these museums contain very fine comprehensive collections of the local minerals and include exceptional fluorescent displays and many items of historical interest.

The Buckwheat dump, which seems to be rapidly decreasing in size each year due to the enthusiasm of Franklin collectors, is still capable of producing very interesting material if several facts are kept in mind. Spectacular fluorescents and large crystals have become extremely scarce and the collector must come prepared for hard work in order to unearth them. Collectors have been combing the dump after dark with untraviolet lamps for many years and have left very little behind. To make the best of the Buckwheat dump, one should first read Palache (1935) and Frondel (1972) and take particular note of the obscure minerals. These have more than likely been overlooked by most collectors. Among those found in recent years by the author are pyrite, chalcopyrite, carminite, flinkite, cahnite, galena, chalcocite, cerussite, anglesite, eveite and gahnite.

This paper is the result of a thorough investigation of unusual and interesting unknowns from the specialized Franklin-Sterling Hill collection of the Harvard University Department of Mineralogy. Appreciation is hereby expressed to John L. Baum, Frank X. Edwards, Alice Kraissl and Ewald Gerstmann whose collections also provided interesting and useful material. Described herein are seventeen minerals new to the locality and a number of unusual occurrences and associations of minerals previously described.

Anglesite $PbSO_4$

A specimen recently found at the Buckwheat dump consists of a thin galena-chalcocite vein cutting garnet-pyroxene rock. The galena contains numerous vugs lined with well-formed micro-crystals of anglesite and cerussite and balls of malachite. This is the first recorded find of anglesite and cerussite at Franklin although both minerals have been reported from Sterling Hill. (Palache, 1935, p. 57 & 129).

Arsenopyrite $FeAsS$

Simple micro-crystals of arsenopyrite showing {001} and {110} have been found on a fracture surface cutting vuggy gray dolomite from the Buckwheat dump at Franklin. Although well formed arsenopyrite crystals are relatively common in the Franklin marble, this is the first recorded occurrence of the mineral in association with gray dolomite.

Barysilite $Pb_3Si_2O_7$

An unusual gray botryoidal type of barysilite was discovered during a recent investigation of xonotlite and

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[1] **Mineralogical Contribution No. 492, Harvard University**

calciothomsonite. The mineral occurs as 1/8 inch gray balls on a fracture surface in massive yellow-brown garnet and reddish-brown hancockite from the Parker shaft at Franklin. All previously encountered barysilite from this locality occurs as white embedded masses with curved lamellar structure (*Dana's Textbook of Mineralogy*, 1932, p. 584).

Berthierite $FeSb_2S_4$

1/8 to 1/4 inch crystals of berthierite were found among fragments of stibnite and realgar in a small vial labelled "Pb,Sb sulfosalt: Sterling" by C. Palache (Harvard #109648). The crystals are dark, metallic gray, striated, unterminated prisms. Because berthierite is soluble in hydrochloric acid, it is likely that much of this mineral has been destroyed in the acquisition of insoluble residues from realgar specimens.

Bianchite $ZnSO_4 \cdot 6H_2O$ — *Hexahydrite* $MgSO_4 \cdot 6H_2O$

John L. Baum recently presented Harvard with several specimens (Harvard #109645) from the 1100 foot level of the Sterling Hill mine exhibiting white efflorescences 1/8 inch thick on brown willemite-franklinite-calcite ore. X-ray powder diffraction and optics indicate that the soft white powder is an intermediate member of the bianchite-hexahydrite solid solution series. Under the soft material is a harder white crust of gypsum. During the three months that these specimens have been in our possession, the efflorescence has grown much thicker.

Brochantite $Cu_4(SO_4)(OH)_6$

Three sulfate minerals new to the locality have been discovered in altered and weathered ore from Sterling Hill. The original unweathered material consisted of magnetite, garnet and blue apatite grains in calcite. This rock was subsequently mineralized by copper and lead-rich solutions resulting in the deposition of galena and chalcocite. Surficial weathering resulted in the introduction of sulfate-rich solutions causing removal of calcite and the deposition of crystals of brochantite, linarite, devilline, gypsum, malachite and friedelite.

The brochantite occurs as dark green micro-crystalline crusts intimately associated with crystals of bright blue linarite, pale greenish-blue devilline and glassy colorless gypsum lining cavities left by the solution of calcite (Harvard #109646).

Cahnite $Ca_2B(OH)_4(AsO_4)$

Cahnite has always been counted among the rarest minerals from the Franklin area. However, a number of specimens of this mineral have been encountered recently including two specimens from the Buckwheat dump. All of the specimens consist of glassy cahnite micro-crystals associated with carminite, flinkite, franklinite and garnet micro-crystals lining vugs in a yellow-green garnet-franklinite matrix. The cahnite crystals show the forms {100}, {110}, {111} & {111} and a few are twinned on {110} . On close examination of specimens with the matrix described above, many cahnites are sure to be unearthed.

Carminite $PbFe_2(AsO_4)_2(OH)_2$

Carminite occurs at Franklin as radial aggregates of dark red prismatic micro-crystals associated with micro-crystals of flinkite, cahnite, franklinite and andradite lining vugs in a yellow-green garnet-franklinite matrix (Harvard #109463). Carminite is a very rare arsenate which has been reported from only three other localities in the U. S.: Eureka, Nevada; the Tintic district, Utah, and an unstated locality in Colorado.

Chondrodite $2Mg_2SiO_4 \cdot Mg(F,OH)_2$

A large specimen consisting of 1/4 to one inch pinkish-brown rounded crystals with rounded franklinite octahedrons in coarsely crystalline calcite was found adjacent to the fence surrounding the Buckwheat open pit directly across Evans Road from Franklin Mineral Museum (Harvard #109347). These crystals were determined by x-ray powder diffraction to be chondrodite. Similar specimens, the exact locations of which are unknown, were seen in the Harvard collection (labelled clinohumite) and in the John L. Baum collection in a section of core.

Nearly all of the humite group specimens from the Franklin area, including all of the light tan to dark orange material common in the limestone quarries of the area, are norbergite.

Chrysocolla $CuSiO_3 \cdot 2H_2O$

Chrysocolla has been confirmed in a specimen on display at the Franklin Mineral Museum belonging to the collection of Mrs. Alice L. Kraissl (FMM-ALK 14.2.5). The chrysocolla is light blue in color and is associated with azurite, franklinite, willemite and a nearly amorphous black manganese oxide. Its exact location at Franklin is unknown. Chrysocolla is also associated with the copper-rich vein described under cuprite.

Cuprite Cu_2O

Recently, during the reworking of an old pillar at Sterling Hill, a black to deep red, 1/8" to 1/2" vein of massive cuprite was encountered. The cuprite is associated with rounded, grey willemite grains, dull to very lustrous black franklinite crystals, pale light green willemite prisms, coatings of pale blue chrysocolla and pale green to yellow-green coatings and crystal rosettes of cuproadamite all in a coarsely crystalline calcite. The largest specimen of this material is in the collection of Ewald Gerstmann of Franklin.

Chalcotrichite, the capillary variety of cuprite, has been noted on an old Canfield specimen (Harvard #109643) labelled "Azurite xls, cuprite, aurichalcite: Franklin, N.J.: G. Rowe 1910". The specimen is essentially a dolomite vein cutting ore. The minerals present in the vein are massive dolomite, chalcocite, chalcopyrite and sphalerite, radiating azurite crystals, micro-tufts of malachite and aurichalcite and micro-needles of chalcotrichite.

Cuproadamite $(Zn,Cu)_2(AsO_4)(OH)$

Investigation of copper-rich specimens from Franklin and Sterling Hill has resulted in the discovery of several specimens of cuproadamite from both localities. The identity of the mineral was established by x-ray powder diffraction and the presence of copper was confirmed by the use of the ARL Spectrographic Analyser. Harvard Specimen #89973 from Franklin consists of dark blue, radiating micro-crystals of azurite, pale to dark green crystalling crusts of cuproadamite and light blue crystals and coatings of an unknown copper arsenate on highly altered calcite. The calcite is veined with reddish-brown stilpnomelane. A similar specimen of cuproadamite is in the Alice Kraissl collection on view at the Franklin Mineral Museum. This mineral was also found at Sterling Hill in association with the recently discovered occurrence of cuprite described in this paper.

During recent months, a considerable number of specimens labelled adamite from Sterling Hill have been circulating in the Franklin area. These specimens consist of pale yellow veins and disseminations with franklinite grains in calcite. The pale yellow mineral fluoresces pale green. This fluorescence combined with the presence of arsenic as indicated by chemical analyses resulted in the labelling of this material as adamite. However, x-ray powder diffraction study of several samples of this material indicate a mixture of zincite and willemite (hence the green fluorescence) and no adamite.

Devilline $Cu_4Ca(SO_4)_2(OH)_6 \cdot 3H_2O$

Devilline occurs at Sterling Hill as pale bluish-green coatings and feathery micro-crystals with brochantite and linarite in the association described under brochantite. Devilline is a rare sulfate which has been reported from only a few localities in the world. The major locality is at Herrengrund, Czechoslovakia where devilline was erroneously named herrengrundite.

Djurleite $Cu_{1.96}S$

It is impossible to distinguish between the sulfides chalcocite Cu_2S, digenite Cu_2S, djurleite and anilite $Cu_{1.75}S$, without the use of x-ray techniques. All four are soft, metallic in luster and silvery in color. For this reason, many specimens labelled chalcocite may actually be one of the other sulfides. Several Franklin specimens labelled chalcocite were x-rayed and one of these (Harvard #109476) was identified as djurleite. The lustrous metallic gray djurleite occurs with dolomite and hematite in a 1/8" to 3/4" thick vein cutting typical franklinite-willemite ore. Investigation of other Franklin chalcocite specimens all surely will turn up additional djurleite and perhaps the other sulfides mentioned above.

Epsomite $MgSO_4 \cdot 7H_2O$

Epsomite occurs as a white 1/8" thick, coralloidal efflorescence on a fracture surface in gneiss from Sterling Hill (Harvard #109646). Epsomite is commonly found as crusts and efflorescences on the walls of mine workings where the ground waters are rich in magnesium. The mineral is still forming at Sterling Hill.

Eveite $Mn_2(OH)(AsO_4)$

Eveite occurs as tan to brown tabular micro-crystals in a vug in a matrix consisting of very tiny black franklinite and brown willemite grains in coarsely crystalline calcite. The specimen (Harvard #109459) is from the Buckwheat dump at Franklin where this matrix is very common. Associated with the eveite are pale green willemite prisms, pink rhodochrosite rhombohedra, gray dolomite rhombohedra, very tiny irridescent franklinite octahedra, reddish-brown cubo-octahedral crystals of spinel and very lustrous, silvery graphite flakes.

Eveite, the manganese analogue of adamite $Zn_2(OH)(AsO_4)$, was first described from Langban, Sweden, by Paul B. Moore (1968).

Flinkite $Mn_2^{\prime\prime}Mn^{\prime\prime\prime}(AsO_4)(OH)_4$

Flinkite occurs at Franklin as small (1-3 mm) rosettes of dark yellow-brown bladed crystals associated with micro-crystals of carminite, cahnite, franklinite and garnet lining vugs in a yellow-green garnet-franklinite matrix (Harvard #109463). The Franklin flinkite is very similar to the type material described from the Harstig mine at Pajsberg, Sweden by Hamberg (1889).

Heulandite $(Ca,Na_2)Al_2Si_6O_{16} \cdot 5H_2O$

A new occurrence of heulandite from an unknown locality at Franklin (Harvard #109647) consists of a fracture surface in pink-colored gneiss coated with yellow-orange micro-crystals of heulandite.

Hodgkinsonite $Mn(ZnOH)_2SiO_4$

Hodgkinsonite occurs at Sterling Hill as a pinkish-tan botryoidal coating and as very tiny, reddish-brown micro-crystals on a fracture surface in coarse franklinite-zincite-calcite ore (Harvard #109472). Associated with the hodgkinsonite are colorless fluorite cubes and black hetaerolite crystals. This is the first reported occurrence of hodgkinsonite from Sterling Hill, although the mineral is well known from Franklin as bright pink crystals and crystalline masses.

Kaolinite $H_4Al_2Si_2O_9$

Kaolinite has finally been authenticated among the clay minerals from Sterling Hill. The specimen was discovered by J. Gouger of Franklin and is now in the collection of John L. Baum, also of Franklin. It consists of white, powdery kaolinite with micro-crystals of hemimorphite on altered jeffersonite.

Kutnahorite $CaMn(CO_3)_2$

The unit cell dimensions, indices of refraction and specific gravity of kutnahorite approaching ideal composition more closely than any material previously described (Frondel & Bauer, 1955; Gabrielson & Sundius 1966) are presented in Table 1. The kutnahorite (Harvard #109405), from Sterling Hill, occurs as a pink granular aggregate forming a thin vein cutting franklinite ore. The unit cell dimensions were obtained from x-ray powder diffractometer data and the specific gravity was measured by use of a 25 ml. pycnometer. The indices of refraction were measured in sodium light by the immersion method.

Table I
Analyses, unit cell dimensions, indices of refraction and specific gravity of kutnahorite.

Ideal	Sterling Hill	Kutnahorite
MgO	.47	
FeO	.80	
MnO	31.77	32.99
SrO	TR	
BaO	TR	
CaO	25.25	26.08
ZnO	1.40	
CO_2	40.31	40.94
	100.00	

$Ca_{.960}(Mn_{.922}Zn_{.037}Mg_{.018}Fe_{.023})_{1\cdot 040}(CO_3)_2$

Analyst, Jun Ito. Analysis recalculated to 100.00 after deducting traces of Al_2O_3, SiO_2 & Fe_2O_3. The cation assignments in the subjoined formula are arbitrary.

a	4.870Å ± .005Å
c	16.302Å ± .003Å
Sp. G.	3.144 ± .005
ω(Na)	1.740 ± .001
ϵ(Na)	1.547 ± .001

Linarite $PbCu(SO_4)(OH)_2$

Linarite occurs at Sterling Hill as bright blue transparent micro-crystals with brochantite and devilline in the association described under brochantite. This is the first occurrence of linarite in New Jersey. The occurrence of linarite is unusual because it normally occurs as a secondary mineral in the oxidized zone of copper and lead deposits. These elements are very rare at Sterling Hill.

Magnesioferrite $MgFe_2O_4$

What appears to be magnesioferrite occurs at Sterling Hill intimately mixed with a black septechlorite[1] (Harvard #109649). In this magnesioferrite-chlorite matrix are white, hexagonal prisms of willemite up to 1/2 inch in diameter. The magnesioferrite was discovered by use of x-ray diffraction and is not visible in the sample to the unaided eye.

Margarite $H_2CaAl_4Si_2O_{12}$

The margarite-corundum-anorthite assemblage here noted was found in the Franklin marble adjacent to the West Shaft of the zinc mine at Sterling Hill. (Fig. 1 in Metsger, Tennant & Rodda, 1958). The occurrence consists of pale green platy crystals of margarite up to several centimeters in length intergrown with crudely formed crystals of red corundum and white crystals of anorthite. The corundum partly encloses the margarite crystals, and the anorthite envelopes both of these minerals. When the calcite matrix is dissolved, tiny crystals of a number of accessory minerals are released. They include arsenopyrite, rutile, sharply formed crystals of graphite, a green garnet and octahedra of dark green to brownish-black chromian variety of gahnite. A few pseudomorphs of corundum after a spinel were also observed.

A chemical analysis of margarite is given in Table II. The mineral is biaxial negative, 2V moderate, with α 1.625 ±.004, β 1.640 ±.001, γ 1.641 ±.001, $X \backsim c$ and $Z = b$. The measured specific gravity is 3.03 ±.01. Single crystal x-ray study by the precession method established that the material is the two-layer polytype, with cell dimensions a 5.10Å, b 8.84Å, c 19.05Å and $\beta \backsim 100°$.

Table II
Chemical analysis of Sterling Hill margarite.

SiO_2	29.70	MgO	.12
Al_2O_3	49.97	MnO	.53
Fe_2O_3	.25	Li_2O	.21
Cr_2O_3	.07	Na_2O	1.24
V_2O_5	.10	K_2O	.05
TiO_2	.25	H_2O+	5.60
CaO	11.68	H_2O-	.23
			100.00

Analyst, Jun Ito, 1964. Recalculated to 100.00 after deducting 3.00% insoluble corundum. Spectrographic traces of Cl, Ga, Mn, Ba, Sr, Y, Yb, Ni, Mo, Ag, Cb, Sb.

Rosasite $(Cu,Zn)_2(OH)_2(CO_3)$

Rosasite occurs at an unspecified locality at Franklin as tiny blue-green balls on hemimorphite micro-crystals lining cavities in highly altered, rusty calcite (Harvard #89979, 89980). It is easily confused with malachite and aurichalcite to which it is closely related.

Thomsonite $(Ca,Na_2)Al_2Si_2O_8{\bullet}2\ 1/2H_2)$

Of the many investigated specimens labelled "calciothomsonite," only one gave the x-ray powder pattern characteristic of thomsonite. This Parker Shaft specimen is in the collection of John L. Baum and consists of a radiating group of white, one inch long, thomsonite needles in a vug in a matrix of hancockite, garnet and manganaxinite. It would be desirable to get x-ray confirmation of the original thomsonite from the Parker Shaft which was described by Gordon (1924) as calciothomsonite because of the presence of nearly 16 weight percent of CaO. Calciothomsonite is not an accepted species name. All of the other encountered specimens labelled calciothomsonite are xonotlite and are described later in this paper.

Uranophane $CaO{\bullet}2VO_3{\bullet}2SiO_2{\bullet}7H_2O$

Uranophane occurs at Sterling Hill as the major constituent of the reaction zone surrounding a uraninite cube (3/4 inch on edge) found by Charles Key. From this cube, a date of 960,000,000 years was arrived at as the age of this deposit. None of the original uraninite is still in existence. The reaction zone is brown-yellow in color and is 1/8 to 1/4 inch thick.

Xonotlite $5CaSiO_3{\bullet}H_2O$

During a recent investigation of thomsonite, numerous specimens of xonotlite, all of similar association, were encountered. These specimens consist of white radiating and matted groups of xonotlite needles with purple clinohedrite and green willemite in an altered hancockite-

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[1] a chlorite mineral consisting of serpentine-like layers spaced seven angstroms apart.

roeblingite-andradite-franklinite matrix. All are from the Parker Shaft at Franklin. The xonotlite needles are more loosely grouped than the thomsonite needles and are considerably more abundant.

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Fig. 1. **Aerial view of the Utah Copper mine, Bingham, Utah, as of August, 1960. Mine dimensions are approximately 2 miles on its long axis (NE-SW) by 1 1/2 miles wide (NW-SE). The outlined area includes the altered limestones under discussion. The geology of this area is shown in Fig. 2.**

Occurrence and Infrared Analysis of Unusual Zeolitic Minerals from Bingham, Utah

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ABSTRACT

An extensive suite of unusual zeolitic minerals has formed as a hydrothermal alteration product of silicated limestone adjacent to the disseminated copper deposit at Bingham, Utah. Mineral species which have been recognized include thaumasite, apophyllite, 14Å tobermorite, gyrolite, okenite, stilbite, thomsonite and many other species which have thus far not been identified.

The minerals occur in the Commercial limestone and are zonally distributed with respect to the Bingham stock. With increasing distance from the stock the zones are (1) a silicated zone characterized by garnet, diopside and epidote, (2) a silicified zone and (3) a silicated zone characterized by wollastonite. Further out the limestone is recrystallized and bleached, these effects decreasing until unaltered limestone is reached.

Only a small portion of the Commercial limestone was examined for the presence of unusual mineral species. The unusual species did not occur until a distance of approximately 1400 feet from the contract or 3600 feet from the apparent center of mineralization was reached. They occur as fracture fillings and veinlets cutting massive wollastonite rock and may be associated with sulfide mineralization. The unusual species become more abundant as distance from the contact increases, and at a distance of 1600 feet thaumasite may make up ten percent of the rock mass.

Infrared analysis was used in the identification and classification of the minerals, and x-ray diffraction and infrared data for the identified species is presented. Variation in composition of several of the species is suggested by systematic changes in their infrared spectra.

INTRODUCTION

Mining of the disseminated copper deposit at Bingham, Utah, began in 1904. Since that time this deposit has been of continuing interest to geologists and mineralogists alike. A bibliography of papers written about the district, its geology and mineralogy would require several pages. Despite this prolonged study, new information worthy of professional interest is continually being discovered.

