the Mineralogical Record

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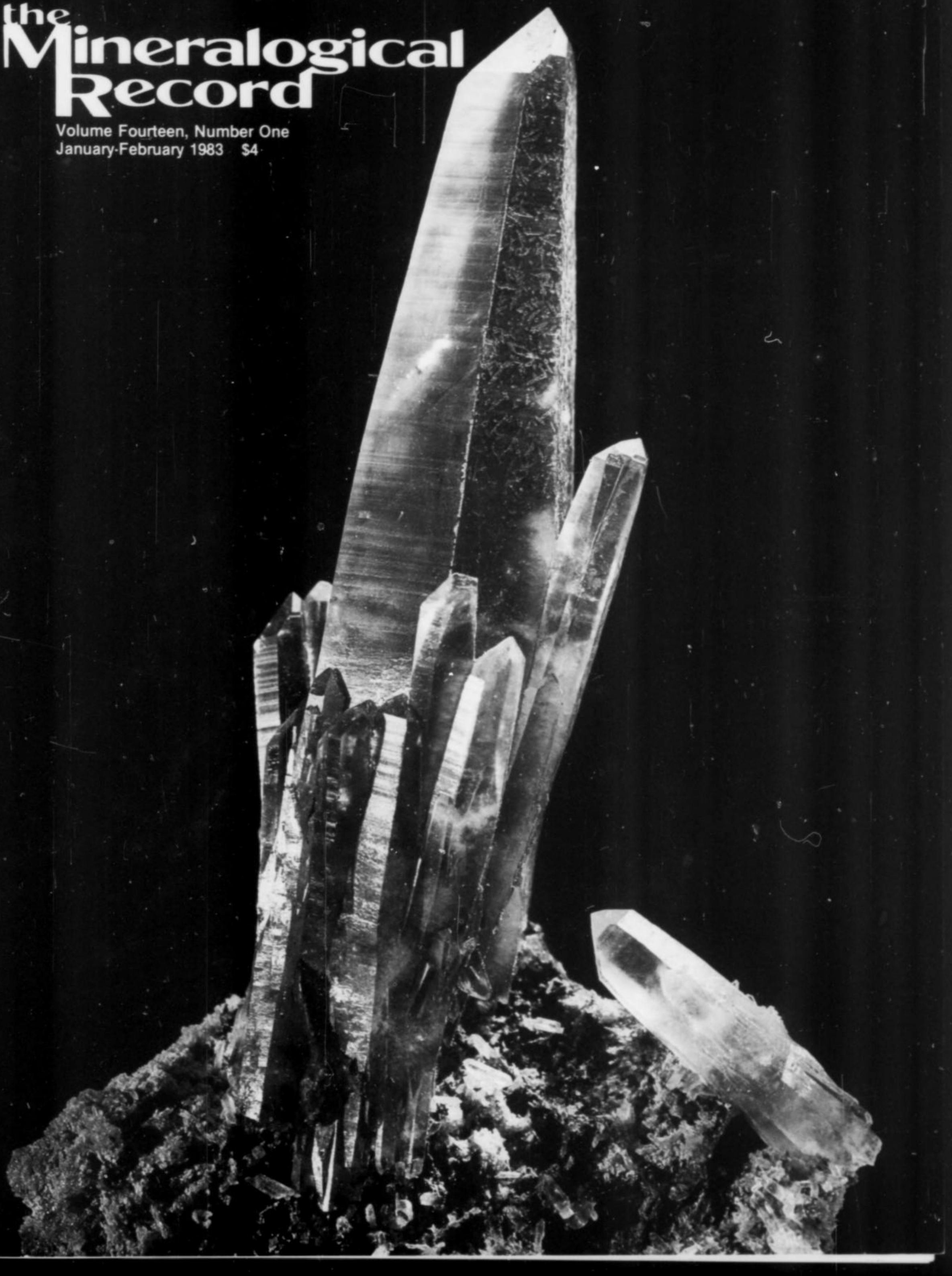

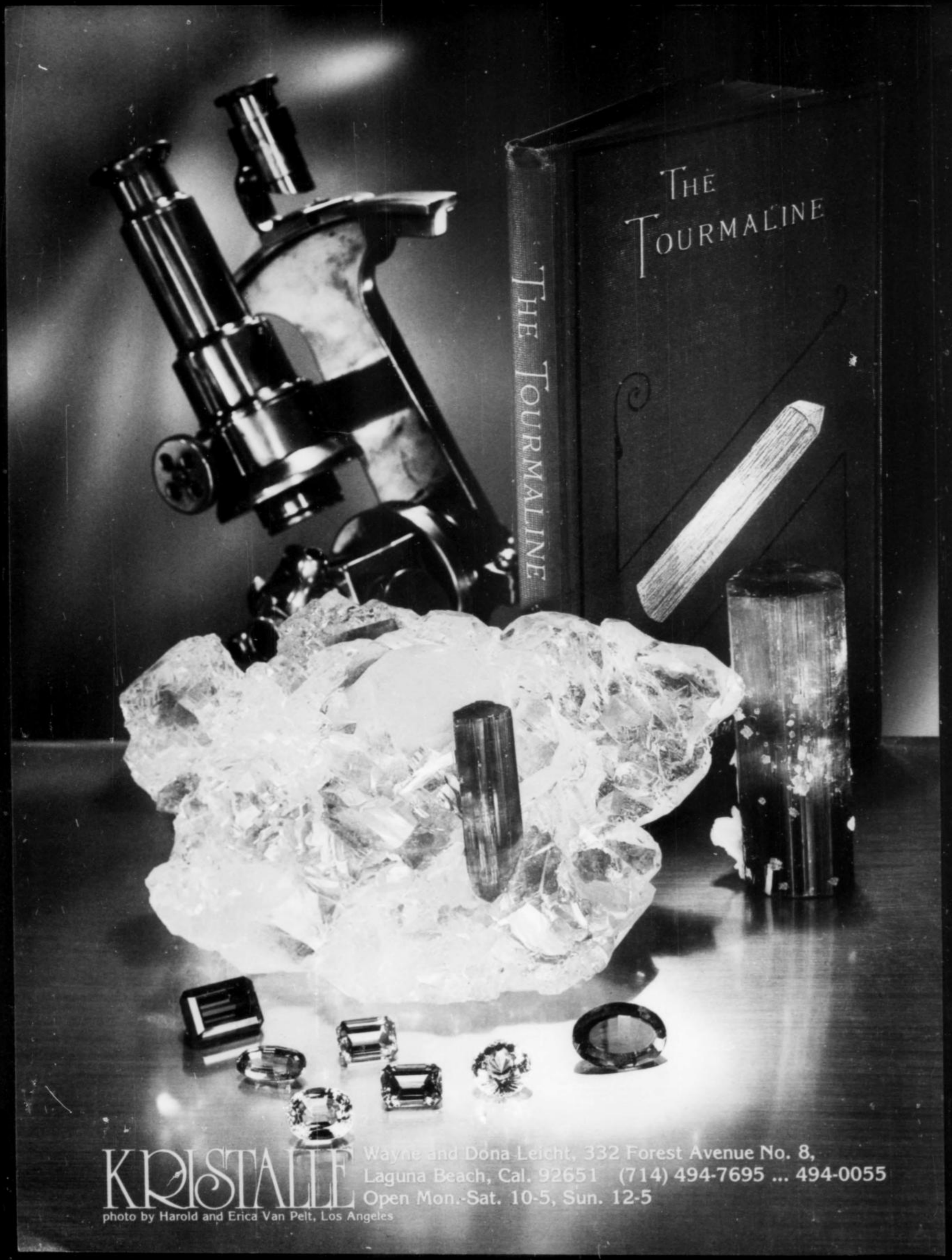
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Articles

Celestite from Salem, Indiana 7
by L. D. Wells, D. K. Jones and W. J. Schaub

Minerals of the Derbyshire Orefield 15
by R.S.W. Braithwaite

Graphite from the Lead Hill mine, Ticonderoga, New York 25
by R. J. Lauf and A. E. Pasto

Field-collecting dealers – A survey 33
by B. L. Sage

Lotharmeyerite, a new mineral from Mapimi, Durango, Mexico 35
by P. J. Dunn

Taeniolite, an uncommon lithium-mica from Coyote Peak, Humboldt County, California 39
by R. C. Erd, G. K. Czamanske and C. E. Meyer

Ferroaxinite from Bridgeville, New Jersey 43
by W. Cummings

Departments

Editorial – Mineralogie sans Argent 2
Notes from the Editor 3
Microminerals – Some Trades by W. Henderson 47
What's new in minerals? by W. E. Wilson 53
Notes from Mexico by W. D. Panczner 57
Record Bookshelf 59
Letters 61

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COVER: AMETHYST from Guerrero, Mexico. The crystal measures about 9 cm; Olaf Medenbach specimen and photo. For more on Guerrero and its amethyst, see Bill Panczner's new column, *Notes from Mexico*, on page 57 of this issue.

EDITORIAL:

Mineralogie sans Argent

Despite the above title, I am not going to discourse on the silver-free mineral species. I have always felt that the *Record* has much in common with *Gourmet* magazine, and *Gourmet* has a regular column entitled *Gastronomie sans Argent* or, loosely translated, "Eating well on a budget." This essay will address itself to the problem of enjoying minerals on a budget.

The economic times being what they are, it seems that many of us cannot afford to spend as much on mineral specimens as we used to. Of course, those collectors who can still afford to pay significant prices are having a field day, with less competition for the very fine specimens. Hats off to those folks . . . it's a buyer's market. But everyone else is in something of a quandry. Not knowing what else to do, some have become depressed about the situation and quit collecting permanently! Actually there are quite a few alternatives short of that drastic step, and my purpose here is to list some of them.

Generally speaking, there are two problems that can befall a mineral budget: (a) reduced funds, and (b) no funds. Each has its own set of alternatives, so let's deal with them one at a time:

Strategies for Reduced Funds

1. Try to get what you like at a lower price.

The most common way of doing this is to haggle harder with dealers, be a comparison shopper, and search more diligently for "sleepers." Another way is to get minerals closer to the source . . . get to know wholesalers and convince them to sell to you at the dealer price. Or buy directly from field collectors. This strategy is tough on the retailer, since your gain is his loss. I don't mean to offend *Record* advertisers, but there is no denying that this is an alternative.

2. Buy fewer specimens.

This alternative is obvious; if your funds are cut in half, you can still buy the kind of specimens you are accustomed to if you just buy half as many.

3. Buy smaller specimens.

In general, smaller specimens cost somewhat less than larger specimens of the same overall quality. Therefore, the cabinet collector might turn to miniatures; the miniature collector might develop a taste for thumbnails; and anyone might take a shot at micromounting.

4. Buy lower quality specimens.

This is perhaps the most difficult alternative to implement, considering that a person's taste for quality tends to increase over the years rather than decrease. Nevertheless it should be considered preferable by far to the abandonment of collecting altogether.

5. Collect in a related field.

There is no shortage of related fields in which to collect. A few years ago, several people got the idea of collecting old mineral labels and, because no one else was doing it at the time, they have built large and fascinating collections at extremely low cost. Mining memorabilia can be fun, and many types of items are still very inexpensive. Collecting books related to minerals and mining is an active field, with items available from a few dollars to tens of thousands of dollars. If books are too rare and expensive, one might collect photocopies of works relating to a particular topic. Collecting the autographs of famous mineralogists is relatively untouched. A collector could surround himself with *pictures* of beautiful minerals: show posters, museum posters, mineral calendars, book plates, artwork, slides and prints. There are undoubtedly more possibilities.

Strategies for No Funds

Even with no funds at all, there are still many ways of making acquisitions (short of theft).

1. Field collecting.

Though there may be some minor cost involved in field collecting (mainly transportation), collectors can go in groups and split expenses. Field collecting has the great advantage of almost unlimited potential . . . if a discovery is made, who knows what the quality or quantity might be? And most field collectors will agree that *any* specimen would have more meaning and value if self-collected. In fact, there have long been collectors who never actually buy anything; their entire collections are personally dug in the field.

2. Work for a mineral dealer.

Hire out to a mineral dealer at some show, offering to work in his booth for a certain number of hours in exchange for a certain specimen. Young collectors might consider working a summer for a dealer, either in his shop or in the field . . . it's been done.

3. Be a collection broker.

The broker searches out moldy old collections containing marketable pieces, then matches them up with interested dealers and takes a commission from the dealer in specimens (this is more difficult than it sounds, and requires considerable luck). Or you might find a person who wants to sell his collection (or an inherited collection) but doesn't know how to go about getting the best price; you contact dealers, take care of the negotiations, and charge the owner a commission in specimens. (Crafty brokers are occasionally able to charge *both* sides a commission!)

4. Deal by deficit financing.

For example: buy a batch of minerals for $200, with 30 days to pay it off. Select a specimen to keep, sell the *remainder* for $200 and pay off the original purchase.

5. Trade from your collection.

There is always the personal collection, acquired during better times, that one can work with. Trade specimens for different ones. There may be no actual gain involved, perhaps there will even be a small loss. But the trade results in new specimens to look at, play with and learn from. Of course, the entire collection can be sold and new specimens bought with the proceeds. The selling may be difficult, but once the money is in hand it's a great market in which to be buying, and the option is open to change specialties completely.

For some people, the above alternatives may not be viable. When, for whatever reason, acquisition of specimens is temporarily or permanently impossible, there are still enjoyable ways of keeping the mineral-oriented mind entertained:

6. Enjoy someone else's specimens.

The love of minerals is a pleasure to experience even if you can never own a single specimen. After all, how many art experts feel they must actually *own* a Rembrandt or a Picasso? Enjoyment of minerals *is* enjoyment of art, nature's own art, and personally owning examples is not specifically a requirement.

So, do what most art lovers must do. Visit every major museum you can, perhaps do volunteer work there, get to know the curators and make yourself useful to them. Be acquainted with as many dealers as possible; visit them even if only to browse, talk, learn and see what's new (but do so without being a nuisance and taking up too much of their time). Attend as many mineral shows as possible, where you can see dealers' stocks and the displays of collectors, museums and dealers. There are countless thousands of specimens out there to be seen and appreciated.

7. Improve your knowledge.

Far too many collectors are content to fondle their specimens without ever attempting to really learn much about them. Readers of the *Record* are, for the most part, not in that group. But it never hurts to be reminded that vast amounts of knowledge are available for the asking. And we do sometimes get lazy.

Consider the prospect of making yourself a self-taught specialist in some area, perhaps silver minerals, for example. A check of the standard references (Fleischer's *Glossary of Mineral Species,* Hey's *Chemical Index of Minerals*) will reveal which minerals fall into the group. Using the list of species as a guide, you can begin building a file on each one. Photocopies of articles (including the original descriptions), notes on localities and perhaps geological or geochemical factors, notes on where the best specimens are located – these can all be included. In some cases even a single species presents fertile ground for serious study. Or you might choose a particular locality on which to make yourself an expert. Many collectors have followed this course and obtained great satisfaction.

If not specialization, then the generalist approach can be taken. Read all the magazines and books available, and slowly build an encyclopedic knowledge over the years. Start with recent issues of some of the other mineral magazines such as *Rock & Gem, Rocks & Minerals, Lapidary Journal* or *Gems and Minerals,* and read back through the older issues, right back to their first issue. Major libraries commonly have complete sets of such periodicals, and they make interesting reading, especially from a historical standpoint. Don't forget the *American Mineralogist;* it was originally founded in 1916 with some of the same goals as the *Record,* and the early issues are very readable. Farther back are defunct publications such as *The Mineral Collector . . .* more of a challenge to find.

Why not take a college course, perhaps a night class, in elementary mineralogy? It need not be taken for credit.

In short, there is nothing to stop you from filling your mind with interesting information about minerals. You can work at your own speed, compete with no one, and enjoy yourself immensely.

8. Help others.

Volunteer work can be a great source of satisfaction, fun, learning and fellowship. Help out with a local show. Prepare slide lectures for mineral clubs and share your own knowledge. Take some young collectors on a field trip. Offer to prepare showcase displays for local libraries and high schools (high schools *always* need fresh showcase displays). Volunteer to work in a museum. You might even qualify to be an unpaid research assistant to an established mineralogist. (Some of the chores are dull, and a commitment of time is required if the scientist is going to invest time in your training. But the rewards can be great in terms of satisfaction and being where the action is.) Here again, a little imagination will reveal many different ways to give of yourself in an enjoyable, mineral-oriented way.

9. Be social.

Among the greatest joys of mineral collecting is the comradeship of the other collectors. The age barrier evaporates. People's occupations are temporarily forgotten. Everyone who loves minerals knows that he or she is automatically a member of a great unofficial fraternity. And all members have that one fascinating interest in common, which is an unending source of conversation and debate. Love of minerals is, in most people's view, an admirable character trait by itself, like love of animals and children. So even with total strangers you'll have one thing in your favor: they will appreciate your love of minerals.

Mineral clubs and study groups are fine vehicles for socialization. Field trips, mineral shows, museum visits with friends, all of these have their human component which need not be sacrificed just because you can't afford to buy more specimens at present!

So be of good cheer, all you flat-broke mineral collectors. If you think about what it means in the broader sense to have your appreciation, your sense of wonder about minerals, you will see that the ability to *buy* is by no means all there is to enjoying your own love of minerals.

notes from the EDITOR

RARE, IMPORTED COPIES of the RECORD!

Sharon Cisneros (*Mineralogical Research Co.,* 704 Charcot Ave., San Jose, CA 95131) reports that she has recently purchased from a dealer in Germany a long-hidden stash of the famous *TSUMEB!* issue (book) of the *Record* (Vol. 8, no. 3, 1978). All, she says, are in new condition, and are available as follows:

A. Cover badly scuffed; perfect inside:	$20.
B. Cover slightly scuffed; perfect inside:	$25.
C. Perfect condition inside and outside:	$30.

The Record has been sold out of the Tsumeb issue since nine months after its publication, so this is a rare opportunity.

MORE ARIZONA ISSUES?

Readers may have noticed the statement published on the title page of the Bisbee issue (Arizona-III), which read: "Third in a series of four issues devoted to Arizona." The purpose of that statement was to forestall those planning to bind up their Arizona issues separately, who might not realize that the series was not yet complete. Well, it seems that Arizona-IV has swelled excessively, and you will now be receiving *Arizona-IV* followed by *Arizona-V.* Watch this space, and I'll let you know when the series is finally complete. And rest assured that, with localities like the Ray mine and the Old Yuma mine still to go, we are not yet close to scraping the bottom of the Arizona barrel.

NOTICES

Curatorial opening: Curator of Geology at the Morris Museum of Arts and Sciences, Morristown, New Jersey. Immediate opening; preference given to a candidate with an advanced degree in geology, paleontology or related field with previous museum experience. Primary responsibilities include research, collection management, public interpretation, teaching, permanent and temporary exhibition research and development. Salary commensurate with experience. Send resume to: John D. Peterson, Director, Morris Museum of Arts and Sciences, P.O. Box 125, Convent, NJ 07961.

Hired, David W. Thayer, 37, as Curator of Earth Sciences at the Arizona-Sonora Desert Museum near Tucson. Thayer, formerly Geology Instructor at Yavapai Community College in Prescott, Arizona, holds Masters degrees in Spanish and Geosciences from the University of Arizona (1974). Caves and fossils are his specialties, with which he has extensive field experience in the Southwest, Sonora and Baja. Thayer is the founder of two of Arizona's three speleological (caving) organizations, is a member of the Paleontological Society and the National Speleological Society. Robert Middleton will continue as conservator of the mineral collection and resident mineralogist.

BROKEN HILL BOOK!

As you can see from the advertisement on the facing page, the *Record* is proud to be the principal North American distributor for a spectacular new book on the famous deposit at Broken Hill, New South Wales, Australia. (This means that all American dealers can order books at the dealer discount directly from us rather than from the publisher in Australia, as can subscribers at the retail price.)

Broken Hill is among the most important specimen localities in that part of the world, and certainly worthy of its own book, as the 170 color mineral photographs will attest. Included are comprehensive descriptions of all of the species which have been identified from Broken Hill, as well as treatments of the history, geology and literature (over 500 bibliographical entries.) Two editors (Dr. Howard Worner, Dr. Ralph Segnit), nine authors (Bill Birch, Geoffrey Blainey, Albert Chapman, Oliver Chalmers, Haddon King, Dr. Neville Markham, Simon Pecover, Dr. Ian Plimer, Brian Stevens), three photographers (David Barnes, Frank Coff, John Fields) and one crystal drawing specialist (Judi Pecover) collaborated to produce this monumental work, and their love of the subject shows.

We have also obtained a very limited number (four) of the special leather-bound edition ($110) . . . 300 of these were printed, of which 200 will be sold, and many of those have already been spoken for in Australia. Readers interested in obtaining one of these special editions should let us know immediately . . . there is no guarantee that we will be able to obtain any more.

We are hoping our main shipment will be here in time for the Tucson Show in mid-February.

GLOSSARY 1983!

Wondering when the next edition of Fleischer's indispensible *Glossary of Mineral Species* will be out? Wonder no more: we are striving to have copies ready for the Tucson Show in mid-February. There are a great many additions and changes, which author Fleischer has been sending us in updates right up to press time. In addition, with a new computerized compilation, typesetting and layout system we expect to reduce errors almost to zero. The price will be $8 plus 50¢ per copy postage and packaging, with the standard discount to dealers, and a 20 percent discount to clubs ordering 10 copies or more. We had to raise the price a little over the edition of three years ago, but $8 is still remarkably inexpensive for a reference book.

SOMETHING SPECIAL

At our annual auction last year at the Tucson Show, Dr. and Mrs. Anthony Kampf put up for bid a home-cooked dinner and a personal behind-the-scenes tour of the mineral facilities at the Los Angeles County Museum of Natural History (where Tony is curator). Winning bidder was Marty Zinn, who informs me that the dinner was a feast and the tour was fascinating . . . "This purchase had to be the best buy of the auction," said Marty. Well, I am pleased to announce that the Kampfs have been coaxed into offering the tour-dinner for two again this year at the auction. May the best (and hungriest!) bidder win.

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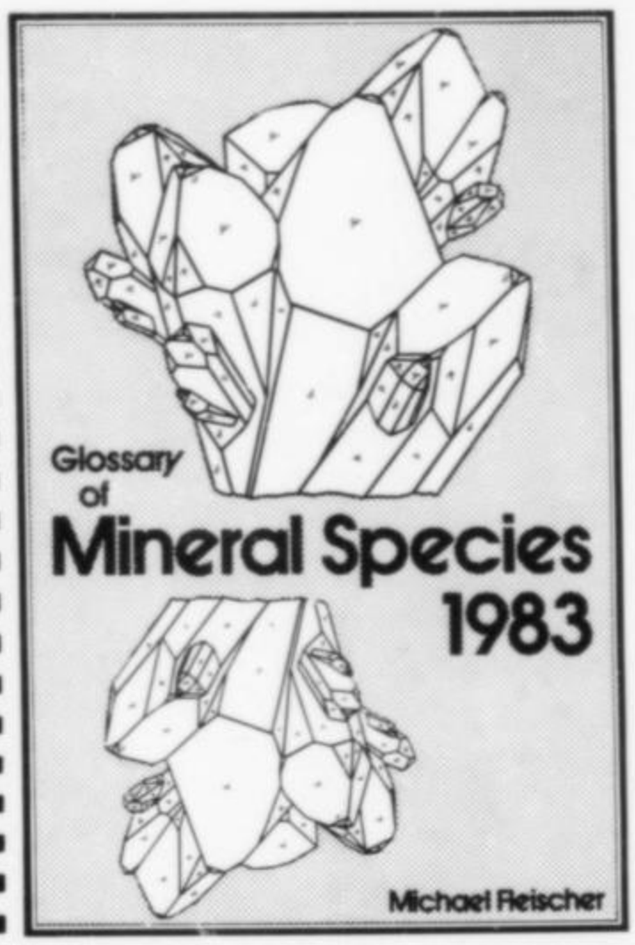

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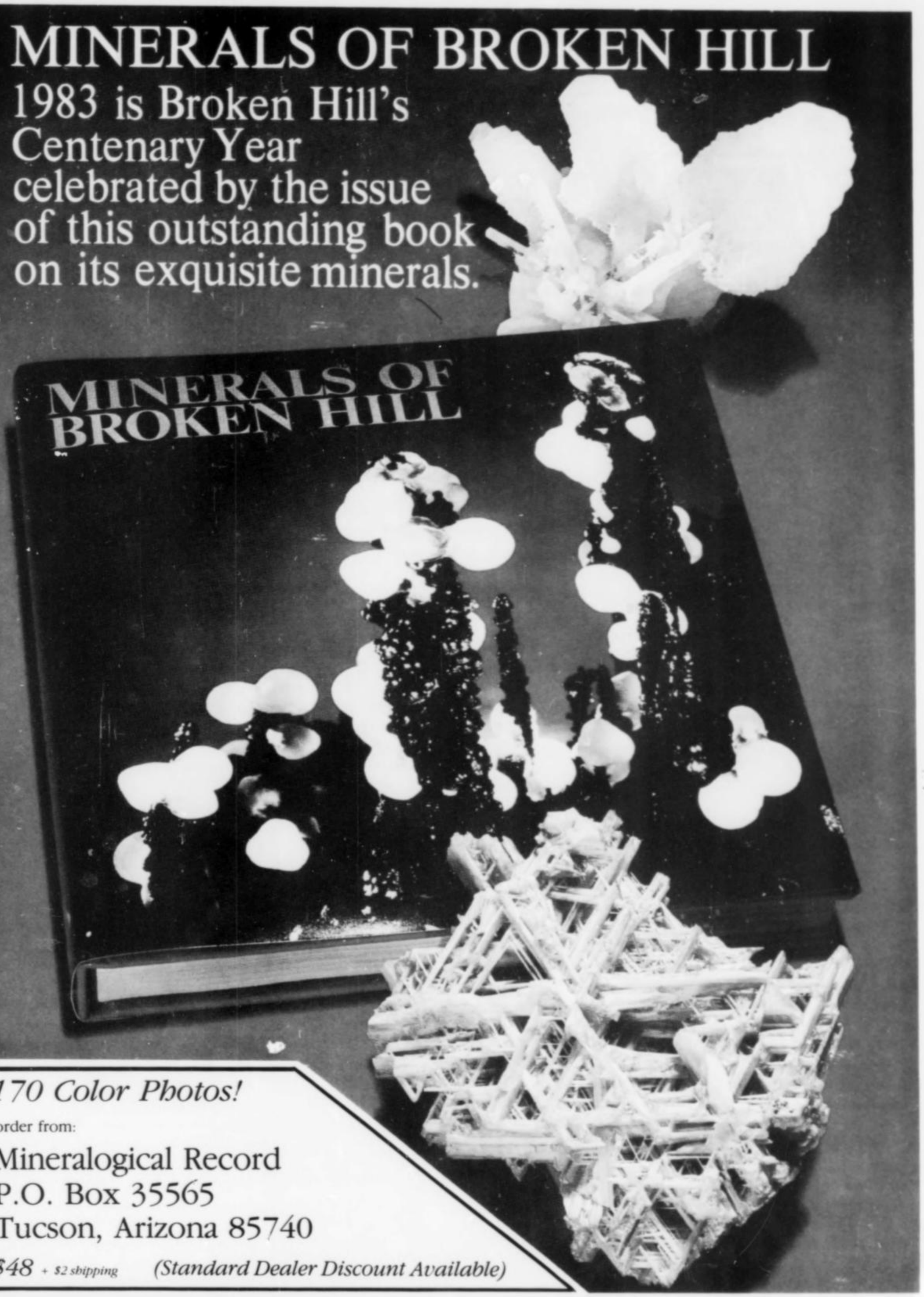

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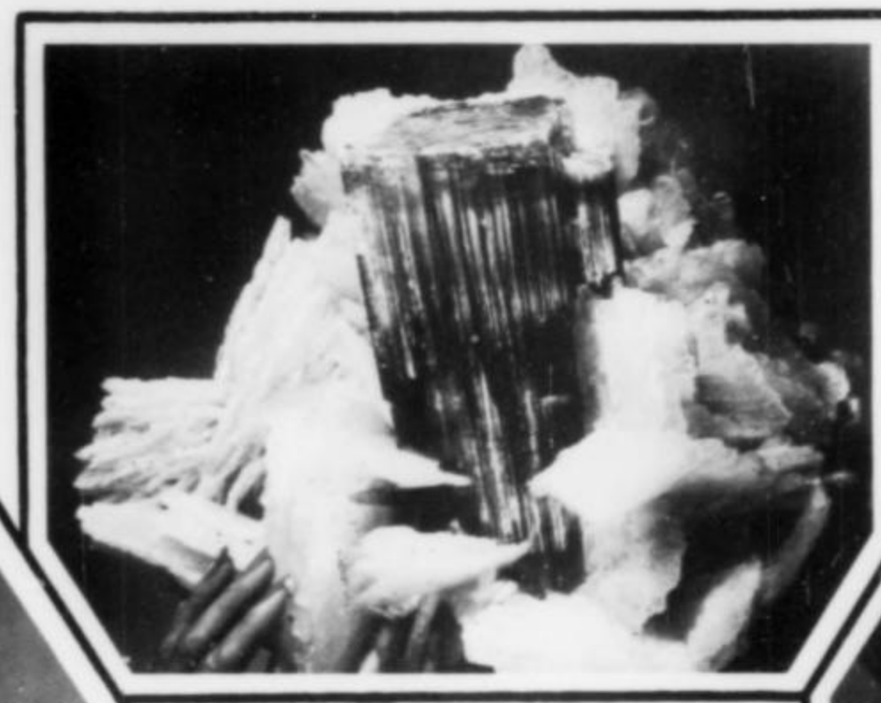

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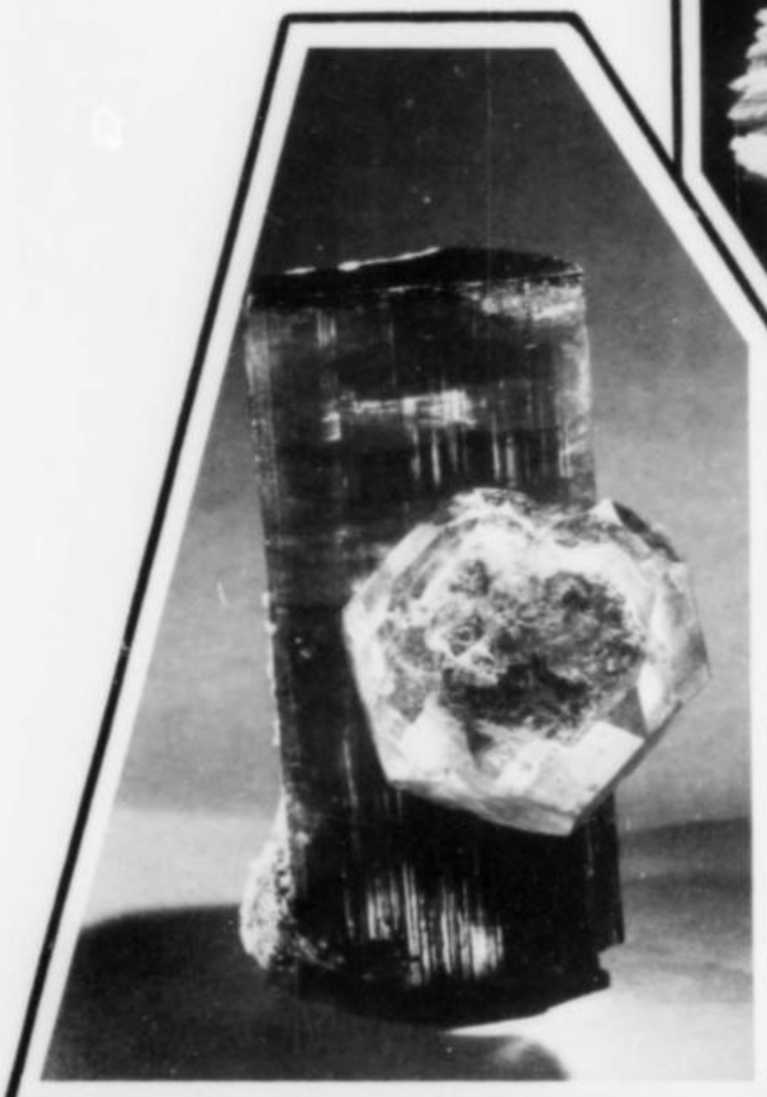

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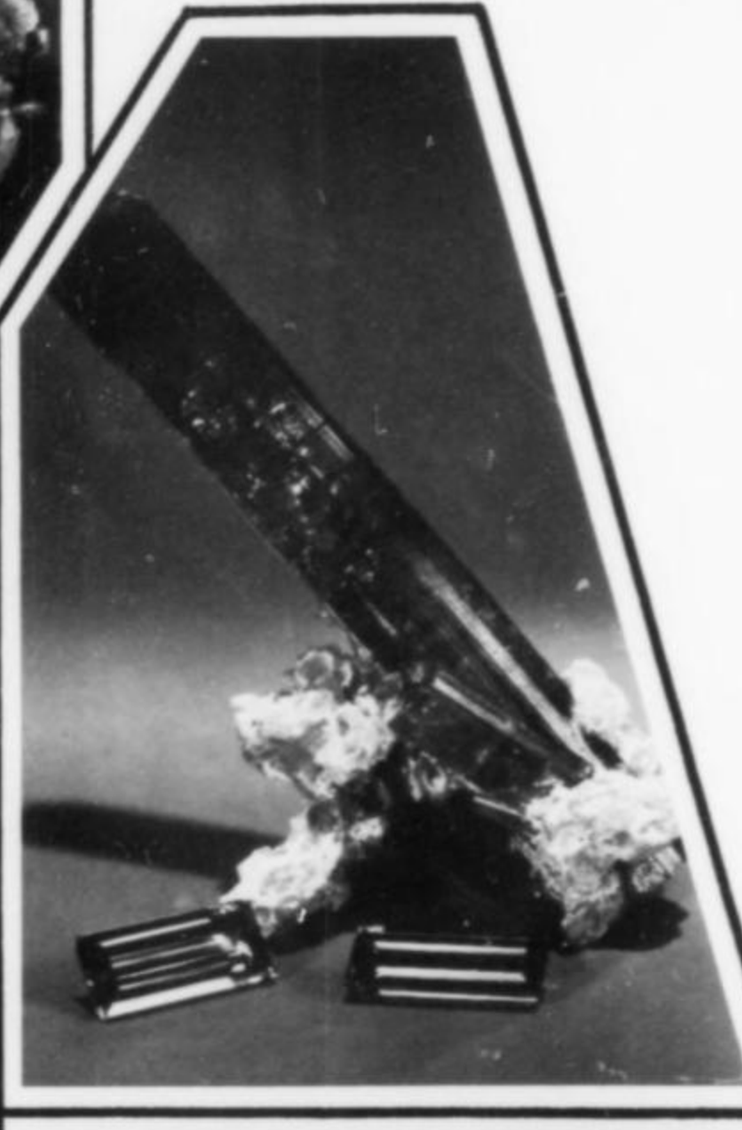

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The Hoosier Stone and Concrete Corporation quarry near Salem, Indiana, has yielded extremely well-formed, colorful crystals of celestite up to 8 cm in length. These occur in geodes in the Middle Mississippian Harrodsburg limestone. Other minerals found in the geodes include calcite, dolomite, sphalerite, gypsum, quartz, barite, marcasite and pyrite.

HISTORY

Quarrying of limestone has gone on in south-central Indiana since the early 1800's (Rooney, 1970). The stone was used for ballast, bridge abutments and lime. In the middle and late 1800's, a demand developed for dimension stone cut from the Salem limestone. This formation is ideal for use as a dimension stone because of its thickness, sparse jointing and lack of partings. Also characteristic are its softness and lack of pronounced grain, permitting it to be carved in detail. Expansion of railroads to the area allowed the market to extend along the Great Lakes to the Eastern Seaboard. The stone was commonly known as "Indiana Limestone" or "Bedford Limestone." It still dominates the domestic dimension limestone market, though current production is centered around Bloomington, Indiana, where the Salem limestone is thicker than in the Salem area.

Lime (CaO) was produced at quarries just west of Salem from 1884 to 1945 (Ault *et al.,* 1974). The main source rock was again the Salem limestone with its thick beds containing in excess of 95 percent total carbonate, thus producing a highly pure lime after calcining. The upper part of the Harrodsburg limestone is quite pure and was also used. Limestone was placed in vertical limekilns (Fig. 2) and heated by wood, oil or coal to drive off carbon dioxide. (The calcining reaction is: $CaCO_3$ + heat = CaO + CO_2.) During this period, the Hoosier Lime and Stone Company, precursor to the Hoosier Stone and Concrete Corporation, ran the quarry operation. Though minor production in the area continued until 1945, the Hoosier Lime and Stone Company closed its lime plant in 1932. Reasons for the shutdown were thick overburden, slow production, high overhead costs and a scarcity of capital for new equipment during Depression years.

Today, as in the past, crushed stone rather than dimension stone or lime is the principal product of the quarrying just west of Salem. The stone is now used as aggregate and in cement. Collecting for this study was done in the Hoosier Stone and Concrete Corporation quarry, located 1 km west of Salem, in the northeast corner of section 24, T2N, R3E. Collecting by the public is not allowed.

GEOLOGY

The quarry lies in Washington County between the Cincinnati Arch to the east and the Illinois Basin to the west. The rocks of the county are generally dipping to the west-southwest toward the basin at a regional dip of approximately 5 meters per kilometer. The study area is located within the Mitchell Plain physiographic province, which is characterized by relatively low relief and karst topography. It is bounded on the east and west by the Norman Upland and Crawford Upland physiographic provinces, respectively (Sunderman, 1968).

The two formations exposed in the quarry are the Harrodsburg limestone and the conformably overlying Salem limestone, which together comprise the Mississippian Sanders group. Though 18 to 24 m thick in Washington County (Sunderman, 1968), only the uppermost 8 m of the Harrodsburg limestone is exposed in the quarry. These rocks consist of a gray to bluish gray, medium-bedded, stylolitic, geode-bearing biocalcarenite with irregularly bedded, grayish black shale layers at the top. The celestite-bearing geode zone is generally restricted to these shale layers and the interbedded limestone. The Salem limestone is 18 to 28 m thick in this county with only the bottom-most 9 m remaining below the present-day erosional surface at the quarry. The exposed rock is a light grayish brown, thick-bedded biocalcarenite.

The depositional environment of the Harrodsburg limestone is significant. As the formation overlying the Borden group clastics, it represents the first appearance of limestone-forming shallow seas after an extensive period of deltaic deposition (Sunderman, 1968). Likewise, the Salem limestone was deposited during Middle Mississippian time in the high energy area of a shallow sea.

Figure 1. **Location of the Hoosier Stone and Concrete Corporation quarry.**

minations, apparently the result of alternating {210} and {100} faces (Fig. 6). Celestite also occurs as intergrown crystalline masses.

The celestite occurs as transparent to translucent, lustrous crystals up to 8 cm in length, and ranges from colorless to various shades of blue and gold-orange. Some crystals exhibit zoning with respect to color. Bernstein (1979) suggests that the orange coloring is due to the presence of cuprous ions. However, our spectrographic analysis of blue, gold-orange, and colorless celestite indicated that there are nearly equal concentrations of copper in the three color varieties. The authors also found the iron concentration in gold-orange celestite to be more than ten times greater than in the blue or colorless celestite. This correlates with the close physical association of marcasite inclusions with gold-orange coloring. The blue coloring is thought by Bernstein (1979) to be related to the presence of radiation-induced hole centers stabilized primarily by potassium. The authors found blue celestite to have approximately six times

Figure 2. **Abandoned vertical limekilns near the quarry. Photo by Kerry Jones.**

MINERALOGY

Celestite is the most collectible mineral in the quarry. Although originally thought to be barite by earlier collectors, X-ray diffraction and density analysis have correctly identified this mineral. Spectrographic analysis by W. H. Dennen has shown a barium substitution mean value of only 1.3 percent in the celestite-barite solid solution series. Celestite crystallizes in the orthorhombic system as prismatic crystals elongated along the *a*-axis, as tabular crystals elongated along the *b*-axis, and as almost equant crystals elongated on the *c*-axis (Fig. 5). A few crystals exhibit curved, striated terthe concentration of lead as did the other color varieties.

