the Mineralogical Record

Volume Six/Number One

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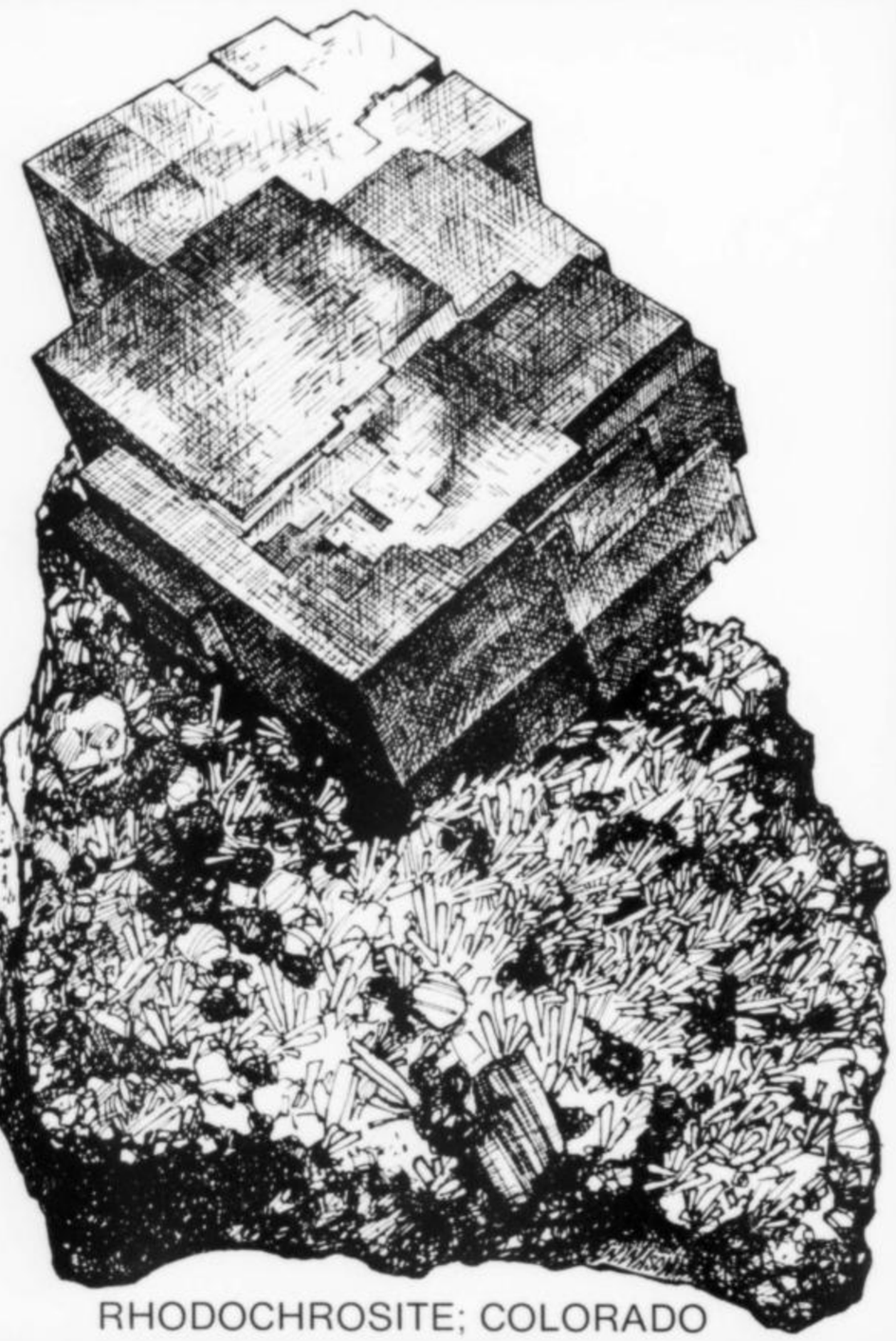

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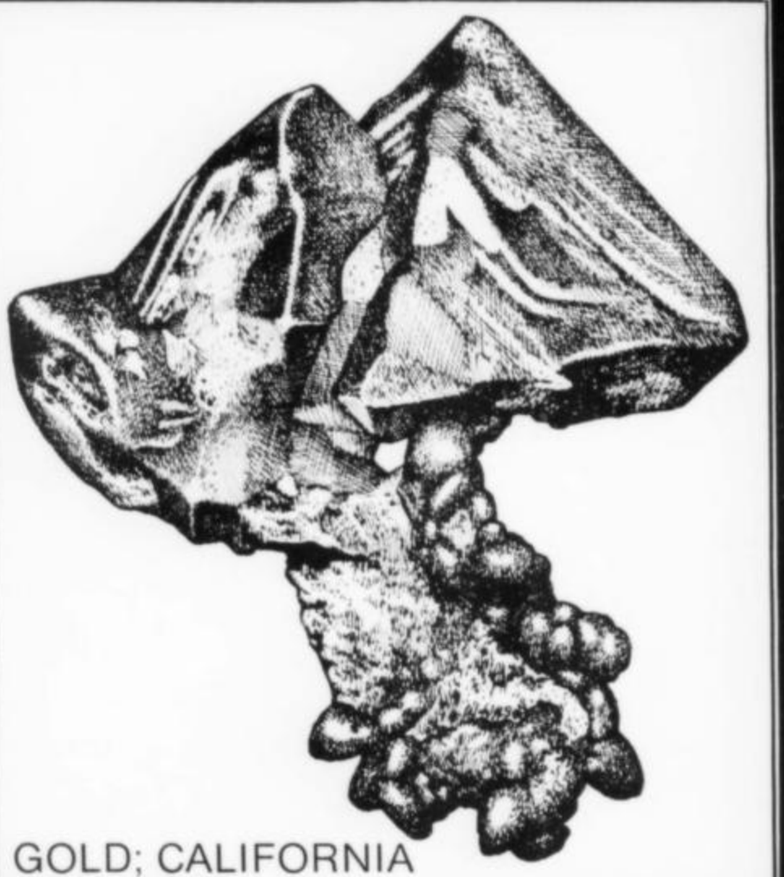

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Volume Six/Number One
January—February, 1975

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address

the Mineralogical Record
Post Office Box 783
Bowie, Maryland 20715
Telephone: 262-8583

editorial matter

Contributed manuscripts and news items are welcomed, but acceptance is subject to the approval of the editorial board. They should be mailed to the editor at the aforementioned address, and should be accompanied by a stamped, self-addressed envelope. No responsibility can be assumed for unsolicited material.

publishing information

The Mineralogical Record is published bimonthly by the Mineralogical Record, Inc. P.O. Box 783, Bowie, Maryland 20715.

subscriptions

The Mineralogical Record costs $10.00 per year, domestic and foreign.

Second class postage paid at Bowie Md.

feature articles

departments

GOLD, Placerville, California. From the collection of Bob Melzer, Tucson, Arizona. Photograph by Thomas J. Trebisky.

Guest Editorial

Where Have All The Quarries Gone?

By Marie Huizing

For the most part quarries are exactly where they've always been, only their status is changing or, as is more often the case, it has already changed. Many old, familiar mineral localities are now closed to collecting.

In its mineral museum, the Cranbrook Institute of Science, Detroit, Michigan, has a floor to ceiling showcase of magnificent Ohio minerals, all from the favorite haunts of early Ohio collectors. The full impact of the case comes with the realization that these stately crystals are sitting in silent tribute to remind us of what was once ours to seek, but now, and perhaps forever, is beyond our reach, for most of these quarries have been closed to collectors. Worse yet, they are not closed with a door slightly ajar so at least some material is getting out, nor is the door hinged to give hope it will again open. These closed doors are nailed tightly shut. The Cranbrook case might just as well have been entitled "In Memoriam of Ohio's Mineral Heritage". Instead of gracing private and public collections, the fate of proud beauties such as these is now the rock crusher. Such a sad waste of natural beauty!

What has caused the collector to be *persona non grata*? The sheer number of collectors today makes quarry managers nervous. Collectors abuse privileges, insurance companies worry, quarry managers can't be bothered - all these are factors in the closing of sites. Why hasn't something been done or attempted to stop this trend? Does no one care? Of course collectors care. But individually or as small groups they just don't know how to remedy the situation. The extent of most collectors' interest in the problem is to bend or break the rules on their own personal behalf, when what is needed is for the collector to work to change the rules for everyone's benefit. But how? The urgent need is for the involvement of people who not only care, but who also know what to do and are willing to devote the time and energy to do it and/or to help others do it.

I keep waiting for an article to appear in a hobby publication spelling out guidelines for organizations, individuals, and federations who are willing to work to reopen collecting areas but need direction. It doesn't seem to be forthcoming. *Why*? We read articles on subjects such as what tools to take collecting, or how to clean the material we find. Why aren't these authors also writing articles that will assure us that we will indeed have a use for these collecting tools in the future and that will assure us that we will indeed be finding material to clean? We sit at our organizational meetings and ponder the great questions of dues deadlines, membership lists, name tags, and refreshments for our social events, while the object of our interest, the minerals themselves, are being shut off from ready access with a frightening finality and swiftness.

Go to Cranbrook, see that graveyard case, and think about it! And while you're thinking, ask yourself these questions: Will we one day be reminiscing about the good old collecting days when we could get into the quarries we now frequent? How much longer before there are no more quarry doors to be closed? What can we do NOW to reverse this unhappy trend?

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KEITH PROCTOR
88 RAVEN HILLS CT.
COLORADO SPRINGS, CO. 80919
PHONE: 303-598-8805

(Private shows in my home by appointment only)

I'LL BE AT THE TUCSON SHOW — LOOK ME UP AT THE DESERT INN, FEBRUARY 14, 15, 16

FM friends of mineralogy

FM CHAPTERS?

I have heard mounting criticism of the FM regional structure. Only a very few regions have reported strong activity at the local level within their areas. Members are too widely scattered inside far-extended geographic boundaries to make possible any close-knit community of activity and interest. One especially active region reports many requests from individuals associated with adjacent less-active regions for inclusion as members within this region.

The regional set-up was a necessary step in the effort to decentralize national authority and localize project activity. It proved successful at first and helped to bring in many new FM members. Now it is proving an impractical means of reaching and unifying the interests and activity of members widely separated throughout a region. Some regions span several states with only a thin scattering of members over a vast area. Geography thus becomes unrealistic as a means of defining regional boundaries.

FM president Earl Pemberton and members of his executive committee have been much concerned with this problem and a plan for drastic reorganization of the regional structure will be proposed at the FM annual meeting in Tucson in February.

One criterion alone would seem to justify the existence of a local group: that of sufficient member activity in the local area. This explains the success of the several very active regions, as reported in this column, where vigorous local groups have operated. A small nucleus of dedicated members is usually responsible for initiating and carrying on such group activity within the region. These regions have their own officers, committees, meetings, field trips, publications, local projects; and there is strong interest in the collecting and descriptive study of minerals occurring in the region.

Arthur Y. Johnstone, regional coordinator of Region 5, has reported the existence of a very active local group concentrated around Detroit, while the rest of Region 5 consists of members scattered very thinly over four states. He suggests that wherever there are enough interested members to start a local group in any area, regardless of geographic size, such groups, perhaps best called "chapters," could become the local operating units. Members too isolated geographically to become closely associated with any active local group, could just as well participate in FM at the national level as to try to join the nearest chapter.

There is vital need for such local chapters. Most FM projects are best implemented by members working closely together in local areas. It seems impractical to try to carry on these projects on a necessarily impersonal and loosely-coordinated nationwide scale. Local chapters would prove the most effective means of encouraging member interest and activity through personal association and local involvement; and of enlisting new members. It could also relieve national FM from much labor and committee activity now proceeding on a far-flung nationwide, indeed international, scale.

Several large problems would confront the formation and operation of local chapters. These might include: the degree of independence possible for a chapter; financial operations and responsibilities relative to national FM; geographic size limitations; minimum number of active members needed to justify application for chapter status; dangers of harmful competition with local mineral clubs already operating in the same local area, where too small a geographic size is permitted.

Much of the ideas here expressed represents the thinking of members of the executive committee of Region 3, one of the largest and most active of all FM regions. Additional recommendations for the possible initiation and operation of local chapters, based on the experience of Region 3, would include: a large degree of independence; full responsibility for managing finances; stressing the educational aspects of all projects implemented locally; promoting the descriptive mineralogy of the local area; working closely with interested professional mineralogists and educational institutions within the local area; cooperating with local mineral clubs; favoring a state (for the U.S.) or province as the most effective geographic size. One might add that a major factor contributing to the success of Region 3 within the state of Pennsylvania is the keen interest of its members in the mineralogy of this state. One of the founding goals of Friends of Mineralogy is to promote and try to bring back the now almost-forgotten science of descriptive mineralogy.

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.

Specimen Requests

Dear Sir:

As part of a study of relative stability relationships of minerals in the Fe-Ni—S system I am interested in acquiring specimens of iron and nickel sulphide minerals, and in particular pentlandite of varying iron to nickel ratios. Chips and pieces of the various minerals would be suitable. (Please include complete locality information. Ed.) I would greatly appreciate your help in this matter.

W. W. Barker, Division of Mineralogy, CSIRO
Private Bag, P.O., Wembley, Western Australia, 6014, Australia

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Dear Sir:

I am planning a course in Geology to be offered here at West High School. The outlay for a course of this type is very large and we have limited funds available. A nine weeks introductory course in mineralogy will be offered. If any club, private collectors, etc., would like to donate specimens to this undertaking it would be greatly appreciated.

Also, several students as a group-interest project are planning a school collection. Anyone wishing to help them out is certainly welcome.

Thank you,

John C. Beam, West High School
3300 Sutherland Avenue, Knoxville, Tennessee 37919

Come on gang, let's show them how generous **Record** readers can be. Ed.

AN AMERICAN MINERALOGIST

PART VIII

by Arthur Montgomery
Lafayette College, Easton, Pennsylvania 18042

Mineral curating during the thirties

Samuel G. Gordon proved himself a conscientious and capable mineral curator. His concern was to build at the Philadelphia Academy of Natural Sciences a greater mineral collection. He not only must care for it, but enlarge and improve what was there. He would leave no stone unturned to put the Academy minerals to best possible scientific and popular-educational use. By such means he could give minerals and mineralogy higher interest and stature at the museum. He had come in 1913, as a student-helper working under Mr. Keeley who was an honorary mineral curator, to handle, catalog and put in order the extensive recently-acquired William Vaux collection. As time went on, and Mr. Keeley became increasingly inactive, the younger man established himself as the central driving force of the mineralogy department.

By the early nineteen-thirties, twenty years after Gordon came, great things had been accomplished. The Vaux collection, 12,000 specimens of exceptional caliber, had been rearranged, catalogued, and securely housed in sixteen steel-drawer cabinets in rooms behind the Geology Hall on the Academy's ground floor. Several thousand of the finest Vaux minerals had been exhibited in display cases in the Geology Hall. The older pre-Vaux Academy collection of 7,000 specimens, mostly mediocre in quality but of much historic and regional value, had been cleaned up and put in better scientific order in ten more cabinets. The many minerals from Pennsylvania localities contained in this latter collection had been separated and combined with Gordon's own widely collected material from the State to fill several additional cabinets. This separate Pennsylvania collection, which was to be enlarged to about 3,000 specimens before Gordon left the Academy, remains today the finest of its kind. Gifts of smaller collections and miscellaneous specimens by the hundreds, from friends of the Academy, private donors and others, kept coming in too—and all these had to be cared for, catalogued and made a part of the greater collection being assembled. But that was only one aspect of what the young assistant curator had accomplished. His four major col-

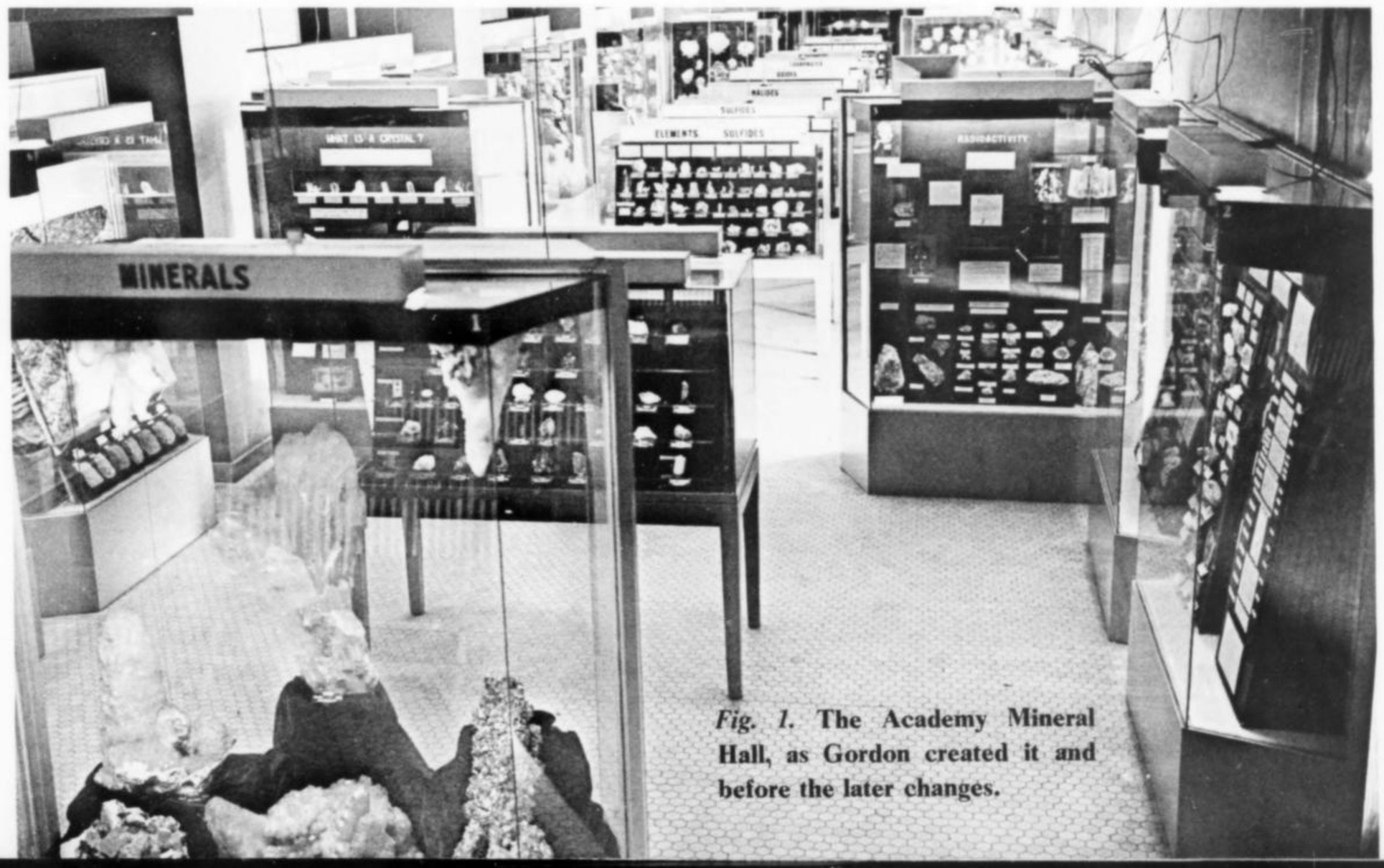


Fig. 1. **The Academy Mineral Hall, as Gordon created it and before the later changes.**

lecting expeditions had brought to the Academy a wealth of new material, beautifully crystallized, rich in rare and exotic minerals. Several of these latter species he had proved to be new to science; and he had made himself, chiefly through self-learning, an expert enough mineralogist to thoroughly research these and describe them in the literature. Many of his publications had appeared, mostly in Academy journals, ranging from descriptive, geologically-oriented works on Pennsylvania minerals to more specialized papers and reports dealing with petrology, optics and crystallography. Last but not least among these publications were his vivid and popular accounts of the collecting expeditions. It seems clear that almost singlehanded he had created a mineralogy department second to none at the Academy in curatorial activity, vigorous scientific research and layman-directed educational program.

His material rewards, however, had been small indeed. It was not until 1928, after fifteen years at the Academy, that he was promoted from assistant to associate curator. His salary, even well into the later nineteen-thirties, amounted to no more than $2,200 a year. This situation began to be a source of worry and dissatisfaction to him. But concern for economic benefits had not brought him to the Academy, and such rewards were not necessary to keep him there. What he was following was his unquenchable interest in minerals; what he needed was a place to study and work with them, where the challenge to explore their properties and hidden scientific meaning could be fulfilled. The Academy, in that sense alone, may have been the best place for him to be.

Fig. 2. **One of the wall cases, designed by Gordon, showing the effectiveness of the display before the later changes.**

One aspect of his department's growth had been his development of a laboratory for mineral research. He set it up in the rooms behind the two balconies overlooking

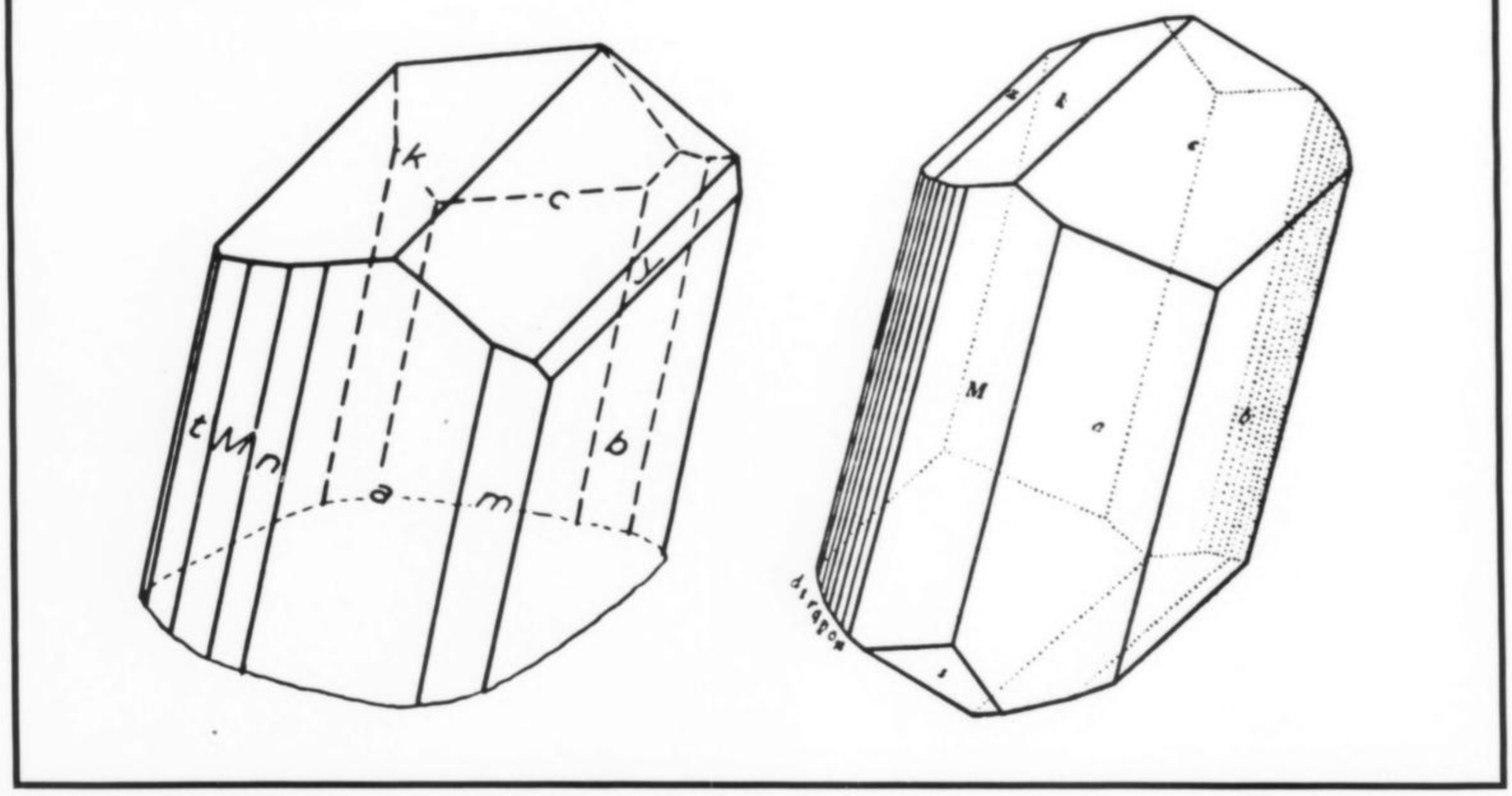


Fig. 3. **Crystal drawings of gordonite, left (from F. H. Pough, *The morphology of gordonite;* Am. Min. 22, 1937, p. 625) and paravauxite, right (from S. G. Gordon, *Vauxite and paravauxite, two new minerals from Llallagua, Bolivia;* Proc. Ac. Nat. Sci. Phila., 75, 1923, p. 265).**

the Geology Hall. A good deal of its apparatus was for chemical testing and analyses; some of that had come from Gordon's own home laboratory. He had made himself into a competent analyst through self-study and attendance at night-school chemistry courses at the University of Pennsylvania and Drexel Institute. This competence and the laboratory's facilities were needed for the investigation of rare and new species collected on his expeditions. Other equipment included a binocular and a petrographic microscope, a two-circle goniometer (in its dark-room installation) for crystallographic research, a refractometer for gemstone identification, a massive rock-trimmer machine, and various smaller-scale apparatus for mineral study. Most of the funds used to equip the laboratory were derived from sales of duplicate specimens collected on his expeditions, or else came out of his own pocket.

