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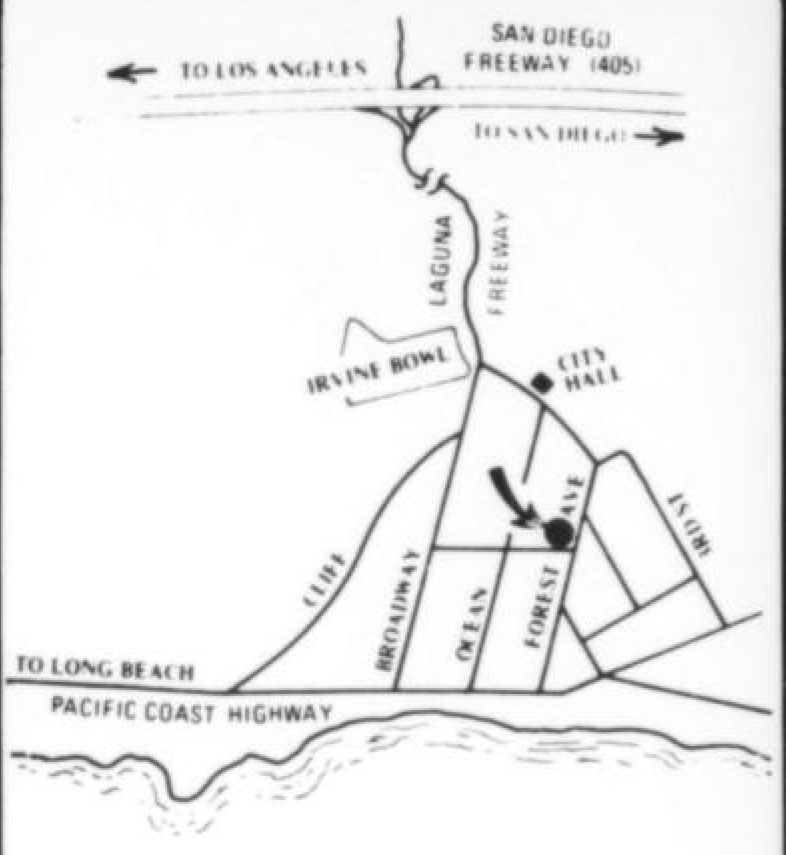