The celestite is essentially restricted to a zone 2 m thick at the top of the Harrodsburg limestone. The crystals are commonly unattached within the geodes. Although vibrations from blasting may have caused this, doubly terminated crystals with no apparent point of attachment occur. Some crystals exhibit etching. In many of these specimens, the etching is restricted to the {011} faces. This selective dissolution is due to constraints imposed by the atomic structure. Calcite partially overgrown by etched celestite shows no dissolution, thereby indicating that the etching solutions were not

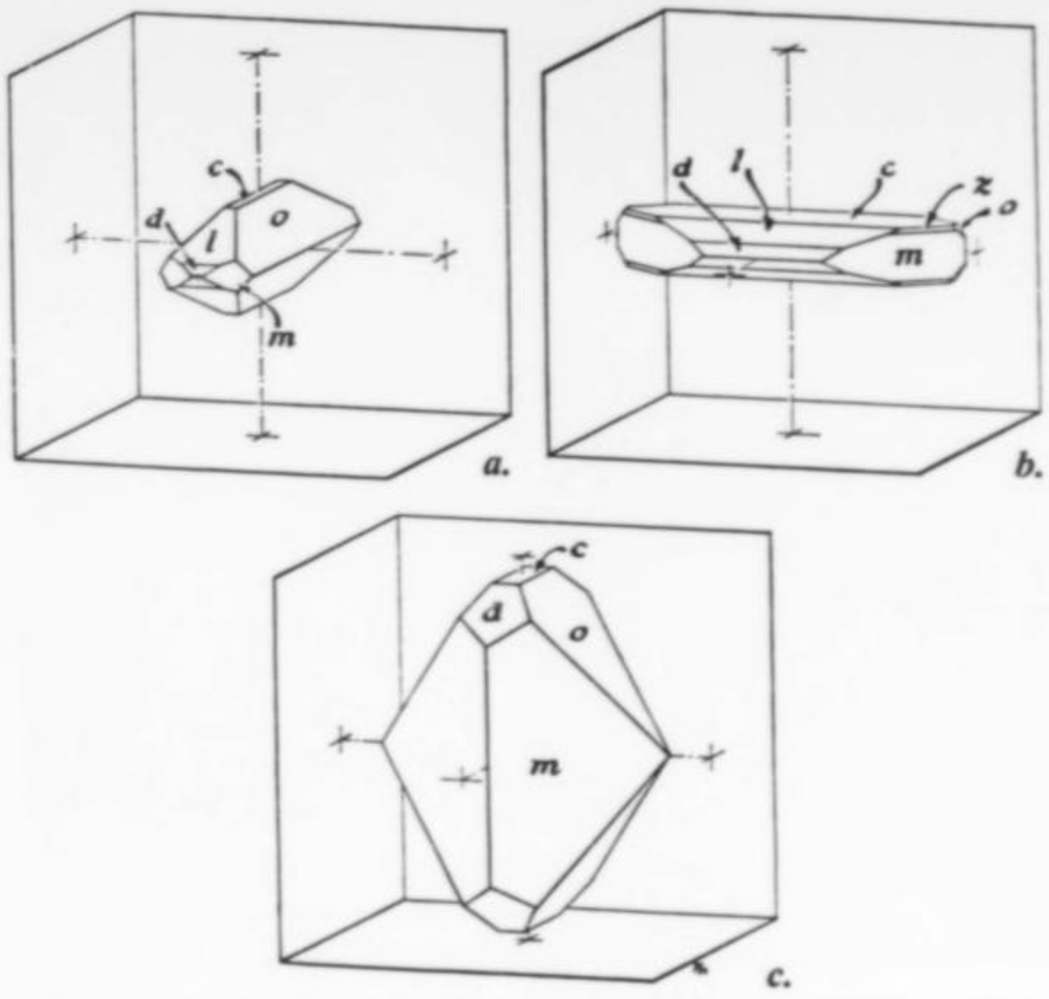

Figure 3. **Crystal forms of celestite: pinacoid *c*{001}; rhombic prisms *m*{210}, *o*{011}, *l*{102}, *d*{101}; rhombic dipyramid *z*{211}. (a) Prismatic crystal elongated along the *a*-axis. (b) Tabular crystal elongated along the *b*-axis. (c) Almost equant crystal elongated along the *c*-axis. After Berry and Mason (1959).**

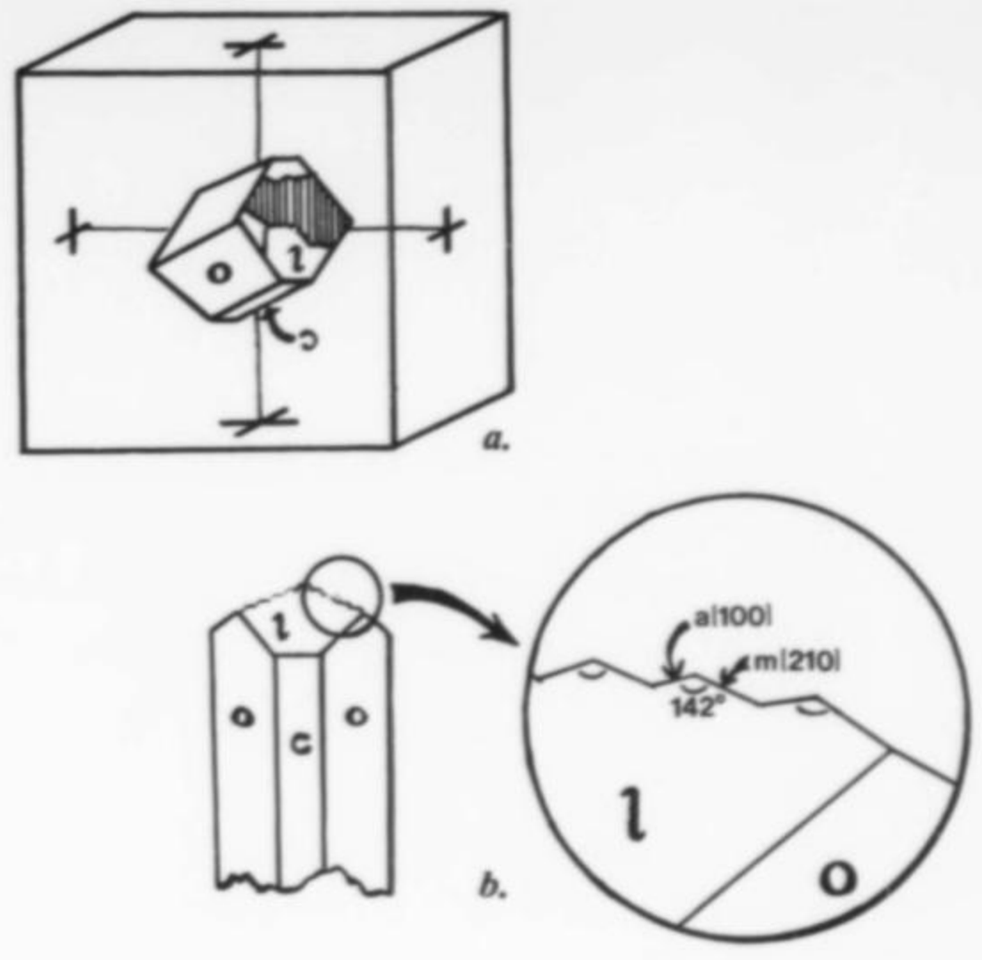

Figure 4. **(a) Drawing of a celestite crystal exhibiting a curved, striated termination. (b) Idealized and exaggerated close-up of the termination showing the competition of *m*{210} and *a*{100} faces (drawings by Andy Amster).**

undersaturated with respect to calcite.

Calcite occurs as translucent, white to gray or pale yellow scalenohedral crystals reaching 4 cm in length. They are closely associated with quartz and, when below the celestite zone, with dolomite. Some calcite crystals are doubly terminated and phantoms are occasionally encountered.

Dolomite occurs within the Harrodsburg limestone below the celestite zone. The crystals are white to pink, saddle-shaped rhombohedrons lining the walls of geodes. The pink color is apparently bleached upon exposure to sunlight. Crystals are generally small (4–5 mm) and very lustrous.

Sphalerite is found occasionally as very dark yellowish green, striated crystals, but more often occurs in a massive form.

Gypsum is found in the Salem limestone as transparent to opaque, colorless to white masses filling geodes. Some such masses display an esthetic morphology probably due to weathering.

Quartz is the most abundant of the geodal minerals in the quarry. It occurs as fine, fibrous chalcedony grading into coarse, euhedral crystals. The quartz crystals are generally translucent and colorless, although the larger crystals (up to 1 cm) commonly exhibit a white, frosted appearance. Some of the quartz occurs as small aggregates of doubly terminated crystals.

Barite occurs as opaque white bladed crystals to 3 mm, in groups on calcite and dolomite.

Marcasite, in minute filiform crystals, is included within the celestite.

Pyrite, in tiny cubic crystals, is found as a dusting on calcite, dolomite, and barite crystals.

DISCUSSION

A thin section of the chalcedony-quartz rind of a geode in the celestite zone was found to contain inclusions of relict anhydrite. This supports the Chowns and Elkins (1974) theory that quartz geodes of Mississippian age are pseudomorphous after anhydrite nodules. Arid supratidal flats or *sabkas,* such as found today in the Persian Gulf, can provide a suitable environment for primary anhydrite deposition. Generally, gypsum develops in the wetter portions of the *sabkas* while nodular anhydrite occurs landward in more desiccated sediments. However, occurrences of recent anhydrite are rare, with evidence suggesting that gypsum may be the more common if not the only original calcium sulfate mineral (Murray, 1964).

In a shallow water environment, gypsum beds can be formed by two mechanisms: (1) precipitation and sedimentation in a body of water with evaporation greater than influx; (2) growth of crystals with displacement of unconsolidated sediment beneath the evaporitic environment (Murray, 1964). The resulting gypsum beds are later replaced by anhydrite upon burial. If this replacement is accompanied by compaction of the sediment, then draping of sediment both over and under the crystals will occur, thus forming a nodule. The characteristic cauliflower-like shape of the nodule may be due to expansion resulting from the force of crystallization of anhydrite. After uplift and erosion of overlying strata the anhydrite, in turn, may be replaced by gypsum.

The initial post-evaporite event in geode formation is the volume-for-volume replacement of the margin of the anhydrite nodule by microcrystalline quartz (Chowns and Elkins, 1974). This rind formation is thought to have taken place prior to or during compaction and the consequential migration of interstitial fluids. Evidence for this early timing of initial silicification is collapse fracturing of the rind. During a later stage of this silicification, the dissolution of the anhydrite exceeds quartz replacement thus developing a void in the nodule. The quartz and later minerals then have adequate space to form euhedral crystals. The most likely source of silica is the siliceous sponge spicules which commonly undergo solution upon burial.

Within the quarry there is a vertical zoning of mineral assemblages. These can be divided into three groups (Fig. 12). Minerals in geodes of Group 1 are quartz, calcite, dolomite, barite, pyrite and sphalerite. Group 2 is the celestite-bearing geode zone and contains

Figure 5. **Light blue and gold prismatic celestite crystal 3 cm tall, exhibiting the interesting curved termination. Another celestite crystal, 1.5 cm long, protrudes from the back of the specimen. L. D. Wells collection.**

Figure 6. **Blue and gold prismatic celestite crystal, 5 cm long, showing parallel growth and sharp color zoning. D. K. Jones collection.**

Figure 7. (Left:) **Doubly-terminated, pale blue celestite crystal 2.5 cm long. The crystal shows no apparent point of attachment to the wall of the geode.** *(Center:)* **Large, steel blue, tabular celestite crystal 5.6 cm across.** *(Right:)* **Colorless, sharp, tabular celestite crystal 3.5 cm across. W. J. Schaub collection.**

Figure 8. **Colorless, transparent, complex celestite crystal 4.8 cm long. D. K. Jones collection.**

quartz, calcite and marcasite in addition to celestite. Gypsum, quartz and calcite are present in geodes of Group 3. The zoning was probably caused by changes in physical and chemical conditions during the upward migration of mineralizing fluids. Paragenetic relationships suggest that there are two generations of calcite. The first generation calcite is the dominant type below the celestite zone and is characterized by translucent white, sharp scalenohedrons. The second generation calcite consists of smaller, pale yellow, rounded scalenohedrons, and occurs mostly within the celestite zone.

With the exception of the evaporites, the quartz rind, and possibly celestite, postlithification deposition by reactions involving meteoric water and upward-seeping formation waters is considered the effective mineralizing mechanism (Fisher, 1977). Perhaps the sharp demarcation of the celestite zone is due to the action of the shales as an aquaclude to these upward-moving waters. Postlithifi-

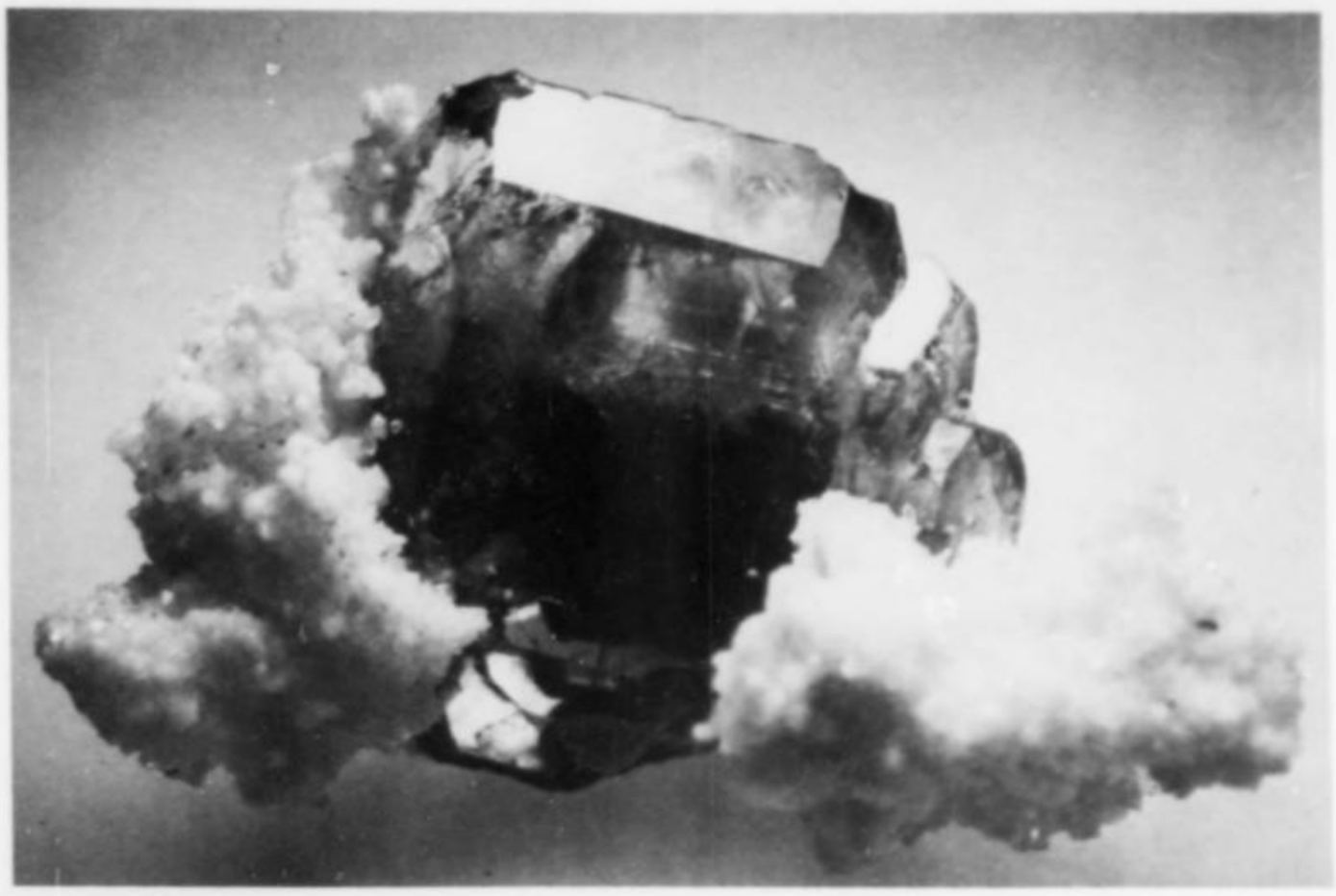

Figure 9. **Pale blue tabular celestite crystal 1.5 cm across with milky white crystalline quartz masses. W. J. Schaub collection.**

Figure 10. **Large, pale gray celestite crystal 7.5 cm long with a 4-cm celestite crystal attached. (The smaller crystal has been reattached to the larger crystal.) L. D. Wells collection.**

cation, basinally-derived fluids normally tend to migrate toward the areas of least pressure, i.e. the structural highs, while depositing minerals on the high areas and along their flanks (Fig. 13). Similar models have been proposed in relation to ore mineralization. The location of the quarry on the flank of both the Illinois Basin and the Cincinnati Arch is just such a favorable area. Fluid inclusion data by Roedder (1967) support the formation of geodal minerals from meteoric waters, therefore a mixing of meteoric and formation waters could be a workable hypothesis (Fisher, 1977).

A thin section of a celestite crystal showed abundant inclusions which are thought to be anhydrite. Emission spectrographic analysis indicated a high amount of calcium which would support this possibility. This and the geodal nature of the celestite masses suggest that the celestite is secondary, replacing anhydrite. The replacement reaction is $CaSO_4 + Sr^{+2} = Ca^{+2} + SrSO_4$ (Frazier, 1975).

At a later time, anhydrite dissolved and the less soluble celestite that had partially replaced anhydrite remained and continued to grow into euhedral crystals. However, the doubly terminated crystals showing no apparent point of attachment probably grew within the dissolving anhydrite meshwork. Celestite formation occurred after quartz rind formation. It is not certain whether celestite crystallized during or after diagenesis.

The possible sources of strontium are varied. Seawater with a decreased Ca^{+2}/Sr^{+2} ratio due to gypsum and anhydrite formation, for example, is favored by Frazier (1975). Strontium can substitute for calcium in minerals such as aragonite and anhydrite and, to a lesser degree, in calcite and gypsum. Wood and Shaw (1976) suggest dolomitization of aragonite as a method of releasing Sr^{+2} into solution. Strontium from the hydration of anhydrite to form gypsum and the dissolution of gypsum is thought to be the Sr^{+2} source of celestite-forming solutions by Carlson (1980). Recrystallization of aragonite to calcite or silicification would also release Sr^{+2} to form celestite (Hess and Rose, 1967). Strontium in the study area is probably due to an interplay of the sources described above.

These mineralized geodes represent an unusual and particular series of geological events. The formation of evaporites, the actual

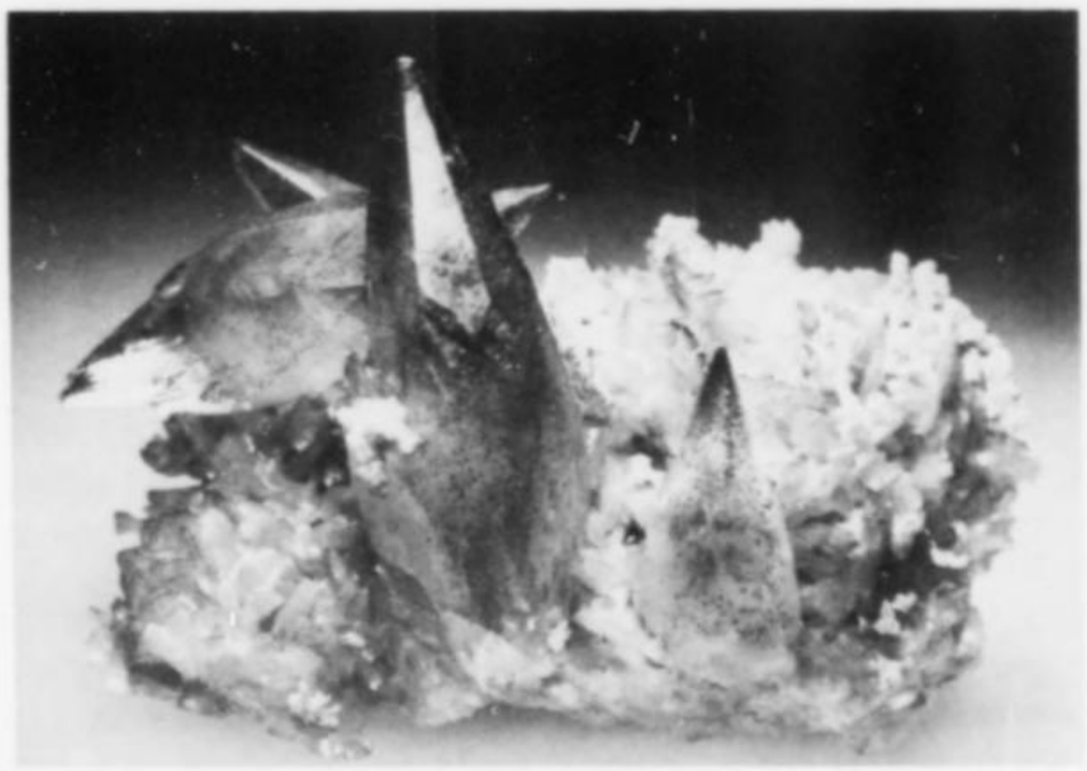

Figure 11. **Smoky calcite crystals with white barite blades on pink dolomite crystals. Pyrite inclusions outline phantoms in the calcite crystals. Largest calcite crystal is 3 cm long. Specimen is 5 x 2.5 cm. L. D. Wells collection.**

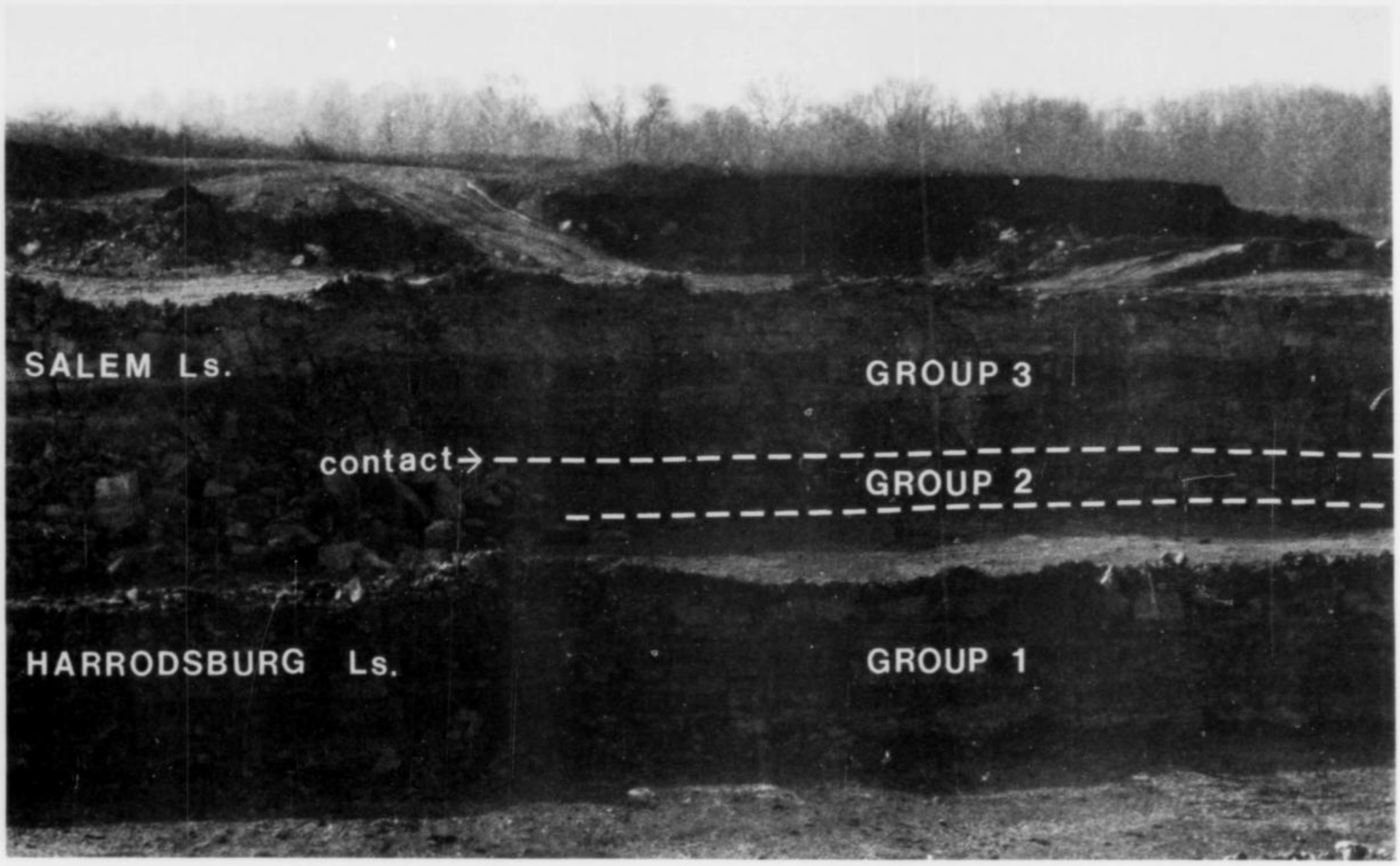

Figure 12. **The three mineral assemblage groups and the celestite-bearing geode zone shown in relation to the Salem limestone-Harrodsburg limestone contact in a vertical face at the quarry. (Photo by Kerry Jones.)**

geode genesis, and the subsequent mineralization of the geodes are all intriguing problems that warrant further research. The details of such deposits may also provide useful information in the search for ore bodies such as those of the Mississippi Valley type.

ACKNOWLEDGMENTS

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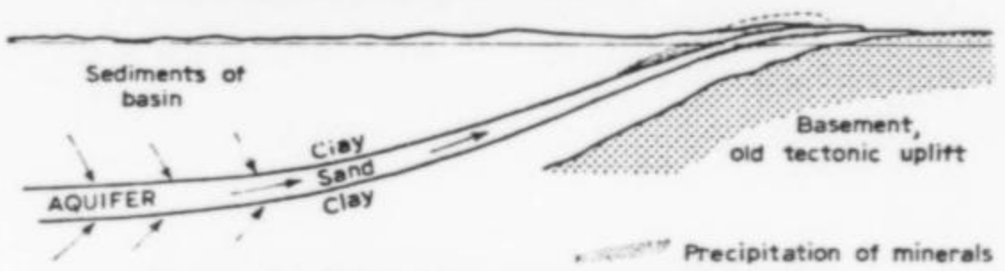

Figure 13. **Sketch showing an example of formation water flow from the center of a basin to an area of lesser pressure on its flank (after Dozy, 1970).**

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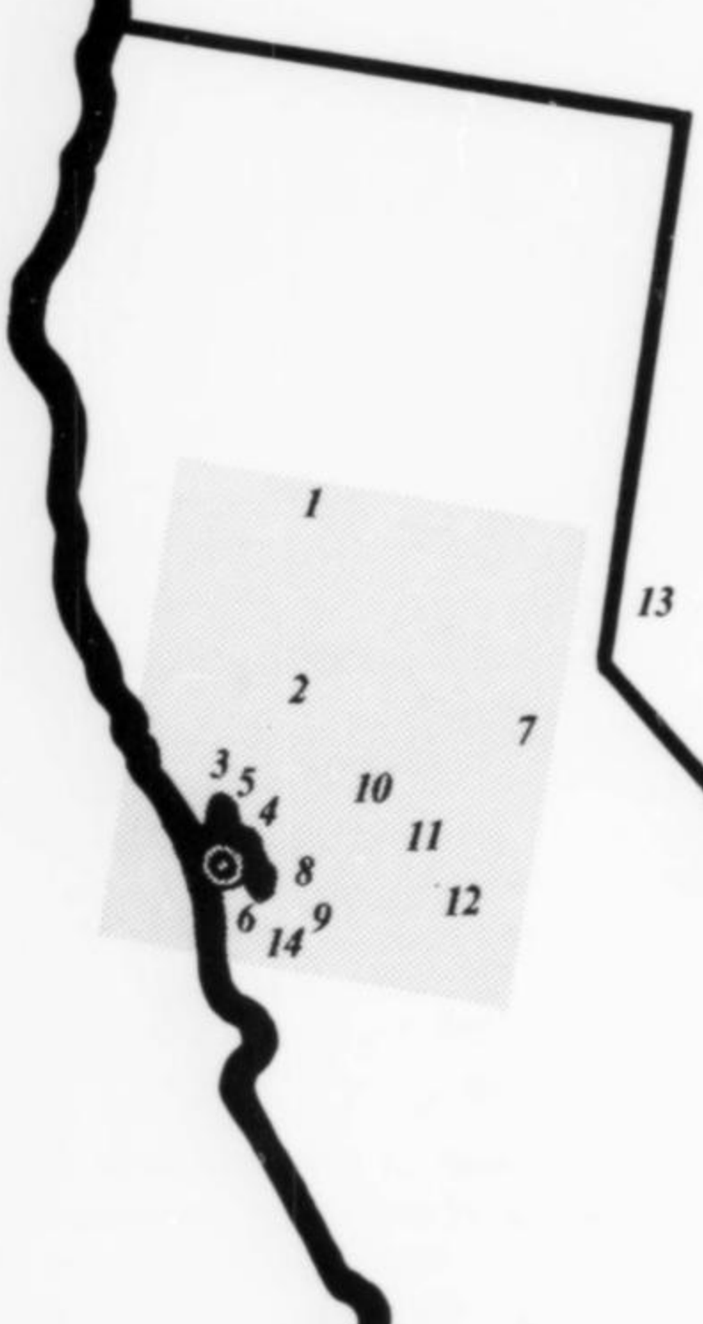

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minerals of the Derbyshire Orefield

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The Derbyshire orefield in central England has been a lead mining center since ancient times. Many of the oxidation species found there have great historical and specimen interest. The area is famous for "blue john" fluorite, and includes the type locality for matlockite.

INTRODUCTION

The Derbyshire orefield is situated in the Peak district, the southern termination of the Pennine Hills, in North Derbyshire and in the adjacent parts of Staffordshire, England. The orefield is in a hilly area of considerable scenic beauty, and much of it lies within the Peak District National Park.

The geology of the area is dominated by the Derbyshire Dome, some 20 miles across. The central outcrop of Carboniferous (Viséan) limestone leads upwards (outwards in outcrop) to the impermeable Edale (= Yoredale) shales, which pass upwards into the Millstone grit, and further out to the Permo-Triassic New Red sandstone. Volcanic activity during the Carboniferous is evidenced by the presence of impermeable sills and lava flows, and some vents, within the limestone. These are mainly olivine-doleritic in composition, and are known locally as "toadstones," either from their lack of mineralization ("Todt-Stein" = "dead-stone"), or from their speckled greenish appearance.

The lead-zinc mineralization is in the form of fault veins (locally known as "rakes"), pipes and replacement flats, and is almost completely confined to the upper (outer) parts of the Carboniferous limestone, particularly on the eastern flanks of the outcrop, occasionally passing up a little way into the shales. A number of small Carboniferous limestone inliers outcrop, mainly around the southern half of the dome. These are mostly strongly mineralized, suggesting mineralization of the buried peripheral limestone. The mineralization is Permo-Triassic, hence later than the toadstones, which exert only a local influence on ore distribution (e.g. by damming).

Caves are common in the limestone area, though not usually well endowed with stalactitic growths. A number of famous show-caves lie within the area, most of which are combinations of mine workings and natural caverns. The Blue John and Treak Cliff Caverns at Castleton are "blue john" mines; the Speedwell Cavern in the same district is an old lead mine approached by boat along a drainage adit. The Rutland, Masson, Cumberland and other caverns at Matlock Bath are old to ancient lead mines. Poole's Cavern at Buxton is noted for evidence of prehistoric human occupation.

The area has been a lead mining center since ancient times. The Romans were particularly active here, and a number of inscribed "pigs" or ingots of lead, smelted locally, have been found. Lead mining has declined since the late 19th century, and fluorite mining now predominates.

MINERALOGY

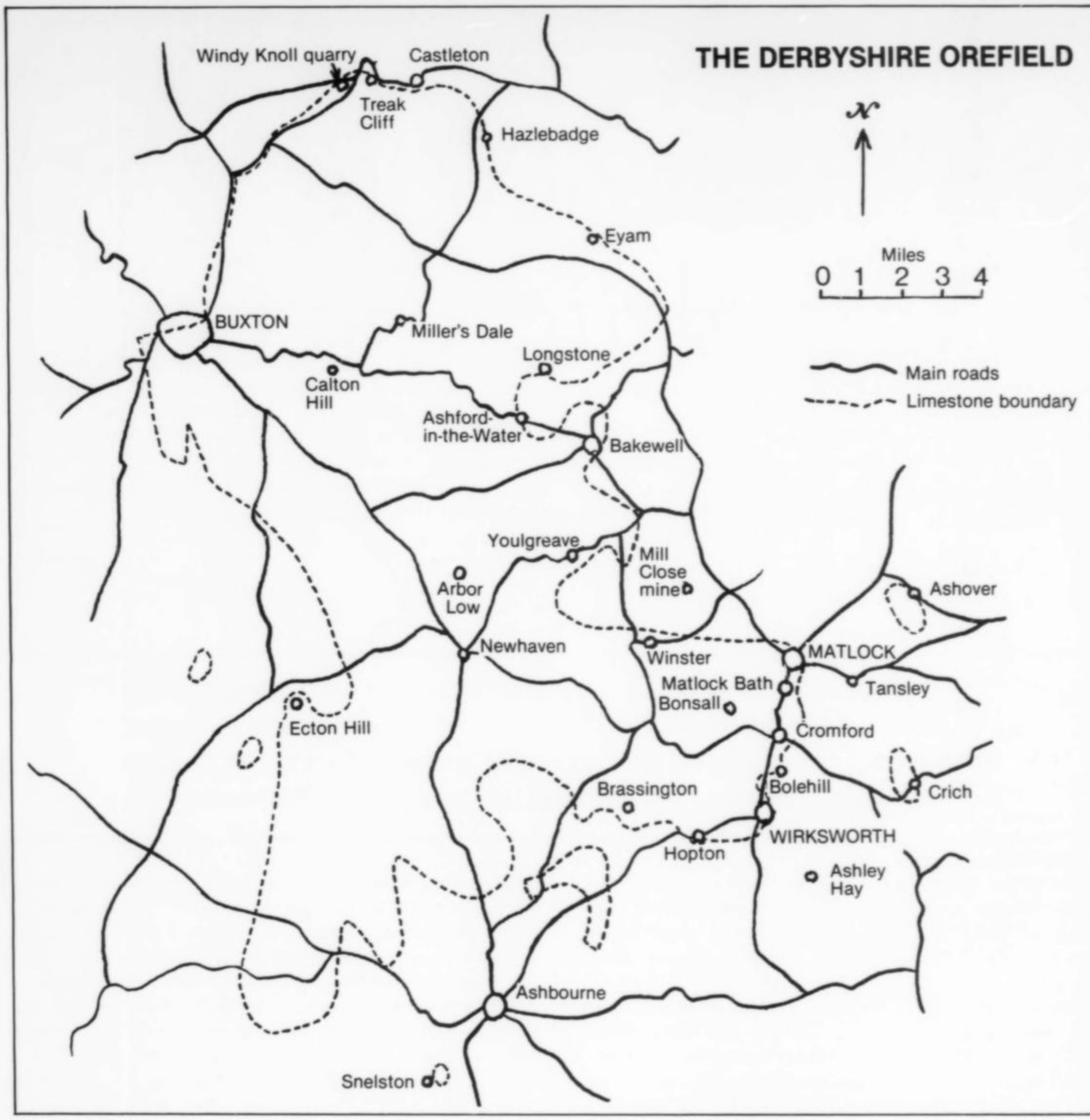
Apart from the rock-forming minerals, not considered in this paper, the mineralogy of the area is dominated by the lead mineralization, with less zinc and sporadic copper in a calcite-barite-fluorite gangue. The distribution of dominant gangue minerals shows distinct overlapping zoning, with calcite towards the center of the dome, followed outwards by barite, and to the periphery by fluorite (Wedd and Drabble, 1908).

The primary ore minerals in the area are of major industrial value, but usually of little specimen interest; their supergene oxidation products, on the other hand, are much less common and of limited industrial value, but include material of great historical and specimen interest. The gangue minerals, being common and typically well crystallized or in other attractive forms, are of both industrial and specimen value.

ELEMENTS

Graphite C

Reported as inclusions in calcite from the Mill Close mine, Wensley (Mueller, 1951).



Sulfur S

Listed by Mawe (1802). Uncommon in the area. Microscopic crystals are found closely associated with anglesite as an alteration product of galena, as at the Dene quarry, Cromford, and at Hazlebadge (Braithwaite and Ryback, 1963b).

Copper Cu

Very rare in the area. Has been found as inclusions in calcite at the Riber mine, Matlock (Varvill, 1959). Also found at Ecton Hill (Garner, 1844).

Silver Ag

Very rare. Small amounts found by R. J. King in a sill at Ible, near Matlock (Ford and Sarjeant, 1964a).

OXIDES

Hematite Fe_2O_3

Found in the area, usually as an oxidized replacement product of limestone. It is normally rather dispersed, but at a few localities small concentrations have been mined in the past (Farey, 1811). The material is massive and not attractive to mineral collectors.

Goethite FeO(OH)

Not uncommon in the area, as a normal oxidation product in the form of "limonite," "ochre," etc. Pseudomorphs after pyrite and marcasite crystals are occasionally found (Miers, 1896). Tiny hemispheres and needles occur on and in some of the quartz crystals in the volcanics, as at Calton Hill. A few small bundles of stalactitic rods were found in a small cavity in the Masson quarry, Matlock, in 1963.

Wad MnO_2

Widespread, mostly in small amounts (Farey, 1811). Pockets of wad have been worked in the past, e.g., near Winster and Hopton.

Cuprite Cu_2O

Uncommon, usually massive, brownish (Adam, 1845; Sarjeant, 1957; Ford and Sarjeant, 1964a).

Tenorite CuO

Rare in the area. Reported from Watersaw Rake, Longstone (Ford and Sarjeant, 1964a) and Ecton (Sarjeant, 1957).

Quartz SiO_2

Listed by Mawe (1802), quartz is not a normal gangue mineral in the area. In association with the mineralization it occurs occasional-

Figure 1. **Dolerite in Calton Hill quarry, showing amygdule complex lined with quartz and calcite. Author in foreground. Photographed in 1961 by George Ryback.**

Figure 2. **Sphalerite, black crystals on colorless fluorite cubes with chalcopyrite inclusions from the Ladywash mine, Eyam. RSWB specimen and photograph, field 2 inches across.**

ly as small crystals or as chalcedony, usually cherty. Attractive clusters of small crystals, typically bipyramidal, are found as a secondary mineral in amygdules in some of the dolerites, notably at Calton Hill. These crystals are usually colorless, but in some cases smoky or amethystine, and are commonly spotted with tiny hemispheres and sometimes needles of goethite. Loose crystals, the so-called "Buxton diamonds," have been found in soils resulting from weathering of these volcanics.

SULFIDES

Galena PbS

The major ore of lead, ubiquitous in the orefield. Good crystals, usually cuboctahedral, and not very common.

Sphalerite ZnS

Widespread, but less common than galena. Good crystals uncommon, the best in recent years probably being those found at the Ladywash mine, Eyam, usually scattered on clusters of colorless fluorite crystals with pyritic inclusions.

Chalcopyrite $CuFeS_2$

Of widespread occurrence but usually in small quantities. Has been economically workable at a few scattered localities, mostly on the fringes of the area, as at Ecton where it is also found as small bright crystals on and in calcite scalenohedrons (Green and Strahan, 1887). Small crystals are common as zoned inclusions in colorless fluorite cubes from the Ladywash mine, Eyam.

Pyrite FeS_2

Widespread in small amounts.

Marcasite FeS_2

Widespread in small amounts. Goethite pseudomorphs of well-shaped crystals are sometimes found.

Bravoite $(Ni,Fe)S_2$

Found at the Mill Close mine, Wensley (Bannister, 1940), and at other localities, mostly near Matlock (Ixer, 1974).

Millerite NiS

Found in the Tansley borehole (Ramsbottom, Rhys, and Smith, 1962), as beautiful golden needles spanning a cavity. Fine golden needles of millerite up to about half an inch long were found in a calcite vein in decomposed olivine dolerite exposed in the late 1970's in the Fall Hill quarry, Ashover, but the exposure is now buried by rubble.

Pyrrhotite $Fe_{1-x}S$

Rare. Found in the Tansley borehole (Ramsbottom, Rhys, and Smith, 1962), and at a few other localities.