He was especially busy with museum-display work during the thirties. One of his aims had been to build a small separate mineral museum of unsurpassed excellence; and he achieved it in 1936. Another curatorial innovation had been to install in 1928, at the rear of and between the two balconies overlooking the Geology Hall, the first public display of fluorescent minerals in the country. Despite lack of up-keep, this last remains one of the best anywhere for mineral selection and arrangement, effectiveness of combined short-wave and long-wave ultraviolet lamp set-up, explanation (by means of a phonograph record with voice recording) of the phenomena presented, and spectacular beauty of fluorescent effects.

The north balcony became the site of the Mineral Hall. It was a long, narrow and unattractive-looking area, with limited space and a bathroom-like tile floor plus pipe fixtures exposed along the wall, yet he transformed it into a self-contained museum outstanding for artistry of displays and educational content and interest. Here Gordon proved himself a pioneer in breaking away from the age-old museum custom of laying out long lines of minerals, of as many species as possible, in drab array and buried in lifeless display cases; with all these systematically and perfectly arranged, but explained and livened-up hardly at all for practical meaning and layman benefit. What Gordon did was to use less than a thousand specimens, chiefly from the best of the Vaux collection and his expedition material, and arrange these tastefully and with plenty of elbow-room between each one in a series of striking and eye-catching exhibits. Smaller cases were placed at intervals through the central part of the hall, while larger, taller ones stood against the sides and at the far end. In a separate alcove, between the far end and the fluorescent display area, he had developed a "Pennsylvania Hall," featuring displays of Pennsylvania minerals noteworthy for quality, size of crystals, rarity, locality, and regional-geologic association and meaning.

The display cases were all his own design and making. They were constructed with a maximum use of glass to enhance visibility. Glass panels were cemented directly together without supporting fixtures. Backgrounds in the wall cases, which housed specimens of large size and spectacular quality, were of black velvet; in these the minerals, resting against the velvet-covered wall-board panels upon small invisible clear-glass shelves, seemed to float in space. Light flooded down through the glass tops of these cases from fluorescent-tube lamps housed in unobtrusive dark containers. In the small centrally-located cases, with tiers of glass shelves on both sides, hardly anything but clear glass could be seen. Even crystal mounts consisted of rods of glass or clear plastic, and specimen labels were of plastic with indented lettering.

Last, but not least, he had developed near the entrance to the Mineral Hall a series of educational exhibits interpreting minerals and mineralogy for the layman. These explained minerals, graphically and by means of well-chosen examples, in terms of their origin, chemistry, properties and crystallography; related them to their geological surroundings; and treated them additionally as regards certain special aspects such as radioactivity, meteorites, gems and local collecting areas. In 1938 he published articles describing these exhibits both for their scientific content and technical design in *Nature* (Display and reference exhibits in museums; 141, 1938, p. 213-214) and in *The Museum's Journal* (Educational lay-outs and sequences: new methods in geological displays; 38, 1938, 165-175).

A sad aftermath is that after Gordon left the Academy in 1948, amateurs acting as part-time volunteer curators managed to undo much of what had first been achieved in the displays. Rough, drably-colored plaster backgrounds were substituted for the black velvet in the wall cases, and other innovative display features were similarly changed from an appearance of simplicity and beauty to garish unattractiveness. Very few persons are now aware of these detrimental changes. The photographs in Figures 1 and 2 provide a glimpse of some of the exhibits as they appeared in Gordon's time. That this Mineral Hall remains so outstanding, despite later harmful changes and with hardly any up-keep in thirty years' time, proves the achievement of its builder.

Part of the job of any inadequately-financed museum curator is to enlist public interest and support. Gordon seems to have been tireless in his efforts along these lines. Notebooks in the Academy Library files relating to his curatorship are full of newspaper and magazine clippings and photographs recording his incessant popular talks, the varied activities of the Mineral Department, and all sorts of publicity items designed to appeal to the laymen, bring them to the Museum, and open their eyes to the color, fascination and educational importance of minerals.

Sam Gordon's enthusiasm for minerals, his tireless energy in pursuing their scientific study, and his constant efforts to publicize their interest and educational meaning, served to attract a large number of volunteer workers to the cause throughout his later years at the Academy. He

Fig. 4. **Sam Gordon, Mr. Cadwalader and the motorcycle used on the Chilean expedition.**

not only encouraged, he also taught a long line of assistants and co-workers. Some were young people. He influenced them toward scientific study and mineral research; and a good many were thus started on their way to successful careers in mineralogy and other sciences. A partial listing of these Gordon protégés and their present fields of endeavor would include: Arthur Boucot, paleontologist; Judith Weiss Frondel, mineralogist; Louis Moyd, mineral museum curator; William Parrish, x-ray specialist; Edwin Roedder, mineralogist; Lester Strock, x-ray specialist. Older volunteer associates were there also, likewise influenced by Sam's personality and example into careers in science (Hugh McKinstry, noted Harvard economic geologist, was one) or at least toward higher levels of amateur mineralogical study and interest. Dr. Judith Weiss Frondel, Harvard mineralogist, recalls how Sam encouraged all of them to become better scientists; never allowing them to give up on a research problem, however difficult, and requiring them to work it out on their own.

The naming of gordonite

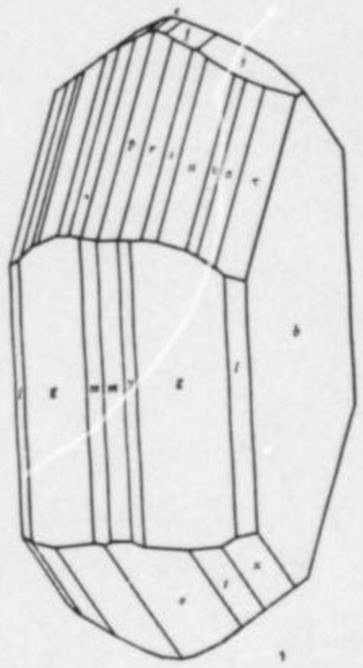
Few important honors came to Sam Gordon during his lifetime. But one that must have meant a great deal was the naming of *gordonite*. This new species was named after him in 1930 by Esper S. Larsen and Earl V. Shannon (The minerals of the phosphate nodules from near Fairfield, Utah; *Am. Min.*, **15**, 1930, 307-337). The circumstances are worth telling.

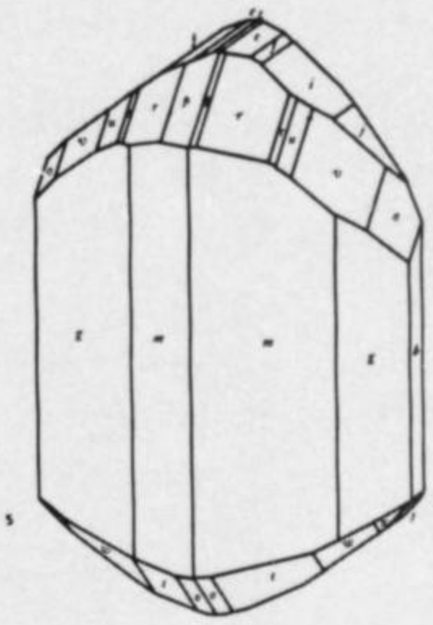
The mineral to be named *gordonite* was one of a group of phosphates Professor Larsen found to be new which occurred in the variscite nodules from Fairfield, Utah. It was the only well-crystallized species in this group, appearing as small glassy grayish laths clustered on green variscite within cavities in the nodules. Larsen determined the crystals to be new through measurement of their distinctive optical properties. But somewhere in his morphological study of the crystals, their close resemblance to the lath-like triclinic crystals of paravauxite, described by Gordon as a new Bolivian phosphate in 1923, must have become evident. Measurement of interfacial angles on the Fairfield crystals, furthermore, yielded results very close to some of those reported by Gordon for paravauxite, which gave added meaning to the resemblance. Larsen almost surely would have received from Gordon a reprint of the latter's paper on vauxite and paravauxite printed in the Academy Proceedings of 1923. Thus the crystal drawings and crystallographic data on paravauxite included in that paper—which would have been needed to call his attention to the crystallographic resemblance between the two species—should have been readily at hand. The reprint would have enabled him also to compare the chemical formulas of the two minerals, and notice the further striking similarity there. The formula of paravauxite is $FeAl_2(PO_4)_2(OH)_2 \cdot 8H_2O$; that of the Fairfield phosphate, as analyzed by Shannon, $MgAl_2(PO_4)_2(OH)_2 \cdot 8H_2O$. The sole chemical distinction was that in the Fairfield mineral, magnesium had taken the place of the iron present in paravauxite. Since atoms of ferrous iron and divalent magnesium are roughly similar in size, one element alone of the two could be present in the atomic structure of one species to make that species chemically distinct from the other, yet without altering the atomic structure common to both. With the atomic arrangement the same in both minerals, the crystallographic features would have to be similar. The reason for the close relationship between the two minerals could be fully explained, therefore, in terms of their *isostructure*.

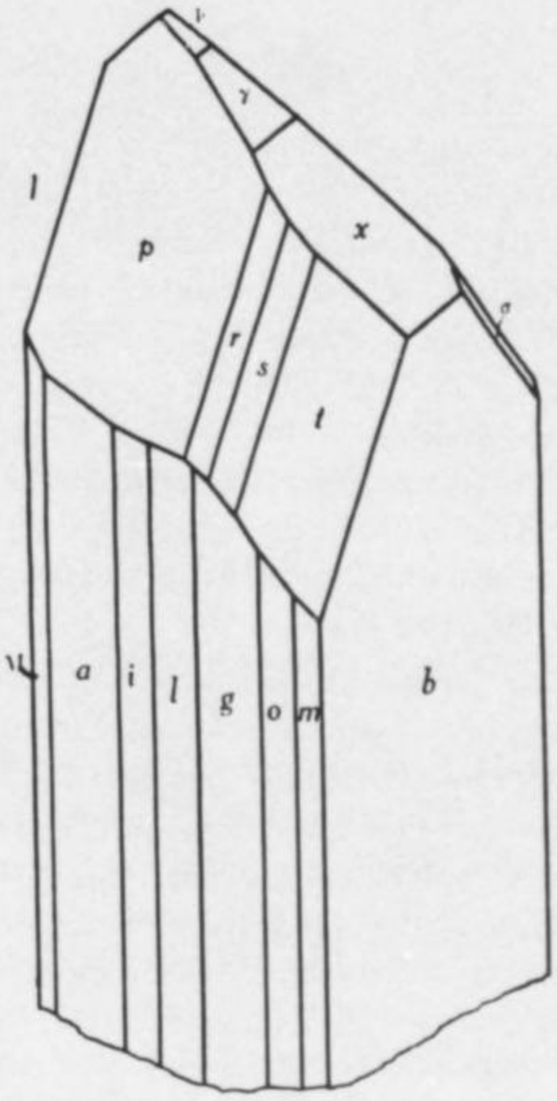
The decision of Larsen and Shannon to name the Fairfield mineral *gordonite* was as fully justified as it was richly earned. Not many mineralogists have had their names associated with such a well-crystallized and attractive mineral as is gordonite. It seems especially fitting that Gordon's meticulous research study and validating description of a species found by him to be new, and indeed collected by him on one of his Bolivian expeditions, should be so recognized and rewarded.

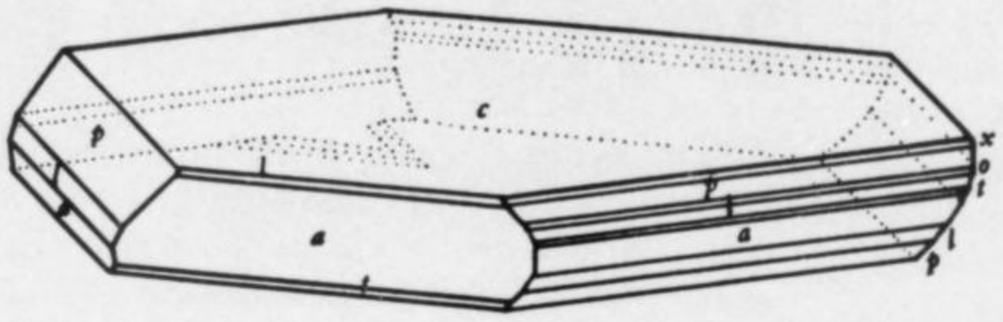
Expedition to Chile

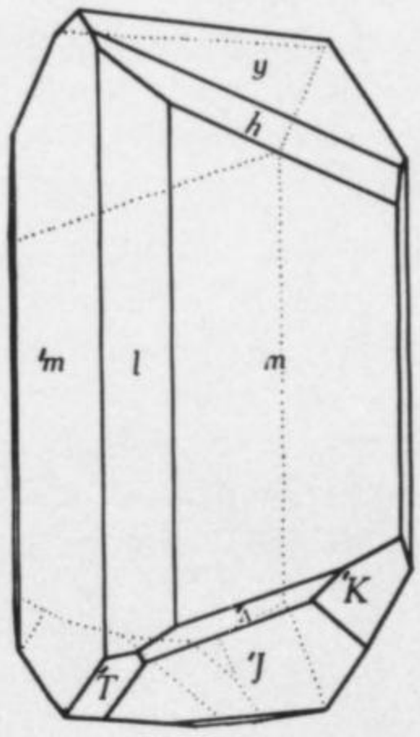
Only one foreign collecting expedition was undertaken in the thirties, from among the several Gordon planned during that period. In early 1932 he had nearly all arrangements made for a second trip to southwestern Greenland, on which the two sons of George Vaux, Jr., were to go along, when last-minute difficulties in securing adequate financing and official Danish permission forced its abandonment. In early 1934 another expedition was planned to the Los Islands off the coast of French Guinea, but that also fell through. He did manage to make a number of less ambitious collecting trips to various parts of the United States during the thirties and early forties, using two-week to four-week vacation periods for these. Thus in 1933 he visited localities in Virginia; in 1934 he went to North Carolina and Arkansas; in 1939 he made a month's journey to the Southwest, including localities in California,

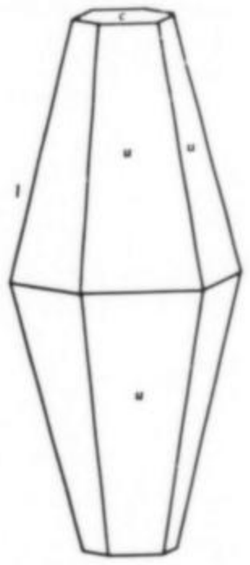


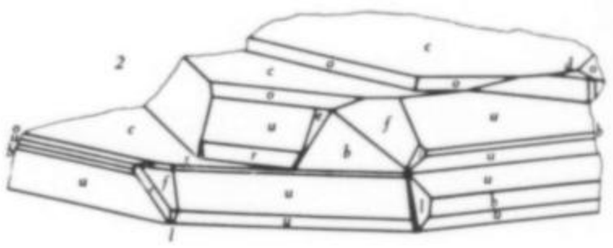


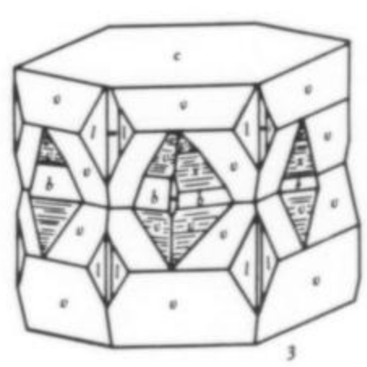


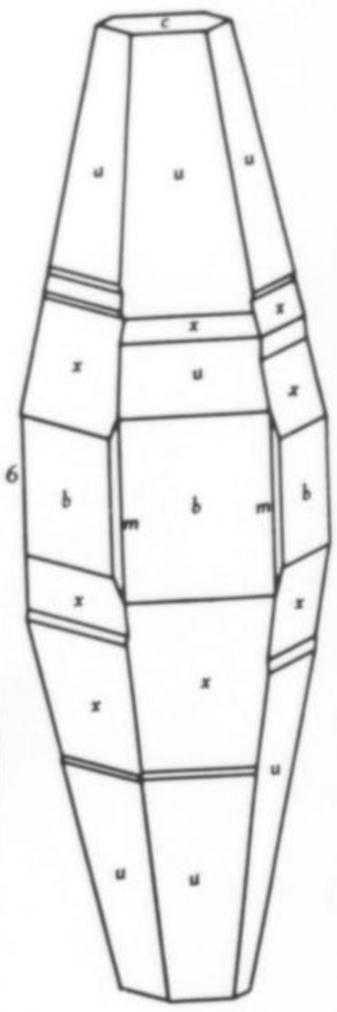


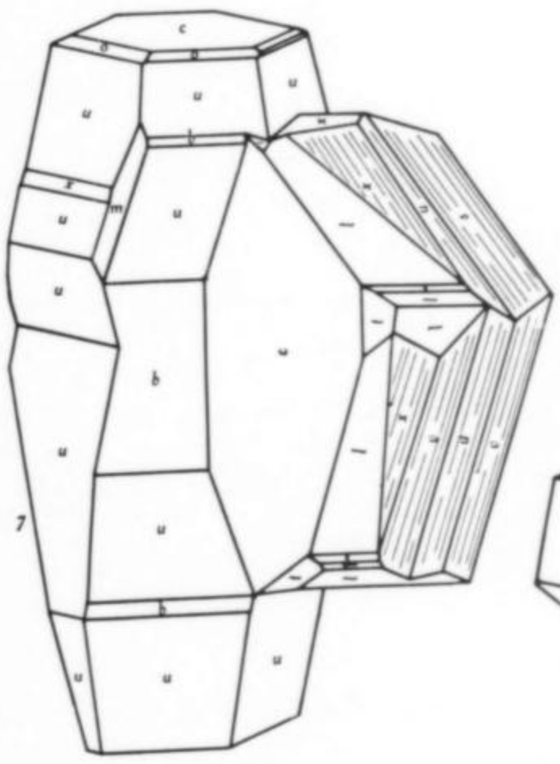


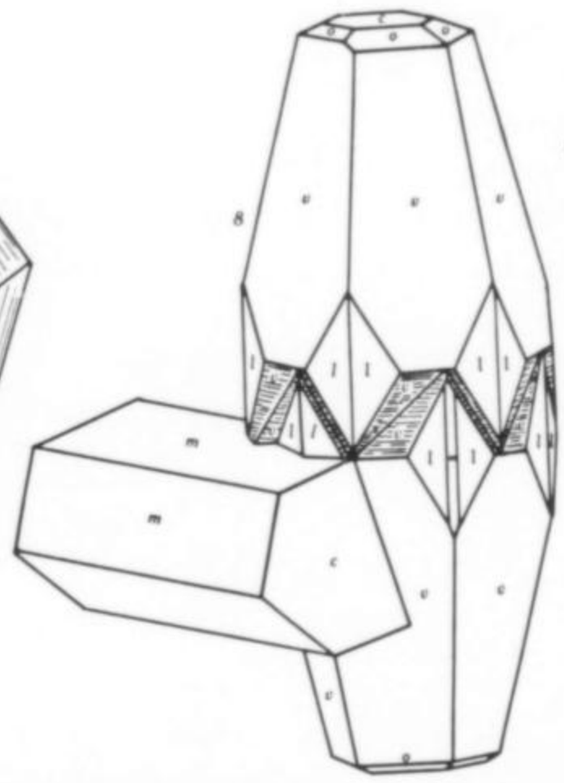


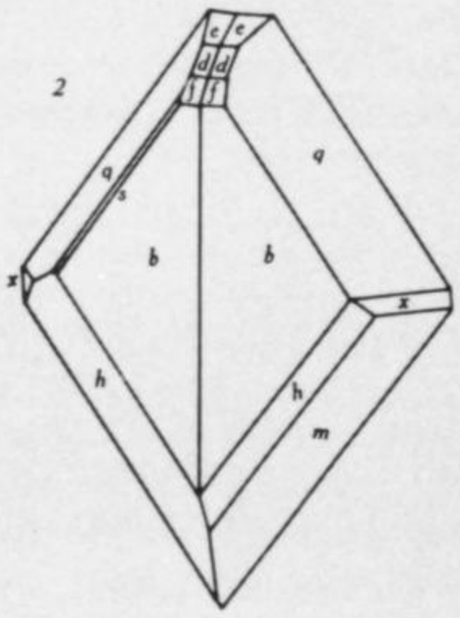












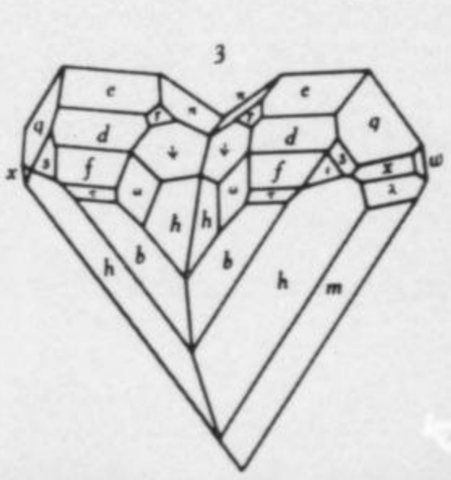


Fig. 5. **Crystal drawings by Gordon (numbers next to these are those used in his Figures) of his Chilean minerals, arranged by groups. Starting at top left in the shaded section, tamarugite, 1 & 5, Quetana and La Companiea (*Notulae Naturae*, No. 57, 1940, p. 4); metavoltine, La Companiea (*Not. Nat.*, 64, 1940, p. 2); alunogen, 1, and pickeringite, 5, Francisco de Vergara (*Not. Nat.*, 101, 1942, p. 4., 5). In this box at top left, krőhnkite, 2 & 3, Quetana (*Not. Nat.*, 72, 1941, p. 3); penfieldite, 1,2,3,6,7,8, Sierra Gorda (*Not. Nat.*, 69, 1941, p. 4, 5).**

Nevada, Arizona and New Mexico; in 1940 he managed a four-weeks' trip to the West and Northwest, with collecting concentrated in Oregon, Washington and South Dakota; and in 1941 there was a four-weeks' "Trans-Pecos" expedition, covering 6000 miles, reaching little-visited parts of west Texas and southern Arizona, and staying within a total budget of $242. All such collecting brought to the Academy quantities of fine and rare minerals as well as geological materials for the museum's expanding rock collection. In between the larger trips, he seldom missed week-end opportunities for visits to localities in Pennsylvania and adjacent states.