In the course of investigating silicated and hydrothermally altered limestone members of the Oquirrh formation adjacent to the Utah Copper ore body, a number of uncommon zeolitic calcium silicates were identified. These minerals occur filling cavities and veins in massive wollastonite rock and apparently were formed by the same hydrothermal activity which caused the sulfide mineralization. Varying amounts of sulfide minerals, particularly pyrite, pyrrhotite, chalcopyrite, sphalerite and galena may occur in the veins with the unusual silicate species.

Minerals which have been identified at the Bingham locality include thaumasite, apophyllite, 14Å tobermorite, gyrolite, okenite, stilbite and thomsonite. Many other minerals have been isolated but not yet identified.

Those who are familiar with the mineralogy of the altered limestones at Riverside (Crestmore), California, (Murdoch, 1961), will notice the similarity in the mineralogy of that deposit and the mineralogy of the altered limestones at Bingham. Only a small proportion of the minerals occurring in the limestones at Bingham have been identified to date, and the list of minerals occurring at this locality will probably eventually rival that of Crestmore itself.

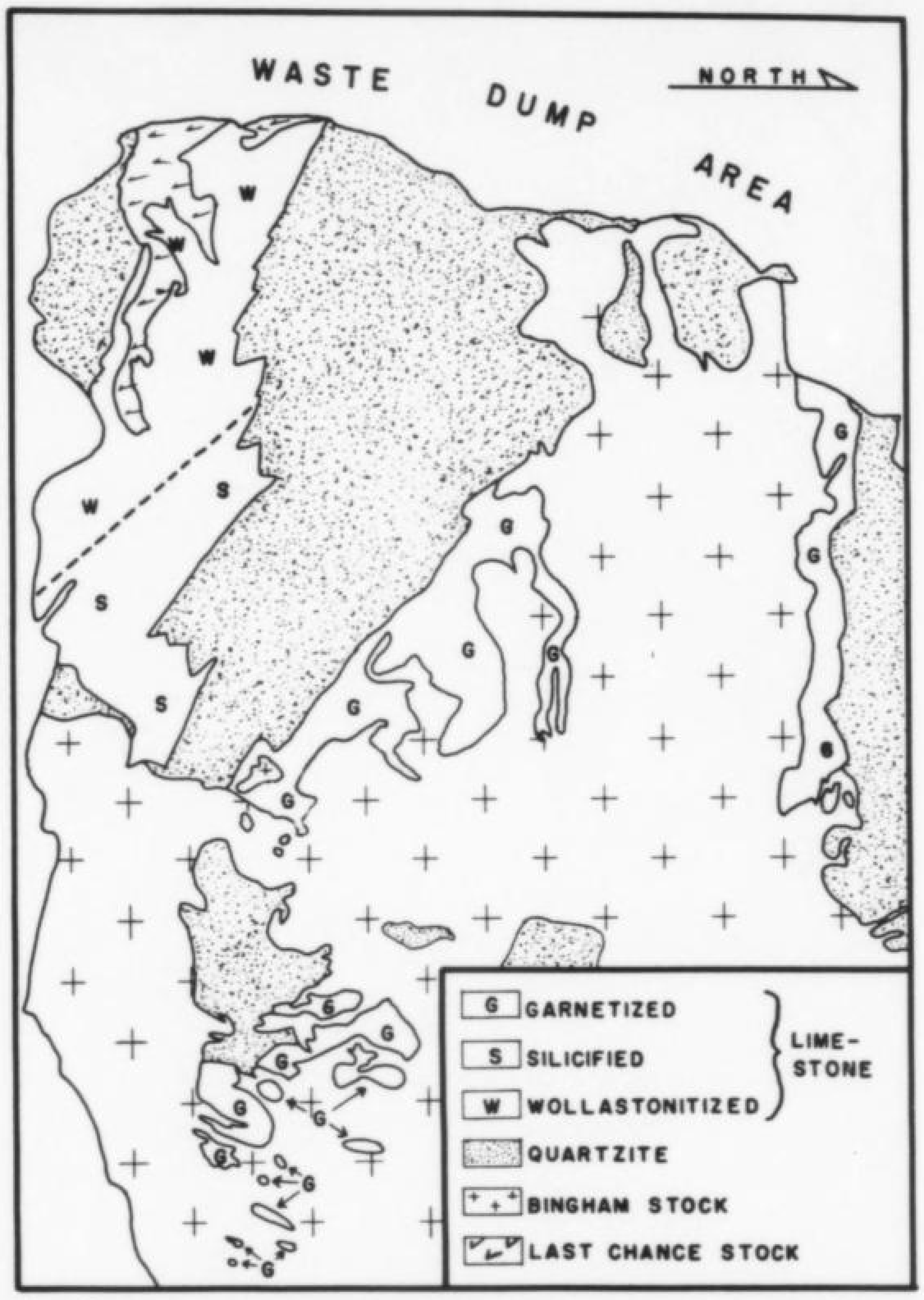

***Fig. 2.* Geologic map showing distribution of altered limestone in the southwest portion of the Utah Copper open pit mine.**

It was generally possible to purify enough of each mineral for x-ray diffraction and infrared spectra analysis. A few of the minerals occurred in relatively large, pure masses. This was particularly true of thaumasite, and was true of 14Å tobermorite and apophyllite to a lesser extent. All of the other minerals were impure to one degree or another. Thaumasite, calcite and wollastonite were the most common contaminants which had to be removed in purifying samples.

Heavy liquid and magnetic concentrations were used in separating the minerals of interest from the rock matrix, but it was necessary to hand pick each of the samples under a binocular microscope in order to obtain the high purity material used in the instrumental analyses.

Acid leaching of samples to remove calcite was generally avoided since most of the minerals of interest are also highly susceptible to acid decomposition. In addition, many of these minerals contain carbonate as an essential constituent. Acid leaching could partially or wholly remove such structural carbonate, causing misinterpretation of the composition of a sample.

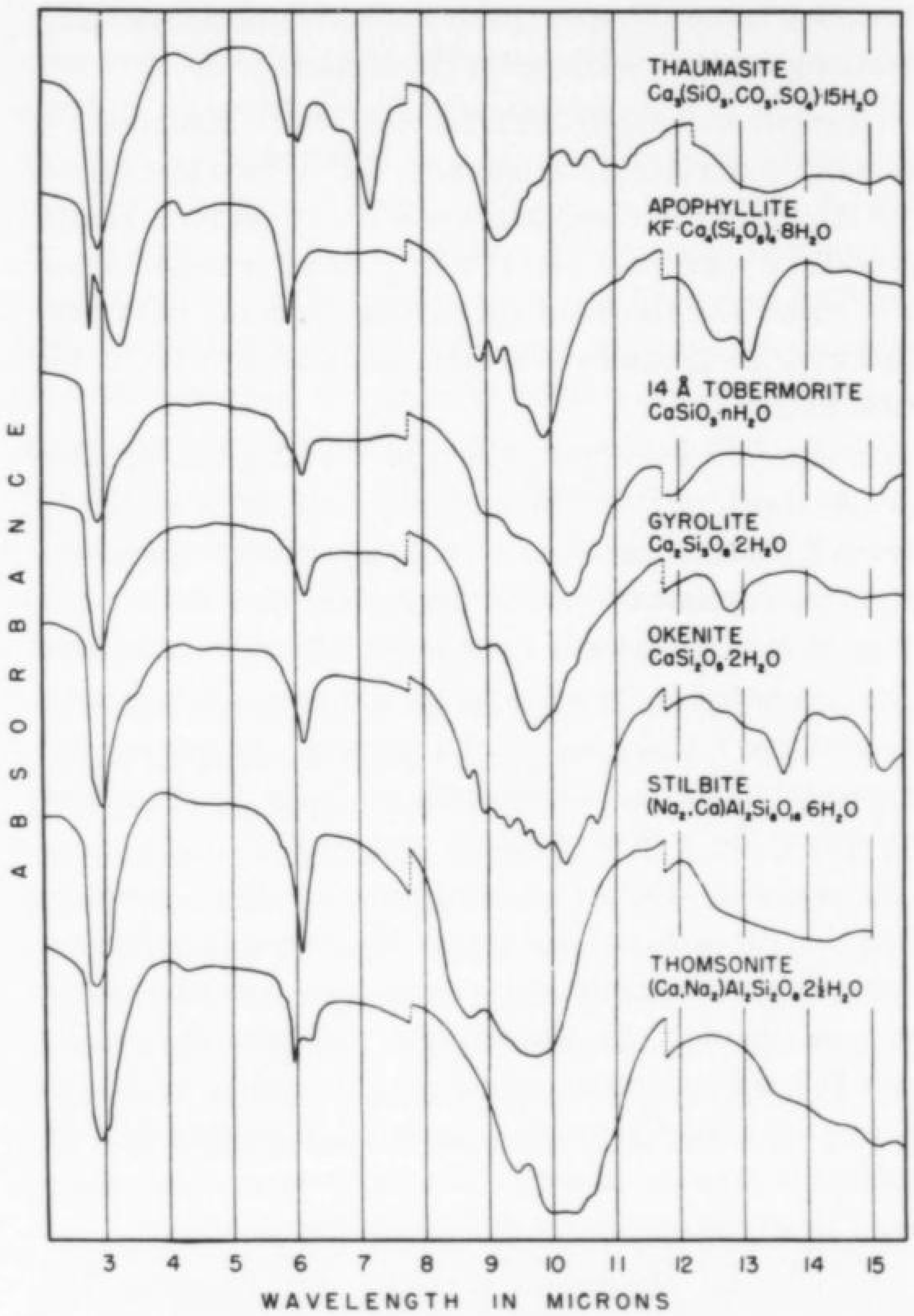

***Fig. 3.* Tracings of infrared absorption spectra obtained with minerals from the Bingham alteration suite.**

HOST ROCK GEOLOGY AND MINERALOGY

Limestone is a prominent host rock for sulfide mineralization in the Bingham district and much of it is somewhat altered and silicated. Winchell (1924) studied the altered limestones at Bingham in 1924, and Hunt (1957) and Stephens (1960) studied altered limestones in the underground workings of the United States and Lark mines respectively. These studies recognized the normal tactite and clay alteration types, but failed to recognize the zeolitic alteration which is being reported here.

The zeolitic alteration area in question is exposed in the southwest quadrant of the Bingham pit and is shown in Figure 1. This figure shows an aerial photograph of the Bingham pit which was taken in August of 1960. Pit configuration and geology have not been drastically modified since that time.

The geology of the limestone area is shown in Figure 2. It can be seen from this figure that most of the limestone which is isolated from the contact has been either silicified or converted largely to wollastonite. The quartzite area between the garnetized contact limestone and the silicified and wollastonitized limestone has been mineralized with sulfides and contains some clay and chloritic alteration. Its bulk composition has been only slightly changed, however. In contrast with this, the mineralogy of the limestone has been drastically changed. While some calcite remains, by far the largest part of the rock has been replaced by wollastonite or silica.

The transition from silicified to wollastonite rock is indicated by the dashed line in Figure 2. It should not be thought that this represents an abrupt change in the rock mineralogy, however. The change from silica to wollastonite replacement takes place over an interval of at least 200 feet, and thaumasite first becomes apparent within this same interval.

The first occurrence of thaumasite is in small veins less than two millimeters in thickness which cut the silicified rock. These small thaumasite veins first appear about 1400 feet from the intrusive contact, but do not become abundant until a distance of about 1600 feet from the contact is reached. The abundance of thaumasite appears to be directly related to the abundance of wollastonite in the rock. That is, as wollastonite becomes more abundant in the rock, more and larger thaumasite veins are also noted in it.

MINERAL DESCRIPTIONS

Thaumasite. By far the most common vein mineral in the subject area is thaumasite. This mineral fills veins in the massive wollastonite rock and may be found in most parts of the rock mass where wollastonite occurs. Thickness of the thaumasite veins ranges from microscopic to a maximum of 2 1/2 inches. Most veins, however, are less than 1/2 inch in thickness, and those thicker than 1 inch are uncommon.

Almost invariably the thaumasite veins have a columnar or cross fibered structure. This structure becomes less marked in the thicker veins, and in the thickest ones the thaumasite may have a friable, sandy texture. Color of the

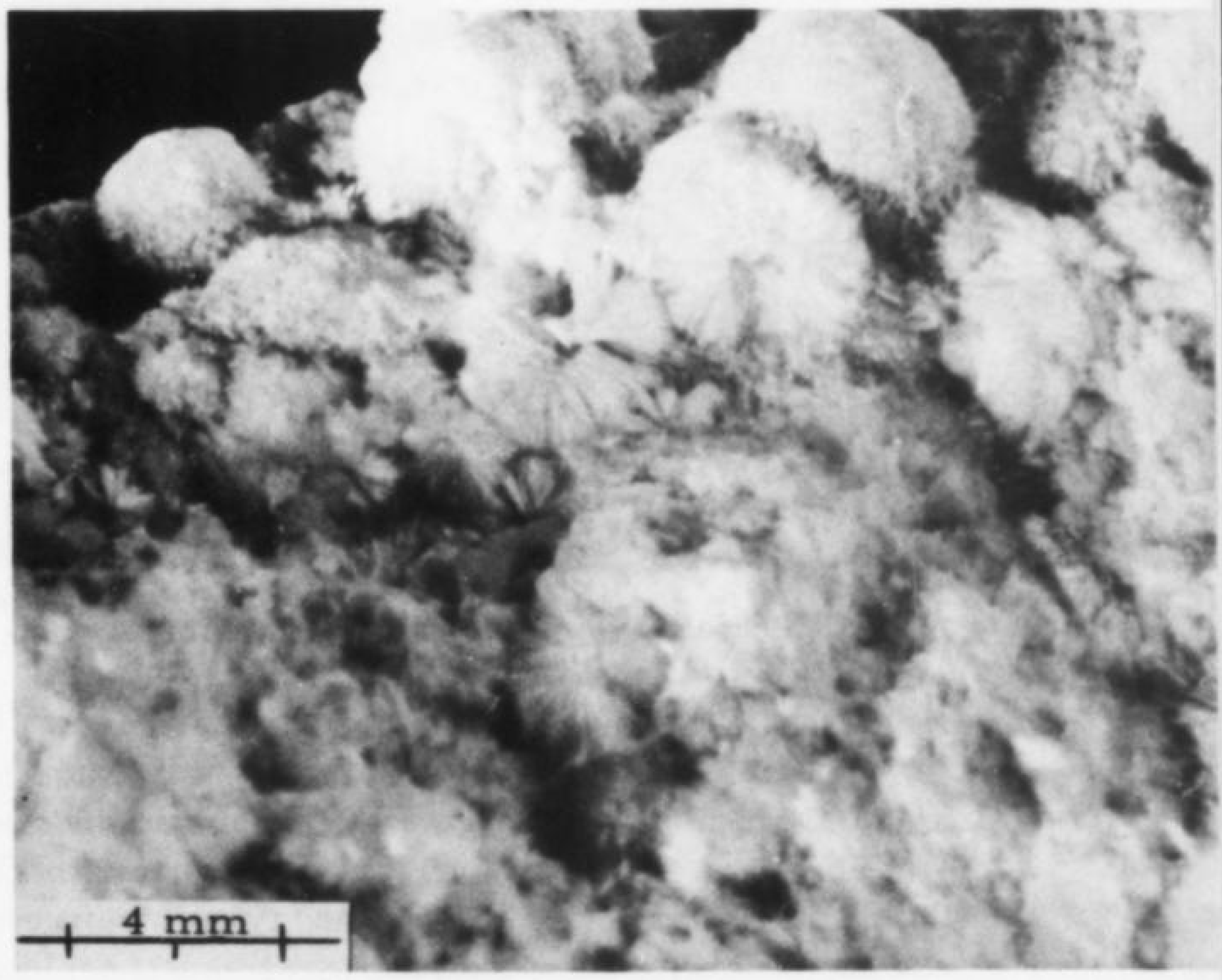

***Fig. 4.* Okenite forms botryoidal coatings of radiating crystal groups on vugs.**

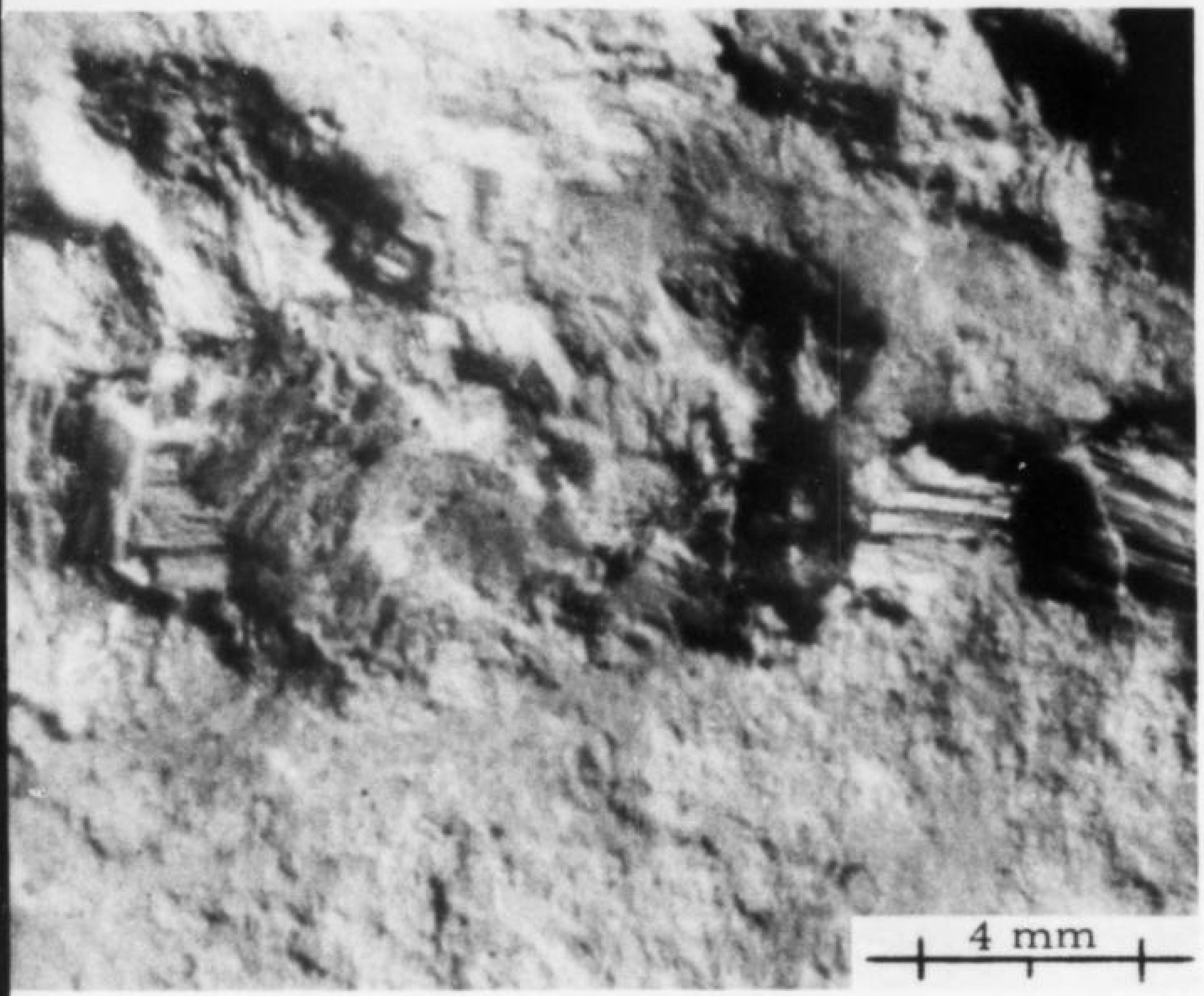

Fig. 5. **Foshagite occurred as a thin selvage along one side of a thick vein of thaumasite. The foshagite is the zone of distinct cleavages at various angles that runs through the center of the photograph.**

