# the Mineralogical Record

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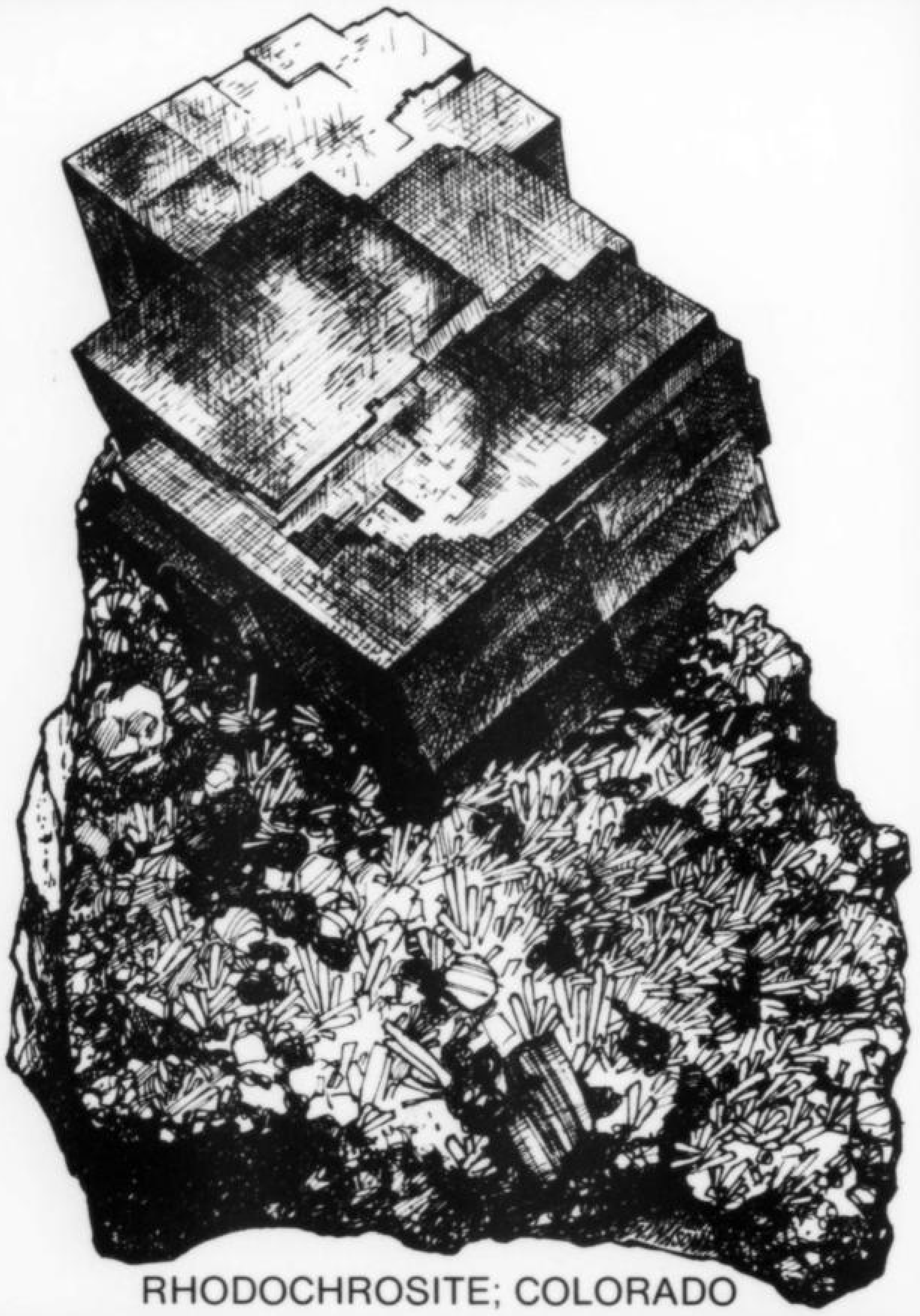

# the Mineralogical Record

Volume Five/Number Six
November-December, 1974

affiliated with the Friends of Mineralogy

**editor & publisher**
John S. White, Jr.
*Division of Mineralogy*
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**design & composition**
*Bowie Graphic Art Services, Inc.*
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**address**
the Mineralogical Record
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**editorial matter**

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## feature articles

## departments

SPODUMENE, Urucupa mine, Itambacuri, Minas Gerais, Brazil. Smithsonian specimen acquired from Martin Ehrmann in 1967. Three photographs of the same crystal showing extreme color variation when viewed in three different directions. The crystal is 31 cm (12.1 inches) long and it weighs 7,465 grams (16.5 pounds).
Photographs by J. S. White, Jr.

# Editorial

# A RECORD FIVE YEARS

On closing out our fifth year of publishing the *Mineralogical Record*, it is a good time to offer some comments about the endeavor. It is my opinion that the *Mineralogical Record* has done just about what it set out to do. The contents of the first five volumes seem to treat rather effectively a broad area between lightly technical mineralogy and amateurism; the science and the hobby; the "serious" mineral collector and the mineral art object collector. In spite of minor criticism that some of the articles are too technical to be understood by all of our readers, I know that we have included no more than a minimum of technical material in the magazine and, in fact, the vast majority of the contents can easily be understood and comprehended by all collectors. An attempt has been made to open a window to the science for the amateur. This included an effort to make the amateur feel he can be very useful to the science by providing specimens and information. Much of this has been accomplished through encouraging amateurs to write articles for publication, and some very fine ones have been produced. While I regret that there haven't been as many of these of publication quality as we would have liked, it is worth noting that far more articles submitted by professional mineralogists have been *refused* than those by amateurs. Almost no articles from amateurs have been rejected. In many cases we have worked hard to help improve articles by amateurs so that they would be a credit to the authors as well as the journal. I am particularly eager to attract more such articles.

Many changes have taken place in the magazine itself and in the production effort in the past five years. We now have sufficient lead-time with articles so that we can send galley proofs to authors for reviewing prior to publication. This is a luxury that we couldn't afford in the first couple of years. Starting out far behind the calendar, we have managed to pick up weeks or months each year so that now we are, for the first time, right on schedule. Just a year ago the November-December issue was not mailed until late in January of the following year. This issue (November-December) is being mailed early in December. Between June 3, 1974, and October 9, 1974, (just four months and six days) we mailed out four issues! With increasing circulation we have been forced to turn to a professional mailing service and have computerized our subscriber list. This gives us great flexibility in billing and in terminating subscriptions that are not renewed in time. The address labels are also computer generated, hence they are now more legible. A code appears on the label showing subscribers precisely when their renewals are due (see volume 4, no. 6, p. 276 for explanation).

I have not avoided controversy. In fact, I have created quite a lot of it. In my judgement this is the first time that any mineral journal has employed this device to bring out opposing views on contemporary matters while, at the same time, providing a forum for these views. I believe that it is healthy to discuss openly the problems that may concern all of us, rather than to pretend they don't exist, or to argue them within little-known committees where the diverse opinions are never made public.

A large debt of gratitude is owed to our faithful readers and to a very fine group of advertisers. I am especially proud of the advertisers who appear regularly on our pages. I call upon you readers to support them by buying minerals from them. They deserve your support and we depend upon it. But buying from the advertisers is only one way to provide support. Another is persuading other mineral collectors to subscribe to the *Record*. Circulation must grow dramatically to assure the magazine's continuance. Advertiser support and contributions are not enough in themselves to keep it going although they have been a big help and are absolutely necessary.

It will not come as a surprise to anyone to learn that many of our production costs have

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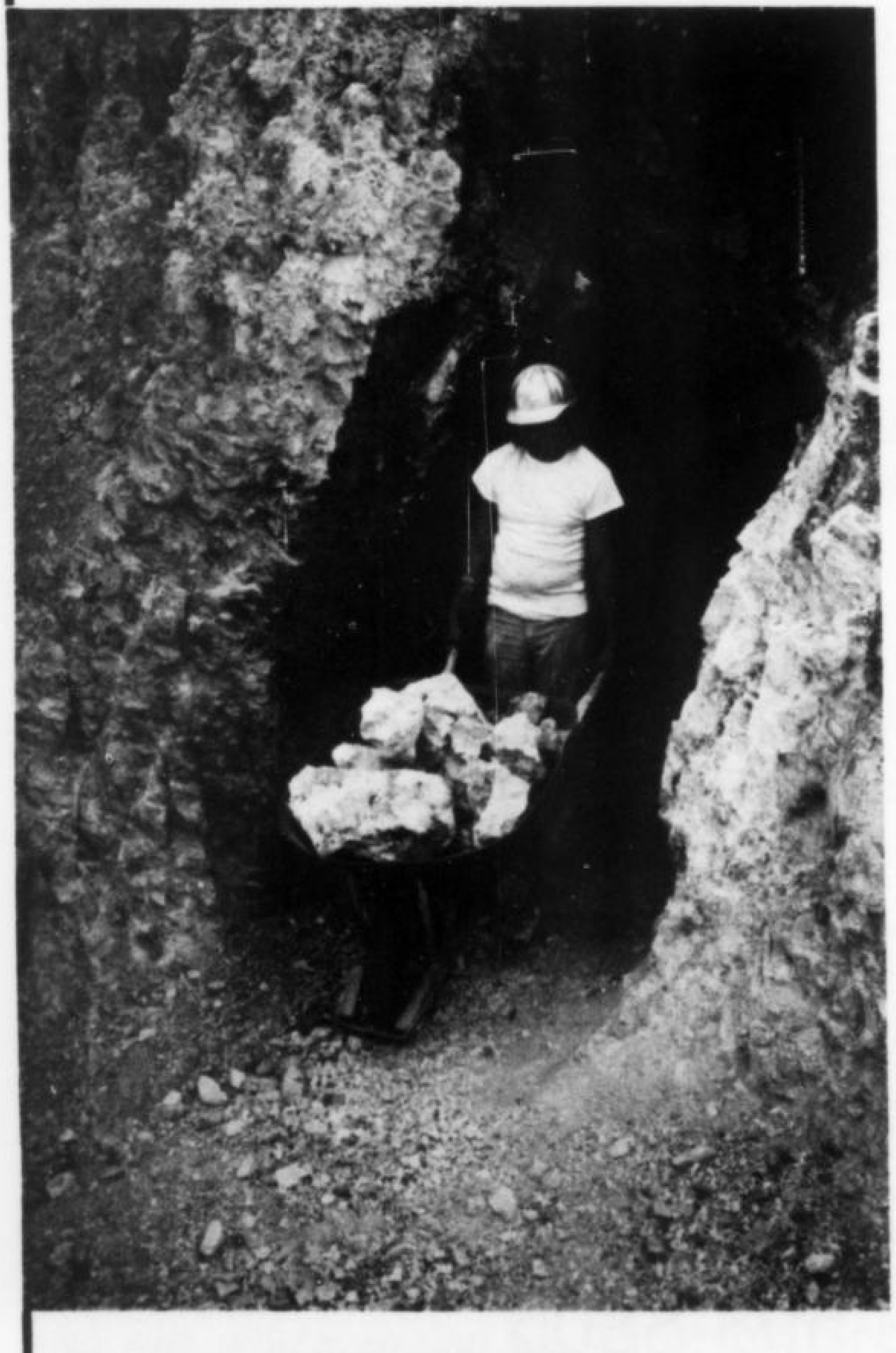

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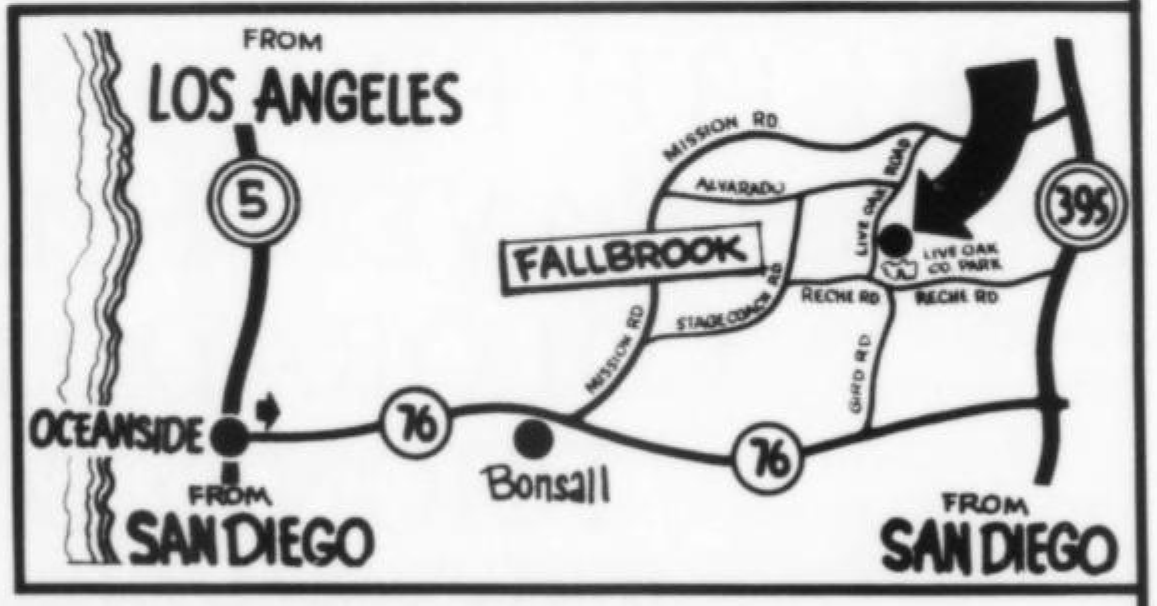

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# FM friends of mineralogy

### Activities of FM Region 12, The Pacific Northwest
### by M.M. Groben, Region 12 Coordinator

Since its first meeting in Portland, Oregon, on September 3, 1972, Friends of Mineralogy, Region 12, has had two busy and productive years.

At that first meeting, there were only ten members, including the Regional Director. There were no officers. There were no committees. Even an attempt to find a Secretary-Treasurer resulted in failure.

But the enthusiasm was there. Because we were such a small group, it was decided that only one project would be attempted at a time, and in this manner we would not spread ourselves too thin. Various projects were discussed. The decision was that at first our efforts would be concentrated on promoting subscriptions to the *Mineralogical Record*. Both FM and *MR* were struggling in their infancy and we felt that if the *Record* were to fail, FM might lose out also. Gil Griffin, Seattle, volunteered to lead this project and his efforts were to prove very successful.

It was at this same meeting that Tom Tuttle, Pasco, Washington, suggested that meetings be held every six months, preferably at the same time and place where a gem and mineral show was being held. His suggestion was approved and a series of very productive meetings has resulted.

Several months after the September meeting in Portland, Rich O'Donnell, Puyallup, Washington, volunteered to be Secretary-Treasurer for Region 12. Rich's newsletters have been dispatched with promptness and regularity ever since.

The Spring meeting of 1973 was again held in Portland. Our membership had now increased to eighteen. Bob Smith, an instructor at Seattle University, volunteered to be Chairman of the Educational Committee. Gil Griffin reported that we had been successful in promoting over 50 years' worth of subscriptions for the *Mineralogical Record*. We felt this was quite an accomplishment.

There was also some preliminary discussion in connection with a second project, Mineral Locality Registration and Preservation. Several members expressed their concern that the disclosure of such information might have serious consequences if it were to get into the hands of the wrong people. This objection was valid and no further action was taken, although all the members were encouraged to give this project more thought so that we could discuss it at the next meeting and make it workable.

The highlight of this meeting was a fine lecture illustrated by a series of slides by FM member, Rudy Tschernich, Snohomish, Washington. Rudy is an expert on zeolites and his presentation of "Zeolites of Skookumchuck Dam, Washington" (*Mineralogical Record*, Vol. 3, Number 1, 1972, pp. 30-34) was made doubly interesting by some excellent slides of the fabulous mesolite that has been found at this locality.

In June, 1973, a sub-regional meeting of the Oregon members was held at the home of Sharleen Harvey, Hillsboro, Oregon. The main topic of discussion centered on how Locality Registration and Preservation could be made workable in our region. Mike Groben, Coos Bay, Oregon, presented a Registration form that he had prepared and had printed for this purpose (reproduced here). The form is printed on ledger paper 11" x 17" and has a place for a map as well as ample room for other pertinent information. Acceptance of this form was unanimous. Many of the members took copies so that they could record various localities on forms they wished to submit at the next meeting, provided all members would be in agreement concerning promotion of this project.

On September 29, 1973, the fall meeting was held in Seattle. Membership had grown to 24 members. Bob Smith has placed our first educational exhibit on display at the Seattle Gem & Mineral Show. It was decided that we would now make Locality Registration and Preservation our main objective. But could we get around the objections which some of our members had voiced? If not, we were in danger of either losing members and creating hard feelings or else needing to drop the project. But a possible solution began to materalize. Deposit the maps and descriptions with a "custodian" and in addition form a committee of three who would approve or disapprove of requests to the custodian by anyone asking for any of this information. In order that members could give this idea more consideration, it was decided that final action would be taken at the next meeting when all members could be present to voice their opinions.

The next meeting was held in April, 1974, at St. Helens, Oregon. Membership had grown to 29. Bob Smith, with the aid of Harold Dunn, Mohawk, Oregon, had placed our educational exhibit on display for the second time at the Springfield, Oregon, show several months earlier. The main topic of this meeting was Locality Registration and Preservation. Preliminary discussion at the previous meetings had done much to overcome the original objections to this project. The following rules were finally worked out to apply specifically to Region 12:

1. All Locality Preservation forms will be held in strict confidence by a "Custodian" who will be elected annually by Region 12 members in good standing.
2. No locality information will be given to anyone unless a unanimous vote is received from a committee of three consisting of the original author of the locality, the custodian, and one other elected F.M. member from Region 12. (In the event that the author of a particular locality is the custodian or the 3rd member of the committee, a 4th alternate F.M. member from Region 12 will be elected and act as a substitute to bring the committee to a total of three).
3. Any locality information that is released to *anyone* will be stamped as follows:

   > "May not be reproduced without written permission of Friends of Mineralogy, Region #12" *and* signed in ink by the Custodian. (Any reproduction will not have the Custodian's original signature and the guilty party reproducing this information can be determined from the Custodian's records.)

4. All localities will be reviewed on the 10th anniversary of their donation by the entire membership at the annual meeting. If there are no objections at that time, the information can be released to the National organization for whatever disposition it may wish. If there are objections and a majority vote is not obtained to release this information, it will be held for a period of five years before it is reviewed again.

The rules set forth by the members were accepted. Reports by 36 localities were now submitted by those members who had taken forms at the previous meetings. Claire Kennedy, Portland, was voted "Custodian" and all locality information was turned over to him to be kept in confidence.

It was now time to think about a new project. We discussed the possibility of publishing a small directory that would contain the following information about Region 12: A list of all the public mineral collections, a list of the known mineral collectors, a list of Regional geological and mineralogical publications, a list of dealers and mineral shops, and a list of speakers and programs available within our region. Since there was ample enthusiasm for this project, members were appointed to help compile these lists so that they would be ready at our next meeting in the fall.

Our last meeting was held in Forest Grove, Oregon, on August 10, 1974. Our membership had now grown to thirty-one. Bob Smith had placed our educational exhibit on display for the third time at the Northwest Federation Show. Five new Locality Registration and Preservation forms were submitted to Claire Kennedy.

Various lists of dealers, collectors, publications, speakers, and public collections were submitted at this time, even though we recognized they were not complete. These lists, in their preliminary form, will be compiled and edited within the next several months and printed in a small directory about the size of Michael Fleischer's 1971 *Glossary of Mineral Species* (5x8"). The lists will be enlarged at each subsequent meeting and new editions of the directory will continue to be published to make the directory more complete. When the Directory is more complete, copies will be sent to all FM regions together with our newsletter.

This last Region 12 Meeting was highlighted with an interesting lecture entitled "Mineral Families" by Paul Desautels. The meeting was opened to the public and several hundred people were in attendance.

What will our next project be? We don't know yet, but we know it will be interesting. Why don't you come and attend our next Region 12 meeting this coming winter?

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

# AN AMERICAN MINERALOGIST PART VII

*by Arthur Montgomery*
**Lafayette College, Easton, Pennsylvania 18042**

## Expedition to South America and Africa

It was the family of George Vaux, Jr., which in 1928, following his death, made possible the fourth and most ambitious of all Samuel G. Gordon's mineral collecting expeditions. This was to South America, especially Bolivia, and parts of southern and central Africa during 1929-1930. The family contributed the lavish sum of $3,300.00, while funds from the W. S. Vaux Fund at the Academy supplied $1,700.00 more. This generous backing was undoubtedly most of all a means of honoring the memory of Mr. Vaux. At the same time, it is in sharp contrast to the far smaller and quite insufficient financial aid given to Gordon for his earlier expeditions. The much increased contribution from the Academy is especially noteworthy, and it may have been an additional contribution of the Vaux family.

Gordon left New York by ship on August 15, 1929. His itinerary included: two months' collecting in the Bolivian Andes; embarkation from Buenos Aires for Capetown on November 6, after brief visits to mineral museums in Rio de Janeiro and Buenos Aires; two month's collecting in various mining regions of South Africa, Southwest Africa, Rhodesia, Belgian Congo and Tanganyika; embarkation from Dar-es-Salaam on the African east coast on February 2, 1930, for Marseilles; two weeks' visiting museums and mineral dealers in France and England; return to New York on March 22, 1930. It was a trip lasting more than eight months, which proved exceptionally successful in the collecting and purchasing of minerals for the Academy and George Vaux collections. Sixty-three boxes of specimens were shipped home from Bolivia; ninety boxes were sent from various points in Africa. In letters and accounts of the expedition, Gordon describes the quality and abundance of crystallized material as being far superior to any secured on earlier expeditions. It shows what Gordon could accomplish on his collecting expeditions with more generous financial support.

His eight-page popular account of the first part of the trip to the Bolivian Andes, printed in the Academy Year Book (1930, p. 60-68), is not given here because it deals with areas and mining localities in Bolivia already described in an earlier Academy Year Book (1925, p. 29-38) and reprinted in Part 5 of this series.

Very few of Gordon's letters telling about his collecting experiences have been preserved. It is lucky that one of a number he might be expected to have written now and then to members of the Vaux family is intact in the Gordon correspondence file at the Academy Library. This letter was sent to Mrs. George Vaux, Jr., on October 31, just after reaching Buenos Aires by train from Bolivia, and a few days before boarding a small ship for Capetown. Nonpertinent parts, comprising perhaps one half of the four pages, are omitted.

"My dear Mrs. Vaux:

Bolivia lies now behind me, and the first part of the trip is over. The two months spent there have been extremely fruitful, as is evidenced by sixty-three (63) boxes of specimens, or almost as many as the total number obtained on the last two expeditions to the Andes combined.

The principal minerals have been the vauxite group: vauxite, paravauxite, and metavauxite. Not only has enough material for research work in the chemistry and physical chemistry of the group been obtained, but fine series for both collections. And there are enough choice duplicates of paravauxite to supply all of the collections of the world.

The paravauxite and metavauxite are superior to anything obtained before. In fact, the previously collected material is just junk. In addition there are many fine cassiterites from Araca (of which I wrote you previously), and 8 boxes of wonderful pyrite crystals from a new mine. One group of inch pyrite crystals weighs 125 pounds!

There are enough fine duplicates, particularly of paravauxite, to pay the entire costs of the expedition so far; and most institutions will be glad to get some of the material.......

From Oruro, where I last wrote you, I went to Llallagua. The mines are much larger, and there are today over 110 stopes and some 120 miles of workings.......

In the three and a half weeks here I went pretty throughly thru the mine, although a couple of the sectional engineers steered me clear, or tried to, of several sections. Here is the reason.