The one foreign expedition he was able to undertake during this period was to Chile in 1938-1939. It was to last from four to six months, aimed to make a rapid mineralogical survey of the Atacama desert, and depended on a three-wheel motorcycle as a cheap means of transportation in a rugged and mostly inaccessible region. Funds were extremely scarce, as usual, which helps explain the motorcycle. He could not have made the journey at all except for a grant from the American Philosophical Society, plus a generous private donation from the president of the Academy, Mr. Charles Cadwalader (who suggested the motorcycle).

Gordon and his motorcycle left by ship in early September, 1938. Once out on the burning sands of the inhospitable Chilean desert, the motorcycle proved more trouble than it was worth. It did get him to the main collecting areas he wanted to visit, such as Chuquicamata and Sierra Gorda; but when he had to leave the few passable roads, the vehicle overheated, refused to operate properly at the high altitudes, and became mired in sand. He finally reached Copiapo in southern Chile after many weeks of toil and tribulation. Despite such handicaps, he managed to collect a fine series of the rarer copper sulfates and other unusual minerals common to the region. And by remarkable perseverance, he found his way to more than a hundred mines and prospects. He shipped back to the Academy no less than 26 boxes of specimens. One of these contained a 171-pound iron meteorite; it had been found near Quillagua in northern Chile, was the only one of its kind, and Gordon managed to purchase it in Antofagasta for $200.

Some of the minerals collected were very unstable compounds formed in burning parts of the mines at Chuquicamata. With his usual resourcefulness he was able to preserve some of these after collecting them through use of special containers and sheets of paraffin he had brought with him by means of which the containers could be hermetically sealed.

On this expedition he also collected at the nitrate fields of Maria Elena and the guano deposits near Mejillones. Several localities in northern Peru were visited as well, before his return to the Academy in early January of 1939. Total expenses of the entire four-months' expedition were not much more than $1,000.

Part of the Chilean material still awaits study, but Gordon put the best of it to excellent scientific use in the several years of active work remaining to him at The Academy. From 1940 to 1942 he published nine Academy research papers, under the general series title of *Notulae Naturae*, based on study of some of the extremely rare and little-known species collected. One of these, a hydrated aluminum chloride, proved to be new and was named *cadwaladerite* after the Academy president. One paper was devoted to a description of the large meteorite.

Gordon did some of his finest mineralogical research in his study of the minerals collected on this expedition. The published data on some of these had been incomplete or even erroneous in part. He had a genius for discovering sharply-formed microscopic crystals in specimens of minerals never before found so well crystallized. Considerable of the crystallographic constants, data and drawings, published in 1940, 1941 and 1942 in his *Notulae Naturae* papers on tamarugite, metavoltine, alunogen, pickeringite, krohnkite and penfieldite, are given in *Dana's System of Mineralogy*, 7th ed., Vol. 2, 1951, and thus are now used as standards for these species. Since only a few of the drawings could be used in the Dana volume, however, a number of the others, remarkable for their complexity and beauty, are reproduced in Fig. 5.

PERSONALITY SKETCH

C. WROE WOLFE
Crystallographer, Educator and Philosopher

Pete J. Dunn
Department of Mineral Sciences
Smithsonian Institution
Washington, D.C. 20560

There are few mineral people in the Boston area, or in New England, who have not been influenced in some way by the efforts of Caleb Wroe Wolfe, or C. Wroe Wolfe as he prefers to be called. A professor of Geology at Boston University for 33 years, he has been an inspiring teacher of geology, mineralogy, crystallography, and many other courses. Hundreds of his students have gone on to illustrious careers in mineralogy and geology, guided by the dedication to excellence imparted by Wroe Wolfe while they were under his tutelage.

Wroe Wolfe started his academic career as an agriculture student at River Falls State College in Wisconsin. After graduation, with a scoutmaster's uniform on his back, his only suit of clothes packed, Wroe hitch-hiked to Boston and came to the School of Theology at Boston University with the intention of becoming a Methodist minister. A year of study there convinced him that his ideas and convictions about theology were not orthodox enough to fit into the format of the church. The conventional ministry was not for him! Wroe went to Harvard University for an M.A. and then a PhD. in Geology in 1940. In 1941, he came to Boston University as a Professor of Geology, a post he was to hold for 33 illustrious years!

A virtuoso with the two-circle reflecting goniometer, Professor Wolfe was responsible for many of the angle computations, and crystal drawings, in the first two volumes of the 7th edition of *Dana's System of Mineralogy*. He also prepared the statement of crystallographic procedure in the introduction to Volume I of the *System*. In 1953, Wroe published his *Manual for Geometrical Crystallography*, which is still the classic in this field. His first paper, on rőmerite, was followed by many others on mineralogy and crystallography.

Dr. Wolfe has ever been willing to address mineral clubs in the Boston area, and elsewhere. He was president of the Boston Mineral Club in 1946, and has been an honorary member to the present day. His lectures have stimulated, and sustained, a continuing enthusiasm on the part of New England mineral collectors. He has no mineral collection himself, preferring to add to the collections of Boston University, in which he taught. He has led hundreds of people to innumerable mineral localities in New England and elsewhere.

Wroe Wolfe is best known as a dedicated teacher. With a booming voice, and a finely-honed knack for holding a student's attention while "stretching his mind", Wroe Wolfe has not only introduced thousands to the wonders of the earth, but enthralled them in the process. He is a commanding personage in the classroom or lecture hall, and a warm and extremely compassionate counselor for those students who seek his advice. In recognition of his superior teaching ability, he has been chosen as the 1974 recipient of the Neil Miner Award, the highest award of the National Association of Geology Teachers.

He has special interest in the geology of Massachusetts and west central Maine, where he has conducted courses in field geology for many years. He is as capable in the field as in the classroom or laboratory, with the refined talents of observation and attention to detail which make him a fine field geologist. In 1971, at the age of 62, he bested four of his students in a steep climb (as the crow flies, without trails) up the most difficult face of Little Bigelow Mountain in Maine! His interpretations of the metamorphic geology of west central Maine have done much to unravel its complexities. He is indeed a consummate geologist, with talents in all of its various specialties.

Geologist, crystallographer, educator, and philosopher, Wroe Wolfe was honored in 1949, when a mineral he had first noticed in New Hampshire was named wolfeite in his honor. A second mineral, wroewolfeite, was named for him in 1974. A special edition of the *GSA Bulletin* will be published in his name, in 1975, with papers contributed by his friends and former students.

Not content to be inactive, or to leave the teaching of geology, which he dearly loves, he has now, upon his retirement from Boston University, taken a full-time position as Professor of Geology at Salem State College in Massachusetts.

Always one who practiced what he preached, who has been kind and gentle to a fault, who treats all with honor and respect, Wroe Wolfe has made, and continues to make, the lives of all who know him a little richer for the experience.

The initial rediscovery of tourmaline at the Dunton gem pit, Newry, Maine, was made during the latter part of August, 1972. Dale Sweatt of Peru, Maine, was prospecting on land which he owned adjacent to the Dunton gem pit, and had also obtained permission to do some superficial exploration at the Dunton pit from the International Paper Company, the owner of the property. Sweatt, at the time, had little knowledge of geology and had enlisted the aid of an acquaintance, Jim Young, to inspect the sites. On a trip down the mountain from the Dunton pit, Young and Sweatt met George Hartman of Portsmouth, New Hampshire, who enlisted their aid in exploring an area which he felt had possibilities.

The three men starting digging at a point in the dump adjacent to a ledge left by Nevel when he last worked the mine in the late 1930's. When they reached a depth of approximately 8 feet, they found what appeared to be the beginning of a small pocket in the ledge. This pocket was developed with hammers and chisels and turned out to be a small pod containing a handful of rather ordinary small tourmaline crystals.

Encouraged by this moderate amount of success, the men continued digging deeper into the dump. The level at which they were now working was rather precarious in that they had to remove large boulders and at the same time had to prevent the sides of the dump from caving in.

Gem Tourmaline... Rediscovered at Newry

Dean A. McCrillis
37 Congress Street
Rumford, Maine 04276

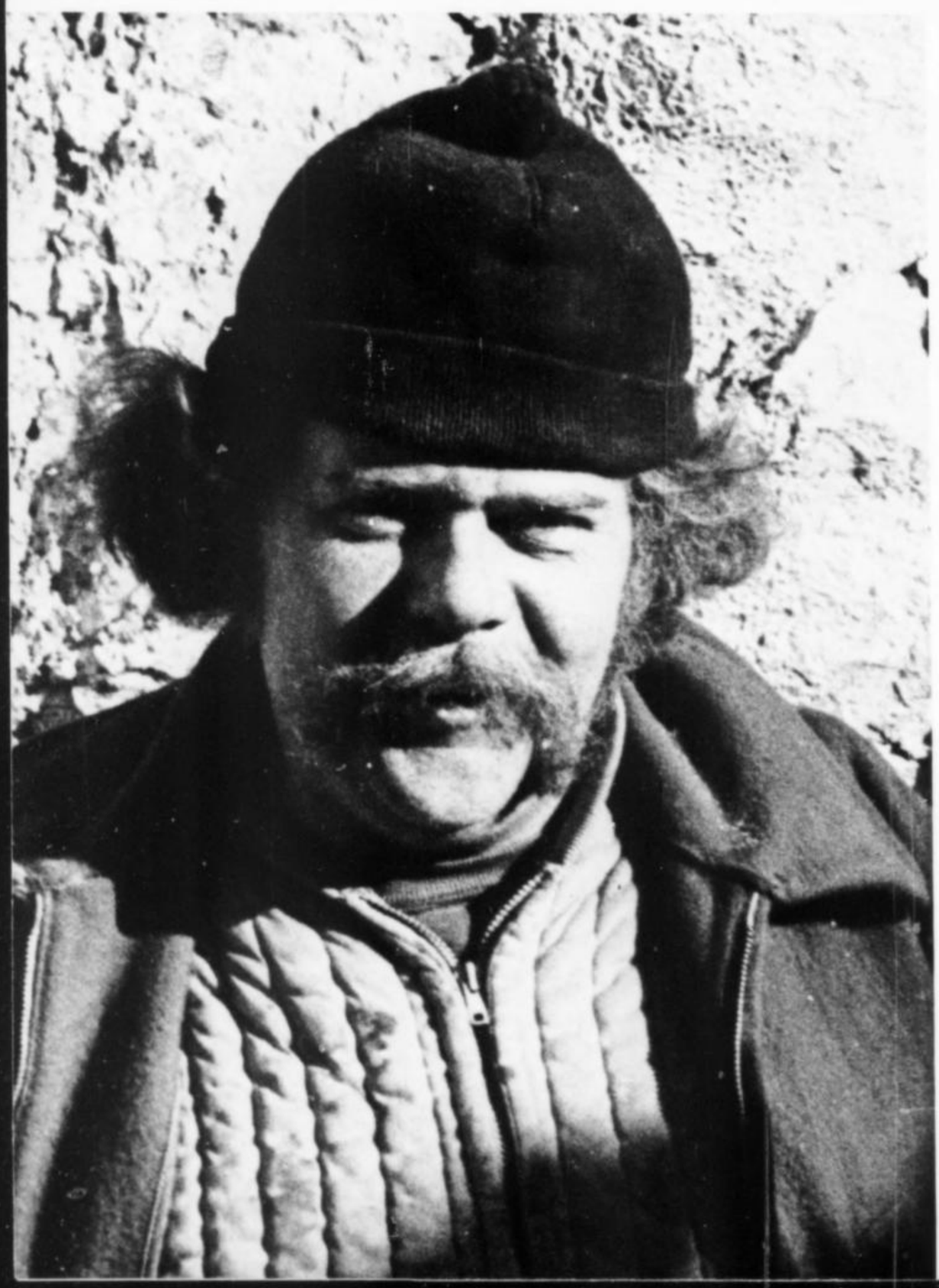
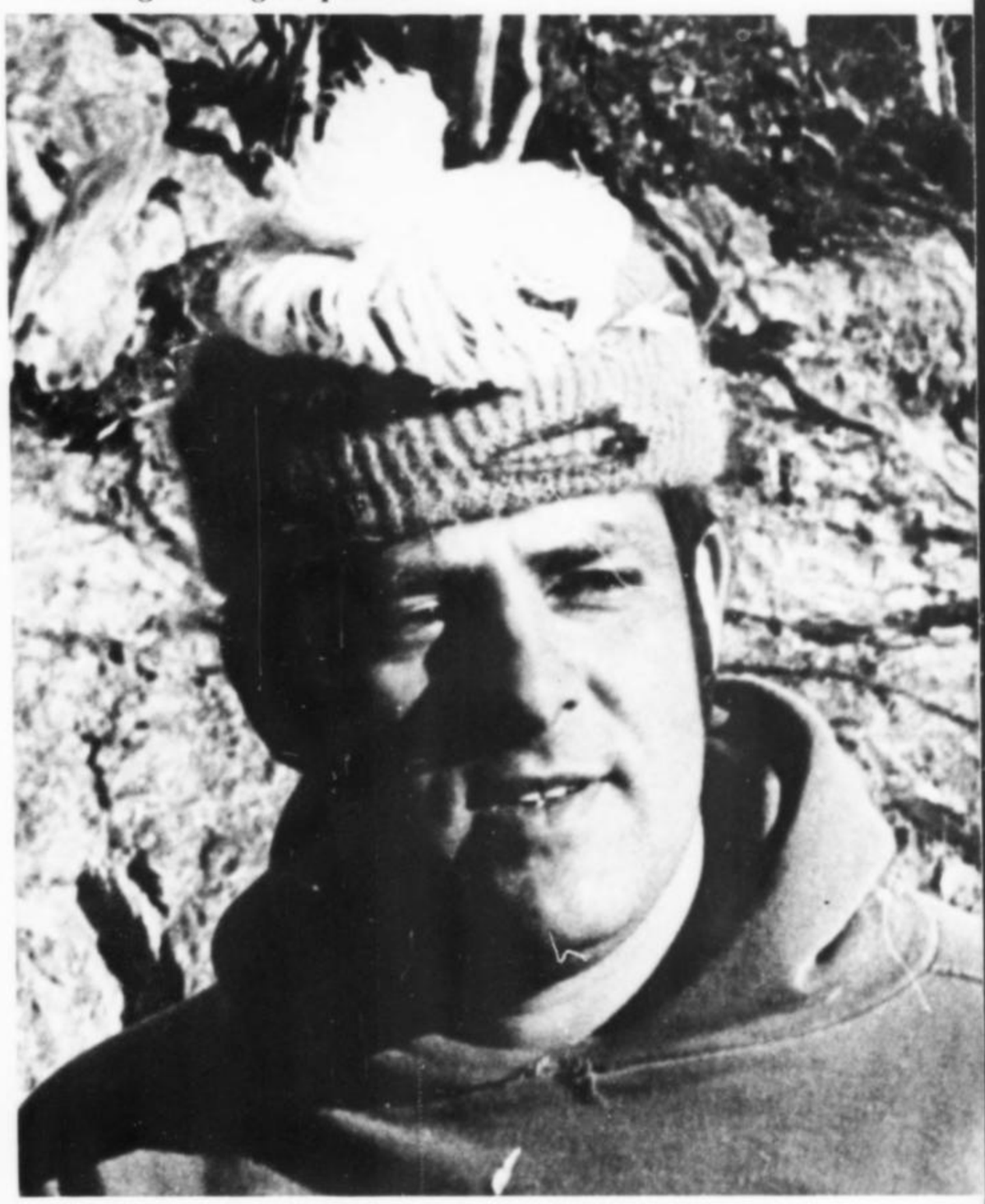


Fig. 1. **Dean A. McCrillis. One of the three original owners of Plumbago Mining Corporation.**

Fig. 2. **Left, Dale Sweatt. One of the three original owners of Plumbago Mining Corporation.** *Fig. 3.* **Below, George Hartman, Jr. One of the three original owners of Plumbago Mining Corporation.**



The sides of the hole were shored up with logs and cross supports and extreme care was taken in removing the rubble.

At around the 11 foot level, another pockety area was discovered in the ledge. Again, using hammer and chisel, this area was explored and more tourmaline was found.

By now, the men had been working almost without rest for three days and the intensity of their work, together with the size of the hole, had attracted the attention of the dozens of rockhounds who came to the Dunton pit each day. The men decided that inasmuch as so much of their time and effort had gone into developing the hole, it would be wise for them to arrange a schedule so that at least one of them would be in the hole at all times. To leave the hole, even temporarily, could result in other rockhounds taking it over and thus reap the benefits of their previous three days work. The men decided to alternate going down the mountain to get food and to rest.

On one of their trips down the mountain, Young and Sweatt contacted me and solicited my appraisal of the material they were finding. My impression of the first samples which they showed me was that it was good, but really no better than specimens many other people had found digging deep in the dump. I did suggest that it probably would be wise to spend more time developing the pockety area. Two days later, Hartman and Sweatt came off the mountain and showed me some new material they had found. This was of substantially better quality than the material previously shown to me, although I still had some doubts as to the quality of the tourmaline. I entered into an agreement with the men to advise them on their digging techniques, to appraise the material they were finding, and to help them in their digging, if necessary.

The next morning, I went up the mountain and observed the area in which the men were working. From the surface the hole appeared a little forbidding, even though I had done this sort of thing many times myself. By now they were 12 or 13 feet down into the dump and two or three feet into ledge. In order to observe the pockety area in the ledge, it was necessary to very gingerly climb down the hole, putting one's feet in exactly the right niches so as not to cause a cave-in. When I got to the pockety area, I observed what appeared to be the beginnings of a rather large vug. The vug had two channels, one going straight into the ledge and the other veering off slightly to the right. The area between the two channels was primarily a lepidolite plug. The right channel contained crystalline cleavelandite, tourmaline in matrix, and some tourmaline crystals that, although not of the best quality, were definitely pocket crystals.

The whole situation was now much more exciting to me. I left the area that afternoon and advised Sweatt and company to continue digging in the pockety area, concentrating on the right channel. I returned the next morning to find that the men had worked a good part of the night and had enlarged the pocket considerably. They were now finding even better tourmaline crystals than those found the previous day. By this time all three of the original finders were extremely tired and edgy. Other rockhounds were still sniffing around the excavation and appeared to be waiting in anticipation of any momentary abandonment of the hole to move in and take over. My sons and I spent most of the day digging in the pocket and improving the safety factors in the hole. Another two days passed with all of us alternately spending time in the hole, getting rest, and going home to clean up.

The weekend was now upon us and relatives and friends showed up to help in the sorting, packing and carrying down off the mountain of the material which had been removed. Things were still rather tense and the partners were now giving some thought as to their next move. In a sense nature intervened, when a series of severe thundershowers on Sunday evening practically filled the hole with water. The partners who were on the mountain at the time more or less arbitarily decided to fill in the hole with large rocks and boulders. At this point the hole was abandoned and the partners met at my house to determine what to do next.

After much discussion the majority conclusion was that some sort of attempt should be made to obtain a lease from International Paper Company so the material could be mined properly. One of the partners disagreed with this strategy and declared that he wanted to strike off on his own by going back to the mountain to reopen the hole and get what material he could. It was agreed that the next weekend (Labor Day Weekend, 1972) all the partners would gather to divide what material had already been found and then go their separate ways. At this point it is noted there are four partners instead of the original three, as I was now considered a partner. After the division, the three who had opted for trying to seek a lease would contact International Paper Company in an attempt to negotiate some arrangement for mining, while the fourth would go back to the mountain and extract what he could, as long as he could, by traditional rockhound methods.

A period of two or three weeks followed in which things remained more or less in limbo. Initially, the company showed very little interest in leasing the property, and the fourth partner, along with a friend, intermittently dug out the original hole and continued to extract unknown quantities of tourmaline and accessory minerals. When the paper company became more interested in leasing the land, they closed off the mine site and erected "No Trespassing" signs in the immediate vicinity of the original pocket. The hole was again filled in with large boulders, some of which weighed more than a ton. Negotiations continued between the paper company and the partners who were seeking a lease.

On October 12, 1972, Dale Sweatt, George Hartman and myself, now incorporated and acting as Plumbago Mining Corporation, entered into an agreement with International Paper Company, whereby Plumbago Mining received exclusive rights to mine the old Dunton gem pit for a period of 10 months. The corporation hired Frank Perham, a graduate geologist with many years of experience in mining local pegmatites, and went to work.

The first thing the company did was to clean out a section of the dump that led to the original pocket discovered in August. We opened the pocket from the rear of the original opening and were extremely disappointed to find that the pocket had been completely cleaned out. The pocket contained remnants of small tourmalines, flash cubes, empty wine bottles and approximately 30 to 40 burned out candles. It was obvious that some time between the day the paper company had closed the pit and filled in the original hole and the time when Plumbago Mining Corp. started to mine, other people, probably over a period of several nights, had re-entered the pocket and cleaned it out.

Naturally we were discouraged at this point, but decided that more exploration was in order. Tests, blasting and exploration went on for a week or so with poor results. On Sunday, October 22, 1972, a very cold, rainy and snowy day, we finally located what appeared to be the beginnings of two small pockets. The pockets were left undisturbed and we spent most of the day removing overburden. In the late afternoon, we drilled near the site of the other pockets and made one blast. This blast opened up a small pocket which contained minute pencils of green tourmaline.

At this point in the narrative, I am going to quote directly from the daily log I kept while we were mining. This is done for reasons of accuracy and it is hoped that the reader will not find the change of tense annoying.

"Monday, October 23, 1972 — It rained hard today, but we continued to work and developed the pocket found the previous night. Dug out many large and rather nice tourmalines. Appears that this pocket may be larger than we thought.

Tuesday, October 24, 1972 — Weather broke very cold and clear. Set off two small blasts to enlarge the entrance of the pocket and spent most of the morning cleaning up around the outside of the pocket. Around noontime we were able to see into the pocket and were extremely pleased and excited to see a vast display of tourmaline. We extracted a bushel basket of large tourmaline crystals, not many of good gem quality, but beautiful color. We left tonight with some feelings of hope.

Wednesday, October 25, 1972 — Fred and Dale continued to work the pocket opened yesterday, cleaned out the remains in the pocket and explored to see if it went further. Frank and I moved around the corner and drilled

in the floor of the pit where the dump had been. We quickly got into what appeared to be another pockety area and after careful blasting opened a pocket of the finest tourmaline we had seen to date. The crystals were interlocked in a nightmarelike tangle similar to "pickup sticks" and were covered with a greasy black film of manganese stain. Every once in a while we would take a crystal out and wash it in a puddle of water just to reassure outselves that it was really tourmaline we were finding. It seems inconceivable that we will ever be able to match up these crystal sections, as the interlocking must have taken place many thousands of years ago. We are now beginning to worry about safe storage for our tourmaline. Dale went down off the mountain today and rented the two largest safe deposit vaults available in a local bank.

Even though the mine is completely posted with "No Trespassing" and "Danger—Blasting Area" signs every 50 feet, we are constantly being bothered by rockhounds. We roped off the area and hired Bob Brown of Hanover to help us with the mining and to keep people away from the mining area.

The manganese pocket seems to be heading in a southeast direction and things look very promising. As we enlarged the pocket, even better material is showing up and the quality of gem material is picking up.

Thursday, October 26, 1972 — A bright, clear day. We worked the new pocket very carefully, by hand, and extracted a large quantity of very fine material. This has been our best day so far.