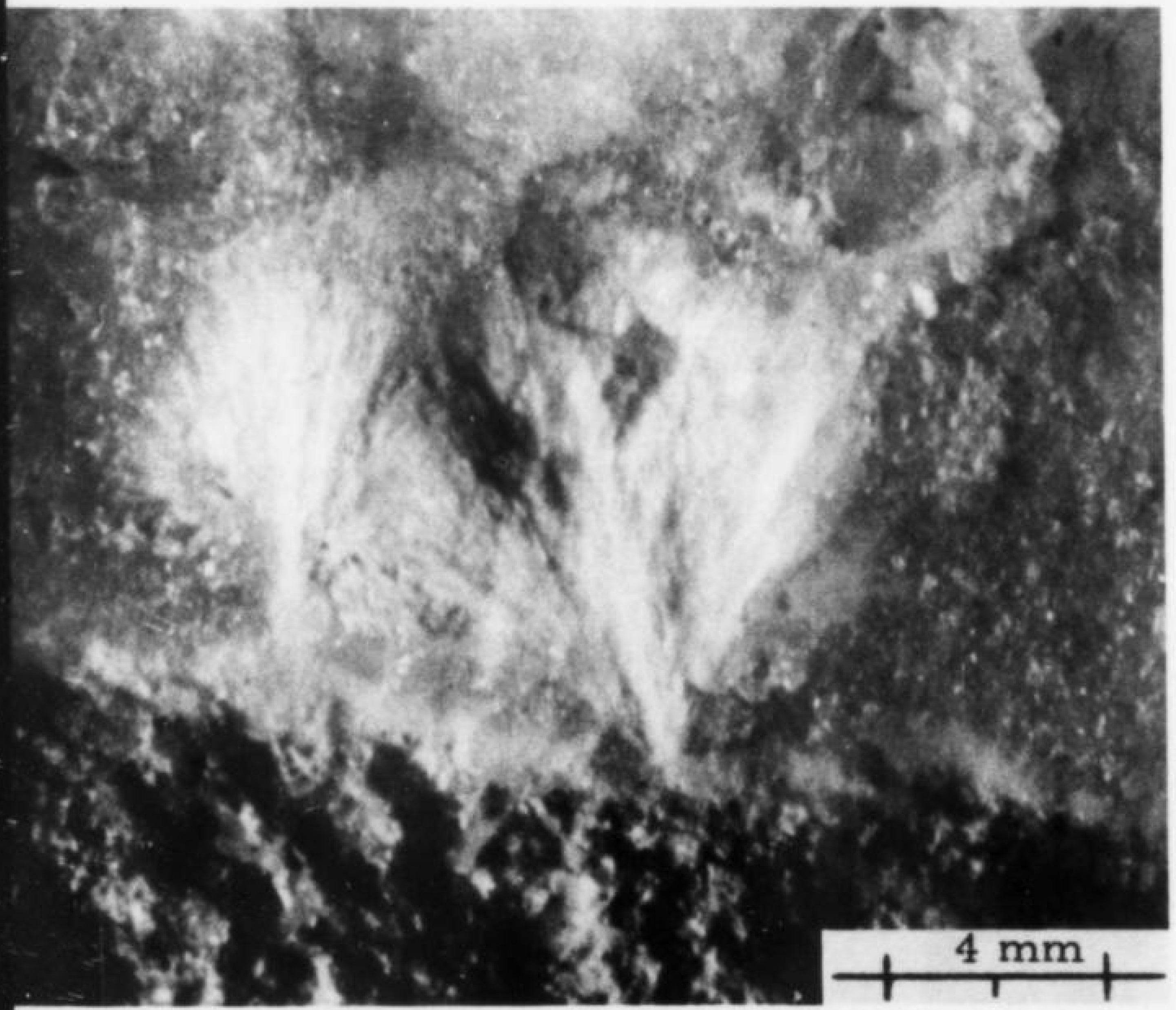

Fig. 6. **Thomsonite forms radiating crystal groups which protrude into an apophyllite vein.**

thaumasite varies from white to yellow, although some of it appears gray due to the presence of very fine sulfides. Well-developed crystals are rare, but in a few instances thaumasite crystals up to 5 mm long and 0.5 mm in diameter may be found in open cavities.

An infrared spectrum for thaumasite from Bingham obtained with a typical sample is shown in Fig. 3. Systematic variations in the infrared spectra of different samples suggest composition variations in the mineral.

Apophyllite. Apophyllite is second only to thaumasite in abundance as a vein filling mineral, and is often intergrown with thaumasite in composite veins. It occurs both as well crystallized specimens and as fine grained, massive material in veins. The Bingham apophyllite generally has rather small crystals, probably averaging less than 0.5 mm on the prism faces.

The infrared absorption spectrum for Bingham apophyllite obtained with well-crystallized material is shown in Figure 3. Infrared analysis of well-crystallized specimens gave very consistent spectra, suggesting that the composition of such samples is relatively uniform. Some variability was noted in the infrared spectra obtained with massive and fine grained specimens, however, suggesting that such material may not always have precisely the same composition as the well-crystallized apophyllite.

Tobermorite. The 14Å tobermorite is a fairly common mineral in the area and it is generally associated with thaumasite. Its most common occurrence is as snow white, massive veins cutting the wollastonite rock and thaumasite veins. In a few instances fine radiating crystals of tobermorite were identified growing in open vugs and perched on apophyllite crystals. In such cases the tobermorite formed nearly spherical masses up to 5 mm in diameter.

The infrared absorption spectrum for Bingham 14Å tobermorite is shown in Figure 3. Some variations in the infrared spectra obtained on tobermorite specimens was noted, suggesting that there may be some compositional variation between samples of the mineral. It is highly probable that these variations represent some of the other tobermorite species.

Gyrolite. To date gyrolite has been found in only one sample from the Bingham locality. In this case it was intergrown with coarsely crystallized calcite which formed the central zone of a composite galena-sphalerite-pyrite vein. In some cases sphalerite is intergrown with the gyrolite. Other minerals in the vein were thaumasite, 14Å tobermorite, vesuvianite and garnet.

Both the gyrolite and the calcite were of an off-white color with a faint suggestion of pink. The gyrolite formed sheafs and books of platy, micaceous cleavages. Most such crystal aggregates were less than 5 mm on their maximum dimension, but occasionally cleavage plates greater than 1 cm on their maximum dimension were found.

Gryolite from this locality closely resembles brucite, and at first was mistaken for that mineral. As with brucite, the cleavages have a pearly luster and are easily separable into flexible lamina.

The infrared spectrum for Bingham gyrolite is presented in Figure 3. Since only the one specimen was found, reproducibility of data obtained with material from this locality has not been determined. Both the x-ray diffraction and infrared data were similar to those of gyrolite from other localities, however.

Okenite. Two different modes of occurrence have been observed for okenite at Bingham. The mineral was first noted as a matted, felt-like mass of hair-like crystals filling an open space adjacent to a thaumasite vein. These crystals lay parallel to the plane of the open space, but showed no orientation in the other two dimensions. The second occurrence was as botryoidal masses of fibrous to radiating crystals partially filling open vugs in granular diopside-wollastonite rock. Botroyoidal coatings of this type were generally 5 to 10 mm in thickness. In both cases, color of the okenite was white, with a silky luster.

Infrared spectra obtained on material from the two occurrences were almost identical, indicating little or no compositional variation between them.

Stilbite. Stilbite occurs in only a small portion of the lime silicate area, but is quite abundant where it does occur. It forms sharp, water clear crystals lining vugs, and also veins of massive, radiating material. The host rock in the area where stilbite occurs is distinctly different from that of the main wollastonite rock mass. The stilbite-bearing rock has a porous, granular texture, in many ways resembling an intrusive rock. Its most prominent minerals are a dark green pyroxene and a medium green amphibole. Stilbite and wollastonite are the major light colored minerals in the rock.

Little or no variation was noted in infrared spectra of different stilbite samples from this locality, so composition of the mineral is probably rather uniform.

Thomsonite. Three distinctly different modes of occurrence have been noted for thomsonite from the Bingham locality. Most striking is the occurrence of coarse, radiating crystal groups partially filling open cavities in the same wollastonite-pyroxene-amphibole rock in which the stilbite occurred. Second was as radiating crystal groups embedded in calcite, and third was as small crystal groups associated with another zeolite in veins in a dike which cuts the wollastonite rock.

The thomsonite occurring in open cavities was snow white and relatively coarse, and a few crystal groups being as much as one cm in length. The thomsonite occurring in calcite had a wide range of colors, including olive green, gray, yellow and white. The crystal groups in calcite are generally not larger than five mm in diameter. Thomsonite from the veins in dike rock were colorless and glass clear. This material formed sheaf-like crystal aggregates, generally less than two mm in length. Some of these crystal aggregates had terminations on the prism ends, an uncommon occurrence with thomsonite.

Considerable variation was noted in the infrared spectra obtained with material from the three occurrences, so they probably differ from each other in composition.

SUMMARY AND CONCLUSIONS

Hydrothermal alteration of silicated limestones has produced an extensive suite of unusual minerals at Bingham, Utah. Both the anhydrous tactite minerals and the unusual hydrated species formed in response to temperature and mineralizing solutions associated with the Bingham stock. Evidence supporting this conclusion may be seen in the zonal distribution of both the anhydrous tactite minerals and the hydrated zeolitic species. The presence of sulfide minerals in the veins containing the hydrated zeolitic species also suggests such an origin for them.

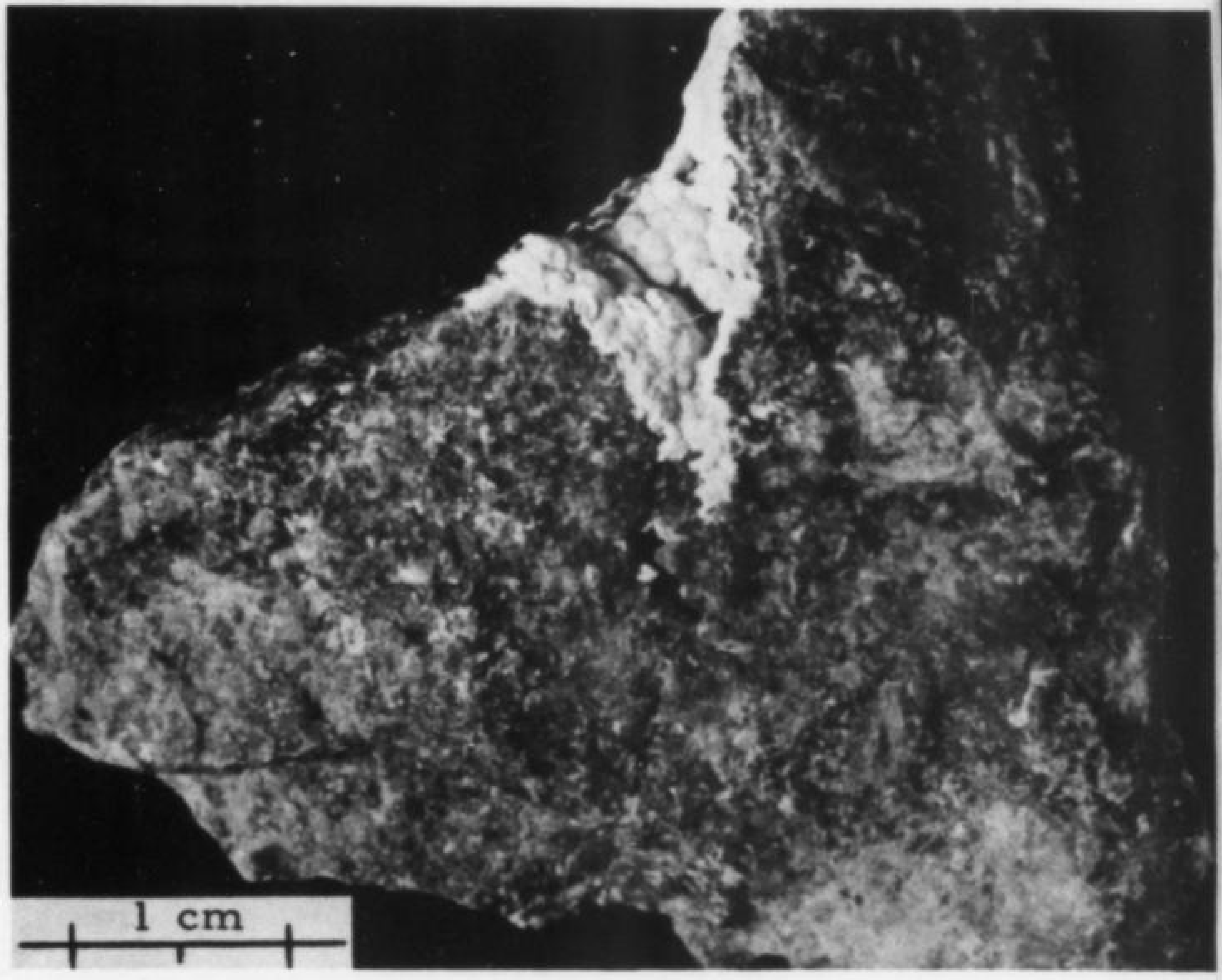

Fig. 7. **White tobermorite forms a botryoidal coating that lines a vug in amber brown calcite.**

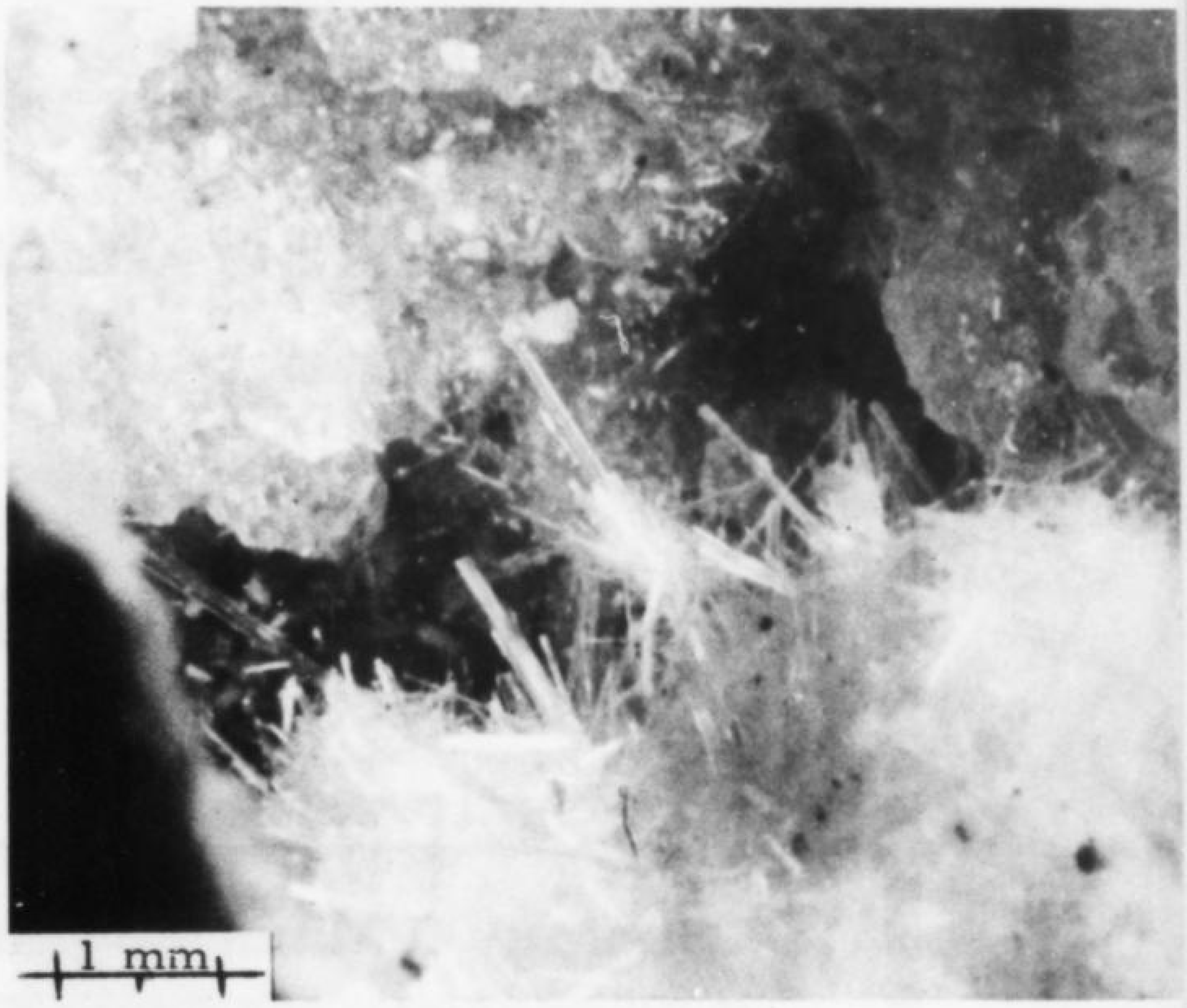

Fig. 8. **Needle-like thaumasite crystals project into an apophyllite lined vug.**

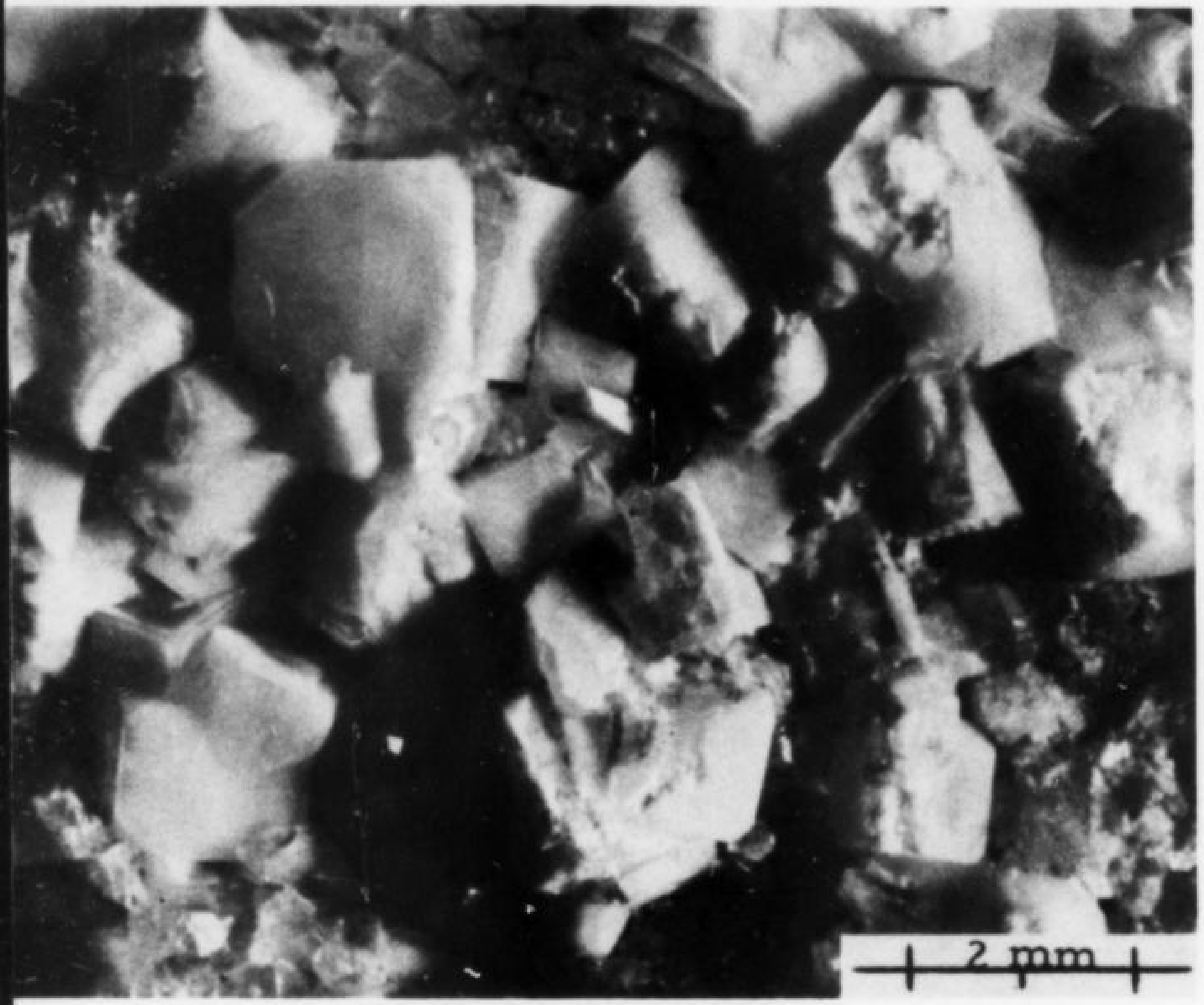

***Fig. 9.* Milky white apophyllite crystals coat a fracture surface in wollastonite rock.**

The resemblance of the Bingham mineral assemblage to that of Crestmore, California, is striking. While mineral assemblages such as these have not been widely recognized, they are probably rather common in areas where limestones have been hydrothermally altered. The most common species, particularly thaumasite and apophyllite, may superficially resemble calcite. This resemblance is unquestionably the reason these minerals were not recognized earlier at Bingham, and this same resemblance has probably prevented their recognition at other localities.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation for the help and encouragement which management and employees of Kennecott Copper Corporation offered us in the course of this study. To be particularly thanked are Mr. S. R. Zimmerley, Director of Research, Western Mining Divisions Research Center; and Dr. William C. Peters, Chief Geologist for the Utah Copper Division of Kennecott Copper Corporation.