You remember that last fall the assistant mine superintendent brought up some specimens. Well he has been

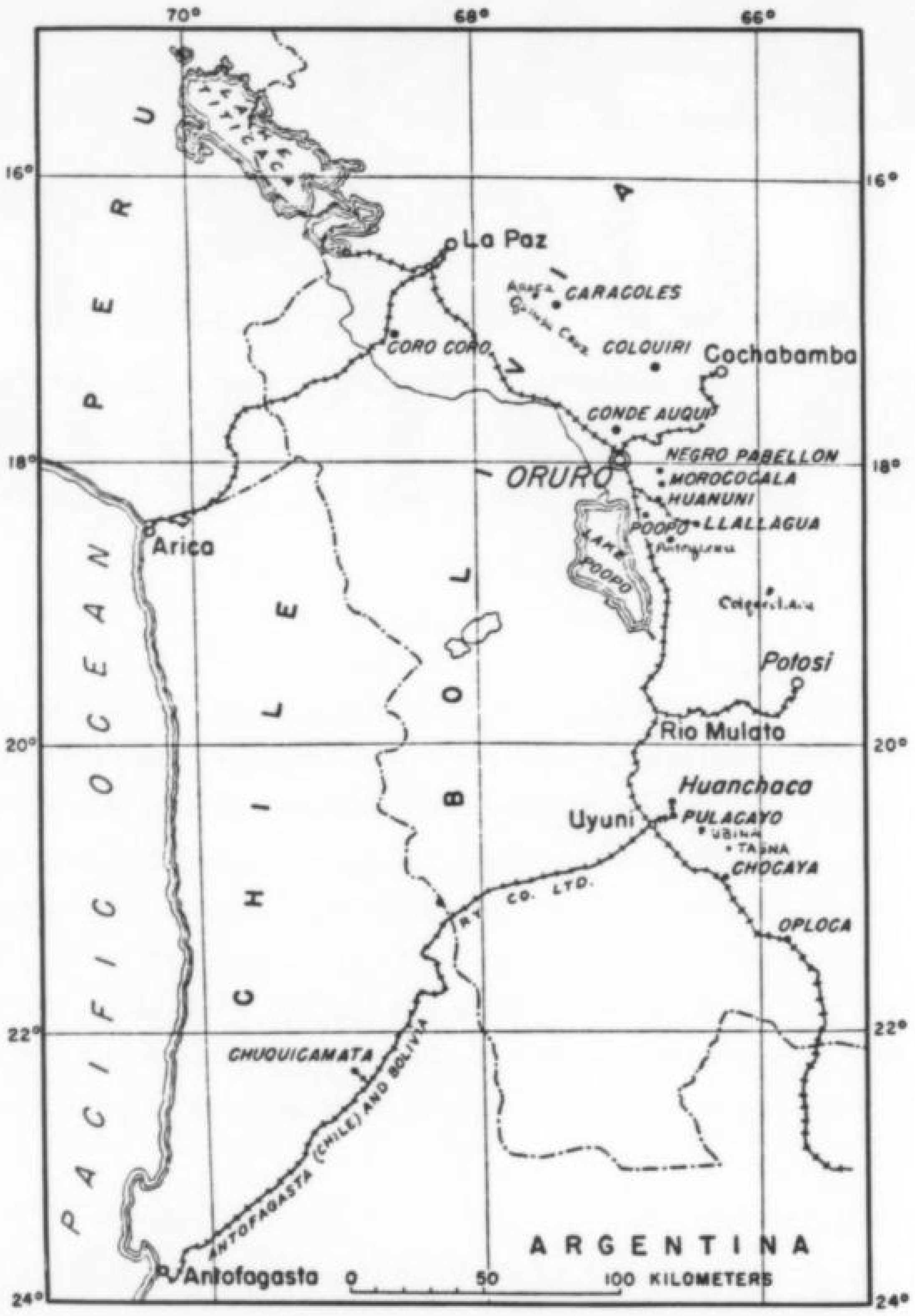

*Fig. 1.* **Map showing Bolivian tin and tin-silver localities, adapted from F. M. Chace (*Tin-Silver Veins of Oruro, Bolivia*, Ec. Geol., 43, p. 336, 1948). Most deposits visited by Gordon are included.**

keeping his eye open since. The General Manager told him I was coming to Bolivia, so he renewed his efforts, most commendably, to gather specimens.

He saw the metallurgist one day and said to him confidentially: "Gordon is coming down next month, and I have the finest collection of vauxite, paravauxite, and metavauxite in the world; and if wants it he has to come across with $1000." He stated that he knew where there was another big vug that he was going to empty.

Now it happened that the metallurgist was somewhat interested in minerals and had a small, but poor collection.

..........

The metallurgist then asked a young engineer he knew who had charge of a richly mineralized section of the mine if he had seen any paravauxite in the mine. "Paravauxite? What's that?" he inquired. Well, he described the mineral. Sure, he knew where there was a fine vug of the mineral. And he brought out a small piece and had it confirmed. It seems that the engineer had seen the assistant mine superintendent (the man who was going to hold me up) stop and dig out a specimen, and then tell the boy to carry it carefully to his house.

The young engineer got busy and filled up half a dozen boxes of paravauxite. Then I came along. He told me a story about how some former workman had found it, and wanted to sell it; said workman keeping secret part of mine same was found in. After a couple of days, during which he steered me away from this section of the mine, I bought it for $103, approximately. It was wonderful stuff, and while I felt that I might come across the vug later, I wanted to gather in every scrap to avoid having any of it get to Ward's or any other institution. The next day, after having packed up the previous purchase, he said that the man had brought in another lot. This was somewhat better, and I bought it for $75. Meanwhile I steered clear of the assistant mine superintendent, and bided my time to purchase his vivianite, metavauxite, and vauxite. He realized that this competition had ruined his price. I got his stuff toward the end for less than $350, or about a third of his original price.

So having cleaned these fellows out, and gone pretty well thru the mine, I decided to look for the lost paravauxite vug. One day the young engineer said he was not going into the mine. So at 9 o'clock I headed for his section, picking up a boy at his office to carry the bag. I knew about where the cross vein should be, and felt quite sure it was on the 195 level. Within half an hour I had found it. The engineer thought he had cleaned it out. Several large chunks of rock blocked up the entrance. After an hour's work I had it well opened up; and in such shape as to get out some fine specimens. All that I thought it was possible to get out.

When I left Llallagua, I shipped 49 boxes to Oruro. The mine is much lower in grade of ore. There are about 3 years of ore reserves blocked out. While at Llallagua I visited the mine of Vila Apacheta.......

I returned to Oruro on October 11. The next day was Columbus day, and then Sunday. Monday I had to see Grace and Co. and make arrangements about shipping the boxes. Tuesday night at 10:30 I left Oruro for Poopo, arriving there an hour and a half later. I left my bags in the station, and walked a mile to the mill, where I was put up for the night. The next morning at 7 A.M. I hired a truck to drive me to Callipampa; the mill of the Monserrat mine I wanted to visit next. There the mine manager took me up to the mine in his car, about an hour's drive. I returned in the evening with a couple of boxes of specimens, riding the tram. This tram is even longer than the one at Caracoles, but there are not the wide chasms. One can get a fine view of Lake Poopó, and the distant volcanoes of the Chilian border.

That same night, at 1:30 A.M., I caught the international train at Poopó, having had a sleeper reserved. The next morning I got off at Uyuni, and about 10 A.M. left in an autocarril (auto running on narrow gauge railroad tracks) for the Pulacayo mines. There was nothing much new here, and the next morning, after much difficulty in getting mules, left for Ubina.......

I rather enjoy the long mule rides. One gets into interesting country. But the trouble is what you get into at the end of the ride: native Indian huts and rotten food. I gathered 8 boxes of extraordinary pyrite specimens. While here each meal consisted of two soft boiled eggs, a couple of slices of canned pineapple, and a cup of cocoa: morning, noon, and night. I could not go the rest of the stuff. The manager was the acme of hospitality. I suspect he turned his room over to me. He was ever solicitous about my work and welfare, and did everything he could to help.

The next problem was to get five mule loads of stuff away, with only two mules. I left on Sunday morning on one of the mules, another carrying the baggage and an Indian guide walking. The trail was very bad. We saw 7 wild vicuña, and 2 condors. It was 5:30, 8 hours later, when we arrived at Tasna. I scared up two more mules, and sent all four back for the rest of the boxes of specimens.

I spent a day in the bismuth mines at Tasna, then went by auto to Chorolque; stopping at Quechisla to have dinner with the Guggenheim manager there, Mr. Horace Graham, and his wife. After a day at Chorolque, I went to the Animas mine near Chocaya for the rest of the week. This ended the Bolivian part of the trip.......

Just before leaving Bolivia, I received the last, and in many respects the most important of the letters of Introduction from Mr. Shaler. Those to the mine of Tsumeb and Grootfontein, which I expect to visit first. I now have letters to all of the mines I am interested in in Africa. The boat is scheduled to leave B. A. on November 6th, but it may be a couple of days late. It is only a 3000 ton boat, terribly small,......it is scheduled to reach Africa about Thanksgiving date.

Sincerely yours,

Samuel G. Gordon"

It took several weeks for Gordon's small steamer, leaving Buenos Aires on November 6, 1929, to reach South Africa. Two days after reaching Capetown, on December 4, he was on the train bound for the copper mines at Tsumeb in Southwest Africa. Excerpts from a letter to his friend, H. W. Trudell, and one to C. M. B. Cadwalader, managing director of the Academy will be interspersed with a few selections from his travel article *In Really Deepest Africa*, printed in the Academy Year Book (1931, p. 47-54), to piece together a very incomplete account of his collecting experiences. Missing from it, are his descriptions of visits to diamond mines at Kimberley and Pretoria gold mines of the Rand at Johannesburg, and platinum deposits near Potgietersrust northwest of Johannesburg.

Excerpts from *In Really Deepest Africa* (p. 47-48) begin the story:

"In Really Deepest Africa

After two successful months of collecting in the tin mines of the Bolivian Andes, I left Buenos Aires on November 6, 1929, for Capetown. On the twelfth day out Table Mountain appeared on the horizon. Capetown is situated on a little peninsula between the Atlantic and Indian Oceans, and is separated from the mainland by a neck of recent sands and alluvium.....

On December 4th, I left Capetown for Tsumeb in Southwest Africa, 1,770 miles by rail. By early morning we had passed the picturesque coastal ranges, and were well into the Karoo—a dreary, dull, and desolate plateau. After a change at De Aar junction, the crossing of the Orange River was a relief from the monotony. Beyond Upington the train skirted the Kalahari desert, and canvas water-

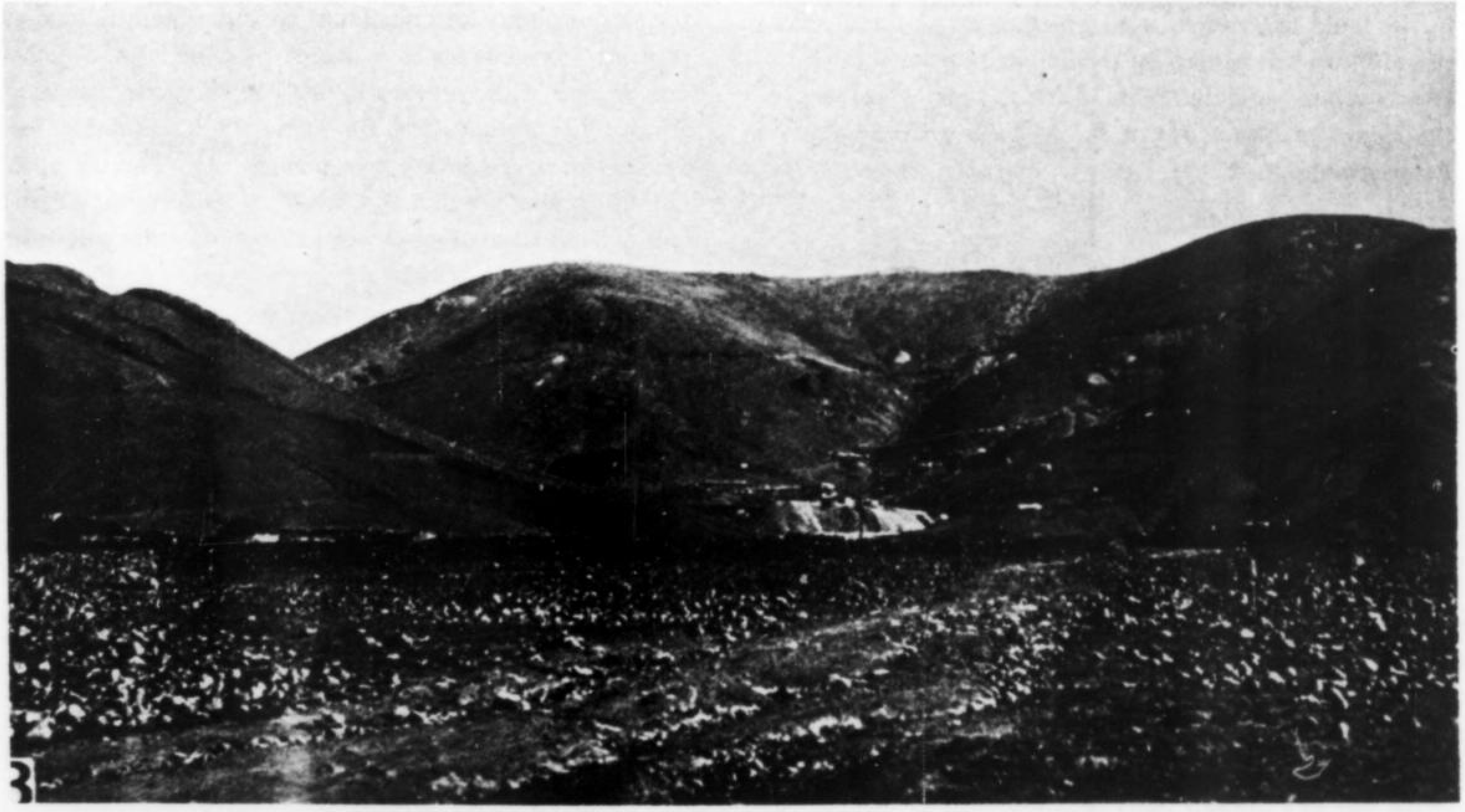

***Fig. 2.* Llallagua from the north, with large Siglo XX mine dumps near center, well past village. Gordon photo, from Proc. Ac. Nat. Sci. Phila., 96, P. 14, 1944.**

bags—religiously filled at the stations—appeared from each car window. Here and there a jagged kopje (hill) rose about the flat parched terrain.

Four days later the train arrived at the little Tsumeb station, illuminated by the glow of a nearby smelter. The copper mines of Tsumeb are noted among mineralogists for extraordinarily perfect crystals of azurite, cerussite, anglesite, and smithsonite. Germanite, tsumebite, and schultenite are peculiar to this deposit. Surface workings extend to a depth of 100 feet, while underground operations have reached a depth of 1,400 feet. I visited first the 8th level workings. The tunnels are narrow, and at each face were groups of naked Ovambos, working under the supervision of a mine boss.

With such few working faces, and these in solid ore, it did not look favorable for gathering fine crystals. But, in one place, some stains of azurite were visible, and getting a ladder I climbed to the spot and started working. Half an hour later I broke into a vug of large azurite crystals. Much time was spent in carefully chiseling out groups of these rather fragile crystals, which were then wrapped in tissue paper and placed in a bag. The mine is hot and damp, and the air soon became foul from the flickering carbide lamp. By noon the best of the crystals were removed, and a later visit disclosed that the miners had destroyed what remained, in their eagerness to get specimens. During the rest of the week specimens of cerussite, smithsonite, fluorescent sphalerite, and many other minerals were added to the collection. Visits to the nearby vanadium mines of Abenab and Bobos, and the idle zinc mine at Berg Aukas produced descloizite, sphalerite, and smithsonite."

The letter to Trudell, from which more pertinent selections follow, was written on December 11 from Kimberley. It was printed in July, 1954, at Mr. Trudell's request, in the *Keystone Newsletter* of the Mineralogical Society of Pennsylvania.

From letter to Trudell:

..."It was three days and nights to Tsumeb. The best scenery, that near Capetown, was passed during the night. Most of the trip was along the edge of Bechuanaland, particularly along the Kalahari Desert.

I got to Tsumeb late on Sunday night. The climate is comfortable, quite warm in the sun in the day, but real cool at night. It is about 5000 feet above sea level. The mine is worked as an open cut down to about 100 feet, and thence to a depth of 1800 feet by underground workings. I was told that the upper levels were exhausted and these were the ones which contained all the azurite, cerussite, etc. crystals. That I should have come 15 years ago. Further that some gentlemen visiting the Geological Congress in South Africa had come up in September including one Dr. L. J. Spencer, of the British Museum. So it did not sound as though I was going to be able to gather much at the mine. As I did not expect much in the way of assistance, I had pinned my hopes on the "Silver Pick" and was well provided with good pound notes Sterling for the operations.......

On Monday morning, early, I went around to the office of the company. I found the manager away for a couple of days. However, his assistant or secretary introduced me to the mines superintendent, and arranged for going down the hole. However, I spent Monday going over the dumps and ore piles which contained some smithsonite crystals.

Tuesday was the first day in the mine. And what a day! Hectic? A few more days like that and I'll be down with nervous prostration. Remember that I did not expect to collect anything, with all the German bosses ready to clean out any crystals and ship them to Maucher in Munich. And that I had expected to get everything with a "silver pick," and then perhaps not much.

In company with the superintendent I went down to the 800 foot level, the uppermost being worked, and pretty deep for crystallized secondary minerals. The workings are of such a nature that only a half dozen places of about 10 ft. square are visible on any level. The first few looked most unpromising. But one of the miners said there was a little azurite showing up above. I climbed up and saw some poor battered crystals, and thought that a little work might produce at least something to show for the trip. The shift boss tried to get me away from the place, but I had the superintendent sit on him.

The latter, of course, did not expect me to find anything and went off. I got to work in the wall, and cut all around the place where the azurite showing was, and had the extraordinary fortune of busting into a beautiful pocket of azurite crystals up to 6 inches long, and three inches across; one of the prettiest sights you ever saw. I worked slowly and carefully. The mine is very hot and damp, and I nearly drowned in my own perspiration. The air up in the hole would get foul and hot from the lamp and every half hour I had to climb down and lie on the dirt pile from exhaustion. News of the find spread around and at 11:30 the superintendent and his assistant came around. I had already packed away in my bag the best specimens, but the vug continued into a cylindrical vug, lined with smaller crystals. The assistant who came up first, tried to break off some crystals, but I pulled his hand away. He tried all sorts of subterfuges to get into the place. Then the superintendent came up, looked in and became incoherent. All he could say was "I have been here fourteen years, and never have I seen such crystals." The best, I had in my bag. He left the shift boss to guard the place, and later sent the assistant down to open it up further. In the afternoon, when I went down again, I found that they had created havoc, just ripped everything out with dynamite and hammers, nearly everything coming out broken. Everybody seemed to be scrambling in trying to get some crystals; particularly since big ones sell for about $100.

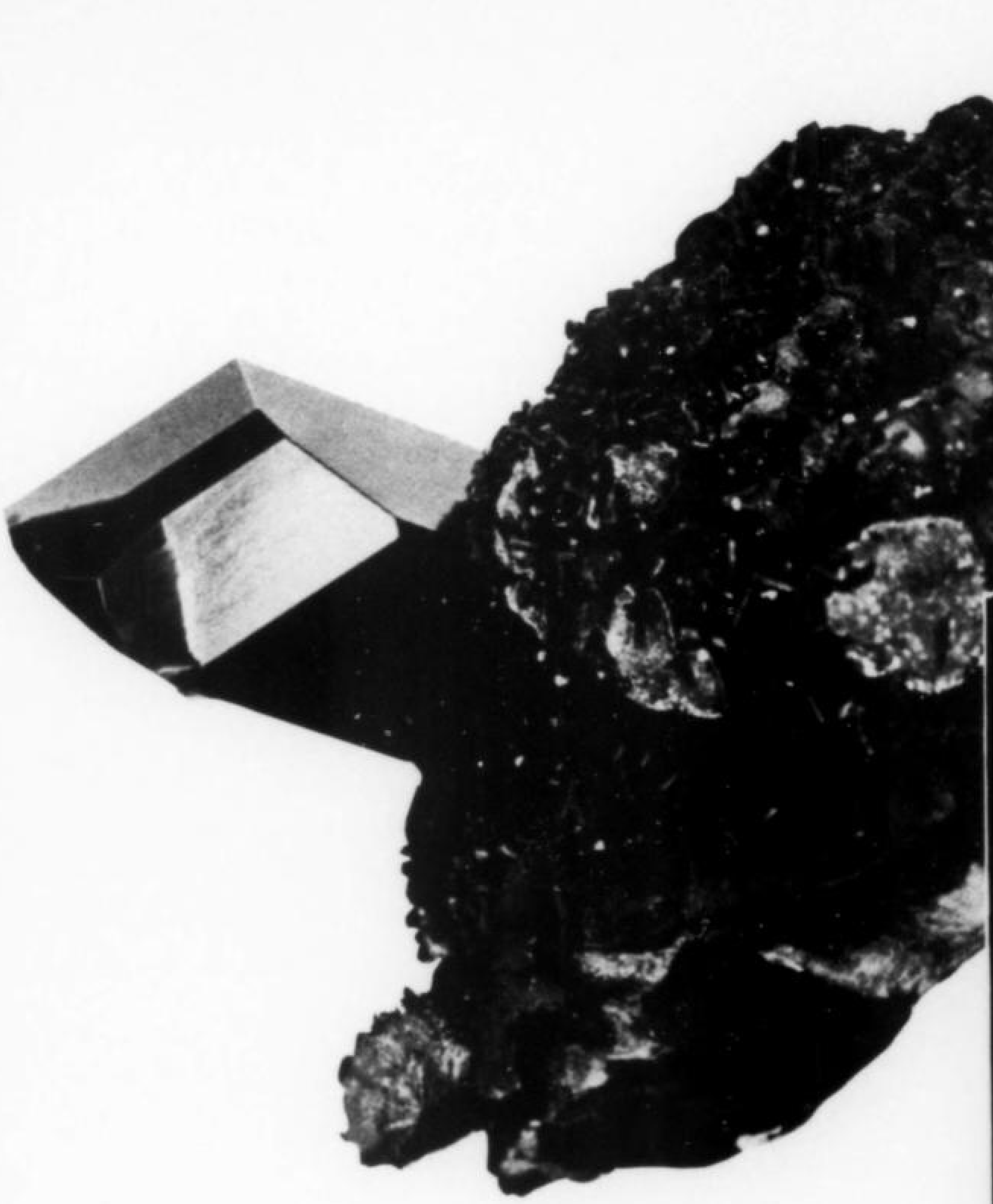

*Fig. 3.* **Water-clear crystal of deep greenish-blue vivianite, an inch long and perched on siderite crystals, from Llallagua. Gordon photo, from proc. Ac. Nat. Sci. Phila., 96, Pl. 26, 1944.**

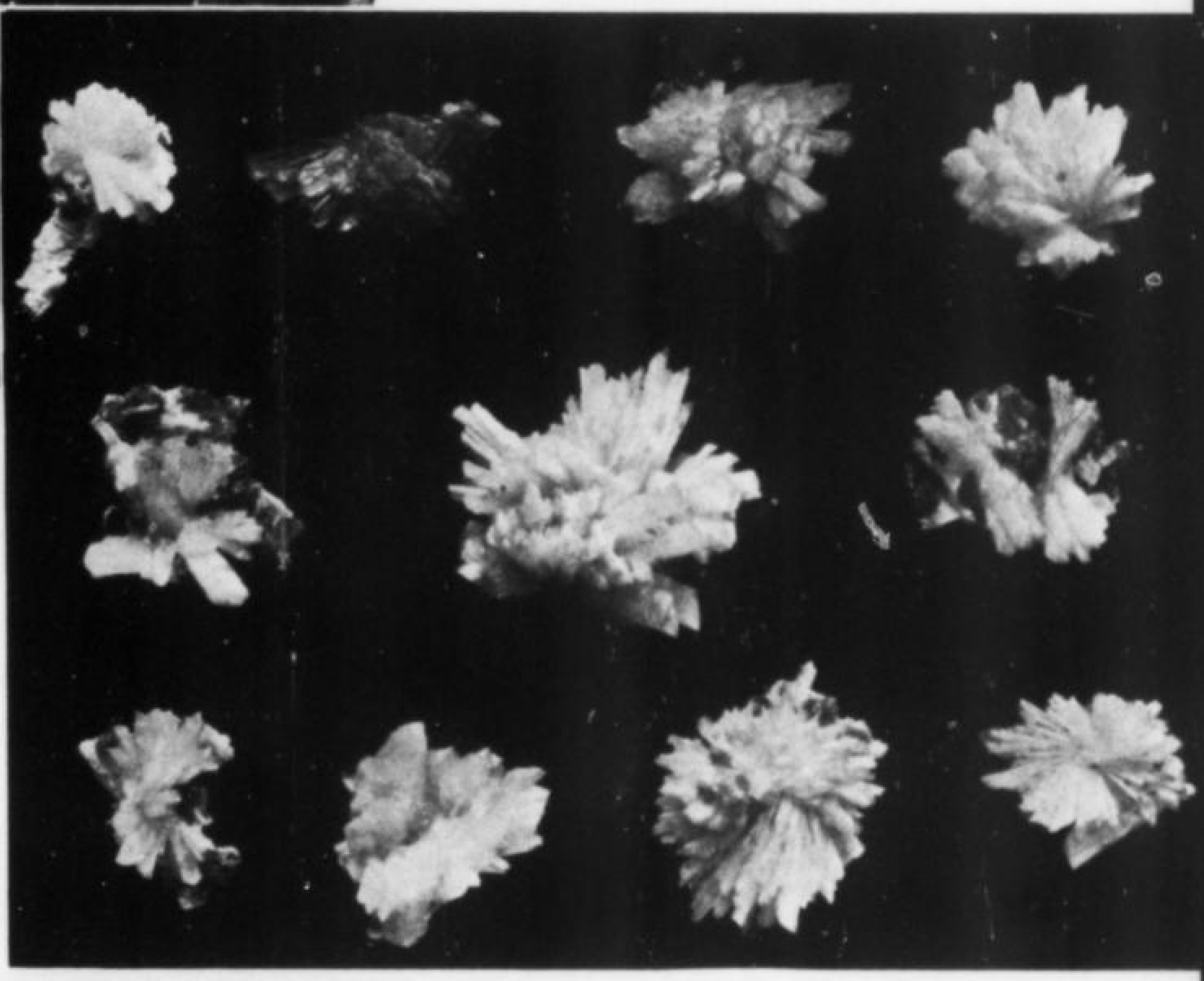

*Fig. 4.* **Clusters of paravauxite crystals more than an inch long from Llallagua. Proc. Ac. Nat. Sci. Phila., 96, Pl. 26, 1944.**

*Fig. 5.* **Map of southern Africa adapted from Rand McNally-Cosmopolitan Atlas, 1951. Most places visited by Gordon are shown, except for Broken Hill, Rhodesia, 200 miles south of Elizabethville, Congo, and the Katanga copper-uranium mines 60 miles northwest of Elizabethville.**

When I got out, I was told that the mine manager, who was also a director, was back, and wanted to see me and the specimens. These were all carted to his office. He seemed all excited, walked around in circles, and asked me what I wanted. I told him that I wanted to ship off the specimens I had collected. He said that was absolutely impossible. Pleasant words after I had sweated all day gathering them. He said that their value was extraordinary and that they had none in the office in Berlin, or the German universities, and how therefore could he let me have them. He had up to this time not seen the specimens, they were being unpacked. He happens to be something of a collector, and naturally did not want any one to cart off the stuff from his mine. He was quite beside himself. I suggested cabling Berlin, but he stated that if I did that, he would also. As a matter of fact, I am sure that they would have upheld him, certainly they would not cross a fellow-director, particularly the mine manager. By this time the specimens were unpacked, and he walked over to them. Apparently they exceeded even his expectations. The superintendent kept muttering, "I have been here 14 years, and never have I seen such crystals." I was too tired to be obstreperous and hence tried diplomacy. It seemed almost impossible to reason with him, but by appearing magnanimous and appealing to his eagerness to get hold of the specimens, I got him to agree to divide the specimens equally, each of us taking a choice alternately. Certainly under the circumstances I could not hope for more than an equal half of the finds. He could just as easily have taken them all, or perhaps made a generous gesture after picking out the best and giving me the junk.