Arsenopyrite FeAsS

Rare. Listed by Hall (1868) from Eyam, and from Ecton by Sarjeant (1957).

Tetrahedrite $(Cu,Fe)_{12}Sb_4S_{13}$

Reported only from the Mill Close mine, Wensley (Bannister, 1940).

Chalcocite Cu_2S

Rare in the area. Listed by Stokes (1879).

Greenockite and Hawleyite CdS

Thin coatings of powdery yellow "greenockite" are found occasionally on sphalerite and other minerals at a few places, as at the Mill Close mine (Russell, 1911), where it has also been found as inclusions in hemimorphite. Some of this greenockite may well be hawleyite, which has been identified recently at the Fall Hill quarry, Ashover, in addition to greenockite, and some may be neither.

Figure 3. **Dump of the Bage shaft, the only surviving dump of the Bage mine, in 1979, looking east. No phosgenite or matlockite has been found on this dump. J. I. Wilson photograph.**

Cinnabar HgS

Microscopic amounts of brick-red powdery cinnabar were found, associated with smithsonite, in Rutland Cavern, Matlock Bath in 1962 (Braithwaite, Greenland, and Ryback, 1963a). This was of interest as the first identification of any mercury mineral from the British Isles. Since then small amounts have been found elsewhere in Derbyshire and in a few other parts of Britain, and commercial amounts have been obtained from the Gortdrum mine, Ireland.

HALIDES

Fluorite CaF_2

Fluorite is common in the area, especially in the peripheral zone and in some of the inliers, e.g., Ashover, Crich, Ecton, where in places it is the dominant gangue mineral and metasomatic alteration product of limestone.

It commonly occurs well crystallized in cubes, occasionally showing bevelling with {013} and, rarely, vicinal faces. It is normally colorless, but dark purple material is common in certain areas, particularly around Castleton and at other scattered localities. Yellow fluorite is occasionally seen, sometimes with a deep purple outer zone.

Apart from a narrow red-fluorescing band in a few specimens from one cavity at Castleton (Braithwaite, Flowers, Haszeldine, and Russell, 1973), fluorite from the area is characteristically nonfluorescent under ultraviolet radiation. This lack of fluorescence and somewhat limited color range contrasts with the famous colored and fluorescent specimens from the Northern Pennines around Weardale, and is connected with the low rare-earth content of Derbyshire fluorites in contrast to the high rare-earth content of the Northern Pennines material (Dunham, 1952; Braithwaite, Flowers, Haszeldine, and Russell, 1973).

Some Derbyshire fluorites have been used for ornamental purposes; "Crich spar" is mentioned below under barite, and the beautiful purple banded variety known as "blue john," exclusively from the Treak Cliff reef knoll at Castleton, is world famous. Small pieces of blue john are still being mined, but the large pieces required to make the larger bowls and urns of the 19th century are no longer available. The deep purple color of Derbyshire fluorite is rather different from the color of the Northern Pennines purple fluorites, and is due to radiation damage from traces of radioactive elements in the environment (MacKenzie and Green, 1971; Braithwaite, Flowers, Haszeldine, and Russell, 1973), and not to the presence of hydrocarbons as formerly supposed. The attractive clusters of colorless cubes with pyritic inclusions, which came until recently from Ladywash mine, Eyam, have already been referred to.

Phosgenite $Pb_2CO_3Cl_2$

Once known as "cromfordite" from the classical British locality of "Cromford near Matlock," the actual locality is an air shaft to an old level in the Bage mine, in the village of Bolehill, between Cromford and Wirksworth (Greg and Lettsom, 1858). Localities such as "Matlock," "Cromford," "Wirksworth," "Bolehill," "Cromford Level," "Wallclose mine," or "Arkwright mine" for phosgenite and for matlockite almost certainly refer to this locality. The level is now inaccessible, and the air shaft has been built over, hence no specimens have been found here for well over a century. All dumps and many old shafts in the vicinity have been examined; no trace of phosgenite or matlockite has been found and, indeed, Brice Wright, who rediscovered the locality in 1851, said "I have examined every mine in the neighbourhood, and have not met with a

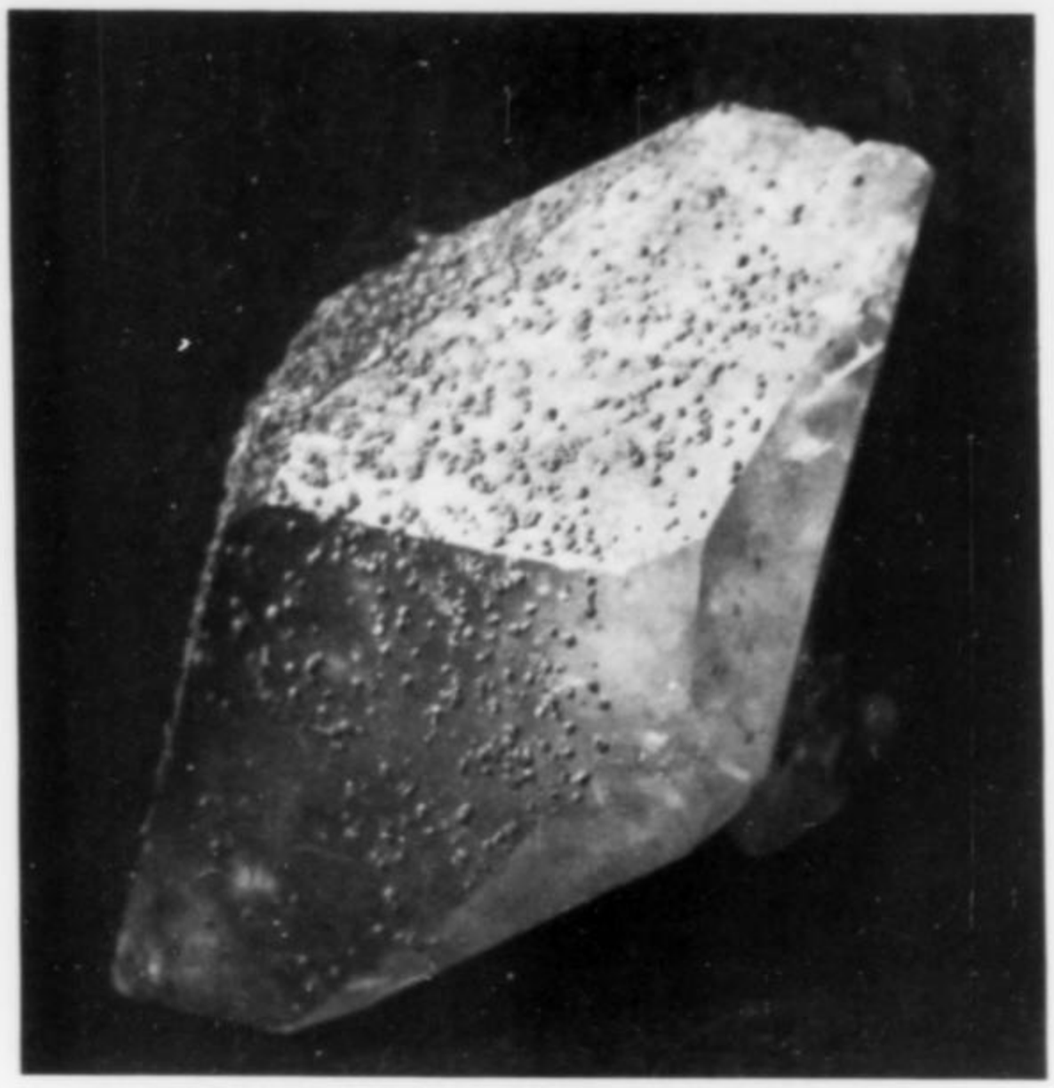


Figure 4. **Calcite, colorless scalenohedron 2 inches long, sprinkled with small brown smithsonite crystals, from the Riber mine, Matlock. RSWB specimen (60-19) and photograph. Collected in 1960.**

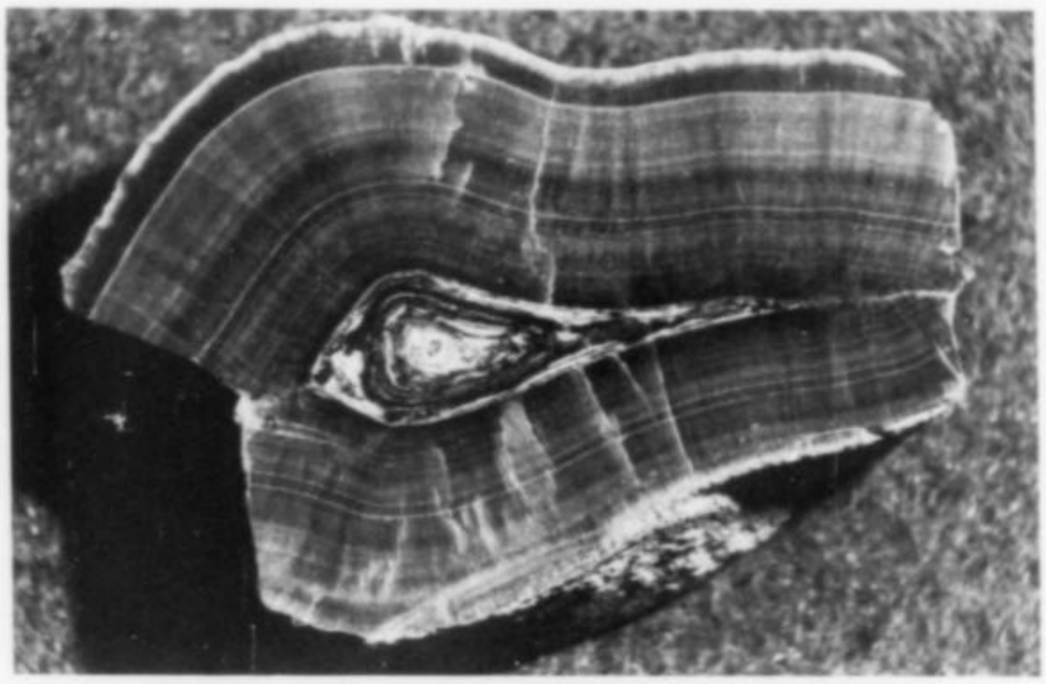


Figure 5. **Brown stalactitic barite ("oakstone"), polished across grain, from Arbor Low, Middleton-by-Youlgreave. RSWB specimen (74-86), 2½ inches long, and photograph.**

single crystal of this mineral (phosgenite), except at the spot referred to" (in Greg and Lettsom, 1858). However, members of a mine exploration society have recently penetrated the old workings and are said to have found small quantities of phosgenite. A. H. Stokes (1879) claimed to have obtained one small specimen from the Meer Brook Sough mine, Wirksworth. This could be the Merebrooksough mine, some 600 yards from the Bage mine, or Merebrook Sough, a drainage level nearly 3 miles long, passing under Wirksworth not far from the Bage mine. A report by Parsons (1896) of "white ore (cromfordite?)" from the Mill Close mine, Wensley, is probably an error for cerussite or possibly anglesite.

The phosgenite forms colorless tetragonal crystals of short or long prismatic habit, commonly transparent and brilliant, with sharp terminations. A few crystals twisted about the *c* axis were found, and one is on display in the British Museum (Natural History). The crystals are soft and have a pronounced cleavage,

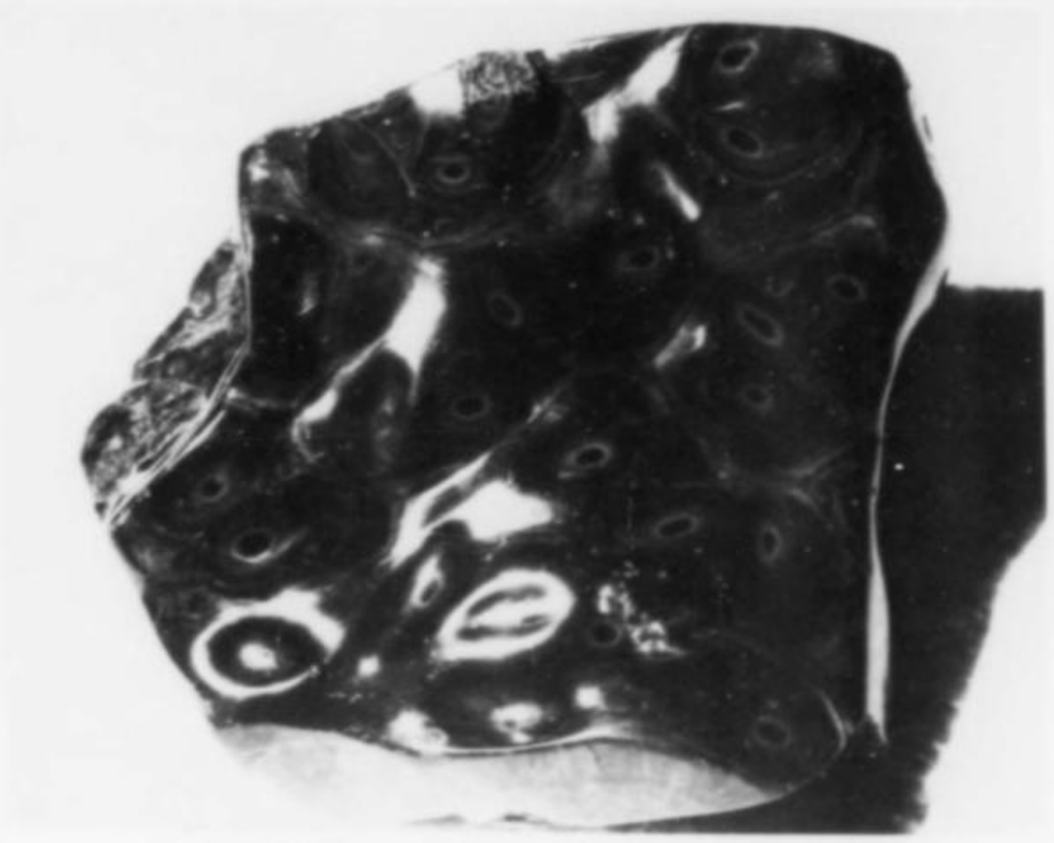


Figure 6. **Brown stalactitic barite ("oakstone"), polished with ropes to give "eyes." Arbor Low, Middleton-by-Youlgreave. Nineteenth century specimen, 5 x 4 inches. RSWB specimen (69-140) and photograph.**

and are therefore easily damaged. They show a brilliant yellow fluorescence under ultraviolent radiation. The crystals are perched on galena, and associated with fluorite, barite, sphalerite, cerussite, anglesite and occasionally matlockite.

Matlockite PbFCl

The type locality of "Cromford near Matlock" (Greg, 1851) is the only locality in the area, and is the same as that for phosgenite, an air shaft to an old level in the Bage mine, Bolehill (Greg and Lettsom, 1858), hence again no specimens have been found for well over a century, and few good specimens are known. "Rutland mine" for matlockite, quoted by Bannister (1934), is an error (Braithwaite and Ryback, 1963a). It sometimes occurs on the same specimens as phosgenite, and a specimen from the late Arthur W. G. Kingsbury's collection, now on display in the British Museum (Natural History), shows this association. Matlockite was originally believed to be an oxychloride of lead until the fluorine content was analyzed (Nieuwenkamp, 1933; Hey *in* Bannister, 1934).

The specimens form aggregates of pale yellowish, pearly, tetragonal plates, exceptionally to 2 inches across, with a yellow fluorescence in ultraviolent radiation, with fluorite, barite and other minerals on galena.

CARBONATES

Calcite $CaCO_3$

The most common gangue mineral in the area. Often well crystallized, with crystals nearly always dominated by the scalenohedron, but the crystals, although commonly large and well-formed, are not often really transparent and with smooth faces. A few heart-shaped butterfly twins, twinned on [10$\bar{1}$1] were found at Eyam many years ago (Rudler, 1905). In 1975 a trial drive in the Ladywash mine at Eyam came across a cavity complex containing some beautiful, sharp, transparent crystals, from half an inch to over an inch long, combinations of prisms and scalenohedrons, with rhombohedral terminations, scattered on layers of colorless fluorite cubes. Fortunately, a few trays of these specimens were collected at the time, as no more were found afterwards, and the drive is now abandoned and inaccessible. The best specimens are probably those in the British Museum (Natural History), and in the author's collection. Scalenohedral calcites are also common in the dolerite amygdules and, rarely, rhombohedral crystals of "cuboid" habit are found.

Figure 7. **Entrance to the Clayton adit, Ecton Hill, in 1963. Dumps of the Dutchman level are visible on the hillside; view is looking north-northeast. RSWB photograph.**

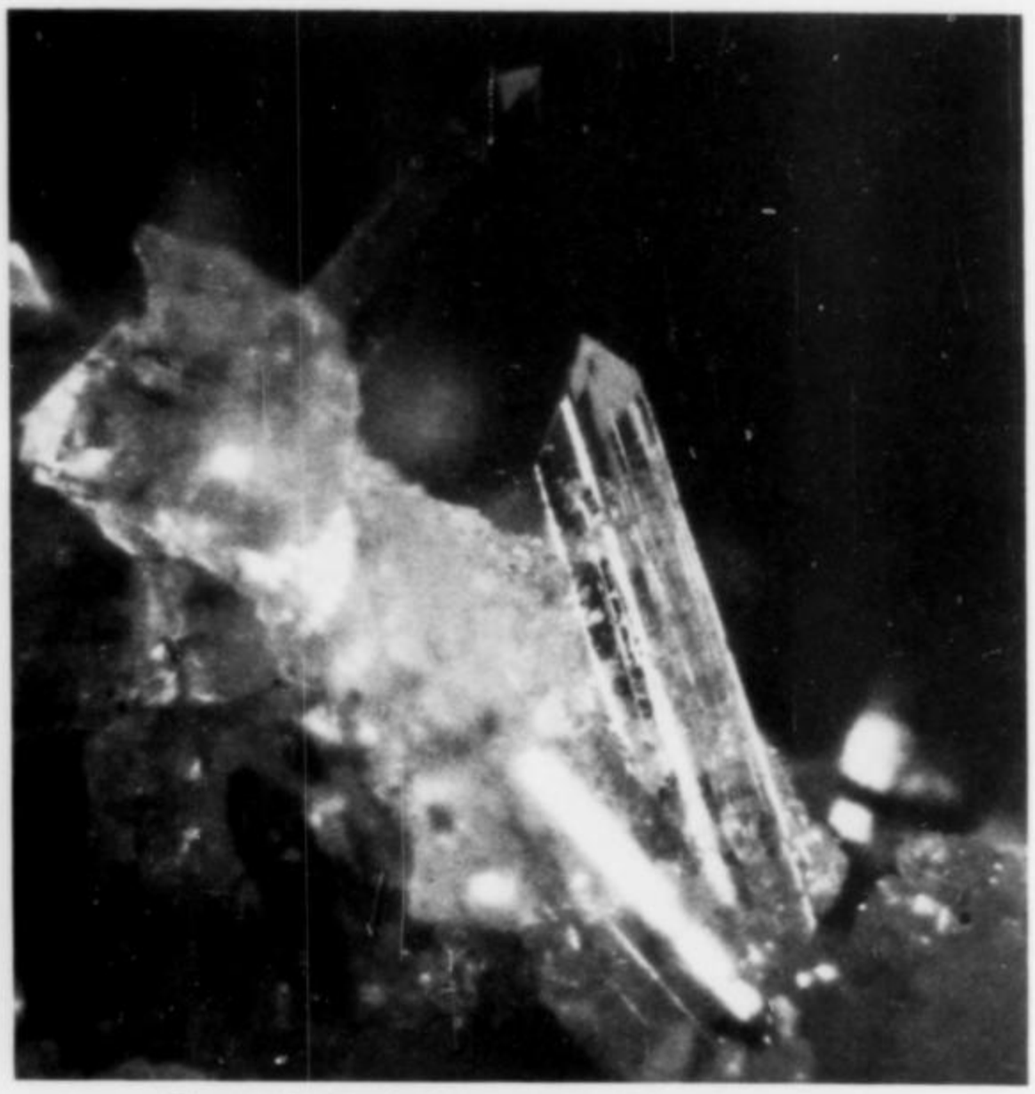


Figure 8. **Anglesite, colorless blades in galena, from the Dene quarry, Cromford. RSWB specimen (60-93) and photomicrograph, field 3/16 inch across. Collected in 1960.**

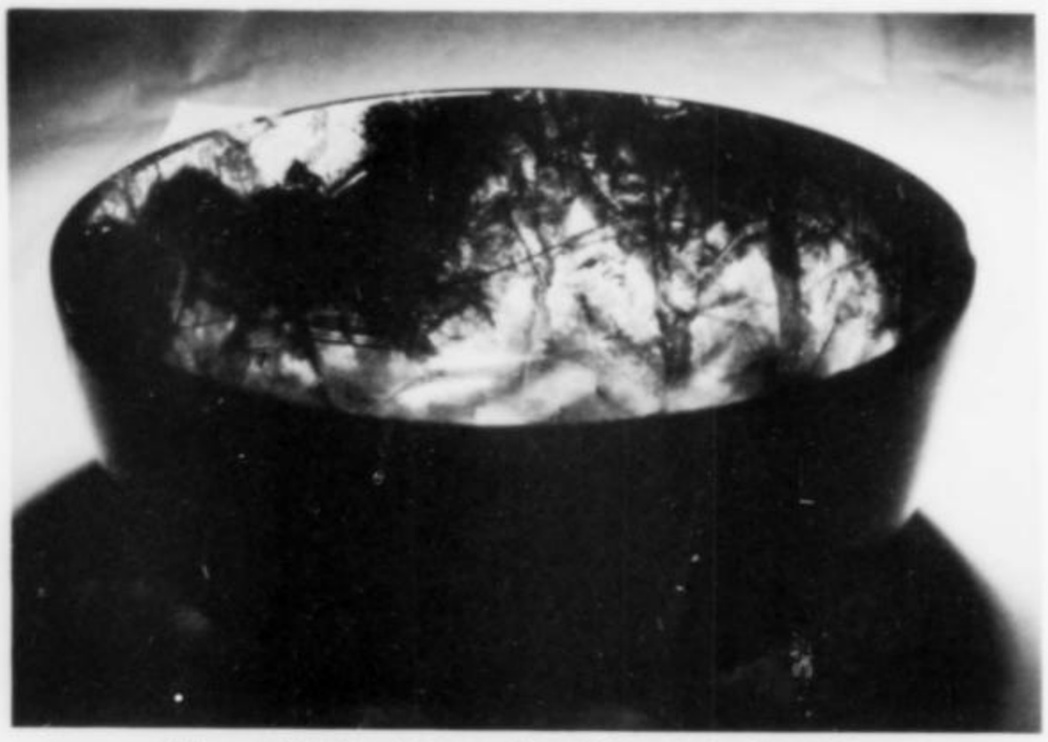


Figure 9. **Fluorite, variety "blue john," antique polished bowl 5 inches across. Blue John mine, Castleton. RSWB specimen (77-56) and photograph.**

Dolomite $CaMg(CO_3)_2$ and **Ankerite** $Ca(Fe,Mg,Mn)(CO_3)_2$

Despite widespread dolomitization of parts of the limestone, crystalline dolomite and ankerite are of rare occurrence in the area.

Siderite $FeCO_3$

Rare in the area. Reported by Mawe (1802) and Farey (1811).

Aragonite $CaCO_3$

Reported by Adam (1845). Not very common; found at a few localities, usually compact radiating (rarely pale greenish-blue), and occasionally as "flos-ferri," as at the Wapping mine, Matlock Bath.

Witherite $BaCO_3$

Listed by Mello (1875). Rare in the area, in contrast with barite.

Cerussite $PbCO_3$

Listed by Mawe (1802). The commonest lead supergene mineral in the area, usually as a massive white coating or as small grayish white or brownish white crystals on galena. Larger crystals, to 2 inches, were found in earlier centuries, at which times small localized deposits of massive cerussite were economical. The best crystals came from the southern part of the orefield, particularly from the vicinity of Wirksworth.

Dundasite $PbAl_2(CO_3)_2(OH)_4 \cdot H_2O$

Very rare. Found at the Mill Close mine, as small radiating

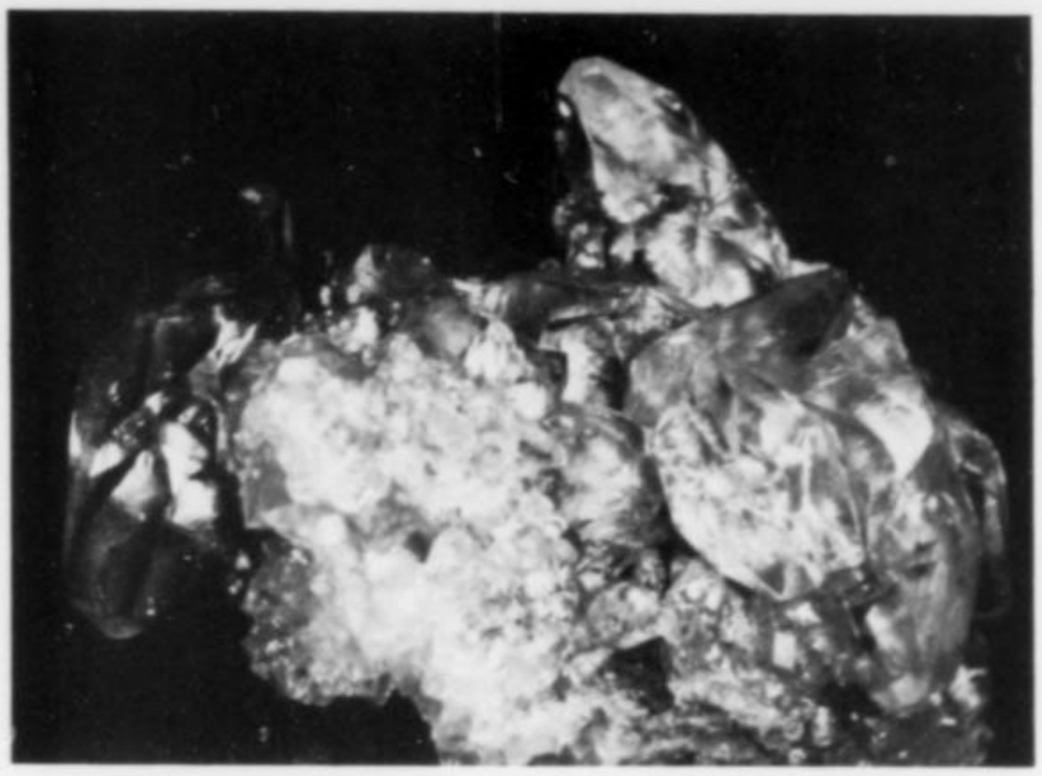


Figure 10. **Calcite on fluorite from the Ladywash mine, Eyam. Calcite crystal on the left is 1 inch long. RSWB specimen (75-189) and photograph.**

Figure 11. **Aurichalcite on fluorite; view is 2 inches across. Rutland Cavern, Matlock Bath. RSWB specimen (62-413) and photograph. Collected in 1962.**

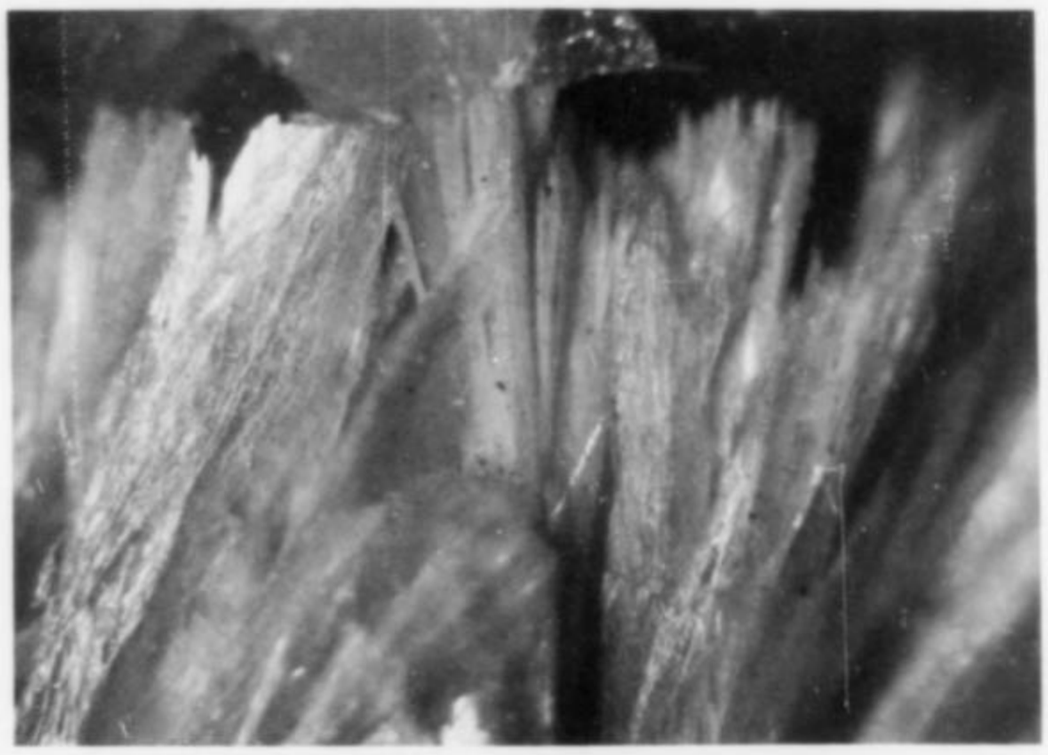


Figure 12. **Aurichalcite from Rutland Cavern, Matlock Bath. RSWB specimen (62-418) and photomicrograph, field 0.16 x 0.12 inches. Collected in 1962.**

Figure 13. **Aurichalcite on fluorite from the Clayton adit, Ecton Hill. Specimen 2¼ inches long. RSWB specimen (63-289) and photograph. Collected in 1963.**

clusters of white needles, and as pale yellow spherules on fluorite and chert (Russell, 1911).

Phosgenite see under *HALIDES.*

Smithsonite $ZnCO_3$

Listed as "calamine" in the old literature, e.g., Adam (1845), Greg and Lettsom (1858). Common in the area, usually friable massive "dry bone ore," sometimes mammillary, and as small rounded rhombohedrons rarely exceeding 0.1 inch. Localities are widespread, but particularly common in the Matlock area.

Hydrozincite $Zn_5(CO_3)_2(OH)_6$

Found occasionally in the area, as at the Mill Close mine (Traill, 1939, Hazlebadge (Braithwaite and Ryback, 1963b), Ecton (Braithwaite, Ryback, and Greenland, 1963), the Golconda mine, Hopton (Ford and Sarjeant, 1964a). Commonly forms stalactitic coatings on cavity and mine walls.

Aurichalcite $(Zn,Cu)_5(CO_3)_2(OH)_6$

Rutland Cavern at Matlock Bath is one of the earliest known localities for aurichalcite or "cupreous calamine" (Tooke, 1837; Adam, 1845; Connel, 1848; Greg and Lettsom, 1858; Braithwaite and Ryback, 1963a), and is the classical British locality. It forms pale green, felted or pearly crusts or tufts of blades up to 5 mm long, often associated with rosasite and hemimorphite and scattered on fluorite and calcite. Although attractive and having micromount potential, the specimens tend to be sparsely covered and do not compare with those from Mexico, Arizona or Iran. Small amounts have been found at a number of other localities in the area, but the best specimens have come from Ecton Hill, in particular from a cavity in the Clayton adit (Braithwaite, Greenland, and Ryback, 1963b; Braithwaite and Knight, 1968).

Rosasite $(Cu,Zn)_2CO_3(OH)_2$

Identified in specimens from the Rutland Cavern in 1959, where it is found as small, dark green, hemispherical aggregates in close association with aurichalcite (Braithwaite and Ryback, 1963a), and later found under similar circumstances at a few other localities.

Malachite $Cu_2CO_3(OH)_2$

Widespread but usually in small amounts and not important as specimen material.

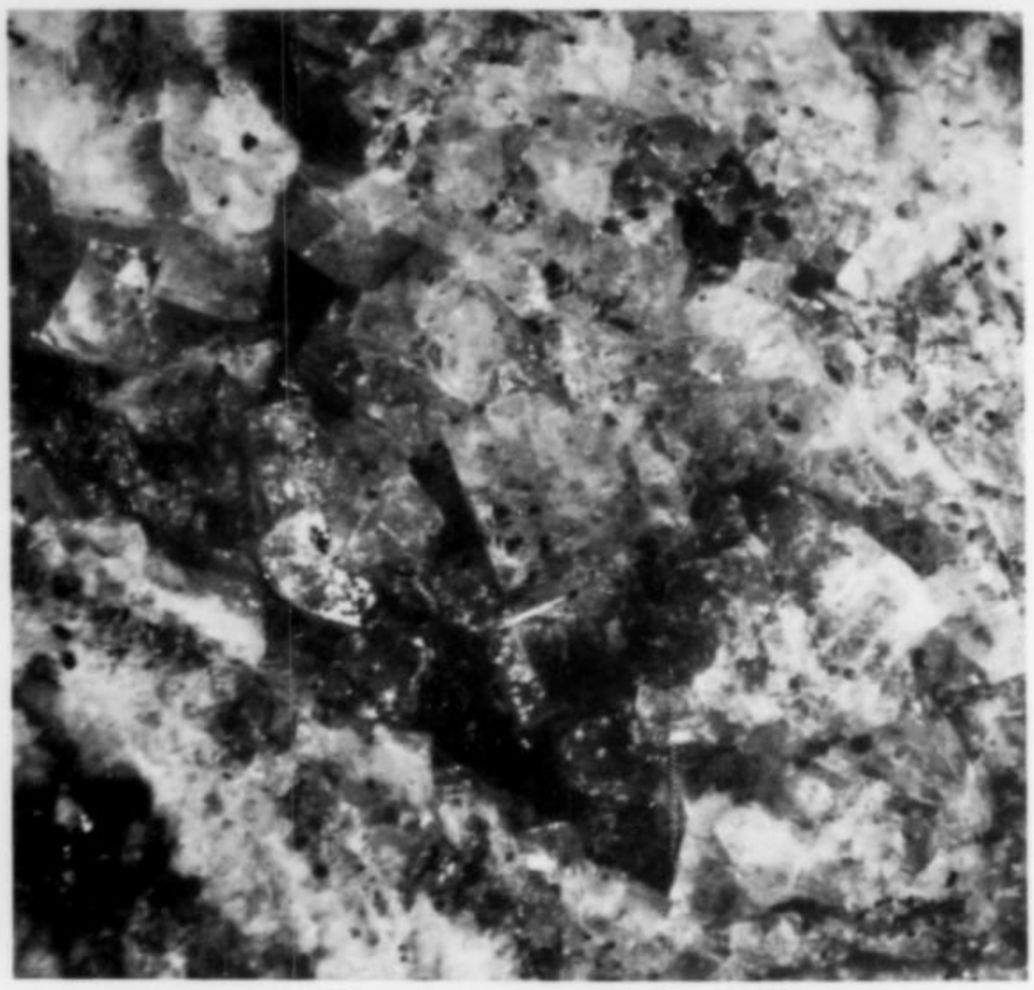


Figure 14. **Rosasite on fluorite from Rutland Cavern, Matlock Bath. Portion showing is 2½ inches across. RSWB specimen (62-414) and photograph. Collected in 1962.**

Figure 17. **Linarite with serpierite from the Bag mine, Ecton Hill. RSWB specimen (72-515) and photomicrograph; the field is 3/16 inch across.**

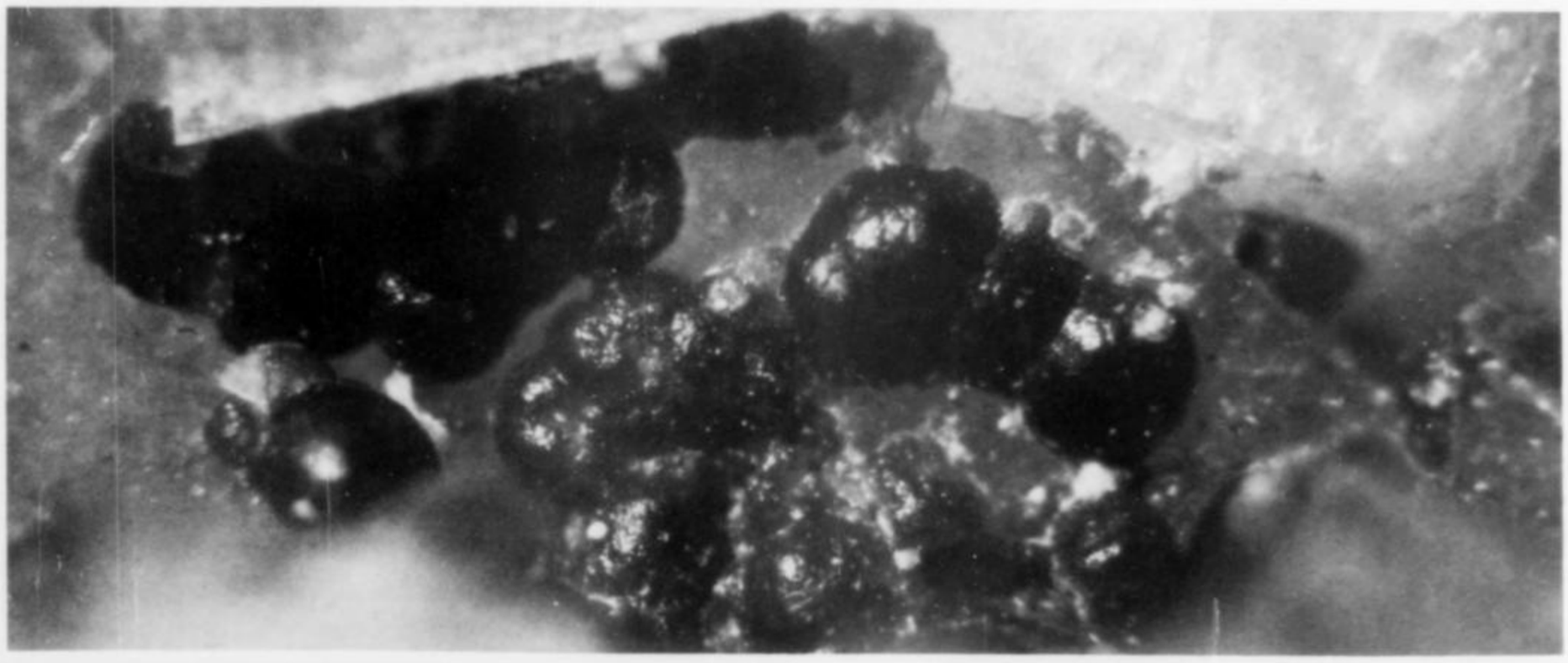


Figure 15. **Rosasite on fluorite from Rutland Cavern, Matlock Bath. RSWB specimen (59-14) and photomicrograph; field 3/16 inch across. Collected in 1959.**

Figure 16. **Celestite from the Clayton adit, Ecton Hill. The largest crystal is 3/8 inch long. RSWB specimen (62-370) and photograph. Collected in 1962.**

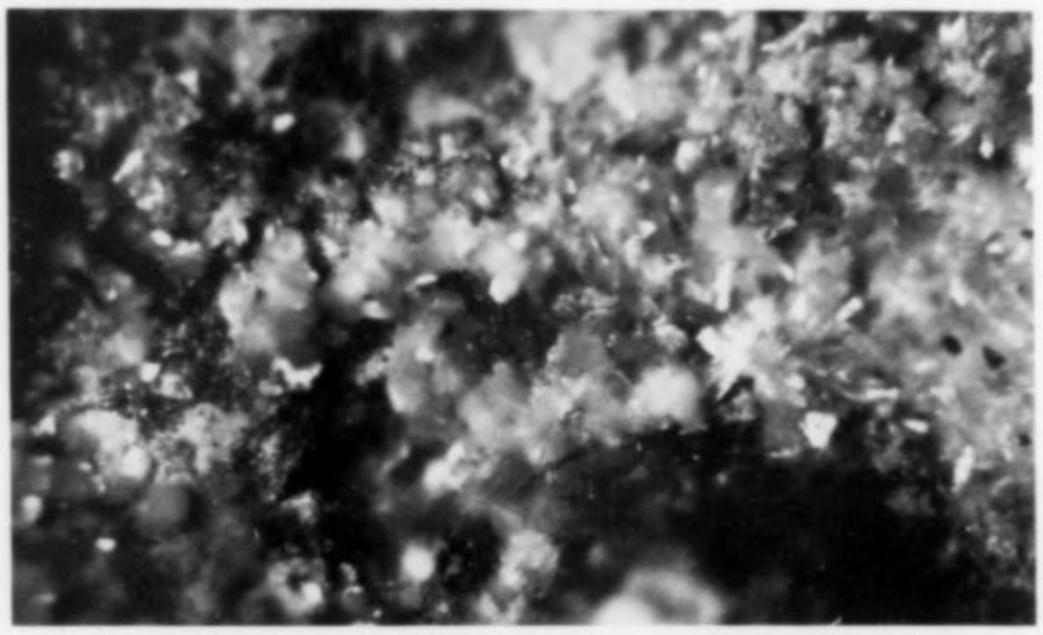


Figure 18. **Serpierite from the Clayton adit, Ecton Hill. RSWB specimen (72-515) and photomicrograph; the field is 3/16 inch across. Collected in 1972.**

Azurite $Cu_3(CO_3)_2(OH)_2$

Uncommon. Small amounts have been found at a few localities; not usually well crystallized. The best crystals from the area are probably those found in the Ecton mines (Garner, 1844), these being much less than 0.1 inch long.