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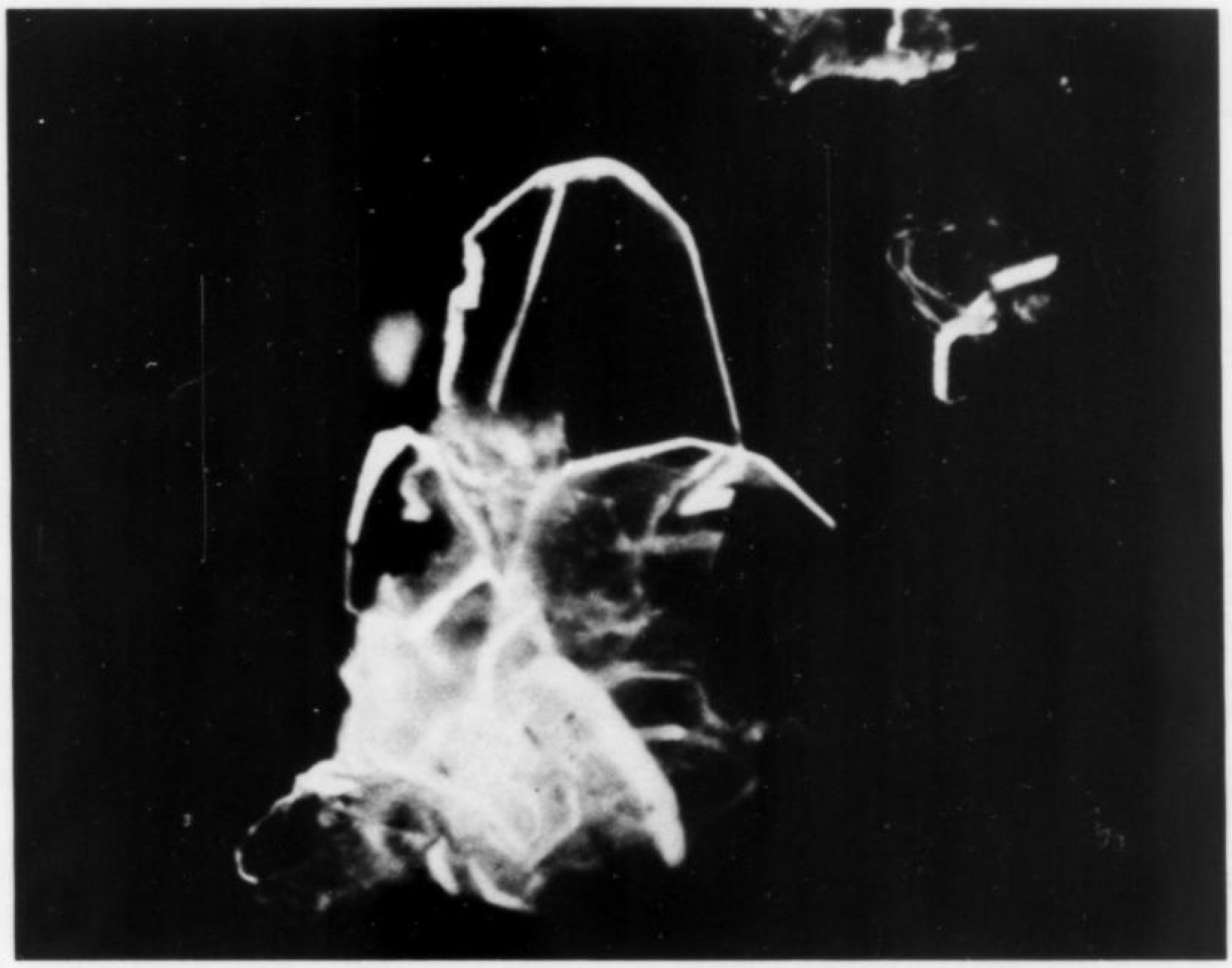

Fig. 1. **Cluster of brannockite crystals photographed while fluorescing under short-wave ultraviolet light.** ***Photograph by Julius Weber.***

Brannockite, A New Tin Mineral

by John S. White, Jr., Joel E. Arem, and Joseph A. Nelen **(Smithsonian Institution, Washington, D. C.),**
Peter B. Leavens **(University of Delaware, Newark)** *and Richard W. Thomssen* **(Tucson, Arizona)**

INTRODUCTION

In 1968 one of the authors (JSW) was informed of the existence of a fluorescent mineral from the Foote Mineral Company's spodumene mine at Kings Mountain, Cleveland County, North Carolina. The informant was Mr. Carter Hudgins of Marion, North Carolina, who collected and donated to the National Museum of Natural History an extremely fine specimen.

An x-ray powder diffraction pattern was immediately taken. The pattern bears a strong resemblance to that of osumilite in terms of line positions, but intensities show substantial differences. The habit — very thin, transparent hexagonal plates — extended the analogy. The early evidence appeared to suggest that the mineral is a structural analog of osumilite, and ensuing studies proved this to be the case.

Brannockite is the lithium-tin analog of osumilite, with the formula $KLi_3Sn_2Si_{12}O_{30}$. It is free of the elements aluminum, iron and magnesium and the only significant departure from a "clean" composition is less than a percent of Na_2O. Four analogs of osumilite are now known but brannockite is the only tin and lithium bearing member of the group and also the only one found in a pegmatite. Osumilite occurs in volcanic rocks; roedderite, merrihueite and yagiite all are limited in occurrence to meteorites. Milarite, a hydrous potassium, calcium and beryllium aluminosilicate is considered a structural analog, however its anomalous optics (biaxial?) casts doubt upon its true structural nature.

brannockite
$(K,Na)Li_3Sn_2[Si_{12}O_{30}]$
merrihueite
$(K,Na)_2Fe_2(Fe,Mg)_3[Si_{12}O_{30}]$
osumilite
$(K,Na,Ca)(Fe,Mg)_2(Al,Fe'',Fe''')_3[Al_2Si_{10}O_{30}]\bullet H_2O$
roedderite
$(Na,K)_2Mg_2(Mg,Fe)_3[Si_{12}O_{30}]$
yagiite
$(Na,K)_{1\cdot 5}Mg_2(Al,Mg,Fe)_3[Al_2Si_{10}O_{30}]$

The mineral is named for Dr. Kent C. Brannock, Chemist, Tennessee Eastman Company, Kingsport, Tennessee, who first called the authors' attention to the rare minerals

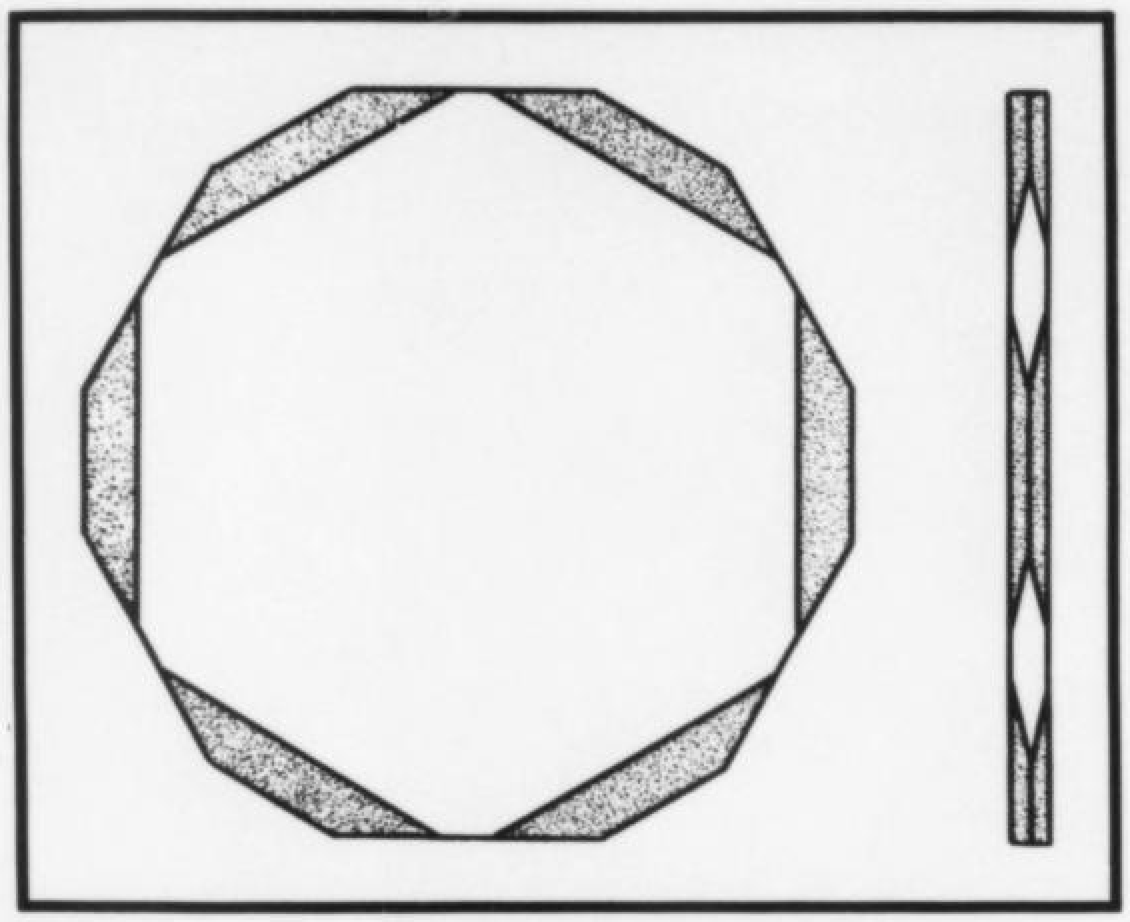

Fig. 2. **Two views of idealized brannockite crystals.**

of this locality and was instrumental in helping them obtain specimens. He has been a constant source of inspiration throughout the course of our studies of the Foote mine's minerals, an effort leading to the description of the new species switzerite, eakerite and tetrawickmanite prior to the present one, and the identification of more than eighty established species.

OCCURRENCE AND PROPERTIES

Brannockite occurs in minute amounts in late hydrothermal portions of the lithium-tin enriched pegmatite mined primarily for spodumene near Kings Mountain. It is found in vugs and on flat fracture surfaces in leached pegmatite associated with bavenite, pyrite, tetrawickmanite, stannian titanite (4-6% Sn), albite and quartz. Due to the small size of the crystals (<1 mm), their perfect transparency and absence of color, brannockite is very difficult to see unless viewed under short-wave (only) ultraviolet light which causes the mineral to fluoresce a bright blue-white. Many crystals have extremely tiny pyrite crystals scattered over their surfaces but the relative ages of brannockite and bavenite could not be determined.

Brannockite is uniaxial negative with birefringence about .002-.001, $\epsilon = 1.566$ and $\omega = 1.567$. There is no optical evidence of twinning or cleavage. The mineral is brittle but hardness was not determined owing to the minuteness of the crystals.

The crystals of brannockite are so tiny, transparent, and rarely free of attached minerals (bavenite and pyrite especially) that the technique of flotation in methylene iodide (thinned with acetone) was used because all that was needed was one clean crystal. The densities of other minerals in larger crystals were carefully measured. These were then placed in the same solution with a brannockite crystal for comparison. Phenacite from Brazil (2.960) remained suspended well above brannockite while brazilianite from Brazil (2.985) was suspended slightly below the new mineral. On this basis a density of 2.980 was assigned to brannockite. The calculated density (Z = 2) is 3.08 gm/cm³.

MORPHOLOGY

The crystals are not complex, only four forms were noted in goniometric studies: {100}, {110}, {114} and {001}. The pinacoid {001} is by far the dominant form as all crystals are very thin plates; the ratio of thickness to breadth being about 1:20. The beveling form {114} is readily discernible on all crystals (Fig. 2). The axial ratio by goniometry is $c/a = 1.430$, which agrees well with the 1.421 ratio calculated from the refined x-ray data.

CHEMISTRY

First attempts at determining the composition of brannockite were with the electron microprobe. The only elements detected and determined in this preliminary analysis were tin and silicon. The very low summation and comparison with the chemistry of the mineral's analogs suggested the presence of significant amounts of one or more light metals. Many of the associated late hydrothermal minerals at the Foote mine are enriched in either beryllium or lithium.

Semiquantitative analyses using a combination of techniques (including flame and d.c. arc emission spectroscopy, spark source mass spectrometry, and electron microscopy) performed at Oak Ridge National Laboratory on a few crystals showed that brannockite contains the alkalis lithium and potassium in substantial amounts, and is free of beryllium. A return to the microprobe and a more thorough analysis gave 4.5% K_2O. A 3.08 mg sample was then analysed by flame photometry which finally provided a more quantitative value for the lithium content and supported the microprobe results for potassium.

The complete analysis (Table I) is in excellent agreement with the ideal, within the limits of the techniques employed and in consideration of the meager amounts of brannockite sacrificed.

Table I. Analysis of brannockite.

	$KLi_3Sn_2Si_{12}O_{30}$	**BRANNOCKITE**	
K_2O	4.2%	3.72+	4.5*
Li_2O	4.0	3.75+	
Na_2O		0.74+	
SnO_2	27.1	28.2*	
SiO_2	64.7	65.8*	
	100.0	102.2	103.0

* by electron microprobe

\+ by flame photometry

Precision of analytical techniques is about ±3% of amount present.

CRYSTALLOGRAPHY

Precession x-ray photographs show brannockite to be hexagonal, space group *P6/mcc.* The precession and powder photographs of osumilite and brannockite are almost identical, indicating a strong structural similarity between the two minerals.

Cell parameters were determined by computer refinement of x-ray powder data (Table II), using the program

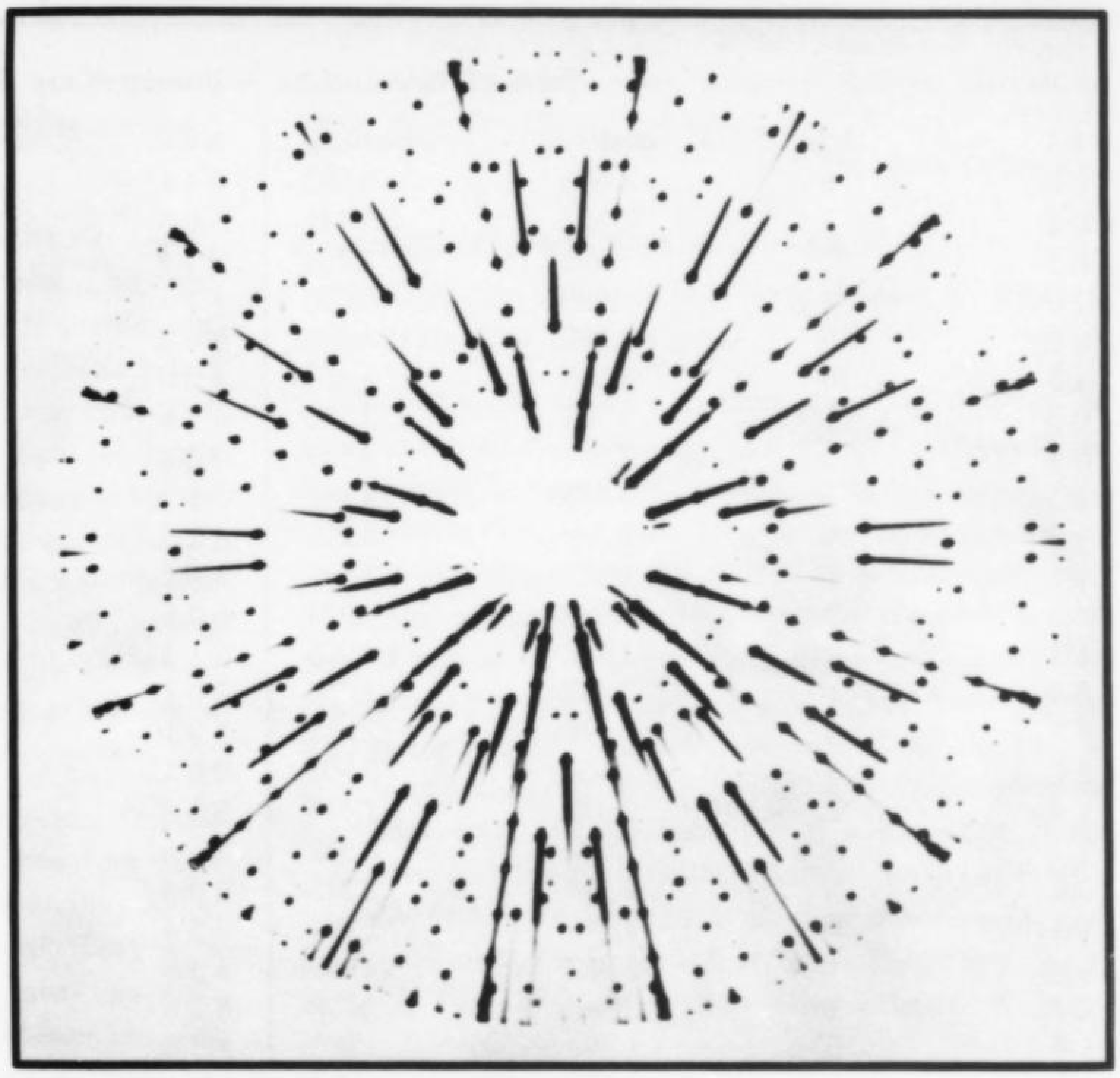

Fig. 3. **O-level precession photograph (001) showing twinned crystals.**

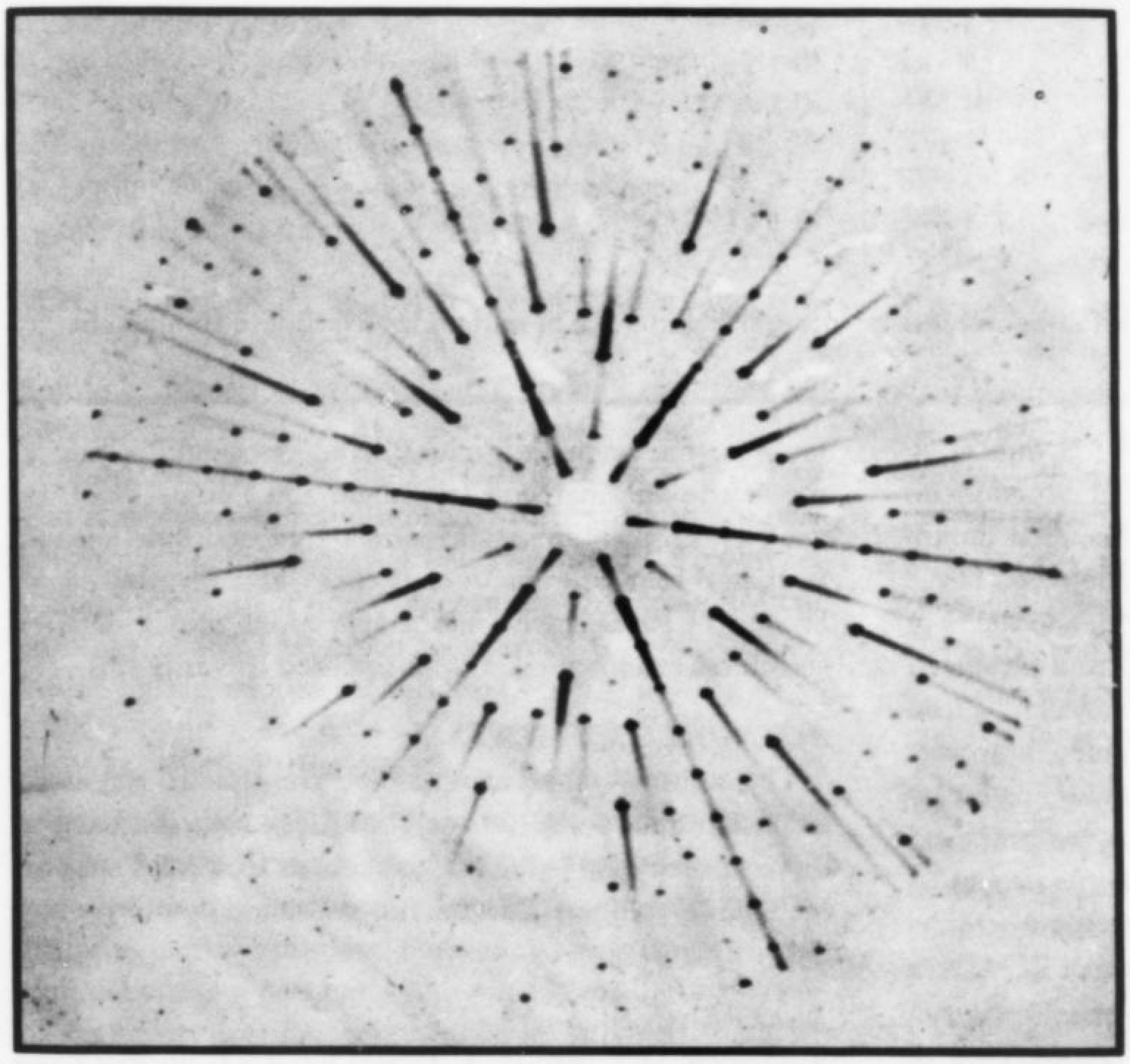

Fig. 4. **O-level precession photograph (001) of an untwinned crystal.**

of Appleman and Evans. Indices for a starting set of *d*-values were assigned by analogy with those of osumilite. Successive refinements and addition of new lines produced a completely indexed pattern. The refined cell parameters are $a = 10.0167(2)\text{Å}$ and $c = 14.2452\text{Å}$. The cell volume is 1237.814Å^3, and $Z = 2$.