At my suggestion we pitched a coin to see who would take first choice as I thought this might give me a look-in on the first specimen. But he won. The division proceeded slowly. While I would be looking them over he would walk over to those he had acquired and then at my specimens. But he became quite happy and after the division, we shook hands and I made arrangements to go through the mine and divide the finds similarly. However, I did not expect to get anything more in the mines, the men were too secretive and would steer me past and well around possible places.

If I had acted differently, I would have lost everything, now I had a good half, (specimens I had come prepared handsomely for) so could stay longer and gather more if the opportunity presented itself. So while I feel outraged, it might have been far worse. However, what I have will look good back in Philadelphia. They are certainly marvelous specimens. And finding a vug the first day in the mine, of such extraordinary crystals, particularly below the levels of such things, happens once in a long time......

Early on Sunday morning, 5 A.M., I left Tsumeb in the last freight car of a goods train.....At Otavi we left this train at 8 o'clock and proceeded to the hotel to await the night train to Grootfontein......

At Grootfontein I was once more amongst gentlemen and scholars. Mr. Feldtmann did everything he could to

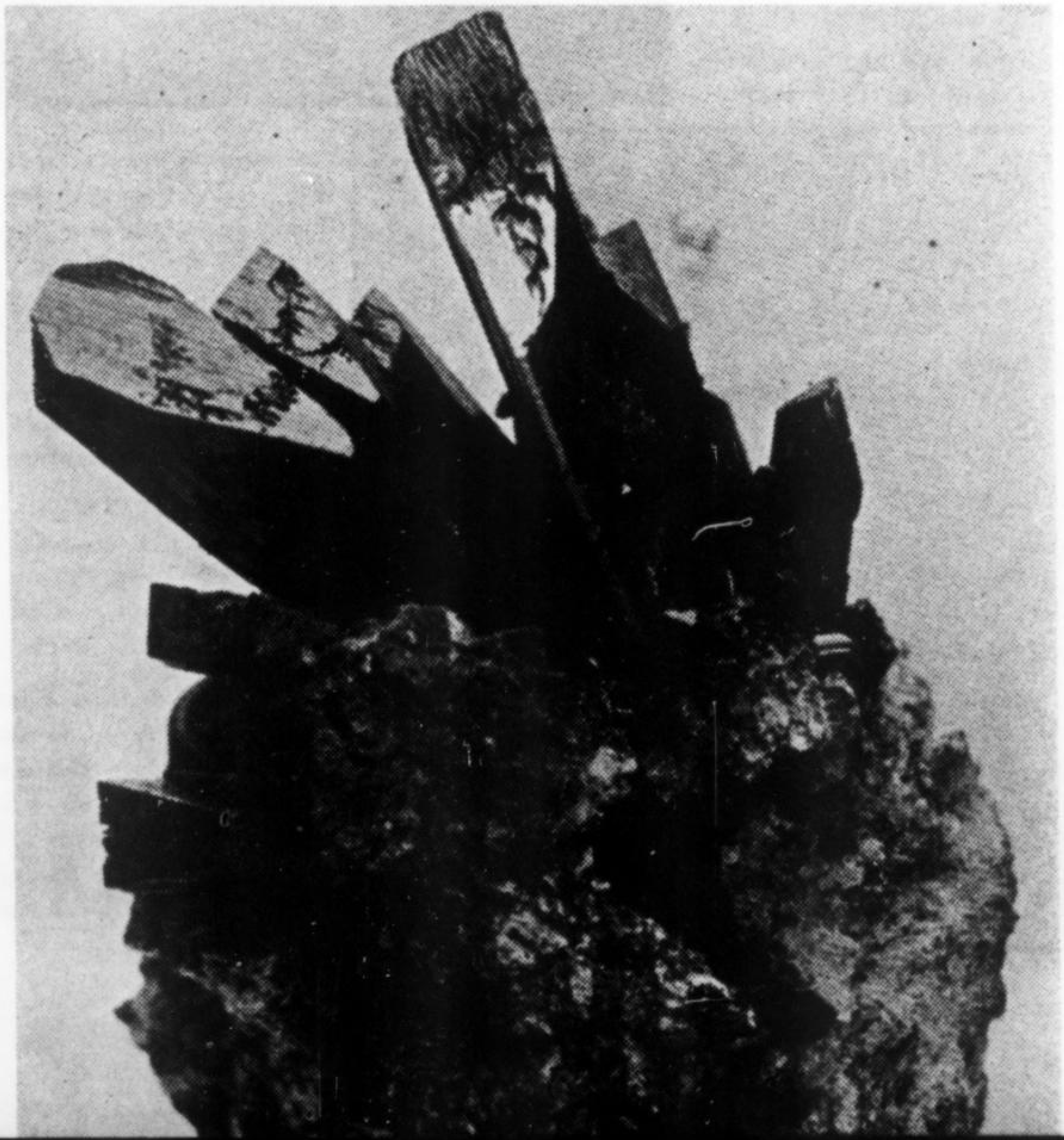

*Fig. 6.* **Group of superb deep-blue azurite crystals from Tsumeb, natural size. Gordon photo, from Year Book, Ac. Nat. Sci. Phila., p. 54, 1931.**

*Fig. 7.* **The Grootfontein meteorite. Gordon photo, from Proc. Ac. Nat. Sci. Phila., 83, p. 251, 1931.**

help me. Monday was a holiday, but he took me out personally to the mine at Abenab, a descloizite locality. For the rest of the period at Grootfontein he loaned me his car and chauffeur. It was a shame the way he brought it in evenings splashed with mud. The technical manager took me out to the Berg Aukas, an old Zinc mine, just now filled with bats.

The most interesting trip was the one out to the big meterorite which lies in the veld, about 20 miles from Grootfontein. When first discovered only a bit of the top was revealed, but it has been well dug around. After careful measurements and careful calculations I estimated its weight to have been over 100 tons! Meteorites are considered property of the State, and pieces cannot be removed from the country. I am heartily in accord with this, meteorites should certainly be well preserved, and protected from specimen hunters.

However, duty is duty. I went out there with the car taking a native named "Goulosh" and a quantity of tools. After 16 photographs and measurements, we started in on the "beast" with a hacksaw, at 10 A.M. We sawed and I hammered my hands to blisters until 5:30 P.M. At that time we had worn out our dozen blades, smashed the hammers, and ruined the chisels. So we turned back to Grootfontein. It liked to have killed Goulosh. He was beginning to complain of thirst. Which was reasonable, seeing that we hadn't had a thing to eat or a drop of water all day. The next day, we went out again with a lot more tools, but it was not until 3:30 P.M. that we got a hunk of the iron off. The manager was surprised at the piece, and I believed somewhat dismayed. However, naturally I would get the best piece that it was possible to get. The two boxes from Grootfontein weighed 210 lbs. making a total of 763 lbs. for the first three weeks in Africa (77 boxes)."

Excerpts from *In Really Deepest Africa*, p. 51, follow:

"Similarly the corundum fields of the Transvaal, covering about 1,800 square miles, have been described as the most extensive known. The industry is reminiscent of one which flourished some fifty years ago in Delaware and Chester counties, Pennsylvania, and in southwestern North Carolina. And like these American deposits, the Transvaal corundum occurs in peculiar desilicated pegmatites in serpentines and associated rocks. In Pennsylvania some veins were the scene of mining, but much corundum was picked up in the fields. Many farmers had the happy thought of following the plow, sinking a crowbar at intervals in its wake. They soon became familiar with the ring of the bar on a hidden boulder of corundum. Similarly, while there have been many excavations along the erratic African veins, most of the corundum today is picked up by farmers in the fields and sold to local agents."

The following two paragraphs are excerpts from a letter written from Broken Hill, Rhodesia, on January 16, 1930, to Mr. C. M. B. Cadwalader, Managing Director of the Academy:

"Arrived all right at Broken Hill, famous for its cerussite, pyromorphite, calamine, smithsonite, tarbuttite, hopeite, and parahopeite, and Homo rhodesiensis: something between pithecanthropus and neanderthal......

Six weeks ago they ran into a lot of tarbuttite of which the mine surveyor had quite a few, which he said I could take specimens of if I did not find any. He took me around the mine and showed me the general region of the tarbuttites, but was a bit hazy about the exact locality. They showed me a big vug, and pointing up to the upper reaches, twenty feet above our heads, said I might get some. I asked for a ladder, but they thought it too dangerous to get up there. However, a ladder was produced, and I disappeared up into the vug. It was a beautiful place: stalactites of limonite coated over with small pyromorphites and tarbuttites, but nothing like the stuff I had seen. The next day I started some searching of my own and saw what looked like a vug boarded up from below. After some argument I got a ladder there, and climbing up, found myself in a vug about 6 feet in diameter and reaching upward at least 20 feet, practically lined with the tarbuttite crystals, easily gotten off in groups. Later in the afternoon I developed 48 films, which came out very nicely."

Excerpts from *In Really Deepest Africa* follow:

"The plateau of Northern Rhodesia is potentially the greatest copper mining center of the world. Just across the border in the Belgian Congo is the Katanga, part of the same plateau, and already one of the principal copper producing areas, as well as the source of nearly all of the radium at present, and half of the annual supply of cobalt.

I had some opportunity to collect specimens of malachite, chrysocolla, linnaeite, and heterogenite at the mines of Likasi, Kambove, Chituru, Luushia, and Ruashi, and the Star of the Congo. A very fine collection of rocks and minerals of Katanga is exhibited in the office of the geological staff at Panda.

The radium mine is located on Kasola Hill, about 15 miles southwest of Kambove, close to the copper prospect of Chinkolobwe. The principal ore mineral (metal) is uranium, which with its associated minerals, occurs in veins about a foot thick in the dolomites and slates. A great variety of minerals occur with the uraninite (pitchblende), but more interest attaches to the green torbernite, and the brilliant orange and yellow oxides, silicates and phosphates, which form an oxidized zone about the masses or pitchblende. The ore is extraordinarily rich, huge blocks of solid pitchblende weighing more than half a ton having been mined. Indeed, it has been stated that it is necessary to mine but a few tons of ore a week in order to assure the world's annual supply of radium (40 grams in 1929). The radium mine is carefully guarded from prying eyes, and no visitors are permitted anywhere near the vicinity. The Union Miniere du Haut Katanga presented the Academy with an excellent series of the minerals of the deposit: becquerelite, curite, dewindtite, kasolite, parsonsite, sklodowskite, soddyite, torbernite, and pitchblende; as well as of dioptase and plancheite from the abandoned mine of Tantara.

On February 4th I turned homeward, taking the night train to Bukama. From Bukama small steamers ply down the Lualaba to Kabalo, three days distant......

Washouts along the Tanganyika line caused considerable delays in travel, for some distances passengers and baggage were taken by motor-boat across the flooded areas. Early in the morning of February 14th I reached Dar-es-Salaam: 'Haven of Peace' to the Arabs. The next day the French steamship General Voyron left for Marseilles.

Ninety boxes of minerals, rocks and ores came to the Academy as the results of the expedition, many of them now being on display in our Mineral Hall."

This fourth expedition was the most successful Gordon ever took. What helped make it so, as already suggested, was the abundant financial support chiefly provided by the Vaux family. He could thus freely purchase minerals, as at Llallagua; where before, he had little more than travel funds at his disposal, and must rely almost wholly on his own collecting efforts. The dollar value alone of the hundreds of superbly crystallized specimens secured on this expedition, for both the Academy and George Vaux collections, is impossible to conjecture. One has only to consider the best of the Tsumeb minerals, and look at a few of these on display in the Mineral Hall at the Academy, to appreciate Gordon's material contributions. On the scientific and educational side, he had brought back a wealth of study and research material which would inspire a large number of his mineralogical papers and enrich through exchange and sales many other institutional and private collections.

The personal letters provide us with fresh insight into what made Sam Gordon a collector par excellence. It seems to have a combination of these attributes: unquenchable optimism, determination and persistence; willingness to withstand every kind of discomfort and hardship; keenness of observation together with a great reservoir of practical and scientific knowledge on mineral specimens, mineral associations and types of geological occurrence; aggressive self-assurance in dealing with recalcitrant miners, collectors and mine officials. The latter qualities may not have always endeared him to others—for, let's face it, he could be an over-confident, breezy and stubborn character at times—but they also built an impregnable self-reliance and helped inspire respect, whether from roughneck workers or persons of influence. To every human being he met on any expedition, he probably most of all imparted his undeviating singleness of purpose in the pursuit of fine minerals. This combination of qualities made him one of the great collectors of all time.

# *An Unusual Occurrence of* BOBIERRITE *at Wodgina, Western Australia*

*by Brian Mason and Pete J. Dunn*

**Smithsonian Institution, Washington, D.C. 20560**

Abstract

Bobierrite, $Mg_3P_2O_8 \cdot 8H_2O$, has been found coating fractures in altered lithiophilite in a pegmatite at Wodgina, Western Australia.

Bobierrite, although originally described over a century ago, is an uncommon mineral. The original material was found in guano from Mejillones, Chile. Other occurrences given in the 7th edition of *Dana's System of Mineralogy* (1951) are in association with apatite at Ødegården near Bamle in Norway; in cavities in a fossil elephant tusk in Pleistocene gravel near Edgerton, Minnesota; and in a fossil enterolith from Marlborough, New Zealand. The only other occurrence we have found in the literature is in a dolomite vein in a Russian carbonatite (Kapustin, 1971).

Wodgina is situated in the Pilbara district of Western Australia, and is the location of a large complex lithium pegmatite (Simpson, 1928). It was a busy mining area in the early years of this century, when it was the world's principal source of tantalite, then in demand for tantalum filament lamps, and tantalum mining has continued in a desultory fashion to the present day.

The Wodgina pegmatite is noteworthy for the presence of large masses of lithiophilite, some weighing as much as half a ton. Most of the lithiophilite is severely altered. Cores of the unaltered mineral are frequently mantled with brown sicklerite, and this in turn with purple purpurite; much of the material is further altered to black manganese oxides.

The bobierrite was found coating fractures in a football-sized block of completely altered lithiophilite. It occurs as thin lath-like crystals, sometimes arranged in rosettes, very soft (H = 2), and with a pearly luster. In appearance is closely resembles gypsum. It was identified as bobierrite by its X-ray powder pattern and its optical properties. The latter are $\alpha = 1.508$, $\beta = 1.514$, $\gamma = 1.541$, $\gamma \wedge c = 27°$; the refractive indices are close to those reported for synthetic $Mg_3P_2O_8 \cdot 8H_2O$ ($\alpha = 1.501$, $\beta = 1.513$, $\gamma = 1.536$), indicating little replacement of Mg by Fe and Mn.

The lack of Fe and Mn in the Wodgina bobierrite is at first glance somewhat surprising, in view of its occurrence in altered lithiophilite. Evidently, however, the bobierrite formed after the complete alteration of the lithiophilite and the oxidation of the Fe and Mn beyond the divalent state, in which state they could replace the Mg. The source of the Mg does not appear to be in the lithiophilite, since an analysis of this mineral from Wodgina (Berggren, in Quensel, 1940) shows 0.00% MgO. Possibly the Mg was derived from local groundwater, a possibility supported by the very local occurrence of the bobierrite; out of two collecting trips to Wodgina (1963 and 1973), only one block of altered lithiophilite was found to contain this mineral.

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# THE OCCURRENCE OF ALSTONITE AT CAVE IN ROCK, ILLINOIS

*by George R. Rossman and Richard L. Squires*

**Division of Geological Sciences • California Institute of Technology • Pasadena, California 91109**

Abstract:

Alstonite, $CaBa(CO_3)_2$, has been identified as coatings of pyramidal crystals on veins of mixed carbonates in specimens of barium and calcium carbonates from the Minerva mine at Cave in Rock, Illinois. This represents the first recorded American occurrence of this mineral. It is biaxial negative, $N\alpha = 1.526$, $N\beta = 1.671$, $N\gamma = 1.672$. Infrared spectra, x-ray powder diffraction data, and emission spectrographic data are reported.

## Introduction:

Alstonite, dimorphous with barytocalcite, is a rare barium-calcium carbonate, $BaCa(CO_3)_2$, which has been previously identified occurring with witherite and calcite at three localities near Alston, Hexham, and Durham, England (Palache, et al., 1954; Spencer, 1911). We now report an additional occurrence of this mineral which marks the first reported occurrence of alstonite in the United States. Alstonite has been identified occurring abundantly in several samples collected at the Minerva No. 1 mine at Cave in Rock, southeastern Illinois, during the summer of 1971.

The mineral occurs as colorless to gray, transparent, sharply terminated pseudo-hexagonal pyramids up to 2 mm in length lining cavities in veins of waxy yellow benstonite, fine-grained calcite, and centimeter size witherite crystals. The occurrence of benstonite from the locality has already been described in this journal (White and Jarosewich, 1970). A scanning electron microscope picture of a cluster of these alstonite crystals is shown in Figure 1. A closeup view of the fractured crystal near the top of Figure 1 is shown in Figure 2. Horizontal growth striations which help to distinguish alstonite from calcite can be clearly seen on this crystal. Secondary alstonite crystals which coat the surface of the larger crystals tend to be more abundant in the valleys formed by the growth striations (Figure 3).

Emission spectrographic analyses of the mineral indicated that Ba and Ca were the only major cations and that no trace elements were present in significant quantities. X-ray powder diffraction patterns, however, failed to agree with any of the substances tabulated in the J.C.P.D.S. files; in particular, no agreement was obtained with the

***Fig. 1.* Scanning electron microscope photograph of a cluster of alstonite crystals from Minerva No. 1 mine, Cave in Rock, Illinois.**

*Contribution No. 2434

barium-calcium carbonates. An infrared spectrum indicated that the mineral was a carbonate of relatively simple structure (Figure 4). Comparison of this infrared spectrum with the spectra of a series of barium and barium-calcium carbonates indicated that the spectrum of the Minerva mineral was identical in all respects to the spectrum of the alstonite specimen from Alston, England. It furthermore agreed with that portion of the alstonite spectrum reported by Adler and Kerr (1963) obtained from a Northumberland, England, specimen. Figure 5 shows the spectra of Minerva witherite ($BaCO_3$), Alston alstonite, Cumberland barytocalcite $BaCa(CO_3)_2$, and Minerva benstonite in the diagnostic 750-650 cm$^{-1}$ region. The absorption of infrared radiation in this wavelength region, which occurs as the $CO_3^{=}$ groups undergo bending motions, is sensitive to small changes in the symmetry of the ions in the immediate vicinity of the $CO_3^{=}$ groups, and thus provides a sensitive means of identification. The optical properties of the Minerva mineral which were determined and found to be in good agreement with those of Alston, England, alstonite (Table I) confirm the infrared identification of the mineral.