SULFATES

Barite $BaSO_4$

A common gangue mineral in the area, normally somewhat friable, chalky white, pink or brownish in color, opaque and of "cockscomb" habit. Distinct crystals with any degree of transparency do not normally occur except as microscopic secondary platelets (Braithwaite and Ryback, 1963a), though a few platy crystals have been found in a small vein in grit at Alport Hill, Ashley Hay (Ford and Sarjeant, 1964a). Brown, radiating, bladed material with a mustard-yellow fluorescence under ultraviolet radiation is found at Brownedge near Winster. Brown, compact, banded material ("oakstone") was mined near the ancient stone circle at Arbor Low near Youlgreave (Adam, 1845) in the 19th century for ornamental purposes, and takes a high polish. This material was sometimes polished with ropes to dig hollows through the colored bands to give the effect of "eyes." The exact locality was grassed over and lost for many years until rediscovered in recent times (Ford and Sarjeant, 1964b). "Crich spar," a mottled mixture of pink barite and purple fluorite, is another ornamental variety from the Crich limestone inlier. The pinkish massive variety is occasionally compact enough to be polished.

Gypsum $CaSO_4 \cdot 2H_2O$

Needles of gypsum are common as efflorescences in old mine workings. The mineral also occurs as evaporite beds in Permo-Triassic red beds in the extreme south of the county, associated with anhydrite, where it is sometimes found as compact, fibrous, polishable "satin spar," as near Chellaston.

Anhydrite $CaSO_4$

Found massive in evaporites; associated with gypsum in southern Derbyshire and the adjacent counties.

Celestite $SrSO_4$

Beautiful blue crystals of celestite up to 0.5 inch long, very similar in color and habit to those from Chittenango Falls, New York, were found in one small lens a few feet long near the limestone-shale boundary in a level in Ecton Hill, Staffordshire (Braithwaite, Greenland, and Ryback, 1963b). The lens has been culled by subsequent collectors and no material remains.

Anglesite $PbSO_4$

Not common, cerussite being preferred owing to the carbonate-rich environment; but very fine crystals have been found in a few localities. Small crystals, micro- to about 0.2 inch, can still be found but larger crystals, to 4 inches, were found in earlier centuries, especially near Wirksworth (Greg and Lettsom, 1858).

Linarite $PbCuSO_4(OH)_2$

Very rare. Small blue crystals of linarite have been identified by the author on specimens from Rutland and Masson Caverns at Matlock Bath, from the inlier at Snelston, and from Ecton Hill with serpierite.

Brochantite $Cu_4SO_4(OH)_6$

Very rare in the area. Identified by the author and G. Ryback on specimens from the Ball Eye quarry, Bonsall, and from the inlier at Snelston.

Serpierite $Ca(Cu,Zn)_4(SO_4)_2(OH)_6 \cdot 3H_2O$

This rare species has been found as crusts of beautiful blue microscopic blades closely associated with gypsum in the Clayton adit, Ecton Hill (Braithwaite and Knight, 1968), and subsequently in other parts of Ecton Hill, sometimes accompanied by linarite.

Melanterite $FeSO_4 \cdot 7H_2O$

Rare, mostly as efflorescences in shales, as at the Odin mine, Castleton (Hall, 1868).

Jarosite $KFe_3(SO_4)_2(OH)_6$

Occurs occasionally as yellowish powdery coatings on shales.

PHOSPHATES AND ARSENATES

Pyromorphite $Pb_5(PO_4)_3Cl$

Listed by Mawe (1802) and known locally as "green linnets," pyromorphite has been found in small quantities at a number of localities scattered about the area, commonly associated with cerussite on decomposing galena. It is usually pale green in color, and poorly or indistinctly crystallized. At some localities (Bonsall Moor, Masson Hill, Youlgreave) an indistinctly crystallized pale green variety occurs which shows slight differences in its X-ray diffraction pattern from "normal" pyromorphite, and distinct shifts in its phosphate infrared absorption frequencies. This "abnormal" pyromorphite has also been found at Wanlockhead, Dumfriesshire, Scotland; at Craighead quarry, Lanarkshire, Scotland; and at the Potts Gill mine, Caldbeck, Cumbria (G. Ryback, D. F. Ball, A. W. G. Kingsbury, private communications), and is still under investigation.

Mimetite $Pb_5(AsO_4)_3Cl$

Locally known as "brown linnets," but rare in this As-poor area, mimetite has been recorded from a small number of localities, mostly near Winster and Miller's Dale (Green and Strahan, 1887).

Vivianite $Fe_3(PO_4)_2 \cdot 8H_2O$

Reported from the area (e.g., Greg and Lettsom, 1858), but is rare.

SILICATES

Chlorites

Various chlorite minerals have been reported from the area, mostly associated with the volcanics. A notable occurrence is delessite from the Calton Hill quarry (Tomkieff, 1926).

Clay minerals

Various clay minerals have been found, and some have been worked commercially in pits, particularly near Brassington and Newhaven.

Chrysocolla hydrated copper silicate

Rare in the area. Reported from Ecton (Ford and Sarjeant, 1964a), and also found at the Calton Hill quarry and at the Dene quarry, Cromford.

Hemimorphite $Zn_4Si_2O_7(OH)_2 \cdot H_2O$

Bunches and crusts of small, clear, colorless, radiating crystals are found in the oxidized zone at various localities and make attractive micromount material. Particularly common in the vicinity of Matlock Bath, as at the Rutland Cavern (Greg and Lettsom, 1858; Braithwaite and Ryback, 1963a). Confused with smithsonite in old reports, largely on account of the mutual name of "calamine," of which hemimorphite was the "electric" variety.

ORGANICS

Bituminous minerals

Bituminous materials are found at a few localities, particularly near Castleton where, for example, at the Windy Knoll quarry they are found as black shiny nodules in brownish black stalactitic form, and as sticky greenish brown seepages which polymerize on exposure to become rubbery elastic elaterite. Castleton is the original locality for elaterite, which was described from there as "subterraneous fungus" by Mr. Lister in 1673. Bitumens are found nearby, associated with "blue john" fluorite, and were at one time believed to be the cause of the "blue" color (actually purple). The "black marble" used for making ornaments, particularly clocks, in Victorian times after the death of Prince Albert, is a bituminous limestone from near Ashford-in-the-Water (Ford, 1958).

UNCONFIRMED MINERALS AND PROBABLE ERRORS

Among unconfirmed species reported from the area are leadhillite, cotunnite, chalcophyllite, tyrolite, strontianite, rutile, gold, native lead, arsenic, zinc, "zinc oxide" and minerals of bismuth and cobalt.

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Graphite from the Lead Hill Mine, Ticonderoga New York

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ABSTRACT

The graphite deposits in and around Ticonderoga, New York, have been worked since at least the early nineteenth century. Natural flake graphite was used for lubricants, pigments and, especially, for crucibles used in the metals industry. More recently, small single crystals from the Lead Hill mine have been used for nuclear research. During visits to this mine in 1969 and 1981 several types of specimens were collected including: 1. graphitic marble produced by regional metamorphism; 2. graphite crystals in large rhombs of calcite, where regional metamorphism was followed by local igneous metamorphism; 3. graphite flakes disseminated through a coarse granitic pegmatite; and 4. massive graphite from the interface between the intrusion and the surrounding rock.

HISTORY

Natural flake graphite is known from many localities around the world (Bates, 1969). In the United States, commercial graphite deposits occur in the Adirondack Mountains of New York (Fig. 1), as well as in Alabama, Pennsylvania, California and elsewhere. The Adirondack occurrences were known in the early 1800's, and it appears that the first commercial graphite mining in the area took place sometime around 1850 at Lead Hill (also referred to as "Chilson Hill") near Ticonderoga. At that time, much of the finer graphite was used in stove polish, while the coarser flakes were used primarily to make crucibles for metallurgical processes.

The Lead Hill mine was operated by the American Graphite Company in the early 1850's. The Joseph Dixon Crucible Company bought the American Graphite Company and continued to mine the deposits at Lead Hill, later shifting its interest to nearby mines at Hague and at Graphite. Work at Lead Hill continued sporadically under small leases until the early 1900's. A very thorough description of the history and the geology of the area was published by Alling (1917), who reported that the Lead Hill mine was already abandoned at that time.

More recently, Lead Hill has provided single crystals of graphite suitable for nuclear research (Ohr and Noggle, 1971; Hinman *et al.*, 1970). It was in this connection that W. E. Atkinson, W. P. Eatherly and T. S. Noggle of the Oak Ridge National Laboratory visited the Lead Hill mine in 1969; and the present authors visited the site in 1981. (Research-grade crystals are obtained by dissolving the marble in acid and then carefully selecting those flakes which have not undergone deformation. A hundred kilograms of graphite-bearing marble ultimately yield perhaps ten to twenty grams of suitably perfect crystals.)

GEOLOGY

Alling (1917) presents a complete discussion of the geology of 24 graphite properties, including Lead Hill. In an earlier paper, Bastin (1910) discussed the petrogenesis of the Adirondack deposits. Alling (1917) gives the following description of the "northern" deposits which include Lead Hill:

> "Two general groups of rocks are involved: the first, a great series of sedimentary rocks, originally bedded limestones, sandstones and shales, that have been altered by earth forces to crystalline limestones, schists and gneisses. The second group comprises igneous rocks, among which granite is especially prominent. Igneous rocks are later in age and have invaded the sedimentary series from below. Where the hot fluid mass, saturated with various gases, came in contact with the sediments, especially if they were limestones, and the proper conditions obtained, graphite was developed by complex chemical and physical reactions within the zone of contact."

THE LEAD HILL MINE

The original mine workings are, at this point, difficult to reconstruct in detail. However, it appears that what Alling calls the "Woodchuck" workings were located in 1969 (Fig. 2) and partially mapped (W. P. Eatherly, private communication, 1981). A smaller working (Fig. 3) was visited in 1981 and excellent specimens were obtained from the dumps, which were heavily overgrown and scarcely recognizable (Fig. 4). The tunnels were generally shallow

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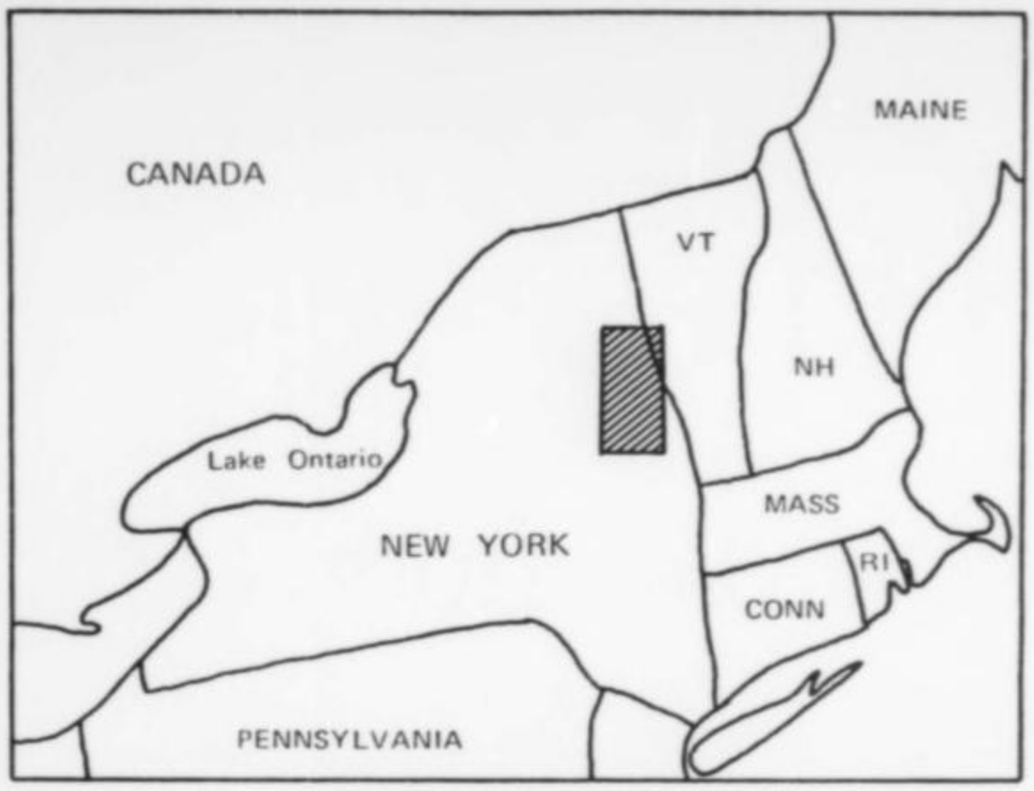


Figure 1. **Location of the New York State graphite deposits in the Adirondack Mountains.**

and gradual collapse over the years has turned many of them into trenches 1.8 to 2.4 m deep. A few sinkholes are also present. In 1969 there was access to most of the underground workings. The area visited in 1981, on the other hand, was almost completely filled in by collapse and the accumulation of forest debris. One small hole led underground, but would have required substantial digging to admit a person.

DESCRIPTION OF SPECIMENS

The authors have obtained specimens at Lead Hill that represent: 1. regionally metamorphosed limestone; 2. contact metamorphosed limestone; 3. graphite-bearing pegmatite; and 4. massive graphite from the actual contact interface.

Type 1. Graphitic Marble

Graphitic marble is fairly common in the Ticonderoga area. It is

Figure 2. **Lead Hill mine (Woodchuck workings?) visited in 1969. Photo by W. P. Eatherly.**

Figure 3. **Area of the Lead Hill mine visited in 1981.**

Figure 4. **Dump showing moss-covered rocks, most of which contain graphite crystals. Note disintegrated rock at lower left.**

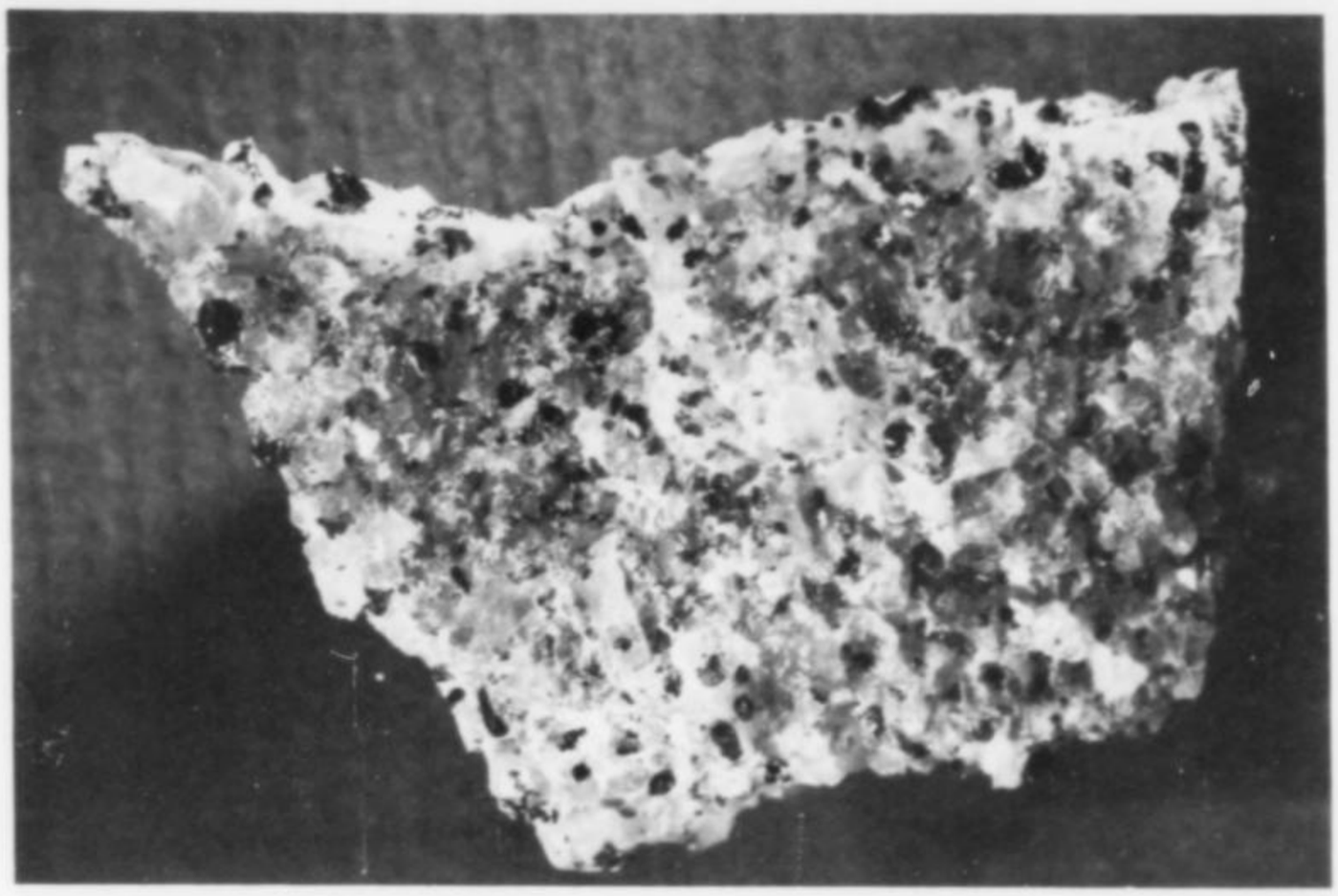


Figure 5. **Fine-grained Type 1 graphitic marble. Specimen length ≈ 5 cm.**

Figure 6. **Fine-grained Type 1 graphite; SEM photograph of fracture surface. Three flakes protrude from the calcite matrix. Center flake is ≈ 160 μm thick.**

believed to be the product of regional metamorphism acting on carbonaceous Precambrian sediments (Grenville series). The result is a crystalline limestone having flakes of graphite and small crystals of various accessory minerals. Type 1 specimens range in grain size from 1 to 2 mm (fine) to about 2 cm (coarse).

Type 1 material deteriorates on exposure to the elements. Type 1 rocks on the surface of the dump were in various stages of disintegration, presumably because of the dissolving action of rainwater along grain boundaries so that the rock is first reduced to loose

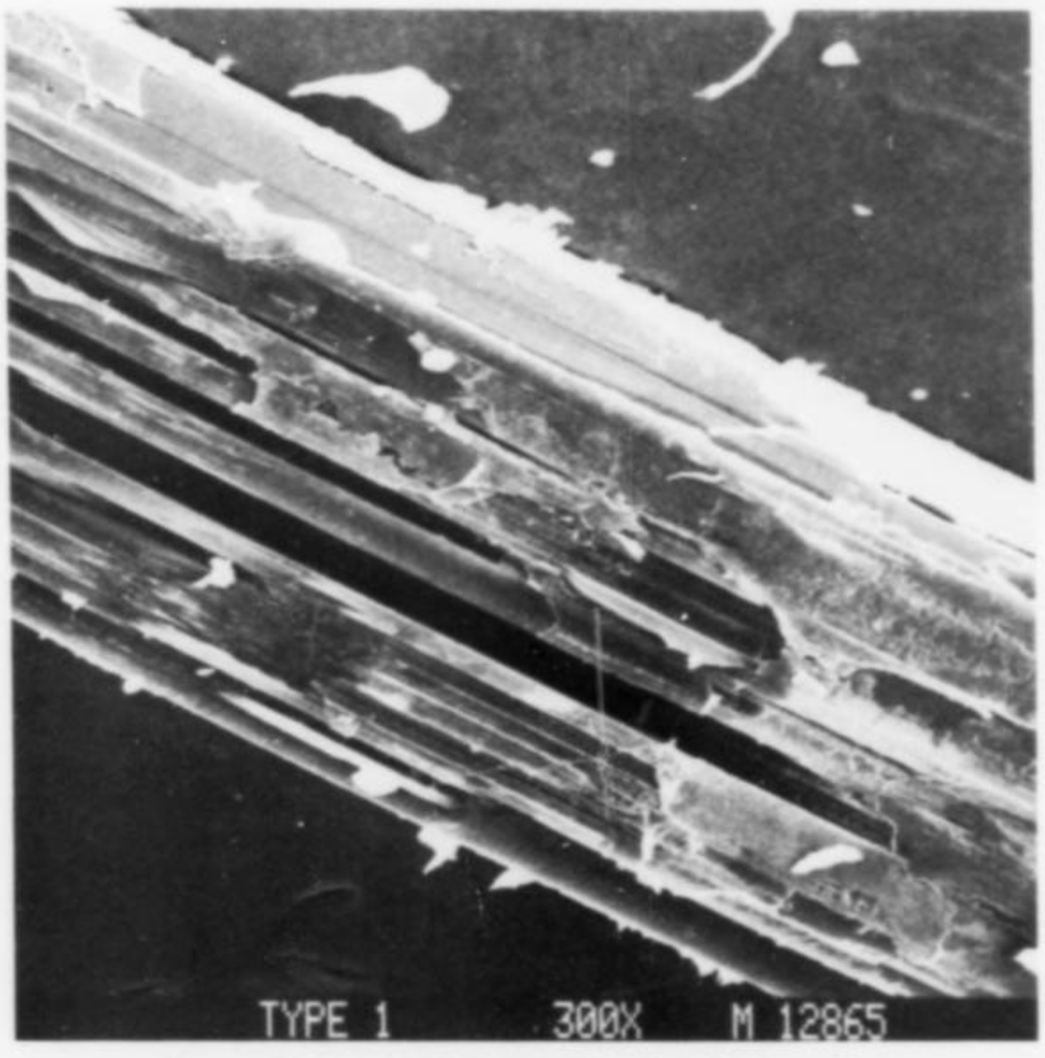
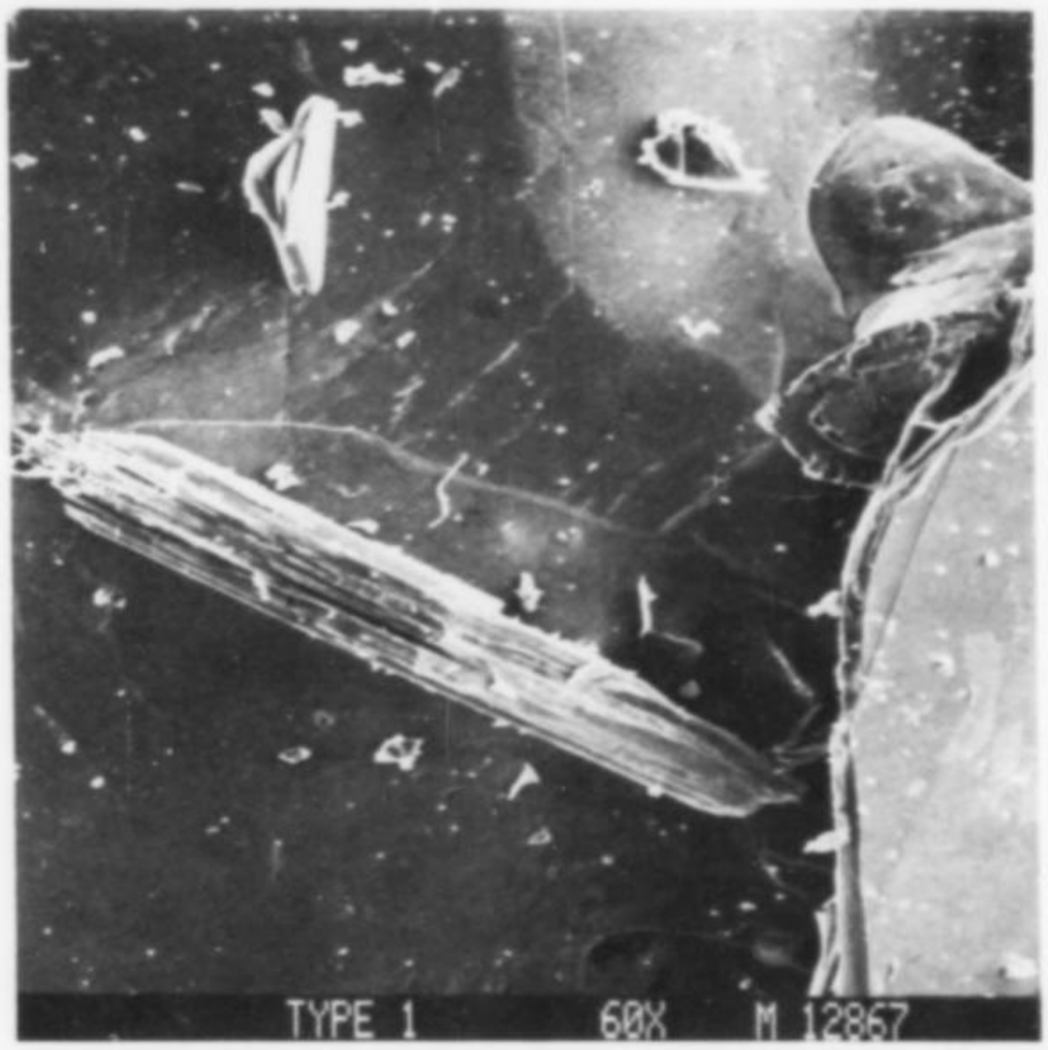


Figure 7. **Detail of Fig. 6, showing the lamellar structure of the graphite crystal.**

grains while most of the calcite is still present. Eventually, very little is left other than the silvery graphite flakes which are generally not attacked.

The highly reflective graphite flakes in Type 1 can be seen clearly in Figure 5. Scanning electron microscopy (Figs. 6, 7) shows that the flakes are composed of parallel lamellae approximately 10 μm thick.

A characteristic feature of Type 1 graphite crystals is the presence of striations oriented at 60° to one another on the {0001} faces



(Fig. 8). The striations are minute surface steps (Fig. 9) and appear to be twin boundaries of the graphite (i.e., they are not an imprint of some feature in the surrounding calcite).

Accessory minerals in the graphitic marble occur as grains 1 to 3 mm in diameter. To obtain samples for X-ray diffraction (XRD) 32 g of marble were dissolved in HCl, leaving ~4 g of residue. Most of the residue is quartz, some of which is intergrown with one or more graphite crystals forming small clusters. Much of the remaining mineral matter occurs as small, green, single crystals (up to about 1 mm). These were separated and identified by XRD as diopside, $CaMg(SiO_3)_2$. A light green acicular phase was also separated for XRD. While it could not be positively identified, the diffraction pattern suggested a member of the tremolite-actinolite series. A brown phase was observed but was not sufficiently plentiful for XRD analysis. These brown crystals have a lensoid habit with some crystal faces developed (Fig. 10). EDX analysis in the SEM showed these crystals to be sphene ($CaTiSiO_5$). All of the foregoing minerals are compatible with free silica, and may be expected in a rock of this type.

Type 1 graphite crystals are the most desirable for research purposes since they are the least deformed and, therefore, contain

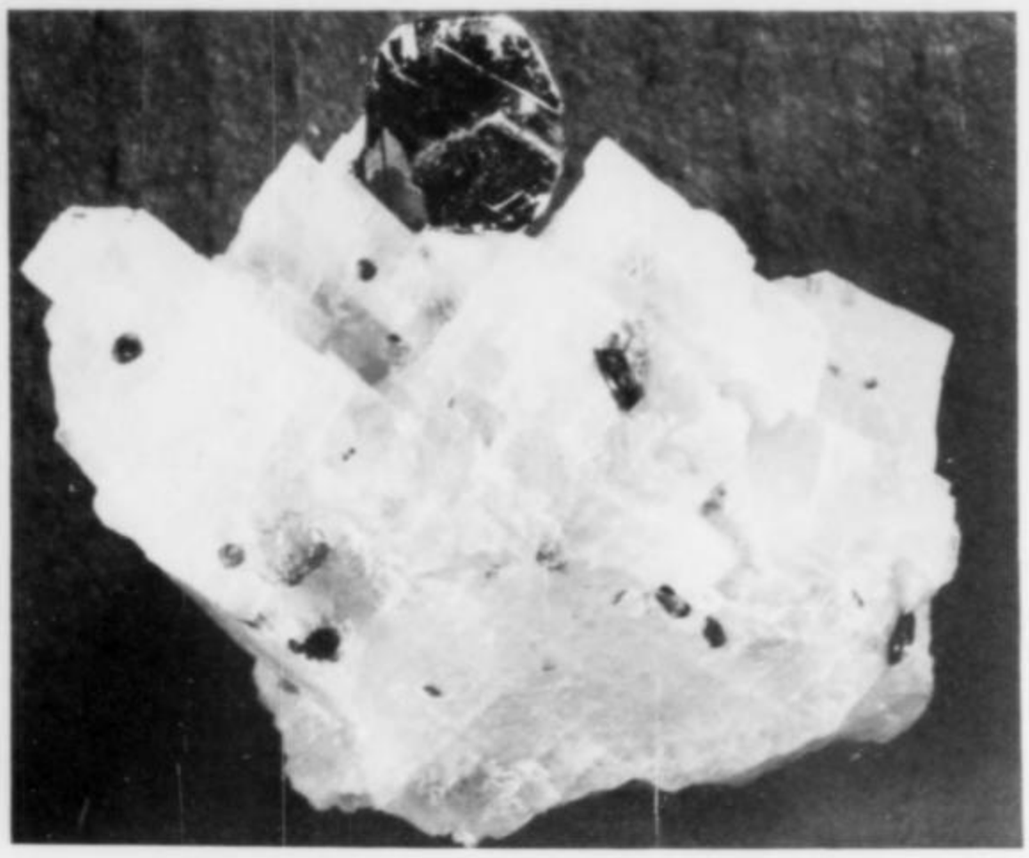


Figure 8. **Coarse-grained Type 1 graphite. Note striations on face of large crystal. Crystal is ≈5 mm across.**

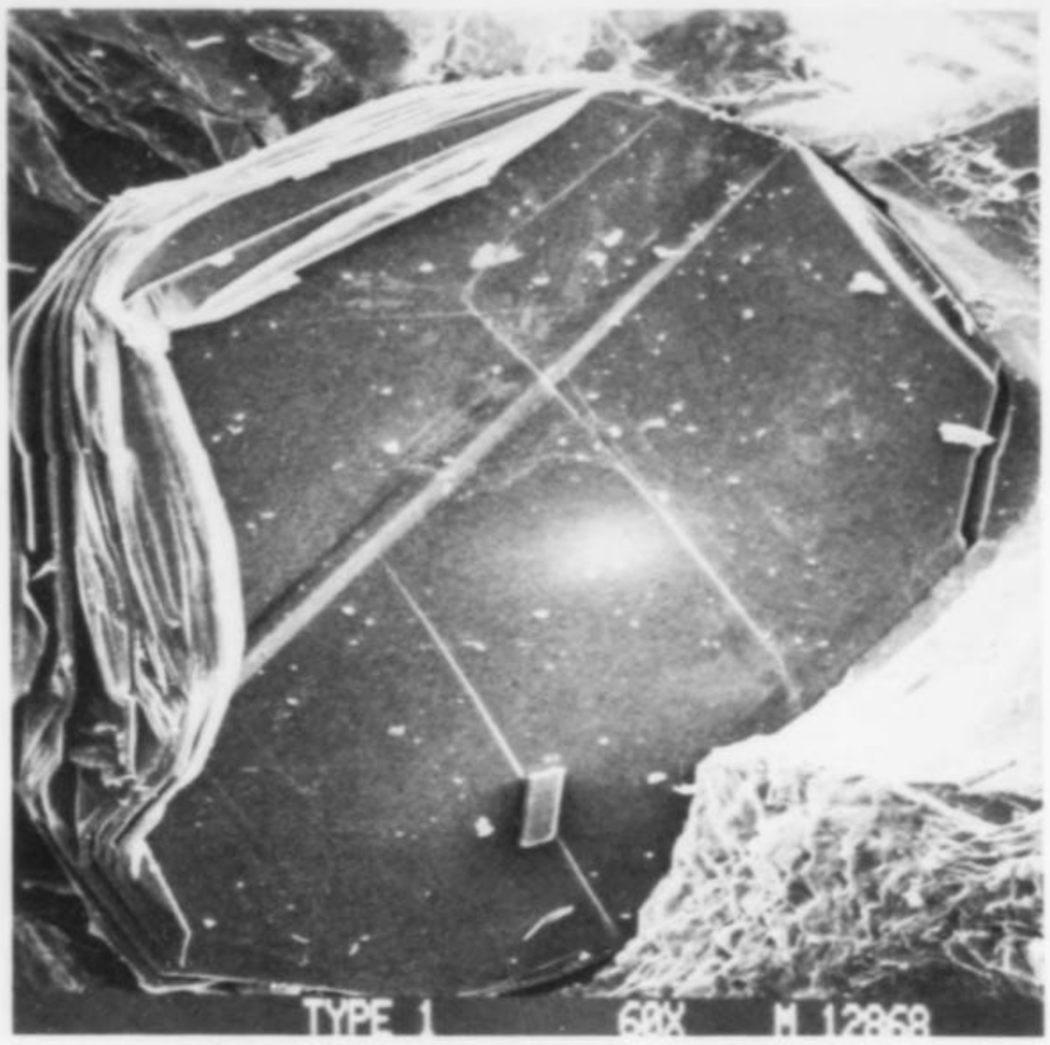


Figure 9. **SEM photograph of a graphite crystal 1.5 mm across, showing that the striations are small surface steps. Note also the damaged area at left, demonstrating the flexible nature of the lamellae.**

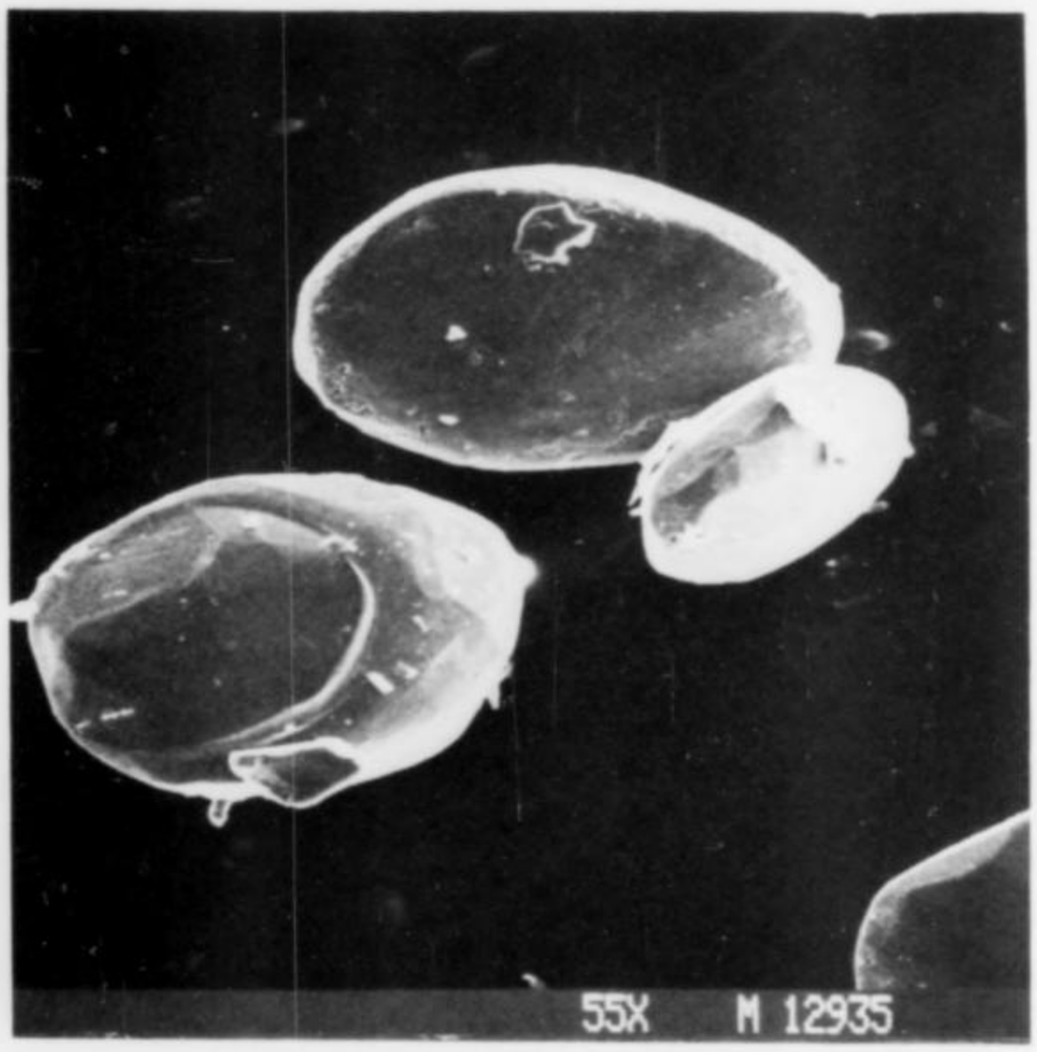


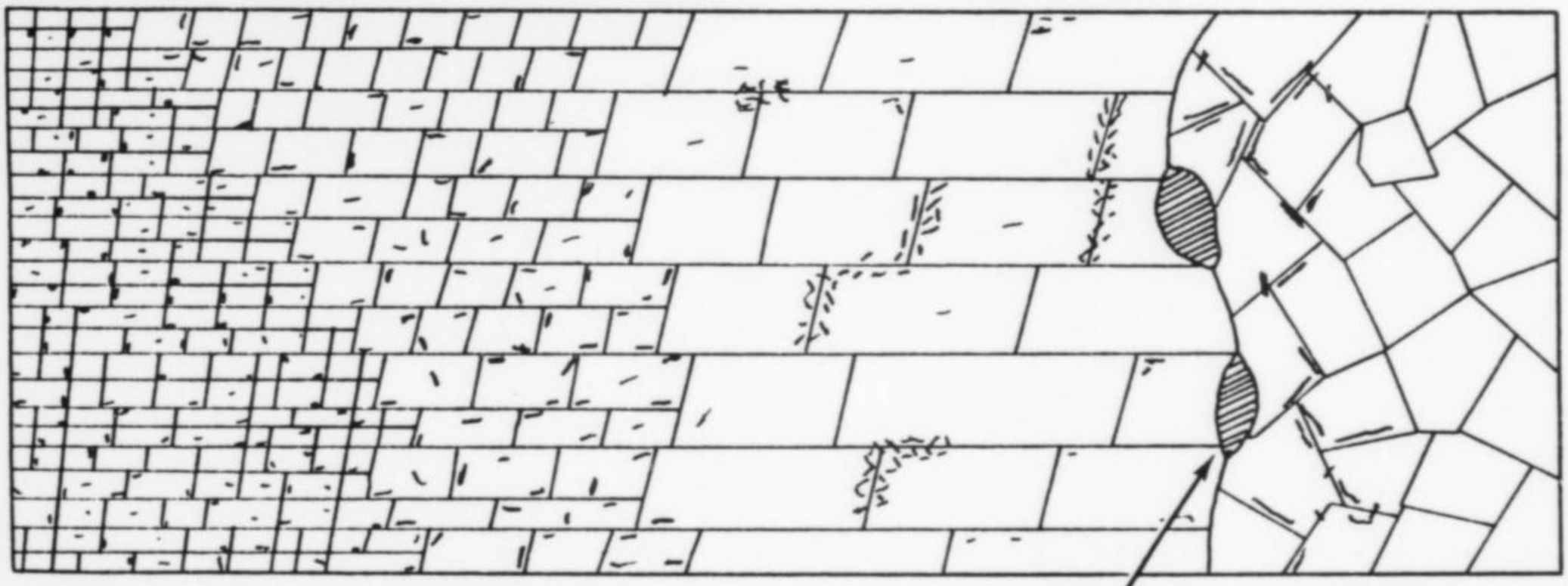
Figure 10. **SEM photograph of lens-shaped sphene crystals extracted from the calcite matrix with HCl. Note the crystal faces on the two lower crystals.**

fewer flaws. To extract crystals for radiation damage studies (T. S. Noggle, private communication, 1981) the calcite matrix is dissolved in HCl. The graphite crystals are examined at low magnification to select only the ones that are not deformed. It was found that otherwise perfect crystals will deform by twinning, even when carefully handled with tweezers, but can be picked up and handled safely using a very soft brush.