Precession photographs of several brannockite crystals appeared as shown in Fig. 3. Twinning was suspected because of an obvious doubling of rows of strong spots on the photographs. A search for untwinned material eventually produced a crystal that gave the photograph in Fig. 4. Many of the crystals examined gave *c*-axis, zero-

Table II. Brannockite — Powder X-ray Data.

h k l	I/Io[1]	dcalc(Å)	dmeas(Å)
1 0 0	6	8.675	8.693
0 0 2	8	7.122	7.141
1 0 2	7	5.505	5.504
1 1 0	2	5.008	5.000
2 0 0	8	4.337	4.343
1 1 2	10	4.096	4.109
2 0 2	1	3.705	3.722
0 0 4	2	3.561	3.559
1 1 3	1	3.446	3.467
2 1 0	4	3.279	3.295
2 1 1	5	3.195	3.198
1 2 2	3	2.978	2.977
1 1 4	9	2.902	2.905
2 0 4	1	2.752	2.754
3 0 2	6	2.679	2.681
2 2 0	6	2.504	2.502
2 1 4	2	2.412	2.413
2 2 2	5	2.362	2.362
3 0 4	5	2.245	2.245
3 1 3	6	2.146	2.147
2 0 6	1	2.082	2.088
2 2 4	2	2.048	2.048
3 1 4	6	1.994	1.992
4 1 0	2	1.893	1.892
4 1 1	2	1.876	1.874
3 0 6	6	1.835	1.833
0 0 8	3	1.781	1.784
4 0 5	5	1.726	1.725
4 1 4	4	1.671	1.671
4 2 2	2	1.598	1.599
4 1 5	1	1.577	1.577
5 1 1	2	1.549	1.548
5 0 5	2	1.482	1.482
2 2 8	4	1.451	1.453
5 1 4	1	1.427	1.428
6 0 2	3	1.417	1.416
5 2 0	3	1.389	1.389
4 2 6	1	1.349	1.344
4 3 4	3	1.324	1.325
2 1 10	1	1.307	1.310
6 1 2	2	1.300	1.297
4 0 9	2	1.278	1.278
6 0 6	3	1.235	1.236
6 1 5	4	1.200	1.200
3 0 11	3	1.182	1.182
3 2 10	2	1.158	1.158
0 0 13	3	1.096	1.096
5 2 9	6	1.044	1.044
6 3 6	2	.9928	.9928
9 0 3	1	.9446	.9447
7 3 4	1	.941	.941
6 3 8	1	.931	.932
8 2 6	1	.8795	.8795
8 3 5	2	.8415	.8414
4 3 14	2	.8283	.8283
6 6 3	2	.8221	.8221
10 1 2	1	.8180	.8180
10 1 4	1	.8022	.8022
9 3 2	2	.7969	.7969
11 0 3 10 1 6	2	.7779	.7779

[1] Visual estimates from powder photograph. Silicon used as internal standard, Cu radiation (Ni filtered) camera 114.6 mm diameter.

level precession photographs the same as Fig. 3, indicating a non-random relationship between pairs of brannockite crystals. Two lines of spots in the twin precession photographs are common to both individuals of the twin. These lines pass through the reflections 210 and 510, and the twin would, at first glance, appear to be equally well produced by using either of these directions as a twin axis. Close scrutiny of the untwinned and twinned nets, however, indicated that some weak maxima are not duplicated by twinning about [510] , and therefore [210] is the proposed twin axis for brannockite. The measured displacement of the twinned nets in brannockite precession photographs is 21°23', quite close to the calculated value of 21°47' for twice the angle between (210) and (110).

COORDINATION AND STRUCTURAL FORMULA

The general formula for osumilite-type minerals is $Me^{XII}Me_2{}^{VI}Me_3{}^{IV}(Si,Al)_{12}{}^{IV}O_{30}$ where Na, K and Ca are generally present in 12-fold coordination, Mg and Fe in both 6- and 4-fold coordination, and Al, Mn and Ti in 4-fold coordination. The ideal formula of brannockite is $KSn_2Li_3Si_{12}O_{30}$, which fits well the general structural formula for the osumilite group (including osumilite, yagiite, roedderite and merrihueite)(Bunch and Fuchs, 1968). By analogy, Sn in brannockite is in 6-fold coordination and Li is in 4-fold coordination. If there is a distribution of Sn and Li between the 4-fold and 6-fold sites a detailed structural examination will be required to verify this.

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What's New in Minerals, continued from page 55

structure (the intersection of two faults was not responsible). Much open space was produced and the mineralogy of both pipes is quite similar.

Within the breccia pipe from which the natrolite came, natrolite was by far the most abundant mineral. The crystals were generally not attached to the walls of cavities but were found broken off and loose. Those few crystals found still attached to basalt were broken off near their base, and in cases were healed to yield new terminations. A small fraction of the crystals were doubly terminated. Heaps of crystals were cemented together by a mixture of basalt dust and heulandite. Other crystals were deformed but not broken. A small-displacement vertical fault running through the breccia may have been responsible for movement within the breccia. Blasting as a source of broken crystals can be ruled out.

Along with the natrolite, rather large analcime crystals were found, some of fist-size. These analcimes were often well formed. They show some evidence of etching, especially in bottom surfaces in contact with basalt. They were often natrolite encrusted. Calcite crystals, also unusually large, occurred, sometimes enclosing natrolite. The calcite is brown in color and shows phantoms. Copper sulfides of colloform texture were found as well. Weathering of this material yielded a single (out of thousands) blue natrolite crystal which is in my collection. Also found were prehnite, some datolite, and what may be gmelinite. Heulandite commonly coats the other minerals in tiny crystals of unusual form.

Let me summarize what I've found out concerning paragenesis. First, the open space was produced by steam explosion. Second was deposition of prehnite, followed by simultaneous deposition of analcime, calcite, and sulfides. Third was deposition of natrolite. After most growth had been completed, heulandite began to coat the natrolites. Fourth, movement occurred and reshuffled the contents of the breccia pipe. Some deposition of heulandite and natrolite occurred after the movement. Last was formation of sulfide weathering products."

HOW TO FIND TURQUOISE

"In briefly describing a deposit of turquoise on the Fort Apache Indian Reservation, Arizona, Richard T. Moore mentions that anomalous radioactivity detected at the site during surveys flown by the U. S. Atomic Energy Commission caused a particular search to be made of the turquoise quarry for the source mineral. This was found to be the copper-uranium-phosphate *metatorbernite*, and 'inasmuch as turquoise is a copper-aluminum-phosphate, the association with metatorbernite seems reasonable, and *it is suggested that prospecting for turquoise can be aided materially by using radiometric methods.'* And further, 'Two additional anomalies were discovered ... and these should be critically examined for turquoise.' Reference: Moore, R. T. (1968) Mineral deposits of the Fort Apache Indian Reservation, Arizona. *Arizona Bureau of Mines Bulletin* 177, pp. 54-5."

John Sinkankas

RAMSDELLITE-GOETHITE EPITAXY?

The following note was sent in by Garrett K. Johnson of Santa Fe, New Mexico ...

"While looking at the fine SEM photos of minerals in geodes from Chihuahua (Sept/Oct, 1972), I was struck by the decided epitaxial relationship between ramsdellite and goethite (Figs. 11 a-c). An observation of further interest is that ramsdellite is stated to be a "relatively common mineral" in these geodes, whereas ramsdellite is in general not at all common. I am not aware whether an accurate relationship has been established between the free energies of ramsdellite (orthorhombic MnO_2) and pyrolusite (tetragonal MnO_2), but the overall impression from chemistry and mineralogy is that pyrolusite is the phase favored thermodynamically under most conditions, and that ramsdellite is a fairly unusual structure for this composition. If this be so, one would say that any occurrence of ramsdellite must have been attended by some special circumstances.

It may be that the special circumstance in the geodes was the prior existence of crystallized goethite. Goethite and ramsdellite both crystallize in the orthorhombic system, though this by itself is not necessarily significant. It happens that they are very similar structurally, though this is not a particularly obvious possibility from inspection of their compositions. (See, for example, A. F. Wells' *Structural Inorganic Chemistry*). If the usual formulae are rewritten as Mn_2O_4 and $Fe_2O_4H_2$, bearing in mind that ionic hydrogen occupies no appreciable lattice volume, this structural similitude becomes more plausible. In goethite the effect of the hydrogen, as H^+, is to shorten certain O-O distances by hydrogen-bonding, making them somewhat shorter than the corresponding distances in ramsdellite. Besides being nearly isostructural, the ionic radii of Fe(III) and Mn(IV) are very close, and I would think the lattice parameters of ramsdellite must be nearly the same as those of goethite.

When two phases are commensurate in this fashion the possibility of mutual epitaxial nucleation and growth almost always exists. (The chief failure of current theories of epitaxy is their inability to explain why this phenomenon sometimes occurs between phases that are *not* simply commensurable!) Epitaxy will be most familiar to many readers in the form of "cloud-seeding", wherein ice crystals are induced to form on the surfaces of particles of another material, such as beta silver iodide, which has a lattice enough like that of ice to serve as a "template".

The observations on ramsdellite and goethite raise the question whether the very presence of ramsdellite in the Chihuahuan geodes may not be the result of the structural coercion afforded by the pre-existent goethite. That is, has the goethite provided a pattern sufficiently like ramsdellite for ramsdellite to grow rather than pyrolusite? A possible test observation is, has pyrolusite been observed that was not associated with pre-existent goethite?

Considering the ubiquitousness of goethite, it might be worthwhile to examine samples from other manganese-bearing areas for the presence of ramsdellite.

I certainly do not assume that these possibilities have escaped the notice of the authors of the article; I know it was not their intention to interpret their interesting microscopic observations in such detail."

Comments on Mr. Johnson's letter have been provided by Howard T. Evans, Jr., of the U. S. Geological Survey ...

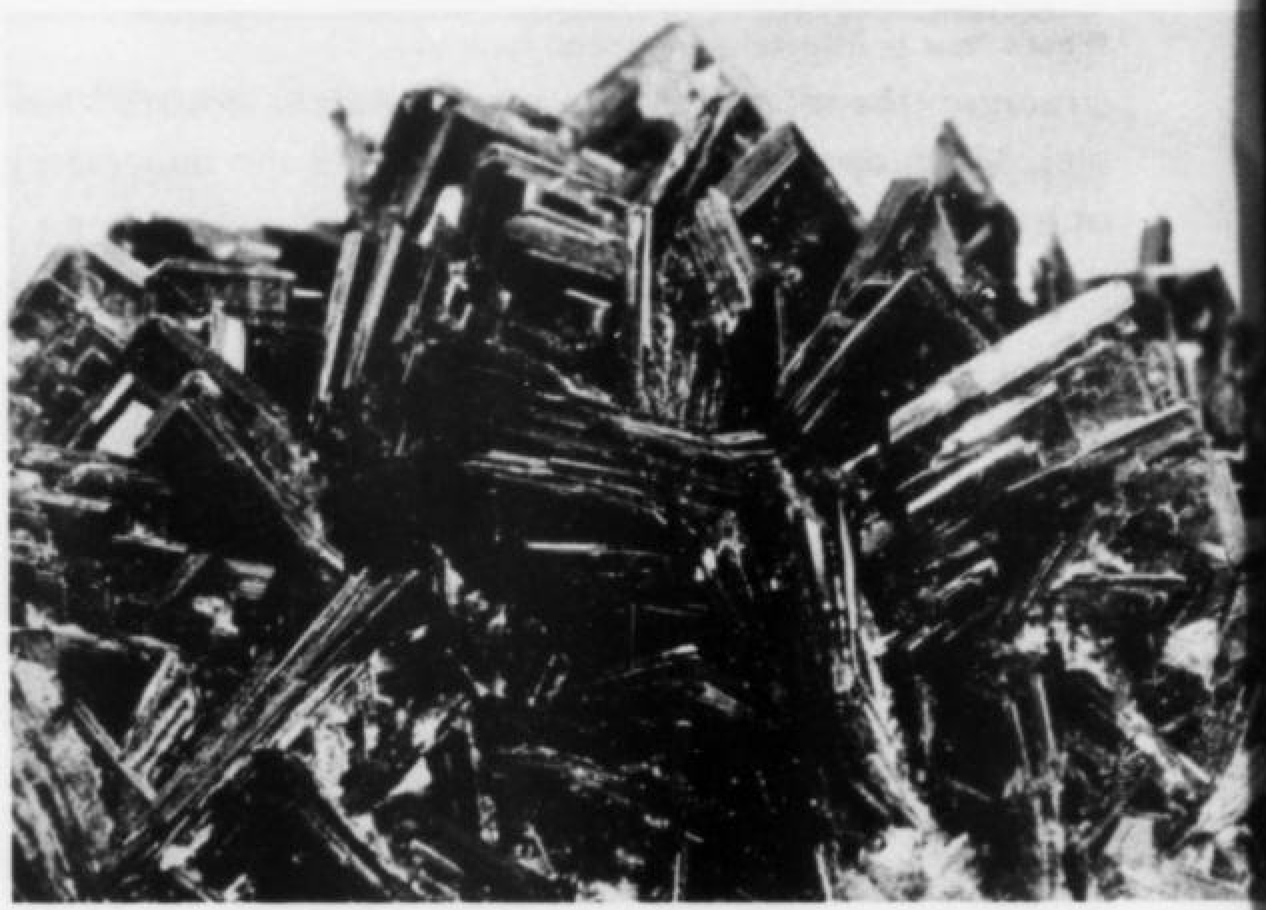
"Robert Finkelman (the principal author of the geode article) has suggested that I comment on the astute observations of Mr. Garrett K. Johnson on the morphology of ramsdellite. There is indeed a nearly perfect epitaxial relationship between ramsdellite and the obviously earlier goethite. Their orthorhombic crystal structures are very similar and always in parallel position. As Mr. Johnson says, a substrate crystal can stabilize a metastable form of another substance through epitaxial control, but only in very thin films in which the interfacial energy effects are still felt. However, a metastable form could not be produced in bulk form in this manner. In the case of ramsdellite, a much more likely explanation is that the ramsdellite is pseudomorphous after groutite, which grew at some earlier time as a stable form. The groutite also has a structure close to that of goethite, and the epitaxy is perfectly natural. The groutite was then oxidized by loss of hydrogen to the air ($2HMnO_2 + 1/2\ O_2 - 2MnO_2 + H_2O$) at low temperature so that the solid ramsdellite is unable to revert to the stable pyrolusite.

Further details of this process and the evidence supporting it are described in a paper in the *American Mineralogist* by Fleischer, Richmond and Evans (vol. 47, pp. 47-58, 1962)."

APACHE REVISITED

A note from Wendell E. Wilson ...

"As a result of recent rains in the Globe, Arizona, area, mud and rubble slides have buried the first crawl-hole in the Apache mine, famed for its bright-red vanadinites. About eight feet of dense debris covers the area near the hole, and much more threatens to come down soon. Extensive digging and shoring would be required to make this section passable again. With the main tunnel to the stope closed, intrepid collectors have constructed a precarious series of ladders down the hole in the ceiling of the stope. More ladders are needed however, and the danger of caving is still great. Only the most dedicated and/or foolhardy will probably be collecting in the Apache mine from now on."



Gemmy metatorbernite crystals from Musonoi. The platy crystals average about 1/2" on an edge. Smithsonian Institution specimen. ***Photo by Joel E. Arem.***

METATORBERNITE

Old habits are hard to break but changes in mineral nomenclature are especially slow in gaining adoptance. Although many collectors have been aware that autunite (a hydrated calcium uranium phosphate) is unstable under normal room conditions, and alters by losing some of its water, we still persist in labeling the altered material autunite. It should, of course, be referred to as meta-autunite because, once altered, it isn't autunite any more. Meta-autunite is a perfect name for the material because it is an informative one — it says first that the mineral is not autunite, but it also emphasizes the genetic relationship between the two phases. Many of us have watched in dismay as autunite from the Daybreak mine, near Spokane, Washington, altered to meta-autunite and slowly disintegrated as a result of that alteration.

It is probably not so well known that torbernite behaves in much the same manner. Thus there are probably no torbernite specimens in any mineral collections unless they have been kept in liquid since they were collected.

All torbernites do not display so obviously that they have altered to metatorbernite. While most become opaque and light-colored, where once they were transparent and dark green, many of the extraordinary crystal groups from Musonoi, Zaire (formerly Congo), remain beautifully transparent and deep green in color. This is such a striking departure from normal that it was suspected that torbernite from this locality was probably stable and would not alter. However it has recently been demonstrated by x-ray diffraction that even the Musonoi specimens have all changed to metatorbernite. A special camera which permits a tiny crystal fragment to generate a "powder pattern" was used in order to be certain that the transition was not produced while grinding the sample to a powder.

Therefore most, if not all, torbernite in collections should be relabeled metatorbernite just as other labels should be changed to meta-autunite, metazeunerite, etc.

THE COLLECTOR

by Richard A. Bideaux

Some older mineralogies can afford substantial pleasure on present day reading. One such is the *Manual of the Mineralogy of Great Britain and Ireland,* by R. P. Greg and W. G. Lettsom, 1858. With a strong reliance on chemistry and crystallography, this text is one of the earliest to resemble our present-day works, and has never been properly updated, so still serves as a major source on British minerals. About 240 species are described in its 483 pages, including those for which Cornwall, Cumberland, Scotland and Ireland are principal. Locality descriptions are for the most part brief, but occasionally an extended discussion will be given. One Scottish locality for gold caught my eye: "Gold has been observed by Mr. Tennant accompanying cubic pyrites near the Marquis of Breadalbane's shooting-box, nine miles south of Glencoe." Or, on one of the most noted Scottish minerals: "This beautiful and rare species was found in cutting a railway tunnel at Bishoptown, near Paisley, in Renfrewshire, and has not been since met with there. It occurred usually in small but very perfect and brilliant crystals, generally insulated, engaged in a porphyritic greenstone, on mammillated Prehnite, associated with calcite, natrolite, and occasionally galena. The largest crystals were not more than a quarter of an inch or thereabouts in diameter, generally very minute. The species is named in compliment to Lord Greenock, now Earl Cathcart, by whom it was first noticed. The first crystal of Greenockite was found by the late Mr. Brown of Lanfine House, nearly fifty years ago, on the north side of the Clyde, was by him taken for blende; this crystal was more than half an inch across."

Frequent reference is made to specimens in private hands, as for example, the following under anglesite: "Two of the finest crystals of Anglesite yet found in Great Britain or Ireland, and now deposited in Mr. Greg's collection, one of them 4 inches in length, and also extremely perfect and translucent, came originally from the neighborhood of Wirksworth, though the name of the precise mine was not mentioned."

The activities of dealers figure prominently in some descriptions as well. Under fluellite: "Contains, according to Wollaston, fluorine and aluminum. It was first noticed by Levy, and is an extremely scare mineral; a few specimens were obtained about forty years ago, and none again met with until four of five years since, when Mr. Richard Talling, an active and intelligent dealer in minerals at Lostwithiel, succeeded in obtaining a few specimens at the old locality, Stenna Gwyn, near St. Austell in Cornwall, in minute crystals associated with uranite and acicular Wavellite on a gray quartz rock; it sometimes forms a crust of minute crystals in clefts of the quartz-rock itself. For the last four summers (it is only during dry weather that the spot is accessible) Mr. Talling has in vain endeavored to procure a single fresh specimen, but as he intends renewing his search, it is to be hoped that his perseverance will again be rewarded. In the meanwhile it may be of service to him to mention, for the information of collectors, that he still has in his possession two or three specimens of this very rare species at their disposal."