Discussion:

In spite of the discrepancy between the x-ray powder diffraction results and the J.C.P.D.S. file for synthetic al-

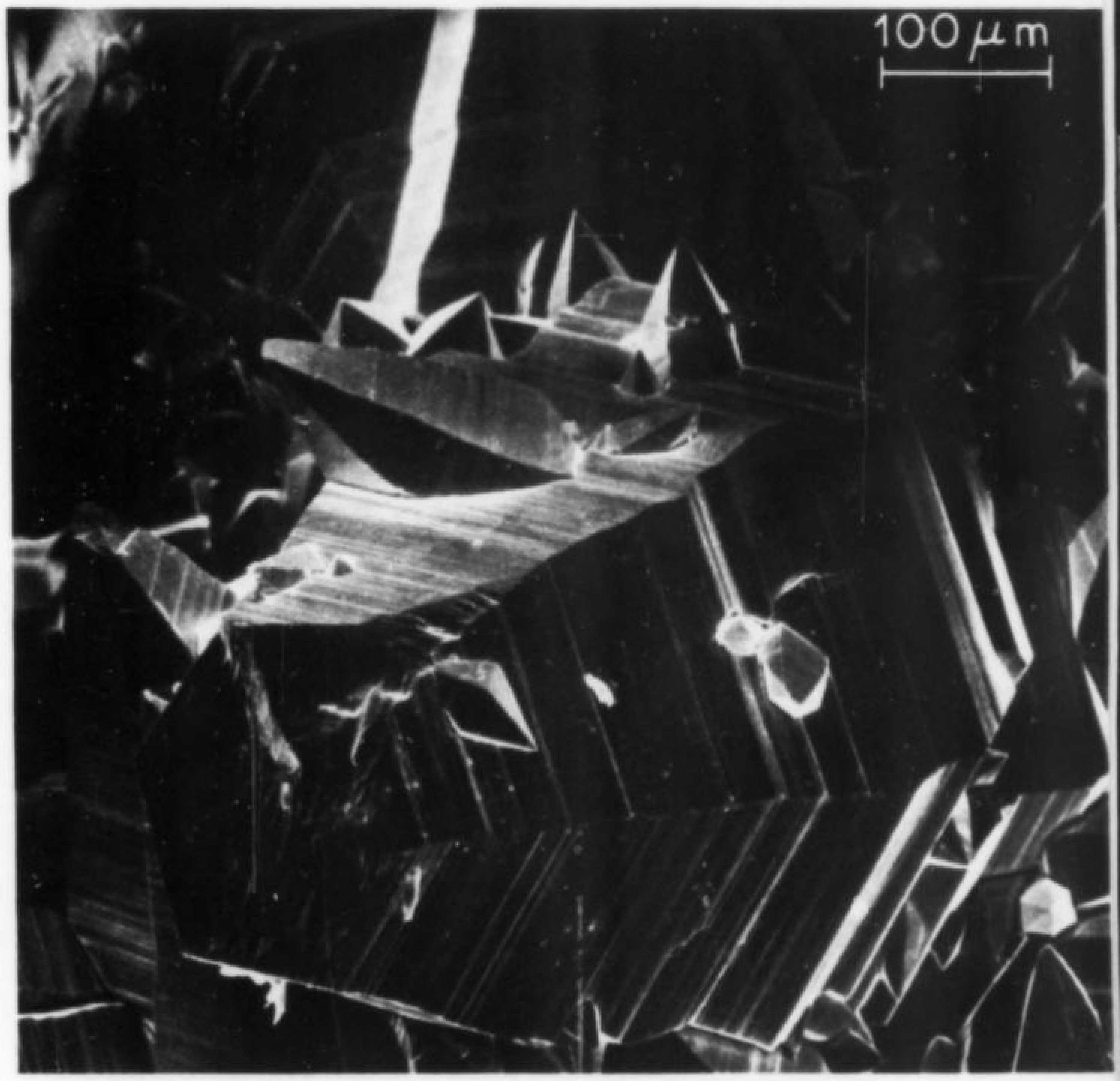

*Fig. 2.* **Scanning electron microscope photograph of a fractured Minerva alstonite crystal showing prominent growth striations.**

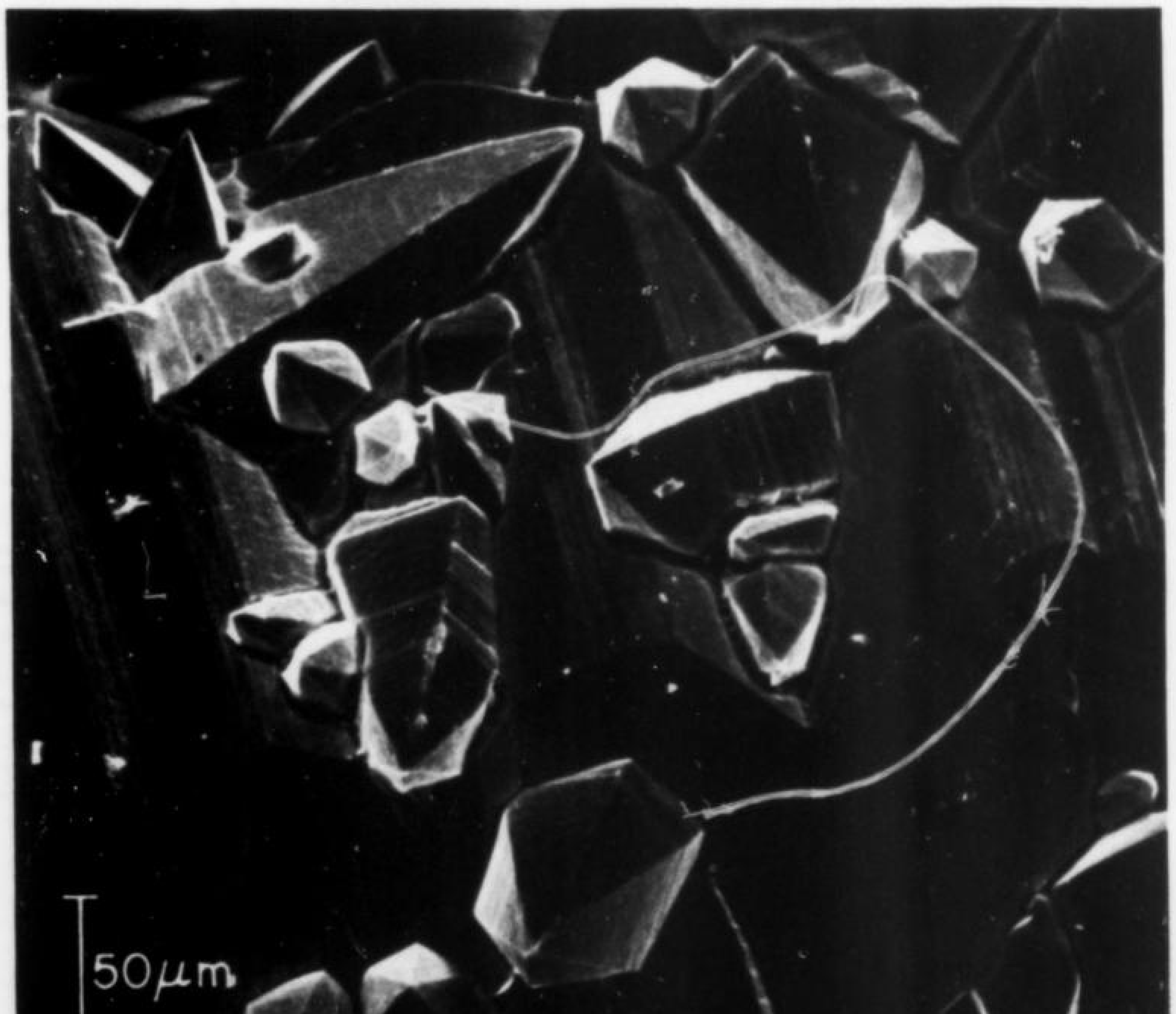

*Fig. 3.* **Scanning electron microscope photograph of a Minerva alstonite crystal showing a close-up view of secondary crystals growing in the valleys of the growth striations.**

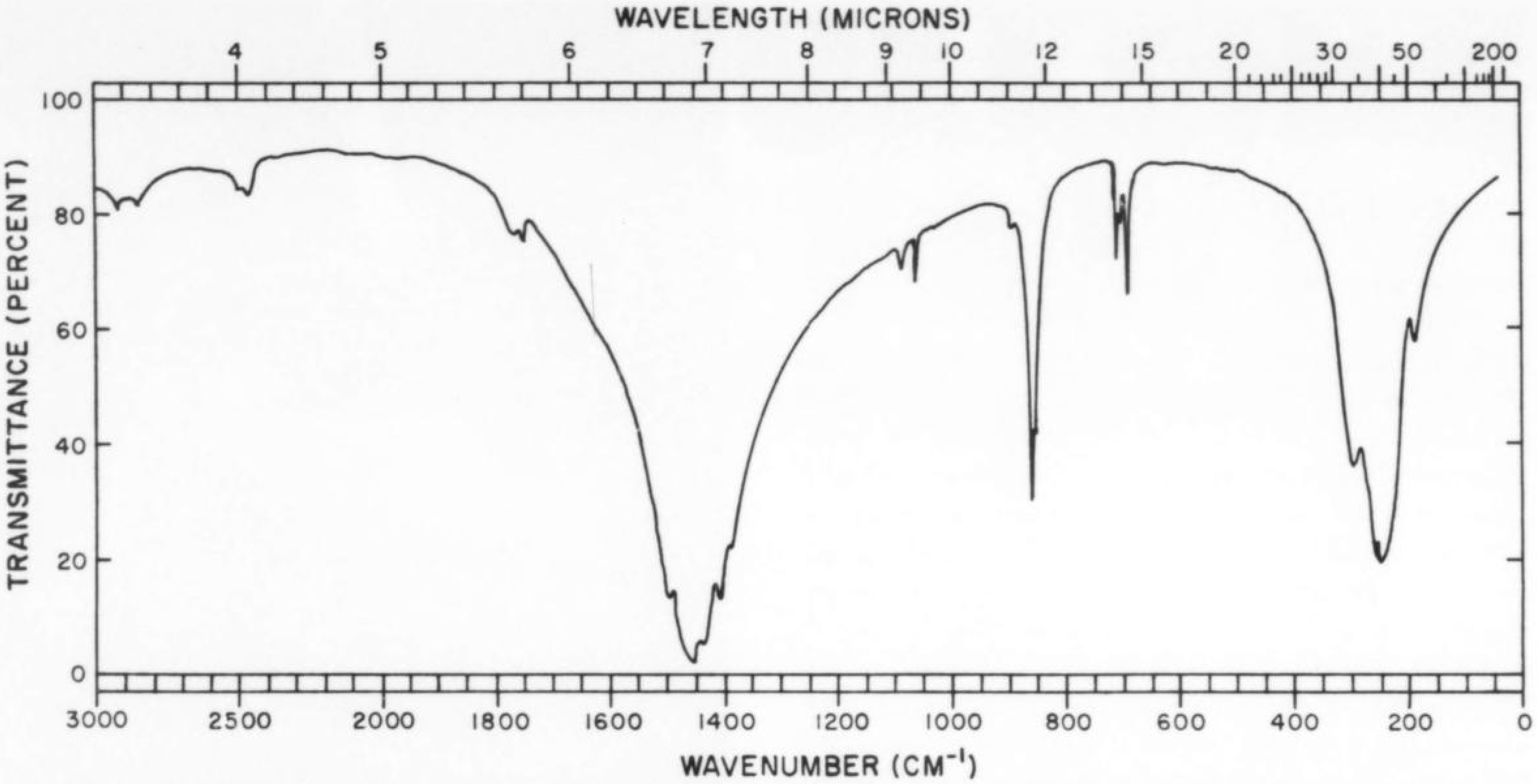

***Fig. 4.*** **Infrared absorption spectrum of Minerva alstonite. Powdered samples in KBr pellets, 4000-300 cm$^{-1}$, and in paraffin wax 300-33 cm$^{-1}$.**

stonite, the identification of the Minerva mineral is certain in view of the exact agreement with the infrared and optical data for the Alston, England, specimen. Furthermore, we obtained the powder diffraction pattern for the Alston, England, alstonite which was found to be in excellent agreement with the pattern of the Minerva alstonite. These x-ray data are tabulated in Table II. The powder pattern of the Northumberland alstonite specimen (NMNH #78840-3) used by Adler and Kerr (1963) was obtained by Mr. Pete Dunn at the Smithsonian and was also found to agree with the data tabulated in Table II. We conclude that the synthetic barium-calcium carbonate called alstonite, whose patterns are in the J.C.P.D.S. files, is not identical with the natural alstonite. To date, about 100 grams of alstonite have been identified. It is found to be associated with all the benstonite specimens which we have seen from the Minerva mine, although it could be easily mistaken for calcite upon casual inspection.

Acknowledgment:

We thank W. J. Rodekohr for bringing to our attention the unidentified mineral in the Cave in Rock specimens, and Stephen Weiner for assistance with the electronmicroscope photography.

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Table I Optical and chemical properties of alstonite from Cave in Rock, Illinois, and Alston, England

| | Cave in Rock, Ill. | Alston, England |
|---|---|---|
| N$\alpha$ | 1.526 | 1.526 |
| N$\beta$ | 1.671 | 1.671 |
| N$\gamma$ | 1.672 | 1.672 |
| | Biax – | Biax – |
| Emission Spectra | Major Ca, Ba | Major Ca, Ba<br>Minor Sr |

Table II X-ray Powder diffraction data for Minerva No. 1 mine alstonite.

| d-spacing | intensity | d-spacing | intensity |
|---|---|---|---|
| 4.185 | 1 | 1.764 | 1 |
| 3.538 | 10 | 1.664 | 1 |
| 3.083 | 3 | 1.638 | 2 |
| 2.822 | 4 | 1.585 | 7 |
| 2.503 | 8 | 1.524 | 2 |
| 2.163 | 4 | 1.483 | 2 |
| 2.044 | 8 | 1.445 | 6 |
| 1.940 | 8 | 1.305 | 7 |
| 1.840 | 8 | 1.278 | 7 |
| | | 1.255 | 6 |

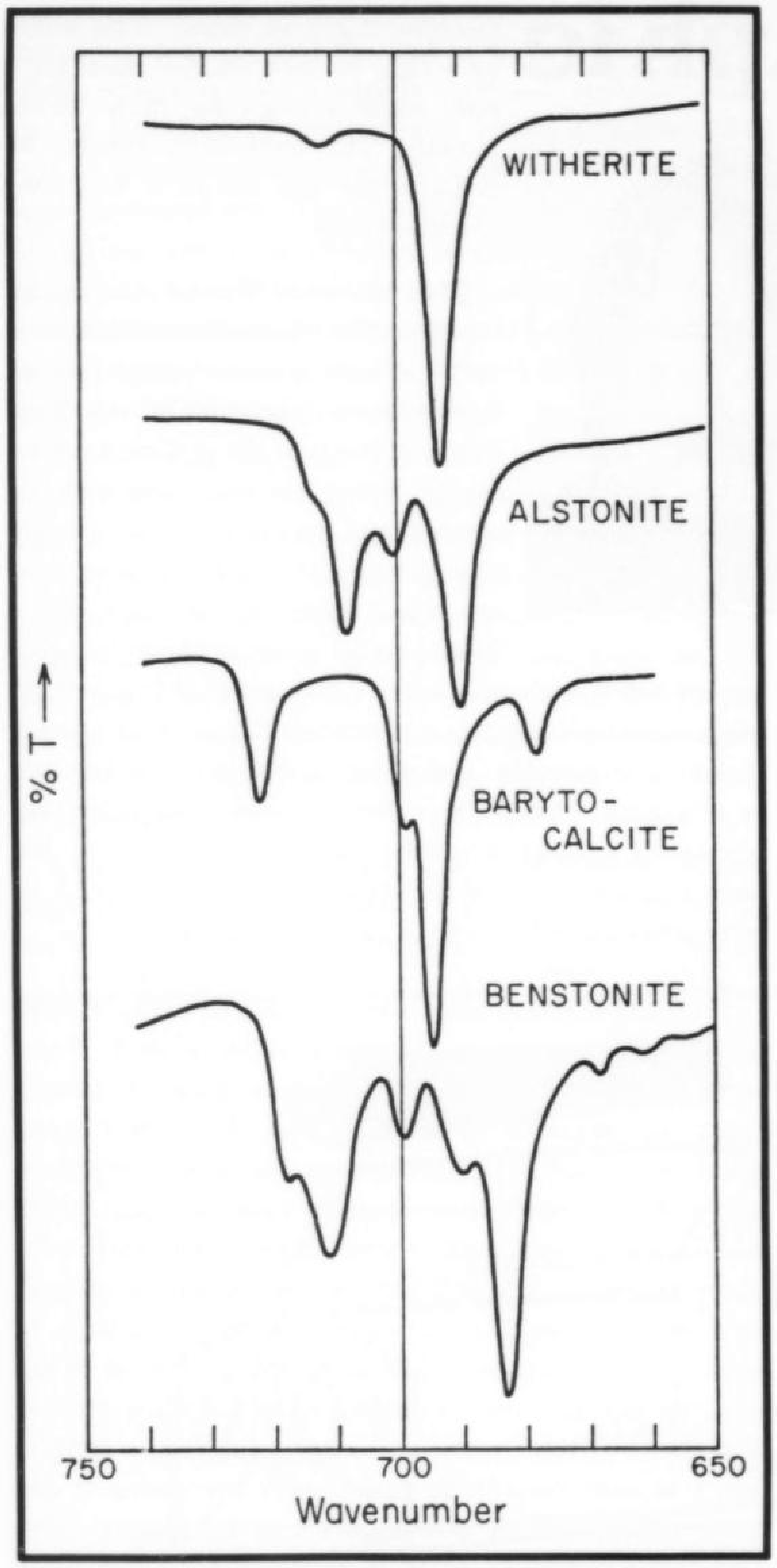


***Fig. 5.* Comparison of the infrared absorption spectra of barium carbonate minerals in the diagnostic 750-650 cm$^{-1}$ region.**

**Judge Ervan F. Kushner presents copies of his new book,** *A Guide to Mineral Collecting at Franklin and Sterling Hill, New Jersey* to John Leach Baum (left) and Ewald Gerstmann (right).

Because of the notable contributions made by both Messers Baum and Gerstmann to the mineralogy of Franklin, the book has been dedicated in their honor.

Mr. Baum, a student of Charles Palache, while at Harvard College, joined the New Jersey Zinc Company upon graduation. He retired from the Company, as Resident Geologist, after 32 years of service.

Ewald Gerstmann is the owner of one of the world's largest and most definitive collections of Franklin and Sterling Hill minerals.

*Photograph, Harri-Anne Studio, Franklin.*

## IMA PREPARES NEW DIRECTORY

The new *World Directory of Mineral Collections* contains adequate information about more than 200 mineral collections in 22 different countries. It has been prepared by the Commission on Museums of the International Mineralogical Association, Peter C. Zwaan, chairman, Marjorie Hooker, secretary, and Ole V. Petersen, secretary.

Orders for copies should be addressed to either: **Miss M. Hooker, Secretary of the I.M.A., U.S. Geological Survey, National Center 958, Reston, Virginia 22092; or Ole V. Petersen, Secretary of the Commission on Museums, Østervoldgade 7, DK 1350, Copenhagen, Denmark.** The cost is $4.00 per copy (postage included).

# The Photographic Record

by Wendell E. Wilson

### *The Super-tube for photomicrography*

It has been argued that the world's finest mineral specimens are micromounts because the greatest potential for perfection is invariably realized in these tiny crystals. I've often wished for some technological breakthrough: an invention that would make it possible to expand micromounts to hand specimen size! They might not *weigh* any more than they did originally, but at least people could handle them and appreciate them with considerably more ease. Unfortunately such an invention is not currently available, even through Heathkit, so we must find other means for observing and appreciating micromounts. There are two possibilities, each with advantages and disadvantages.

The most common solution is the use of some kind of microscope. The advantages are (1) new specimens may be immediately examined, and (2) specimens may be moved around while under observation, to see the sides and back, and also to examine all parts of the specimen in the sharp focus zone. Disadvantages are (1) usually only one person may use a microscope at one time, and (2) the depth of focus is *extremely* small, especially for high magnification.

The other solution is photomicrography. Advantages are (1) increased depth of field, (2) photographs are viewable by many people simultaneously, (3) specimens may be shown more easily and more rapidly. Disadvantages are (1) time and trouble involved in taking the photographs, (2) inability to "move" the specimen being viewed in a photograph.

But why quibble over the disadvantages? If the collector owns a camera as well as a microscope he can make use of *both* methods and combine their advantages! Julius Weber has promised us a future column on his sophisticated photomicrography techniques. Also in the future is a column on simple photomicrography with an ordinary microscope. This installment, however, is devoted to photomicrography *without* a microscope.

For only a few dollars it is possible to construct a relatively high-quality system capable of magnification *on the film* of 20X or more! This would be a field of view smaller than 1 x 2 mm, small enough for most micromounts. The method is simply the construction and use of a very long extension tube.

The characteristics of lenses are such that the length of extension needed to achieve a desired magnification is directly proportional to the focal length of the lens. At present I am using the 50mm lens that came with my camera, and my longest tube is 3 feet in length (although I know of at least two 5-foot tubes in use). If I had a 25 mm lens I could achieve the same magnification with only a 1-1/2-foot tube. If two sets of bellows are used *together*, a maximum extension of around 15 inches is possible. But stringing bellows together can be an expensive proposition. Several homemade tubes and one set of bellows would be just as good. Most of the photos in my article on the Rowley Mine (*M. R., v. 5, 1*) were taken using 8 to 20-inch cardboard tubes.

The tube is constructed from cardboard (with or without the telescoping capacity) as shown in figure 1. If you were to construct 2 or 3 telescoping cardboard extension tubes, accompanied by a set or two of standard metal tubes, you would have a system capable of any magnification within the range determined by your lens focal length and the maximum length of your longest tube. This could easily extend to 20X and even higher. In theory there is *no limit* to the length of extension you put on the lens. In practice the extension is limited by the resolution of the lens, the increased need for light on the specimen, and the dimensions of your room. Too much light can be dangerous; it is quite possible to cause many specimens to discolor, crack, deform or even melt under intense light. The compensatory increase in exposure time eventually becomes impractical, although B & W film can be extended further than color film.

Unless the tube is lined with black velvet, "milky", low-contrast shots will result. This is caused by internal reflections along the inside of the tube, which are largely absorbed by the velvet but are *not* adequately absorbed by any type of paint or black paper. The velvet can be glued down with white glue or rubber cement; be careful not to crush the velvet mat into the glue by pressing too hard. All edges of the velvet must be dabbed with glue, or fraying will shed tiny fibers that could get into the camera mechanism.

One set of standard metal extension tubes can be used to connect the lens and camera body to the tube. The two smaller rings of the set can be screwed onto the camera body and the large ring is taped or screwed onto the *front* end of the lens, so that the lens is mounted backwards. Macro lenses are not normally reversed. Adapter rings can be purchased to reverse most lenses. Construct the tube so that the metal rings slide snugly inside the velvet-lined cardboard tube. The lens and camera body can then be slid out and easily attached to different tubes as the situation dictates. If you are making a telescoping tube be sure that the fit along the telescoping section is snug enough to stop light from entering the tube along the crack. A minimum 2-inch overlap is advisable.

In actual operation this system is somewhat different from what you may be used to. The lens is set at infinity and the shot is composed and focussed at a large aperture (*f*/2 to *f*/8). No tripod is used; the whole assembly is placed on a table and focussing is accomplished by sliding the entire camera-tube-lens system back and forth on the table top. Positioning the tiny specimen in the proper position and orientation while adjusting the lighting angles can be a tedious, tiring, frustrating task but the results are definitely worth it.

A big problem with such tiny specimens is adjusting their height, because a difference of a few tenths of a millimeter can be crucial to the composition of the shot. It can be done with clay, but it is easier with a small adjustable stage such as pictured in figure 2. The elevation of the specimen can be easily and safely adjusted to a very accurate degree.

As with most other factors in photomicrography, lighting can be even more troublesome than it is in close-up photography. As the specimen must be situated within an inch or two of the lens to be in focus, the possible lighting angles become more limited. It also becomes difficult to see the specimen through the viewfinder well enough to focus, even at full aperture, because the amount of light reaching the viewfinder is so small. In general, if you can see well enough to focus at *f*/2 you can get a good exposure in no more than 2 to 4 minutes.

Some people prefer an electronic flash set a few inches away from the specimen. The flash is fired by hand after the shutter is locked open. You can discharge the flash from several positions around the specimen before closing the shutter and the results will be cumulative, as if you'd had 4 or 5 flashes going off at the same time. This method requires some preliminary experimentation to determine how many flashes from how far away are necessary to produce a good exposure with a particular film speed, lens, and extension length. Lighting angles can be pre-

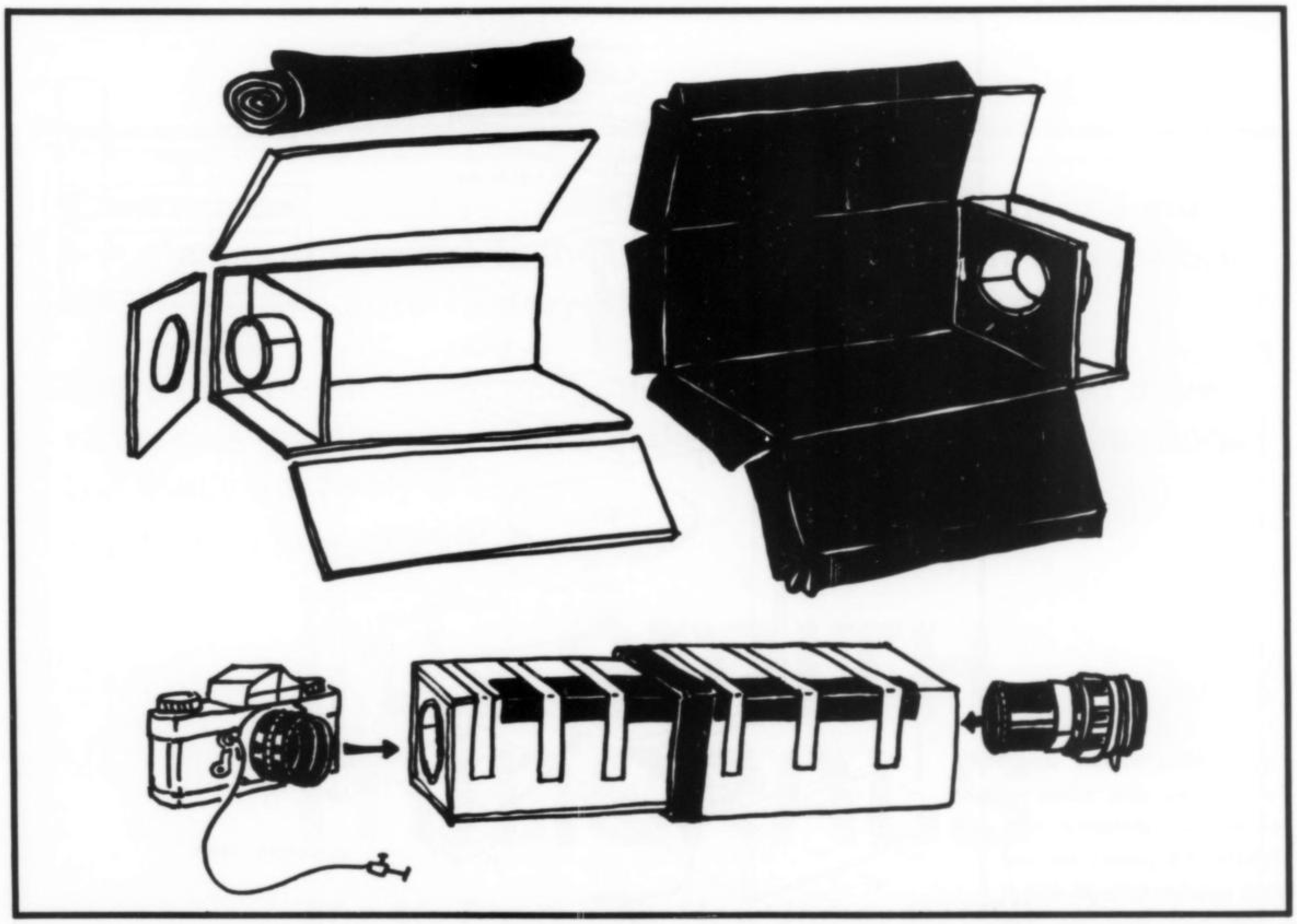


*Fig. 1.* **Construction of a telescoping extension tube from corrugated cardboard (length optional). Inner sleeves must be carefully sized to fit snugly over metal tubes on lens and camera body. Cardboard is assembled and black velvet attached using Elmer's Glue and nylon strapping tape.**

determined using high intensity lamps. One-flash shots will solve most system-vibration problems.