Friday, October 27, 1972 — Another fine, clear autumn day. Spent most of the morning cleaning up around the sides of the pocket and digging out rubble, at the same time, trying to leave some of the crystals in place to show visitors from the State of Maine Geology Department due in the afternoon. Late in the morning, while cleaning the back of the pocket, we found the beginning of another vug. Pulled out two or three crystals the size of beer cans. Left the area intact until arrival of Robert Doyle, State Geologist, and his assistant, Walter Anderson. Showed them the beginning of the new pocket and invited each one in turn to remove a crystal or two. They were tremendously excited and we had a hard time getting them out of the pocket.

It is apparent that these clusters of large crystals occurred thousands of years ago when some pressures or tremors caused the crystals to break off from the sides of the pocket and fall in a mass to the center and sometimes base of the pocket. We found that by carefully removing crystals and then laying them in rows outside the pocket, we are able to match some sections. This is a frustrating process, as crystals seem fairly uniform in diameter—two or three inches—and similar in appearance, i.e. deep red cores with thin layer of green on outside. Have wrapped crystals from same clusters together and placed them in same box—hope to make better matches at some later date. Doyle,

Fig. 4. **Entrance to main pocket with cart and track used to haul tourmaline out of mine, October, 1972. Pit just behind track was the so-called manganese pocket.**

Fig. 5. **Inside of main gem pocket looking out of entrance to mine, October, 1972.**

Anderson and Malcolm McLean from the paper company, assisted Dale and Fred in partly cleaning and wrapping crystals, while Frank and I very gingerly took them from the pocket. All hand work now. The further we go, the more difficult it becomes to reach the tourmaline. We are constantly being bothered by surface water seeping from the back of the pocket. As we are afraid to blast near the crystals, we have to chisel by hand to make room in the pocket to work. Many times, one man has to bail water while the other works to extract the crystals. This leads to some very strange body positions and entanglements. On more than one occasion, when either Frank or I have become cramped or cold from laying in the water, we have had to stop and figure out how to untangle ourselves in order to get into a new position. We are now deep enough into the ledge so that even with the problem of seeping water, it is warmer inside the hole than out. Actually, I don't think we are really paying too much attention to the physical discomfort at this point, as the tourmaline seems to get better and better and more abundant the further we go into the wall.

Dale went to the bank today and negotiated the lease of a vault in the cellar to store material, as we have already outgrown the safe deposit vaults previously rented.

Saturday, October 28, 1972 — Very cold and dismal today with a light drizzle. Enlarged outside of pocket by hand to give us more room to work. Found what appears to be the beginning of another pocket behind the one we are now working. By laying on our backs in the present pocket and reaching up as far as we can through a small fissure in the back of the pocket, we can feel large crystals but can't get them out through the hole. By chiseling and prying on the wall, we enlarged the hole enough so that Frank could get the top part of his torso into the pocket. He brought out some very fine tourmaline and a great deal of granular and crystalline albite, most of it snow white and very pretty. Enlarged the pocket in the afternoon so that two of us can work inside. Hard to tell at this point the size of the pocket, but there seems to be no end in sight. We have to work very carefully as we find nests of tourmalines randomly dispersed in the cleavelandite. We uncovered one tremendous crystal today, green, about 13 inches long, 4-1/2 inches in diameter, semi-transparent to transparent with a basal pinacoid termination. Carefully scraped the albite away from the crystal and left it in place. Various members of the party working outside the pocket came in, one at a time, to see this magnificent specimen before we removed it. We even induced Frank's wife, Mary, who is a claustrophobic, to come in and take a look.

We are now about 12 to 13 feet inside the mountain. I can't help but feel sorry for those working outside the hole. It seems that they are doing all the dirty work while Frank and I have all the fun, even though we are cramped and the physical labor is very hard. We worked late into the night today. There seems to be no boundary as yet to the interior of the pocket. Frank was so tired, he slept on the mountain tonight in the guard's shack. Dale and I took all the material we mined today, which must have amounted to at least 200 pounds of tourmaline, down off the mountain and stored it in my mother's summer house as the bank was closed.

Sunday, October 29, 1972 — Arrived back at the site at dawn. Frank was already working inside the hole. I joined him inside the hole and Dale worked outside, trying to

make room for the rubble we will be pushing out through the entrance. Inside the pocket, we spent most of the morning cleaning out some of the debris and exploring the pocket in an attempt to determine just how extensive it is. At this point, it is at least 15 feet long and 8 feet high, and there appears to be another chamber forming over to our right.

By afternoon, we left the first chamber, even though there are still plenty of tourmalines there and started to explore the second chamber. Our only light sources are battery lanterns. Usually Frank and I spell each other, one holding the lantern while the other works. At times we both stop and put on both lanterns to explore. It is truly too beautiful to describe. There are pillars of purple lepidolite with very crystalline white albite piles between. Protruding from the albite are tourmaline crystals of all sizes and colors. As we worked our way into the second chamber, the tourmalines appeared to be smaller but even gemmier. Most of the tourmalines now are from two to four inches in diameter, some with red cores and a green rind, and others solid green. We have found no solid red crystals so far.

It rained hard all day and was very windy and cold, but nobody seemed to mind. Of course, Frank and I were inside the hole and we were not aware of the weather at all. When Dale is not shoveling rubble out, he huddles inside the entrance to the pocket and wraps and packs the better specimens.

The State sent two photographers up to take movies and still pictures but they were able to take still pictures only due to the bad weather.

Dale's wife and my wife helped with the sorting outside the hole. The section of the pocket we are in now is so rich with tourmalines that even after the two of us in the pocket have picked out the better and bigger crystals, all of the refuse we send out has to be sorted again. There were several times today when Frank and I were literally blocked in the hole, as we had so much matrix material piled up at the entrance. Those outside couldn't shovel it out fast enough to keep the entrance open. I don't think either one of us gives any thought to the confinement because we are having so much fun and I don't even mind not smoking. I tried smoking once or twice but found the smoke too irritating because of the small space and the lack of circulating air. Every once in a while, someone would send in a can of beer or an Italian sandwich and we will eat and drink as we work.

We are now 25 to 30 feet inside the ledge and have to handle the material at least twice before we can get it out to the entrance of the pocket. The volume of material produced today is unbelievable, as it was even more than yesterday—somewhere in the vicinity of 300 pounds. We all packed the material on Dale's truck and everyone left the mountain, except me. I was too tired and spent the night in the guard's shack. Tomorrow morning, Dale plans to find more space in the bank to store the material.

Monday, October 30, 1972 — Fred returned today after a weekend at home and was obviously very pleased with the amount of material we were finding.

The road from the guard's shack at the Twin Tunnels up to the mine is almost impassable. The heavy rain washed out many areas, and made the 300-400 yard assent from the Twin Tunnels to the mine very hazardous. We have to be able to get at least one vehicle up there to haul our supplies and bring the tourmaline down at night. Bob has been spending some time working on the road—corduroying it with small trees where he can. Frank's Jeep pickup truck and my Landrover are the only vehicles that can make it up to the mine site.

When Frank arrived this morning, he brought with him a 15 foot board to which he had attached rails on either side. He also brought his son's red cart and a long length of rope. He thought this would be a more efficient way for us to get the material out of the pocket. We laid the track from the entrance of the pocket to the beginning of the second chamber, braced the underneath of the track with rocks and rubble, and now have a crude but very efficient mine railroad.

There is still a great deal of water seeping into the pocket which is good in one sense, in that it indicates there is at least one more pocket area ahead of us, which we are inadvertently draining while we are digging. However, it does make things very uncomfortable, as we are laying or kneeling in water most of the time.

We have worked out a system where Frank and I take turns using the cart. He is now working in the first chamber and I am working in the second chamber. When one of us comes to an area of good tourmaline, that person carefully picks and packs out the better specimens while the other uses the cart to send out the albite, lepidolite and smaller tourmalines that have to be shoveled away to get at the better material. The rubble is still so rich with good tourmaline that is is now taking two or three people on the outside of the pocket working all the time to pick out the smaller tourmalines from the other material. There is so much material to be sorted that at the end of the day we bag anywhere between 15 and 20 bags of unsorted pocket material to be sorted at some future date. These bags are used grain bags and weigh anywhere from 150 to 200 pounds when we get them filled.

We are going to have a problem getting off the mountain before snow flies, but we are doing the best we can with what we have.

Mr. and Mrs. Bryant of Winthrop Mineral Shop, came up today to help us sort, along with my wife and Frank's wife.

We took another large load of material to the bank this evening. The bank is letting us store the material in some vacant offices on the second floor of the building until we can find a vault or something more suitable. Although all the material is stored behind two locked doors, I hope we can find a place soon that is more secure.

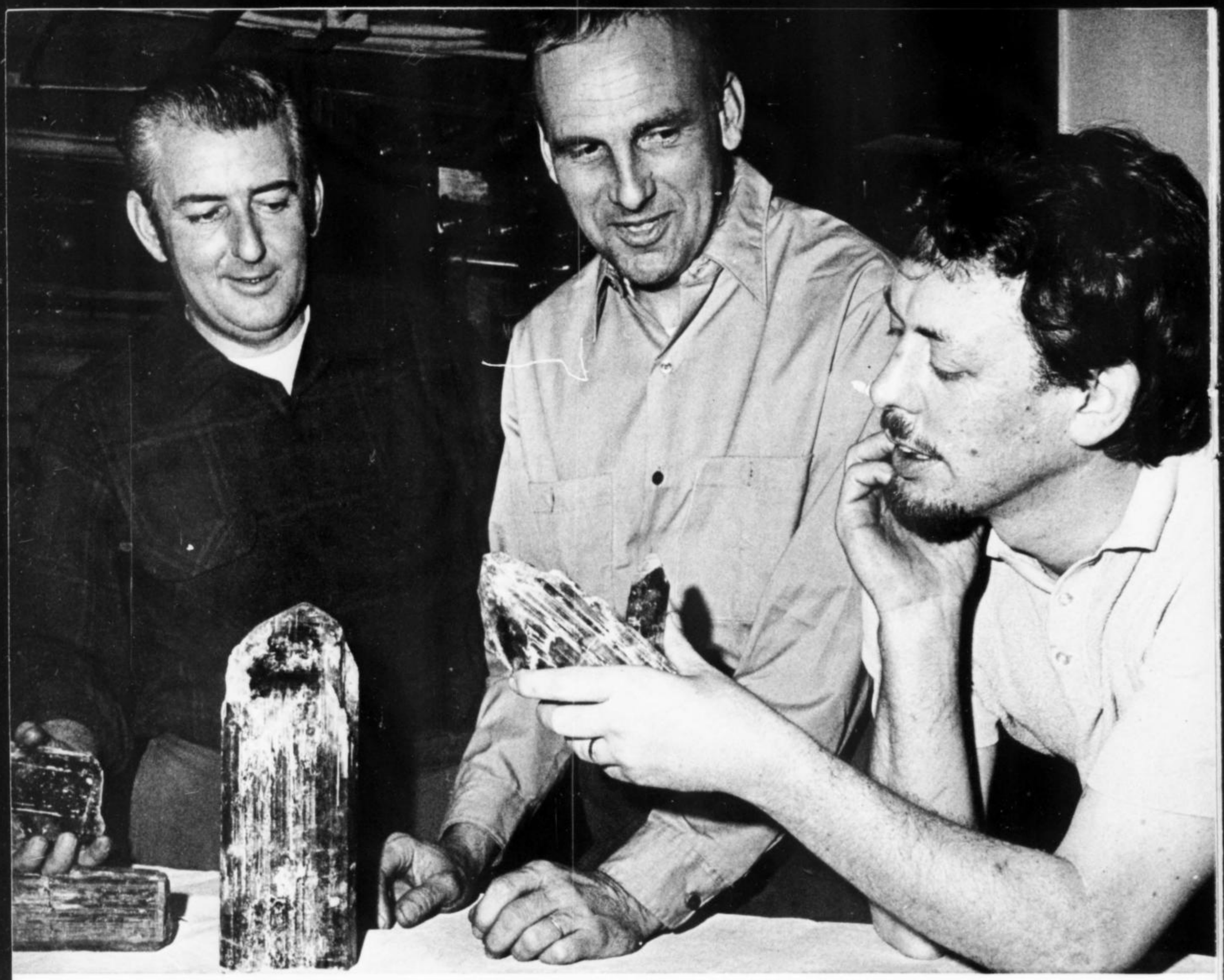


Fig. 6. **Dale Sweatt, Frank Perham, and Vincent Manson at completion of tourmaline appraisal in January, 1973. Crystal in foreground measures approximately 13 by 4½ inches.**

Tuesday, October 31, 1972 — A fine day today. A friend of ours arrived to photograph the area and our activities, so that we would have a visual record. Dale spent the day sorting and supervising the loading of materials, while Frank and I continued working the two rooms in the pocket. The second pocket seems to be coming to an end, although the quality of the material is still top notch. There were times today when I shoveled whole shovelfuls of tourmalines, or at least 90% tourmaline, into our little cart. Most of these were pencil size and a little larger and were very gemmy.

We still keep two men on the mountain every night. They check the pocket two or three times during the night. The amount of gems just lying around, both inside and outside the pocket, is incredible, and would be a great temptation to anybody if they knew they were there. Of course, we have tried to keep all of this very quiet and we do have the protection of being two miles away from the nearest road. Our access road to the Twin Tunnels has a locked gate and people would have to get by the gate, drive up two miles of road, get by the guard's shack and then up the road from Twin Tunnels before they got to the site.

Wednesday, November 1, 1972 — Our insurance men checked the site today, for safety, and found everything to be fine. I think the thing that bothered them most was the ride in my Landrover over the last 400 yards of road.

Dale, Frank and I worked hard to find some good tourmaline in place inside the pocket to show visitors from Smithsonian, Boston University and from International Paper Company due at the site this afternoon. Bob and Fred cleaned up around the mine area and bagged some of the unsorted material. Frank and I drilled three holes inside the pocket to see if we would find another pocket in the immediate vicinity, without success.

Pete Dunn and John White of the Smithsonian, John Stewart of Boston University, Robert Doyle, the State Geologist, Jack Burger and another man from International Paper Company, together with four or five photographers, arrived at the site this afternoon. We were able to show them some tourmaline in place and many boxes of material that had been sorted today. Gem production today was the lowest it has been in the last four or five days, but still extremely good.

Thursday, November 2, 1972 — Dale and I spent most of the day off the mountain talking with representatives from the Company about security for the material and also showing the men from the Smithsonian some of the specimens stored in the bank. The other men working at the mine spent most of the day preparing to do more blasting. Production again low.

Friday, November 3, 1972 — Rain again today. Had to use a portable pump to keep water out of the pocket. Spent most of the day working over the rubble looking for things we had missed. The rain actually helped in this respect, as it washed the material as we sorted. Bagged a lot of material we did not have time to sort but that was too good to leave on the site. Fred went home for the weekend. Dale, Frank and I brought over 100 bags of the lower grade gravel and specimens down the mountain and stored them in a garage at my house.

Saturday, November 4, 1972 — Dunn from Smithsonian and Stewart from Boston University came back again today and found what we expected, just small pockets with almost no tourmaline in them. Lots of rare phosphate minerals in pockets that made the museum people happy but which were of no commercial value. Took more bags to my garage.

Sunday, November 5, 1972 — Snowing hard today. Frank, Dale and I worked to get as much of the heavy equipment off the mountain as possible. Frank and I took the compressor down behind his pickup truck, but got bogged down in the mud a couple of times. Going down the last steep pitch to the Twin Tunnels, the compressor jackknifed, and if it hadn't been for Frank's experienced driving, we probably would have had a bad accident. Dale took the bucketloader down and then we moved all the rest of the equipment to the foot of the mountain. The combination of snow and ice made the main road from the Twin Tunnels to the foot of the mountain almost as hazardous as our short stretch of road from the Twin Tunnels to the mine. Glad we got the equipment down today, for if we had waited any longer, we would have had to wait for enough snow to build a snow road to get the equipment down. We do not anticipate further mining this fall, but will be kept busy during the winter, grading, sorting and matching what we have found so far."

The winter of 1972-1973 was spent cleaning and sorting the material mined in the fall. In January, Dr. Vincent Manson spent a week weighing, fine grading, and appraising all the tourmaline.

Then we began to make plans for processing and marketing the gems. A lapidary shop and offices were set up in rooms over the bank. This was an exceptionally convenient location as we could go to the vault in the cellar of the bank whenever we needed additional material.

Also, during the winter we spent some time on the mountain exploring other locations on the leased property. A new long term lease was worked out with the paper company and plans were made for the next summer's work. In the winter of 1973, Fred Hartman sold his interest in Plumbago Mining Corporation to John Marshall of Millis, Massachusetts.

During the summer of 1973 we worked the mine rather steadily and opened another 8-10 pockets of tourmaline. The volume was not as great as the previous fall but the quality was still there, so plans are being made now to work the mine again this coming summer. The frustrations and excitement of mining a pegmatite are that you can never really predict when or what you are going to find next, thus, our hopes are high that there will be equally exciting events in store for us next year.

I think that all the people associated with Plumbago Mining are well aware of our very good luck in this venture and are also very grateful to the many people who helped us reach this point in our development—to name a few:

Our Wives
Frank Perham
Robert Brown
Mr. and Mrs. Stearns Bryand of The Winthrop Mineral Shop
Thomas Garbotz
The people at Perhams Mineral Shop
Robert Doyle and Walter Anderson of State of Maine Department of Geology
Malcolm McLean of International Paper Company
Ron Kley of the Maine State Museum
John White and Pete Dunn of the Smithsonian
John Stewart of Boston University
Vincent Manson of the American Museum of Natural History
and the many others who gave us their time and advice.

Photographs 1-5 by J. S. White, Jr., photograph 6 by "Brad Crafts".

ELBAITE FROM NEWRY MAINE

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Fig. 1. **"The Jolly Green Giant", National Museum of Natural History specimen. Dunton gem mine, Newry, Maine.** ***Photo by J. S. White, Jr.***

INTRODUCTION

The Dunton pegmatite on Newry Hill in the town of Newry, Maine, was the site of an exciting and interesting gem discovery in August of 1972. Gem tourmaline, which had been found at the mine in the past, was rediscovered in substantial quantities, both as rough gem material and exhibit-quality crystals.

The Dunton pegmatite is one of five on the top of Newry Hill and is the most famous due to the discovery of gem tourmaline in the early part of this century. It is at an elevation of 1450 feet and has a lenticular surface exposure of approximately 60 by 4 meters. The pegmatite was first mined in 1901 by H. C. Dunton in search of gem tourmaline. It was subsequently operated as a mine from 1926 to 1929 by the General Electric Company, this time for pollucite, a major ore of cesium, which was in great demand at the time. During the years 1929 to 1938, the mine was worked by Mr. W. D. Nevel, who had operated the mine for General Electric in previous years. The pegmatite was next mined by Harvard University and the Whitehall Company of Keene, New Hampshire, in 1948 and 1949. Various small pockets were found in 1967 and 1968 and yielded some fine crystals.

Tourmaline is a complex boron silicate and the name is for a group consisting of several species, all of which have similar physical and optical properties. The separate species are listed below. The general formula for the tourmaline group is $(Na,Ca)(Mg,Fe^{+2},Fe^{+3},Al,Li)_3Al_6(BO_3)_3Si_6O_{18}(OH,F)_4$ and the species is determined by the dominant element among (Li,Mg,Fe^{+2},Fe^{+3}).

Schorl . . . . . Fe^{+2} tourmaline—found at Newry only in the wallrock of the pegmatite.

Dravite. . . . . Mg tourmaline—not found at Newry (usually found in metamorphosed limestones).

Elbaite . . . . . Li tourmaline—found in abundance at Newry.

Buergerite Fe^{+3} (F) tourmaline—not found at Newry.

Seventy years of mineral collecting in the Dunton pegmatite have produced an impressive list of primary pegmatite minerals and secondary phosphates. The list below

Fig. 2. **"Log" sections of elbaite, Newry, Maine.** ***Photo by J. S. White, Jr.***

reflects only those found in the present (1972-1973) phase of mining.

Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Muscovite	$KAl_2(AlSi_3)O_{10}(OH)_2$
Tourmaline	$(Na,Ca)(Mg,Fe^{+2},Fe^{+3},Al,Li)_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$
Cassiterite	SnO_2
Columbite	$(Fe,Mn)(Nb,Ta)_2O_6$
Lepidolite	$K(LiAl)_3(Si,Al)_4O_{10}(F,OH)_2$
Albite	$(Na,Ca)AlSi_3O_8$
Amblygonite	$(Li,Na)Al(PO_4)(F,OH)$
Roscherite	$(Ca,Mn,Fe)_3Be_3(PO_4)_3(OH)_3 \bullet 2H_2O$
Herderite	$CaBe(PO_4)(F,OH)$
Autunite	$Ca(UO_2)_2(PO_4)_2 \bullet 10\text{-}12\ H_2O$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Eosphorite	$(Mn,Fe)Al(PO_4)(OH)_2 \bullet H_2O$
Beryllonite	$NaBePo_4$
Uralolite	$CaBe_3(PO_4)_2(OH)_2 \bullet 4H_2O$

DESCRIPTION OF THE CRYSTALS

The elbaite crystals vary in length from 27 cm to micromount size. The largest single crystal measuring 27 x 10 cm (Fig. 1), is in the National Museum of Natural History and has been nicknamed "The Jolly Green Giant." The majority of the crystals obtained, by weight, consist of broken "logs" of single, non-matrix crystals of watermelon tourmaline (Fig. 2). These "logs", as they are called, are sections of crystals, in many cases terminated, which had been broken in prior earth movements or explosion of the pockets. It is obvious from the rehealing of the broken ends of the crystals that mineral-forming solutions have been active at some time since the event(s) responsible for the breaking of the crystals. In the majority of the rehealed sections the partially healed fracture surfaces have a dull velvety luster. In some cases the crystals have regrown to the extent that some flat crystal faces were formed over the fracture. These "log" sections vary in length and have an average diameter of 4 to 5 cm. Many of these crystals have fine and complex terminations are are beautiful display specimens. Some of these "logs" can be rejoined to make reassembled crystals of considerable length. A section has been found which appears to be a piece of the originally longer "Jolly Green Giant" but cannot be matched due to the lack of the intervening section, which was not discovered and may have been lost in the break-up of the crystals in past geological time. The broken surface of the "logs" is roughly perpendicular to the prism.