Perhaps you stumbled momentarily at the uranite in the above description? Not all of the species named in this book are as we know them today: uranite is our present meta-torbernite, under which we find: "Cornwall; magnificient specimens of this beautiful species were met with in considerable abundance at Gunnis Lake, near Callington, some years since. They occurred in large thin aggregated plates, associated with smoky-gray quartz, at the depth of about 90 fathoms from the surface. Several young mines now being in work in the immediate neighborhood of Gunnis Lake, there is every hope that specimens of equal beauty to those contained in collections of some years' standing will again be met with."

Cromfordite is another; as to its present name, phosgenite, Greg and Lettsom have only to say: "Breithaupt's name, Phosgenit, ... is based upon a notion which is not only too fanciful to render it admissable, but is at the same time incorrect."

"Many years ago a few fine specimens of this rare mineral were met with in an air-shaft to a level at a mine between Cromford and Wirksworth in Derbyshire. Most of those specimens are preserved in the British Museum. No more were afterwards procured in consequence of the mine becoming flooded. A deeper level being then driven, the shaft in question became drained. Hearing of this, Mr. Bryce Wright, an intelligent and zealous dealer in minerals, now residing in London, determined to take the matter up, and succeeded in making out, in 1851, the precise shaft in which the crystals had been originally met with. His further labours were rewarded by the discovery of a few fine specimens of this very rare species, in cavities in decomposed galena, here and there associated with

Anglesite and Matlockite. The exact spot where the crystals were originally met with was then called the Bage mine, and is in the middle of a little village called Bole Hill. In speaking of the crystals of this mineral rediscovered, Mr. Wright says, 'they are only found at certain places in the mine where decomposition of the galena has taken place. I have examined every mine in the neighborhood, and have not met with a single crystal of this mineral, except at the spot referred to; and as the mine is no longer in work, I do not think it likely that this locality will furnish any more specimens.'"

"Some of these crystals are exceedingly fine and large, being highly modified, transparent, and in a few instances, 2-1/2 inches long."

And for matlockite: "This basic chloride of lead, with which, as a natural species, mineralogists have only recently become acquainted through the zeal of Mr. Wright of Liverpool ... in decomposed galena, associated occasionally with Cromfordite, in one of the air-shafts of an old level near Cromford in Derbyshire. Crystals always tabular, seldom large, though a crystal in the possession of Mr. Nevill measures nearly 2 inches across."

Cornish cassiterite is justly world-famed: "The most curious and beautiful crystals of tin ore, the most remarkable for the perfection of their form and the multiplicity of their combinations, were met with some years ago at the Wherry mine, near Penzance. Everything connected with this mine was curious: the shaft was not on the mainland, but was sunk through artificial earthworks below high-water mark; and the rock in which the tin ore occurred is a chloritic conglomerate, the nodules of chlorite being, as it were, cemented together with the oxide of tin. It is in the crevices and hollows between the nodules that the crystals alluded to were found. The workings at the Wherry mine have been given up for many years." Sir Arthur Russell, pre-eminent collector of British Minerals, once wrote an article on the Wherry mine, which can be consulted in the *Mineralogical Magazine* for more details.

Under siderite (today called chalybite by the British!): "At Virtuous Lady mine are likewise found hollow cubes of siderite, from a small size to 3 or 4 inches square; in the interior of the cubes there are not unfrequently a few splendid tetrahedral crystals of copper pyrites, remarkable for the beauty of their tarnish, and for the manner in which they are traversed with diverging groups of opaque-white, radiating groups of quartz crystals. The original cubic crystals on which the siderite has been deposited, may probably in most cases have been pyrites, which is very abundant in that form at this locality, but the authors know of one instance in which this spathose covering completely invests a cube of fluor. In the British Museum there is a very fine specimen of these curious hollow cubes, which are known to the miners by the name of *boxes*. Many fine and interesting crystallizations of this mineral have occurred at the Virtuous Lady mine."

Every serious collector would enjoy having a copy of this book on their shelves; with the number of reprints in circulation these days, it is unfortunate that this has not been selected for reproduction. Sir Arthur Russell had been compiling notes for a revised version before his death, and these are with his collection at the British Museum. Perhaps someone will continue the effort, but the flavor of the original work will be impossible to capture.

AFMS SCHOLARSHIP FOUNDATION HONOREES

One of the most gratifying accomplishments of the American Federation of Mineralogical Societies was the creation of its Scholarship Foundation. This is a separate organization with its own elected officers. The members of this organization are the Directors of the AFMS.

Each year, up to 1971, a person with outstanding accomplishments in the field of Earth Sciences was honored during the National Convention. Each Honoree had the privilege to select an Institution of his choice and with its help select students, who received the Foundation's Grants. These Grants are awarded to help the Grantee to earn an advanced degree, either an MS or PhD in the field of Earth Science.

As the Scholarship Foundation's funds grew, so did the grants and the number of them. From one grant of $300.00 per year for two years, or a total of $600.00, these grants grew so that now the Foundation is able to award six grants of $750.00 each for two years, or $1,500.00 for two years, to each of the grantees. Only the income of the fund is used for that purpose.

Since 1972 each Federation selects its own Honoree within the bounds of its Federation.

1973 Honorary Award Winners of the AFMS Scholarship Foundation

California Federation — H. Stanton Hill (Geologist)
North-West Federation — William G. Melton, Jr. (Paleontologist)
Midwest Federation — Stuart Struever (Archeologist)
Eastern Federation — Robert L. Nichols (Geologist)
Rocky Mountain Federation — Theodore R. Walker (Petrologist)
South-Central Federation — Donald McGannon, Jr. (Geologist)

The AFMS Scholarship Foundation is proud indeed to be able to present awards to these distinguished men for their great contributions in the field of Earth Sciences.

The Record Bookshelf

***Kristalle unter der Lupe*, by Dr. Werner Lieber, Ott Publishing Co., Thun, Switzerland or Munich, Germany, 1972, 244 pp., (89 German marks, about $30 U. S.)(in German).**

This book is primarily a picture book of rare or seldom seen crystallized mineral specimens. It is also a guide for photographers and a source of enjoyment for all who love beautiful crystals. The title tells everything, but the subtitle "Small treasures in color", emphasizes the concept of this beautiful and informative book. This is the latest of Dr. Werner Lieber's books. It contains 88 full page color plates and many other black and white photographs and line drawings. It is, in one sense, a picture book and yet it is much more.

In the preface Professor Hugo Strunz expresses " ... Attractive are the pictures which Werner Lieber, a Master of Photography and enthusiastic Friend of Minerals, shows us of crystals found in clefts in the mountains, druses and mines of our earth. Masterpieces of nature are reproduced true to form and color, and invite deep reflections. They will stimulate friends of minerals to better their own collections and will find new friends among those who love minerals and rocks." In the introduction, Werner Lieber states that this volume is dedicated not only to lovers of minerals and crystals as collectors, but also to friends of photography, to be a source of inspiration.

The author gives a short, but thorough, explanation of the concept of the "building blocks of crystals", atomic structure and space groups, formation of crystals, habits, spiral growth, distortion and etching, twinning and form of crystal aggregates. Next are descriptions of micromounts, thumbnails and miniature minerals, tools for collecting in the field, and the trimming, cleaning and mounting at home. These chapters are, of necessity, relatively short since the book is primarily slanted toward the photography of the specimen. The various microscopes and illuminators, photoequipment and the orientation of the specimen for photography are thoroughly discussed. Many pages are devoted to micro- as well as macro-photography, camera attachments for the microscope, the use of extension bellows, the types of films and the number of lamps used to achieve the desired result. Of special interest to photographers of minerals is the section of the book called: Remarks to the color plates. All 88 color plates are described in detail. There are 12 pages of explanation of how the plates were taken; the objectives used, stop and exposure times are given. The importance of illumination, direction and number of lights, emphasis of certain crystal faces to bring out the crystal structure, are noted. Selection of views and self-criticism are found in these pages. Point illumination, achieved through the use of flexible fiberglass optics, is described. The author emphasizes that not every item which may be well-known to a photographer is mentioned. He invites the readers to express their wishes or ideas to him so that they may be considered in the next edition, if such is required.

The bulk, and certainly the most beautiful section, of the book are the 88 full size color plates of the minerals (see cover photo, this issue). The right-hand page carries the color photograph and the facing page gives the name of the mineral, locality, origin of the name, the composition, and a short description of the crystal form with some crystal drawings. In most cases the associated minerals, as well as some other locations of where the mineral was found, are given.

As Professor Strunz mentioned in the preface, only a master photographer with a thorough knowledge of crystallography can bring out the important features of the crystals shown on each color plate. This has been accomplished to a high degree in this book. This volume is not only an excellent guide and inspiration to photographers of crystallized mineral specimens, but it should also be within reach at all times to every lover of minerals, to spend a few minutes or hours with these beautiful small jewels of nature.

Paul Seel

***Glossary of Geology*, edited by Margaret Gary, Robert McAfee, Jr., and Carol C. Wolf, published by the American Geological Institute, 2201 M St., N.W., Washington, D.C. 20037 ($22.50).**

In 1950 a group of geologists in Tulsa, Oklahoma recognized the desirability on agreement of definitions used by geologists. They outlined a project that ultimately was undertaken by the American Geological Institute. The result was the publication, in 1957, of *Glossary of Geology and Related Sciences*, containing about 14,000 entries. In 1960 a second edition appeared, *Glossary of Geology and Related Sciences, with Supplement*. The supplement contained an additional 4,000 terms.

The new glossary contains nearly 33,000 terms, was ten years in the making, and is based on definitions by 175 authorities. Of particular interest to readers of the *Mineralogical Record*, the mineral species coverage is essentially the same as in the *Glossary of Mineral Species, 1971*, published by the *Record*. Both are by the same authority, Michael Fleischer. The definitions in the *Glossary of Geology*, in addition to giving chemical composition, for most species include anywhere from a line or two to a long paragraph of information such as crystal system, properties, and mode of occurrence.

The new *Glossary of Geology* is an outstanding piece of work and would be a very useful addition to the library of everyone concerned with geology and related subjects on any level.

George Switzer

***Colorful Mineral Identifier,* by Anthony C. Tennissen, photographs by Werner Lieber, Sterling Publishing Co. Inc., 419 Park Avenue South, New York 10016, 1969, 224 pp., 117 color plates, $3.50.**

This little volume (4-1/2 x 5-3/4 x 3/4 inches) will be a pleasant surprise to mineral photograph enthusiasts. Ninety-nine minerals, including several varieties, are represented in a series of excellent color photographs by Werner Lieber. The minerals are well chosen, representing most of the common species and also a few rarely seen in photographs such as pharmacolite, uranophane and harmotome. There are many outstanding specimens illustrated; in my opinion not a single photograph bears replacing. The wide variety of magnifications, the exceptional rendering of luster characteristics, the sharpness of focus, and the artistic compositions and lighting all attest to the great skill of the photographer. A careful study of these plates constitutes a real lesson in mineral photography from which even professionals can benefit. In particular the photographs of vivianite, bournonite and gold are the best I have ever seen of these minerals. One of the nicest features of this book is the attractive *hard* cover printed with color photographs.

The format is neat and concise. In general, alternate pages contain a description of a mineral, giving basic data such as composition, physical properties, crystal system, habits and occurrences. On the facing page opposite each description is a 2-3/4 x 3-3/4 inch color photograph of the mineral. The magnification for each photograph is given. Nearly three-fourths of the specimens are thumbnails or miniatures; most of the remainder are small cabinet pieces, and seven could be considered micromounts. The one glaring oversight is the lack of locality data for the specimens pictured.

Colorful Mineral Identifier has two possible uses. You can buy it for yourself because of the excellent photographs, or you can give a copy to someone who is new to mineral collecting. It is an ideal book for developing an interest in minerals, and because of the high photographic quality it actually *is* useful for identification on the beginner level. The cost is nominal, averaging only 3 cents per color plate.

Wendell E. Wilson

***Gemstone and Mineral Data Book* by John Sinkankas, Winchester Press, 460 Park Avenue, New York 10022, 1972, 346 pp., $8.95.**

In his preface Captain Sinkankas describes *Gemstone and Mineral Data Book* as being "designed specifically for use by mineralogists, gemologists, jewelers, and lapidaries". Actually only about one-sixth of this book is of interest to gemologists, jewelers and lapidaries exclusively. The remainder is a highly valuable, useful, and time-saving compilation of information that mineral collectors will repeatedly refer to. Comprehensive lists and tables of the following types are included: chemicals and reagents useful in mineral identification, minerals according to their specific gravity, minerals according to their hardness, minerals according to their cleavage, habit, optical and fluorescent properties, chemical tests used in mineral identification, the meaning of Greek and Latin word forms commonly used in the earth sciences, German mineral names and their English equivalents. and a great many other handy tabulations. For the collector attempting to identify minerals without the aid of x-ray equipment this book will be the only reference necessary in many cases. Another section tells how to recognize and prepare meteorite specimens. And if you are planning a collecting trip to Laurion, Greece, for instance, *Data Book* will even tell you the climate in Greece during various times of the year!

Also included is a comprehensive section on the cleaning of mineral specimens. This section is a perfect compliment to Pearl's *Cleaning and Preserving Minerals* (reviewed here in Vol. 3, no. 6). The data is arranged by mineral to be cleaned whereas Pearl's arrangement is according to the substance to be removed. A separate list of reagents for cleaning is included. Most of the entries indicate only the solubility of the particular minerals in acids, but many give detailed cleaning methods, and the work as a whole is remarkably complete. As in Pearl's treatment, there is no index, but if the two books are used together an index is not needed. Some overlap between the works of Sinkankas and Pearl on cleaning minerals is to be expected considering that Sinkankas referred to *Mineral Collector's Handbook*, the same book from which Pearl built his present guide. But there is much new material added from Sinkankas' own considerable personal experience.

In general, *Gemstone and Mineral Data Book* contains such a great deal of diverse and comprehensive material that virtually anyone in the earth sciences should find it useful.

Wendell E. Wilson

KENT C. BRANNOCK, EDITORIAL BOARD MEMBER, DIES

On Wednesday, February 21, Dr. Kent C. Brannock, of Kingsport, Tennessee, died of cancer at the age of 49. "Casey" Brannock was a devoted mineral collector, an inspiration to countless other collectors, and a diligent student of mineralogy. In recognition of his many contributions a new mineral has just been named *brannockite* in his honor (*Mineralogical Record,* this issue).

Dr. Brannock was a native of Independence, Virginia, but lived in Kingsport for the past 25 years where he was senior research associate for the Tennessee Eastman Company. He had a distinguished career as an organic chemist. Just last year he won the Herty Award, which is given annually by the American Chemical Society (Georgia Section) in recognition of the work and service of outstanding chemists who have contributed to their chosen field and are from the southeastern section of the country. He was recently made a member of the editorial board of the *Mineralogical Record*. When the *Record* was only in the planning stage, Casey provided sound counsel, encouragement and advice, and throughout its three years of existence he offered editorial assistance. His ideas were always absolutely sound, his reasoning extremely logical, and many of his suggestions were implemented.

Casey started collecting minerals when he was a young boy. In more recent years, weather permitting on weekends, Casey was in the field searching for new localities or digging further into old ones. Nearly ten years ago he became fascinated with the minerals of the Foote Mineral Company's spodumene mine near Kings Mountain, North Carolina. He sent many specimens from this locality to museums and collectors around the world. His discoveries there stimulated a serious study of Foote mine minerals by several mineralogists, so it is entirely appropriate that brannockite is one of the new species from this mine.

Casey was a fine gentleman admired by all of his associates. He loved the out-of-doors and could identify most of the wildflowers of the east-central states. His relaxed manner and wonderful sense of humor put people at ease immediately in his presence. Casey Brannock was truly a great man; his greatness derived from a rare blend of excellence as a chemist and an amateur mineralogist with a remarkable degree of humility and love of mankind.

Yedlin on Micromounting

We forget, sometimes, that the title of this column includes the word "Micromounting". We were brought up sharply when a matter of basics arose at a recent question and answer session at a mineral club meeting. We became aware of the fact that we had been assuming that all readers were more or less advanced in the hobby, and were completely grounded in its fundamentals. Not so! One of the queries was about microscopes — how high a magnification was needed properly to study micromounts.

Some years ago we observed that there was a lifetime of work for any collector at 20X (twenty magnifications, not diameters). About 95 percent of our own work is done at this objective-ocular combination. The 5 percent of the time that you may be reaching down for the minuscule doesn't justify the added effort and cost of very high powered equipment.

There is so much to see at 20 power that delving into 60, 72, or 100 magnifications continuously causes the low power stuff and its beauty to pass you by. On occasion you will need, perhaps, 36X or 48X to study a termination, or the direction of a striation, or something similar, and for this reason we suggest that your instrument have changeable oculars and objectives. Fixed optics limit your observations; with a small added investment you may adapt to almost anything you may need. This may seem a contradiction of our original premise, but we still insist - very low power will serve you adequately.

What should a good 'scope cost? There is quite a variation in price. The instrument can run about $100 (Edmund Scientific Co., Great Barington, N. J.) to perhaps $720.00 (Bausch & Lomb, American Optical, Zeiss, Leitz, Wild, Nikon) with various median amounts, depending upon needed refinements. But all viewing tools should have certain fundamentals, regardless of price. These include: 1. Stereo-binocular type, so that observations may be made for long periods of time without undue eyestrain or stress; 2. Fine optics, for without them all else is of little value; 3. Changeable oculars and objectives for mobility of operation; 4. Solid frame and careful tooling, for the body of the 'scope, which holds the optics, does constant work and must be stable and long lasting; 5. Interpupillary adjustment, for all heads were not created equal; 6. Wide field optics, so that there is visible more than a mere point on a surface; 7. Long working distance from objective to specimen, so that manipulation and study may take place adequately.

The fine 'scopes have all of these features, and more. Many of the less expensive ones do also, but the majority of the least costly ones do not, although they may incorporate some of these necessities. Read the yellow pages of your telephone directory under optical equipment, scientific instruments or microscopes. Very often large institutions purchase new microscopes, trading in older, but quite satisfactory, tools as part of the deal. Many a micromounter has been able to lay his hands on a good used magnifier at a fraction of its original cost. The seller usually reconditions these used tools, and they're good for years. First check them out with a specimen or two. If they're troublesome to use, cause straining, and give poor vision, forget them. Nothing is a good buy if it doesn't work.

Consider this, too, when obtaining a microscope, even a fairly expensive one. When you've reached the status of a micromount collector your interest in minerals is a firm one and can be counted on to last for many years. If you will self amortize your investment over the number of years that you can reasonably expect to maintain an interest in the hobby you will find that the cost is something like twenty dollars per year, a trifling sum when considering the joys of the art. And the saving in specimen cost will pay for the instrument in no time at all. If you subsequently develop an interest in things other than mineral collecting, there is a constant demand for good used 'scopes. You'll be ahead.

Bear in mind that no microscope is of any use without good lighting. The manufacturers of these enlargers all make lights, too, some as integral parts of the instrument. Unfortunately they're expensive. The "Tensor" light and others of its type are not really capable of doing a good job. Something with a transformer to bring house current down to automobile lamp voltage (G.E. 1483) is the basic principle of the American Optical light, a fine one. We've seen goose necked desk lamps used to advantage, the summer heat controlled with an electric fan, and in some cases a magnifier on a stand placed between the light and the mineral on the stage of the 'scope. Get the best if you can afford it. You'll not regret it.

NOTES: The tetrahedrite from Walton, Nova Scotia, (*Mineral. Record*, Vol. 3, No. 5, pg. 203) is tennantite. Dr. Arthur Roe at the Smithsonian (personal communication, November, 1972) "The x-rays are quite unequivocal on this point ... and this tennantite often has epitaxial chalcopyrite on it ..."

The Baltimore Mineral Society, publishers of the *International Directory of Micromounters,* will furnish copies at seventy-five cents each. Address: 7 West Mulberry Street, Baltimore, Maryland 21201.

Small dark green paper tabs on old specimens and labels at Amherst College were affixed to preserve the paper from destruction by vermin. They contain arsenic. We saw no vermin and the labels were intact, ergo ...!

"You can't tell the players without a scorecard." As a youngster we sold programs for Dodger games at Ebbetts Field, Brooklyn, New York, and that was our sales pitch, and continues to be, for we emphatically state that no specimen should be without an accompanying label giving name and explicit locality as a minimum, and preferably affixed to the specimen.

On the occasion of our visit to Detroit last fall we visited Wayne State University to look at its mineral collection, and came across the remains of another famous assemblage, which had been discarded, and partly reestablished at Wayne. The labels read: "Edison Mineral Cabinet, Orange, New Jersey, U. S. A. Collector, G. F. Kunz." David Lowrie, curator at the college, said that the collection had been at Thomas A. Edison's museum, at his death went to the Ford museum at Dearborn, and somehow was discarded and disbursed. Wayne State, luckily, was able to resurrect a small portion of the assemblage which, last fall, was being processed to go into its collection. We do not know the why or how. We do know that it is sacrilege to permit such a thing to occur.