How do you compute exposure times if your meter only goes up to 1 second or less? Simple: determine the proper *f*/stop at a 1 second exposure. If the proper stop is *f*/5.6, for instance, you know that you are three stops away from *f*/16, which is what you want for best depth of field (unless, of course, your lens will stop down farther). Move the aperture to *f*/16 for the shot and you have cut the light level in half three times. Therefore you must *double* that 1 second three times (1 + 1 = 2, 2 + 2 = 4, 4 + 4 = 8) and you will find the exposure time indicated is eight seconds. Since the film response slows down for exposures over about 1/2 second, you will usually have to increase that by another step, to 16 seconds, to achieve a good picture. Time it on your watch while using a cable release.

With such long exposures the big nuisance is vibration. Traffic outside, someone walking through the room while your exposure is taking place, or even a big sneeze can cause a blur, lack of sharpness, or tiny "ghosts" on your film image. This effect can be minimized by doing your photography in the basement on a concrete floor, on a sturdy table. It will help to place some heavy objects on the table, sand bags, books, an anvil, an old engine block or whatever, to increase the system's inertia and damp out vibrations. Do not touch the table during exposure. Tape down your end of the cable release, depress it, and screw down the lock so you can lean back and time the exposure without touching anything. "Sandbagging" the tripod in a similar way is also advisable.

It turns out that this system actually produces better photographs than most microscopes do. The reason is that most microscopes have a fixed "*f*/stop" which is large enough to admit plenty of light to the eye. The camera and film do not require nearly that much light because of the time-exposure and flash capability. With the system here described, the viewfinder may appear to go almost completely black when you stop down to *f*/16, but a good exposure will result nevertheless, and the photograph will have *much* greater depth of field than obtainable with a microscope. If the system is improved by using a macro lens or wide-angle lens and a good tele-extender the depth of field can be increased significantly further.

Wendell Wilson
8042 Bryant Avenue South
Bloomington, Minnesota 55420

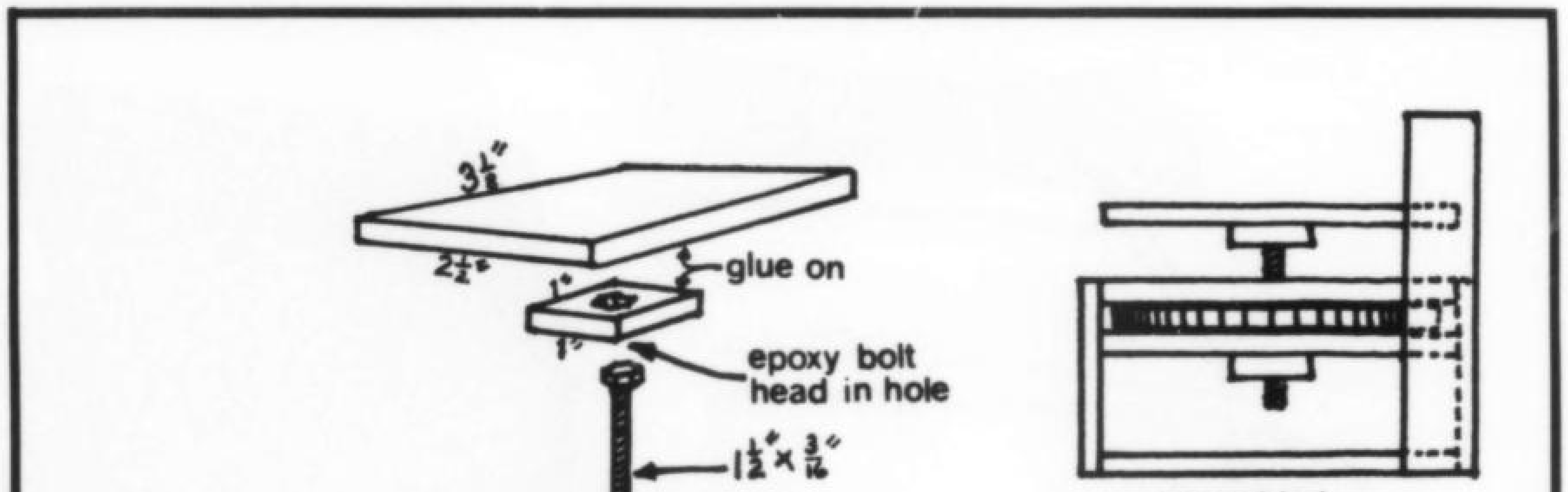
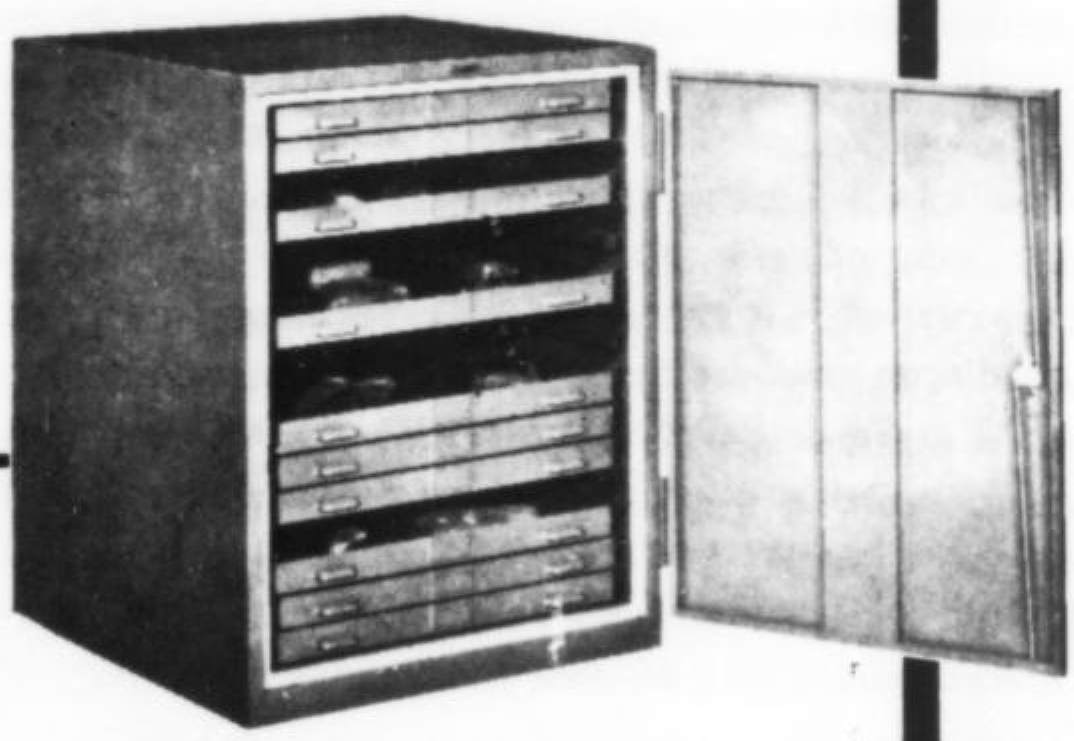


***Fig. 2.* Micromount stage. Turning the disc raises or lowers the specimen very slightly. All pieces are cut from quarter-inch plywood. Screw bolt into the two nuts before gluing nuts into disc so that nuts will be aligned with each other.**



# THE PA

INTRODUCTION

The Palermo mine is located near the village of North Groton in Grafton County, New Hampshire. The locality described here is often called the Palermo #1 mine because it is the largest and oldest of three neighboring pegmatite operations of the same name. In spite of its small size the Palermo mine is among the world's foremost localities for rare phosphate minerals. These minerals have been exposed during the intermittent mining activity that has occurred in Groton for nearly a century. The Palermo mine was initially opened for mica, but changing economic conditions have also resulted in the production of feldspar, beryl, and quartz. Only recently has the mine been worked solely as a source of mineral specimens. Palermo is the type locality for several species, including whitlockite, palermoite, wolfeite, and bjarebyite. It was also the second known locality for graftonite and brazilianite.

The purpose of this article is to summarize the geology and history of the Palermo mine. There are many detailed descriptions of the minerals that have been found here, but little has been written about the historical background of the locality. To help remedy this situation the author has gathered fragments of the Palermo mine's history from various sources and attempted to reconstruct its interesting past.

GEOLOGY OF THE PALERMO PEGMATITE

The Palermo mine contains both surface and underground workings in a granite pegmatite. This pegmatite is surrounded by quartz-mica schist of the Devonian Littleton formation. The foliation of the schist strikes northeast and dips steeply to the southeast. The formation contains large metacrysts of sillimanite that may be seen in glaciated ledges adjacent to the mine (Fig. 1).

Cameron *et al.* (1954) have described the geology of the Palermo mine in detail, and much of the following information is from their report. The outcrop of the Palermo pegmatite is 160 feet wide and 220 feet long. It is mostly concordant with the country rock and plunges northeast at 35-55°. Cross sections by Cameron *et al.* (1949, 1954) show that the pegmatite probably extends down-dip for at least 200 feet. It is a fine example of a zoned pegmatite—one in which different mineral assemblages are present in concentric layers. The zones at the Palermo mine are parallel to the contact with the country rock, but some of them are discontinuous and do not extend completely around the core. Cameron recognized the following zones in the Palermo pegmatite:

(1) *Border zone*: This discontinuous zone is the outermost part of the pegmatite. It is a thin (2-4 inches) and fine-grained mixture of quartz, muscovite, and oligoclase.

(2) *Wall zone*: The wall zone of the Palermo pegmatite is up to 2 feet thick. It is discontinuous and found only along the east contact. This medium-grained zone consists of albite, quartz, muscovite, biotite,

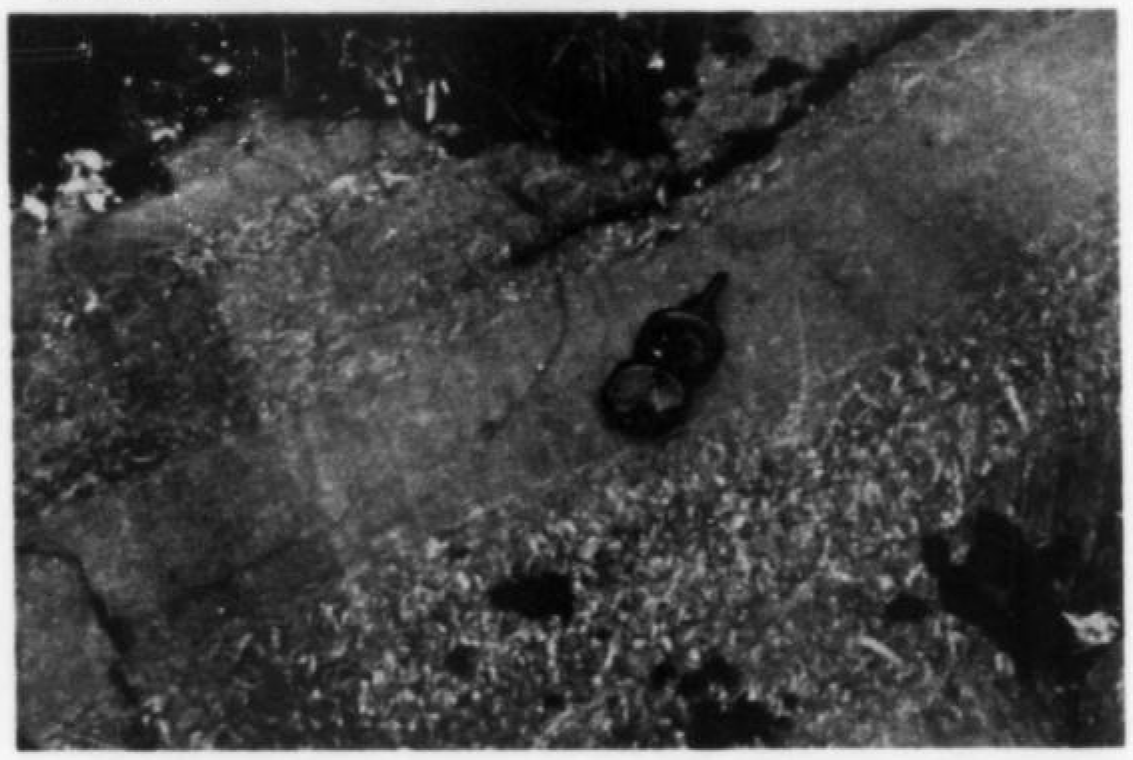


***Fig. 1.*** **Sillimanite in an outcrop of the Littleton formation adjacent to the north side of the Palermo pegmatite. The compass points north.**

# ALERMO MINE

## NEW HAMPSHIRE

*Woodrow Thompson*
**Department of Geology and Mineralogy,**
**Ohio State University, Columbus, Ohio 43210**

and tourmaline. It has been the source of minor sheet mica.

(3) *Outer intermediate zone*: This zone is 5-25 feet thick and extends around the full circumference of the pegmatite. It is an aggregate of quartz and albite with lesser amounts of perthite, muscovite, biotite, tourmaline, and other minerals.

(4) *Middle intermediate zone*: The middle intermediate zone lies along the underside of the pegmatite's core. It is a mixture of albite, quartz, and muscovite. This is the main sheet mica zone, and much of it was removed during the early days of mining at Palermo.

(5) *Inner intermediate (core margin) zone*: This zone is mostly perthite. It formed a cap over the northwest part of the core. Feldspar and beryl were mined from the core margin zone, and some of the beryl crystals were up to 8 feet long (Frondel and Lindberg, 1948).

(6) *Core zone*: The core of the Palermo pegmatite is a quartz-perthite mixture with some scrap mica and beryl. The upper part of this zone also contains cleavelandite-muscovite replacement bodies and large triphylite pods. The lower side of the core is separated from the middle intermediate zone by another cleavelandite-muscovite replacement body. However, the latter unit is absent on the south face of the pegmatite outcrop, and the two zones are instead separated by a quartz-plagioclase unit. Like the cores of most granite pegmatites, the core zone at Palermo contains a lot of quartz. It was recently mined as a source of this mineral.

It is apparent from the above descriptions that the zonation of the Palermo pegmatite is significant to both the miner and mineral collector. Economically valuable mineral concentrations are often haphazardly distributed in pegmatites. Therefore a practical knowledge of how minerals may be concentrated in zones enables the miner to explore the pegmatite with a greater probability of finding the desired mineral. The collector is likewise aided in his search by making analogies with previous mineral discoveries in other zoned pegmatites.

## HISTORY OF THE PALERMO MINE

The Palermo mine was known as the "Hartford mine" during its earliest period of operation. The year in which the mine was opened is uncertain. Frondel and Lindberg (1948) claimed that it was 1863. If the mine had been opened that early, it is surprising that Hitchcock (1877) did not mention it in his monumental volume that described the geology of New Hampshire. He did pinpoint the locations of several "granitic veins" and beryl discoveries in Groton, but there was no mention of the Hartford mine. The present author believes that it was probably opened in the late 1870's, at about the time that Hitchcock's books were

***Fig. 2.* A 1941 view of the entrance to the old underground stopes at Palermo mine.**

published. The Hartford mine was certainly in operation by 1877 (Cameron *et al.*, 1954), and it was worked for muscovite more or less continuously until 1905 (Verrow, 1941).

According to Child (1886) the Hartford Mica Mining Company originated in Hartford, Connecticut, and had a capital of $300,000. The mine in Groton was certainly a large venture for the early days of mica mining. Sterrett (1915) reported that 85 miners worked at the Hartford mine, while 25-30 women were hired to sort and trim the mica. Most of the work was done underground with hand drills. Two open cuts were made in the south face of the pegmatite. These excavations were extended underground to the north and northeast by means of a horizontal adit from the eastern cut and an inclined shaft from the higher western opening. The principal entrance was the cut at the southeast corner of the pegmatite. It opened into a large room that contained a hoisting engine. Tracks were laid from this room along a series of stopes that were steeply inclined to the northeast for a distance of about 300 feet. The hoist room was connected to the western inclined shaft by a short raise. These underground workings allowed the miners to follow the rich sheet mica zone that lay under the core of the pegmatite. Waste rock was hauled out on tracks and dumped south of the mine. There was also a third open cut near the north edge of the pegmatite. A steep incline was driven southeast from this cut to connect with the main underground stopes. Material from the north part of the mine was dumped on the hillside northeast of the pegmatite. The miners were overly enthusiastic in their exploitation of the rich mica zone—they removed nearly all of the supporting pillars and created a dangerous condition in the stopes (Sterrett, 1923).

The General Electric Company purchased the Hartford mine in the early 1900's, and the locality had acquired its present name by 1913 (Sterrett, 1915). General Electric reopened the Palermo mine on a limited basis in 1914 and continued to work it through the following year. They pumped out the underground openings to a depth of 60 feet. Mica was mined from the upper part of the western stope, and the dumps were turned over in search of scrap mica.

In 1922 an east-west pit was cut into the northern part of the Palermo pegmatite. J. A. Rodgers was in charge of the mine, and he removed feldspar for use in making dishes. The feldspar was brought down to Rumney, from which it was shipped out by train. Mining continued at least into 1923. During the intervening winter the rock was pulled to Rumney on a sledge by a team of horses.

It is possible that the Palermo mine was worked through the late 1920's, though information on this period is sketchy. Berman (1927) reported that a superintendent was there at the time of his visit, but there was no mention of active mining. However the mine had attracted the attention of prominent mineralogists by this time. Berman's article dealt with the discovery of graftonite at Palermo and said that it was the second locality for this phosphate mineral. (Penfield described the original occurrence at Grafton, New Hampshire, in 1900.)

The Palermo mine lay idle during the 1930's, but mineral collectors continued to make important discoveries. Verrow and Leggett visited the locality in 1939 and found the first known specimens of whitlockite, $Ca_8(Mg,Fe)(PO_4)_6$. This mineral was described by Frondel (1941) and has since been found in such diverse environments as tooth enamel and the lunar rocks. Figure 2 shows the main entrance to the old underground workings at Palermo as it appeared in 1941.

General Electric reopened the mine in 1942 and operated it through 1943 for mica and beryl. Most activity was on the surface, though the company did recover muscovite from the underground workings. A 15-foot shaft for beryl was sunk at the bottom of the north open cut (Cameron *et al.*, 1954). It reportedly yielded 33 tons of this strategic ore of beryllium (Reiner, personal comm.). Small cuts for beryl were also made in the northeast, east, and central portions of the pegmatite outcrop. According to Cameron the central cut produced 35 tons of beryl in 1943. The dumps were also reworked once again for scrap mica.

In 1944-1945 U.S. Geological Survey workers made detailed maps of the Palermo mine as part of the Strategic Minerals Investigation program. This study resulted in the excellent report by Cameron *et al.* (1954) entitled *Pegmatite Investigations, 1942-1945, New England*. It is very useful to anyone who is interested in the New England pegmatites.

Palermo was active again by 1947. This time it was worked for at least two years by Herbert Ashley of West Rum-

***Fig. 3.* Vertical shaft in the western part of the Palermo mine. Quartz core zone (white) and triphylite pods (gray) are visible in foreground.**

***Fig. 4.* Open pit resulting from recent blasting in the central part of the mine.**

ney (Ashley Mining Company). It is probable that the vertical shaft in the southwest part of the mine was opened by Ashley's company because it is not shown on Cameron's earlier map (made by Hadley and Main in 1944). This shaft is shown in Figure 4. It connects at a shallow depth with the inclined shaft in the western part of the underground workings.

Ashley's enterprise was very diversified; he mined mica, feldspar, beryl, and triphylite. Triphylite, Li(Fe,Mn)(PO$_4$), is abundant at the Palermo mine. It is the primary mineral from which many of the rare species were derived by alteration. These secondary phosphates occur along with masses of fresh triphylite near the outer part of the pegmatite's core zone. The triphylite was stockpiled as a potential ore of lithium, but most of it apparently never left the mine. Mineral collectors eventually removed the piles that remained.

Every period of activity at the Palermo mine has revealed an assortment of fine minerals, and Ashley's operation was certainly no exception. In 1947 Frondel and Lindberg found specimens of brazilianite, thus making Palermo the second locality for this rare mineral. Wolfe discovered the first specimen of the new mineral wolfeite, (Fe,Mn)$_2$(OH)-(PO$_4$), in the same year (Frondel, 1949); and he added ludlamite to the growing list of species from this locality. 1947 was also the year in which strunzite was discovered at Palermo. It was subsequently found at other localities and described as a new species by Frondel (1957). Strunzite, (Mn,Fe)Fe$_2$(OH)$_2$(H$_2$O)$_6$(PO$_4$)$_2$, occurs abundantly at Palermo as straw-colored fibers in small cavities. It is popularly known as "Frondel's whiskers".

The Palermo mine was given lasting recognition a few years later when Mrose (1952) published her description of palermoite, $SrLi_2Al_4(OH)_4(PO_4)_4$. Palermoite is often implanted on quartz and easily escapes notice. It occurs as small, colorless crystals that are distinguished from quartz by their rectangular cross sections and longitudinal striations on the prism faces. Quartz crystals from the vicinity of the core zone should be closely examined for this mineral.

Aside from sporadic exploration, there was not much activity at the Palermo mine during the 1950's. In 1961 a group of South Carolina miners worked the inclined shaft that is now seen at the north margin of the pegmatite (Bjareby, 1967). A rich pocket of phosphate minerals was exposed near the mouth of the shaft. The present author collected specimens of scorzalite, vivianite, messelite, ludlamite, siderite, and pyrite from the vicinity of this pocket. The vivianite was especially notable for its presence in large chunks instead of the usual thin crusts or films. Moore (1965) and other collectors found some excellent hühnerkobelite (alluaudite) crystals in the same area.

During the period 1964-1966 the Palermo mine became a supplier of quartz for building aggregate. It was worked first by Robert Burleson of North Carolina, and then by Rex Howard for the Mineral Materials Company of South Lyndeborough, New Hampshire (Reiner, personal comm.). These operators extracted quartz from the pegmatite's core zone. They started mining in a room near the entrance to the old southeast stopes (now backfilled) and enlarged the opening upward until it reached the surface cuts. The intersection of the new cavern with the surface was expanded into a large open pit in the central part of the pegmatite. This resulted in a sizable arch being left between the pit and the original entrance. Collectors were rewarded with good specimens as mining progressed, and it was even possible to drive to the mine in the middle of winter. Beryl crystals up to 3 feet long were exposed in pale rose quartz of the core zone. Other minerals which turned up in the quartz-perthite core were autunite, torbernite, blue apatite, cleavelandite, palermoite, and brilliant crystals of smoky quartz. Triphylite, scorzalite, and many of the usual phosphate minerals were also found in concentrations adjacent to the core.

Following a few more years during which it was visited by many collectors, the Palermo mine entered its most recent and highly publicized phase of operation. Rolfe Paine and Peter Samuelson worked the pegmatite for mineral specimens during the summer of 1973. They blasted out a large volume of rock on the south rim of the central pit in order to expose pods of phosphate minerals (Fig. 3). Specimens of beryl and attractive blue scorzalite were removed and sold to collectors. Collecting at the mine itself was allowed on a fee basis, and one could find the rare phosphates in micromount to hand specimen sizes. The author noted large pieces of triphylite, heterosite, rockbridgeite, and messelite. The latter mineral occurred as fibrous white masses with pyrite and greenish-black rockbridgeite. A wide variety of phosphates were present in micro crystals; and it was easy to find such minerals as childrenite, strunzite, and laueite. Several unidentified species are being investigated by Paul Moore of the University of Chicago. At least one new mineral—bjarebyite—has been discovered as a result of this work (Moore, Lund and Keester, 1973).