CRYSTAL MORPHOLOGY

Newry elbaite crystals are predominantly prismatic with the hexagonal prism $\{10\bar{1}0\}$ dominant and the trigonal prism $\{11\bar{2}0\}$ subordinate in development. The trigonal prism is severely striated and the hexagonal prism less so. In some cases the two prisms are equally developed resulting in crystals with a rounded triangular cross section. The few doubly terminated crystals are all hemimorphic,

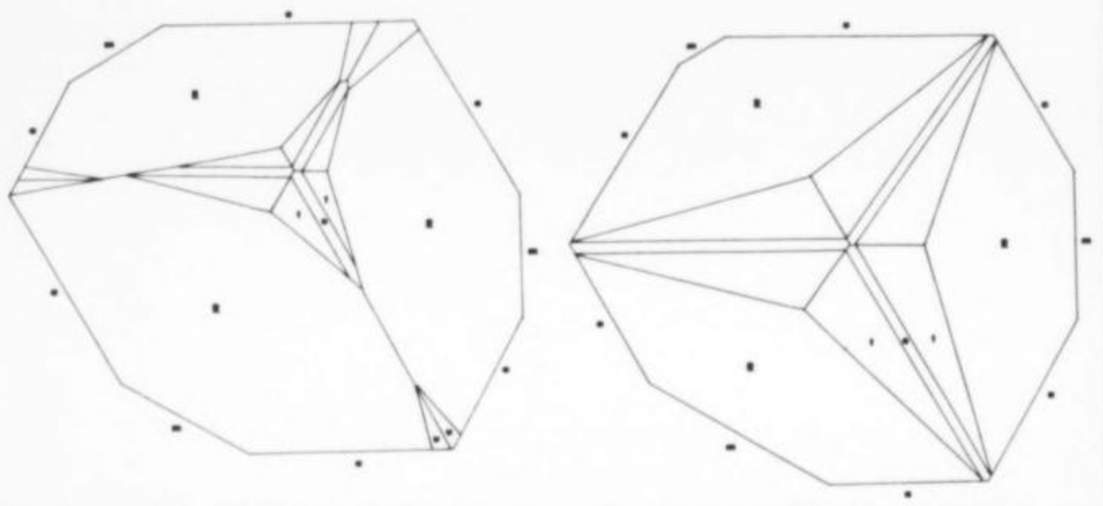


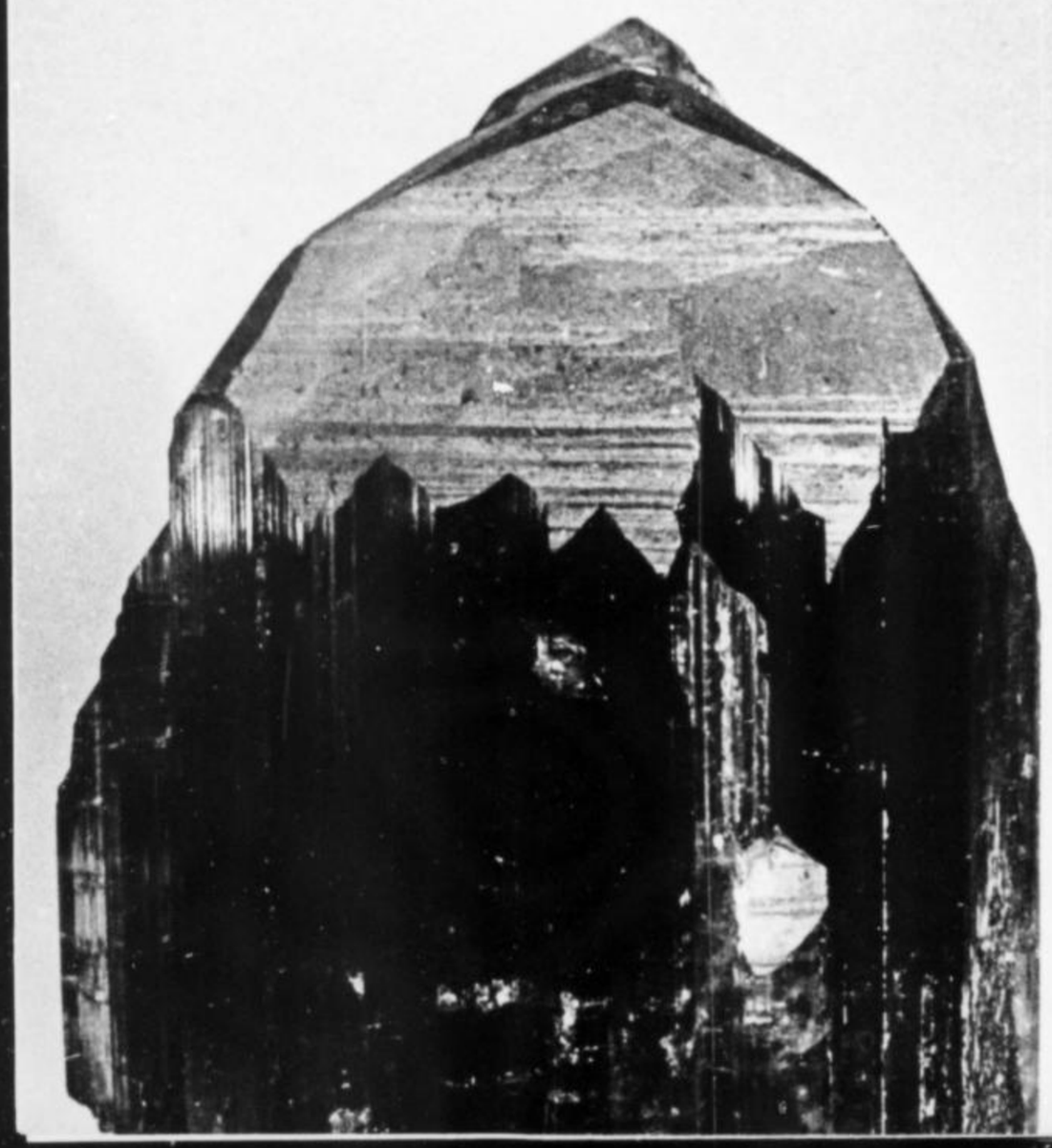
***Fig. 3.* and *Fig. 4.* Idealized drawings of acute termination of Newry elbaite.**

having an acute trigonal pyramidal termination at one end and a pedion with shallow pyramidal truncations at the other.

The most common terminations on the Newry elbaite crystals are shown in Figures 3 and 4. These diagrams reflect the dominant morphology of the terminated crystals and are not intended to be geometrically precise as they are not based on goniometry. The dominant terminal form is a steep trigonal pyramid {h0$\bar{h}\bar{1}$} modified by thin faces of another less steep trigonal pyramid {0h$\bar{h}\bar{1}$}, which in most of the crystals produces the actual point of the termination. These two trigonal pyramids are further modified by two ditrigonal pyramids {hk$\bar{i}\bar{1}$} and {kh$\bar{i}\bar{1}$}. One of these is quite shallow and is developed as six faces with the shape of a scalene triangle which are near the tip of the termination. The second ditrigonal pyramid is quite steep and is developed as six very small faces located at the junction of the hexagonal prism and the steep trigonal pyramid. The pedion {000$\bar{1}$} is only rarely found on the above described acute termination. A number of crystals were found terminated only by the pedion {000$\bar{1}$} or by the pedion truncated by a shallow pyramid. Some matrix specimens were removed from the pockets but these are few as the pockets were already in a collapsed condition when opened. The matrix specimens are almost always associated with a bluish-white albite and in the case of one particularly attractive specimen of small red and green crystals on albite, the effect was similar to Christmas candy sprinkled on snow! Several specimens were removed from the pocket-wall consisting of bluish-white albite with flattened prisms of elbaite 60 x 10 x 5mm lying with the flattened prism almost parallel to the albite surface. These crystals were doubly terminated and provided fine and attractive specimens in spite of a lack of relief.

Fig. 5.* Elbaite crystal 3.5 x 5 cm showing pedial termination and "chicken tracks" on pedion. *Photo by P. J. Dunn

Fig. 6.* Elbaite crystal 5.5 x 7 cm showing typical termination of Newry specimens. *Photo by J. S. White, Jr.



With regard to the surficial features of the crystals, the luster of the prism is quite high and pleasantly accented by the deep striations (due to the oscillatory growth of prisms *a* and *m*) which give the crystals an extra measure of glitter (Fig. 1). The terminal faces of the crystals are, in many cases, minutely figured with small markings which were described as "chicken tracks" by one succinct observer (Fig. 5). Some crystals are compound and exhibit parallel growth and are very attractive specimens. The luster on the pedion of crystals terminated with the pedion and shallow pyramid is dull. Some have growth hillocks up to 2 cm in breadth, but only 1 to 2 mm high. Striations on the trigonal pyramid *R* are due to competing growth of *R* and *m* (Fig. 6).

TABLE ONE

The forms present, in order of their development, are:

a	hexagonal prism	{10$\bar{1}$0}
m	trigonal prism	{11$\bar{2}$0}
R	trigonal pyramid	{h0$\bar{h}\bar{1}$}
o	trigonal pyramid	{0h$\bar{h}\bar{1}$}
t	ditrigonal pyramid	{hk$\bar{i}\bar{1}$}
u	ditrigonal pyramid	{kh$\bar{i}\bar{1}$}
e	trigonal pyramid	{h0$\bar{h}$1}
r'	trigonal pyramid	{0h$\bar{h}$1}
c	pedion	{0001}
$\bar{c}$	pedion	{000$\bar{1}$}

Tourmaline crystals, being hemimorphic, have different forms at opposite ends of the *c*-axis. Because the ends of the *c*-axis are different, the crystal exhibits a property

known as pyroelectricity. If a tourmaline crystal is heated, it will produce a small static electric charge on each end of the crystal; one end being negatively charged and the other positively charged.

A test was devised by Kundt (Miers, 1929) wherein a tourmaline crystal, while being heated, is dusted with a fine mixture of red lead and sulfur powders. The red lead, being positively charged by friction with the sulfur and the sieve from which it is sifted, is attracted to the negatively charged end of the crystal, and the sulfur to the positively charged end. The terms "analogous pole" and "antilogous pole" are used to describe the positive and negative ends of the crystal, respectively. The Newry tourmaline was examined in the above manner, and it was observed that the analogous or positive end of the crystals is the end terminated by the pedion and that the antilogous or negative end is that which has more acute morphology. Hence, the majority of the Newry crystals are terminated on the negative end.

Most of the elbaite crystals are zoned and the zoning is parallel to the prism and roughly parallel to the pedion. Almost all of the crystals have a thin rind of light green on the prism surrounding a red core. This zoning is quite distinct and in most cases is thin enough to allow the red interior to show through. This thin green layer is usually 1-3 mm thick on crystals 25-75 mm in diameter, and is flawed by tiny fractures, roughly parallel to the pedion, which do not continue into the red core, but appear to, and serve to disguise the gem potential of the red areas.

The majority of the crystals have a clear green termination, comprising about a third to a fourth the length of the crystal, which has no underlying red elbaite. Some crystals were found which are entirely green but no euhedral red crystals were found without a thin green outermost layer. Also found, but less abundant, were crystals in which the dominant zoning was roughly parallel to the pedion. The crystals exhibiting this zoning were ones which had the pedion developed as a dominant form.

Some anhedral red crystals were found within albite, which did not have the final deposition of light green on the outermost surface. In several cases these anhedral red crystals had an inner core of dark blue. In specimens exhibiting all three colors, the color sequence of growth is from a blue interior to red to light green for the outermost zone.

Albite was deposited before, during and after the formation of the elbaite and there is a final snow-white drusy coating of albite on some of the fine elbaite.

GEM POTENTIAL

A great part of the tourmaline discovery is gem material. The elbaite is richly colored in reds and greens and many beautiful gems of high clarity and brilliance have been cut. The red elbaite is a deep burgundy color with a high degree of brilliance and is quite free from inclusions which would detract from the brilliance of the gems. The red material is strongly dichroic and the pleasing burgundy color is seen while viewing light passing parallel to the *c*-axis. It has a weak and diffuse pink color for light passing parallel to the *a*-axis. Very little of the dark blue material is light enough to cut fine gems as it is opaque in the direction of the *c*-axis, but some nice gems have been cut with the table parallel to the prism. The green elbaite is quite clear and fine stones have been cut in many distinct hues. The most beautiful of these is a light apple green, which is free from yellow tinges, and a soft bluish green which is quite outstanding. Some bicolored stones have been cut but this material is less common. Some of the opaque green material is fibrous and should produce fine cats-eyes when cut *en cabochon*. Refractive indices for the red and green elbaite are $\epsilon = 1.618$ and $\omega = 1.636$, and for blue elbaite $\epsilon = 1.623$ and $\omega = 1.642$. Refractive index determinations were made in sodium light.

In terms of quality and quantity, this tourmaline discovery will probably set a record as one of the most notable of all time. Both gems and crystal specimens are available on the market. Donations of tourmaline have been made to the National Museum of Natural History, the American Museum of Natural History and the Maine State Museum.

The author is indebted to Mr. Dean McCrillis, Mr. John Marshall, and Mr. Dale Sweatt of Plumbago Mining Corporation for their assistance and cooperation at the initiation of this study, and to Mr. John S. White, Jr., and Mrs. Gail Dunn for critical readings of the manuscript and suggestions for improvements.

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Fig. 1. **Chalcopyrite, partially overgrown by pyrite, on quartz. The large crystal is 1 cm. Champion vein, 5 level, Tui mine.**

MINERALS OF THE TUI MINE NEW ZEALAND

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The Tui mine, a base metal sulfide occurrence, is one of New Zealand's most prolific specimen localities.

The mine is located on the steep slopes of Mt. Te Aroha, approximately 110 km south east of Auckland. It was originally developed as a silver mine but difficulties were encounted with excess lead and zinc in the ore and the prospect was soon abandoned. About 1885 the mine was reopened to provide lead for the refining of gold/silver ores in the adjoining Waihi-Thames goldfields. This operation soon ceased and until the mid 1960's no additional mining was carried on. With the development of flotation and with increased base metal prices the mine was reopened, and since then has been continuously producing lead, copper and zinc sulfide concentrates. A decline in concentrate prices, high levels of mercury contamination, and increased overheads may now force closure of the Tui mine and sealing of its entrances.

The deposit consists of a pair of base metal sulfide veins, Champion and Ruakaka, formed as an open space filling along fault fissures in Miocene andesite (Beesons Island volcanics) which in the vicinity of the veins has been extensively altered by hydrothermal solutions leading to the deposition of kaolinite and allied minerals in the veins (Weissberg and Wodzicki, 1970).

Mineralization occurred while the faults were still active, as is evident by extensive brecciation throughout the mine. The two veins, Ruakaka and Champion, strike EW and NE, and dip at 68° and 64°, respectively. The Ruakaka vein is a continuous band of sulfides up to 3 meters thick, along which the lead zinc and copper ratios are consistent. The Champion vein shows little consistancy in the lead zinc and copper ratios and the sulfides pinch out in places leaving only fractured wall rock. The paragenetic sequences are similar for both veins (Wodzicki and Weissberg, 1970) with the only mineralogical difference being the occurrence of considerable amounts of cadmium sulfide as a late primary sulfide in the Champion vein. Secondary mineralization has only occurred to a shallow depth along solution channels with primary sulfides evident in outcrops along the surface of both veins. The sulfides in these outcrops often show little sign of alteration.

Quartz is the predominant gangue mineral present in both vein systems and also forms a lattice-work of veins in the andesite around the two major sulfide reefs. Crys-

tals exceeding 12 cm long have developed, often containing fluid inclusions. Enhydros are relatively abundant with cavities approaching 13 mm long with 3 mm movable bubbles. Many crystals have multiple cavities and can be doubly-terminated. The majority of the vein quartz present is a coarsely crystalline white mass with a sugary texture. In the Champion vein two unusual forms of quartz have been found. One was of an apple green crypto-crystalline quartz forming masses several kilograms weight in the sulfide. The other was a crystalline quartz of a semi-transparent sky blue colour found in a drift off the main reef.

Calcite occurs throughout the vein system as small veinlets cutting through the quartz wall rock and as crystals on quartz. As the calcite was formed late in the paragenetic sequence after brecciation had ceased, large crystals with minimal distortion have formed. Generally the occurrence of large crystals is unusual at the Tui, but several pockets of transparent crystals up to 10 cm long have been found. Some of the calcite fluoresces a bright red under long wave ultraviolet. The manganese content of this calcite has been determined to be less than 0.1% by spectrographic methods. Most of the calcite crystals found have been etched or overcoated by other later solutions and their precipitates.

The occurrence of dolomite in base metal sulfide veins is often noted. At the Tui, dolomite forms small pure white saddle crystals coating quartz crystals. The dolomite crystals seldom exceed 1 mm in diameter. Larger crystals to 1 cm diameter have been found in a small vein cutting the wall rock and adjoining andesite in the axcess adit to Ruakaka two level.

Ferroan dolomite and ankerite are found infrequently throughout both veins. In the upper levels it has often partially oxidized to a brown colour. The crystals seldom exceed 5 mm. They occur most notably as encrustations on quartz in the Champion vein.

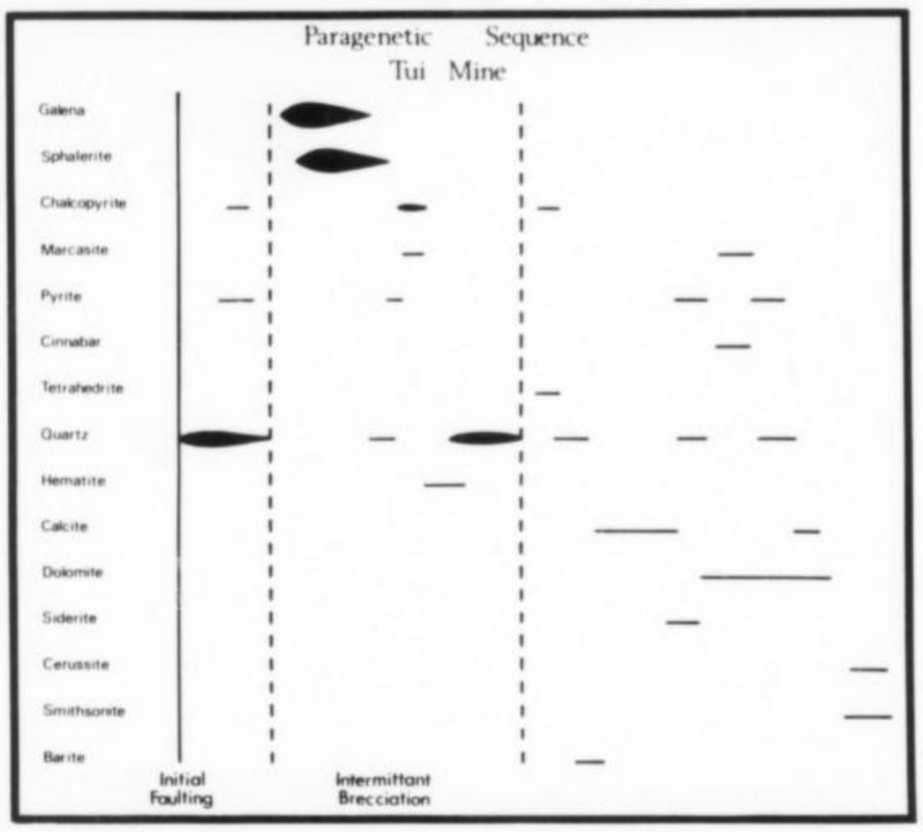
Siderite is found throughout the Tui mine. In the Ruakaka vein it forms clove green crystals and crystalline balls on quartz. Crystals have been found up to 13 mm in diameter. The siderite from the Champion vein is generally altered dull brown and is very friable.

The occurrence of hematite at the Tui is of a most unusual origin. It is a primary mineral which has formed finely crystalline masses intermixed with quartz and siderite. Individual masses may weigh 1 kg or more. The whole mixture has large chalcopyrite masses and lenses intermixed throughout and surrounding. Much of the gangue quartz associated with the hematite is coloured a pale mauve. This unusual occurrence of hematite is in the lower Champion levels.

Barite occurs throughout the Tui mine as large crystals up to 3 cm along the face. The morphology is of the simplest orthorhombic form with wide {001} and narrow {110} faces. The crystals are rarely transparent and colourless. They generally occur on quartz and sometimes display a considerable amount of etching by later hydrothermal solutions. It is not uncommon to find barite from the Champion reef to be overcoated by marcasite, cinnabar, smithsonite and dolomite crystals.

Of the sulfides at the Tui, sphalerite predominates. It forms large cleavable masses throughout the mine. Crystals are not very abundant although they have been found up to 28 mm diameter. The sphalerite has a variable iron content ranging from less than 0.1% to over 15%. The more iron-rich varieties are known as marmatite. Large skeletal

Fig. 2. **Barite. The crystals are 1 cm. Champion vein, 4 level, Tui mine.**



groups of marmatite crystals have been recovered. The sphalerite crystals are usually well formed with clean bright and smooth faces resembling sphalerite from Trepča, Yugoslavia. Sphalerite from the Ruakaka vein is sometimes overcoated by a later finely crystalline pyrite and chalcopyrite.

Galena forms large pure masses often exceeding 100 kg in the Ruakaka vein. The masses are coarsely crystalline with individual cleavages often exceeding 20 cm on an edge. Galena crystals often etched and covered by later minerals have been found in both veins. Both cubic and octahedral galena crystals have been recorded. The crystals seldom exceed 25 mm in diameter. The faces often show a considerable amount of modified growth with consequent hoppering in symmetrical patterns.

Chalcopyrite is found throughout the vein system with pyrite and quartz in the wall rock breccia. It is found as small masses and specks disseminated with pyrite, this

Fig. 3. **Cerussite. Stope 4, 3 level, Ruakaka vein, Tui mine. Actual size.**

Fig. 4. **Smithsonite. Stope 18, 3 level, Ruakaka vein, Tui mine. Actual size.**

forms the first period of sulfide mineralization. During the second period of hypogene sulfide mineralization chalcopyrite was again deposited. The chalcopyrite from this period formed as large masses and in places is the predominant sulfide present. In the Ruakaka vein, chalcopyrite is found as small blebs and masses seldom exceeding 2 cms disseminated in galena and sphalerite. In the Champion vein chalcopyrite is found as large masses and in places occurs as a continuous vein. Crystals are generally micro although well formed bright tetrahedrons up to 3 cm have been collected. Frequently they are overcoated by quartz and still later sulfides. In the closing stages of the high temperature mineralization a still later period of chalcopyrite was deposited. This filled cleavages and fractures in the previously deposited minerals. Minor tetrahedrite was deposited simultaneously. The occurrence of the later chalcopyrite and tetrahedrite is only observed in polished sections. The diameter of the veinlets and fractures seldom exceeding 0.05 mm.

Pyrite is most abundant as finely disseminated grains in the wall rock breccia, associated with chalcopyrite. It also forms cubic crystals with the second period chalcopyrite. These crystals have been found up to 8 mm diameter. Both chalcopyrite and pyrite were deposited simultaneously. In the lowest Ruakaka level pyrite crystals have been found embedded in quartz. The size of these crystals often exceeds 2 cms. Pyrite is also found in the Champion vein as a very late sulfide associated with the lower temperature cinnabar mineralization. Marcasite is abundant, forming rims around chalcopyrite. It is also found as 2-3 mm balls within chalcopyrite masses and crystals. The chalcopyrite which contains marcasite also contains small pyrite crystals. Both minerals may have formed simultaneously. A second later marcasite occurs as small balls which have formed on barite crystals. This occurrence is limited to the Champion vein.

Cinnabar is found as crusts and earthy pulverulent masses coating sulfides, quartz and carbonates in the Champion vein. It is often coated by quartz, pyrite and carbonates. No notable large crystals have been found. Minor amounts of cinnabar have been observed in the upper levels of the Ruakaka vein.

Native gold has been observed to occur as microscopic inclusions in some of the chalcopyrite from the Champion vein in the vicinity of M stope. It is seen only in polished sections.

The most recent discovery has been in the main Champion level striking north. At approximately 1300 yards from the portal on five level Champion, a vug was encountered where large primary sulfide crystals were found. These, and the quartz wall rock in the vicinity, had copious amounts of bright yellow greenockite and orange hawleyite forming crusts to several mm in thickness. Most hand specimens contain the dimorphs as a mixture.

SECONDARY MINERALS

The only supergene sulfide at the Tui mine is covellite. It occurs replacing sphalerite along fracture planes. Occasionally sphalerite will be totally replaced leaving a blue black pulverulent mass. More frequently covellite is found as a surface coating on ore that has been exposed to atmospheric oxidation, the bright metallic blue coating being only a few microns thick.

Hydrated iron oxides and carbonates found on the surface outcrops, which occasionally form a gossan, are considered here as mixed oxides, or as commonly termed limonite. The limonite formed when oxidation has proceeded to considerable depth is very frail. Thus any secondary minerals formed within it are very difficult to obtain and preserve in reasonable sized specimens. Both veins show areas of oxidation, normally along water channels in sheared and fractured areas.

A large mass of compact goethite with small amounts of lepidocrocite occurred in four level Ruakaka, as a dark brown compact mass with orange brown inclusions of lepidocrocite. It was formed as a result of ground water percolating through a fractured zone and altering a large mass of pyrite *in situ*.

The aluminium silicates kaolinite, halloysite and allophane occur as a direct result of hydrothermal alteration of the andesite during the primary vein mineralization. They were deposited simultaneously with the primary vein minerals and so form white pulverulent masses within the sulfides and quartz. They are found throughout both veins and appear equally abundant in all levels. Large pale blue waxy masses of allophane were found in two level Ruakaka early in 1972.