From Pete Dunn, at the Smithsonian: (dated December 13, 1972) "It has been said that the wurtzite from Thomaston Dam, Connecticut, was of a type that changed to sphalerite under the crushing necessary for a powder x-ray photo. This thought intrigued me and I checked it out by taking a regular powder photo after crushing the sample in the usual fashion, and then took another x-ray using the Gandolfi camera which gives powder photos from single crystals. Result — both photos perfect sphalerite patterns, and identical, indicating that the Thomaston wurtzite is really sphalerite paramorphic after wurtzite. I used two crystals with picture book wurtzite morphology which I collected at Thomaston myself." (Ed. note: Change your labels.)

Some years ago, when we were active in construction in central Massachusetts, we attended a meeting and spoke at the Westford Mineral Society. At the close of the session member Roscoe Corey introduced himself, presented a tray of minerals from Laurium, Greece, and said "Help yourself. I got these from a friend stationed in Athens who is a beginning collector and who sent this stuff to me". The "stuff" was annabergite, fluorite, smithsonite and some slags. The friend was George Ineson, who has since retired to New Hampshire, and whom we visited a week ago (January 18, 1973) with some fabulous results. Ineson had three cartons of duplicate material from Laurium, ranging from one inch specimens to "boulders" five to six inches in size. We took it all. The outstanding things were clusters of annabergite crystals $(Ni,Co)_3(AsO_4)_2 \bullet H_2O$, kelly green, monoclinic; fluorite; smithsonite in sundry colors; azurite; and some of the ancient slags, dumped into the ocean beginning at about 480 B. C., after galena was smelted down to extract silver for the "Glory that was Greece". Some 2500 years of soaking in sea water had its way with these slags, the residual lead combining with chlorine and other elements to form lead oxychlorides and others, some of which are unique to the region.

The minerals and mining of Laurium, Greece, deserve more detailed treatment. We propose to do an article for the *Mineralogical Record* in the future. The area still has minerals. A couple of mines are presently operating, and the dumps are extensive.

In the *Mineralogical Record* of September/October, 1972 (Vol. 3, No. 5) we discussed the availability of minerals for the micromount collector at the Strickland Quarry, Portland, Connecticut. Thursday, January 18, 1973, the temperature in New England rose to a placid 55 to 60 degrees. Marcelle Weber and Anne Jacobs of the New Haven club couldn't remain indoors, and were impelled to visit Strickland for a couple of hours just to scan the surface of the dumps. Among others they found bertrandite in 3 crystal habits; fluorite, transparent octahedrons showing phantoms of alternating cubes and octahedrons; crystals of clear albite; pyrite; lepidolite; and cookeite. All of these finds were good enough to add to anyone's collection. Dick Schooner, visiting the same area about a month prior, reports: "Strickland quarry, though not worked for many years, is not dead by any means. I found a chunk of amblygonite, about four inches in size, covered with perfect deep red manganotantalite crystals. I tipped over a boulder on the dump and uncovered a face of pegmatite, about three by six inches, with a dozen or more plates of molybdenite on it. When I trimmed it and searched the debris, I found four beautiful crystallized specimens. Just as I was leaving I spotted one of those lens-like pods of calc-silicate rock in the schist. Splitting it I obtained the finest wollastonite ever found from there, almost six inches long and an inch thick. These, added to some pale lavender scapolites I dug up earlier in the afternoon, provided a wonderful return for almost no effort."

We'd commented on Mildred Watson's find of enargite from the Tri-State district (*Mineralogical Record,* Vol. 3, No. 5). Subsequently a note was received from Anthony Gricius of Richmond, Illinois, advising of another reference to a discovery of the mineral in this famous lead-zinc area. "Enargite and Plumbojarosite at Picher, Oklahoma", *American Mineralogist,* Vol. 20, No. 11, November, 1935, pp. 799-805. A most interesting article, for it discusses a whole series of associated minerals and the origins of the ores in the area.

In trimming specimens to size with edged pliers or front edged cutters used by cobblers and ceramic tile workers, a good trick is grasping the specimen with the tool, inserting the tool up to the wrist into a large plastic bag, and then exterting breaking pressure. The advantages are manifold. First, the flying fragments are confined to the sack where they may be recovered and examined for crystals. Second, there is no danger of damage to the eyes and face, for there are no flying particles. Third, the finish on furniture and floors is preserved, and this certainly helps to maintain amicable relations with the Head of the Household.

Buy and use a good mineral book. Affix a label to your specimens. Keep your microscope in good operating condition.

THE MINERALOGY OF PENNSYLVANIA JUST REPRINTED

Samuel G. Gordon's fine book *The Mineralogy of Pennsylvania,* helpful to collectors of Pennsylvania minerals for many years, is now available in a hard-bound edition for the first time.

More than 200 Pennsylvania minerals are described in the first half of the book (physical properties, crystallographic data and chemistry), in a sequence following the *Dana System of Mineralogy*. The most useful portion of the book, however, is the locality information given in the second half: mineral localities of Pennsylvania. Locations are listed alphabetically by counties and townships. Every locality is described in detail, and the minerals found there are listed and briefly described. References to the literature are also provided. Locality information is keyed to the coordinate system used in U.S. Geological Survey topographic sheets.

The Mineralogy of Pennsylvania has long been considered the guidebook of mineral collecting in Pennsylvania. It has been reprinted by Friends of Mineralogy, Region 3, to extend its usefulness to new generations of collectors. The new hard-bound edition, 255 pages, costs $5.50, plus an additional 50¢ for postage and handling. Checks may be made payable to Friends of Mineralogy. Send orders to Mrs. Eleanor Kaufell, 4028 Benson St., Philadelphia, PA 19136. Pennsylvania residents add 6% state sales tax.

Friends of Mineralogy, continued from page 52

Guidelines for FM educational exhibits were tested and revised based on experience accumulated at half a dozen shows. These guidelines have now been accepted for use by the AFMS. While the exhibits project seems to be successfully completed, other educational efforts (including a Speakers' Bureau and the production of professional-quality slide shows) will be started soon.

Specimen Registration: Originally launched by Richard Bideaux, this committee has been slow to start active work, largely due to the difficulties of establishing goals and guidelines. A form has now been generated for registration of collections with FM, and is now being distributed in FM regions. John and Marge Sinkankas have expressed keen interest in taking over and expanding the functions of this committee, and it is anticipated that the work of registration will become more and more visible in coming months.

Mineralogical Record: Arthur Montgomery volunteered to serve as FM editor for the *Mineralogical Record.* All news and material relating to FM, for *Record* publication, should be sent to Dr. Montgomery at: Dept. of Geology, Lafayette College, Easton, Penna. 18042.

Locality Preservation: Mrs. Judith Frondel suggested that the name of this committee be changed to "Mineral Conservation", including locality conservation, rather than preservation. Conservation means "wise use" and seems to better fit FM's goals and present capabilities. The goals and structure of this committee are currently being revised and expanded.

Davis Lapham, who started the Preservation Committee and achieved considerable success in its development, recently retired from active FM work due to illness. Dr. Lapham's contributions to FM have been outstanding. He provided many of the ideas and suggestions that have shaped the present organization. His energies were largely responsible for building Region 3 (Pennsylvania) into one of FM's strongest and most active Regions. In addition, he has started action in Pennsylvania toward the preservation of localities, such as the mines at Cornwall, that may well guide FM's efforts in this area in the future. We hope that renewed health will allow Dr. Lapham to again become active in FM affairs.

Questions have arisen recently regarding the fiscal year of FM and payment of dues. It was decided to firmly establish these dates to leave no questions open on the dues period. The calendar year of FM is February 1 to January 31. Dues must be in the hands of the Secretary-Treasurer by April 30 of each year to prevent being dropped from membership for that year. For this first year of FM's official existence as a Corporation, and in light of past uncertainties, dues paid after September 30, 1972 will count toward 1973 membership. If a member joined before this date or paid 1972 dues before this date, 1973 dues are still required to maintain membership.

One of the most exciting FM activities scheduled for 1974 is a symposium, sponsored jointly by FM, MMAC, TGMS (Tucson Gem and Mineral Society) and the University of Arizona at Tucson. Co-sponsorship and participation by the MSA is hoped for and anticipated. The symposium will be a 2-day event, to take place on Sunday and Monday, February 10 and 11, 1974, at the Tucson Community Center. The Tucson Gem and Mineral Show will take place in the same location on February 8-10, and the symposium would thus overlap the last day of the show. Two major themes will be discussed: mineral nomenclature, terminology and systematics; and the mineralogy and paragenesis of porphyry copper deposits. There will be additional time for a session containing general papers as well.

The symposium is intended as a social, as well as a scientific event, where people interested in mineralogy on all levels of sophistication can exchange ideas, discuss minerals, research, collecting and collections, and hear papers of mutual interest. The level of presentation will be essentially that of the *Mineralogical Record*, with an emphasis on the best possible visual materials to augment papers presented.

This meeting culminates a major goal of FM, namely to help fill a gap that has existed for many years in promotion of mineralogical interest on an intermediate level. It is hoped that the symposium will help to reestablish a strong liaison among mineralogists in many field of interest, pursuing their avocation on many levels of sophistication. The setting is ideal — the meeting will occur in the same locale as one of the world's most important mineralogical events, the Tucson Gem and Mineral Show. The symposia are intended to attract curators, collectors, students, and professional geoscientists. Announcements of this event will be forthcoming, giving additional details. Readers of the *Record* should consider participation in the symposium. Anyone wishing to contribute papers should contact: Joel E. Arem, Dept. of Mineral Sciences, Smithsonian Institution, Washington, D. C. 20560. A program will be compiled from the papers accepted. It should prove of great interest to all mineralogists who wish to maintain contact with the various aspects of their field.

Treasurer's Report

SUMMARY:

Cash Balance, Feb. 1, 1972	$1,210.95
Receipts	2,768.00
Total	3,978.95
Disbursements	908.57
Cash Balance, Feb. 1, 1973	3,070.38

Itemized Receipts and Disbursements,
Feb. 1, 1972 - Jan. 31, 1973

Receipts

Dues (466 paid-up members)	2,491.00
Special gifts	100.00
Book sale	158.00

For subscriptions to *Mineralogical Record*	19.00
Total	$2,768.00
Disbursements	
Educational Competition Awards	50.00
Educational Competition Expenses	115.41
FM Regional expenses (5 regions)	289.97
National Secretary expenses	396.19
Incorporation expenses	23.00
Payments to *Mineralogical Record*	19.00
Special Charges (uncollected dues)	15.00
Total	$ 908.57

FM OFFICERS AND DIRECTORS

OFFICERS — 1973

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1242 West Pelaar Street, Tucson, Arizona 85705
Vice-President: Joel E. Arem
6451 Fairborn Terrace, New Carrollton, Md. 20784
Secretary-Treasurer: Wayne C. Leicht
P. O. Box 2514, Costa Mesa, California 92626

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10) Richard Bideaux
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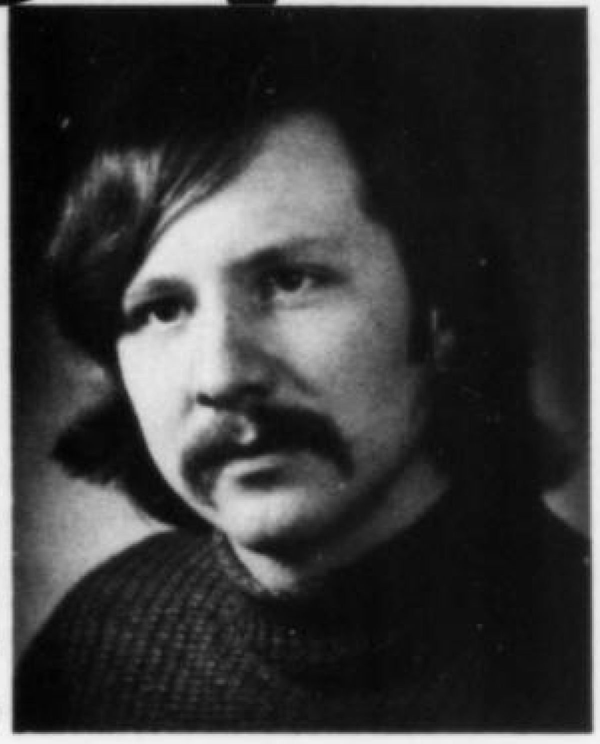
MATHIASEN MINERALS — NOW FULL TIME

Gary and Carol Mathiasen announce that Mathiasen Minerals has gone from part-time to full time business. More time will be given to attending mineral shows, expanding stock, assisting customers, and putting out lists.

When in the San Francisco Bay Region, you are invited to stop by and see our complete line of minerals. Also, please write for current listing: 41149 St. Anthony Drive, Fremont, California 94538, 415-657-0994.

The Photographic Record

by Wendell E. Wilson

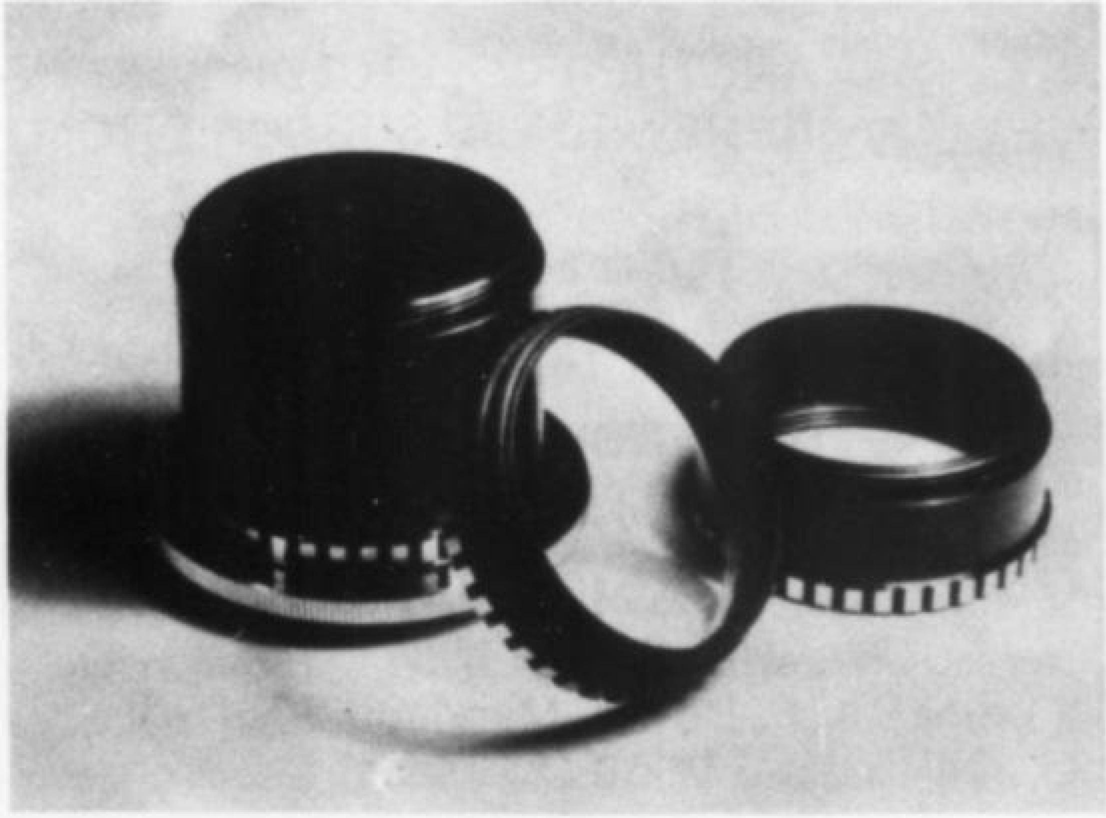


If you have decided that taking up mineral photography sounds like a good idea, you're probably now thinking about expenses. This is the only serious barrier you are likely to face. In order to do specimen photography you need a camera with close-up capability. That means a single-lens reflex (SLR) camera. The reason is the viewfinder. Suppose you're up close, shooting a picture of your favorite thumbnail. With a regular (double-lens) camera the main lens would be looking right at the specimen while the viewfinder lens higher up on the camera body would probably not see it at all. What is needed is to be able to see through the main lens yourself, and see exactly what your film will see. An SLR accomplishes this with a little mirror which reflects the light from the lens up through a prism and to your eye. When you take the picture the mirror flips up out of the way for a moment allowing light to reach the film, then returns to its original position. For a camera like this you will have to pay between $150 and $460, depending on the model you choose and the special features you want. Used cameras are less expensive, but you never know how they were treated by their original owner, and you do not get the long warranties which come with new cameras.

The first problem is how to intelligently select a particular brand of SLR camera in your price range. For close-up photography it is imperative that the lens be completely removable. A *desirable* feature is that the mirror be lockable in the "up" position when you're ready to shoot. Otherwise it flips up and down by itself on exposure, causing a very slight vibration which can reduce the sharpness of your picture. This effect is very minor, but still worthy of consideration. Another desirable characteristic is high mechanical quality of the camera mechanism, and a fourth is high optical quality. Other than these four criteria the selection of special features is pretty much a matter of personal taste. *Modern Photography* magazine, December 1972, describes in detail (but does not test) twenty-eight 35mm SLR's in which you might be interested. The film for these cameras is 35mm and is the principle size used by amateurs and many professionals alike.

Larger-format photography will be discussed in a future column. *Consumer Reports* magazine, August 1972, tested 33 models and rated them all on mechanical quality, convenience of use, and frequency of repair. One of *CR's* most interesting findings is that the difference in quality between optical systems of all the cameras tested was *negligible*, thus eliminating that factor from consideration in the choice of a camera. (This is a relatively new development in the manufacture of cameras. Reports in previous years have noted significant differences in optical quality, but it looks as if widespread excellence has finally prevailed.) Using *Consumer Reports'* findings as a guide, I personally would want a camera rated "very good" or better in mechanical quality. It should have a removable lens and mirror lock. This reduces the 33 choices to 5 possibilities. These are the Minolta SRT-101, Canon FTB, Nikkormat FTN, Nikon Photomic FTN, and Beseler Topcon Super D. *CR* rated the Beseler as having a "worse-than-average" repair record whereas the other four had "better-than-average" repair records. So the best choices would seem to be the Minolta, Canon, Nikkormat, and Nikon. The list prices are $300, $303, $320, and $460 respectively, but discounts of up to $100 can sometimes be obtained. Certainly "lesser" cameras will work quite well. I own a Miranda Sensorex (purchased for $190) and obtain very satisfactory performance. I have friends who are getting good results with Pentax and Mamiya-sekor.

You should obtain copies of the magazine issues mentioned or look them up in a library. Study them and compare the features for yourself. Then visit several camera shops, check out prices, test the "feel" of the cameras, and decide which one is best for both you and your pocketbook. You will often be given lens choices with a camera. They are designated by numbers representing the largest



Extension tubes.

diameter of lens opening (*f*-stop) possible with that lens. Smaller numbers mean larger openings and lenses, and are more expensive. You don't need them; you will always be using the *smallest* opening because it yields the greatest depth of field. So if given the choice between an *f*2.8 and an *f*1.4 lens, for instance, save yourself a few bucks and get the *f*2.8. The smallest lens opening on nearly all lenses is *f*16, however a few will go down to *f*22 or even smaller. These can add extra depth of field and are desirable. I recall a lovely legrandite spray about one inch in depth and height. It just wasn't possible to get the entire specimen in sharp focus, from back to front, with my lens, but the lens on Joel Arem's Nikkormat goes down to *f*22, and the extra margin was just enough to allow him to capture the whole piece.

No matter which of the many fine cameras you choose, it will last a lifetime with proper care, which is more than you can say for an automobile. So don't feel guilty about blowing all that money on a camera ... it will be a joy forever.

Unfortunately one needs more than just a camera for close-up photography. But one thing you do NOT need is another lens. The standard lens on your camera will work fine. You will notice when you turn the focussing ring on the lens to adjust for closer shots that the lens actually moves forward away from the camera body. Most cameras will not focus closer than about 17-20 inches, which means that you won't be able to photograph specimens smaller than about 5 or 6 inches. What is required is to get the lens farther yet from the camera body. There are two ways. Extension tubes are simple metal cylinders of various lengths which you attach between your camera and lens (hence the need for a removable lens). Bellows extenders can also be attached between camera and lens, which allow easier adjustment to proper extension, but the runners sometimes interfere with the subject. Extension tubes cost around $12 and bellows around $19.