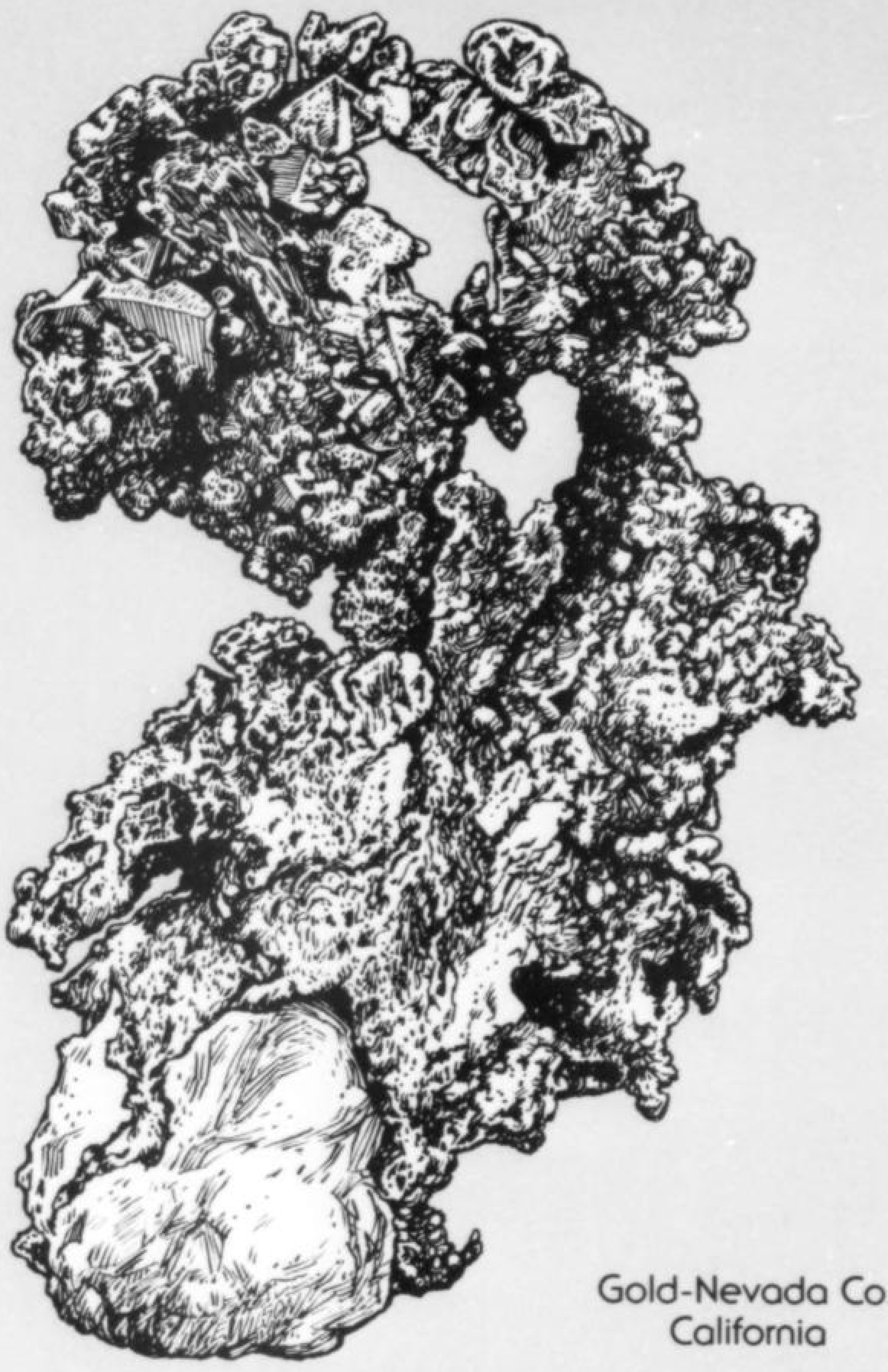
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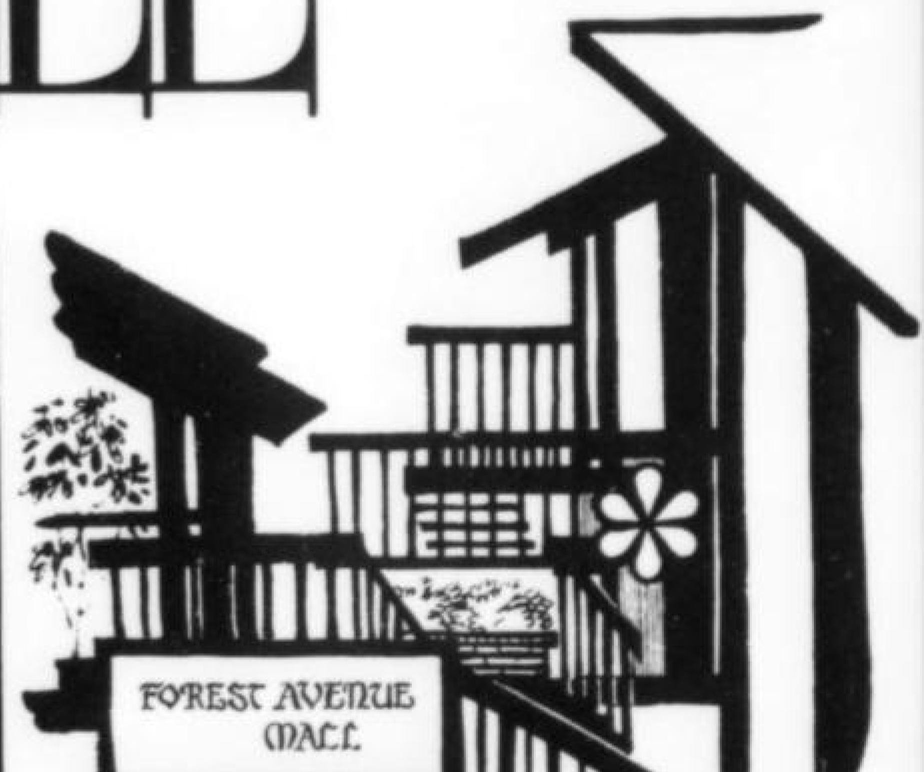

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Volume Ten, Number Three
May-June 1979