Smithsonite is not a common mineral at the Tui, although when it does occur it is found as large botryoidal masses. These are found both lining cavities in quartz and covering barite. Often colourless, it is frequently super-

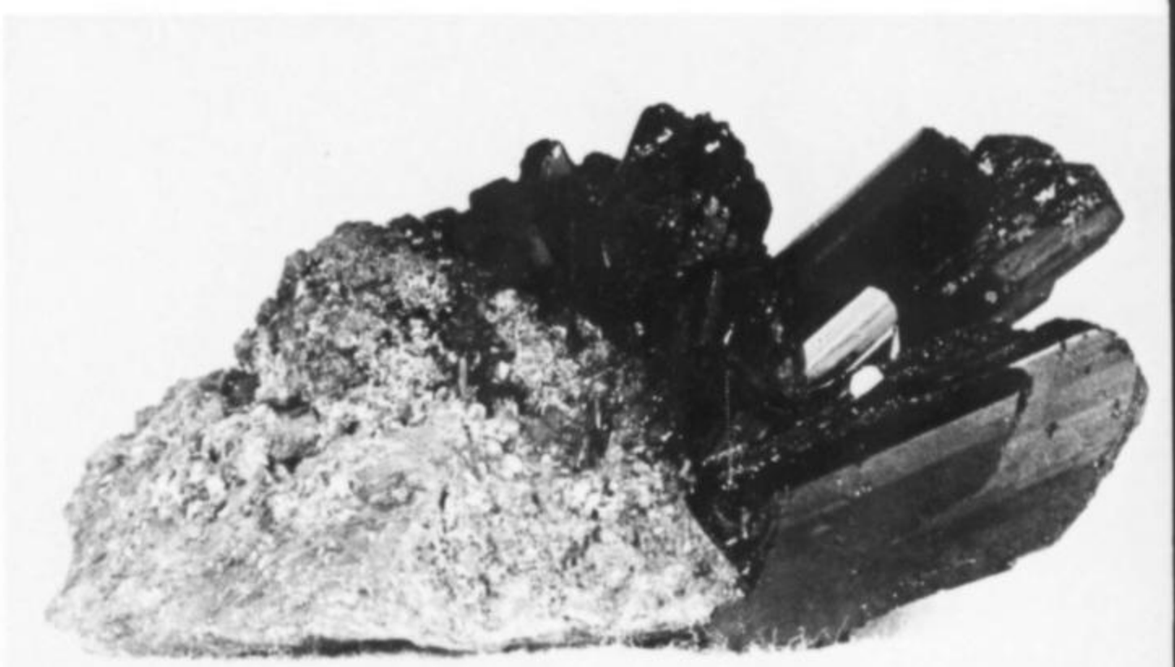


Fig. 5. **Azurite on kaolinite. The crystals are 4 cm long. Stope 3, 3 level, Ruakaka vein, Tui mine.**

ficially coated by limonite. Masses of microscopic crystals forming radial aggregates have also been found. Smithsonite is relatively abundant in three level Ruakaka stopes 2 and 3 and Champion three level.

Jarosite, a basic potassium iron sulfate, is found as coatings in all the upper levels. It also occurs in the adjacent country rock. No large crystals have been observed. Micro drusy encrustations in cellular quartz form the most noted examples. These occur in the uppermost Champion level and have minor amounts of minium and massicot associated as earthy coatings.

In the upper levels native copper is found associated with the clay minerals kaolinite, halloysite and allophane. The most abundant occurrence was in stope 3, three level Ruakaka. Associated with the native copper were several other copper minerals described below.

Tenorite, the black oxide of copper, has been found as masses altering from malachite. The samples found came from the upper Ruakaka levels. Micro cuprite crystals, as well formed octahedrons to 3 mm are abundant, filling cavities in sphalerite and limonite. Associated with the cuprite are masses of velvet malachite, the fibres attaining lengths to 5 mm. Occasionally the malachite forms large, solid botryoidal masses. Azurite is found as masses enclosed by sphalerite and as free growing crystals in a mixture of the clay minerals. Well-formed crystals, some 1 cm long, are abundant when enclosed in clay. No. 2 stope, three level Ruakaka, has yielded the best azurite crystals, some attaining a length of several centimeters. Linarite has been found associated with native copper and osarizawaite as small crystals up to 3 mm.

Osarizawaite is found as dense masses associated with kaolinite, halloysite, native copper, linarite and beaverite. Its occurrences are limited to No. 3 stope, 3 level Ruakaka, and a small veinlet in 3 level Champion. It forms yellow green pulverulent masses in limonite gossan in the Champion vein. No native copper, linarite or azurite were associated with it in this occurrence. The osarizawaite from the Ruakaka vein forms dense masses with all the mineral being enclosed by linarite, azurite, native copper and clay minerals. The Ruakaka osarizawaite has light tan masses of beaverite intermixed with the other members of the assemblage. Total quantity of osarizawaite found from both veins would not exceed a kilogram.

Serpierite, devilline—these two basic sulfates with formulas $Ca(CuZn_4(SO_4)_2(OH)_6.3H_2O$ and $CaCu_4(SO_4)_2(OH)_6.3H_2O$, occur as small aggregates of sky blue and lime green crystals. These coat fractured vein rock and are often coated by masses of matted micro gypsum crystals. Chalcanthite has been seen associated with melanterite and epsomite in one of the old drives, now inaccessable due to caving. Chalcanthite has been marketed in New Zealand having been accredited as originating from the Tui. This material is as large crystals and crystal groups. Its origin is not natural and represents the work of some enterprising person.

The Tui has afforded many specimens of galena eyes surrounded by anglesite and cerussite rings. Although the anglesite is crystalline, crystals larger than 1 mm are unusual. Masses of anglesite to several kilograms are abundant in three level Ruakaka in the oxidized shoots. By far the most abundant secondary lead mineral is cerussite which forms masses to several hundred kilograms of finely crystalline material. Cerussite is also found as water clear terminated crystals 1 cm long in cavities in gossan. The most spectacular cerussite is the matted white straw crystals often exceeding 8 cm in length. Opaque 2 cm plates were found nestled in limonite. This was common in the upper portion of stopes 2 and 3 on three level Ruakaka, this area being worked during 1968-1969. The fractured zone was again encountered in two level and stoped through to the surface. Although the crystals were plentiful, very few were preserved.

The unusual mineral dundasite, $PbAl_2(CO_3)_2(OH)_4.3H_2O$, was found in one small pocket on two level Ruakaka late in 1972. The entire pocket was mined through and the ore processed before the mineral was identified. Thus only a few specimens over 8 x 10 cm exist besides a few dozen thumbnail to miniature specimens. The dundasite has been described as the most spectacular found. It forms small white to sky blue radial crusts encrusting straw cerussite and limonite. Small solid masses of sky blue dundasite have also been recovered from the vug. When examined under a microscope the dundasite appears as elongated crystals. The blue colour is apparent only on the very extreme of the terminations as a coating less than a micron thick. The crystals show little prism development.

Specimens other than sulfide minerals from the Tui mine are very difficult to obtain and consequently few private collectors or museums have representative collections. Collecting, due to the steep nature of the country and obvious dangers of an underground mine, is discouraged. The more unusual minerals were limited to small pockets and once mined have remained absent in later mining. As the mine may now be closed and sealed there is little chance of additional specimens being found or made available to the mineral market. During active production only a very small number of specimens were obtained and collectors with samples are now very reluctant to part with them as they are generally irreplaceable.

ACKNOWLEDGEMENTS

The author wishes to thank the Management of Norpac Mining Company, whose mining leases were made available for this investigation; J. Abatematteo, D. Hazard and E. Coppard for much valued assistance and discussion; the New Zealand Geological Survey and Chemistry Division of the Department of Scientific and Industrial Research for the various analyses and use of equipment; and J. F. Lewin for much valuable discussion and reviewing this paper.

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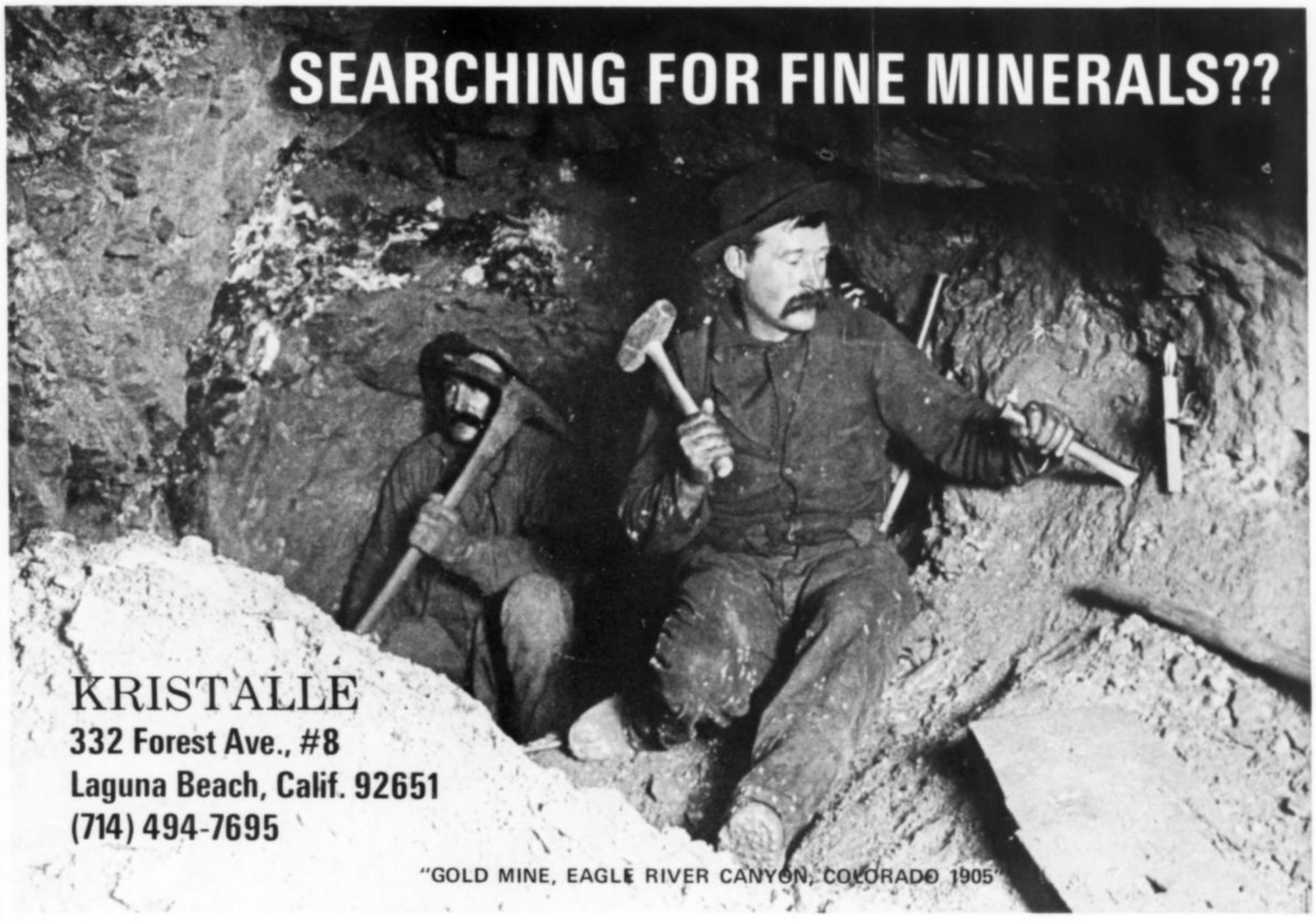
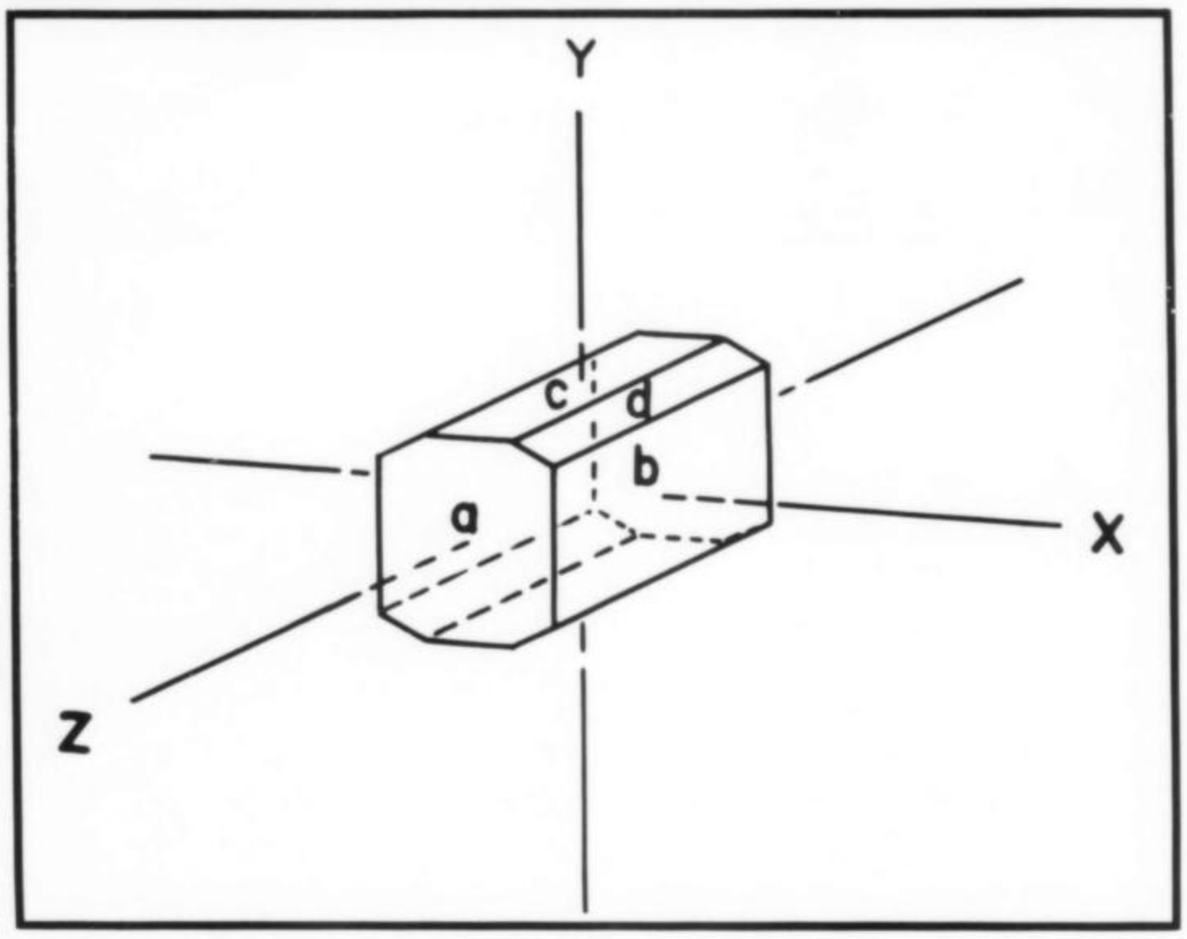


GRAEMITE

A New Bisbee Mineral

by S. A. Williams
and Phillip Matter III
Phelps Dodge Corporation
Douglas, Arizona



ABSTRACT

Graemite has been found in one specimen collected in 1959 by Richard Graeme for whom it is named. The specimen came from the Cole shaft at Bisbee, Arizona.

The specimen contains several large teineite crystals embedded in malachite and cuprite. The largest of these are pseudomorphosed by dense aggregates of platy graemite crystals.

The specific gravity is 4.13 ±0.09, H = 3—3.5. The color is near jade green, RHS-125A. Brittle with good cleavage on {010} and distinct parting on {100}. Optically (+) with 2V calc = 48-1/2°, n_α = 1.920, n_β = 1.960, n_γ = 2.20; dispersion low. Pleochroic with Y > Z = X and Z and Y blue green, X yellowish green; X = *b*, Y = *c*, Z = *a*.

Strongest lines are 6.395 (10), 3.434 (8), 12.803 (5), 2.558 (5), 2.873 (4), 2.343 (4), 5.640 (3), 2.801 (3); *a* = 6.805 Å, *b* = 25.613, *c* = 5.780. Probable space group *Pcmm*. With Z = 10, Dcalc = 4.24 g/cm³.

Chemical analysis showed CuO = 31.0%, 31.9, 30.0; TeO_2 = 60.8%, 61.4, 61.4 by AA and colorimetry respectively. Water by the Penfield method gave 7.0%, 9.5. This leads to $Cu_{9.77}(TeO_3)_{9.62}.11.42\ H_2O$ or $CuTeO_3.H_2O$.

INTRODUCTION

Although Bisbee is a mining camp well known for its beautifully crystallized oxide ores of copper it has produced surprisingly few new species during its life. Probably the main reason for this is the simplicity of its hypogene ores in terms of the elements present and mineralogy. Nevertheless, some of the new species found there have been remarkably abundant or well crystallized in the type specimen. Paramelaconite is a good example and spangolite probably is as well.

The new species graemite carries on this tradition for, although only one specimen is currently known, it is quite spectacular for a new species. The piece was retrieved from an ore car in 1959 by Richard Graeme and recently loaned to us for identification. The specimen came from the 1200 level of the Cole shaft, probably from the 202 stope, the only active oxide stope in the upper Cole at that time.

The type specimen measures about 2-1/2 x 2-1/2 x 2 inches and is a loose spongy aggregate of cuprite crystals embedded in a dense matted matrix of tiny malachite needles. Embedded in the malachite are several large electric blue teineite prisms. These measure at least 8 mm long and have corroded, pitted surfaces. Cuprite and an occasional graemite crystal are attached to the surfaces. Two very large teineite crystals occur and are totally replaced by graemite. One was at least 20 mm long, the other is 8 mm in cross section, but both are broken.

Graemite replaces these as divergent platy, bladed crystals arranged in random fashion. In the stoutest teineite relic they show a radial divergence but on the surfaces of both pseudomorphs they tend to lie with their long axes [100] near parallel to the prism axis of the teineite. The specimen contains an estimated 500 mg of graemite.

During this study a second locality for graemite was found. The samples were provided by John Forrester and were collected at a small prospect in the Dome Rock Mountains, Yuma County, Arizona. These samples consist of massive "chalcocite" in a quartz-tourmaline gangue. Small corroded blebs of bornite and traces of weissite were found embedded in the chalcocite. Fractures are filmed with brochantite and malachite and may be lined with crystalline goethite, and gold. By carefully breaking the chalcocite so that it fractured in fresh material rather than along brochantite-filmed surfaces, small cavities were found that housed goethite, gypsum, teineite, and graemite. As at Bisbee, graemite appears to replace teineite, and the latter mineral is invariably corroded.

The species description is based solely upon the Bisbee specimen.

PHYSICAL PROPERTIES

Graemite is a lovely blue green color, near jade green, Royal Horticultural Society RHS-125A, with a similar but pale streak. In general appearance graemite could be confounded with chalcophyllite, malachite or aurichalcite. The Mohs hardness is 3—3.5, and the mineral is brittle with a good cleavage on {010} and pronounced parting on {100}. No fluorescence was observed in short or long wavelength U. V. The specific gravity was determined on the Berman balance as 4.13 ±0.09 from five trials using a 6 mg sample in toluene at 24.5° C.

CHEMISTRY

Emission spectrographic analysis showed major Te and Cu with a trace of Ag. Microchemical tests confirmed this and a test specific for tellurite gave a strong reaction; testing for tellurate gave negative results. Tests for halogens and sulfate were likewise negative.

Table I shows the results of the chemical analyses. The mineral was dissolved and run in 1:1 HNO_3 by atomic absorption for Cu. Tellurium was determined colorimetrically in 3 normal HBr. We also report an analysis of the teineite; identical methods were used. Water was determined (and observed) by the Penfield method. During heating graemite decrepitated, turning a sickly green and then fused easily to a grey blebby slag. We consider the value of 9.5% H_2O to be erroneously high since a tiny fragment was ejected from the tube during decrepitation.

The analyses lead to the empirical cell contents $Cu_{9.77}(TeO_3)_{9.62}$. 11.42 H_2O or $CuTeO_3.H_2O$. The teineite analysis confirms the formula $CuTeO_3.2H_2O$.

Graemite is easily soluble in cold reagents including 40% KOH, 10% HC1, and 1:1 NHO_3 but is insoluble in water.

MORPHOLOGY AND OPTICS

On the outer surface of the teineite relics, graemite may occur as euhedra of fairly good quality capable of giving reflections on the goniometer. Such a crystal is pictured in Figure 1. The only forms found are *a* {100} *b* {010} *c* {001} and *d* {021}. Although *b* tends to be slightly distorted into a mosaic of near-parallel rectangular domains, *a*, *c*, and *d* give bright crisp reflections. In the interior of the teineite relics the habit changes from that figured to notably extended on [100] and flattened on {010}. Crystals up to 8 mm long were noted. No evidence was seen, either morphological or optical, that graemite is not orthorhombic 2*mm*.

In transmitted light graemite is modestly pleochroic with Y and Z blue green and X yellowish green with Y > Z = X. The optic orientation is shown in Figure 1 and of course extinction is parallel in all orientations since the principal crystallographic directions are pinacoidal.

The 2V (+) is 48-1/2° (calc.) and the indices of refraction are $n_\alpha = 1.920$, $n_\beta = 1.960$ (both ±0.003), and $n_\gamma = 2.20 \pm 0.005$. The latter index was determined in S-Se melts; all indices are for the NaD line. Dispersion of the optic axes was not observed.

X-RAY DATA

The X-ray powder pattern of graemite is typical of a layered mineral with a few strong lines and numerous weak or diffuse ones. An indexed pattern is presented in Table II.

Rotation on all three axes and Weissenberg level photographs were accomplished using CuK_α radiation. These patterns were characterized by strong sets of 0k1 reflections and remarkably weak reflections in the h01 region. Results of this study lead to the proposed space group *Pcmm* but this is not a certainty because of the failure to record many h01 reflections, even after long exposures.

Cell edges were refined from powder data and are as follows: $a = 6.805$ Å ±.006, $b = 25.613 \pm .015$, $c = 5.780 \pm .006$. The calculated density is thus 4.24 g/cm³ which compares favorably with the measured specific gravity, 4.13; Z = 10.

CONCLUSIONS

Graemite apparently replaces teineite as a consequence of partial dehydration of the latter mineral. The source of the tellurium is uncertain, of course, and this element is probably very rare at Bisbee. However rickardite has been noted in trace amounts in the ores (Galbraith & Brennan, 1970).

A number of new Cu-tellurites have been found in the prolific Moctezuma district; some have been described, some descriptions are forthcoming. A suite of unknown tellurites has also been found in Arabia (F. Cesbron, pers. comm., 1973). Diffraction data for these various species fail to show any resemblance to graemite. So far as we are aware this compound has not been known artificially.

It is not unlikely that additional graemite specimens may be found in material collected from the environs of the 202 stope, known for its connellite crystals. Old Bisbee specimens purporting to be connellite should be carefully reexamined. Some may prove to be teineite, originally misidentified on the basis of the striking similarity in color to connellite. The presence of teineite would of course enhance the possibility of coexisting graemite, its natural dehydration product.

TABLE I
CHEMICAL ANALYSES

	GRAEMITE								TEINEITE	
	1	2	3	4	5	6	7	8	9	10
CuO	31.0	31.9	30.0			31.0	.390	30.93	27.4	28.91
TeO_2	60.8	61.4	61.4			61.2	.383	62.06	56.2	58.00
H_2O				7.0	9.5	8.2	.455	7.01	16.7	13.09
						100.4		100.00	100.3	100.00

1, 2, 3 CuO on 0.620, 0.625, 0.455 mg respectively; TeO_2 on 0.620, 0.637, 0.477 mg: analyses by M. Duggan, Phelps Dodge Corporation.