Type 2: Graphite Crystals in Coarse Calcite

There is a nearly continuous gradation from Type 1 to Type 2

Figure 11. **Schematic cross section through the Lead Hill graphite deposit.**



deposits at Lead Hill. The grain size (degree of recrystallization) increases gradually as the intrusion is approached (Fig. 11). Consequently, the distinction between Types 1 and 2 is somewhat arbitrary. However, several differences become apparent when the whole suite of specimens is examined closely:

1. The graphite is distributed inhomogeneously in Type 2, typically forming veins up to 1 cm thick (Fig. 12). In adjacent areas, some calcite cleavage fragments up to about 20 cm across contain no graphite.

2. The color of the calcite in Type 2 is buff to tan, while the calcite in Type 1 is pure white.

3. Accessory minerals are somewhat less plentiful in Type 2 and are distributed inhomogeneously.

Type 3: Graphite in Pegmatite

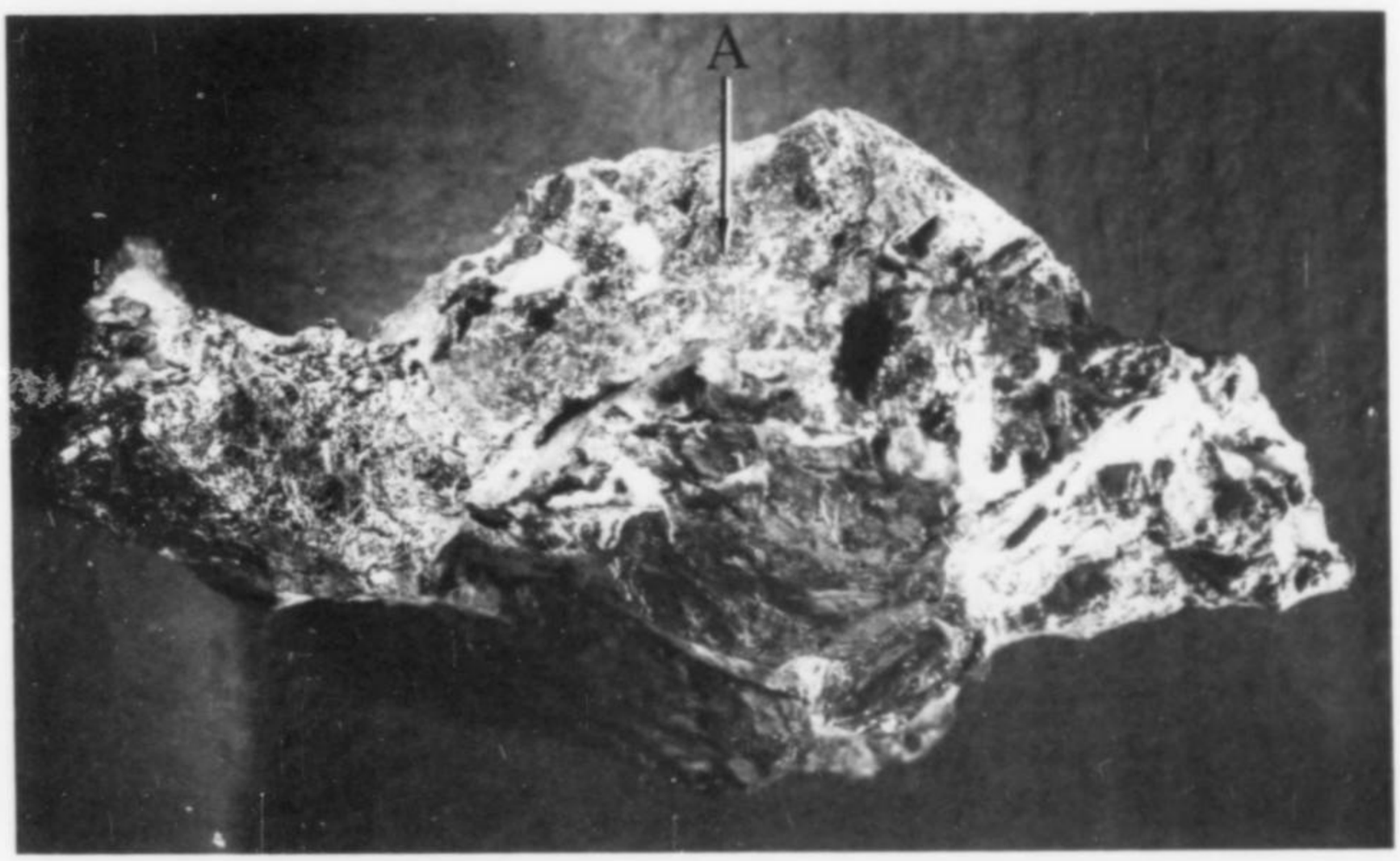
The intrusion responsible for the contact metamorphism observed at Lead Hill is described by Bastin (1910) as follows:

> "The granitic rocks exposed near, or in contact with, the graphitic rocks are nearly all pegmatitic in their texture. Most of them are finely so, the mineral grains rarely exceeding an inch or two in diameter. At the largest of the open pits, however, the pegmatite is coarse-grained and consists largely of clear to smoky quartz with some feldspar in certain parts."

Figure 12. **Type 2 graphite flakes forming a vein 1 cm thick in coarse rhombs of calcite. Overall specimen width is ≈6 cm.**

Figure 13. **Type 3 graphitic pegmatite. Largest flake in center is 2 cm wide.**

Figure 14. **Type 4 massive graphite intergrown with augite (A) taken from the contact zone. Overall length is 5 cm.**



An example of Type 3 graphite is shown in Figure 13. The specimen is composed predominantly of quartz with thin graphite flakes up to 3 cm across distributed randomly. Large masses of this material recovered in 1981 were readily broken open because the graphite flakes form natural planes of weakness. Bastin (1910) suggests that the intrusion could have taken up carbon from the surrounding rock (possibly as CO_2) since the pegmatite is graphitic only around the edges.

Type 3 material does not appear to be significantly affected by weathering. Large rocks at or near the surface of the dump showed some surface discoloration but had not undergone the massive disintegration seen in exposed Type 1 rocks.

Type 4: Massive Graphite

In the contact zone between the crystalline limestones and the in-

trusion, scattered pockets of very coarse graphite occur. Since this is the material that was actually mined at Lead Hill, none of it is presently available from the dumps. Some Type 4 material was, however, obtained from the workings visited in 1969. The graphite masses (Fig. 14) are heavily deformed and are intergrown with a dark green mineral identified by XRD as augite. Bastin (1910) reports augite, scapolite and graphite as the major phases with apatite, biotite, pyrite, pyrrhotite, titanite (sphene) and vesuvianite as accessory minerals. However, the latter minerals have not as yet been identified in the present samples.

SUMMARY

1. Graphite-bearing rocks from the Lead Hill mine provide an excellent example of the successive effects of regional and contact metamorphism.

2. A good supply of Types 1, 2, and 3 still exists at Lead Hill, although some lucky digging is required to recover unweathered material.

3. Research-grade graphite single crystals can be obtained from Type 1 rocks by dissolving the calcite matrix in HCl. The graphite flakes are composed of flexible lamellae and often show surface steps on the basal {0001} plane.

4. Types 3 and 4 are not suitable for fundamental research on graphite properties because the graphite flakes are heavily deformed and cannot be separated readily from their matrices (quartz and augite, respectively).

ACKNOWLEDGMENTS

T. S. Noggle provided samples collected in 1969. W. P. Eatherly furnished information about the 1969 visit and also provided maps enabling the authors to locate the mine.

O. B. Cavin performed the X-ray diffraction analysis and assisted with interpretation of the data. Scanning electron microscopy was done by T. J. Henson and macro photographs were taken by J. W. Nave. L. A. Harris and O. C. Kopp reviewed the manuscript and provided many helpful discussions.

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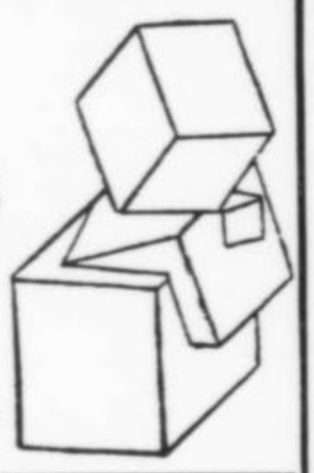

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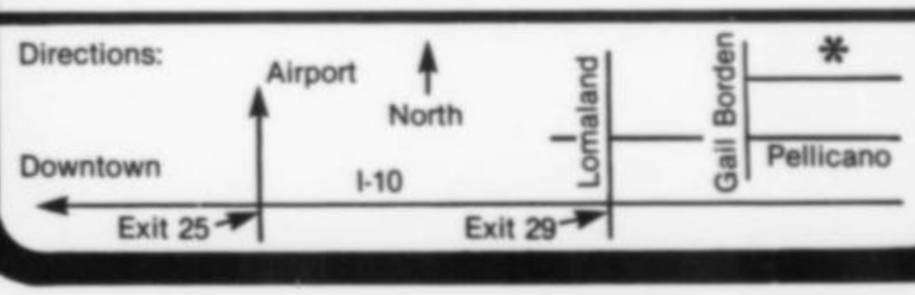

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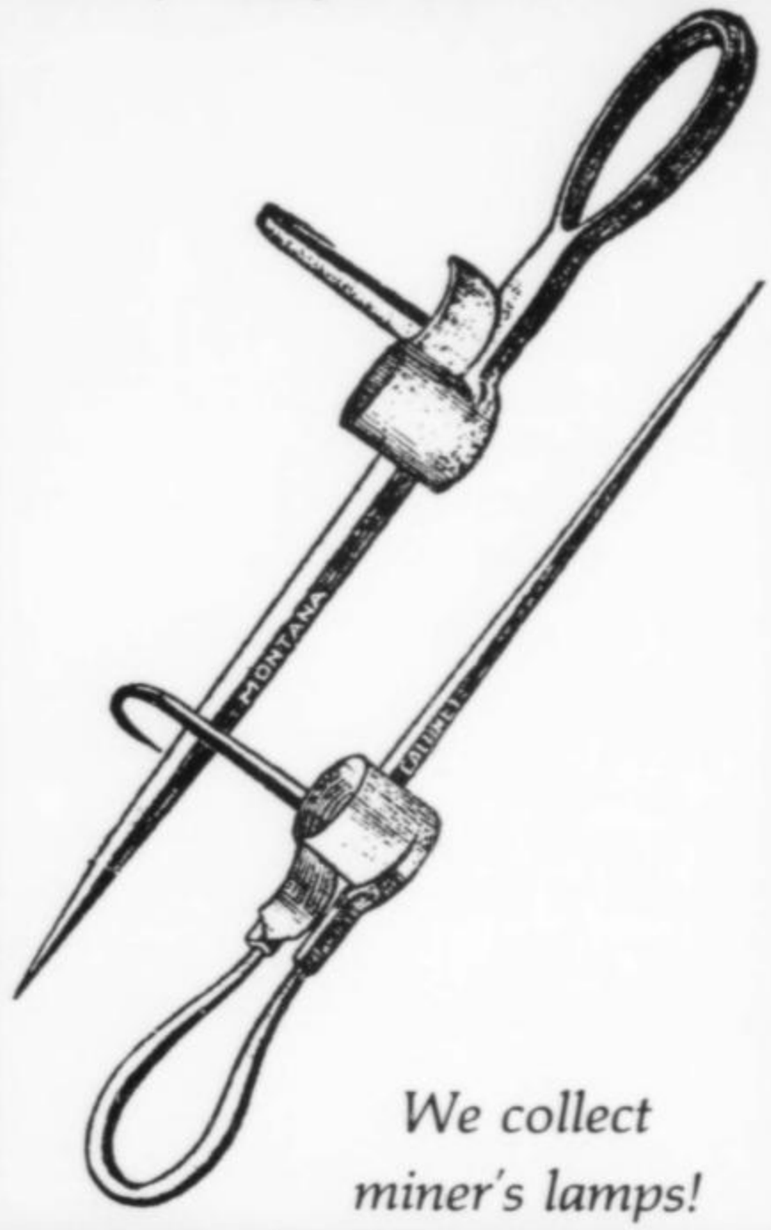

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Field-Collecting Dealers:
– a survey

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"There is a restraining aspect to field-collecting for 100 percent of your income. You must have ready customers to stay afloat, and their demands tend to dictate where and for what you will be collecting. When such a demand is strong it leaves less time for exploration. In many ways the hobbyist collector is a freer bird."
Comments by a dealer

INTRODUCTION

Presented here are the results of a survey taken among dealers who obtain all or part of their mineral stock through personal field collecting. Survey questions probed the nature of their motivations, methods and successes.

Nineteen dealers completed the survey, including one from England and two from Germany. Among the American dealers, one is from Tennessee and the remainder are from the western states of Arizona (10), California (2), Colorado (1), Texas (1), and Utah (1).

RESULTS

In item B, each dealer estimated the percentage of his self-collected stock for the various size categories, and the percentages for all the dealers in each category were averaged.

In items D through K the dealers were given the list of possibilities and asked to rank them in order of importance (rank 1 being the most important). These rankings were then summed for all the dealers; the item with the lowest sum is listed here as most important, followed by items with successively larger rank sums. The ranks shown below as bracketed have nearly identical rank sums

A. Type of Business:
- Sole Proprietorship 59%
- Partnership 29%
- Corporation 12%

B. Size of specimens collected:
- Micromount 10%
- Thumbnail 26%
- Miniature 44%
- Cabinet 20%

C. Average proportion of inventory which is personally collected: 43%

D. Motivations for field collecting:
1. Fun, adventure, comraderie
2. Money
3. Academic interest
4. Recogition

5. As a means to enter the business

Respondents said there had been little or no change in their original motives.

E. Important factors in selection of collecting sites:
1. Curiosity
2. Perceived market for a species found there
3. Maximum financial return
4. Perceived market for quality of specimens found there

F. Logistical factors in site selection:
1. Travel cost
2. Climate and terrain
3. Road conditions
4. Personal physical condition

G. Important sources of information for site selection:
1. Oral and written communication
2. Publications and theses
3. Preliminary visits

H. Importance of legal aspects in site selection:
1. Obtain lease or permission on claims
2. Seek unclaimed localities
3. Stake new claims
4. Ignore ownership status

I. Importance of mineral identification methods:
1. Comparison with reference specimens and published descriptions
2. Visual identification based on simple tests and experience
3. Outside laboratory analysis
4. Commercial assay

J. Importance of various safety considerations:
1. Personal equipment and supplies
2. Presence of companions
3. Auto supplies (extra gas and parts)
4. Leaving detailed itinerary with responsible persons
5. First aid and survival equipment and knowledge

K. Importance of various distribution methods:
   1. Gifts or trades with collectors, museums
   2. Shows, wholesale (including from motel rooms)
   3. Visiting other dealers
   4. Sales from home or store
   5. Shows, retail (including from motel rooms)
   6. Mail order
   7. Contract collecting

DISCUSSION

So, how can the average field-collecting dealer of today be characterized? He is a non-corporate entity dealing predominantly in thumbnails and miniatures; nearly half his stock is personally collected. He collects for fun, but with an interest in finances and science as well. Curiosity and communication with others are his principal tools in finding new localities, though high travel expenses and difficult terrain or climate may discourage him. He takes care with his personal equipment and supplies, generally obtains the property owner's permission to collect (if necessary), and rarely resorts to chemical or crystallographic analyses for specimen identification. The average collector is most likely to meet him at shows, though access to wholesale sections may pose problems.

And he is relatively optimistic. Of the 19 dealers surveyed, ten expected their business to remain steady, and six anticipated growth. Only three expected a decrease in activity. Commerical field collecting seems to be alive and well.

ACKNOWLEDGMENTS

I wish to thank the 19 participants in this survey for thier willingness and encouragement: Charles Baldwin; Central Arizona Minerals and Mining Co.; Andy Clark; Cureton Mineral Co.; Dick Jones Mineral Co.; Gary Fleck; Curt Gilliam; Gleason Heights Minerals Co.; Charles Graeber; Tom Hughes; Laudra Minerals; Peter Megaw; Microminerals International, Inc.; David Shannon Minerals; Francis X. Sousa; Mike Sprunger; Richard W. Barstow; W. Bendig; Walter Zeitschel. *Mineralien Magazin* and *Australian Gem and Treasure Hunter* magazine kindly published requests for dealers to participate in the survey. Karen Lemasters, University of Arizona Marketing Department, provided helpful comments about the survey design.

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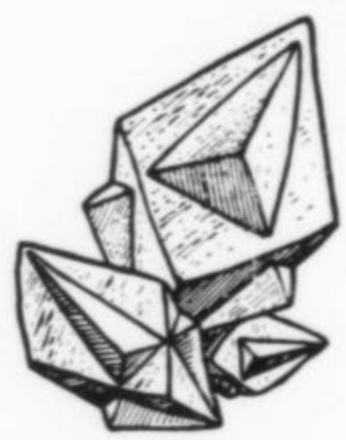

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Lotharmeyerite

a new mineral from Mapimi, Durango, Mexico

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ABSTRACT

Lotharmeyerite, $CaZnMn^{+3}(AsO_4)_2(OH)\cdot 2H_2O$, is a new species from the Ojuela mine, Mapimi, Durango, Mexico. It occurs as dark reddish orange druses coating violet adamite and the accompanying matrix. Lotharmeyerite is vitreous, forms equant crystals, has a Mohs hardness of approximately 3, density of 4.2 g/cm^3, and indices of refraction above 1.80. Chemical analysis yielded CaO: 11.3, ZnO: 18.3, Mn_2O_3: 13.4, Fe_2O_3: 2.7, As_2O_5: 45.7, H_2O by difference 8.6, sum = 100.0 percent. The strongest reflections in the X-ray powder diffraction pattern are: 2.557(100), 3.414(90), 3.175(90), 2.912(90), 2.710(80), 2.822(80) and 4.94(80). Lotharmeyerite may be locally abundant. The name is for Julius Lothar Meyer (1830–1895), in recognition of his contributions to chemistry.

INTRODUCTION

In early 1982, Curt Segeler of Brooklyn, New York, brought to the author's attention a dark reddish orange encrustation which coated the matrix of some recently discovered light-violet adamite specimens from the Ojuela mine, Mapimi, Durango, Mexico. (For more information on this adamite see Wilson, 1982.) Preliminary examination, later confirmed, suggested that this material might be a new mineral species. The new species is named *lotharmeyerite* in honor of Julius Lothar Meyer (1830–1895) in recognition of his contributions to chemistry. Lothar Meyer, a German chemist and physician, developed many of the ideas which led to the *Periodic Table of the Elements;* the Periodic Table was used to predict the existence of then-undiscovered elements and demonstrate the relationships among those already known. His work was done at the same time as that of Mendeleev and they made many parallel observations, with different perspectives, while working independently in 1869. For further information, the reader is referred to the work of Weeks (1960). The new mineral and the name were approved by the Commission on New Minerals and Mineral Names, IMA, prior to publication. Type material is preserved at the Smithsonian Institution under catalog # NMNH 149482.

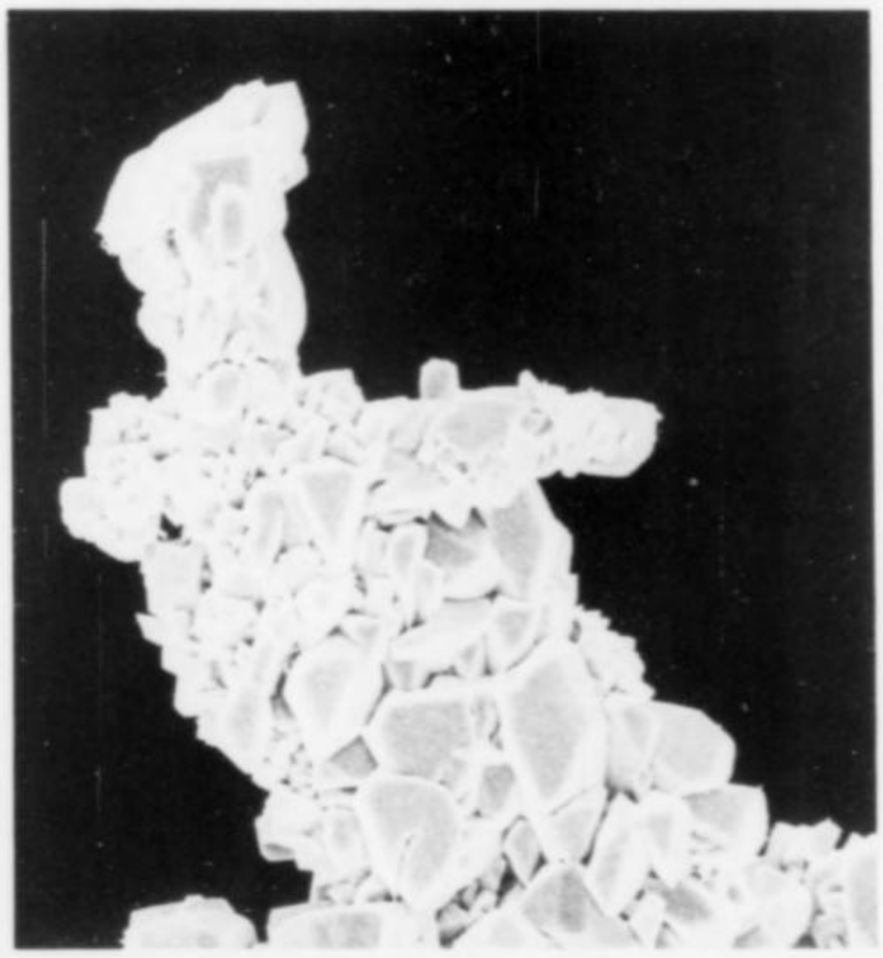

Figure 1. **Scanning electron photomicrograph of a druse of lotharmeyerite crystals from Mapimi, Durango, Mexico. The largest crystal visible here is approximately 33 microns.**

CHEMICAL COMPOSITION

Lotharmeyerite was chemically analyzed using an ARL-SEMQ electron microprobe utilizing an operating voltage of 15 kV and a sample current, standardized on brass, of 0.025 μA. The standards used were synthetic ZnO (for Zn), hornblende (Ca,Fe), manganite (Mn), and synthetic olivenite (As). A wavelength-dispersive microprobe scan indicated the absence of any elements with atomic number greater than 8, except those reported herein. The data were corrected with a modified version of the MAGIC-4 program. Water could not be directly determined due to extreme paucity of material; it was calculated by difference. The analysis is presented in Table 1. The oxidation state of iron was assigned to $^{+3}$ on the basis of microchemical tests which gave a strong reaction for Fe^{+3} and none for Fe^{+2}. The assignment of the oxidation state of manganese to Mn^{+3} is based on a number of factors: the ferric iron suggests a possible site for a $^{+3}$ cation; the dark red color is consistent with the absorption of Mn^{+3} in the visible range; and the presence of associated cryptomelane indicates that conditions in the geochemical environment of lotharmeyerite were consistent with Mn in higher oxidation states. Calculation of a chemical formula, on the basis of Σ ($^{+2}$ and $^{+3}$ cations) = 3, yields: $Ca_{0.96}Zn_{1.07}(Mn^{+3}_{0.81}Fe^{+3}_{0.16})(AsO_4)_{1.89}(OH)_{1.30}\cdot 1.63H_2O$ for analysis #2 in Table 1. This is in reasonable agreement with the theoretical formual of lotharmeyerite, $\mathbf{CaZnMn^{+3}(AsO_4)_2(OH)\cdot 2H_2O}$. The amount of water, calculated here by difference, is subject to error; the formula likely contains 1–2 H_2O. The chemical, physical and X-ray data do not suggest any apparent relationship to known

Table 1. **Microprobe analyses of lotharmeyerite.**

	#1	#2	$CaZnMn^{+3}(AsO_4)_2(OH)\cdot 2H_2O$
CaO	11.9	11.3	11.42
ZnO	17.5	18.3	16.56
Mn_2O_3**	16.3	13.4	16.07
Fe_2O_3*	1.1	2.7	0.00
As_2O_5	45.8	45.7	46.79
H_2O	7.4***	8.6***	9.16
Sum	100.0	100.0	100.0

Accuracy of data: ± 4 percent of the amount present.
* Total Fe calculated as Fe_2O_3 on the basis of microchemical test.
** Total Mn calculated as Mn_2O_3 per discussion in text.
*** Water by difference.

species; Lotharmeyerite is the first natural CaZnMn arsenate known.

DESCRIPTION

Lotharmeyerite occurs only as a druse of evenly-colored, reddish orange, equant microcrystals. No single crystal could by found and thus a unit cell was not determined. The X-ray powder diffraction data, obtained with nickel-filtered Cu *Kα* X-radiation and a 114.6-mm-diameter Gandolfi camera, are presented in Table 2. Lotharmeyerite has a Mohs hardness of approximately 3 and a light orange streak. No cleavage was observed, but the exceedingly small crystal size hindered this observation. The density, determined using heavy liquid techniques, is approximately 4.2 g/cm^3 for a granular aggregate which might have had interstitial spaces. Hence, this value might be slightly low. Lotharmeyerite has a vitreous luster, on both crystal faces and fracture surfaces. Optically, lotharmeyerite is anisotropic with indices of refraction above 1.80. Precise measurements were impeded due to dissolution of the mineral in index of refraction media. Pleochroism is strong with pleochroic colors dark reddish orange and light pinkish orange. The very small crystal size precluded the measurement of the optic axial angle. Lotharmeyerite crystals are equant; a representative crystal aggregate is shown in Figure 1.

OCCURRENCE

Lotharmeyerite occurs with pale violet adamite which has been reportedly found at the Ojuela mine, Mapimi, Durango, Mexico. The sample studied by the author is only 2 cm in diameter and thus limits the interpretation. The author has no direct knowledge of the occurrence and has not seen additional specimens. The esthetic nature of the associated adamite will probably guarantee other specimens being preserved in systematic collections.

On the holotype specimen, the matrix is composed of massive manganese oxides which are cryptomelane, $K(Mn^{+4}, Mn^{+2})_8O_{16}$, in part, and which have a druse of fibrous cryptomelane on vug surfaces. The massive manganese oxides are intergrown with goethite and pale yellow to colorless adamite. The surface of the specimen consists of cryptomelane in a druse aggregate, associated with euhedral pale violet adamite. Lotharmeyerite occurs as a druse of very small reddish orange crystals which coat both of these minerals. Lotharmeyerite is thus the last phase to form.

Table 2. **X-ray powder diffraction data for lotharmeyerite.**

$d_{obs.}$	I/I_o	$d_{obs.}$	I/I_o
6.66 Å	10	1.994 Å	2
4.94	80	1.929	2
4.587	50	1.872	2
4.473	10	1.833	20
3.513	20	1.817	20
3.414	90	1.763	10
3.175	90	1.752	10
3.116	20	1.713	70
2.912	90	1.687	80
2.822	80	1.663	10
2.710	80	1.649	10
2.557	100	1.589	60
2.468	50	1.562	70
2.455	50	1.513	40
2.307	20	1.485	5
2.267	20	1.465	20
2.227	5	1.457	20
2.204	5	1.420	10
2.129	50	1.412	10
2.056	2	1.377	20
2.023	2	1.360*	20

* - plus approximately 20 lines to 1.00 Å.
Intensities estimated visually. Cu *Kα* X-radiation

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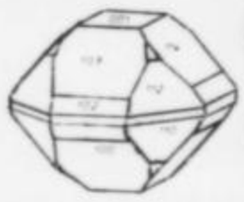

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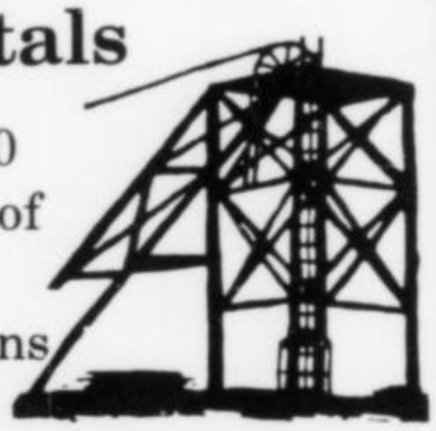

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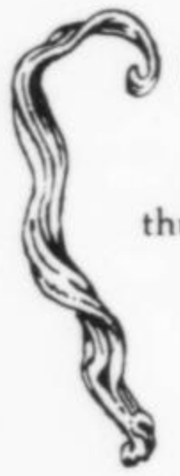

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Taeniolite

an uncommon lithium-mica from Coyote Peak, Humboldt County, California

by **Richard C. Erd, Gerald K. Czamanske**
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INTRODUCTION

Taeniolite has been found as a single occurrence in a mafic alkalic diatreme at Coyote Peak, Humboldt County, California; the geologic setting was described by Czamanske *et al.* (1977, 1978). The mica, unusual in its color (light greenish brown), was observed in a single hand specimen (77-CYP-L2), analyzed by electron microprobe, and found to be distinct in composition from the reddish-brown phlogopite typical of the diatreme. Taeniolite is a rare mineral; so far as we are aware, this is the second U.S. occurrence since the original discovery at Magnet Cove, Arkansas (Miser and Stevens, 1938). It has also been found in alkalic rocks of similar petrology in Greenland (where it was first described) and in several occurrences in the U.S.S.R. (Semenov, 1959; Eremenko and Val'ter, 1963; Gerasimovskii, 1965; Semenov *et al.*, 1969; Ganzeeva, 1973) including the Khibina massif (Chukhrov, 1978), which is notable for its mineralogic similarity to Coyote Peak (Erd and Czamanske, 1982).

OCCURRENCE

Taeniolite occurs as a few platy euhedral crystals, as much a 1 mm thick and 3 mm in diameter, in a late pegmatitic clot that also contains natrolite, pectolite, aegirine, barytolamprophyllite, rasvumite and sphalerite (10.5 mole percent FeS). Taeniolite is absent in the massive host rock, which includes phenocrysts of olivine and titanomagnetite in a groundmass of diopside (variety *salite*) schorlomite, nepheline, melilite, apatite, perovskite and phlogopite. The petrology of the host rock and of the pegmatitic clot containing taeniolite is otherwise typical of the intrusive rock at Coyote Peak. Specimen 77-CYP-L2, however, was not found in place and is the sole specimen found to date that contains taeniolite. Our investigation has been hampered by the small amount of taeniolite available for study.

PHYSICAL AND OPTICAL PROPERTIES

The taeniolite is pale to medium greenish brown and has a vitreous luster. The specific gravity, measured in acetone-bromoform mixture and checked with a Westphal balance, is 2.85 ± 0.01. The Mohs hardness is 3½. Optically, the mica is biaxial negative, with $\alpha = 1.541$, $\beta = \gamma = 1.570$ (all ± 0.002, Na light); $2V \approx 0°$. These indices of refraction are virtually identical with those reported for taeniolite from near Mount Nepkha in the Lovozero massif, Kola Peninsula, U.S.S.R. (Semenov, 1959). Coyote Peak taeniolite has moderate pleochroism, with Z = Y = reddish brown › X = pale greenish brown. The color seen in hand specimen is mostly that of the X vibration direction.

X-RAY CRYSTALLOGRAPHY

Single-crystal X-ray precession study (with Zr-filtered Mo radiation) shows the taeniolite to be of the 1*M* type. The structure of synthetic taeniolite was studied by Toraya *et al.* (1977), who found the space group to be $C2/m$. The X-ray powder pattern (not included here), obtained using a 114.6-mm-diameter Debye-Scherrer camera and Mn-filtered Fe radiation, is closely similar to published data for taeniolite. The unit-cell dimensions, refined by least-squares analysis with the program of Appleman and Evans (1973), are $a = 5.254(2)$Å, $b = 9.110(4)$, $c = 10.187(2)$, $\beta = 99.85(4)°$, $V = 4.80.4(1)$Å^3 (parenthetical figures are *estimated standard deviations*).

CHEMICAL COMPOSITION

Taeniolite was analyzed using a three-channel ARL EMX-SM electron microprobe with an accelerating potential of 15 kV, a sample current of 0.02 μA on benitoite, and count intervals (about 10 seconds) fixed by beam-current termination. The biotite and amphibole described by Czamanske and Wones (1973) were used as standards for most elements; supplementary standards were Mn_2O_3 for Mn, a synthetic fluorphlogopite for F (9.01 weight percent), and a natural sodalite for Cl (6.82 weight percent). Count data were stored and analyses computed on line using the data-reduction scheme FRAME (Yakowitz *et al.*, 1973). In addition, an ion-probe analysis for Li, B and Be was made by Ian M. Steele. The average values obtained are (in weight percent): SiO_2, 53.5; Al_2O_3, 3.00; TiO_2, 1.06; FeO, 3.35; MnO, 0.21; MgO, 18.3; Li_2O, 2.4; K_2O, 11.3; Na_2O, 0.27; F. 6.3; total, 99.69. Total iron is considered to be FeO; SrO and BaO are both less that 0.04 weight percent; and B, Be, Ca and Cl were not detected. The value for Li_2O is considered approximate, owing to absence of a suitable standard (Ian M. Steele, written communication, 1978). Assuming that (F + OH) = 2, we assign 1.30 weight percent H_2O and obtain the formula:

$$(K_{1.01}Na_{0.04})(Al_{0.01}Ti_{0.06}Fe^{+2}_{0.20}Mn_{0.01}$$
$$Mg_{1.92}Li_{0.68})(Si_{3.76}Al_{0.24})O_{10}(F_{1.40}OH_{0.60}).$$

Despite the analytical uncertainties mentioned above, there is "superior" agreement ($1 - K_p/K_c = 0.019$) between the chemical data, optical data and specific gravity, using the compatibility index of Mandarino (1979) for the Gladstone-Dale relationship. For com-

parison, the compatibility index for taeniolite from Magnet Cove, Arkansas, using the data of Miser and Stevens (1938), equals 0.020.

The chemical composition of the Coyote Peak taeniolite (though uncertain for Li, H_2O, and Fe^{+2}/Fe^{+3}) agrees well with the compositions reported for other naturally occurring taeniolites but contrasts strongly with the compositions of other micas at Coyote Peak. Phlogopite and biotite of widely varying composition are characteristic of the rock variants at Coyote Peak, but none of these variants contains more than 41.2 weight percent SiO_2.

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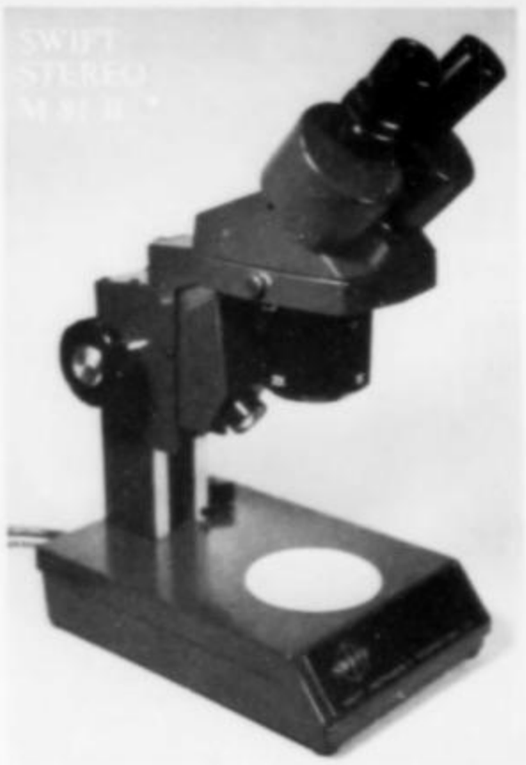

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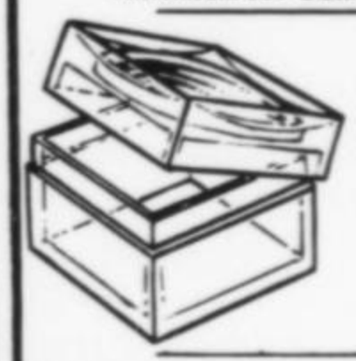

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Ferroaxinite

from Bridgeville, New Jersey

by **Warren Cummings**
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INTRODUCTION

In recent years a group of veins containing abundant ferroaxinite has been exposed in a small quarry, formerly operated by the Oxford Stone Company, 1.5 km south of Bridgeville, New Jersey (Fig. 1). The mineralized fissures cut Precambrian amphibolite and form a complex network within a fault zone at least 3 m wide. Most of the veins are narrow, less than 4 cm wide, and they are very vuggy. Although Drake (1968) has shown that the rocks of the region were intensely deformed and pervasively fractured during early Paleozoic time, the ferroaxinite-bearing fissures show little evidence of post-mineralization shearing.

The ferroaxinite occurrence in the Oxford quarry is the most extensive of 6 similar axinite localities. These localities are scattered along the northwest margin of a range of highlands, known geologically as the Reading Prong, between Bethlehem, Pennsylvania, and Fishkill, New York (Frazier, 1882; Edwards, 1978; Palache, 1935; Zodac, 1940). In addition, near the center of this belt of occurrences, manganaxinite and other boron-bearing minerals are found in veins crosscutting the famous orebody at Franklin, New Jersey. All these localities are in Precambrian metamorphic rocks near their contact with Paleozoic quartzite and dolomite.