Articles

Departments

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notes from the EDITOR

AUCTION 1979

Our annual auction at the Tucson Show was very successful again this year. We hope to assign much of those funds raised to the production of our future special issue on Arizona localities. In particular I want to thank the Tucson Gem and Mineral Society for making the hall available to us; Rock Currier for his interesting lecture which led off the evening; A. L. McGuinness and Gary Hansen who, as tag-team auctioneers, made this our most entertaining auction ever (they have both promised to do it again next year too!); and to our volunteers Pat Carlon, Ron Bentley, Dick Thomssen, Walt Risch, Dick Hull, Bob Jones, Don Olson, Tom Gressman, Jim Logan, Jonathon Weiss, Jim Yankopoulous and my wife Carolyn who helped with record-keeping, bid spotting, table-tending and the numerous other tasks necessary to carry off such an event.

Presented here is a listing of everyone (I hope) who donated to the auction this year or made cash donations during the last 12 months, except a few who wished to remain anonymous. Because the *Mineralogical Record* is an official non-profit organization, all such donations are tax-deductible. Donors receive a letter of acknowledgment and thanks which may be used for tax purposes; if anyone has made a donation this year but is not on the list below and did not receive such a letter, please let me know and I will see to the correction.

I think the deductibility of donations means little to most of our donors, however; their main purpose is to help the *Record* continue and grow, for which they deserve the thanks of all of us who love the *Record*.

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A NEW BOOK IN PROGRESS

Suppose you asked the average mineral collector, "What kind of new mineral book would you like to see on the market?" Perhaps he would say, "I'm tired of pretty picture books with nothing else to offer. How about a book on famous mineral localities, telling about the histories, the old miners and their stories, the minerals they found, and of course a pile of super mineral photographs to illustrate it." It so happens that just such a book is currently being put together by Peter Bancroft (author of *The World's Finest Minerals and Crystals*), in association with the *Mineralogical Record*.

Bancroft is not one to restrict himself to armchair research. During the two-year preparation period he is taking a number of information-gathering trips all over the world, and plans to visit many if not most of the planned 100 famous localities personally. Talking with the miners themselves, photographing the localities, collecting local tales, arranging for the finest professional photographs of specimens, Pete is a whirlwind of activity during his trips. Back at home between trips he copes with a mountain of correspondence bringing new and hitherto unpublished information and old photographs. "Look at these marvellous photos of the abandoned Japanese stibnite mines," he said to me when I visited him in Fallbrook; "The local mayor went up into the mountains himself and took these for me!"

The purpose of Pete's book will be to provide a truly interesting and readable reference on a large number of famous localities. He hopes that such concepts as the transience of great localities, the dangerous and fascinating atmosphere of underground mining, the flavor of local cultures, and the historical background of these localities will come through. A great deal of original, never-before-published information is accumulating which should make Pete's book an immediate classic. Naturally the minerals of these localities will be the focal point, covered by non-technical discussions and fine photography by the acknowledged masters.

Information and assistance will be greatly appreciated in rounding up photographs, literature and first-person data on these localities. And so, to let readers know which localities Pete is working on, we are publishing the following working list in the hope that people with information will get in touch with Pete. Write to:

Dr. Peter Bancroft
3538 Oak Cliff Drive
Fallbrook, California 92028

Just as a teaser, Pete has sent us the lead article for this issue on the famous Taewha scheelite mine in Korea. Treatment of other localities for his book might be longer or shorter, depending upon the information available, but even this short article demonstrates the value of personal encounters with the mines and the miners.

Famous localities to be covered:

Himalaya mine, Mesa Grande, California
Tourmaline Queen mine, Pala, California
Pala Chief mine, Pala, California
Red Ledge mine, Washington, California
Benitoite Gem mine, San Benito Co., California
U.S. Borax mine, Boron, California
Royal Peacock mine, Virgin Valley, Nevada
Hale-Norcross mine, Virginia City, Nevada
Copper Queen mine, Bisbee, Arizona
Red Cloud mine, Yuma Co., Arizona
Tiger mine, Pinal Co., Arizona
Cresson mine, Cripple Creek, Colorado
Sweet Home mine, Alma, Colorado
Crystal Peak area, Crystal Peak, Colorado
Bulldog/Commodore mine, Creede, Colorado
American Tunnel mine, Silverton, Colorado
Leonard mine, Butte, Montana
American Sapphire mine, Yogo Gulch, Montana
Green Monster mine, Prince of Wales Is., Alaska
Joplin District, Joplin, Missouri
Coleman mine, Jessieville, Arkansas
Minerva mine, Cave-in-Rock, Illinois
Kearsarge mine #2, Houghton, Michigan
Hiddenite mine, Hiddenite, North Carolina
Franklin/Sterling mines, Franklin, New Jersey
Pulsifer quarry, Auburn, Maine
Dunton mine, Newry, Maine
Las Vigas mine, Vera Cruz, Mexico
Potosi mine, Santa Eulalia, Mexico
Naica mine, Naica, Mexico
Valenciana mine, Guanajuato, Mexico
Ojuela mine, Mapimi, Mexico
Mina la Bufa, Charcas, Mexico
El Bote/Sobrete mine, Zacatecas, Mexico
Amelia mine, Santa Rosalia, Mexico
Korgal/Mawi mines, Nuristan, Afghanistan

Darreh-Zu mine, Badakhshan, Afghanistan
Nishapur mine, Khdrassan, Iran
Ratnapura mine, Ratnapura, Sri Lanka
Peridot mine, St. John's Island, Egypt
Cleopatra mine, Zabara Mountains, Egypt
Meralani mine, Arusha, Tanzania
Lua Allni mine, Lua Allni, Kenya
Muane mine, Alto Ligonha, Mozambique
Shinkolobwe mine, Katanga, Zaire
Musonoi mine, Katanga, Zaire
Miami mine, Karoi, Rhodesia
Premier mine, Kimberley, South Africa
Tsumeb mine, Tsumeb, Southwest Africa
N'Chwaning mine, Kuruman, South Africa
Mibladen mines, Morocco
Barroca Grande mine, Panasqueira, Portugal
Duranes mine, Almaden, Spain
Monteponi mine, Iglesias, Sardinia, Italy
Agrigento mines, Sicily, Italy
Rio Marina/Grottad'o mines, Elba, Italy
Bourgoin mine, Chessy, France
La Gardette mine, Le Bourg d'Oisans, France
Florence mine, Egremont, England
Height mine, Durham, England
Herodsfoot mine, Cornwall, England
Göschenen clefts, Göschenen, Switzerland
Lengenbach quarry, Bina Valley, Switzerland
Knappenwand, Salzburg, Austria
Tunaberg mine, Tunaberg, Sweden
King's mine, Kongsberg, Norway
Himmelsfurst mine, Freiberg, East Germany
Ilfeld mine, Ellrion, East Germany
George Wagsfort mine, Johanngeorgenstadt, East Germany
Neudorf mine, Harz Mountains, East Germany
Annaberg mine, Annaberg, East Germany
Pucher-Schacht mine, Schneeberg, East Germany
Schneckenstein mine, Gottesberg, East Germany
Grube Samson, St. Andreasberg, West Germany
Idar-Oberstein, West Germany
Zinnwald mine, Bohemia, Czechoslovakia
Stribro mine, Pribram, Czechoslovakia
Joachimstal/Jachymov mine, Bohemia, Czechoslovakia
Schemnitz/Kremnitz mines, Banska-stiavnica, Czechoslovakia
Baia Mare mine, Baia Mare, Romania
Galicia mine, Galicia, Poland
Machow mine, Tarnobrzeg, Poland
Mursinsk mine, Ural Mountains, Soviet Union
Takovaya mine, Ural Mountains, Soviet Union
Trepča mine, Kosovska, Yugoslavia
Plaka/Kamareza mine, Laurium, Greece
Mont St-Hilaire, Quebec, Canada
Jeffrey quarry, Asbestos, Quebec, Canada
Arsukfjord, Ivigtut, Greenland
Muzo mine, Muzo, Colombia
Chivor mine, Chivor, Colombia
Impresa Minera Catavi mine, Catavi, Bolivia
Unificada de Potosi mine, Potosi, Bolivia
Siglo Vente mine, Llallagua, Bolivia
Dolores Tercera mine, Chanarcillo, Chile
Quiruvilca mine, La Libertad, Peru
Bella mine, Artigas, Uruguay
Santa Rosa mine, Itambacuri, Brazil
Fazenda Anglo mine, Itambacuri, Brazil
Morro Agudoz mine, Piracicaba, Brazil
Conselheiro Pena area, Rio Doce, Brazil
Virgem da Lapa District, Minas Gerais, Brazil
Aricanga mine, Cruzeiro, Brazil
Santa Maria mine, Diamantina, Brazil
Morro Velho mine, Nova Lima, Brazil
Dom Bosco/Saramenha mine, Ouro Preto, Brazil
Lavra da Ilha, Itinga, Brazil
Golconda mine, Minas Gerais, Brazil
Campos mine, Campos, Brazil
Ashley mine, Lightning Ridge, Australia
Olympic field, Coober Pedy, Australia
Proprietary B1 14 mine, Broken Hill, Australia
Adelaide mine, Dundas, Tasmania
Taewha mine, Chungju, Korea
Ichinokawa mine, Saijo, Japan
Wan-Shan-Tchiang mine, Kweichow, China
Konakan mine, Turkestan, China
Tawnaw mine, Mogoung, Burma
Enjouk mine, Mogok, Burma
Khadakvasla mine, Poona, India