4 On 0.2535 mg; Penfield method.

5 On 0.5064 mg; Penfield method.

6 Average of columns 1 - 5.

7 Ratios

8 Theory for $CuTeO_3.H_2O$.

9 By Penfield method; H_2O on 0.209 mg; Teineite: Cu and Te on 0.315 mg, M. Duggan, analyst.

10 Theory for teineite.

Table II

Indexed powder data for graemite;

CrKα radiation, 114.6 mm Straumanis camera

I est.	d meas.	d calc.	hkl	I est.	d meas.	d calc.	hkl
5	12.803	12.806	020	1	2.658	2.661	260
10	6.395	6.403	040			2.660	102
3	5.640	5.638	011	5	2.558	2.561	0.10.0
2	5.274	5.268	021			2.553	091
1	4.789	4.786	031	1	2.517	2.517	052
1	4.273	4.269	060	½	2.492	2.492	270
8	3.434	3.434	061	½	2.423	2.417	261
1	3.375	3.373	210	4	2.343	2.342	0.10.1
2	3.196	3.202	080	1	2.268	2.268	072
1	3.160	3.161	230	1	2.160	2.162	281
2	3.092	3.092	071			2.160	0.11.1
½	3.009	3.005	240	1	2.133	2.133	232
1	2.920	2.913	211			2.134	0.12.0
4	2.873	2.872	012	1	2.029	2.028	092
3	2.801	2.801	081	1	2.003	2.002	0.12.1
3	2.773	2.773	231			2.005	341
3	2.735	2.737	032			2.003	360

plus 20 lines to 1.23 Å, none with $I_{est} > 2$.

ACKNOWLEDGEMENTS, ETC.

We are gratefui to Miss Marjorie Duggan for the excellent analytical work. Phelps Dodge geologist Richard Graeme, longtime collector and student of Bisbee minerals, provided us with the specimen which he had carefully preserved for 15 years. The species is named in his honor.

The type specimen will be housed in the University of Arizona collection. The mineral and name have been submitted to the committee on new minerals and names, IMA.

GALBRAITH, F. W. and D. J. BRENNAN (1970) *Minerals of Arizona*. Ariz. Bur. Mines Bull. 181. Univ. of Ariz. Tucson

Yedlin on Micromounting

We're always learning something. At the close of the 18th Baltimore micromount symposium we went down to Washington for a visit at the Smithsonian. This is always a rewarding thing for we look through the Museum's micromount collection, and invariably marvel at its plethora of fine things. Paul Desautels, curator of the mineral collection at the Smithsonian, still makes micros from time to time, as a therapeutic thing, for the stress of maintaining and enhancing the Museum's collection tends to overwhelm, and a session with the stereobinocular acts as a calming influence.

We'd noticed his pedestals. He uses balsa wood, very soft, but whereas most of us use prepared sticks of this material, varying from 1/8 to 1/4 inch square, and three feet long, cutting them to adequate lengths as needed, the Desautels' technique is somewhat different. He has obtained three foot long balsa, 1 by 1-1/2 inches in cross section. He saws billets one half to five eighths inch thick from these sticks, and then cuts pedestals from them, sizing them according to the specimen to be mounted. The cleavage - no - *grain* of the wood is at right angles to the 1 by 1-1/2 inch surface, and two snips with a sharp blade does the trick. A half to five-eighths inch covers most situations, but there is nothing that says you cannot have half a dozen such billets. of varying thicknesses, to cover all contingencies. The cost is less, too. Quarter inch balsa sticks have gone up in price from about a nickel to a quarter.. The lumber cost is in your favor when the larger sizes are used. Less saw labor, fewer sawcuts — you can come out on top.

We'd been wondering about silver remains at Laurium, Greece. The locality was the scene of ancient mining operations some 2500 years ago, with slave labor operating the mines for silver bearing galena, and producing some seven million tons of dumps in the process. The galena was hand cobbed, washed, roasted and then cupelled, resulting in a residue of silver, early used to build a fleet which defeated the Persians at Salamis, and then to establish Athens as the cultural center of the world. Slags from this smelting operation were cast into the sea at Laurium, and 2500 years of immersion in sea water resulted in some combinations of elements that produced new minerals, and some rare known ones — in short, a new locality for lead oxychlorides and associates. Among these are laurionite, paralaurionite, penfieldite, fiedlerite, georgiadesite, anglesite, phosgenite, cerussite, matlockite and others, all resulting from the imperfect extraction of lead from the ores.

Now, with some 8 percent of silver in the galena it is logical to expect that some of this metal, too, was dumped into the sea as residue in the slag. Question: What happened to it? Answer: The recent determination of some blue minerals in the slag as boleite- $Pb_9Cu_8Ag_3Cl_{21}(OH)_{16}\bullet H_2O$ — (See *Mineralogical Record*, Volume 4, page 262) accounts for some of the silver. A good deal was lost, perhaps, as argentite or acanthite (Ag_2S), black sooty residues being ignored by investigators. Chlorargyrite (AgCl) should have been found, but we're assuming that conditions were favorable for the formation of these minerals. Maybe 2500 years of soaking in the oceans was not conducive to the depositing of such materials.

Some years ago one of our sources of plastic boxes delivered them in two units, one as boxes and the other as lids. In some cases the tops were a bit too large, and dropped off when the specimen was manipulated. We take plastic tape, the "magic transparent" type, put out by the 3 M company, and wrap a section around the shoulder of the box, increasing its size a couple of thousandths of an inch. After it's been placed it can be trimmed as per sketch.

Jules Bernhardt, of the Nassau (New York) Mineralogical Society, suggests preserving the label and its legibility by coating it with a layer of clear nail polish. "Better than regular lacquer", he says, "because a bottle of the stuff contains the right sized brush". He uses a "Rapidograph" pen for small print and added legibility. He goes on to suggest that for those who want to remove specimens for photography the thing to do is to mount the pedestal on heavy black paper, fastening this to the bottom of the plastic box with "Elmer's School Glue", which is completely water soluble. A few drops of water and the specimen becomes removable without damage. "And besides, you don't have to paint the bottom of the box".

The Pacific Micromount Conference is coming up the first weekend of February at Santa Monica, California. Get details from Marion Godshaw, 633 21st Street, Santa Monica, 90402. This is a great seminar, with fine facilities and fine programs. A week later, Tucson, Arizona; perhaps the greatest mineral show on earth. If a mineral occurs anywhere it will show up at Tucson. We've

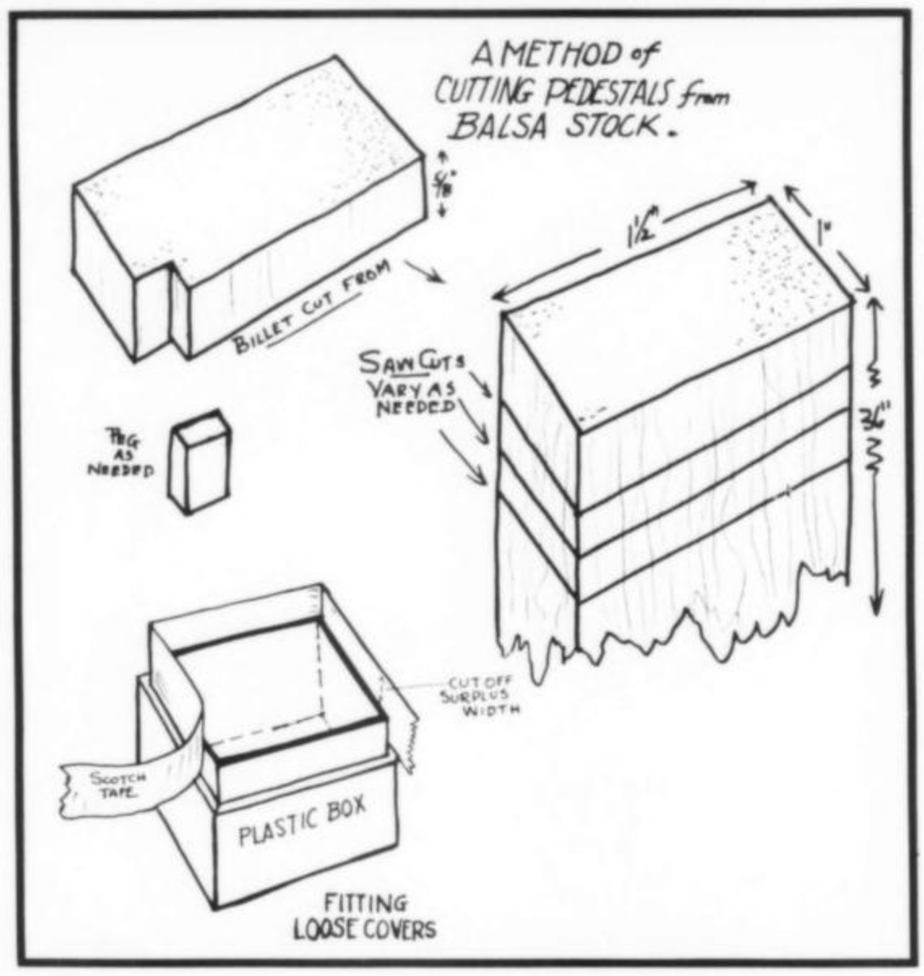
obtained some of our rarest and best specimens at this show. Visitors at this event boast that there is so much activity that no one gets to sleep for the duration. True, but for a different reason. At all hotels, as you pass down the corridors, all room doors are open. All beds, tables, floors and flat surfaces are completely covered with flats of minerals for sale. There just isn't anyplace to sleep. Meanwhile, the exhibits, show dealers and wholesalers flourish at the show itself. And the local establishments — Bideaux, Davis, Western — all have their latch strings out, whether you're there to acquire or to observe.

Baltimore's 18th annual micromount symposium, under the aegis of the club's new president; Bob Jaxel, went off smoothly at its usual fine meeting place, the Stemmers Run Jr. High School, where old-time member John Jedlicka is principal. As usual, open house festivities were in order the night before, with slide programs being featured. The meeting was devoted to native elements, and included talks by Julian Reasenberg of the New York Mineralogical Club, who outlined the what and why of native elements, Neal Yedlin's talk of ancient mining of copper in northern Michigan, Paul Seel on diamonds, Lou Perloff's slides of micros of native elements and of pegmatite phosphates, and Bob Gait of the Royal Ontario Museum in Toronto, who told of his experiences when exploring for diamonds in Tanzania.

Some 81 microscopes were in evidence and in use. Exchanges, give-aways, sales (of minerals, books and equipment) went on continuously, and informal sessions of mineral identification progressed throughout the two days.

Last April the Canadian Micro Mineral Association held its eleventh workshop conference in Toronto, New and larger facilities and quarters provided more than adequate working space at this now famous meeting. The programs included Joe Mandarino, of the Royal Ontario Museum, whose subject, "Eastern Canadian Minerals, Where they Occur and Why", Violet Anderson's superb mineral slides, of an unforgettable quality, and Cliff Vickery's talk and demonstrations on "Technical Aids to Identification of Minerals". There was a mineral auction, and the meeting was enhanced by Muriel Wood's display entitled "The World of Micromounting". Here, too, were sales, exchanges, give-aways, and instant information. Ross Anderson's organizing abilities were evident, for the meeting place was excellent, and the 1975 meeting is in the works: — at the Etobicoke Educational Centre, at Junction 401 and 427. Toronto, about the third weekend in April.

The seventh edition of *International Directory of Micromounters* is available. This is a list of names and addresses of all those interested in micromount mineralogy as taken from attendance lists at shows, through lists supplied by club members, and recommendations of individuals. A dollar, postpaid, from Baltimore Mineral Society, c/o Randolph S. Rothschild, 2909 Woodvalley Drive, Baltimore, Maryland, 21208.



Bob Bates, 501 East Euclid, McPherson, Kansas, 87460 writes and asks how the experts (sic) catalog their collections. "I started by just numbering from 1. on" he states, "Now that I'm into the hundreds it gets difficult to find a certain specimen in the collection".

Let's see. We don't know about the experts, but there is no reason to arrange the mounts in the cabinet numerically. Sure, the number is for the journal, the card catalog or whatever — just to tie the data on the card with the specimen. Most collectors house their specimens alphabetically, and sub-arrange by state and country. A few, Perloff for one, set 'em up according to Dana, or Hey, or Fleischer, or by other chemical or structural systems. Teaches 'em the chemistry of minerals, and requires a great memory, which most of us do not have. Cross index your files - as must museums do - numbers and alphabet, with a further set-up to take care of specialties, like locality specimens, state specimens or whatever. You'll do fine, and be able to locate anything within a few seconds.

We run into exhibit errors all the time, and cannot understand how a label can be in error in an exhibited case at a show. Getting together specimens and setting up a display entails enough effort so that a spelling check, or rules check, taking but a little more time, is justified; nay, imperative. At the Danbury, Connecticut, show last fall: — Cerrusite (misspelled) and from Africa, yet (not a country). We deplore the casual nomenclature abounding: clear spodumene as kunzite, very pale green spodumene as hiddenite (where's the chrome?), and yellow goethite crystals in quartz from Brazil as cacoxenite. We admonished a dealer about this at a Federation show a while ago. The response: "I bought the 'stuff as cacoxenite, and I'm gonna sell it as cacoxenite. No one's gonna tell me

how to run my business". A solid vote for free enterprise.

Hatfield Goudey, 1145 West 31st Avenue, San Mateo, California 94403, sent a letter of interest, dated September 30, 1974. "Dear Neal: There should be a micromount of sonoraite in your collection and it is on its way... In *Mineralogical Record*, Vol. 3, pp. 82-84 (1972), Dick Gaines mentioned that only five specimens of sonoraite were known. Since my discussion with him last February and search of records and material, I can account for one additional specimen (in my wife's miniature collection) and eight micromounts. There are probably a few additional specimens and micromounts around labeled "emmonsite" from Goldfield, Nevada. A few of those might be sonoraite. I would like to hear from anyone who obtained emmonsite from me in the 1940s and 1950s. So check out your emmonsite. The specimen we got from Goudey is in yellow, rather compact acicular crystals, filling a seam.

Van King comes up with some Maine micromounters. He'd furnished a specimen from the collection of Ben Burbank, of Topsham, a 1 inch fragment of pegmatite with torbernite on it. This is mounted on a wooden flat, 1-1/2 by 1 inch, front bevelled to hold a label. It meets the description - a natural mineral, mounted, in crystals, labelled, and requiring magnification for proper observation. We'd met Burbank, together with Herb Haven of Portland and Ike Skillin of Freeport at Fisher's Ledge, Topsham, and at meetings of the Maine Mineral Society, back in 1939, when we lived on the Kennebec River at Cedar Grove. King goes on to say: "There was a micromounter in Portland, H. Wallace Noyes (Noyes Mountain, Newry?) who died in 1936... Byron McCord was the real collector. I'm trying to find out where his micromounts are... Burbank started about that time as well as a Portland jeweler named Cross... Ray Woodman, who has the Noyes collection, told me that Martin Keith had micromounts, but his son now has them in Arizona. (Ed. note - all you Phoenix people check into this.) It seems that there were more micromount collectors in Maine 40 years ago than today". (Ed note, again. But not more microscopes. In use were many monoculars and hand lenses. These specimens were not units unto themselves, but were adjuncts to regular cabinet collections). Another of the collectors of the minutae was Willis True of Portland. He had a concept of his own, with which we find fault, but which apparently satisfied his needs. He mounted specimens on a pedestal, affixed them to a one inch square of cardboard, which was not installed in a box. He then took a large section of cardboard, cut it to fit into a flat cigar box, and at regular intervals pasted photo corners, in clusters of three, to the large cardboard. The mounts slid into these corners and were firmly in place. Good enough, except that True's specimens were but bits and chips from all the mines and quarries he had visited, crystallized or not. He had a dozen or so beryl chips, rose quartz, feldspars, etc. Included were crystals when available — quartz, apatite, etc. But that's what we like about mineral collecting. For your own edification you may do anything you please.

Buy and use the new Encyclopedia of Minerals (Van Nostrand) and compare your specimens with those included in the book.

Neal Yedlin
129 Englewood Drive
New Haven, Connecticut 06515

What's New in Minerals?

John S. White, Jr.

CELESTINE FROM OHIO

Some beautiful material sometimes turns up at "swaps" at mineral shows and it often pays one to take a few minutes to examine the offerings. At a recent Cincinnati (Ohio) show, a nice selection of celestine from the Maumee Stone Company quarry, Lime City, Wood County, Ohio, was available and, in my judgement, underappreciated. The specimen shown in Figure 1 was donated to the Smithsonian by the swappers who had collected it, Mr. and Mrs. Paul Kuennemeier. This specimen measures five by three and one half inches (12 x 9 cm).

Somehow the word had gotten around that these were strontianite pseudomorphs after celestine but such was not confirmed by x-ray tests. A complete crystal was powdered and thoroughly mixed. The diffraction pattern of a portion of the powdered crystal contained only celestine lines. The crystals are fat tabular and scattered attractively over a calcite crystal-covered limestone matrix. It is easy to understand why these specimens were thought to be pseudomorphs. The edges of the crystals are light grey and nearly transparent but the interiors are milky white and frosted looking, a characteristic of many pseudomorphs.

ARIZONA ARAGONITE

In a recent issue of *MR* (volume 5, p.222) an inquiry was published about a mineral from Arizona carrying an unsual name, a name not found in the literature of mineralogy. It was reported that the mineral is only aragonite and in no way deserving of a new or different name. Since much of this material was circulated under this misappellation, a photograph (Fig. 2) is included herewith so that readers can recognize it.

JEREMEJEVITE FROM SOUTHWEST AFRICA

Jeremejevite, $Al_6B_5O_{15}(OH)_3$, is a very rare mineral and was previously reported only from Mt. Soktuj, in the Adun-Chilon Range in Dauria, Nertschinsk mining district, eastern Siberia, U.S.S.R. A new discovery in a prospect about 75 miles north of Swakopmund, Southwest Africa, has recently been reported.

The crystals are found in a matrix of gypsum, quartz, albite and resorbed blebs of brown tourmaline. The crystals are elongated, hexagonal prisms, light blue in color and up to 22 by 4 mm in size. On casual observation they resemble etched beryl crystals. The Smithsonian has acquired several of these, and one has even been faceted into a 1.44 carat gem. It is step cut, and of a very light blue color. The refractive indices, determined in sodium light with the Rayner dialdex refractometer, are $\alpha = 1.641$ and $\beta = 1.652$. The mineral is uniaxial or weakly biaxial. The blue color is poorly distributed as splotches. The specific gravity is 3.29 and the hardness about 6-1/2 on the Mohs scale. There is no discernible fluorescence in either long or short wave ultraviolet radiation or in x-radiation, and prolonged exposure to ultraviolet radiation produced no perceptible color change.

The above data were collected by Pete Dunn of the Smithsonian Institution.