MINERALOGY

In the veins in the Oxford quarry ferroaxinite occurs as isolated crystals and crusts of crystals (Fig. 2) implanted on epidote. Fer-

Figure 1. **Location map showing the general geology of the Oxford-Bridgeville, New Jersey, area.**

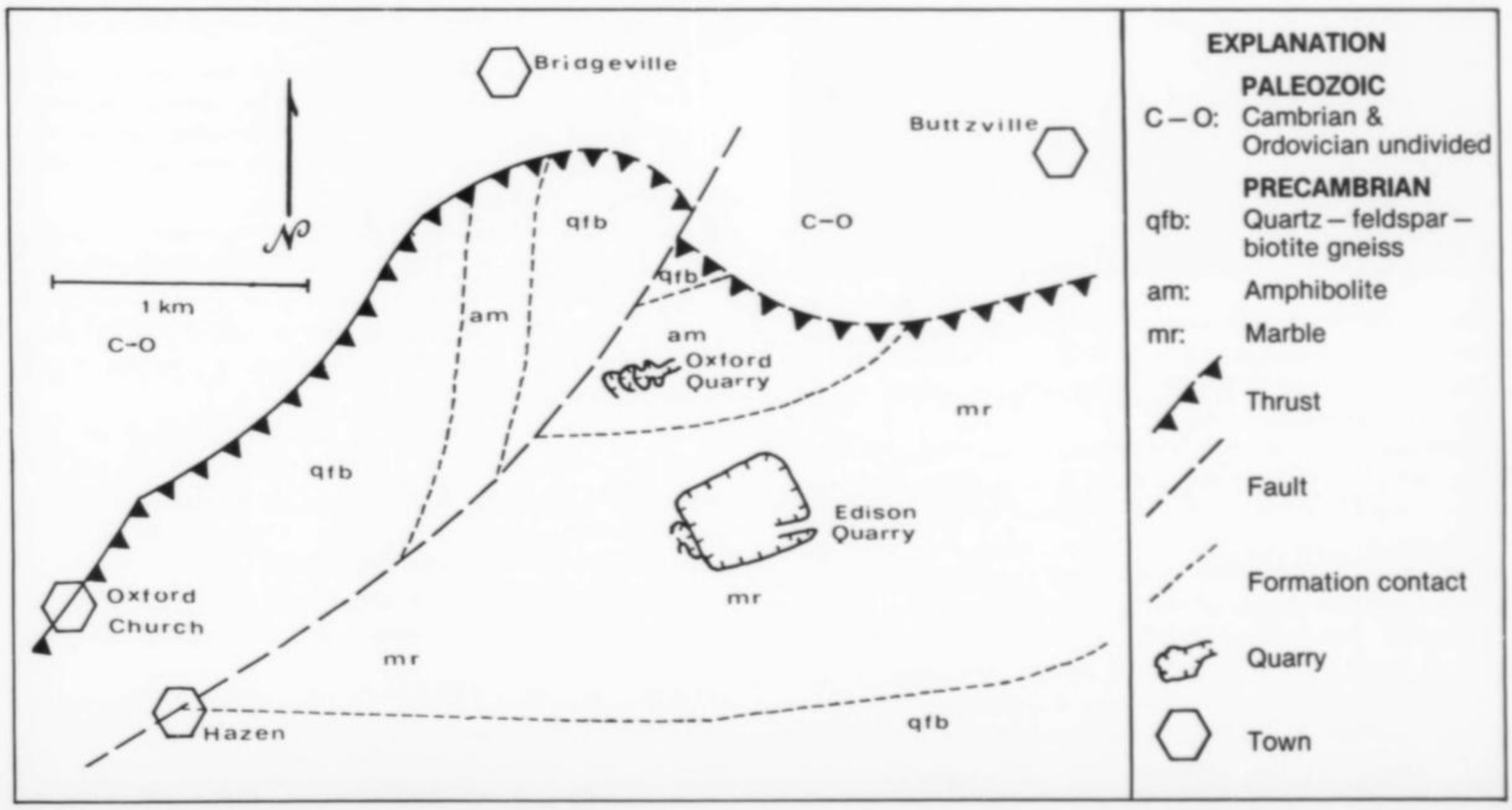
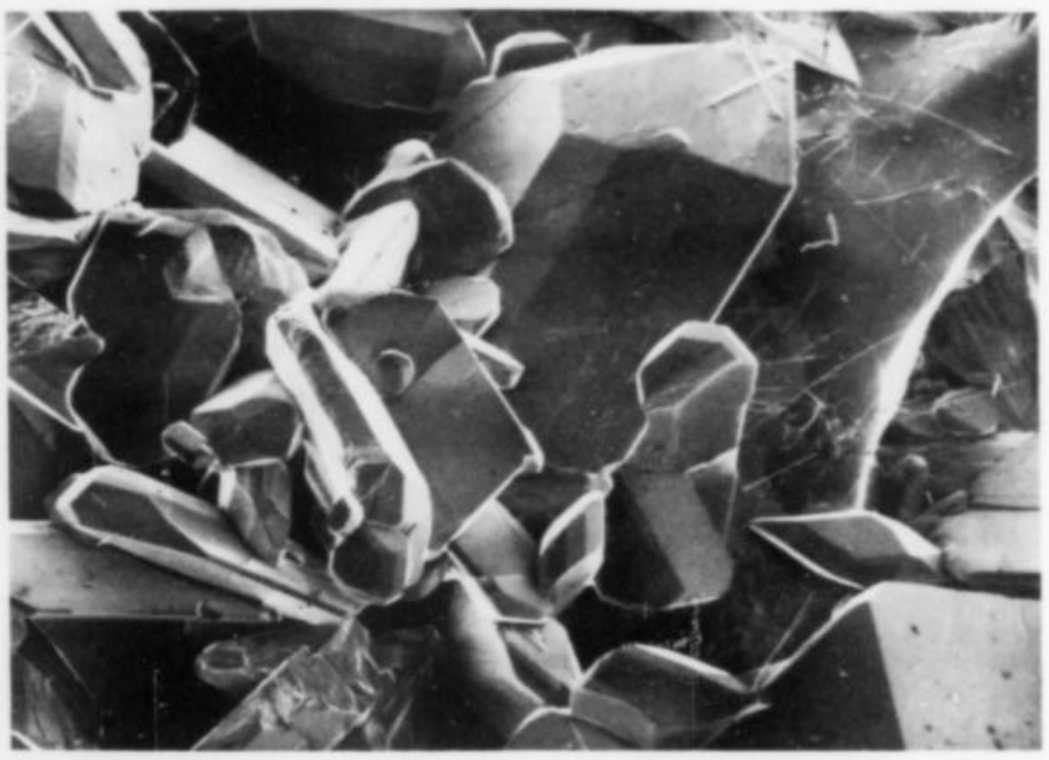


Figure 2. **Group of randomly oriented ferroaxinite crystals, the largest about 1 cm long, which occurred as a crust over epidote on the wall of an open fissure.**

Figure 3. **Scanning electron photomicrograph of ferroaxinite crystals associated with actinolite fibers and an etched remnant of calcite in a vug in massive ferroaxinite. The largest crystal is about 2 mm long.**

Figure 4. **Albite crystal, about 3 mm wide, twinned on both the Albite and Carlsbad laws. Crystals of this type are quite common at the Oxford quarry.**



roaxinite also occurs as massive, coarsely granular aggregates with numerous crystal-lined vugs (Fig. 3). Other associated minerals include actinolite (variety byssolite), albite (Fig. 4), calcite, quartz, pyrite, and manganese oxides.

Ferroaxinite crystals from the Oxford quarry, found in open space, are often sharp, brilliant and a striking pink color. Well-formed crystals range in length from a fraction of a millimeter to 1 cm. Larger crystals, up to 4 cm, occur vary rarely. They tend to be reddish-brown, dull, crudely formed, and incomplete due to the narrow vein width. Nearly all the ferroaxinite crystals from the Oxford quarry exhibit the typical "axehead" habit from which the mineral's name was derived. Doubly terminated crystals are not rare. The number of forms present on individual crystals ranges from 3 to at least 15. The most common forms (visually identified) are M $\{1\bar{1}0\}$, m $\{110\}$, r $\{1\bar{1}1\}$, s $\{201\}$, x $\{111\}$, z $\{1\bar{1}2\}$, and c $\{001\}$.

Chemical analysis, by the author, of a composite sample of hand-picked, transparent ferroaxinite crystals (by atomic absorption spectroscopy) gave: $SiO_2 = 42.44$, $Al_2O_3 = 18.10$, $FeO = 8.14$, $CaO = 19.70$, $MgO = 0.89$, $MnO = 2.65$, $B_2O_3 = 6.14$ (calc.), and $H_2O = 1.59$ (calc.), total = 99.65 percent. Boron and hydroxyl were assumed to be stoichiometric (Lumpkin and Ribbe, 1979). The composition indicates that these crystals are ferroaxinite as defined by Sanero and Gottardi (1968).

DISCUSSION

Examination of petrographic thin sections indicates that the late mineralization in the Oxford quarry resulted from recrystallization of the amphibolite country rock by boron-bearing hydrothermal fluids. The origin and manner of occurrence of the minerals are very similar to the Alpine clefts, best known from Switzerland and described by Weibel (1966).

ACKNOWLEDGMENTS

The author received help and encouragement from many people. I am particularly indebted to Ralph Tomas, Anthony Garwood, Richard Meckley, and Robert Cox.

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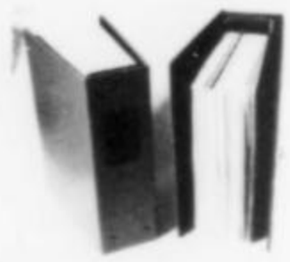

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Microminerals

by **Bill Henderson**

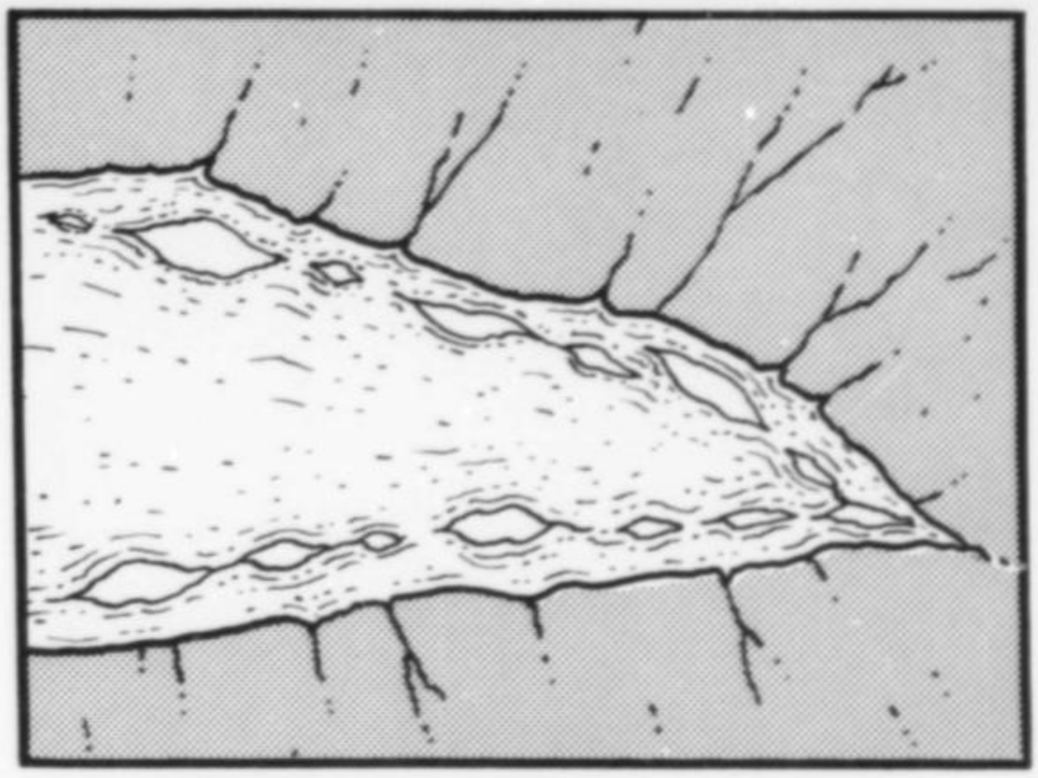

Figure 1. **Location of miarolytic cavities in rotten granite at Government pit, Albany, New Hampshire. Length of exposure, 25 feet. Most of the accessory minerals occurred at the right hand end of the exposure where the rotted granite pinched out. (Fresh granite shown in gray.)**

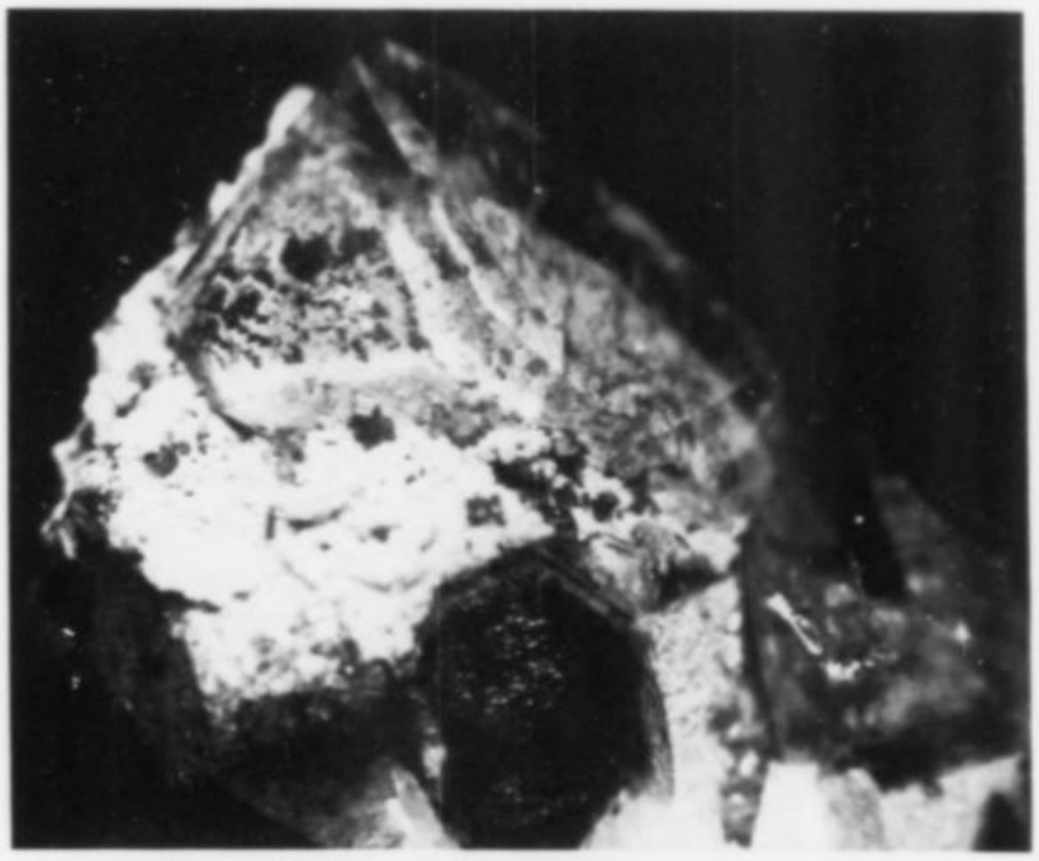

Figure 2. **Quartz phantom over earlier quartz with green chlorite at interface. Photo: 6 mm across, from Government pit, Albany, New Hampshire.**

Figure 3. **Colorless quartz partially encrusting earlier quartz and chlorite, 3-mm crystal from Government pit, Albany, New Hampshire.**

SOME TRADES

Happiness is a package of new microminerals in the mailbox. Surely, nothing brightens a collector's days like a slow and steady trickle of letters and packages from old and new friends discovered while swapping by mail. This column is about a few collectors with whom I have recently exchanged, and about one of my favorite microminerals dealers as well.

Not long ago, Gene T. Bearss (33 North Avenue, Sanford, Maine, 04073) wrote me about his finds at the Government pit, White Mountain National Forest, Albany, New Hampshire. He writes that the locality is about midway between the better known localities at Moat Mountain and the Lovejoy gravel pit. Presumably, they all occur in the same (Conway?) granite.

Gene tells me that he was lucky enough (or, I would think, diligent enough) to open a series of small miarolytic cavities in decomposed granite. The clue to the presence of pockets was the appearance of massive, blue-green microcline around them. The pockets were arranged near the borders of a zone of decomposed granite, as shown in Figure 1, and the best accessory minerals were to be found where the granite pinched out at the right-hand end of the exposure.

The material he sent, both the hand specimens and the micro material, is truly beautiful. It is reminiscent of specimens from Pikes Peak, and is remarkably fresh and clean. The larger specimens show euhedral smoky quartz crystals intergrown with bright, blue-green microcline in euhedral crystals, both on a base of graphic granite.

Of more interest are the micro minerals, some of which are pictured here. A complete list of the minerals Gene found, most of them in euhedral crystals, is as follows:

Minerals Found at Government Pit

Albite	Danalite	Phenakite
Allanite	Fluorite	Pyrolusite
Bavenite	Hematite	Quartz
Bertrandite	Microcline	Sphene
Biotite	Milarite	Topaz
Cassiterite	Monazite	Astrophyllite?
Chlorite	Muscovite	Uralolite?

Besides smoky quartz, Gene sent some very interesting, clear and colorless quartz having excellent phantoms (Fig. 2) and partial crusts (Fig. 3) over an earlier generation of quartz. Between the two

Figure 4. **Colorless, 4-mm fluorite cuboctahedron showing interrupted growth, on smoky quartz and green microcline. From Government pit, Albany, New Hampshire.**

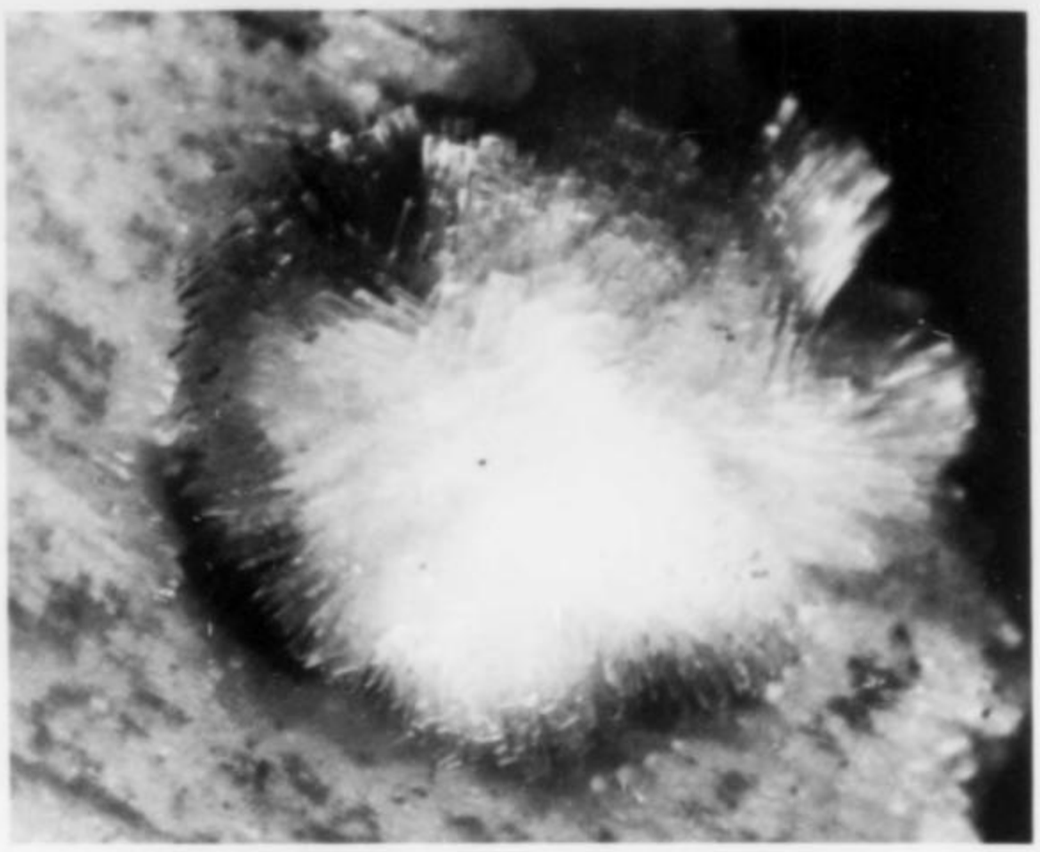

Figure 6. **Radiating laths of pale pink bavenite in hollow in face of feldspar crystal. Size of group: 2 mm. From Government pit, Albany, New Hampshire.**

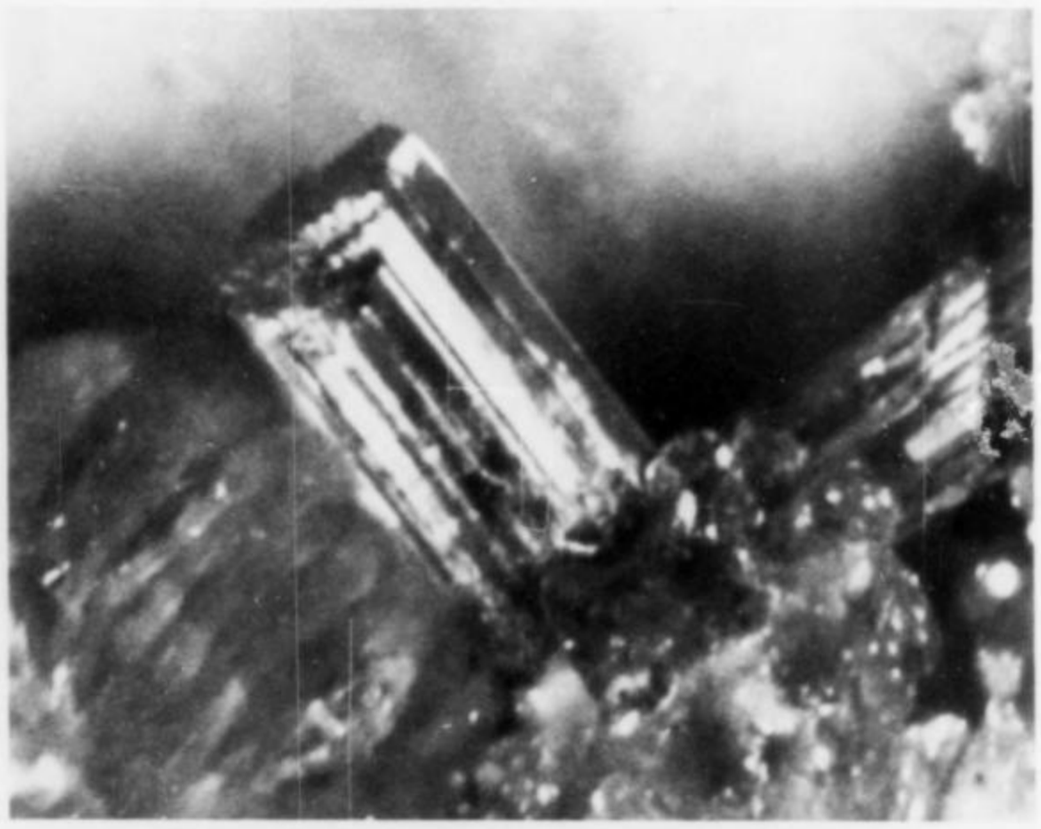

Figure 5. **Transparent, columnar, pale pink crystal of bertrandite, 1 mm long, with smoky quartz. Government pit, Albany, New Hampshire.**

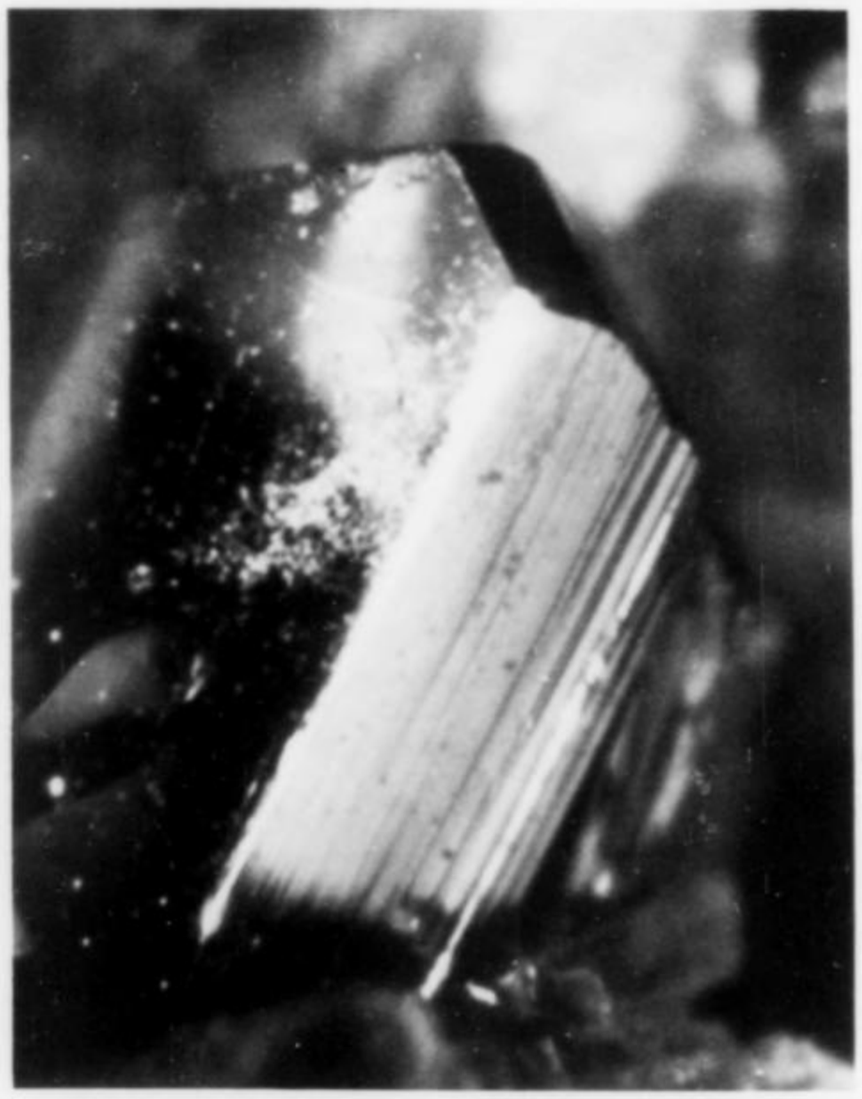

Figure 7. **An equant, metallic-gray, striated crystal of molybdenite, 0.8 mm across, on green diopside. The terminal face is curved. From the Goodall Farm mine, Sanford, Maine.**

episodes of quartz growth, a number of other minerals, chiefly chlorite, grew on the earlier crystals.

Several remarkably clear and sharp fluorite crystals of simple habit are present on some of the smoky quartz/microcline specimens. The cuboctahedron of fluorite in Figure 4 is an example of these and shows an interesting re-entrant angle on its front edge. This is not a twinned crystal. Rather, the re-entrant is made up of two cube faces and is an example of interrupted growth.

Two beryllium minerals are shown in Figures 5 and 6. The first of these is an unusual crystal of bertrandite, unusual because the crystal habit is columnar rather than the common equant or tabular form. Further, although the crystal is quite transparent, it has a pale pink color seldom seen in bertrandite. This appears to be caused by minute inclusions of hematite. The bavenite in Figure 6 is very fine. A pale tan to white in color, the crystals are lathlike, well terminated, and arranged in radiating groups. Some of the groups, including the one illustrated, appear to have partially buried themselves in the feldspar matrix on which they are growing. Somehow, the bavenite seems to have been able to inhibit growth of the feldspar. These bavenites are the equal of the gorgeous crystal clusters recently sent me from the Vigezzo Valley in Italy by a number of Italian collectors.

The rarest of the beryllium minerals Gene sent was milarite in colorless, transparent, columnar crystals with complex terminations. Frustratingly, these would just not photograph, so a verbal description of them will have to do. My favorite of these is a specimen showing a row of milarites much like a crown encircling a smoky quartz crystal.

In subsequent exchanges, Gene has sent many nice microminerals from Maine, including childrenite/eosphorite with roscherite; hydroxylherderite; gemmy, complex apatite from several localities; brightly tarnished, lathlike columbite; terminated crystals of elbaite in blues and greens; and very nice vesuvianite. Two specimens he sent are shown in Figures 7 and 8. The first of these is a brilliant and

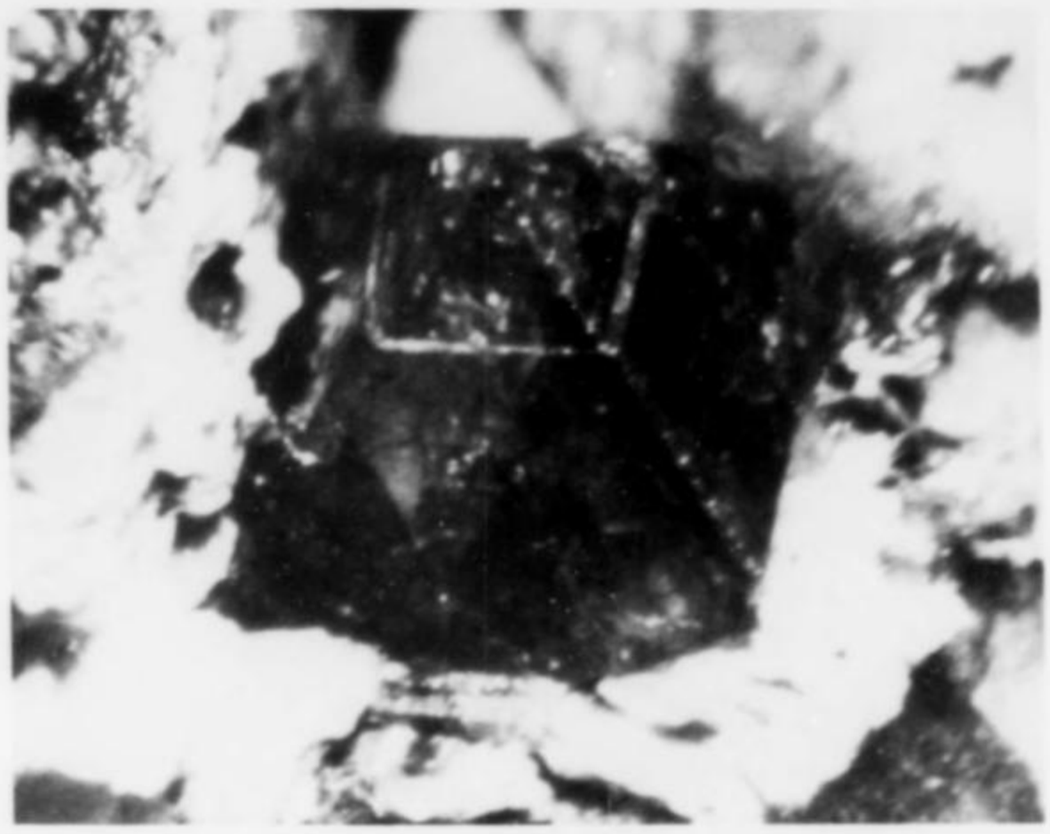

Figure 8. **A 1-mm apple-green octahedron of microlite from the Fisher quarry, Topsham, Maine.**

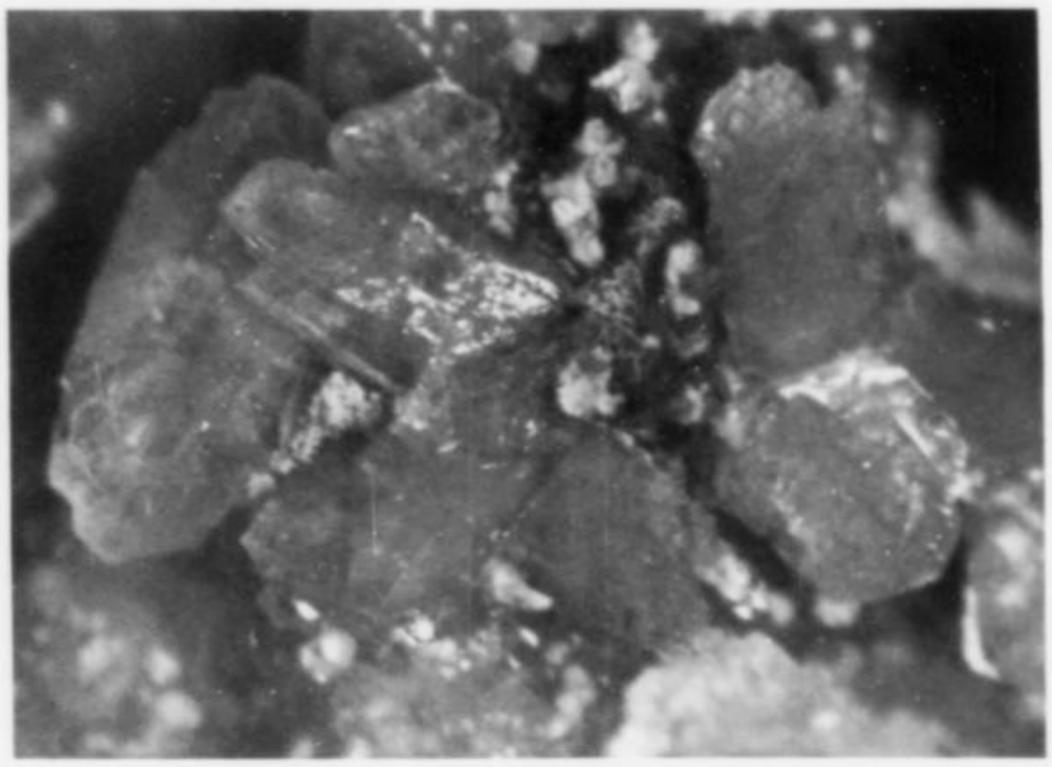

Figure 9. **A group of transparent, subparallel crystals of the barium feldspar hyalophane; field of view is 4 mm; from the Pahau River, Culverden, South Island, New Zealand.**

Figure 10. **Transparent, colorless, radiating erionite crystals, the largest 1 mm long. From Moeraki, Otavi, South Island, New Zealand.**

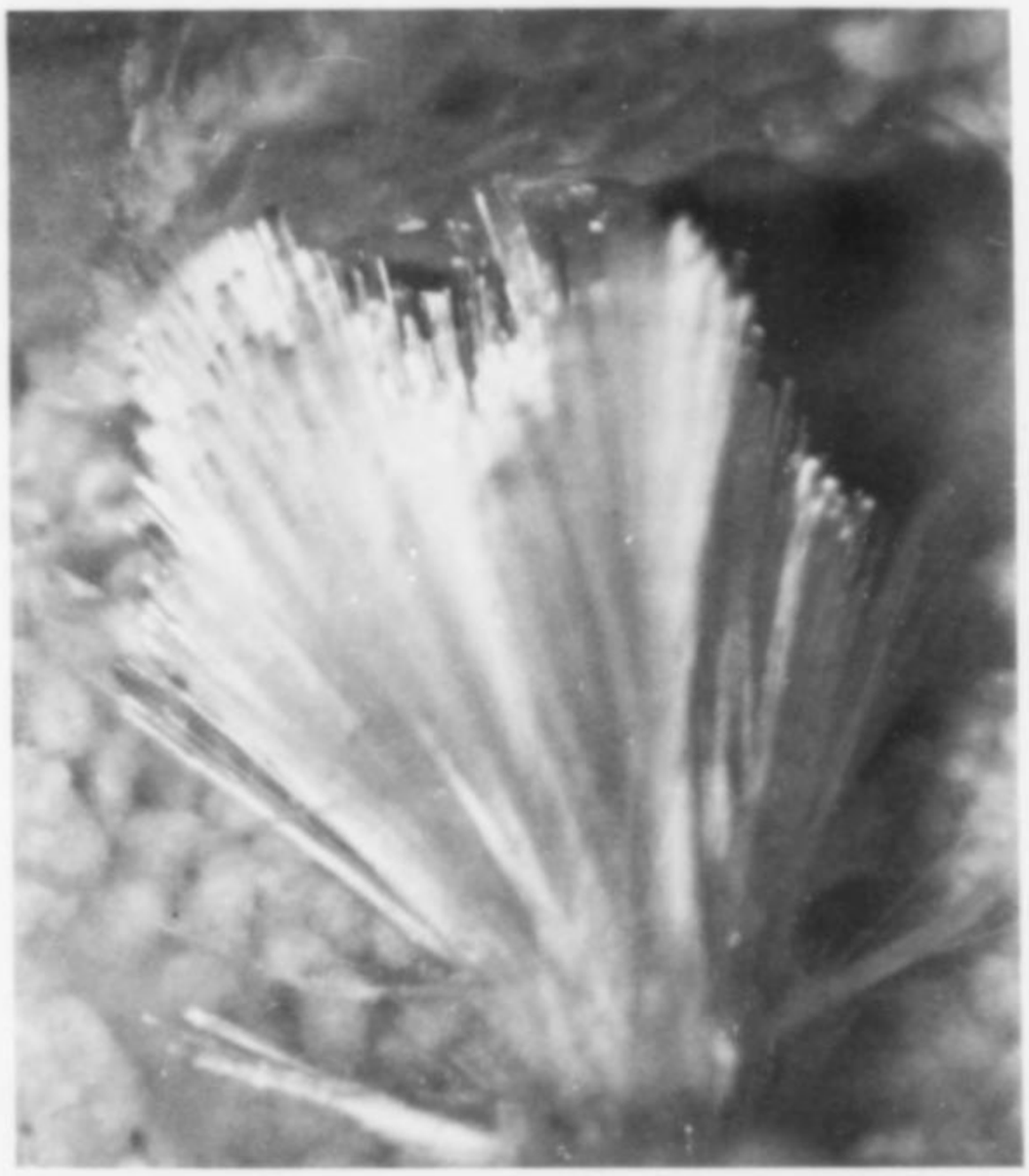

Figure 11. **A 3-mm radiating spray of pale yellow mordenite crystals, well terminated, from near Nelson, South Island, New Zealand.**

well formed micro of molybdenite on green diopside from the Goodall Farm mine, Sanford, Maine. The crystal is almost as thick as it is wide, has a curved terminal face, and is heavily striated parallel to the base. The second specimen is a deep green microlite octahedron with minor dodecahedral modifications from the Fisher quarry, Topsham, Maine.

I asked Gene about collecting at the Government pit. He tells me that the locality is on National Forest Service land and that permits are required. These are obtainable at the Forest Service Station near the intersection of New Hampshire routes 112 and 16. Collecting is becoming a bit dangerous since collectors have seriously undermined the granite ledges, so one must be careful. Imagine how much the Forest Service could do for us through a few minutes' work with a backhoe!

Moving halfway around the world, I would like to describe some very nice material, mostly zeolites, sent me by Ruth Jacobsen (Clifton R.D.I., Takaka, Golden Bay, South Island, New Zealand). A couple of the micro species she sent were more or less unknowns. That in Figure 9 is in transparent, euhedral, subparallel crystals, and looks for all the world like hyalophane from the Binnatal quarry, Lengenbach, Switzerland. Although the matrix of the New Zealand material appears to be a volcanic rock and that of the Lengenbach material is a marble, the crystal forms are exactly the same. Sure enough, optical work showed the unknown crystals to

match hyalophane closely, and the identification was confirmed by the X-ray powder pattern obtained by Pete Dunn at the Smithsonian. Hyalophane is a barium feldspar, and it is comforting that harmotome, a barium zeolite, occurs with it at the New Zealand locality. The books say that almost all the world's reported localities for hyalophane are associated with manganese mineralization. Interestingly, this is not the case for either of the localities mentioned above, the only two from which I have micro specimens of the mineral.

A second unknown sent to me by Ruth, that pictured in Figure 10, also occurred in vugs in a volcanic rock, and was associated with other zeolites. It was immediately sight identifiable as erionite, being identical in crystal form to that from a number of localities in the American Southwest. The optics fit erionite perfectly. The optically clear crystals are simple in habit, showing only the hexagonal prism and base. The terminal faces sometimes show interesting growth spirals in irregular, circular patches, with up to three such spirals on a single face. The crystals are really fine, being the equal in length and exceeding the diameter those from western localities such as Rock Island Dam, Columbia River, Washington; Malpais Hill, Arizona; and Elk Valley, California.

Other fine zeolites have been sent to me by Ruth. The mordenite from near Nelson, South Island, New Zealand shown in Figure 11 is from a locality well known for the mineral. Specimens vary from colorless to pale yellow in color, and the larger crystals show distinct terminations, rare for the mineral. Not shown are very nice phillipsite crystals and a remarkable, pale blue apophyllite in subparallel groups of cavernous crystals from the Pahau River. Finally, Figure 12 shows some very beautiful stilbite lining snow-white cavities or vugs. The crystals have rather flat terminations. Many micro collectors seem to jump to the conclusion that zeolites of this habit are of necessity epistilbite, but this is by no means a sure identification. Stilbite, including this specimen whose identity was checked optically, frequently shows such a flat termination.

I will turn next to some material received from a collector in New Zealand's near neighbor, Australia. He and I just began exchanging within the last few months, long after my column on Australian microminerals appeared. Peter Elliott (P.O. Carey Gully, South Australia 5144, Australia) is one of those chaps (to use the Australian expression) who very carefully describes micro material when he offers it. This makes his lists a real pleasure, as one can be sure of the quality and novelty of the specimens before they are received. Further, with explicit locality information, one knows whether one already has the mineral from a given locality. Peter has sent some really gorgeous things including transparent, columnar barite from Moralana in the Flinders Range; phillipsite from Gads Hill, Tasmania; lavendulan from the Preamimma mine, South Australia; adamite, hedyphane and willemite from the Puttapa zinc mine in the Flinders Range; and brilliant, deep green crystals of brochantite with chrysocolla pseudomorphs from the Pinnacles mine, again in the Flinders Range. He has also sent some remarkably good crystals of chalcocite, sphalerite, digenite and the very rare mineral wittichenite from the Cattlegrid pit, Mount Gunson mines, South Australia. The wittichenite is in sharp, tabular, brilliant gray crystals with an irridescent tarnish, some of them on digenite. Peter's material is very photogenic, but I have not yet had time to take any pictures of it. I am sure he would like to exchange.

An ever-increasing number of dealers are offering microminerals these days. Of these, one of my favorites is Bart Cannon, (1041 N.E. 100th Street, Seattle, Washington 98125). Why one of my favorites? For one thing, he offers nice material at reasonable prices. Further, much of it is self-collected by Bart. Finally, he offers not just rarities which will turn a fast buck but also interesting specimens such as pseudomorphs, twins and inclusions in crystals. It's obvious that he likes minerals for more than their monetary value alone.