The outlook for mineral collecting is good at the Palermo mine, even if it is not worked on a large scale basis. A careful search through the altered triphylite material will reveal crystals of rare and unusual minerals. And regardless of what is found at the mine, the clean air and woodland scenery are sufficient reward for a trip to this locality.

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**Editorial**, cont'd from page 252

increased sharply since our start in 1971. Escalating paper, labor and mailing costs, in particular, have forced upon us the unpleasant necessity for increasing our subscription fee from $6.00 ($7.00 overseas) to $10.00 (one rate to all subscribers, beginning with volume six). I sincerely regret that such a step is necessary but we have no choice. We've delayed this action for as long as possible and trust you will understand that inflation is as much a fact of life for the *Mineralogical Record* as it is for you.

I hope you will continue to support us in all of the various ways that have made possible the production of five years of the *Mineralogical Record* without interruption. It has certainly become clear by now that the magazine has earned your support.

John S. White, Jr.

# The Mineralogy Of The Bo

*by Robert E. Winchell*
**Department of Geological Sciences**
**California State University at Long Beach**
**Long Beach, California**

*and Roland C. Rouse*
**Department of Geology**
**and Mineralogy, University of Michigan**
**Ann Arbor, Michigan 48104**

## *INTRODUCTION*

The boleite group consists of four species: boleite, cumengite, pseudoboleite, and a poorly characterized mineral called percylite. As shown in Table I, all are closely related chemically, being hydrous lead copper chlorides, and crystallographically, having cubic or tetragonal symmetry and one common unit cell dimension of 15 Å. Pseudoboleite and cumengite frequently occur as epitaxial overgrowths on boleite, as might be expected from the near identity of the *a*-parameters. Such relationships suggest that these minerals have very similar crystal structures, a conclusion verified for boleite and cumengite by the authors. A close relationship is also evident geologically. These four minerals usually occur together and usually form in the same way—by the weathering of primary lead and copper sulfides in hydrothermal ore deposits.

The boleite group has received a great deal of attention from mineralogists ever since the first member, percylite, was described by Brooke (1850) from an unnamed locality in Sonora, Mexico. The rest were undiscovered until after 1885, when copper mining operations began in the arid, barren region around the town of Boleo in Baja California, Mexico (Fig. 1). Two definitive studies of the whole group exist — that of Friedel (1906) and another by Winchell (1963), the latter containing a comprehensive review of previous work. Despite these efforts, great confusion still exists in the mineralogical literature with different investigators obtaining conflicting data or making very different interpretations of the same data. The present authors are attempting to resolve these conflicts. In this paper we summarize our progress to date and review critically the results of previous workers.

## *OCCURRENCE*

The minerals of the boleite group have been reported from at least 18 widely scattered localities around the world. The most recently described of these are the type locality at Boléo (Wilson and Rocha, 1955; Johnson, 1962), the Ruhr district of Germany (Seeliger, 1950), and the Anarak and Tabas regions of northern Iran (Bariand, 1963). Two American localities are known: at the Mammoth mine, Tiger, Arizona (Palache, 1941) and at Philipsburg, Montana (Thomssen, pers. comm.). Older references to localities in Mexico, Australia, South Africa, Bolivia, and Chile are cited in Palache et al. (1951). Recently, the authors have also found boleite, pseudoboleite, and cumengite in the slags from the ancient silver mines at Laurium, Greece. (See *Min. Record*, **4**, 262-263).

Boleite is the only member of the boleite group common to all the above localities, although in most places it is accompanied by pseudoboleite. Thus far, cumengite has been reported only from Boléo, the Ruhr, and Laurium. As we shall later show, most if not all of the material described as "percylite" in the older literature is actually boleite ± pseudoboleite. Specimens labeled percylite should therefore be re-examined, preferably by x-ray diffraction, to determine what species are actually present.

Genetically, boleite and its relatives are secondary minerals which occur in the oxidized zones of hydrothermal sulfide deposits. They form during the reaction of primary lead and copper sulfides with supergene solutions containing chloride ion. In most places the source of the lead and silver is primary galena, the copper coming from primary chalcocite and/or chalcopyrite. The one exception is at Laurium, where boleite and cumengite occur in cavities in the smelter slags, which had been dumped into the sea. Apparently, sea water has both leached the appropriate metal cations out of the slags and provided chloride and hydroxyl to precipitate boleite and other halides. By contrast, most other boleite occurrences are in arid regions, where chloride salts are concentrated in the soil by weathering processes and then incorporated into supergene solutions, which alter the primary sulfides. In the Ruhr district chloride is thought to have been leached out of the nearby Permian salt beds. At Boléo the ore-bearing Boléo formation, interpreted by Wilson and Rocha as a deltaic deposit, contains abundant halite. Winchell (1963) has also

***Fig. 1.*** **Map of Baja, California, Mexico.**

# leite Group

shown that the boleite group, with the exception of percylite, can be synthesized hydrothermally. However, there is no evidence in any of the natural occurrences of precipitation of these minerals as primary phases from hydrothermal solutions.

## *BOLEITE*

Boleite was first described as a mineral by two French mineralogists, Mallard and Cumenge (1891a,b), who were studying the mineralogy of the newly-opened Boléo mines. Boleite, which was at first confused with the similar-appearing pseudoboleite and cumengite, occurs as deep blue cubes often modified by small octahedron and dodecahedron faces (Fig. 2). In thin section the crystals are seen to have a complex zoned structure (Fig. 3) consisting of an optically isotropic (or nearly isotropic) core and a rim zone composed of alternating isotropic and anisotropic plates (Fig. 4), which are parallel to the cube faces. These plates are very thin and may be continuous or discontinuous. The anisotropic ones display variable birefringence and other anomalous optical properties suggestive of an inhomogeneous character.

Mallard and Cumenge (1891a,b), and Friedel (1906), believed anisotropic boleite to be tetragonal and untwinned (despite its anomalous optical properties) and isotropic boleite to be pseudocubic due to mimetic twinning of the tetragonal material. It is well-known that twinned crystals often mimic forms of higher symmetry. In the case of boleite each twin was assumed to consist of three interpenetrating individuals. The optic axis of each individual was parallel to one of the three fourfold axes of the pseudocube, hence the observed optical isotropy. Friedel also chemically analyzed both isotropic and anisotropic boleite. For each he found essentially the same formula

$$9PbCl_2 \cdot 8CuO \cdot 3AgCl \cdot 9H_2O,$$

but the anisotropic rim material was slightly lower in silver.

The twinning interpretation of boleite was challenged by Hadding (1919) and Gossner and Arm (1929), who contended that isotropic boleite was actually cubic and untwinned. In an x-ray study the latter authors found boleite to have the space group *Pm3m* and the cell parameter $a$ = 15.37 Å. Their work was attacked by Friedel (1930) and by Hocart (1930), who found anisotropic boleite to be tetragonal with $a$ = 15.4 and $c$ = 62 Å. Gossner then replied and the argument went on for years.

Ito (1950) proposed a complex twinned crystal structure for anisotropic boleite based upon the concept of twinning

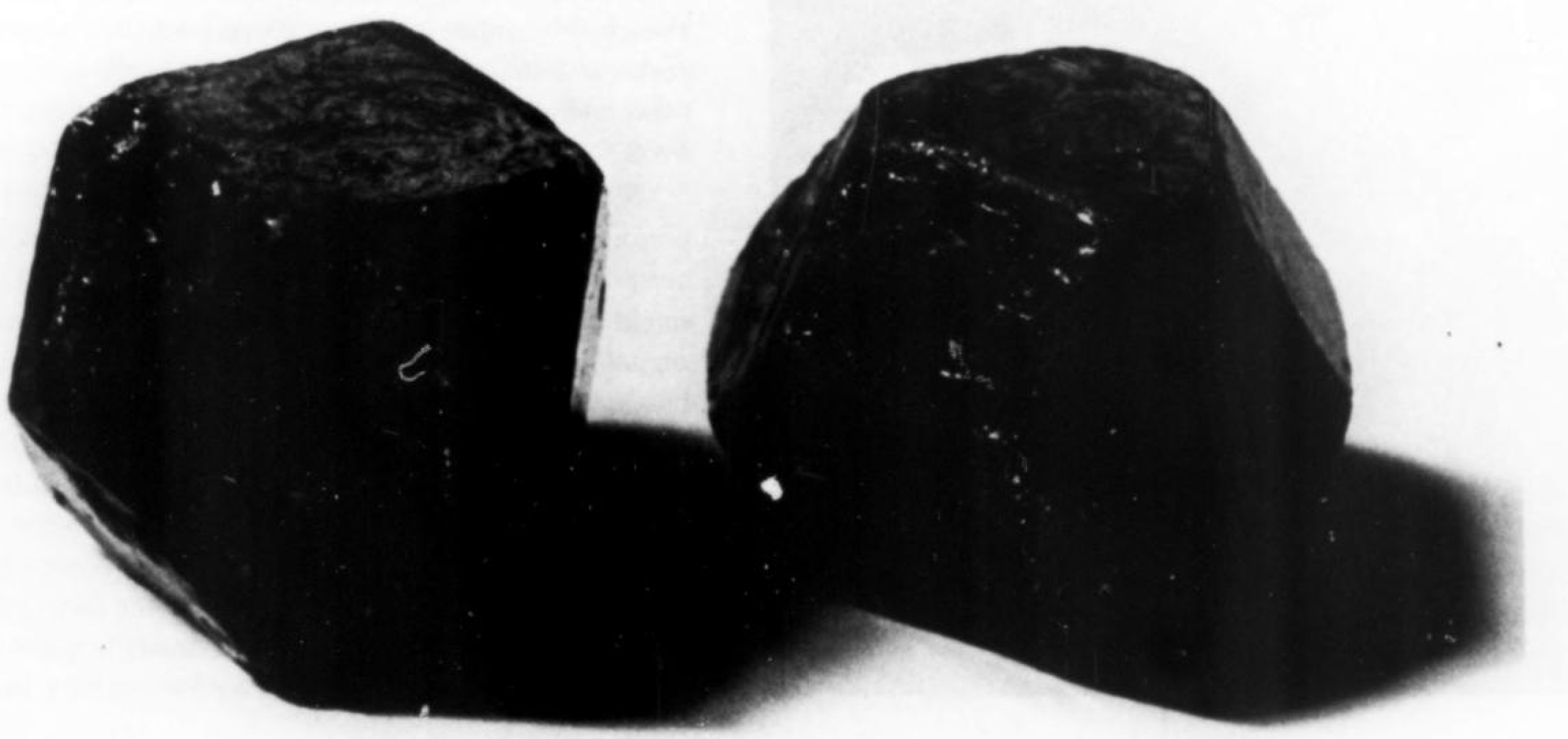

*Fig. 2.* **Cubo-octahedral boleite crystals from Boléo showing unusually well-developed octahedron faces. Photograph by Joel Arem. (NMNH #115763)**

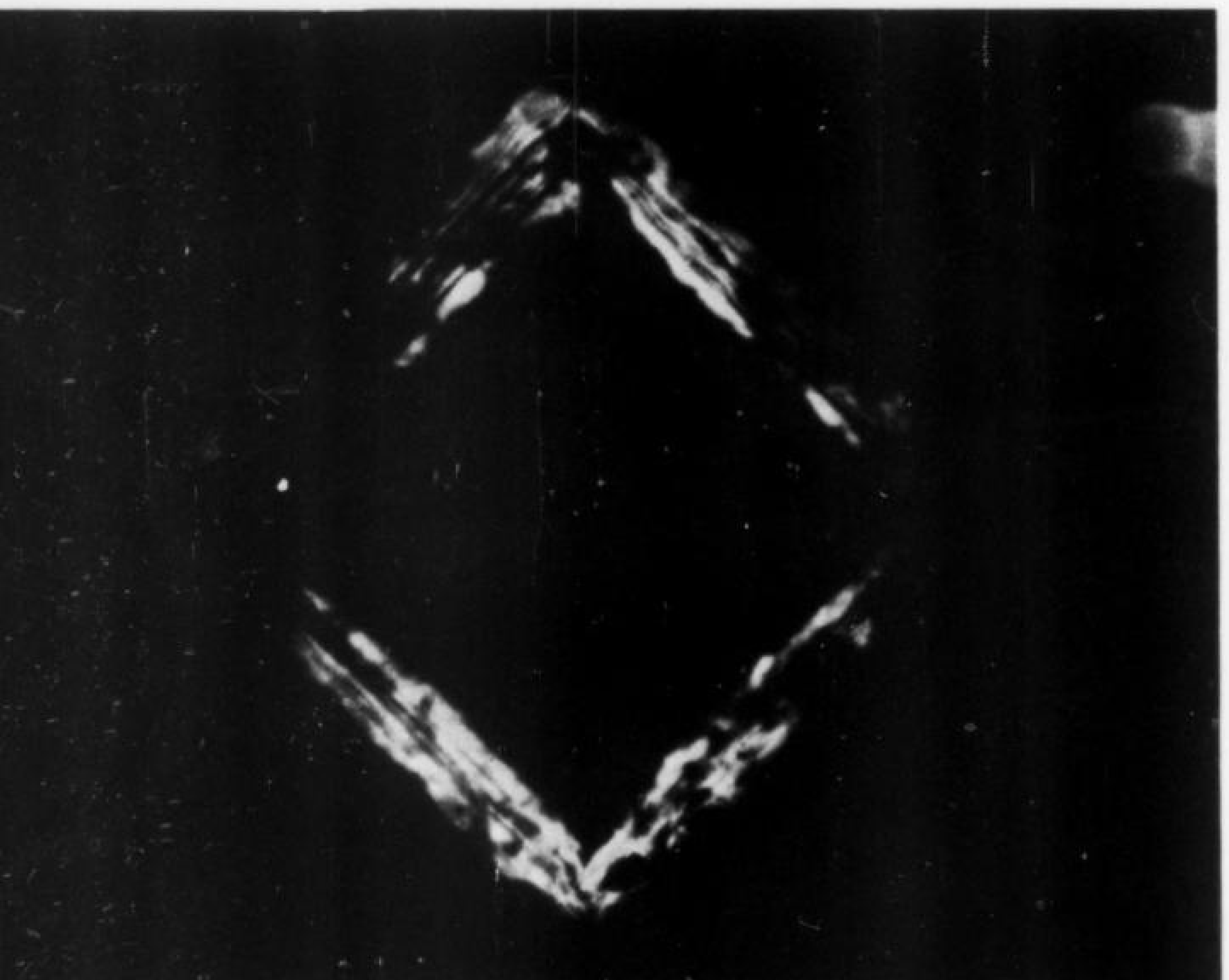

*Fig. 3.* Thin section under crossed polars of a boleite crystal cut parallel to (100). The isotropic core and banded anisotropic rim zone are evident.

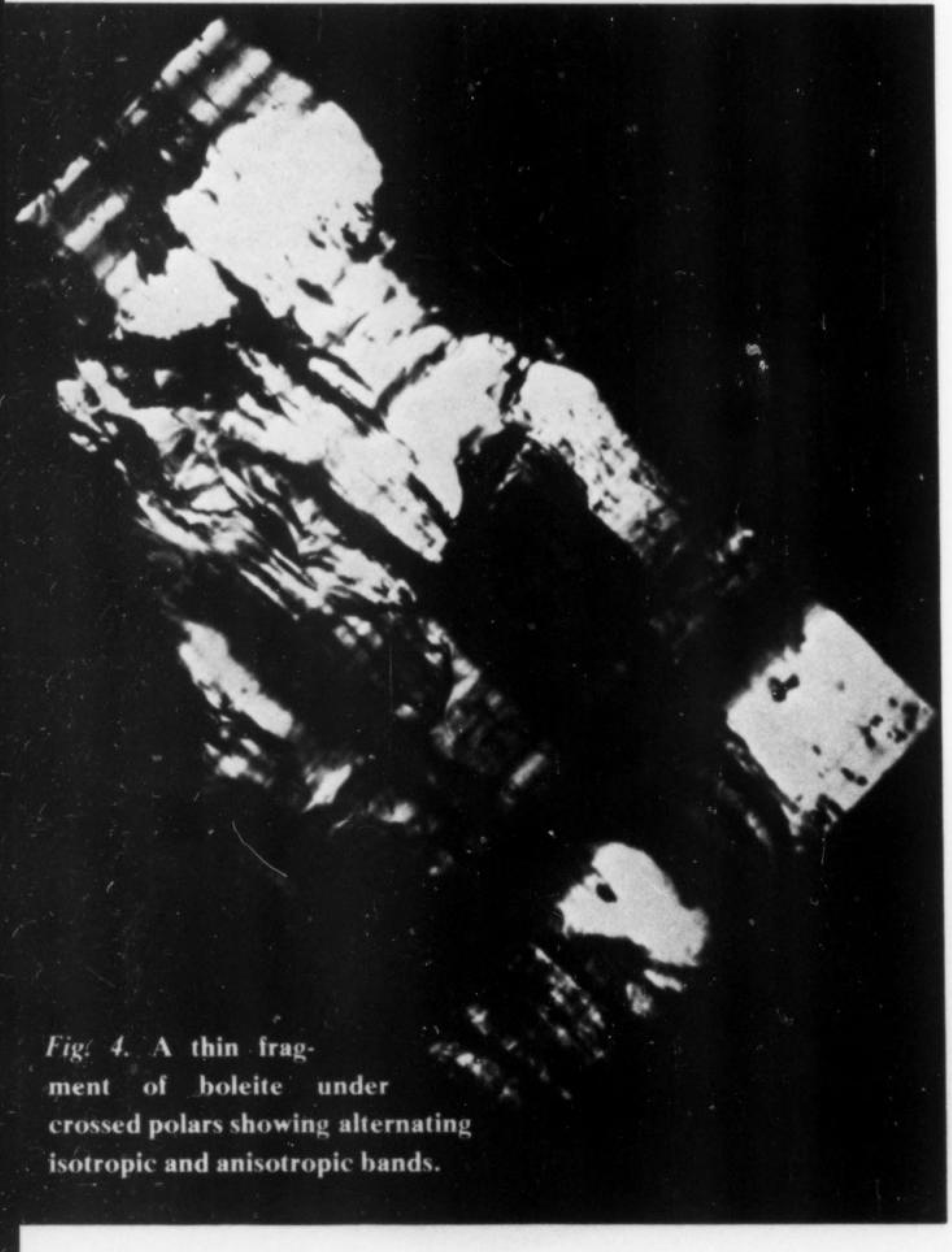

*Fig. 4.* A thin fragment of boleite under crossed polars showing alternating isotropic and anisotropic bands.

of cubic units on a unit cell scale. Ito's twinned structure is tetragonal with a "twinned space group" *I4/mmm* and cell parameters $a = 15.27$ and $c = 60.94$ Å The twin consists of four cubic cells, each having space group *Pm3m* and $a = 15.27$ Å. These data are, of course, identical with the results of Gossner and Arm. To further compound the confusion Mücke (1969) reports for boleite a tetragonal cell having $a = 15.27$ and $c = 61.30$ Å, but in a later article (Mücke, 1972), he changes the *c*-parameter to 30.65 Å and gives a space group $P4_2/mmc$. No explanation is given for this revision and in neither case are his specimens or experimental procedures adequately described. Furthermore, we will later show that tetragonal boleite is probably inhomogeneous and does not show the true symmetry of this mineral. In view of these considerations we believe that Mücke's results should be treated with caution.

The correct symmetry and chemical formula of boleite were finally determined by Rouse (1973) in the course of a crystal structure determination. Boleite is cubic, *Pm3m*, with $a = 15.29$ Å in agreement with the results of Gossner and Arm (1929). The formula is $Pb_{26}Ag_9Cu_{24}Cl_{62}(OH)_{48}$. In addition to its complexity, the structure is notable for having silver atoms grouped into regular octahedral clusters. This makes boleite one of a remarkable group of substances known as "metal cluster compounds" and apparently their first naturally-occurring representative. Anisotropic boleite has also been studied, but a discussion of this anomalous material will be deferred until after a description of pseudoboleite.

Lastly, some further remarks on the boleite crystals from Philipsburg, Montana, are in order, as they are unlike any other boleite seen by the authors. The specimens consist of aggregates of very small cubes, which easily crumble under even a slight pressure. The color is an opaque bluish green resembling that of turquoise but quite different from the normal deep blue of boleite. According to Thomssen (pers. comm.), the crystals occur in the strata underlying on old mill, where silver and copper were extracted from sulfide ores by a process utilizing mercury and salt. Presumably, saline solutions seeped into the underlying rocks and the resulting reactions produced boleite. No other member of the boleite group has yet been found here.

Microscopic and x-ray diffraction examinations, kindly performed by Mr. Pete J. Dunn, have verified that the crystals are indeed boleite. However, what appear to be single crystals are actually aggregates of numerous tiny crystallites and no truly single crystals could be found. Furthermore, most of the cubes are two-phase, their centers being composed of a brown material which gives a diffuse goethite pattern. Evidently, this is a case of boleite being deposited on goethite nuclei. The abnormal color could be due either to the polycrystalline character of the cubes or to some compositional difference from normal boleite. A qualitative electron probe analysis of two crystals showed only Pb,Cu,Ag, and Cl, all normal for boleite.

### *PSEUDOBOLEITE*

Natural pseudoboleite occurs only as epitaxial overgrowths on boleite cubes (Fig. 5), although discrete single crystals have been synthesized by one of the authors (REW). Natural crystals are morphologically tetragonal and show the pyramid, pinacoid, and sometimes prism faces. The luster and deep blue color are the same as those of boleite and when the prism faces are absent, the composite crystals (boleite + pseudoboleite) strongly resemble cubic tetrahexahedra. For these reasons the two species were at first not distinguished from one another. However, Mallard (1893) noticed that the pseudo-tetrahexahedron faces formed a groove or re-entrant angle along the cube edge. Also, the birefringence of the overgrowths was decidedly higher than that of the anisotropic boleite underneath. Since the overgrowths were obviously a new species, Lacroix (1895) proposed the name pseudoboleite for them.

The validity of the new mineral was confirmed by Friedel (1906), who made the only known chemical analysis of pseudoboleite. From it he derived the chemical formula $5PbCl_2 \bullet 4CuO \bullet 6H_2O$. The analysis also showed a small amount of silver, but he assumed this to be due to admixed boleite. Ignoring the chemical and optical differences between boleite and pseudoboleite, Gossner and Arm (1929) claimed that the composite crystals were merely boleite penetration twins and that pseudoboleite was therefore an invalid species. However, Hocart (1930) showed that the latter was indeed tetragonal with $a = 15.4$ and $c = 31.1$ Å. His parameters have since been essentially confirmed by Winchell (1963) and by Rouse (unpublished data). Winchell also found that the powder patterns of boleite and pseudoboleite are nearly identical, indicating that their crystal structures are closely related.

By contrast, Mücke (1969) has reported the parameters $a = 30.46$ and $c = 30.81$ Å and space group *P4/mnc* for pseudoboleite. He also gives as the chemical formula $14PbC1_2 \bullet 12Cu(OH)_2 \bullet 7.5H_2O$. However, in Mücke (1972) this is changed to $28PbC1_2 \bullet 24Cu(OH)_2 \bullet 2AgC1 \bullet 15H_2O$ and the space group to $P4_2/mnc$. As with boleite Mücke's results should be treated with caution, especially so since his unit cell data disagree with those of all other investigators. It is clear that the symmetry and composition of pseudoboleite are not completely settled, although its validity as a species seems well-established.

### *ANISOTROPIC BOLEITE*

Isotropic boleite has been shown to be a cubic, homogeneous mineral, but the nature of anisotropic boleite is less clear. Hadding (1919) considered it to be inhomogeneous and composed of alternating plates of silver-rich and silver-poor material. Likewise, Winchell (1963) showed that its anomalous optical properties could be explained if it were an oriented intergrowth of submicroscopic units, either of two phases or one phase having different orientations. One of the authors (RCR) has obtained x-ray precession photographs of anisotropic boleite which appear to show the same tetragonal unit cell reported by previous workers. It has the same parameters, $a = 15.3$ and $c = 61$ Å, and the same non-space group extinction rule, $l \neq 4n + 2$, found by Ito (1950). However, closer examination reveals that the set of reflections which give the 61 Å translation are not periodic. This means that there is no true 61 Å translation in the boleite specimens studied. It might be added that all anisotropic boleite studied by the author shows this same phenomenon. Further examination of the x-ray photographs shows that the 61 Å set of reflections can be resolved into two subsets having periodicities of 15.3 and 30.7 Å. Since these are the characteristic cell translations of boleite and pseudoboleite, respectively, it is here proposed that anisotropic boleite is really an intergrowth of boleite and pseudoboleite, probably as plates parallel to the cube faces. These plates would be stacked such that (1) their {001} planes are parallel and (2) they produce a pseudo-periodicity of 61 Å along the stacking direction {001}.