Fig. 1. **Celestine**

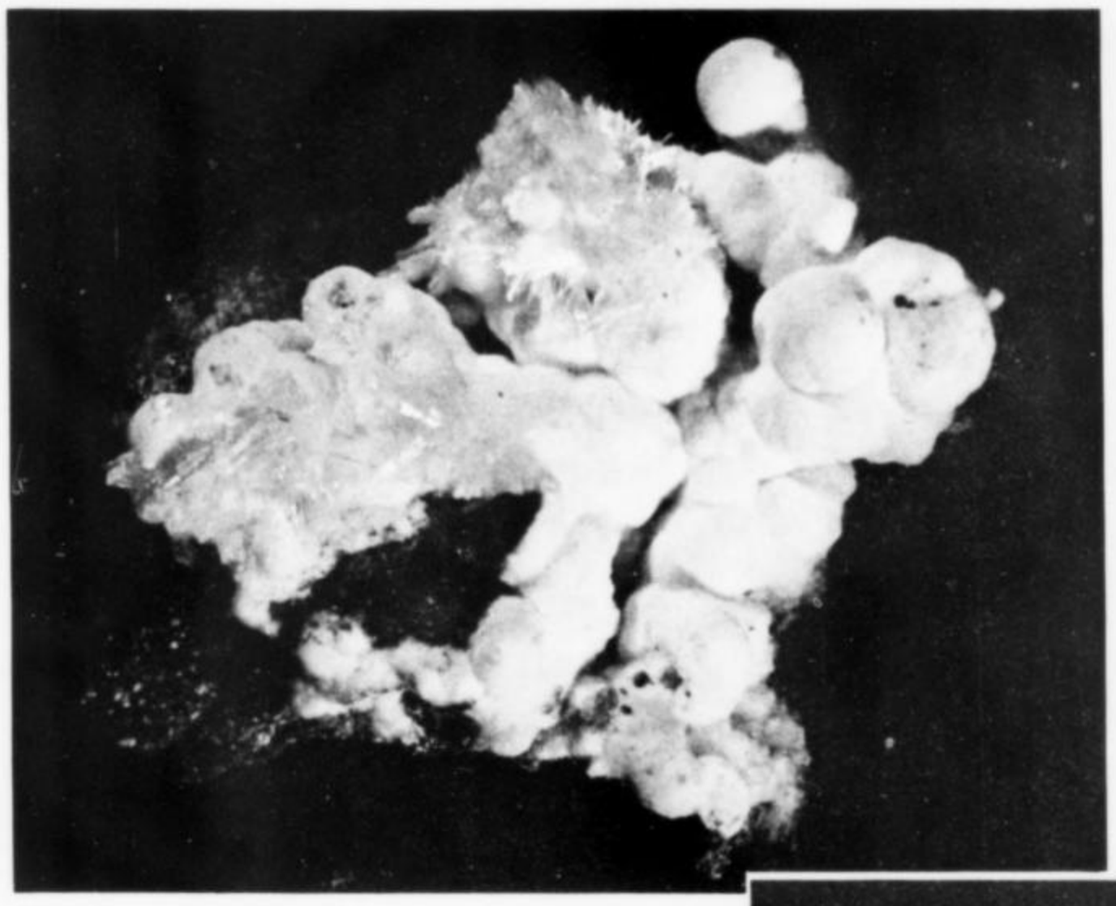


Fig. 2. **Aragonite**

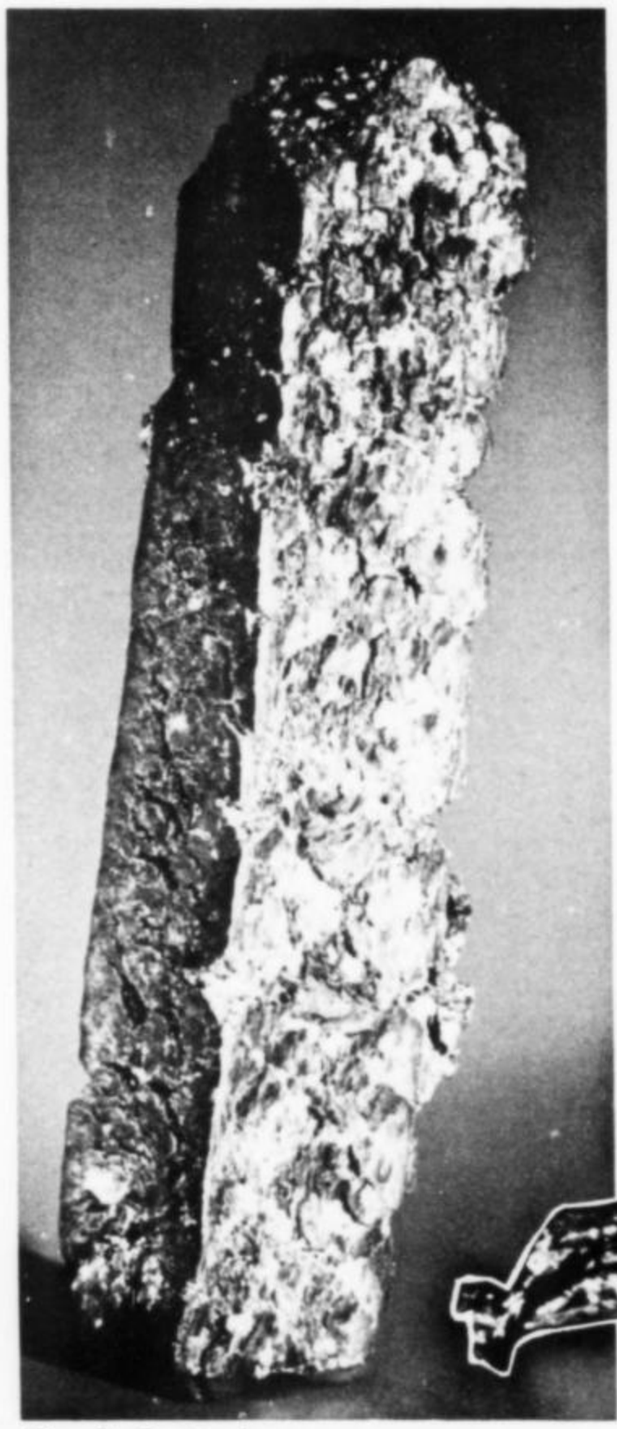


Fig. 3. **Pyrite bars**

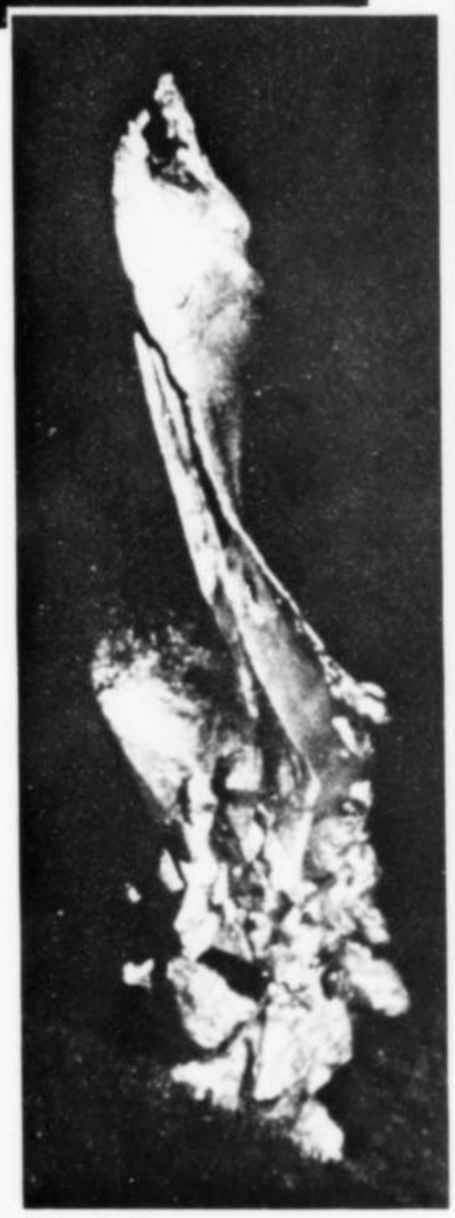


Fig. 4. **Ray copper**

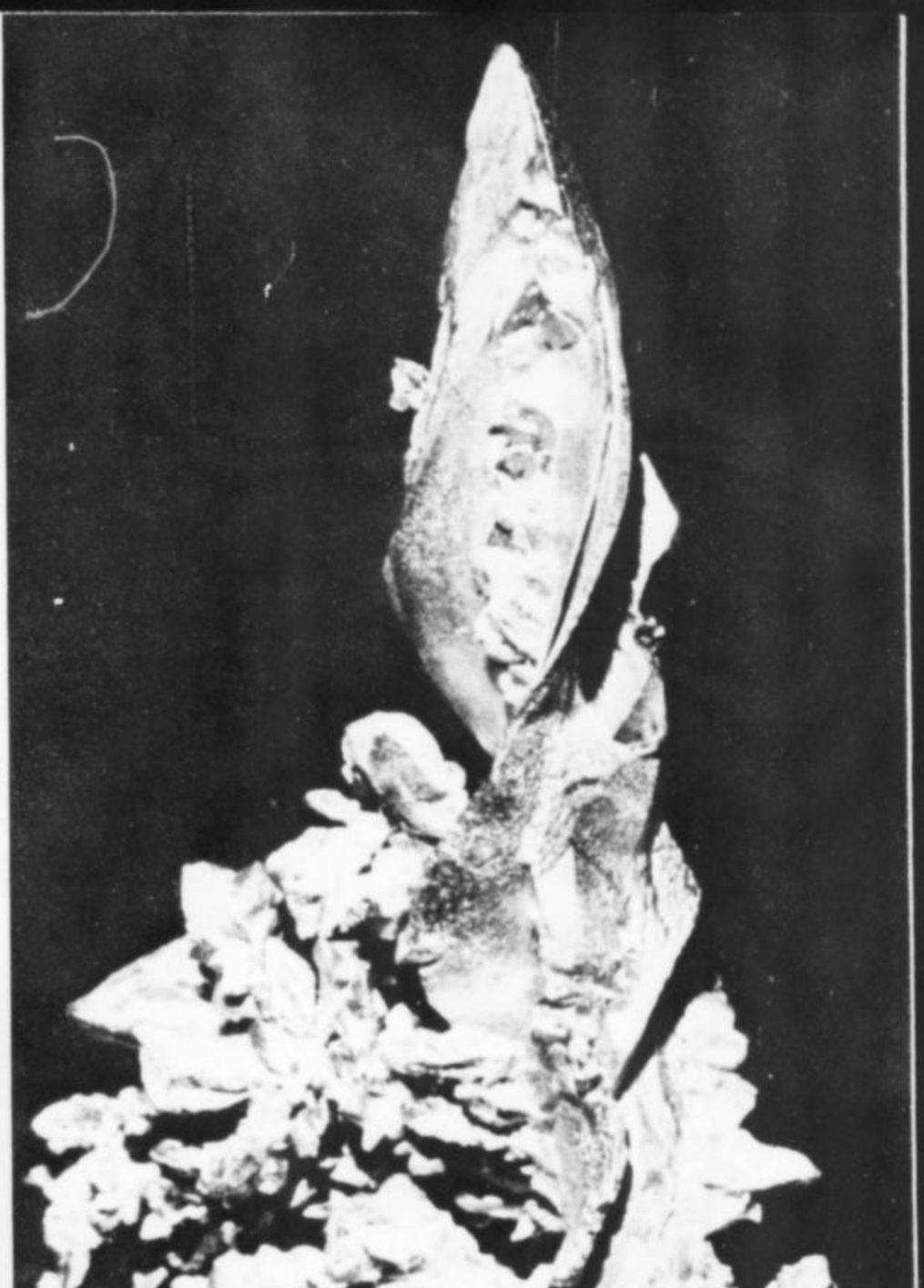


Fig. 5. **Ray copper**

Fig. 6. **Ray copper**

PYRITE BARS

We've all heard of gold "bars", but bars of pyrite are something new. New indeed are the elongated crystals, square in cross section, from Missouri. Figure 3 is a photograph of the finest crystal recovered from the occurrence. This crystal is 12-1/2 inches (32 cm) long and nearly three inches (7.6 cm) wide. It now resides in the Smithsonian collections. The following details about the occurrence

were furnished by Gary Hansen, who has been selling these remarkable specimens:

"The main ore haulage shaft at the Amex mine lifts ore from the 600' and 900' levels. The ore is hauled up in skiffs and ore had been dropping to the bottom of this vertical shaft and interfering with the cables which drive the hoist. This meant that every 2 or 3 weeks the hoist had to be shut down while the fallen ore at the bottom of the shaft was removed. Beginning in April of 1974, a 12° sloping tunnel was started in order to intersect the bottom of the haulage shaft so that the ore could be removed continuously without shutting down the hoist. Approximately 60 feet into this haulage tunnel a pyrite pocket was discovered. It was a lens about 25 x 8 x 3 feet, basically consisting of crystallized flat sheets of pyrite, a pyrite "sand" and interspersed throughout the mass were the rectangular elongated pyrite crystals. The entire contents of the pocket were removed and buried in the tunnel, then brought out of the mine between May and August, 1974. The finest crystal (Figure 1) is in the Smithsonian collection. There were approximately 25 fine crystals from 6 to 9 inches in length and 1 to 2 inches in diameter. The paragenesis is unknown, but (possibly?) a growth over a capillary pyrite or marcasite crystal, as nearly all of the prisms have a small rectangular hole running throughout their vertical axis. Twinning {001} is very pronounced in these crystals."

The locality is the Amex (Molock) lead mine, 1250 foot level, Boss, Missouri.

It was only last year that similar growth distortion in pyrite was reported (*MR*, volume 4, 267, 1973), but in specimens from Mexico. The Mexican crystals are much smaller, differing also in that they are eight-sided in cross section rather than square.

THE RAY COPPERS AGAIN

The following note and the photographs (Figs. 4 and 5) were supplied by William Panczner, the *new* curator of Earth Sciences of the Arizona-Sonora Desert Museum, Tucson, Arizona:

"As reported in a recent issue of MR (volume 5, pp. 233-235), a most unusual copper crystal habit was uncovered several months ago. A check with Susie Davis, a Tucson, Arizona, wholesale mineral dealer and principle source of this material, reveals that this crystal habit from Ray, Arizona, began to appear on the collecting scene toward the end of last year (1973) with the major output coming in the following spring. It seems the last of these crystals hit the market November, 1974.

In going through many of these coppers, a most unique feature has been uncovered: twisted crystals. Most of these exhibit a 180° turn, but many make a complete 360° turn, and a few show several turns. Most of the crystals are small, averaging about 1/4 inch long, with those over 1 inch being rare. The largest presently known is 1-1/2 inches long and is in the collection of the Arizona-Sonora Desert Museum. Of the several thousand crystals examined in all of the different lots, approximately 40 were found to exhibit this most unique twisted feature. Many of them will be made a part of the Desert Museum collection and eventually will be exhibited at the Stephen House Congdon Memorial Earth Science Center."

Figure 4, 5 and 6 (photographs by Merritt S. Keasey, III) show three of these copper specimens, all in the Arizona-Sonora Desert Museum collection. That in Figure 4 is 1/4 inch, the crystal in Figure 5 is one inch and Figure 6 is a large 1-1/2 inch crystal, the largest known to exhibit the twisted habit.

The Record Bookshelf

***Encyclopedia of Minerals*, by Willard L. Roberts, George R. Rapp, Jr., and J. Weber. Van Nostrand Reinhold Company, 450 West 33rd Street, New York, N.Y. 10001 (1974). 693 pages, 128 pages of color, hard cover, 8½ x 11 inches, ($69.50).**

Ours is a relatively small hobby. The science of mineralogy, likewise, comprises a relatively small group. Therefore it is something of a rarity when a book about minerals is widely discussed before its appearance. I must confess that as I first opened the *Encyclopedia of Minerals*, I had been at least partly preconditioned to not like it. Almost immediately it became obvious to me that the advance criticism was ill-founded; the anticipated shortcomings were not to materialize. This book is a mammoth undertaking, a magnificent effort and, perhaps, the most notable American contribution to mineralogy since the first two volumes of the 7th edition of *Dana's System of Mineralogy*. The price is sobering but, if affordable, this is a book that mineral collectors and mineralogists must have.

The format is straightforward. The minerals are presented in alphabetical order. Nearly all those currently known are included, even a large number in the category of doubtful validity. These are identified as such. The data provided for each consist of: some synonomy, the chemical formula, the crystallography (including space group and cell constants), three of the strongest lines of the diffraction pattern, optical and other properties, habit, mode of occurrence and several important localities, and one or two literature references (in English) selected by the authors as the best for a general description of each species. This latter entry is one of the very strong points of the book as one is often confronted with a long list of references from which to choose. The authors have done all of this research for us.

The introductory material is appropriately brief. This is a data collection and the authors wisely realized that a repetition of the standard treatment of crystallography, general mineral chemistry and paragenesis, etc., would be superfluous.

At eight regular intervals through the book are groups of 16 pages of color photographs, six to eight on a page, each two by three inches. The photographs, by and large, are superior and the printing is of high quality. Of particular value are those of minerals rarely, if ever, seen by most of us. For this reason it is a shame that there is so much duplication of common species; six each of anatase, barite, beryl and fluorapatite; *sixteen* of diamond (including eight colorful, but wasteful, Nomarski phase contrast photographs of surface features on diamond crystal faces!). Still, the photographs are mostly splendid and do much to help justify the high cost of the book. Nearly all of them are of micromount sized crystals, so they are unlike the traditional subjects of photographs in other mineral books containing many color pictures.

It is obvious that great care was taken in seeing that the mineral names were spelled correctly. Special emphasis, unmatched in other reference works, was placed in accurately reproducing the proper diacritical marks in mineral names of German, French and Slavic origin.

A large number of synonyms and discredited species are included but the list is far from complete. There seems to be no particular pattern into which the missing names can be fit; those chosen or omitted appear quite random. There are a number of unfortunate inconsistencies and errors. Knebelite, for example, is treated as a valid species; ferricopiapite and ferrocopiapite are denied species status; hydroxyl-herderite is inaccurately described as a *variety* of herderite with OH > F, while hydroxylapatite is correctly given full species status; osmiridium is given as equal to iridosmine, while the former is actually isometric and the latter hexagonal; no light is shed on the gastunite-weeksite problem as gastunite is presented as equal to weeksite and weeksite equal to gastunite but the data under each are quite different, especially the space group and optic sign; chrysolite is incorrectly given species status, stellerite equally incorrectly not; canfieldite is in parentheses after argyrodite making it appear invalid; galkhaite is omitted altogether; cocinerite has formally been discredited but this was missed by the authors.

It is most unfortunate that the authors chose to disregard the recommendations of the Commission on New Minerals and Mineral Names (IMA) as to preferred names in many cases where there has been widespread dual usage. The following names appear in the *Encyclopedia of Minerals* as preferred, in direct opposition to those recommended by the Commission:

bromyrite (should be bromargyrite)
celestite (should be celestine)
cerargyrite (should be chlorargyrite)

devillite (should be devilline)
iodyrite (should be iodargyrite)
niccolite(should be niccoline)
metastrengite (should be phosphosiderite)
cobaltocalcite (should be spherocobaltite)
sphene (should be titanite)
weinschenkite (should be churchite)

It is difficult to understand the failure of the authors to go along with the carefully deliberated and internationally approved choices.

Since no acknowledgment is made to anyone for outside proofreading, we must assume that there was none. Regrettably, a book is too often less than it could have been only because this vital step has been omitted, and *Encyclopedia of Minerals* is no exception. The failings cited above could readily have been corrected if the book had been carefully proofread.

Nevertheless, I am excited about this book. I know it will prove extremely useful to me and I will want it at hand at all times. The authors are to be commended for taking on the immense task of producing such a monumental volume.

John S. White, Jr.

Inventaire Minéralogique de la France, 15-Cantal. By R. Pierrot, P. Picot and J. J. Périchaud, 1971. B.R.G.M. Paris, 112pp., 58 figs.

Inventaire Minéralogique de la France, 05-Hautes Alpes. By R. Pierrot, P. Picot and P. A. Poulain, 1972. B.R.G.M. Paris, 184pp., 54 figs.

(Both volumes available from Éditions du B.R.G.M., 74 rue de la Fédération, 75-PARIS 15e. at 18 francs each plus postage). ($4.00 plus postage).

These are the first two volumes of a new series of regional mineralogical guides to France, produced by La Service de Mineralogie du B.R.G.M. They represent the beginning of a systematic, Department by Department, up-dating of French topographical mineralogy, the first work of its kind since the 5th. edition of Lacroix's *Minéralogie de la France*, 1913.

In the Cantal volume, some 70 localities are described and about 160 species listed (60 more than recorded by Lacroix), whilst in the Hautes Alpes volume, about 108 localities are given and 98 species listed. A clear, simple format has been adopted for the series. A geological sketch map of the Department is marked with numbered dots indicating the localities described in the body of the text. A detailed sketch map is given for each locality, accompanied by the

Michelin 1/200,000 and the IGN 1/50,000 map references. Notes concerning access to the localities are provided including comments on the time and difficulty of the walk. A brief note as to the type of the deposit is followed by an alphabetical listing of the recorded species. The relative abundance of each species is indicated by a prefix letter such as T for trace, R for rare to AA for very abundant, whilst the size of crystals or masses is indicated by the boldness of the type face; bold capitals indicate minerals occurring in masses or crystals larger than one centimetre; ordinary capitals indicate minerals visible to the naked eye or with a hand lens and lower case italics indicate micoscopic particles.

It would appear that even doubtful localities recorded in the past literature are included in these volumes because for several, in the Cantal edition in particular, it is stated that on the authors' visit to the locality nothing was found (actuellement, on ne retrouve plus aucune minéralisation).

In saying that these guides are Departmental, I mean exactly that. Each area is delimited by the Departmental boundary and no account is taken of geological boundaries. If a geologically related deposit falls ten metres within the next Department it is ignored. This is the one criticism I have of this approach which is too parochial, given the delay which must arise before the complete series is available. I think, perhaps, a regional geological approach would have been better. In England, nobody would dream of describing the tin/tungsten province of Cornwall without including its continuity in Devon. However, be that as it may, the B.R.G.M. has chosen a Departmental approach and as far as it goes it is very good.

La Service de Minéralogie is to be commended for the excellence of this new series of guides. Their value to mineralogists, amateur and professional alike, is inestimable, particularly to the foreigner who has not the time or facility to search the French literature beforehand. That the B.R.G.M. is aware of the potential contributions to mineralogy from the amateur is suggested in the Introduction to both volumes where the authors admit that the lists are probably incomplete and request that they be notified of additional species; to this end, a loose printed form is inserted in each copy, to be sent to the B.R.G.M. when a new species is found. It is gratifying to see a professional body acknowledging the

existence and potential value of the amateur; perhaps the professionals in other countries will take note of this.

While these volumes are of great value, not only to the foreigner but in all probability to the native as well, they may be looked upon with some apprehension. In one respect they are dangerous in so far as they present a lot of information in one handy pocket book, thereby promoting the depletion of localities by swarms of "rockhounds". On the other hand, by advertising the localities, it may be argued that the more people visit them the more is likely to be found and possibly new species added to the lists, and in the long run the greater will be our understanding of the mineralogy and mineral genesis of the deposits. It is difficult to balance the potential risks with the potential benefits. I feel that the publication of such guides to cover the British Isles would be disastrous (I cannot comment on the situation in the U.S.). However, in France the status of amateur mineralogy is somewhat more refined than in the English speaking world. In France they do not have "rockhounds" to anything like the degree that we do; hobby lapidary is well nigh non-existent and collectors tend to be true amateurs of minerals. Consequently, the risk of depletion of localities by French amateurs is very slight.

I look forward to the continuation of this series; in the preface to 05-Hautes Alpes it is stated that 29-Finistere is next on the list.

Roger S. Harker.

To the Editor

IRKED

Dear Sir:

I have been annoyed, as have others, by certain prestigious contributors to your fine publication. Comments to the effect, as though it were a foregone conclusion, that we should all train ourselves to focus on the scientific and educational aspects of mineralogy and ascend from any activity "tainted" with lucre. I'm sure I need not labor the point of which activity must precede what. Reality, or history at least clearly demonstrates man's penchants - right or wrong! The manner in which these arrogant references have been made belies (shows to be false) the tolerance which position, privilege and a superior education are supposed to instill. Most of the people I've known in the commercial end of mineralogy have much respect, even occasional reverence for those in the scientific and educational field. I find it unfortunate that some in science and education are so bigoted that they cannot conceal their contempt. It has been my observation that the personal inadequacies of some in "commerce" aren't entirely lacking in the scientific community either. I would hope, therefore, that we might all aspire to higher standards of behavior.

Charles L. Key
Canton, Connecticut

FROM AUSTRALIA

Dear Sir:

The recent reminiscences of Dr. Wherry on KHC_2O_4 are really an over-simplification of the status of whewellite and weddellite. Both these minerals have been found in well substantiated mineral environments where, although the oxalate radical was originally of vegetable origin, the final crystals are the result of diagenetic mineral-forming forces.

The humorous and near-infinite extrapolation to KHC_2O_4 as a mineral and the no doubt frivolous proposal of a name, obviously "rhubarbite" are unbecoming to a person of Dr. Wherry's experience and long scientific career, but a fine and immortal tribute to the well-established cathartic properties of the aforesaid vegetable and to his subtle sense of humour.

On the serious side however, there is a distinct possibility of this compound being found in a well-substantiated mineral environment and I object at attempts, some unfortunately successful, at mineralogically naming artificial compounds (e.g. brownmillerite), corrosion products (e.g. chalconatronite, romarchite), advance common usage of names not yet approved by the I. M. A. (e.g. "blanchardite" *M. R.* **3**, 130) and the reverse, i.e. the publication of adequate data of possible new minerals without the proposal of a name (e.g. monoclinic $BiVO_4$, *Contr. Min. Petrol.* **41**, 325 and $KBa_4TiAl_2Si_{10}O_{32}(OH)_7$, *M.R.* **2**, 192).

Unfortunately these deplorable practices appear to be spreading with

the proliferation of hardware in the hands of increasing numbers of so-called scientists who do not even support an internationally selected panel of experts. The Commission on New Minerals and Mineral Names, I.M.A., has been gathered together for the express purpose of deciding what constitutes adequate data and preventing further publication of synonyms and imperfect mineral definitions.

These actions not only abort the kudos of the conscientious who find the true mineral and follow accepted practices but also jeopardize their inviolate right to name the mineral as they wish.

The editor's concern with nomenclature is not matched by his concern for taxonomy. His weak editorial comment is a lamentable example of rejection of scientific principles for a policy of appeasement to a distinguished correspondent.

This may pass in private correspondence or conversation but definitely not in publications where it is a bad influence on persons unacquainted with the principles of mineral classification.

P. J. Bridge
Carlisle, W. Australia

I agree with much of what reader Bridge says; however, based upon recent decisions of the New Minerals Commission, I still feel that Dr. Wherry's proposal deserves as much consideration as others approved by that group (e.g. urea, romarchite, hydroromarchite). The Commission is fairly effective at judging the quality of the data but they steer clear of making the natural vs. artificial distinction. Ed.

FLUORESCENT MINERAL SOCIETY

Dear Sir:

The Fluorescent Mineral Society invites mineral enthusiasts to contribute articles to its annual publication, the *Journal of the Fluorescent Mineral Society*. The F.M.S. is an organization of persons interested in the study, collecting, identification, and display of fluorescent minerals. The *Journal*, the fourth issue of which will be published summer 1975, is intended to provide information about flourescent minerals of interest to both the beginner and the advanced collector or student. We are eager to receive articles in such areas as description of flourescent minerals from various localities, descriptions of the luminescent properties of minerals, studies on the nature and cause of mineral luminescence, UV lamps and techniques for exciting luminescence, and collections and displays of fluorescent minerals. Persons who have made studies of some aspect of luminescent minerals that are too

specialized for general publications like the *Record*, but not complete enough for the regular scientific journals, are invited to submit them to the F.M.S. We would particularly like to obtain review articles about mineral fluorescence from those who have done scientific work in this field. Although a great deal of research is done on the electronic and chemical properties of luminescent materials, there is very little written about luminescent minerals as such.

All contributions will be reviewed, with constructive changes suggested when appropriate. Manuscripts may be sent to the Fluorescent Mineral Society, 9111 Morehart Ave., Pacoima, Cal. 91331.

Let me thank you in advance for your consideration of my letter, and keep up the good work with the *Record*.

Peter J. Modreski, assistant editor, Fluorescent Mineral Society

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