Figure 12. **Colorless, 1.5-mm stilbite crystals lining a vug in volcanic rock. From Stew Point, Rangitata Gorge, South Canterbury, South Island, New Zealand.**

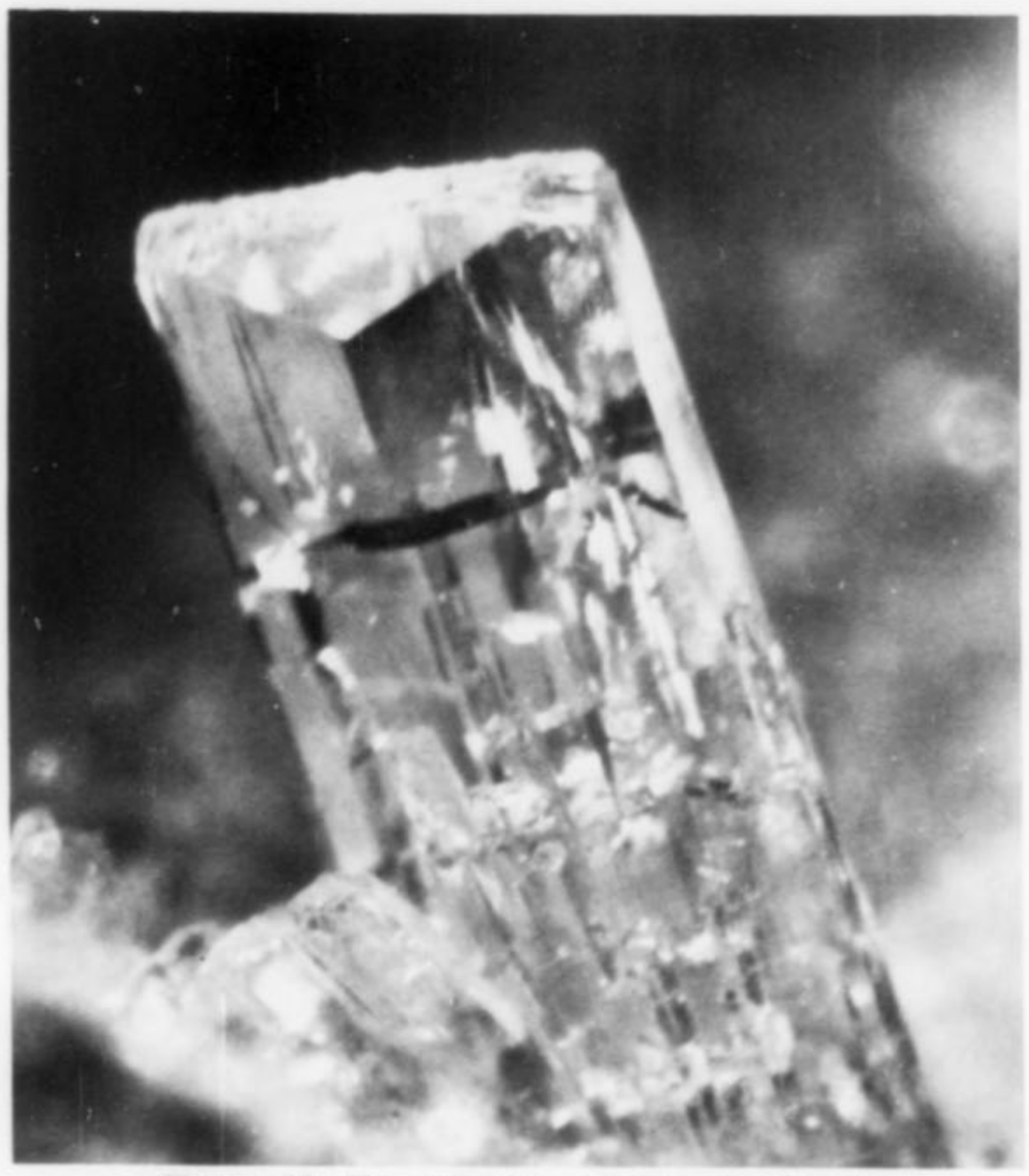

Figure 13. **Transparent, colorless crystal of epistilbite in volcanic rock, crystal 3 mm in length, from the Puu O Ehu quarry, Oahu, Hawaii.**

The epistilbite in Figure 13 is one of the specimens sent recently by Bart. Perfectly transparent, it is from the Puu O Ehu quarry in Hawaii. The crystal shows some internal flaws. Another zeolite, the edingtonite in Figure 14, is from Ice River, near Golden, British Columbia (see v. 12, n. 4, p. 221). The crystals are quite large as micros go, and show irregularities in their growth caused by oscillation between one face and another.

Two other specimens sent by Bart are shown in Figures 15 and

Figure 14. **Colorless to white crystals of edingtonite, group 5 mm across, from Ice River, near Golden, British Columbia.**

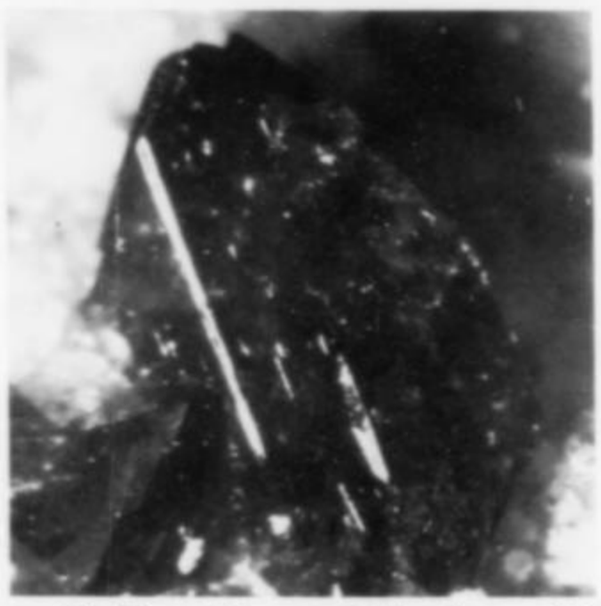

Figure 15. **Deep blue crystals of veszelyite on quartz. The largest crystal is 2 mm long. From Philipsburg, Montana.**

16. The first is a pair of deep midnight-blue crystals of veszelyite from Philipsburg, Montana. Far larger crystals are also presently coming from this locality. The other specimen is a parisite from the Snowbird mine, Alberton, Montana (see v. 8, n. 2, p. 83). The crystal shows the typical tapering parisite habit, but is attractive for its deep honey-brown color and its transparency. It is possible to see right through the crystal.

In his last package, Bart sent two examples of inclusions. The first was of astrophyllite and acmite in smoky quartz, and came from Washington Pass, Washington. The second is one of my favorites. From Goldmeyer Hot Spring, Washington, it is a bright, euhedral pyrite entirely embedded within a terminated, colorless quartz crystal. The front face of the quartz (Fig. 17) has been polished to allow a better look at the pyrite. There is, by the way, a trick to photographing this and other inclusions within host crystals. If the inclusion is in a biaxial (i.e., other than isometric) host, a photograph will yield a double image similar to that seen through a piece of Iceland spar. However, if the specimen is photographed through properly adjusted polarizers, one of the two images is cancelled out and only a single image results on film.

Since this column is about swaps and swappers, I would like to end with a couple of suggestions for those of you who like to exchange by mail. First, as mentioned earlier, describe at length and in detail what you have to offer and where it is from. Second, and to avoid disappointment, keep initial exchanges small, perhaps ten to twenty specimens. Further, don't send more specimens than the other party requests. He may not be willing or able to match in quantity what you send. Use the first exchange or two to find out

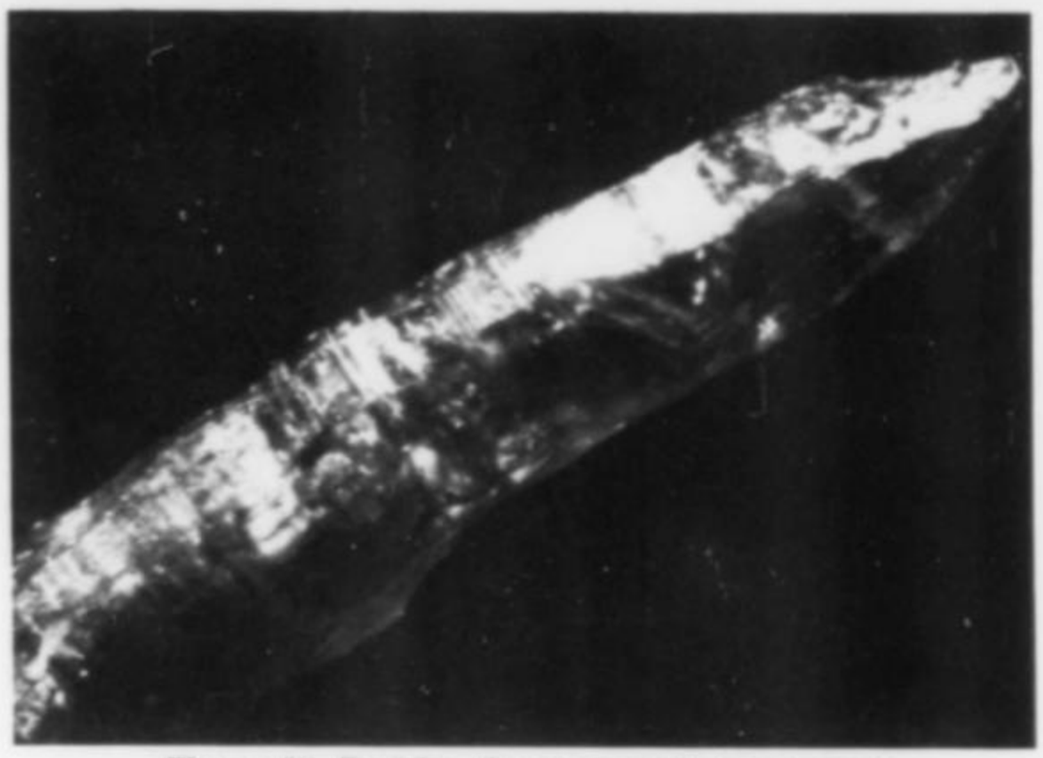

Figure 16. **Parisite, 9-mm crystal, transparent with a deep honey-brown color. From the Snowbird mine, Alberton, Montana.**

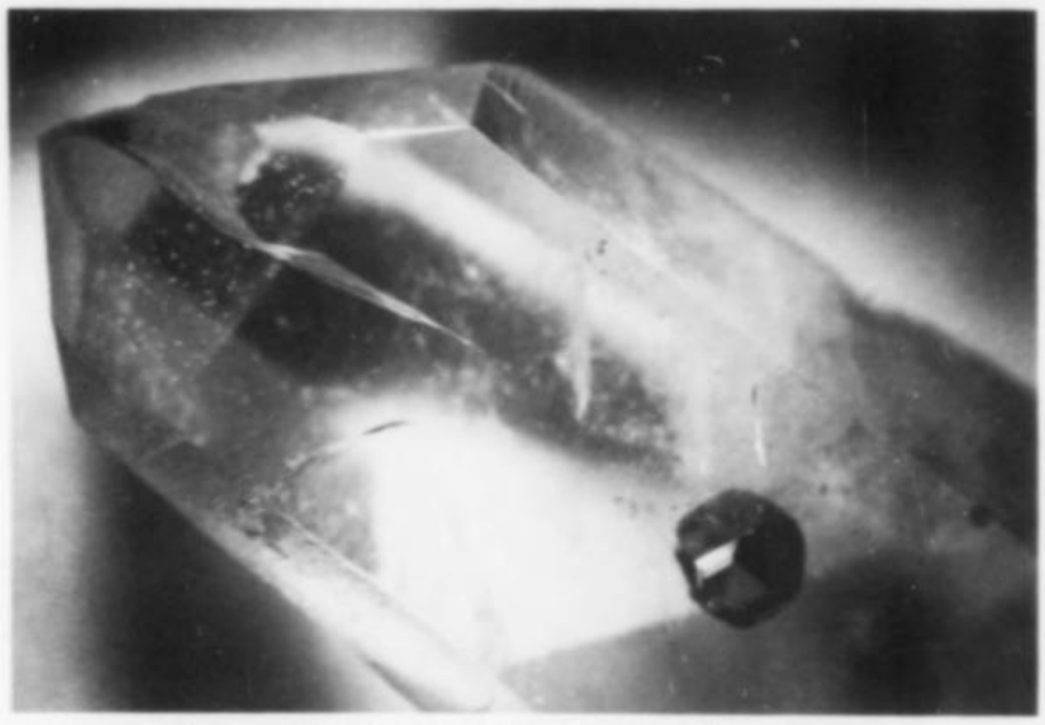

Figure 17. **Pyrite inclusion within colorless quartz crystal. Size of pyrite crystal, 1.5 mm. The specimen is from Spruce claim, Goldmeyer Hot Spring, Washington.**

each other's likes and dislikes and to see whether what he has to offer is really of the quality you want.

And now a word of warning. It is very seldom that a larger specimen or a number of smaller micros glued or stuck to boxes will arrive intact. Usually, the box sounds like a baby's rattle on arrival, and all the specimens have self-destructed. If you must send them in the micro boxes, support them well within the boxes with foam rubber or wadded paper. Specimens, with rare exceptions, travel best wrapped in tissue.

On the subject of packing, I might as well reveal one of my pet peeves. It is not necessary to wrap the paper around a specimen two ways in several inches of cellophane tape. Have you ever tried to undo such things? Jab, jab, jab with the scirrors, the tape catching forever and ever, the specimen crushed in the process. Far better a little, short piece of transparent tape, or better yet, a bit of masking tape. At least, that is easily seen and cut. As to micro boxes, they need not be taped at all. It's virtually impossible to pry loose the tape, and the box is often gummy and stuck up so that it can't be used. Enough.

Finally, try to save some nice duplicates for giveaways to beginning collectors. It's a nice way to make friends and generate new interest in the hobby.

Que tenga buena suerte!

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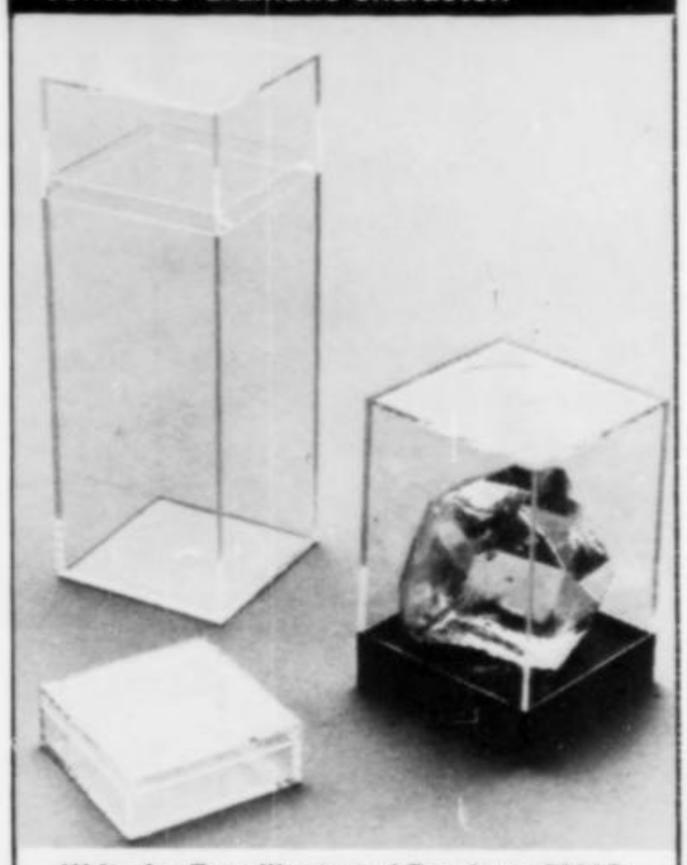

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What's New in Minerals?

by **Wendell E. Wilson**

DETROIT SHOW 1982

Despite a particularly bad economy in the Detroit area, most dealers I spoke with at this year's Detroit Show were reasonably well pleased with their sales. And Bill Meinert, longtime member of the show organization, put to rest any rumors about the ill health of the show itself; a new seven-member show committee has been formed for next year to revitalize the organization. Problems in recent years had cast a pall on the future of the show, but those have seemingly been resolved and Detroit should continue as the nation's no. 2 show (after Tucson).

Particularly pleasing was the change in the satellite show, a collection of dealers unable (or unwilling) to obtain space at the main show hall. For many years the satellite show had been held at the Holiday Inn in Hazel Park, along with a wholesale lapidary show. Then, in 1980, the organizer of the lapidary show there managed to obtain exclusive use of the motel, forcing the mineral show to find other quarters. Many years ago, the first satellite show had been held at the Cymbal-Warren motel (later renamed the Flying Dutchman motel), and so the dealers returned there for a year, but found it unsatisfactory for many reasons. In any case, the following year (1981) the Flying Dutchman was destroyed by fire. This year, the new location was the Holiday Inn farther north in Troy, and it was an ideal choice. The motel is relatively new, very attractive, superbly managed, and in a good neighborhood surrounded by good restaurants. Next door to it is another fine motel (the Red Roof Inn) where many non-dealers choose to stay as well. Finally on firm footing, the satellite show should expand considerably in future years. Dealers interested in space for next year's show should contact Tom Palmer (*Crystal Cavern Minerals*) or Don Olson (*Minerals International*).

The main show at the Armory had no particular theme this year, but the displays were excellent and the entryway exhibit featuring a truly monstrous Tyrannosaurus skull was impressive, to say the least. The following sections (given individual headings this time for easier reference) cover material that turned up at the shows or during the months previous.

CHALCOCITE CRYSTALS FROM MICHIGAN

Rich Whiteman of *Red Metal Mineral Company* ran into something unusual at the White Pine mine, Ontonogan County, Michigan: large crystals of chalcocite to 1½ inches. Chalcocite itself is not uncommon there, but had previously been found only in very small, uninteresting crystals. The new find yielded about 50 specimens from a calcite-filled seam about ¾ inch thick in shale. The calcite was removed with acid, revealing many fine crystals mostly in the range of ¼ to 1 inch. They all have a frosty luster and range from rounded to very sharply formed, in sizes from thumbnail to small cabinet. Red Metal Mineral Company has operated the White Pine mine for a number of years, and has developed a following of collectors interested in Michigan minerals, primarily copper. Other species found at the White Pine mine (though rarely of display quality) include silver, chalcopyrite, barite, chrysocolla, hematite and hydrocarbon compounds.

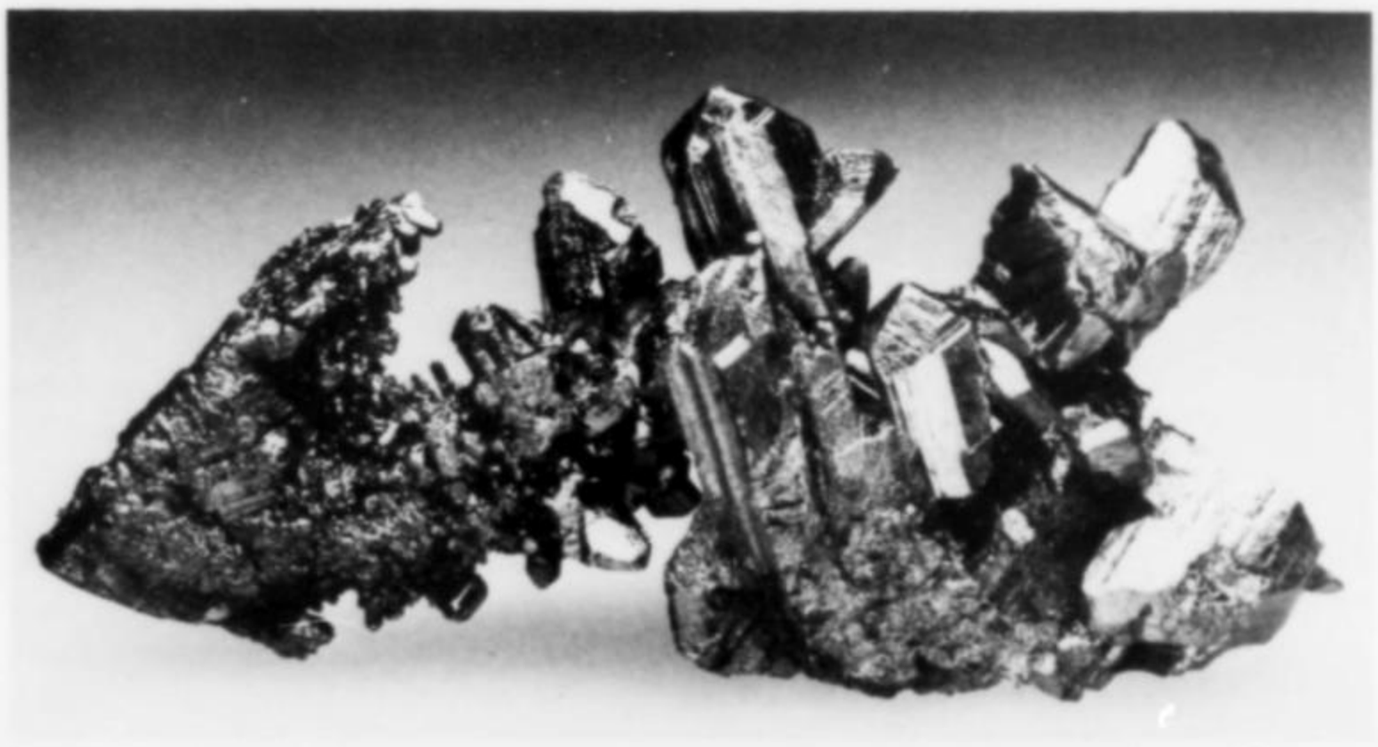


Figure 1. **Chalcocite crystals from the White Pine mine, Ontonogan County, Michigan. The group is 1½ inches across; R. Whiteman specimen.**

Figure 2. **Chalcocite crystals from the White Pine mine, Ontonogan County, Michigan. The group is 2¼ inches across; R. Whiteman specimen.**

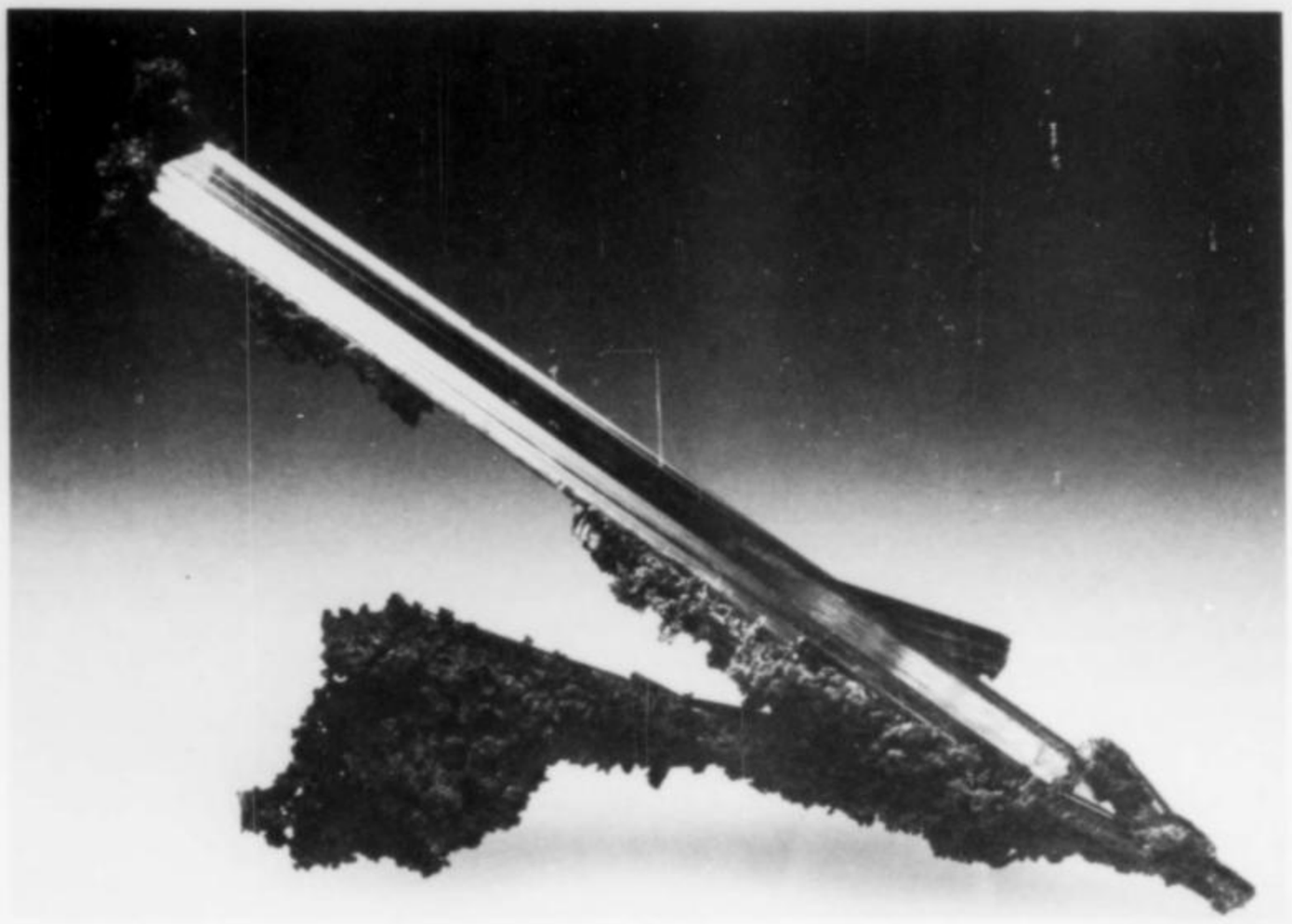


Figure 3. **A stibnite crystal, 3 inches long, with spongy marcasite from the La Salvadora mine, Oruro, Bolivia. Mitch Abel specimen.**

Figure 4. **Amethyst on milky quartz from Hopkinton, Rhode Island. The larger crystal is 2 inches tall. Russell Behnke specimen; collected by Sal Avella.**

BOLIVIAN STIBNITE

Mitch Abel of *Abel Minerals* came out with a fine batch of Bolivian stibnite at last year's Tucson Show, though the specimens received less attention than they deserved because he was located away from most of the mineral dealers and was difficult to find. In Detroit he still had a good selection (see photo). The lot was large, consisting of several hundred specimens of bladed, elongated crystals in sprays and groups to several inches. Though generally without matrix, the stibnite is typically associated with spongy marcasite. The locality, the La Salvadora mine, can stand with the other major stibnite locations as a source of fine crystals.

Figure 5. **Pink rhodochrosite crystals with drusy milky quartz from the 1600 level, Mountain Monarch mine, Ouray, Colorado. The specimen is 2½ inches tall. Harvey Gordon collection.**

SCEPTERED AMETHYST FROM RHODE ISLAND

Here's a story that would make any collector green: some folks in Hopkinton, Rhode Island, were engaged in digging a septic tank in their back yard when they began pulling out beautiful specimens of quartz. The crystals consist of lustrous, gemmy, medium-purple amethyst perched on milky quartz crystals to form scepters. The crystals reach more than 2 inches, and some are spectacular indeed. Several hundred specimens have been found, all apparently imbedded randomly in loose earth. Though no specimens were for sale in Detroit, Russell Behnke brought along the two specimens pictured here, and he can be contacted for more information (see his ad in this issue).

COLORADO RHODOCHROSITE

Harvey Gordon of *Sierra Nevada Minerals* spent nine weeks this summer digging at the Mountain Monarch mine near Ouray, Colorado. They drifted (tunneled) for a total of about 135 feet, and encountered some very attractive rhodochrosite in rhombohedral crystals to 1¼ inches. The crystals are pink and are partially encrusted with minute quartz crystals. About 30 good specimens were recovered. Harvey had a number of other interesting items for sale in his motel room, including thin, platy hematite crystals to about 2 inches, from Sicily.

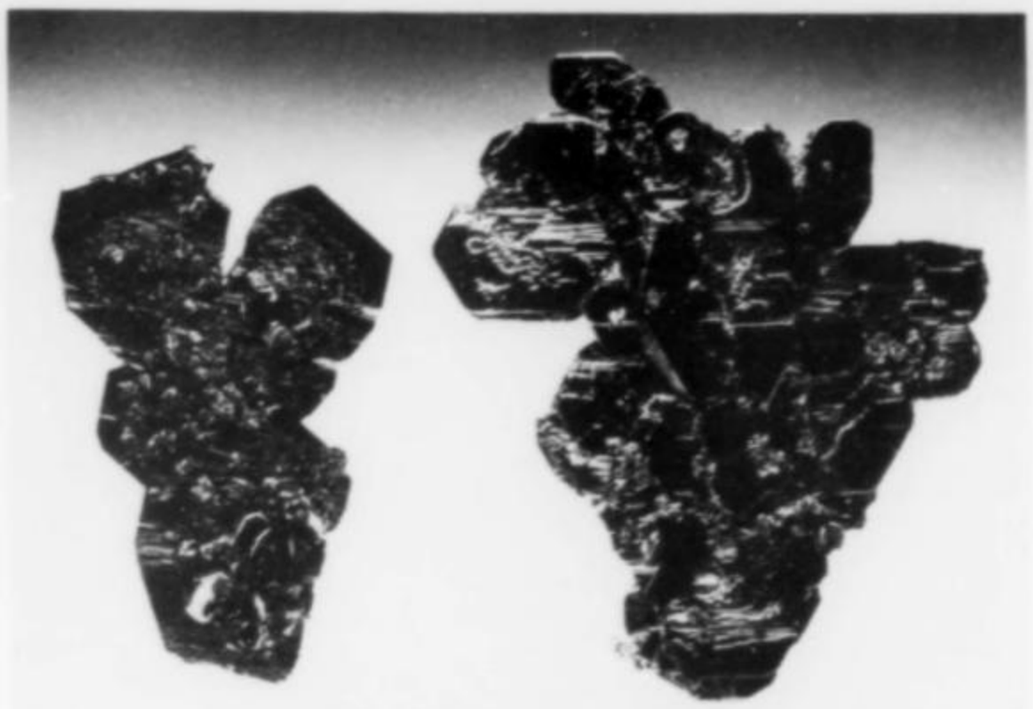


Figure 6. **Very thin, platy hematite in parallel growth, from Sicily. The specimen on the right measures 1¾ inches; Harvey Gordon specimens.**

ILLINOIS BARITE

A recent find at the Denton mine, Hardin County, Illinois, has yielded several flats of very esthetic barite crystals on purple fluorite. Most of the barite is a yellow-cream color, though some crystals are pale blue to gray. All are well-formed, diamond-shaped, and up to 2 inches each. The combination of well-formed barite on richly colored fluorite makes for a fine display piece, and some barite groups which Ron Sohn displayed in his booth at the main show are particularly attractive. The Illinois fluorite district is one of America's most famous and long-lived localities, and it's good to see it still producing some surprises.

LOTHARMEYERITE

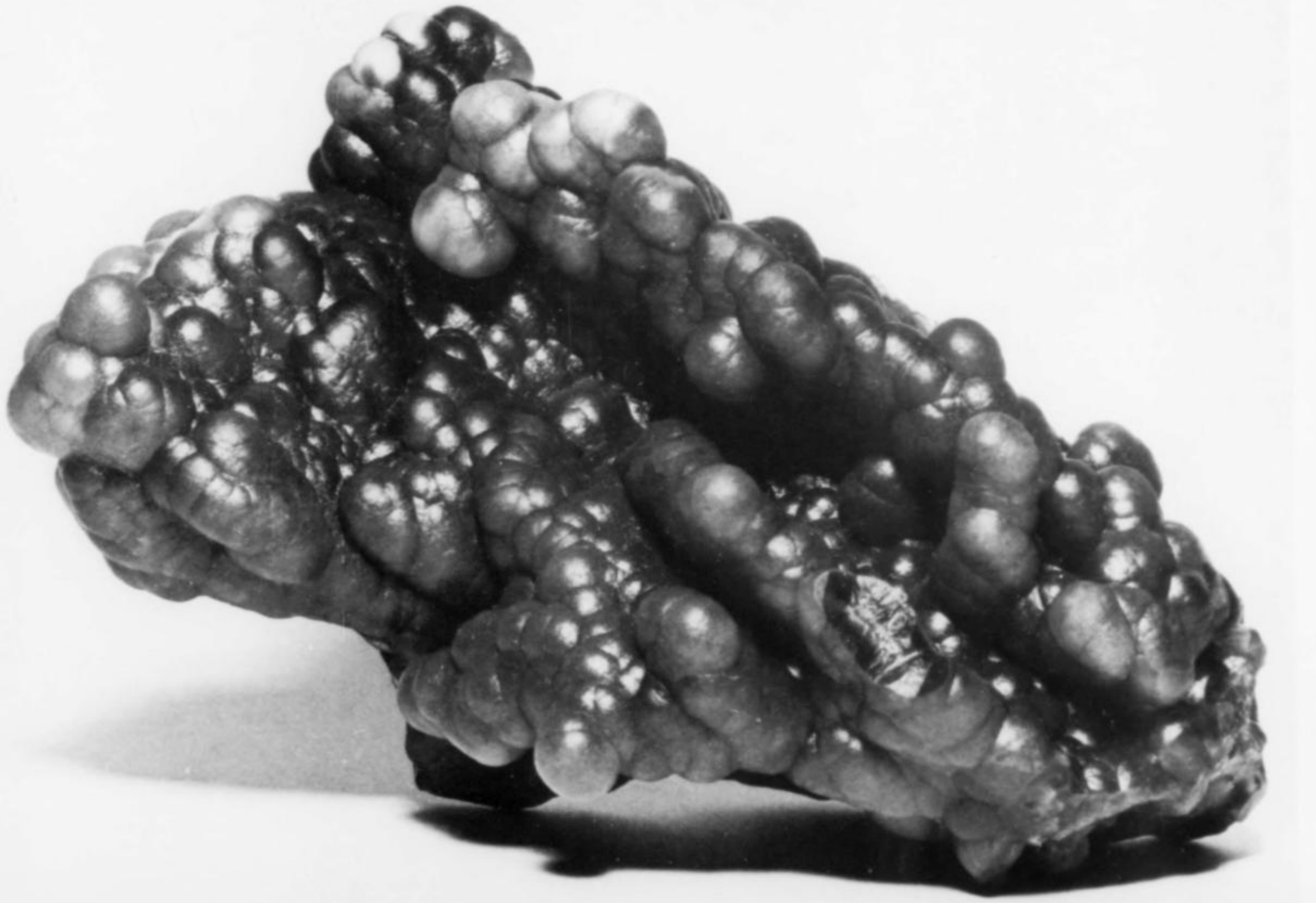
Elsewhere in this issue readers will find the first formal description of lotharmeyerite, a new mineral from the Ojuela mine, Mapimi, Durango, Mexico. It occurs as minute carminite-like crystals on limonite matrix near crystals of the now-famous purple adamite discovered last year. Your editor, having read the lotharmeyerite paper which was still unpublished at showtime, found the mineral in relative abundance (at *Cureton Mineral Co., William Panczner, Wright's Rock Shop,* and elsewhere) at the Detroit shows. This is particularly fine material for micromounters, and can be found on specimens priced low for poor-quality purple adamite which is now widely available.

EPIDOTE FROM SALINE VALLEY

(The following note is from John Seibel, Seibel Minerals, P.O. Box 95, Tehachapi, CA 93561.)

"The summer collecting season produced a surprising new find of superb epidote from Saline Valley, Inyo County, California. Excellent matrix specimens were recovered from a skarn zone, with crystals up to 5½ inches long. Several years of collecting and exploration in this area, primarily for andradite, had previously yielded only mediocre epidote specimens.

Figure 7. **Purple botryoidal fluorite from Canon City, Colorado (oiled), measuring 2 x 3 inches. Barbara Muntyan collection; photo by John Muntyan.**



"The new pocket contained lustrous, sharp, well-formed crystals of olive-green epidote enclosed in calcite. Soaking in dilute hydrochloric acid removed the calcite. Associated minerals include quartz crystals of typical habit (some twinned on the Japan law and measuring up to 1⅛ inches), uralite crystals to nearly an inch, pyrite, clinozoisite, andradite and pink plagioclase.

"This discovery compares well with epidote from Prince of Wales Island, Alaska, and last year's discovery near Hawthorne, Nevada. The skarn area is extensive, and additional prospecting may yield more material."

ADAMITE FROM GOLD HILL, UTAH

(The following note is also from John Seibel.)

"An interesting new discovery of adamite has been made at an old locality, Gold Hill, Tooele County, Utah. I spent several days there with Jim Walker (Long Beach, CA), Bill Hawes and Paula Ott (both of Phoenix) in 1982. We uncovered a zone of adamite and associated minerals in gossan of the Western U.S. mine at Gold Hill. The color of the adamite ranges from lemon-yellow to lime-green to sky-blue; specimens are typically bicolored. Habit is generally spherulitic or rounded growths, though a few specimens are in the form of 'wheat sheaves.' Luster and color are good; spherule sizes range up to 1 inch, but most are under ⅖ inch.

"Associated minerals include excellent, bright green conichalcite on breccia fragments, esthetic sprays of aragonite, small austinite crystals and a large pocket of Japan-law quartz twins.

"The mineralized zone is extremely dangerous due to falling rock, and further collecting there is inadvisable."

BOTRYOIDAL PURPLE FLUORITE FROM COLORADO

(The following is from Don Knowles, Golden Minerals.)

"I first introduced botryoidal fluorite from Canon City, Colorado, at the 1981 Tucson Show, but at that time I had only a couple of flats of second-grade material. In early June of 1982 I spent six days at the locality, and uncovered one pocket that yielded 200 flats of specimens, some of which are undoubtedly the finest known examples of this type of fluorite. Colors range from white to lavender to deep concord-grape-purple, and sizes range from thumbnails to cabinet specimens measuring well over 20 inches.

"The pocket was about 4 x 13 feet in size, and was mostly collapsed. However, at one end of the pocket it opened up intact and exhibited botryoidal purple fluorite hanging down in stalactitic forms.

"Other dealers handling this material include *B&W Minerals, Abel Minerals* and *Jewel Tunnel Imports.*"

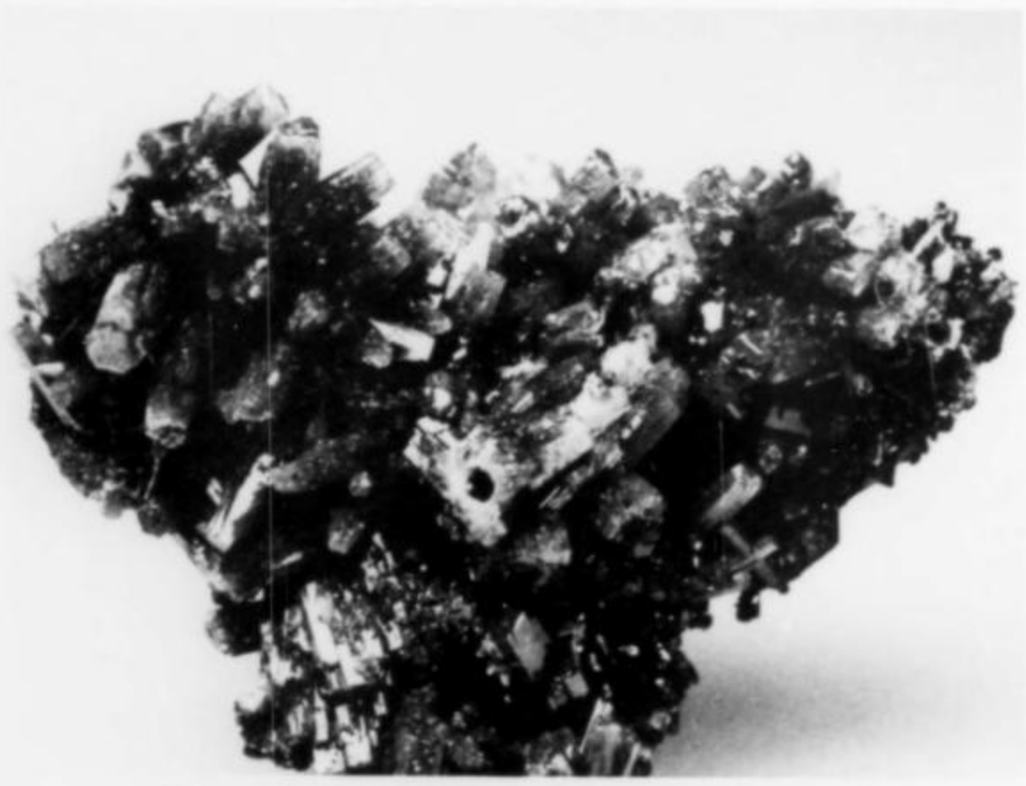


Figure 8. **Brownish gray pyromorphite crystals to ½ inch; from the Bunker Hill mine, Idaho. D. Radakovich specimen.**

Figure 9. **Part of the 11½-ton collection of Walt Lidstrom, shown here filling a moving van from floor to ceiling.**

MORE ON BUNKER HILL

Danny Radakovich (*Lazarus,* 531 Bryden Ave., Lewiston, Idaho 83501) reports that a pocket of gray to slightly brownish gray pyromorphite was recently collected from the 140-18-22 stope, 14 level, Brown orebody of the Bunker Hill mine, Shoshone County, Idaho (see the *Record,* v. 13, n. 5, p. 273 for more on the area). About 5 flats of specimens were recovered by the miners, with crystals ranging up to about ¾ inch. The crystals are very sharp and lustrous, and show typical pyromorphite habit.