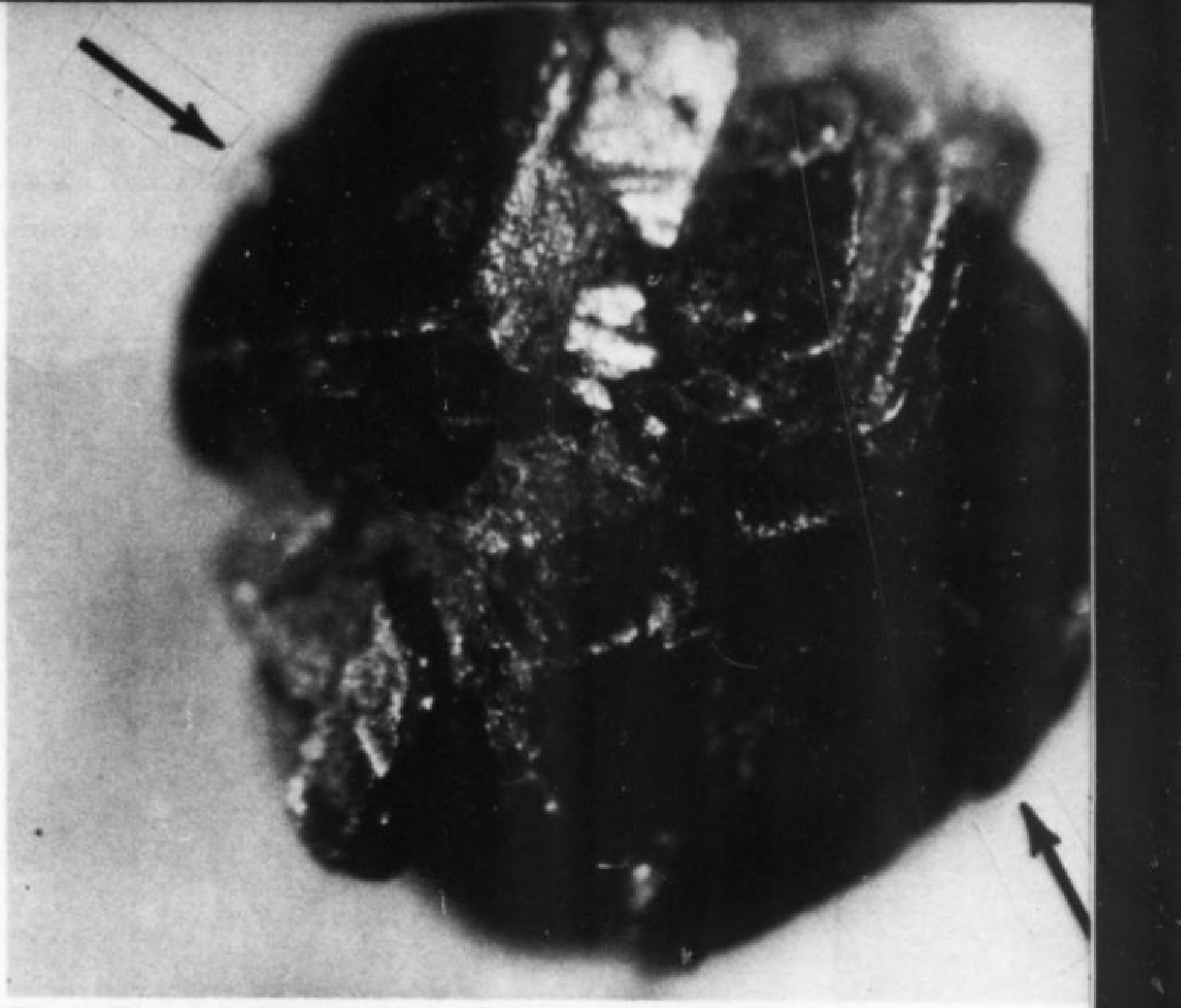

***Fig. 5.*** **Pseudoboleite overgrowths 1 mm on an edge (arrows) on boleite from Boléo, Mexico, viewed parallel to {111} of the underlying boleite. Ohio State University Collections.**

The above interpretation is supported by several known facts: (1) The existence of epitaxial overgrowths of pseudoboleite on boleite such that their {001} planes are parallel. (2) The gradational structure of the composite crystals, i.e. from boleite core to anisotropic rim (which often contains alternating isotropic and anisotropic bands) to pseudoboleite overgrowth. (3) The chemical analyses of Friedel (1906), which show the rim zone to be slightly deficient in silver compared to the core. The presence of a little pseudoboleite (Ag-poor) intergrown with boleite (Ag-rich) would account for this. Although this hypothesis is consistent with the observed facts, it should be emphasized that an explanation based upon twinning, such as that of Ito (1950), is still possible.

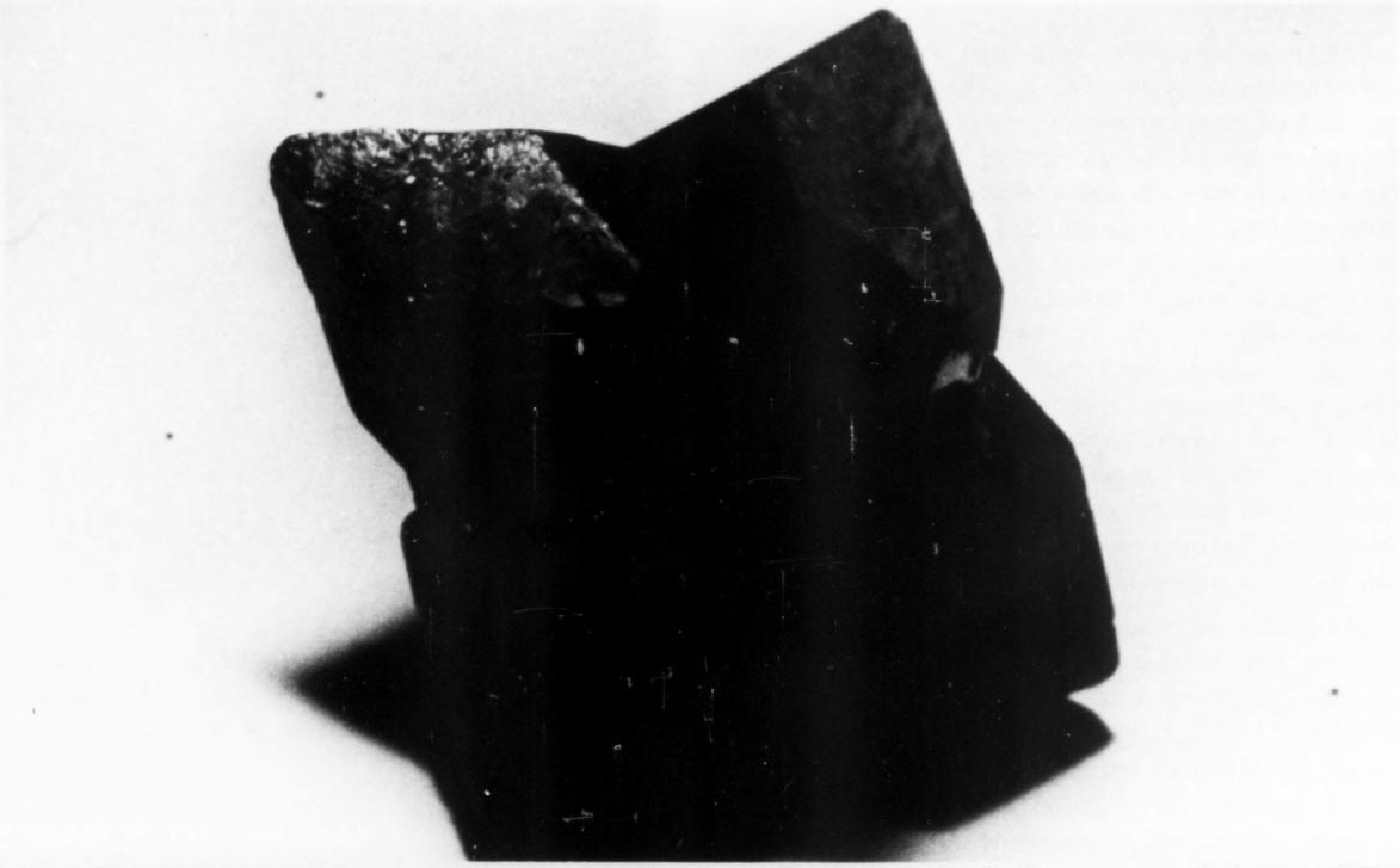

***Fig. 6.* Pyramidal overgrowths of cumengite on the cube faces of boleite from Boléo. Photograph by Joel Arem (NMNH #119257)**

### *CUMENGITE*

Cumengite occurs as isolated dipyramidal crystals and as epitaxial overgrowths on boleite (Fig. 6). Except for its pseudo-octahedral morphology, the properties of cumengite are similar to those of boleite and it is not surprising that the aggregates of fine crystals available to Mallard and Cumenge (1891a,b) were thought to be boleite with an octahedral habit. Although Cumenge (1893), upon discovering larger crystals at Boleo, recognized it as a distinct tetragonal species, it remained for Mallard (1893) to perform a thorough study of the mineral and name it. In a thorough restudy of cumengite Friedel (1906) performed a chemical analysis which yielded the formula $4PbCl_2 \bullet 4CuO \bullet 5H_2O$. An x-ray study by Gossner and Arm (1929) indicated that it is tetragonal, $I4/mmm$, with $a = 15.14$ and $c = 24.66$ Å Their findings were confirmed by Hocart (1930). More recently Mücke (1969) has reported a chemical analysis of synthetic cumengite leading to the formula $5.5PbCl_2 \bullet 5Cu(OH)_2 \bullet 0{,}5H_2O$. On the natural mineral from Boléo he obtained essentially the same cell parameters as previous authors.

In the course of a crystal structure analysis of cumengite by one of the authors (REW), the mineral has proven to be tetragonal, $I4/mmm$, with $a = 15.10$ and $c = 24.52$ Å. Although refinement of the structure is not yet complete, the current R-factor being 18%, it is apparent that the cumengite and boleite structures are very similar. With some exceptions, the two structures appear to be equivalent and involve the same locations and orientation of coordination polyhedra. The tentative chemical formula is $Pb_{19}Cu_{24}Cl_{42}(OH)_{44}$, although there are indications from the structural analysis of non-integral atomic proportions as suggested by Mücke's work.

### *PERCYLITE*

Since its original description percylite has been considered to be a silver-free cubic mineral resembling boleite in color and habit but distinct from boleite and other members of the group. Lack of an exact locality, paucity of type material, the tendency to consider any silver present in the analyses to be due to impurities, and the lack of a more recent definitive study have all combined to give percylite continued status as a valid species. It now appears from a search of the Mexican mining literature that the percylite originally described by Brooke (1850) came from the Pedrazinni mine, San Lorenzo, Sonora, Mexico (Bostard, pers. comm).

Although Percy in his original analysis (in Brooke, 1850) and subsequent analyses of percylite from other localities indicated the presence of silver, the silver was generally considered nonessential and was attributed to impurities. In addition, several investigators during the period 1872 to 1889, in examining specimens of supposed percylite from South Africa and Chile, stated that the mineral was isotropic. Websky (1886) noted the presence of excess water for a percylite composition but this observation could not be verified in a subsequent study. Larsen (1921) cited optical data for two specimens of percylite, one isotropic and one uniaxial negative, from unspecified local-

**Table I. Crystal Chemical Data for the Boleite Group**

| Mineral | Formula | Z[1] | System | Unit Cell ( ) | Space Group |
|---|---|---|---|---|---|
| Boleite[2] | $Pb_{26}Ag_9Cu_{24}Cl_{62}(OH)_{48}$ | 1 | Cubic | $a$ = 15.29 | *Pm3m* |
| Cumengite[3] | $Pb_{19}Cu_{24}Cl_{42}(OH)_{44}$ | 2 | Tetragonal | $a$ = 15.10<br>$c$ = 24.52 | *I4/mmm* |
| Pseudoboleite[4] | $5PbCl_2 \bullet 4CuO \bullet 6H_2O$ ? | 23 | Tetragonal | $a$ = 15.29<br>$c$ = 30.84 | *I4/mmm* |
| "Percylite"[5] | $PbCl_2 \bullet Cu(OH)_2$ | 30 | Cubic | $a$ = 15.28 | *Pm3m* |

[1] Formula weights per unit cell.

[2] Rouse (1973)

[3] Winchell (in preparation). Formula idealized.

[4] Winchell (1963)

[5] Mucke (1972)

**TABLE II. X-ray and microchemical examination of percylite specimens.**

| Sample | X-ray Examination | Microchemical Examination |
|---|---|---|
| BM 89065<br>Type Specimen<br>Sonora, Mexico | Boleite and Pseudoboleite | |
| NMNH R9116<br>Rosario mine<br>Sierra Gorda, Chile | Pseudoboleite | Scattered cubes and octahedra of AgCl<br>Estimated up to 1% AgCl present |
| NMNH R7897<br>Mina Beatrix<br>Caracoles,<br>Sierra Gorda, Chile | Boleite | Large curds, cubes and octahedra of AgCl<br>Maximum AgCl may be present |
| NMNH R1332<br>Broken Hill mine<br>New South Wales, Australia | Boleite | Large cubes and octahedra of AgCl<br>Estimated 5% or more AgCl present |
| Harvard 95812<br>Chile (?) | Pseudoboleite | Small octahedra and cubes and one tetrahedron of AgCl<br>Estimated up to 3% AgCl present |

**Table III. Low angle powder lines of the boleite group minerals**

| Pseudoboleite | | Boleite | | Cumengite | |
|---|---|---|---|---|---|
| $I_{obs}$ | $d_{obs}$ | $I_{obs}$ | $d_{obs}$ | $I_{obs}$ | $d_{obs}$ |
| 4 | 14.73Å | 1 | 15.09Å | 7 | 12.21Å |
| 7 | 13.41 | | | 2 | 7.74 |
| 3 | 12.37 | | | 4 | 7.45 |
| <1 | 10.00 | | | 5 | 7.12 |
| 1 | 8.76 | 3 | 8.85 | 1 | 6.42 |
| 4 | 7.53 | 1 | 7.60 | 2 | 6.07 |
| 2 | 6.79 | 1 | 6.83 | <1 | 5.28 |
| <1 | 6.22 | | | 1 | 5.16 |
| ≪1 | 6.07 | | | 3 | 5.00 |
| 7 | 5.65 | | | | |
| 1 | 5.36 | 2 | 5.40 | | |
| 3 | 5.04 | 6 | 5.10 | | |

Samples from Boléo. Intensities estimated visually on the basis of 10 for the most intense line.

ities. More recently, Seeliger (1950) has identified blue isotropic crystals from the Ruhr as percylite. X-ray powder data for percylite from Sierra Gorda, Chile, was also reported by Sabina and Traill (1960).

Discrepancies in the literature and the lack of modern study led Winchell (1963) to include percylite in a restudy of the minerals of the boleite group. The results are summarized in Table 2.

X-ray studies of the Chilean and Australian specimens proved, by comparison with the powder patterns of boleite and pseudoboleite from Boléo, that these percylites are either boleite or pseudoboleite. Microchemical tests for silver supported the diffraction results. A microscopic examination of a percylite specimen from the material used by Brooke and provided for this study by the British Museum (BM89065) immediately revealed that the small percylite crystals on gold and hematite (Fig. 7) were the typical composite crystals of pseudoboleite overgrown epitaxially on boleite. In order not to damage the specimen, only enough small composite crystals were removed to give usable x-ray and goniometric results. The powder pattern obtained was clearly that of boleite with weak low-angle reflections due to pseudoboleite. Goniometric measurements of the interfacial angle from the pyramid to the base of one of the larger overgrowths gave 63° 32' ±35' compared to 63° 42' (Friedel, 1906) for type pseudoboleite.

Recently, Mücke (1969, 1972) found percylite from the Santa Ana mine, Caracoles, Sierra Gorda, Chile, to be cubic with a unit cell parameter and space group identical to those of isotropic boleite (Table 1). He cited Brooke's formula for percylite but otherwise gave no chemical information on percylite from this locality. Drawing upon the boleite structure proposed by Ito (1950), Mücke (1972) has also suggested a structure for percylite from the Santa Ana mine. However, since Rouse (1973) has shown Ito's structure to be incorrect and since Winchell (1963) has shown percylite from the Sierra Gorda region to be either boleite or pseudoboleite, it appears that percylite from this locality may well be boleite. This interpretation is supported by the previously mentioned identity of their space groups and cell parameters. A re-examination of percylite from this locality is warranted.

In conclusion, we believe that type percylite has been shown to be a mixture and that the same is true of percylites from other major localities. In fact, the existence of a species having the symmetry and chemical formula ascribed to percylite has never been satisfactorily proven by modern methods of analysis. Unless such proof is forthcoming, we believe that percylite should be regarded as an invalid species and the name dropped from the literature.

## *PARABOLEITE*

In his 1972 article, Mücke introduces a new name "paraboleite", which he applies to all compositions intermediate in silver content between boleite and pseudoboleite. A tetragonal cell having nearly the same parameters and formula (but lower in silver content) as his tetragonal boleite is reported for a specimen from the Santa Ana mine. Although such intermediate compositions may well exist, the available evidence does not justify this addition to the mineralogical nomenclature.

## *SYNTHESIS EXPERIMENTS*

Boleite and cumengite were synthesized by Friedel (1894) at room temperature and pressure. More recently, Winchell (1963) was able to synthesize all members of the boleite group (with the significant exception of percylite) using hydrothermal and other methods. The stoichiometric proportions given for these minerals by Palache *et al* (1951) and a hydrous environment were employed in all experiments. The synthetic phases obtained were identified by x-ray diffraction and comparison to the natural minerals.

At 270° C boleite was obtained as green adamantine crystals dominated by the cube but also showing smaller octahedron and dodecahedron faces. Cumengite and pseudoboleite were obtained from room temperature to 270° C depending upon the length of time used for a particular method of synthesis. All attempts to synthesize percylite yielded cumengite or pseudoboleite and cotunnite. From room temperature to 100° C using longer reaction times, blue pseudoboleite formed. For short reaction times near room temperature and above 170° C, pseudoboleite formed as green pseudocubes similar in appearance to symthetic green boleite. However, some of the crystals obtained above 170° C were flat plates very like the plate-like overgrowths of pseudoboleite on boleite found in nature. The synthetic crystals of cumengite were always blue in color and modified or unmodified tetragonal bipyramids in form.

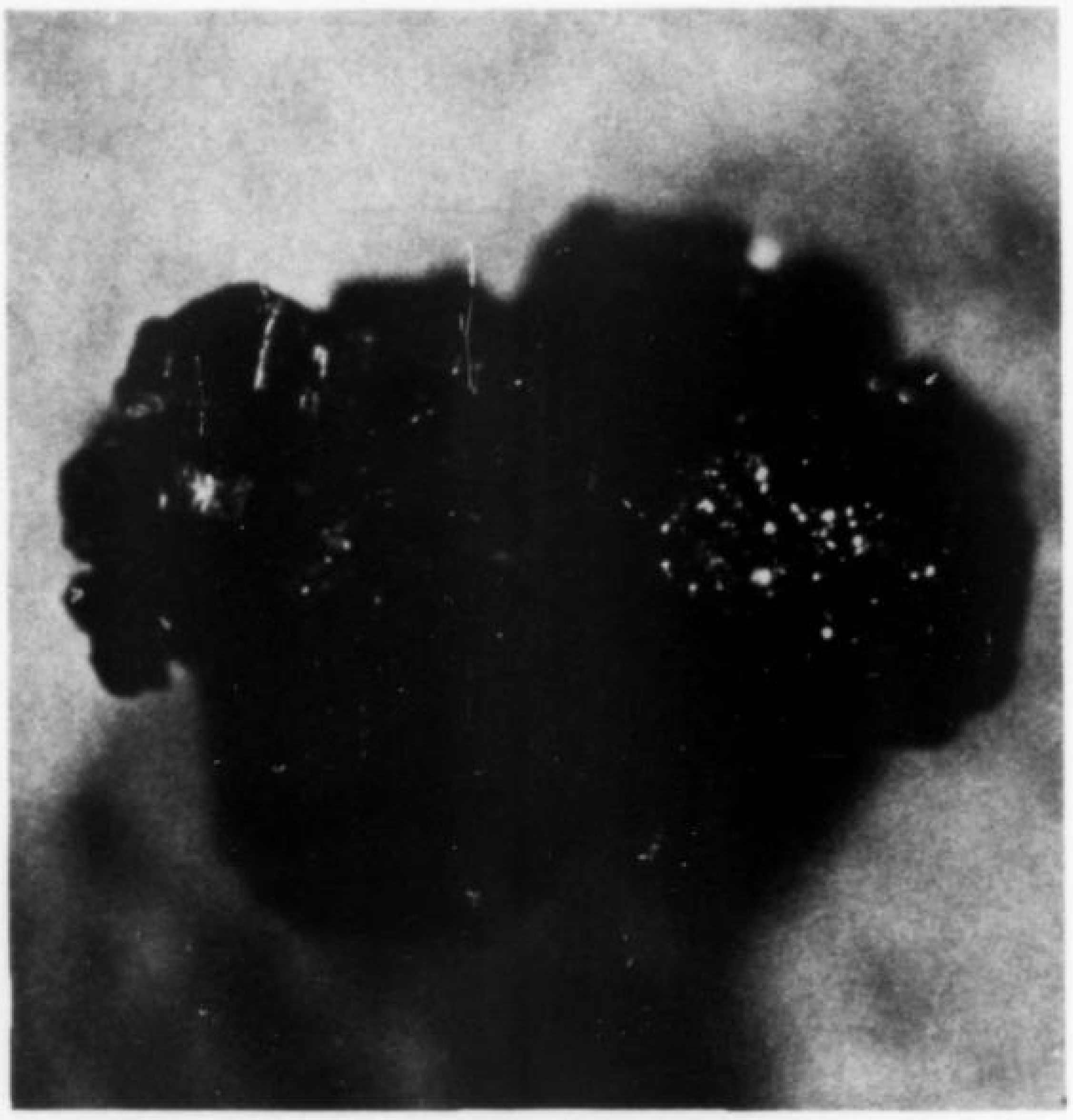

***Fig. 7.* "Percylite" with gold from Sonora, Mexico, showing overgrowths of pseudoboleite on boleite. The largest overgrowths are approximately 1 mm x 0.5 mm on an edge. British Museum specimen #89065.**

In summary, the synthesis experiments of Friedel and of Winchell indicate that the members of the boleite group are stable (or metastable) in a hydrous environment over the whole temperature range from room temperature to 270° C. Natural composite crystals in which all three minerals are present always exhibit overgrowths of cumengite on pseudoboleite, which is, in turn, overgrown on a boleite core. Although pseudoboleite can be produced at room temperature for short reaction times, over longer periods only cumengite is formed at room temperature from charges having the pseudoboleite composition. Given sufficient time, appropriate silver content and temperature of the solutions, it appears that the paragenetic sequence with increasing time, decreasing silver concentration, and decreasing temperature is

Boleite →Pseudoboleite →Cumengite

The significance of the temperature dependence of the color of synthetic boleite and pseudoboleite is uncertain. The explanation may lie in solid solution involving variable silver content, structural distortions with temperature, or combinations of these and as yet unknown factors.

## *IDENTIFICATION OF BOLEITE GROUP MINERALS*

Positive identification of boleite, pseudoboleite, and cumengite can be accomplished by optical or x-ray diffraction methods. However, the optical properties of boleite are variable due to the inhomogeneous nature of the crystals and the optical properties of pseudoboleite are nearly the same as those of anisotropic boleite (Palache, *et al.*, 1951). Powder x-ray diffraction methods are easier and more reliable, although there are ambiguities here too. When pure, boleite, cumengite, and pseudoboleite can be distinguished from one another by examing the low theta regions of their diffraction patterns (Table 3). In mixtures one can also identify pseudoboleite and cumengite unambiguously. However, all of the lines in the boleite pattern are also present in the pseudoboleite pattern. Therefore, in the presence of pseudoboleite one cannot be sure if boleite is there too. However, if a high-resolution camera is used, there may be some diagnostic line-broadening in the low-theta region. This will be due to partially resolved boleite-pseudoboleite doublets. If the material is sufficiently coarse-grained (which is usually the case), the sample should be examined with the binocular microscope before reducing it to a powder. The cubic habit and three good cleavages of boleite are usually enough to identify it.