Another required accessory is a tripod. You'll want to take time setting up your shots, and may want to take fairly long exposures with absolutely no wiggle. You cannot hand-hold the camera in such a situation. Tripods of adequate quality begin at about $25. It should be sturdy and have adjustable tilt in two directions, as well as rotation and height adjustments. *Consumer Reports* tested and rated tripods in their October, 1972, issue.

Your camera can time its own exposures for 1 second or less, but for longer exposures you will need a cable release ($2-3) to hold the shutter open without wiggle while you time the exposures on your watch. For settings of 1 second or less I prefer to use the timed-release button on the camera. It then waits 10-15 seconds after you press the button before it trips the shutter. This gives the camera plenty of time to stop wiggling after you touch it, and eliminates the possibility of transmitting any vibration through the cable release, or having the cable jam in some way.

Many people are surprised to learn that the kind of lights you have can make or break your photos. Use of lighting is where imagination and artistic quality turn your photos from snapshots into masterpieces. This subject is so important that most of a future column will be devoted to lighting.

Wendell E. Wilson
8042 Bryant Ave. So.
Bloomington, Minn. 55420

To the Editor

THE 79 MINE

Dear Sir:

My congratulations and thanks for the two splendid articles with pictures and illustrations of the 79 mine near Hayden, Arizona. Those mineral lovers of us who are privileged to have specimens from such an illustrious mine as "Old 79" truly appreciate such informative and vividly described articles as these. It's likely many of us may never have the opportunity to visit this area, yet now I, for one, have an even more kindred feeling for this mine and the area.

Mrs. Marge Mills
Irving, Texas

Dear Sir:

It's very exciting in the middle of a northern winter to travel via your pages to the mining country of beautiful Arizona. Many thanks for hundreds of happy reading hours.

Lloyd Caesar
Kitchener, Ontario

PRO AND CON

Dear Sir:

I read with interest and with some dismay, your editorial concerning the complaints you had received that your publication was "snobbish, too technical and partial." The dismay was certainly not with your editorial but was in the fact that certain persons felt compelled to make such unwarranted complaints.

I would like to make a suggestion to the persons complaining about your publication being too technical. If they will check with their local bookstore, I am sure they will be able to find some interesting publications to suit their taste. One in particular that comes to mind is a 69¢ How & Why Book on Rocks & Minerals!

I am not really trying to belittle the person making the complaint as I certainly do not have the knowledge to understand all of your technical articles but I appreciate the fact that they are there. If I only read what I already knew, there would certainly be no point in reading it. I think your publication does an excellent job in filling the gap between the "John Brown found a pretty green rock on the side of the hill" type of publication and the completely technical type of publications. I find some of your more technical articles a challenge to increase my knowledge and to remind me that there is such a vast amount of knowledge to be acquired about this mysterious and wonderful universe in which we live.

I commend you on the quality of your fine publication.

T. D. Burns
Charlotte, North Carolina

Dear Sir:

I have just read your editorial in the Nov/Dec '72 issue. I emphatically agree with the criticism of "snobbishness." However, I don't think you have understood the reason for this feeling on the part of your readers (or potential readers who fling it (*Min. Rec.*) down in disgust). It is the *tone* taken by almost all your writers, their style of expression, which gives people the feeling that they are more impressed with their own knowledge and, hence, superiority, than they are with the subject matter. This attitude *is not* peculiar to the *Mineralogical Record* alone, but is found in every "hobby" magazine I have read. In the least "technical" of them, the "snobbishness" takes the form of a vanity in belonging to a group whose members are "the finest on earth", or at least nicer that the average non-member.

One particular expression, which I have come to detest, and which typically conveys this "snobbishness" is "the hobby" used as though there were only one hobby worth mentioning since it is unqualified by ". . . of mineral collecting."

Your advertisers also contribute to "snobbishness" by primarily addressing their ads to collectors of beautiful crystal clusters at relatively high prices.

If your writers *feel* superior to the average mineral collector, and I suspect they do, this is bound to affect their writing, and so there will be nothing to do about it. They will only feel that criticism is unjustified.

Maxine Schmidt
Wheat Ridge, Colorado

It is tragic that those who are enthusiastic over minerals and want to share their enthusiasm with others must be labeled snobs. I doubt that any of us will ever be willing to edit everything we write to assure that nothing remains that may give offense to some element of the readership harboring hostile feelings because of an earlier unfortunate experience. Miss Schmidt, by the way, is not a subscriber. Ed.

Dear Sir:

Your editorial (Vol. III, #6) needs some supporting comment in your favor. I hope to do this but not in the haste this letter requires. I like and use *MR* to further my limited knowledge — keep it up.

W. H. Snair
Grosse Ile, Michigan

Dear Sir:

Of all the various kinds of articles that could be written, I prefer those on "The Mineralogy and Paragenesis of . . .". Keep them coming and keep up the great work on the editorials. As president of the Delaware Mineral Society, I really appreciated the one on participation.

W. M. "Tim" Bryant, III
Wilmington, Delaware

Dear Sir:

I find the magazine very enjoyable and informative, the "middle of the road" type of mineralogical magazine which has long been needed. I find myself in 100% agreement with Mr. White's editorial in the Nov/Dec issue. I find the magazine is just suited for my needs in the teaching field, i.e., a magazine which is scholarly enough to present to my beginning students in geology but not so advanced that they cannot understand it. The complaints which the magazine is receiving must be coming from that all too common group of "mineralogists" who simply have not progressed beyond the most rudimentary phases of the hobby and refuse to acknowledge the fact that there is more to mineralogy than collecting, cutting and polishing, and selling pretty rocks and minerals which they find in their given localities. Please do not bend in their "demands". Incidentally, I feel the article on the 79 Mine by Keith (vol. 3, no. 6) is one of the best your magazine has ever published.

Gene A. Carr
Williamsport, Pennsylvania

Dear Sir:

I agree wholeheartedly that your magazine fulfills a previously vacant position between the technical and the popular. I am a senior geology student with an avid interest in minerals as a hobby. As a geologist I find the popular magazines virtually worthless save for their collecting localities (which I don't get to anyway). The technical journals don't emphasize the joys connected with the collecting and ownership of natures "flowers of the mineral world".

Again, congratulations on doing such a wonderful job these past three years.

Douglas L. Rickman
Rolla, Missouri

Dear Sir:

I found the two articles on the 79 Mine which appeared in the Nov/Dec issue very interesting and would like to see more of this type of material featured, i.e., articles dealing with the minerals from specific localities - Bisbee, Chessy, Tsumeb, etc. It would be particularly desirable if you could persuade some of your foreign subscribers to contribute papers pertaining to areas of which they have detailed knowledge. In particular, I would appreciate seeing an article on the Poona zeolite area.

Eugene E. Sensel
Beacon, New York

Dear Sir:

Regarding the editorial "Snobbish, Too Technical, Partial", may you never bow down to the "run of the mill quality" your critics seem to desire. I and other voluntary subscribers to *MR* recognize the so called snobbishness, technicalities, and partiality as Top Quality professional competence, i.e., technical knowhow and partiality for the *best* on the market (shows, minerals, copy, etc.) may it continue thus ...

As a self schooled prospector I find your copy well within my limitations because I *do* want to learn, I *gain* from *MR*, joyful effort is required on the reader's part, so *MR* is *not* for the slothful rock collector or reader ...

... Keep *MR's* top quality and keep it educational. Mediocrity is death to the progress of not only collectors, mineralogists and science, but to civilization itself.

J. Sesky (prospector)
Chitina, Alaska

Dear Sir:

Congratulations on your fantastic publication.

I thought I'd offer a suggestion — perhaps it's been offered before. I often think about the possibility of asking mineral clubs that have shows if they might give out subscriptions to the *Mineralogical Record* as door prizes. This would help the circulation and possibly open some new eyes.

I don't know how your current subscriptions are running, but I think it would be a disgrace to our hobby if we couldn't come up with enough subscribers to operate in the black.

John R. Anderson
Walpole, Massachusetts

ON MELANTERITE

Dear Sir:

I am amused by the image of melanterite losing its water amid the debate over its attribution, and submit the following ditty:

"The saga of Ducktown melanterite
Has some mineralogists quite uptight.
Are the crystals *au naturel*
Or is Man interventional?
Like melanterite, no theory is watertight."

Joseph L. Tucker
Clayton, Missouri

Dear Sir:

The question about the "naturalness" of some melanterite from the Boyd mine (volume 3, no. 6) raises a matter on which I would like to comment. I am not familiar with the Boyd mine but will use an occurrence of trona with which I am familiar.

A mine tunnel a little ways below the camp at Cerro Gordo (Inyo Mts., Calif.) has an efflorescence of trona on its walls. The only plausible explanation is as follows: fine-powdered trona lines the shores of dry Owens Lake several miles and several thousand feet below to the west. Strong winds blow clouds of this trona up the mountains where some is dropped. Meteoric waters dissolve it and the trona eventually effloresces on the walls of the tunnel. A similar efflorescence occurs in an opening under a shale overhang running back far enough to protect the trona from the winter rains and snows. I haven't had occasion to explore abandoned ground squirrel holes in the area but have every reason to believe that such may very well show similar efflorescence.

Which is a natural occurrence? If the mine adit occurrence is not natural then type laurionite is not natural because it formed from the action of sea water on lead slag from ancient mines. Certainly the protected area under the shale overhang is natural. Or would it fail the test if the area below the overhang had been dug in as a shelter by Indians who inhabited the area centuries ago? Surely we would accept the efflorescence in the squirrel burrow as natural. Or does the intervention of any animal species destroy mineral naturalness? If so, the niter, monetite, newberyite and brushite from guano deposits and much of the calcite and dolomite of marine deposits are not natural. Or is the line drawn between what the human species has done and what other animal species have done? If so, is brushite from guano natural and as incrustations on ancient human bones not natural?

The human species is having its time on this planet, as have unnumbered species before, and, perhaps, as equally unnumbered species may have after our species has run its course. But we are an organic species, a natural phenomenon, as surely as is the ground squirrel, the bat which produced the guano, or the algae or other organisms which played a part in forming the carbonates of marine sediments.

The line between "natural" and the products of controlled synthesis in laboratories is fairly easy to draw. So why not draw it there if a line must be drawn?

H. Earl Pemberton
Santa Monica, California

Dear Sir:

The main argument presented against the validity of the melanterite occurrence is that the mineral would never have formed if there had been no mine. The lead halides of Laurium, Greece would never have formed if the lead slags were not dumped near the ocean; however, these have long been accepted as not only valid mineral species, but as some of the most desirable micromount species known. The iron sulfates and selenium of the United Verde mine, Jerome, Arizona were formed only because of conditions induced by a mine fire; these have also been accepted as valid mineral species. Calclacite forms on calcareous specimens by reacting with the acetic acid in the oak that makes up the museum cases these specimens are housed in. Many other species form on mine dumps that would not have formed if there was no mine.

If it can be said that minerals that *form* as a result of a mining operation are not to be considered valid mineral species, could it not be said that minerals *found* as a result of a mining operation are not valid mineral species? ("It surely never would have formed (been found) if the mine did not exist.") An attitude such as this would reduce mineral collecting to the picking-up of loose pebbles.

I feel as long as there is no deliberate attempt to cause conditions favorable to the formation of minerals, the mineral should be considered valid.

William Kohlberger
Hackensack, New Jersey

PRE-SHOW SELLING

Dear Sir:

I read your editorial in the July/August issue of the *MR* on "Pre-Show

Selling" with great amusement. Having been personally guilty of the heinous crime of selling before the show opens, I can assure you that most of the culprits on the receiving end of this deplorable act are none other than some of the pious museum curators and representatives of a number of the major world wide institutions, who I have personally seen running around frantically 3 or 4 days before the show opens (Tucson) making sure that they aren't going to let anything important get by. I'm sure it is very easy for people in the academic community to pontificate on what is morally correct when they are so detached from the realities of this small but highly competitive business.

I would suggest the next editorial you feel compelled to write concerning pre-show selling should be directed at the pre-show buyers who shall remain nameless at this time. If there were no one there to buy before the show then obviously there would be no pre-show selling, would there be?

I suspect my comments above constitute political suicide (mineralogically speaking), but I feel no one has the right to judge what is morally correct for someone else unless they are willing to abide by those same standards themselves.

I still thoroughly enjoy your magazine and wish you success.

Richard A. Kosnar
Aurora, Colorado

The tone of the editorial alluded to was that this condition is probably unfortunate, especially for those buyers who cannot arrive a day or two before the show, and that control of this condition may or may not be possible. Pontificating is probably a rather strong word to use to describe the editorial since it may carry the connotation of "setting forth dogmatic decrees". Is Mr. Kosnar suggesting that this very real problem should not even be discussed? Divergent views are invited and, in fact, some have already been published in the MR. *It may evolve that controlling pre-show selling is completely infeasible. If that is the case the general recognition of it will have come about only because of the editorial. It is unfair of Mr. Kosnar to label any of the pre-show buyers as "pious". My fellow museum curators did not write the editorial, I did. At least several of these curators do not agree with the editorial so there is nothing inconsistent about their buying before the shows open. Ed.*

FLUORITE WITH CASSITERITE

Dear Sir:

In the interesting description of a pegmatite pocket discovered by Clarence Coil of Colorado Springs (*Min. Record,* Vol. 3, p. 180), surprise was expressed at the occurrence of fluorite with cassiterite. We in Britain find nothing unusual in this association. In the hypothermal tin-tungsten deposits of Cornwall and Devon, fluorite is a common gangue mineral accompanying cassiterite, wolfram and arsenopyrite.

At the South Crofty Mine, some of the lodes have carried massive green fluorite to widths of several feet but crystals are relatively rare. At the Geevor Mine, fluorite is less common;

where it does occur, the green variety the high temperature and the purple the lower. Fluid inclusion studies have given uncorrected temperatures of 310 to 335°C for green fluorite from the Borehold Lode on No. 14 Level and 237 to 264°C for purple fluorite from the Coronation Lode on No. 15 Level. Similarly at Geevor Mine, crystals are rare but I found an exceptional vugh at the junction of the Borehold Lode and the Left Hand Vein on No. 10 Level in 1965. This was an 18" x 12" cavity, filled with a soft red and yellow mottled clay (incipient lithomarge?) which, when washed out, revealed a lining of quartz, pyrite crystals up to 1", minute cassiterites and several large (1" to 2") roughly crystallized, deep purple, cubo-octahedral fluorites. On removing the fluorites, the crystals were found to have bright green cores, exhibiting octahedral colour zoning. Fluid inclusion work gave temperatures of 357 to 377°C for the green cores and 317 to 347°C for the purple outer zones; these results are in accord with the generally accepted ideas that green fluorite is higher temperature than purple and that octahedral crystals form at higher temperatures than cubes.

Cornwall is not noted particularly as a fluorite province, unlike Weardale in County Durham but one or two classic localities do or did exist. The Pell Mine at St. Agnes produced some exceptional specimens — dark purple to brownish cubes several inches across, mentioned by Philip Rashleigh in the 1790s, but only obtainable now from old collections. These, together with the superb crystallized cassiterites, made St. Agnes one of the best districts for the collector in the 18th. and 19th. centuries.

At Menheniot in east Cornwall, Wheal Mary Ann is a noted locality. This mine was in the mesothermal to epithermal range (Cu-Pb-Zn) and fluid inclusions have given temperatures from 150° down to 99°C. This locality is famous for pseudomorphs of chalcedony after octahedral fluorite, specimens of which are still obtainable from the dumps.

Fluorite in Cornwall is not restricted to the hydrothermal deposits. Indeed, it occurs at all stages from magmatic down to epithermal. It is often an accessory mineral in the granite itself and in places it is so abundant as to warrant the name fluorite-granite. It occurs in the pegmatitic stage at various localities and the best to my personal knowledge is the Trolvis Quarry, near Long downs. At Trolvis, small pods of pegmatite are found infrequently, seldom more than a few feet in maximun dimension. I was fortunate to be the first into one a few years ago; it was lined mainly with etched, white albite crystals up to 1" and lustrous black, acicular schorls ranging from 1/2" fluorite cubes, beautifully zoned in purples, with bevelled edges and modified corners. Phenakite has also been recorded from Trolvis, giving us a third typical volatile element; thus we have F in fluorite, B in tourmaline and Be in phenakite.

Consequently, I find nothing unusual in the association of cassiterite and fluorite. What does intrigue me is the occurrence of baryte, which in my experience is an epithermal mineral; could it be that low temperature hydrothermal mineralization has been superimposed upon the pegmatitic material?

Roger S. Harker
Leicester, England

The "surprise" registered in the article about barylite was not in reference to the occurrence of fluorite with cassiterite, it was the writer's reaction to finding fluorite in a pegmatite. I believe that Mr. Harker's hypothesis has serious shortcomings, only one of which is the freshness of the microcline. Superimposition of low temperature hydrothermal mineralization would surely have more or less altered the feldspar to clay. Ed.

LOCALITY LISTINGS

Dear Sir:

I have followed the subject of marking specimens with some interest since the same problem exists in the field of archeology. Since most artifacts are quite small it is difficult to put all information required on them. The answer to the problem lies in a standardized listing of locality. The job may appear large but I think you will find that most of the work has already been done. State and county number-letter abbreviations are already assigned, what is needed is country two letter abbreviations and actual site numbers for each mine, quarry, etc.

As an example let us assume that the Fairfax quarry near Centreville, Fairfax County, Virginia was the thirty-eighth mineral locality reported from Fairfax County. Let us also assume that any collector or museum will readily recognize states of the United States since most are large. Virginia is listed as the 44th state so our system will come out: 44FX38. This is somewhat shorter than: Fairfax quarry, Centerville, Fairfax County, Virginia. I recently cataloged over a thousand artifacts from a single site in Maryland and believe me, if I couldn't have used the abbreviations 18MD41 instead of Pierpoint Site, Montgomery County, Maryland I would be completely blind today instead of partially! This system could be worked out for the Americas with no great effort if a liasion with the Smithsonian's Archeology Division were established. There are states with thousands of archeologic sites but each is treated to the same status of recognition in the system. Most sites are reported by amateurs to a professional archeologist who acts as a State Master Site Recorder. Since archeological sites are subject to pot-hunting (unrecorded collecting) the exact location of many sites is kept secret and the professionals, by and large, respect the amateurs agreement of secrecy. Since it is working for archeology and since most archeology involves about the same numbers of people, why not?

Scott K. Silsby
Falls Church, Virginia

Why not indeed! Ed.

SPECIES COLLECTORS

Dear Sir:

I have been reading the controversy over species collectors with a great deal of interest. While I confess to be one of the breed mentioned I think one point in the argument has been missed. That is that a number of rare and unusual species would not be available unless some collector with a great deal of persistence spent the time and effort to research and collect them. The average collector simply does not have the time, knowledge or inclination to work with the more unusual minerals because of the time-consuming and difficult nature of the task. Only someone with a tenacious streak a mile wide will undergo the task of describing a new mineral or locality unless they have considerable scientific backing.

J. F. Cooper, Jr.
Santa Cruz, California

BRIDGING the GAP

The spark plug works on the principle of electric current bridging the gap between two poles. The buying of premium mineral specimens works on a related principle. One pole represents the larger group of average examples available to the buying public at generally prevailing prices for the type. The other pole represents the small group of choice items — pieces that stand out in their class as examples of rarity, quality and beauty. The cost of these premium items is sharply higher than their lesser contemporaries. This is the gap that must be bridged to obtain the choice examples of each category.

The gap is a formidable obstacle to the majority of prospective buyers. First, to the less practiced eye the average and superior piece will look too similar to justify the substantial price difference. Second, many of those who have developed a discriminating eye see the difference, but settle for less. Third, many people make an adventure out of trying to beat the game by hoping to find gold for the price of lead. For the latter group, of course, lie the biggest pitfalls.

I contend that those who can afford to buy mineral specimens can afford premium pieces. As their investment is substantial in either case, is it not important that they obtain the real equity inherent in a choice example backed by the standing, judgement and integrity of a reputable mineralogist? Since their funds are limited they must therefore buy fewer items of higher unit cost and take longer to accomplish their goal. It will be hard to encounter anyone who has set high standards of selection who regretted it. Those who bridged the gap in the past have reaped rewards of increased value and enjoyment. Those who bridge the gap today will obtain the same benefits.

Today the rewards are greater, for while the premium items are more costly than years ago so are the average items. As the supply of classic specimens has dwindled, the interest has increased. The cluster around the lesser pole has become of lesser quality and vastly more expensive than its intrinsic worth. The specimen produced to fit the pocketbook is usually just that. At the same time the promotions necessary to sell the basically inferior articles must, and have, become more sophisticated.

I buy only the premium article. I believe in it for my own equity as well as for my clients. As such, the items in my lists, which I invite you to request, offer opportunities to those willing to bridge the gap.

* * *

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