WALT LIDSTROM AND ELIZABETH LIDSTROM COLLECTIONS FOR SALE

(The following was received from Margaret Lidstrom, Carmel, California, in response to my inquiry about the collections.)

"I appreciate your interest in the inventory we have here. We used Bekins to move it last month (see photo showing van loaded to the ceiling), a total of 2411 boxes weighing in at 11½ tons. The amount of material is really unbelievable . . . if it weren't so exciting I suppose I'd be overwhelmed. Dad hand-picked a great deal of the material over the last 25 to 30 years, so it is all nice quality, good sellable material. We have the old Mexican things that haven't been out for years, as well as U.S. and European specimens from those extensive collections he used to buy. Also many of the very rare species. Last week I went to Prineville to pick up Mother's private collection, consisting predominantly of silvers, and we found 250 additional flats of specimens.

"So you can see that we have a tremendous stock of material which should become a major source of supply. We want to deal on a wholesale basis only, by appointment, so that each visitor may browse and buy privately, at his leisure. Everything will be priced to encourage a fast turnover, and we will not be selling at any shows (not even Tucson) so as to avoid competing with our dealer customers."

Notes from Mexico

by **Bill Panczner**

My interest in Mexican minerals began late one summer afternoon in 1946, while visiting the American Museum of Natural History in New York. To this day I still remember those magnificent specimens . . . blocky, orange wulfenite from Los Lamentos, large calcite crystals from Guanajuato, and many more. In the ensuing years, those beautiful Mexican minerals from so many unpronounceable locations have held my fascination, and I've made many interesting trips to search them out. These days, Mexico continues to produce a large volume of specimen material, enough to justify a semi-regular column, according to our editor, so here we are!

To most collectors the mines of Mexico are best known for their fine mineral specimens and also for the haze of legends and rumors surrounding them. The country, it seems, is a bottomless well of specimens, though the output is not as consistent or as voluminous as it once was. Nevertheless, fine pieces from localities old and new are still being added to collectors' shelves. Future installments of *Notes from Mexico* will focus not only on current specimen production, but also on the various collections, locations, histories and people of interest to the collector.

Over the last few months the Santa Eulalia district in Chihuahua has yielded several interesting discoveries. Pockets of creedite were uncovered in the El Potosi mine; most crystals range in length from ⅛ to ½ inch, but several giant crystals may have set a record at around 3 inches. The creedite ranges in color from white or colorless to faintly lavender. Another discovery was made in the San Antonio mine: a small pocket of bright green ludlamite. Much of the pocket was lined with small drusy crystals ideal for micromounting, but several dozen specimens with crystals reaching over 3 inches also were collected. (More on the story behind this in a subsequent column.) And that's not all that has recently come from there; several small pockets of rhodochrosite were collected from the 11th level. These bright pink to rose-red crystals generally measure ¼ to ½ inch, but a few reach just over a full inch in size. Also from the San Antonio mine, groups of bright, platy, irridescent marcasite have been found on white dogtooth calcite . . . the crystal habit is somewhat reminiscent of European specimens.

Mapimi, perhaps the most famous mineralized area in Mexico, is at it again. The remarkable find of purple adamite in the Ojuela mine (reported in the May-June 1982 issue) has continued sporadically. Specimens reaching the market recently are smaller in crystal size (½ to 1 inch) than the earlier found specimens, and some are closer to magenta-red than purple. Some associated minerals have now been identified, including coatings of arseniosiderite (X-ray identified), and red encrustations of a new species, lotharmeyerite, described elsewhere in this issue by Pete Dunn. Latest reports suggest that the purple adamite zone has now been backfilled and is inaccessible (though such reports should always be taken with a grain of halite, especially from Mexico). Collectors may recall that mineral dealers in the early 1960's used to receive a little purple adamite in their Mapimi shipments from time to time, though the crystal size was smaller, their numbers few, and the color a lighter purple with a yellowish tint. The color of recently mined adamite varies more than any previous discoveries, from colorless and white to shades of yellow, green, purple and magenta, and commonly as bicolored crystals as well.

Another Ojuela mine species from the 1960's that has not been seen again until recently is fluorite. The new ¼ to 1-inch crystals are bright, bluish purple cubes sometimes associated with olive-green wulfenite and green malachite on barite crystals. During the last year the Ojuela mine has also yielded scorodite crystals, light blue in color and up to ¼ inch in size, in small vugs in a compact goethite.

At least three of Mexico's most famous amethyst localities have been producing. The mines near Las Vigas in the state of Veracruz have recently yielded several large strikes, including dark to pale purple crystals to nearly 4 inches in esthetic groups. Several large plates of crystals were recovered along with hundreds of smaller groups and clusters. The silver mines of Guanajuato are famous for fine acanthite crystals, and also for beautiful amethyst druses and plates which are available again. Some recent specimens have attractive calcite crystals in association. A few specimens of wire silver have also turned up from Guanajuato mines lately, as have some interesting pseudomorphs of calcite after thin, flat, platy crystals, perhaps anhydrite, which have since been dissolved away. The third amethyst locality, Guerrero, has been dormant for several years but a recent find ended the dry spell. The new crystals, 1 to 3 inches in length and of a good, medium purple color, occur in esthetic clusters on matrix, some crystals carrying phantoms and moveable bubbles.

Speaking of Guerrero, very few outsiders have ever visited the amethyst fields there. My son Chris and I had the opportunity to make the trip a few years ago, and we found out why. The region is a major center for the cultivation of the opium poppy and marijuana; amethyst mining is more or less a sideline. Physical access is particularly difficult, as the area is very primitive and is not serviced by roads or rails . . . nearly a day on horseback is required to make the final leg of the trip. The Mexican Army seems to be everywhere in an effort to control the drug problem, and all foreigners are immediately suspected of being drug-runners. We waltzed into the situation totally unaware, but a full strip-search at 6 a.m., with machine guns pointed at us (with the safeties off) brought things into perspective *real* quick.

We finally got to the mine area and found that the amethyst veins run everywhere across the surface and are exploited by trenching. The miners themselves are local Indians, relatively friendly and all remarkably short in stature. They dig the trenches 8 to 12 feet deep, primarily in search of gem-grade amethyst, although they do keep

specimen material as well. They are still somewhat suspicious toward outsiders, however, and I remember that it took the late Curt Van Scriver almost a year of visits before they decided he was okay, and they'd sell specimens to him. (They still wouldn't take him to the mines.)

In the little villages nearby (I'm not sure if they even had names), there appeared to have been no substantive change since the late 1800's. An occasional village might have one radio-telephone but most messages were sent by runners. Probably no locals had ever seen a car, as all transport was on foot or by horseback. They did have limited electricity, but it was turned off at 9 p.m. every night. While we were walking through the village, I saw an enormous pig snoozing at the roadside. My experience with pigs is that they're generally pretty mellow, so I gave the monstrous creature a friendly pat on the flank. The darn thing chased me into the nearest house! Even the pigs in Guerrero are unfriendly.

When we returned to Mexico City, I told J. Patrick Lucey (the American Ambassador) about our visit, and he was horrified. He said that personal danger is so high in that area that he would have done all he could to restrain us, had he known we were going to that area of Guerrero.

Economic problems in Mexico lately have made it almost impossible to get minerals out of the country, especially the precious metals, but we are all hoping that the Mexican government will soon relax its export restrictions. The traditional Mexican pattern of overreaction followed by overrelaxation will probably carry through once again.

William D. Panczner
640 N. La Cholla Blvd.
Tucson, Arizona 85745

(Ed. note: Readers with patience can begin anticipating Bill's forthcoming book, a field guide for mineral collectors in Mexico, to be published by Van Nostrand Reinhold in mid-1984.)

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The Record Bookshelf

***Emerald and Other Beryls*, by John Sinkankas. Published (1981) by Chilton Book Company, (no street address required), Radnor, Pennsylvania 19089. Hardcover, 7 x 9 inches, 665 pages, $37.50 plus $1.75 postage and handling.**

This handsome volume is probably the most complete compendium that has been written about any single mineral except, perhaps, diamond. Sections include History and Lore (153 pages); Chemical and Physical Properties (203 pages); and Beryl Localities (253 pages) plus Appendix, Index, etc.

Under History and Lore, the knowledge of emerald and beryl in antiquity is discussed based on the earliest known writings and archaeological evidence. Because of the rudimentary knowledge of mineralogy prior to approximately the year 1600, descriptive terms for beryl and other greenish minerals are inexact, confusing and sometimes contradictory, and it is seldom possible to be certain that the term emerald really refers to a green beryl and not chrysoprase, tourmaline, or some other green mineral. The progress in recognition and description of the several green minerals which have been used as gems is treated in some detail.

Another most interesting aspect of emerald and beryl gems concerns the magical properties which have been ascribed to them, as well as supposed medicinal benefits. Considering that the forms of beryl rank among the most insoluble substances, it is certain that any benefits derived therefrom when taken internally were purely psychosomatic.

This section concludes with a review of the uses of emerald and beryl gems in adornment, and a description of most of the outstanding examples which are or were known in the regalia of kings and queens, in religious objects, in museums, and in the collections of wealthy individuals.

Under Chemical and Physical Properties are described crystal structure and chemical composition; physical properties; optical properties; color and luminescence; crystallography; inclusions; artificial and synthetic beryls; cutting and polishing beryl; and the geology of beryl deposits.

The section on crystallography is particularly detailed and complete, and includes many line drawings of crystal habits, as well as consideration and illustration of etch figures and growth figures. The diagnosis of beryl gems is also thoroughly treated, in the sections on physical and optical properties and especially the chapter on inclusions, the microscopic study of which not only serves to aid in identifying the gem, but in many instances serves to pinpoint its exact locality of origin.

In the chapter on synthetics, all of the principal methods are discussed and described, including the Chatham, Gilson, Lechatelier, and others. Perhaps due to space limitations, the details of the fluxes used and other critical parameters are treated rather sparingly, so one is left with some feeling of mystery about the subject. In actuality, although the inventors of the processes in current use are secretive about details, enough has been established by the researches of Kurt Nassau and other investigators so the processes are relatively well understood.

The section devoted to beryl localities occupies 40 percent of the book, and alternates between rather dry recitation of occurrences with no further data, and fascinating and lengthy accounts of such classic localities as Muso/Chivor, in Colombia; Mursinsk, Urals, Soviet Union; Minas Gerais, Brazil; Egypt; and many others. Information is given about occurrences in 70 countries, which gives one some idea about the widespread distribution of this mineral.

It is unfortunate that some of the production statistics quoted are not more up-to-date than 1967, for the last 15 years have seen some major changes in the rank of beryl-producing countries. Notable is the emergence of China as the world's principal current source of beryl, displacing Brazil in this respect. On pages 344–345 of the book are presented a geologic plan and cross-section of a remarkable pegmatite in the Mongolian Altai. This body is now known to be at Kokoto Hai, Xinjiang, China, and has in recent years become the world's largest producer both in terms of total output and in current production.

Each chapter is followed by an extensive bibliography.

Because Sinkankas is an expert on gemstones and their cutting and polishing, this is where the emphasis of the book lies, rather than on the industrial applications, which are not covered.

This book, obviously a labor of love on the part of the author, was 15 years in preparation. Large as it is, it represents condensation of a far greater mass of material that he had accumulated.

The book is profusely illustrated with photographs, maps, crystal drawings, charts and diagrams plus 24 color plates, of which the first eight are watercolor paintings of gem beryl crystals very creditably done by the author.

One of the best features of *Emerald and Other Beryls* is the author's easy, literate style of writing, which makes for a book which is a pleasure to read. It certainly represents a "must" for the library of every gemologist and fancier of precious stones, as well as a valuable and interesting adjunct for mineralogists and serious mineral collectors.

R. V. Gaines

***A Systematic Classification of Nonsilicate Minerals* by James A. Ferraiolo. Bulletin of the American Museum of Natural History, Volume 172: article 1 (1982), 237 pages, 7¼ x 10 inches, softcover, $11.05 postpaid. Available from the Department of Library Services, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024.**

This publication presents an updated version of the systematic classification of nonsilicate minerals last published in the 7th edition (1944 and 1951) of Dana's *System of Mineralogy* by Palache, Berman and Frondel. There can be no doubt that an update has long been needed. Over 30 years of progress in mineralogy have yielded more

than 1,200 new nonsilicate minerals and considerable new data on previously known minerals.

The book consists of two sections. The first section is the systematic classification proper. The same 50 classes employed in the last Dana's *System* are utilized. These are divided into types based upon anion/cation ratios as before; however, many new types have been added. Each mineral entry includes its revised Dana number, name, composition, crystal system and space group. Additional columns indicate whether the species is new or has a new composition since the 7th edition and whether its species status is doubtful.

The second section is the bibliography and index. Species are listed alphabetically and cross-referenced to the first section by page number and revised Dana number. References are given to the 7th edition where applicable and to as many as six more recent papers.

Anyone who has occasion to employ Dana's classification scheme will find this well researched and effectively organized update indispensable. While it lacks the vast accumulation of mineralogical data provided by the 7th edition of *The System,* its extensive and up-to-date bibliography provides the references for seeking much of this data. Some may, in fact, find the bibliography to be the most valuable portion of the publication.

I heartily recommend this book, but at the same time I would be remiss if I failed to point out the scientific obsolescence of Dana's classification scheme. The classification, being basically chemical in nature, fails to draw attention to, and indeed often obscures, the structural relationships between minerals which are so important in modern mineralogy. The author, recognizing this fact, has employed more structurally related classifications for the sulfosalt class and two of the four borate classes. His inclusion of the space group for each species also serves to point out structural relationships, albeit indirectly.

The scientific community might have been better served by the development of a new, more structurally based classification scheme, though admittedly this would have been a much more complex undertaking. Perhaps the beauty of the Dana-style classification remains its simplicity. It certainly has tradition on its side and thanks to this excellent update, and a similar one promised for the silicates, it will probably continue to be used for years to come.

Anthony R. Kampf

Principles of Geochemistry **by Brian Mason and Carleton B. Moore. Published (1982) by John Wiley & Sons, 605 Third Avenue, New York, New York 10158. Hardcover, 7½ x 9 inches, 344 pages, $29.95. Fourth edition.**

A basic college (undergraduate) text covering the fundamental concepts of modern geochemistry. Plenty of references for further reading. Advanced mineral collectors with a rudimentary knowledge of chemistry should be able to understand and benefit from this book.

Miners Lamps: volume 2, Carbide Lamps **by Karsten Porezag. (In German, actual title: *Des Bergmanns Geleucht: Offenes Geleucht: Karbidlampen.*) Published by Verlag Glückauf GmbH, Postfach 10 39 45, D-4300 Essen, West Germany. Hardcover, 204 pages with 222 figures, 19 x 24 cm, 58 DM (Deutsch Marks); include extra for airmail postage.**

The first comprehensive reference on miners' carbide lamps, though it deals almost exclusively with large-size German lamps. The large number of figures makes this book of value as a reference even to collectors without a knowledge of German.

Opal, South Australia's Gemstone **by L. C. Barnes and I. J. Townsend (1982). Softcover, 6 x 8 inches, 157 pages, $A 7.50 plus $A 1.50 surface mail or $A 5.50 airmail. Published by the South Australian Department of Mines and Energy, Box 151, Eastwood, South Australia 5063.**

South Australia supplies approximately 80 percent of the world's precious opal. This book, written by two long-time geologists in the opal fields, covers history, geology, mining methods and potential of the four major opal fields: Coober Pedy, Andamooka, Stuart Creek and Mintabie. Some lesser known fields are also described. Over 100 color illustrations included, plus a four-page bibliography.

The Field Description of Sedimentary Rocks **by Maurice E. Tucker (1982). Softcover, 4½ x 7 inches, 112 pages, $12.95. Published by John Wiley & Sons Inc., 605 Third Avenue, New York, New York 10158.**

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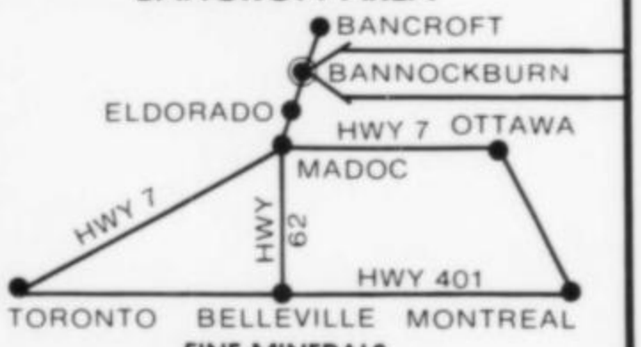

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Letters

IS IT BETTER TO BE A HOG THAN A HOUND?

Dear sir,

Now that we have had mineral postage stamps and other symbols of public awareness, might it be time to have our special day in the year when those who covet the earth, or parts thereof, might celebrate their specialty? A day for open rejoicing of our motivations and urgings might be quite appropriate.

Rather than adopt a new date and have it subject to some degree of argument, we could adopt a day already appropriately named. I suggest that February 2, *Groundhog Day,* is convenient and quite appropriately named as well. It aptly confirms the motivations of many, the habits of some, and the general disposition of some others. Almost all curators and collectors have some traits in common with the critter and having *Groundhog Day* as our national holiday will likely emphasize this. Onward!

Pete J. Dunn
Smithsonian Institution
Washington, D.C.

BISBEE ISSUE

Dear sir,

Please renew my subscription to the *Mineralogical Record.* I know you only increase the price when you have to, and I don't mind. The information contained in the *Record* is a must for the serious mineral collector.

For example, right after I purchased a ¾-inch crystal of cuprite on spongy copper (labeled Bisbee, Arizona) I received your Bisbee issue in the mail. After reading through it I now know that the cuprite probably came from the Irish Mag shaft. A 1 5/16-inch azurite rosette, probably from the Czar shaft, is my second Bisbee acquisition, and my Bisbee subcollection is now well on its way with the help of the *Record.* Your magazine certainly makes life easier and more enjoyable for the collector. My compliments to Richard Graeme, author of the Bisbee monograph, on an excellent job.

John Almquist
Wisconsin Rapids, Wisconsin

MORE ON FAKES AND FRAUD

Dear sir,

The Show Committee of the Tucson Gem and Mineral Society, Inc., wholeheartedly condemns the practice of misrepresenting mineral specimens in any way. Any dealer who flagrantly resorts to such practices will not be invited to participate in future Tucson Shows. Unfortunately, it is a practical impossibility to inspect the stock of each dealer, so it is possible that some faked specimens might still be offered. We will welcome information about any suspect specimens for sale at our show, so that we may investigate and take proper action.

There is one area, however, where we have complete control, and that is the use of deceptive lighting. The following clause is part of the retail dealer's contract for the 1983 Tucson Show:

"The lighting shall be such that the material offered for sale is presented in the way it will appear to the buyer in normal artificial white light. Only standard tungsten lamps, clear, inside-frosted or white coated, and standard cool-white or warm-white fluorescent lamps will be permitted. Fixtures housing the lamps must not have filters or reflectors that alter the characteristics of the emitted light. No daylight incandescent, or daylight pink, red, blue, green or other colored fluorescents will be permitted. The only exception is the use of filtered ultraviolet light to demonstrate the phenomenon of fluorescence in a suitably darkened area."

It is our hope that the show committees for other shows will take similar steps to help maintain the integrity of material offered for sale.

G. Robert Massey
Tucson Gem and Mineral Society

Dear sir,

In the letter from Cal Graeber concerning mineral fakes, he says: "heat and radiation . . . are natural phenomena . . . it seems immaterial how they are generated." The entire formation of mineral species depends on natural phenomena—is it thus immaterial how *they* are generated? I feel the authors' response to Mr. Graeber was a little submissive. They are making fakery respectable by saying it is okay as long as it is noted on the label. Such approval would surely only serve to make all fakery seem less fraudulent. And, remember, *labels get lost!*

Thanks for a great magazine!

M.P. Cooper
Nottingham, England

Dear sir,

Regarding the cover of your January-February 1982 issue depicting an aquamarine on matrix from Virgem da Lapa, I feel compelled to point something out. Years ago I bought a large lot of single aquamarine crystals along with a couple of matrix specimens while visiting Teofilo Otoni in Minas Gerais, Brazil. The bulk of this lot was sold to a German dealer who took it back to Germany. Several years later a well known collector showed me some marvelous matrix aquamarines which he had cleverly extracted from an elderly gentleman in Munich. At the following Tucson Show in 1979, a good friend of mine from Germany told me that the elderly gentleman had received a fake gold in exchange for his "matrix" aquamarines and asked if I would intercede in order to work out an equitable settlement of the problem.

Now to the point: I carefully examined the three "matrix" aquamarines and found them to be absolute, undeniable fakes (*falsificados*). I even recognized some of the aquamarine crystals which I had seen as singles earlier. My German friend then conceded that the elderly collector had a proclivity for constructing matrix specimens, and that his collection contained a large percentage of such specimens, some artfully done.

I have seen and personally examined the matrix specimen shown on the *Record* cover, and recognized it as one of the more crudely done pieces. (After I had exposed the specimens as fakes, I was assured that these specimens would not be passed on, but would instead be returned to the gentleman in Munich.) In fact, while examining it I noticed that he had decided to have the crystal "growing" out of the *underside* of the specimen. This would have meant that the euhedral beryl crystal had grown *inside* a solid orthoclase crystal. I pointed this out to people present and we all had a good laugh; the concensus was that the gentleman should implant his loose crystals on the correct side of the matrix. By the way, the man in Munich did not deny that he had made the specimens; but he insisted they had an intrinsic value nonetheless, and the gold he received in exchange did not.

Richard A. Kosnar
Golden, Colorado

That photo was chosen for the cover because it represented not one but two articles in that issue: Virgem da Lapa, and the Sorbonne collection. We had no idea it might also represent the previously published fakes article. But read on: *Ed.*

Dear sir,

Concerning the beryl used for the cover, the crystal is absolutely not glued. But the specimen belongs to Keith Proctor and is not

from the Sorbonne collection (confusion in our photo records). We saw this crystal some years ago, and it is a perfect specimen, but we later saw many specimens from the same locality which consisted of aquamarine crystals glued on quartz or feldspar.

Pierre Bariand
Curator, the Sorbonne, Paris

BUNKER HILL PYROMORPHITE

Dear sir,

As a footnote to our article on pyromorphite from the Coeur d'Alene district, Idaho (Crowley and Radford, vol. 13, no. 5, p. 273), and also as confirmation of Pete Dunn's note in the same issue (p. 286), I can report that, of eight samples of Bunker Hill mine pyromorphite tested by the Bunker Hill laboratory and U.S.G.S. facilities, the maximum arsenic content found was 7 percent. Dunn reported a maximum of 6 percent in his samples, and in neither case is the maximum sufficiently high for the material to be called mimetite. However, some white to yellow samples of the *polysphaerite* variety (calcium-rich pyromorphite) were identified. Testing involved wet chemical analysis, X-ray diffraction, and spectrographic analyses.

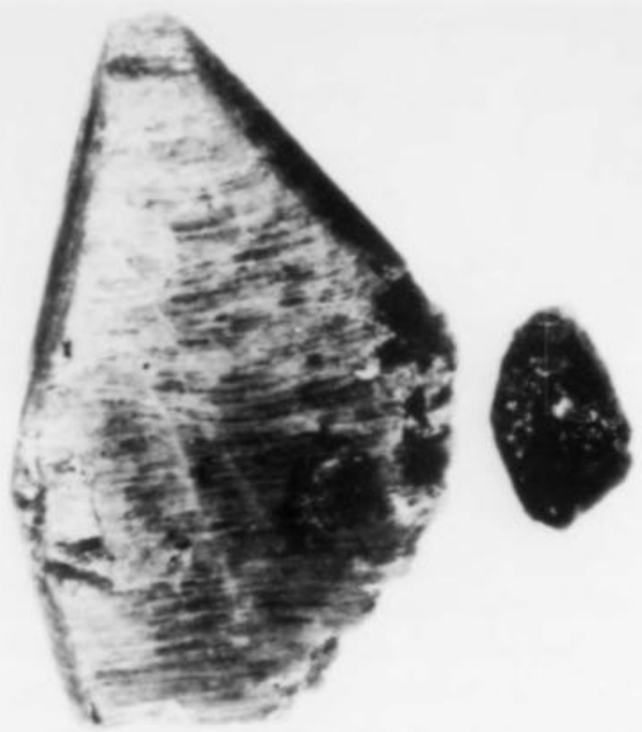
Norman A. Radford
Senior Mine Geologist
Bunker Hill Company, Kellogg, ID

NORBERGITE CRYSTALS

Dear sir,

In a recent issue of the *Record* (vol. 12, p. 377–378) grothine was discredited as a species by demonstrating that the type specimen in the U.S. National Museum collection (no. R4347) is actually norbergite. This is a distinct service to mineralogy and to the writer. Harvard's specimen of Grothine (no. 89581), purchased from the Italian mineral dealer Roberto Palumbo in 1927, is now correctly labeled and placed with the other norbergites.

In that article the author remarked that, "the occurrence [i.e. Nocera] is significant for norbergite, a mineral never having otherwise been found in measurable crystals." In fact, however, euhedral norbergite crystals have also been found at the Nicoll quarry in Franklin, New Jersey. The crystals shown in the accompanying photograph (no. 89341) are those used by Larsen, Bauer and Berman (*American Mineralogist,* **13**, 349–353) to determine the chemistry, morphology and optical properties of Franklin norbergite. At least three other norbergite crystals also exist. One, a fine matrix specimen (mislabeled humite), is on exhibit at the American Museum of Natural History in New York; a small but choice specimen from the Elna Hauck collection is on exhibit in the Franklin Mineral Museum; and a third is in the collection of Fred Parker of Livingston, New Jersey. By drawing attention to this trivial error it is hoped that other norbergite crystals will be recognized.



Another minor error was made in attributing the determination of the norbergite structure to the work of Gibbs and Ribbe (1969) on a Roebling specimen. Actually the structure was determined in 1929 by Taylor and West (*Zeitschrift fur Kristallographie,* **70**, 461–474) using a Harvard specimen; the later work by Gibbs and Ribbe was a *refinement* of the structure through the use of modern equipment and computational techniques.

Carl A. Francis
Curator, Harvard Mineralogical Museum
Cambridge, Massachusetts

ERRATA

In the article on minrecordite (vol. 13, no. 3, p. 131), the authors would like to append the following reference:

TSUSUE, A. (1967) Magnesian kutnahorite from Ryujima Mine, Japan. *American Mineralogist,* **52**, 1751–1761.

In addition, the formula for minrecordite was given incorrectly in one place due to a dropped subscript in typing of the second draft: page 133, second column, should read: ". . . or, ideally, $CaZn(CO_3)_2$." The formula is given correctly elsewhere in the paper.

Regarding the paper on bytownite by Steacy and Rose (vol. 13, no. 2), the bracketed dates in the caption for Figure 2 should read "1797–1860." Also, the last two lines in the paragraph at the top of the second column on page 103 should read: "interstices. Normally, there is limited replacement by other ions, including K^+, Ba^{+2} and Be^{+2}." These errors inadvertently crept into the manuscript, for which the authors apologize.

Regarding the article on ferroaxinite from New Melones Lake, California (vol. 13, no. 5, p. 297), footnote b to the table is an obvious misprint, and should read "B_2O_3." Also, on Figure 18, chamosite and axinite should be amended to read chlorite and ferroaxinite.

EXCHANGES

Dear sir,

Having collected throughout much of Southern Arizona, I would now like to diversify my collection by trading with other collectors for their local minerals. Besides the colorful base metal oxidation products for which Arizona is so well known, I also collect and trade rare and unusual species. I would appreciate hearing from anyone interested in exchanging.

Bruce Maier
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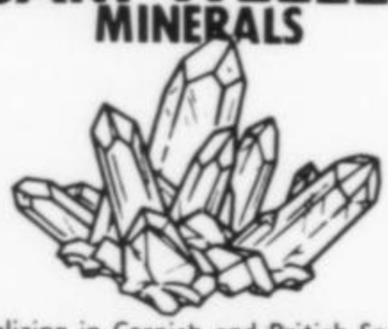

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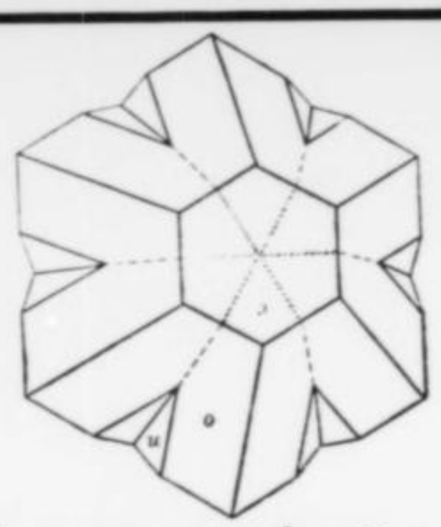

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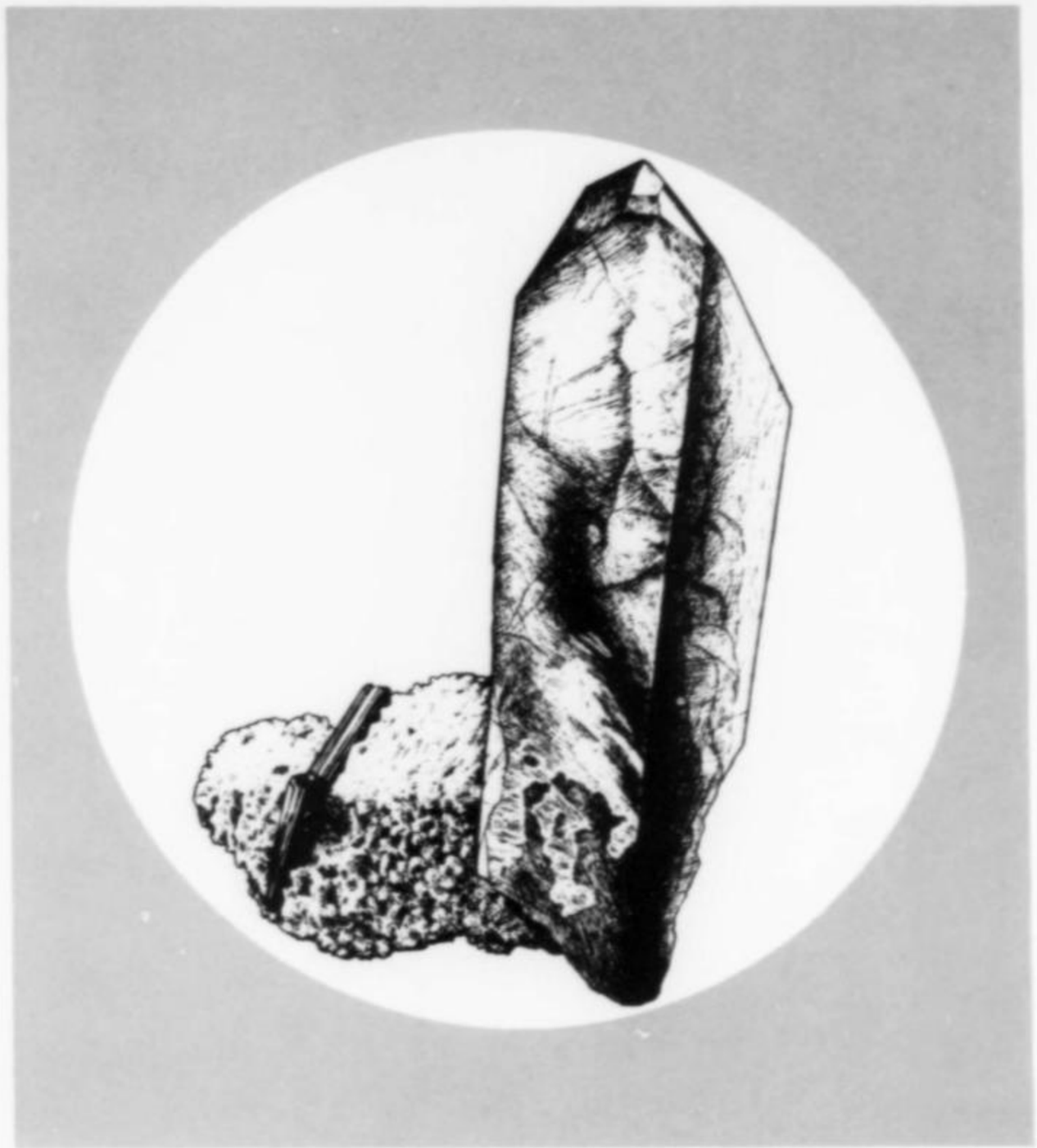
Binders for Min. Record 46
Broken Hill Club 5
Canadian Mineralogist 46
Carion, A. (1-326-01-16) 52
Carousel Gems and Minerals (505-864-2145) 52
Casa de Piedras (915-593-3777) 31
Chaver, J. 30
Christianson, W. D. (705-726-8713) 37
Collector's Choice (713-862-5858) 52
Colorado Gem & Mineral Co. (602-966-6626) 36
Crystal Cavern Minerals (915-593-1800) 42
Cureton Mineral Company 46
D.B. Languages (415-433-8600) 64
Diversified Minerals (801-268-3832) 58
Dupont, J. 30
Earth Resources (414-739-1313) ..... inside back cover
Eckert Minerals (303-861-2461) 30
Excalibur Minerals 30
Fioravanti, G.C. (06-6786067) 37
Glossary of Mineral Species (602-297-6709) 4
Golden Minerals (303-233-4188) 38
Goudey, H. 38
Grayson Lapidary (312-449-1399) 42
Gregory, Bottley and Lloyd (01-381-5522) 41
Hawthorneden (613-473-4325) 60
Howard Minerals 58
Jewel Tunnel Imports (213-357-6338) 42
Jim's Gems (201-638-0277) 52
Kristalle (714-494-7695) ..... inside front cover
Lesnicks-West (602-749-4234) 52
Lidstrom Collections (408-624-1472) 41
Machlis, M. 58
McGregor & Watkins (501-767-4461) 30
McGuinness, A. L. (415-345-2068) 42
Metersky's Minerals 34
Miller, G. & M. (406-549-7074) 52
Mineral Classics (303-642-7556) 386
Mineral Kingdom (713-868-4121) 32
Mineral Mailbox (206-833-6067) 38
Mineralogical Research (408-263-5422) 64, 41
Mineralogical Studies 60
Minerals Unlimited 42
Mono International 64
Monteregian Minerals 64
Mountain Gems and Minerals (503-297-1928) 38
Nature's Treasures (213-373-3601) 38
Northern California Dealers 14
Obodda, H. (201-467-0212) 41
Oceanside Gem Imports (516-678-3473) 38
Pala International (714-728-9121) ..... outside back cover
Panczner, W. (602-624-3747) 31, 52
Pearce, Don 34
P.M.M. 58
Peri Lithon Books (714-488-6904) 38
Philosopher's Stone 38
Precious Earth (800-558-8558) 52
Proctor, Keith 6
Prospector 40
Resource Enterprises 34
Rich, C. C. 40
Roberts Minerals (209-586-2110) 32
Rochester Symposium 34
Salt Minerals 36
S & M Enterprises 38
Schneider's (714-748-3719) 62
Shannon, D. (602-962-6485) 34
Sierra Nevada Minerals (702-329-8765) 62
Silverhorn (403-762-3918) 36
Simkev Minerals 40
Southern California Dealers 63
Stonecraft (317-831-7713) 41
Tetrahedron 58
Topaz-Mineral Exploration 60
Treasure Tunnel 42
Tripp – Shows of Integrity (Tucson) 45
Ultra-Violet Products 34
Universal Gems & Minerals (915-772-5816) 60
Upper Canada Minerals (613-238-5497) 60
Walstrom Enterprises 52
Weber's Minerals (714-436-4350) 42
Weller, Sam (0736-788217) 62
Western Minerals (602-325-4534) 58
What on Earth (614-436-1458) 58
Wright's Rock Shop (501-767-4800) 37
Yount, Victor (703-347-5599) 38
Zirlin – International Handbook 41



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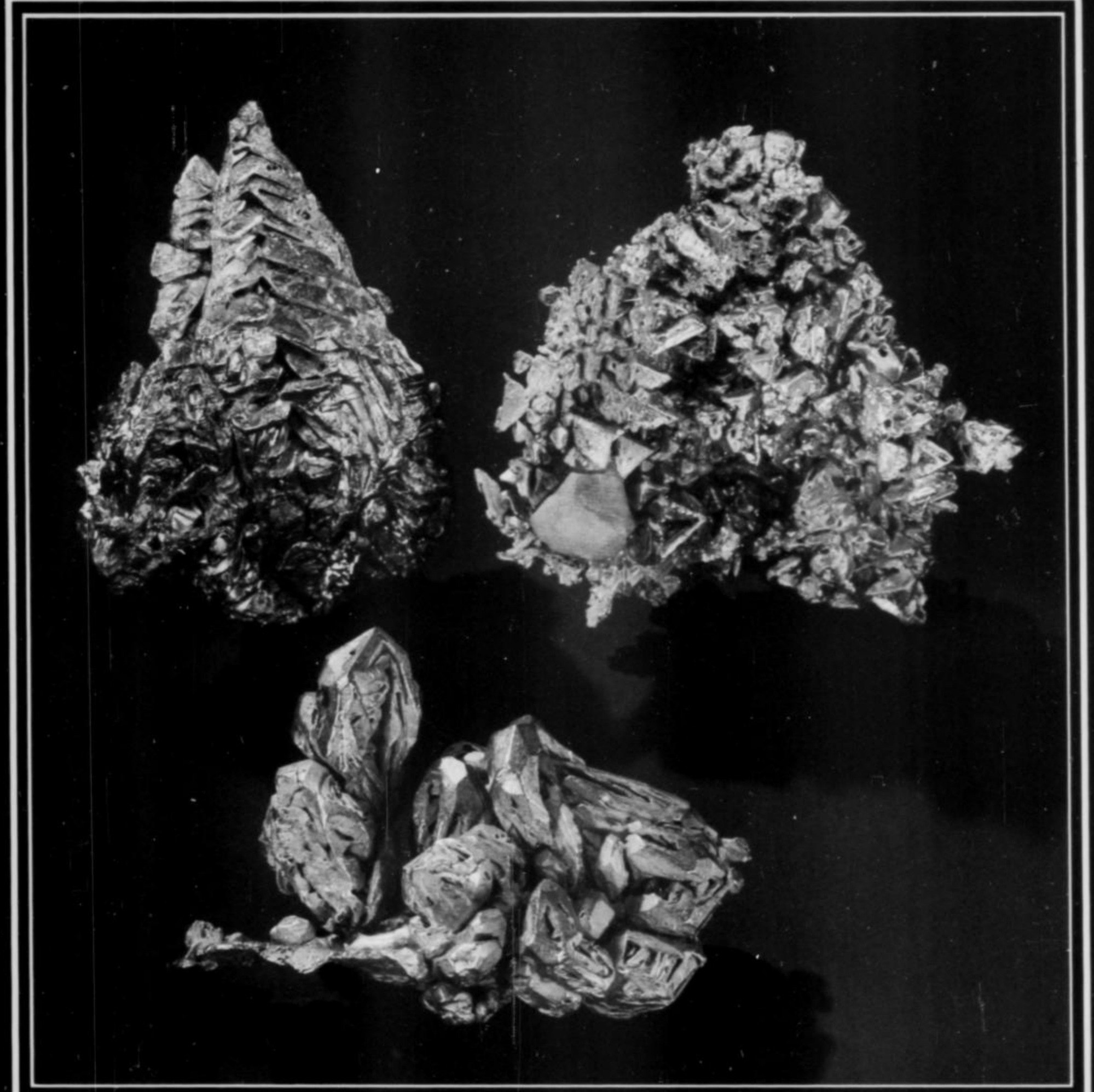

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