## Acknowledgements

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## ERNEST WEIDHAAS

In 1973 Mr. Ernest Weidhaas, of Pelham, New York, considered it one of the high points of his life when he received a special bronze medal, cast in his name, from the Smithsonian Institution. The award was timely for scarcely a year later word was received of his death at the age of 86.

Although plagued with physical disabilities in his later years Mr. Weidhaas remained mentally alert so that he could enjoy his interest in several hobbies until the end. Among his interests, that in Natural History, and particularly in minerals, began long ago. There are few people like him who could, in 1974, boast of having been a charter member of the Mineralogical Society of America. Also, having been admitted to membership in the New York Mineralogical Club in 1918, he was the longest serving member of the New York Club. In the course of this membership he had known and met personally some of the great names such as George F. Kunz and even Madame Curie who visited the New York Mineral Club through the years.

Even though he had broad interests in coins, oriental art, medals, etc., mineral collectors remember most his large collection of the famous prehnite casts from the trap rock quarries of New Jersey. This collection is the most important of its kind ever to be assembled. In 1973 he gavethese specimens to the Smithsonian Institution to be preserved for all future collectors to see.

Mineral collectors also fondly remember Ernest Weidhaas as the elderly gentleman with a fine sense of humor who loved nothing better than to spin a yarn about mineral collectors of the "old days."

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# GALKHAITE:
# A NEWLY DESCRIBED MINERAL FROM SIBERIA FOUND AT THE GETCHELL MINE, NEVADA

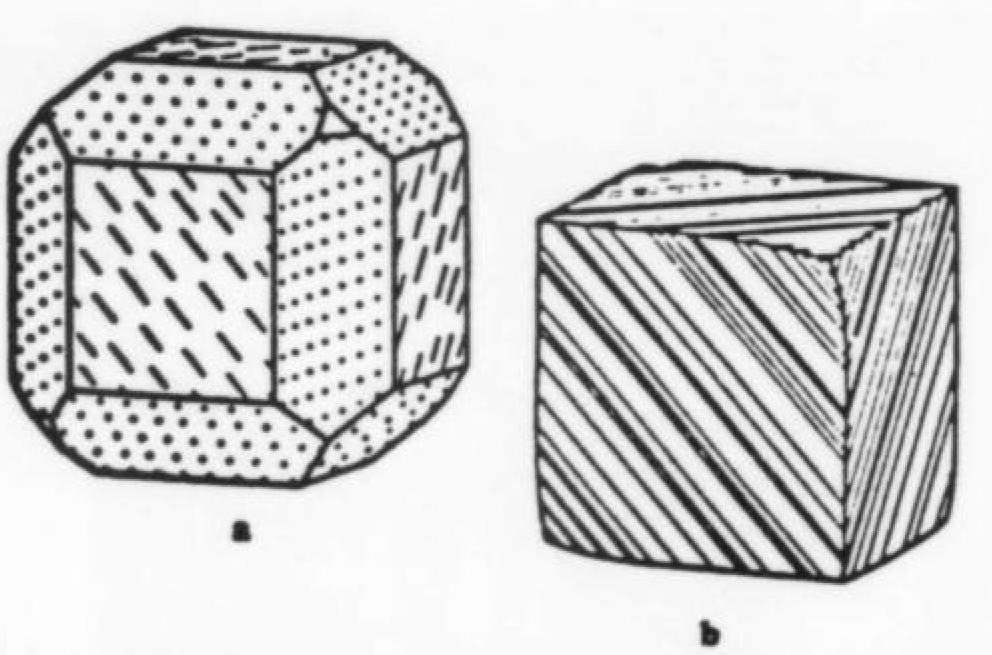


*Fig. 1.* **Galkhaite crystals from the Gal-Khaya deposit (a) and the Khaidarkan deposit (b).**

*by Gerald Jungles*
**4342 View St. Oakland, CA 94611**

So you have collected at the Getchell mine and couldn't bring yourself to dispose of that last 90 pounds. Just as well, for you may have a newly described mineral. Galkhaite is an attractive mineral and has been noticed by a number of collectors and mineralogists, amateur and professional, but has generally been mistaken for cinnabar.

Almost all of the technical information here comes from two translations of a paper in the *Doklady Akad. Nauk SSSR* **205**, (5), 1194-1197, (1972) (one translation is by Dr. Michael Fleischer and the other translator is unnamed), and from the British Museum (Natural History) in a communication from Peter G. Embrey. The paper is by V. S. Gruzdev, V. L. Stepanov, N. G. Shumkova, N. M. Chernitsova, R. N. Yudin and I. A. Bryzgalov. The drawings of the crystals also are taken from this paper.

The mineral, $HgAsS_2$, was named for the locality of first occurrence, Gal-Khaya, N. E. Yakutia. Getchell is the third occurrence since the group who made the discovery also found it at Khaidarkan, Kirgizia. To quote the Soviet article, "Galkhaite occurs here as euhedral crystals (not more than 1 cm in size) and their intergrowths, as irregular grains in other minerals and as granular aggregates. Most galkhaite crystals are cubic and are dominated by the form {100}. The forms *d*{110} and *o*{111} are much less common. There are isolated rhomododecahedral crystals with subordinate faces of the cube which commonly exhibit diagonal combination-type striations, corresponding to the simple edge form {111}, the tetrahedron". The "1 cm in size" is much larger than any I have seen. Many galkhaite crystals from the Getchell mine have a warped, pushed-out-of-shape appearance. I found some very small black rhombic dodecahedrons which proved to be galkhaite (oral communication, Dr. R. C. Erd). These are without modifications and are not striated.

Galkhaite falls into the cubic system with space group $I43m$ and will probably be assigned to the tetrahedrite group. There is no cleavage. With the Soviets' description, "The mineral is brittle and has a hardness of 3". I don't agree, but there's no great divergence here. It seemed to me that *very* brittle and slightly less than H. 3 would be a little more accurate.

In the Soviet publication the color is given as "dark orange-red with small variations of tint" and, further, some have "a black, lustrous film and an irridescent tarnish". In the Getchell occurrence, nearly black for reflected light and dark red for transmitted light would seem to describe most crystals. They may be very lustrous or dull. G. is given as 5.4 to 5.7, streak orange-yellow.

Crystals of galkhaite are more difficult to see than one might expect. Many are so lustrous that they reflect surrounding materials with great fidelity. The usual form (cube) affords relatively few reflecting surfaces.

At the Getchell mine galkhaite crystals are in association with, included by and emplaced upon most commonly occurring minerals, as well as in the black material that makes up the greater part of the rock in the dump of the north workings. The first galkhaite crystal I noticed was embedded in a broken crystal of orpiment. The presence of fluorite seems to signal a better-than-average chance of one's finding this elusive mineral. It's my estimate that hopelessly broken crystals outnumber presentable specimens by a disheartening ratio of 20 to 1 or worse. It's my belief that some of these have been broken in situ—I have seen cleaved orpiment crystals partly repaired and there is a fault running through the Getchell property.

From early 1969 a considerable number of "experts" examined the largest galhkaite crystal that we (my wife and I) have. The greater number of these were attending the micro symposium at Santa Monica in 1970. To their credit, almost all of these "experts" said that they didn't know what they were looking at and most didn't hazard a guess. Looks like the "experts" really are experts indeed. Many interesting remarks and speculations were made but two of them stand out most clearly in my memory. One was the spirited insistence by Dr. Fred Pough that the crystals were cubes (most thought otherwise). The other comment that I recall most clearly was by Si Frazier. After examining with a loupe for about one minute the specimen mentioned above and asking the location, Si said with no qualifications whatever, "It has to be a new mineral".

From experience, I'd say that galkhaite crystals can run, jump, fly, pole vault and levitate. Also self destruct. I fully expect someone to read this and say, "So *that's* what those 3/4-inch crystals are—the ones from the Getchell mine that I put in the garage (shed, basement, under the bed, or wherever)".

## MUSEUMS ROBBED

The mineral collections of several museums in Southern Africa were robbed of a variety of very valuable specimens. In two cases, that of the University of the Witwatersrand and the Alexander McGregor Memorial Museum at Kimberley, the collections were virtually stripped of every valuable sample.

Five museums in Southern Africa were unfortunate enough to have lost dozens of irreplaceable specimens in this way.

The Museum in the village of Pilgrimsrest turned out to be the first to be burgled, and their whole collection of visible gold samples was stolen.

The University of the Witwatersrand was the second and their mineral collection was literally stripped of every valuable specimen. This theft occurred at the end of 1971. Hardly three months later the person or persons responsible allowed themselves to be locked up in the McGregor Museum at Kimberley by hiding away when the museum was closing up for the weekend. They had ample time to choose whatever they wanted, including a most valuable kimberlite and diamond collection which was donated by the De Beers Group of Companies.

According to rumours, the person or persons responsible also gained entrance to the Museum at Swakopmund, South West Africa, but it is not known what damage was done to their collection.

Yet another museum was burgled, that of the Museum of the Geological Survey (Republic of South Africa) and the most valuable specimen, a sperrylite crystal 1.8 cm wide, claimed to be the second largest crystal found, was stolen, together with some visible gold-bearing ore from the Barberton area. This sperrylite was assessed at about $35,000 (American).

Interpol was notified of this series of thefts and provided with a description and photo of the sperrylite crystal. It would be appreciated if the readers of this journal would notify Interpol if a sperrylite specimen is offered which resembles the stolen specimen (see accompanying photo).

# To the Editor

## REACTIONS TO ARTICLES

Dear Sir:

The article on siderite by Gary Carter was decidedly different and refreshing. You are to be congratulated on not editing out his personal comments, as most editors would have done. It is obvious that at the time of this research he was not a professional mineralogist; yet, he has been able to pass along some information of interest even though questions remain unanswered.

However, I do wish he had checked some of his observations a little more thoroughly: this is always the mark of a good scientist regardless of the field of his investigation. For example, one of each of the three strongest x-ray reflections (2.51 and 2.65) do not seem to belong to siderite, indicating a different mixture for each habit. The reader should know what these other minerals are and to what extent they might affect crystal form. In general, a poor x-ray sample preparation (or alignment, etc.) technique will yield poor powder camera results (i.e., weak reflections) but not errors in their positions. This is not true of diffractometer traces where misalignment may yield serious problems. Consequently, it should be possible for Mr. Carter to assess his potential errors, especially with the built-in standard reflections of siderite to check against. Finally, because accurate x-ray data can be useful to additional investigations into this occurrence.

Incidentally, we had just taken a photograph of a brookite crystal on quartz from Mount Carmel, Pennsylvania, that looks almost exactly like your cover. For a moment we thought you had used the same specimen: even our technician (not a geologist) recognized brookite in your photograph immediately.

Davis M. Lapham
Harrisburg, Pennsylvania

Dear Sir:

It was with great interest that I read Gordon's original description of his early adventures in Bolivia (vol. 5, no. 4). It may be of some interest to your readers to obtain a more recent description of some of the same areas that Gordon visited.

It is, of course, unnecessary for one to take the slow boat from some eastern U. S. port to ultimately arrive in the unusual city of LaPaz. One can reach LaPaz in approximately 10 hours by plane from Miami with stops in Panama and Peru. The unique and still steam-propelled railway linking Chile and Bolivia with various outlying mining districts still exists; however, today adequate and modern bus transportation is at least available between LaPaz and the larger cities, particularly Oruro about 120 miles to the south.

LaPaz is apparently very much the same as it was in Gordon's day and can be likened to a city such as Denver draped within one of the side canyons of the Grand Canyon with the Grand Tetons along one of the canyon rims. Major access in and out of this city of a million people is by a single two-lane paved road which climbs the steep canyon wall ultimately to reach the level of the Altimplano at 13,000 feet. Once one reaches the Altiplano a relatively good paved highway allows rapid access to the city of Oruro, the central mining hub for the country.

Oruro is the more-or-less jumping off place for the active districts of Huanuni, Llallagua, Colquiri, and other historical districts such as Potosi. Access to these areas is still somewhat difficult. All roads are unpaved and, while passable in the dry season, are apparently incredibly poor at other times. Transportation by mule is of course available; however, access is also afforded by very crowded, stubby school-type buses.

The mining districts exist in many ways as they did when Gordon visited them. Electricity is available now. Running water and some sewage facilities are present in certain areas. Perhaps the greatest advancements have been in modern mining and milling techniques and machinery. One item of particular interest that Gordon describes is the congregation of Indian women that exists on many mine dumps hand cobbing little pieces of higher grade material from the waste rock, ultimately to sell this material at the mineral bank in Oruro. These brightly attired, somewhat spherical women still exist in relative profusion in some districts and can occasionally be the source of very interesting specimen material.

While I can't really recommend Bolivia as the target for a weekend field trip, or for that matter any kind of field trip unless rigorous and very complete preparations have been made in advance, I feel that it will continue to be a source of moderate amounts of good to very fine specimen material and is therefore worthy of at least contemplation.

Robert B. Cook
Auburn, Alabama

### FAKED SPECIMENS

Dear Sir:

Be aware, once again fraudulent gold specimens are being offered for sale to the collector! Fake gold nuggets, man-made gold wires with matrix are being offered! In the last few months two specimens from two different sources were offered to me from Montana and California. The fake specimens are prepared beautifully, they look very real. However, they can be detected with ease by following these suggestions. In both cases the specimens were prepared very neatly in cedar wooden boxes in the same manner as the fake specimens that were sold out of Colorado a few years ago as Colorado gold. There is a sealed glass cover over the fake specimen(s) which are glued to the bottom of the box. The box is completely sealed in order that the purchaser cannot handle the specimen in any way. There is an old appearing typewritten label under the box lid with a description of the gold from the Mother Lode country of California. The box is heavy in order to have you believe the specimen is gold, but in reality the weight does not come from the specimen. The box contains metal weights under the black cloth used at the bottom. Once the fake specimen is removed from the box it is extremely light in weight and has an obvious odor of glue. In fact, the specimen is prepared by using much glue and very thin gold leaf.

I am fortunate because I am very much aware of these fake gold specimens but the novice collector could really be taken. *Most important*, insist on handling any gold specimen offered to you, especially those that are fastened down with glue on a base. Obtain the seller's name, address, and driver's license number. It would be wise to have another person examine the specimen before purchasing it.

I feel that the tremendous increase in the price of gold today will lead to many more fake gold specimens being offered for sale. Be very cautious!

David P. Wilber
Carson City, Nevada

### EXCHANGE

Dear Sir:

I am an amateur geologist collecting silicates. For this reason, I like to come in contact with colleagues all over the world; when these colleagues are interested in the geology of the Netherlands, Germany, and other countries, we can exchange minerals and perhaps also fossils.

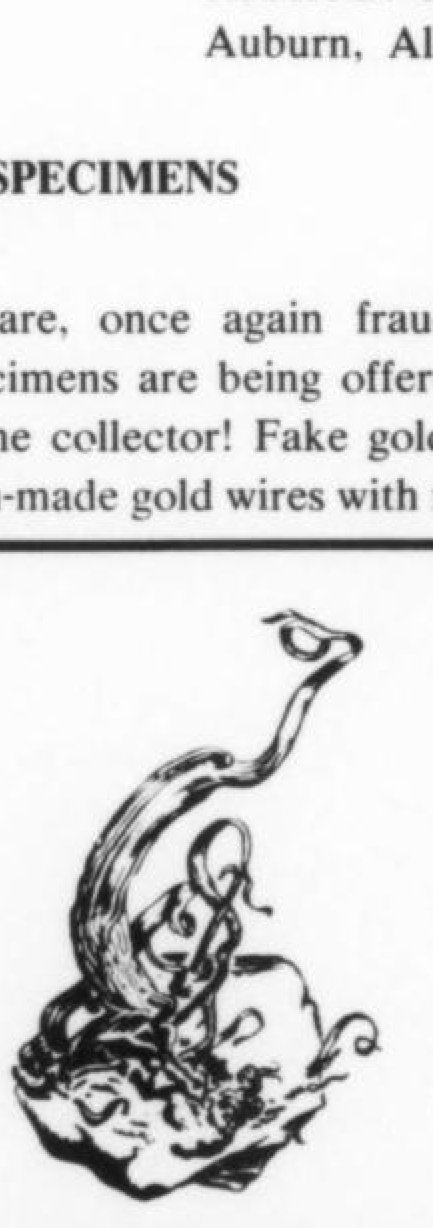
I hope you place my letter in the Mineralogical Record.

P. Bormans
Jozefstraat 3
Susteren, Holland

### LOCALITY NOTE

Dear Sir:

In the article "What's New in Minerals?" (vol. 5, pp. 76-77), I was reading about the calcites from Missouri's St. Joseph lead district. I just wish to point out that there is no such thing as the St. Joseph lead district. The



producing lead belt in Missouri is known by two correct terms; either The New Lead Belt, or The Viburnum Trend.

Also, contrary to labels on specimens offered by some dealers, the town of St. Joseph is not in the lead belt. It is more than 200 miles away in the opposite part of the state. The New Lead Belt lies in southest Missouri in an area contained by Reynolds County, Iron County, and Crawford County. Some nearby towns are Viburnum, Boss, Bixby, and Bunker. The particular calcites mentioned in the article are from Ozark Lead Company's Sweetwater mine in Reynolds County.

If we are to keep accurate localities we must keep on our toes and not just accept localities on specimens blindly. One way is to keep in touch with the literature of state geological surveys and organizations such as the A.I.M.E. who publish books on ore deposits.

Laurance M. Nuelle
Rolla, Missouri

### SOME COMMENTS

Dear Sir:

I read your editorial regarding mineral specimens and schools. I agree with you. I suspect schools are trying to build display collections because they think they will gain status from them, especially in "competition" with other schools. My school had a study collection, which was well used. There is a difference between study and display collections, as you well know. Schools need study collections. However, I do not feel that your editorial will be properly appreciated by most teachers, and will be considered heresy and damned narrowminded. Incidentally, the year that the mineralogy teacher took a sabbatical was the year that several specimens disappeared.

The letters to the editor of Ross W. Glenn and Mimi Merrill regarding the F. L. Smith ads are amusing.

One other item. After reading Wilson's review of *The World's Finest Minerals and Crystals* I purchased a copy of the book. I do not see how a particular specimen of certain minerals can be chosen, particularly when there are thousands of specimens in existance; calcite is a good example of this type of mineral. I do not understand why some specimens chosen for a particular mineral were chosen because of the accompanying minerals on the specimen.

Also, why were there no pictures of any of the clay family of minerals? Just think what a boon for mankind it would be to see the world's finest kaolinite crystal, etc.! How could such an important group of minerals be eliminated?

Henry H. Fisher
Columbus, Ohio

### ON UNAPPRECIATED GIFTS

Dear Sir:

Your editorial on "Unappreciated Gifts" to university museums was read with interest and anguish. Interest, because I am sure you would not have written your editorial without many facts in hand to illustrate your points. Anguish, because the horrors you enumerated do not exist here at the Funk Gem and Mineral Museum at Illinois State University, Normal, Illinois for which we have the curatorial responsibilities. In fact, the entire museum staff of all our museum facilities takes pride in the high degree of professionalism it has attained, and each and every staff member goes about his duties with a conscientious regard for and an appreciative awareness of his responsibilities toward the museums' collections.

We are located on a campus of 18,000 students; we have 4 high schools and 31 junior high and elementary schools in our community. All of these schools use our museums as teaching aids. In addition thereto, being a state supported institution, we do have an obligation to the general public which supports us. Our university is an active, vital part of the community-at-large, and this is doubly true of its museums. All of the articles and columns written and all of the statements made to justify the existence of and the policies for other public supported museums are equally valid and applicable to ours.

At the present time we are formulating new exhibits, displays, and programs which not only teach, but which also cause a little "ohhing" and "ahhing" over the specimens. We are open to the general public six days a week and to school groups at all times. I doubt if we would spark much interest in minerals or mineralogy with only a study collection set up to serve the needs of our geology students.

To get the high quality specimens needed for our exhibits, displays, and programs, we are dependent upon the good will, support, and generosity of private collectors. Our budget, which comes from general tax revenue funds, does not permit much in the way of acquisitions through purchase.

I do not mean to imply that we have no problems to solve or that we need no help, but your editorial did no service by imputing the sins of a few indiscriminately to us all. And may I point out that no museum, large or small, public or private, has a monopoly on conscientious professional personnel; appreciation for its collections; good common sense; nonstagnating policy; or sufficient budget, and that all museums are susceptible to the horrors you described in your editorial and not merely university museums as a distinct species.

I am quite sure that we will now have to take on the additional burden of combating the negative influence of your editorial. I only hope you have not set us back too far in obtaining our goals.

Patricia A. Carlon
Associate Curator
Bloomington-Normal, Illinois

Dear Sir:

Your editorial concerning "unappreciated gifts" hit upon some rather urgent problems, but unfortunately failed to offer any answers. It is truly unfortunate that instances of specimen neglect and misuse are not uncommon among universities, or even small museums for that matter. But to generalize and condemn the support of all universities is as stifling to mineralogy as the criminal act of destroying a fine mineral specimen in a freshman lab. You maintain that the basis of the problem is that "today geology students can go all the way through school and have no contact with mineral specimens." How is this problem ever to be alleviated if the schools never have the "specimens" to expose the students to? Where is the student to go to see and learn about such specimens? Major museum collections are few and far between. This problem is perhaps even more applicable to the average collector who may not have access to the top two or three museums in the country. Where can the collector go to admire and learn about minerals if not the local university?

The editorial also neglected to mention the preservation and maintenance of specimens of local importance. Do you suggest that the University of Arizona give up its Bisbee material, Harvard its historic New England specimens, the University of South Carolina its hiddenite, or Colorado School of Mines its Colorado suites? The list is endless. If these specimens weren't housed in the universities, they would most likely be lost to their localities forever.

But what are the alternatives to donating collections to a university? Donate to a major museum that admittedly has top facilities? Unfortunately, the chances that a major museum would be interested in all but the choicest specimens of a collection are very slim, and the chances that any of the collection would be put on display are even slimmer. I see little difference between the end result of a major museum having the collection and putting the collection under lock and key. Either way, relatively few people have the opportunity to enjoy the collection. What about selling the collection and thereby putting it back into the mineral market where it will pass into the hands of an interested party? This alternative is highly unrealistic while the collector is still active, and stories of disinterested or unknowing families selling collections for a fraction of their true value are as common as those of university neglect. Furthermore, if the collection is sold and purchased by another private collector, what are the chances that the public will be able to see the specimens? Either way, the general public loses.

So, what is the answer? I'm afraid the problem is far too complex to settle in a brief letter. But the universities can be a positive part of the solution. The major complaint levied against universities seems to be their alleged lack of understanding of the value of specimens and their unwillingness to take the responsibility to care for the minerals on a long-term basis. If the university possesses an endowment to provide for a qualified curator on a continuous basis there is little need for concern, and universities such as these aren't nearly as rare as you may lead us to believe. Looking over the list of curators at the Mineral Museums Advisory Council meeting in Tucson last February, I noticed that 33 percent of the members present were representing universities. I also found it interesting that in the same issue of MR that carried the editorial, you included an article on the development of the Amherst College mineral collection. There appears to be a discrepancy in the tone of your editorial and the material you find of value to publish. As for those universities that don't have a curator, it's important to look into the possibilities of providing an endowment for one before entrusting the school with a valuable collection. This could be done by the potential donor or perhaps by an interested local mineralogical society. If this is not possible, then there is little choice but to consider the alternatives noted above. But to not even consider the university has disastrous implications for the future of both the hobby and the profession of mineralogy.

I hope that your editorial has alerted many universities to the need for professional care of those minerals that they may have received as gifts. At the same time, however, I have tried in this letter to alert potential donors to the value of giving their collections to a local institution and the need to give adequate support to maintain and perpetuate these collections.

Peter C. Keller
Austin, Texas

### "TUCSON" OF THE EAST?

Dear Sir:

We recently attended the second New Jersey Earth Science Show at South Orange, New Jersey. Held at the spacious Seton Hall University Student Center, both novice and advanced collector found a friendly atmosphere and plenty of specimens. More than twenty-one dealers from across the country exhibited, offering a fine selection of material.

This Show looks like it could become the "Tucson" of the East, and with the enthusiasm of the New Jersey Earth Science Association we are sure it will.

Ron Bentley
Windsor, Connecticut

# INDEX - VOLUME V

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A GUIDE TO
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