(Note: this is only a working list. Some localities will undoubtedly be dropped and others added as work progresses.)

AIRPORT X-RAYS REVISITED

In my *Photographic Record* column a few issues ago (vol. 9, no. 5, p. 293–294) I reported on the dangers to photographic film posed by airport security X-ray devices. One suggested preventive measure was the use of lead-lined safety bags sold in most photography shops. I purchased one of the bags myself and on a recent trip I allowed it to pass through the X-ray scanning device while I hurried around to see the results of the scan on the television screen. To my horror, all twenty rolls of unexposed film in the bag were clearly and individually visible while the bag itself appeared almost entirely transparent to the X-rays! I consigned that film to unimportant uses and vowed never again to let my film go through such a device. The lead-lined bags must utilize an extraordinarily small amount of lead, and I no longer trust them. If necessary, one might purchase real lead foil and line a box for carrying film, but it is much simpler to request a hand inspection of your carry-on luggage and see that it does not pass through the X-ray device.

famous mineral localities:

the Taewha Mine, Korea

by

Peter Bancroft
3538 Oak Cliff Drive
Fallbrook, California 92028

During the last half century a substantial percentage of the world's best scheelite crystals have come from Korea. In contrast to scheelite from other localities, Korean scheelite seems to have been found over a long span of time, formed larger crystals with sharper faces, and appeared in a wider range of colors. Of major appeal to collectors is the tendency of the scheelite crystals to occur attached to clusters of quartz crystals. As a result, the most striking scheelite specimens on display in collections throughout the world are Korean.

The exact location or locations of the source of Korean crystals has been something of a mystery. Many labels indicate the locality as Tong Wha, but a review of Korean mining journals and geological maps has failed to verify this source name.

I became interested in the Korean scheelite locality while researching it as one of the 100 mines and their treasures to be included in a forthcoming book *Great Gem and Mineral Mines*. It seemed necessary to visit and photograph the scheelite location in order to qualify it for the book. But how does one find a will-o'-the-wisp locality?

Through a Korean friend, Inshik Oh, a resident of Seoul, the *Bando Industries, Ltd. Company* was located. This company is a major Korean producer of molybdenum and tungsten.

Consequently, in October, 1978, I traveled to Seoul and met with Bando's managing director, Chung Uk Moon. Understandably, Mr. Moon was reticent to discuss the whereabouts of his mine for two reasons. One, the mine was now quite old and he is constantly concerned with the safety of anyone in the mines; and, two, he doesn't want collectors at the mine trying to buy specimens from his miners, thus diverting their interests and energies from the paid task of mining.

After I explained that my sole interest in his mine was to gather data on its history and operation, and to take photographs while on the property, Moon consented. He said he would telephone his mine manager and that we would be expected Monday morning. Moon also wanted to clear up the locality misconception. He said he had never heard of a Tong Wha locality and was reasonably certain that most Korean scheelite crystals were produced by his company's Taewha mine.

The Taewha mining region is located approximately 75 km southeast of Seoul. To reach the mine one takes the paved highway from Seoul to Chungju, turning east on a dirt road just after passing the town of Changhowon. The 12 km of scenic back road ford a stream and wind up

Figure 1. **Brown scheelite crystals on quartz, 5 by 11 cm. Photo courtesy of the Canadian National Museum of Natural Sciences, Ottawa.**

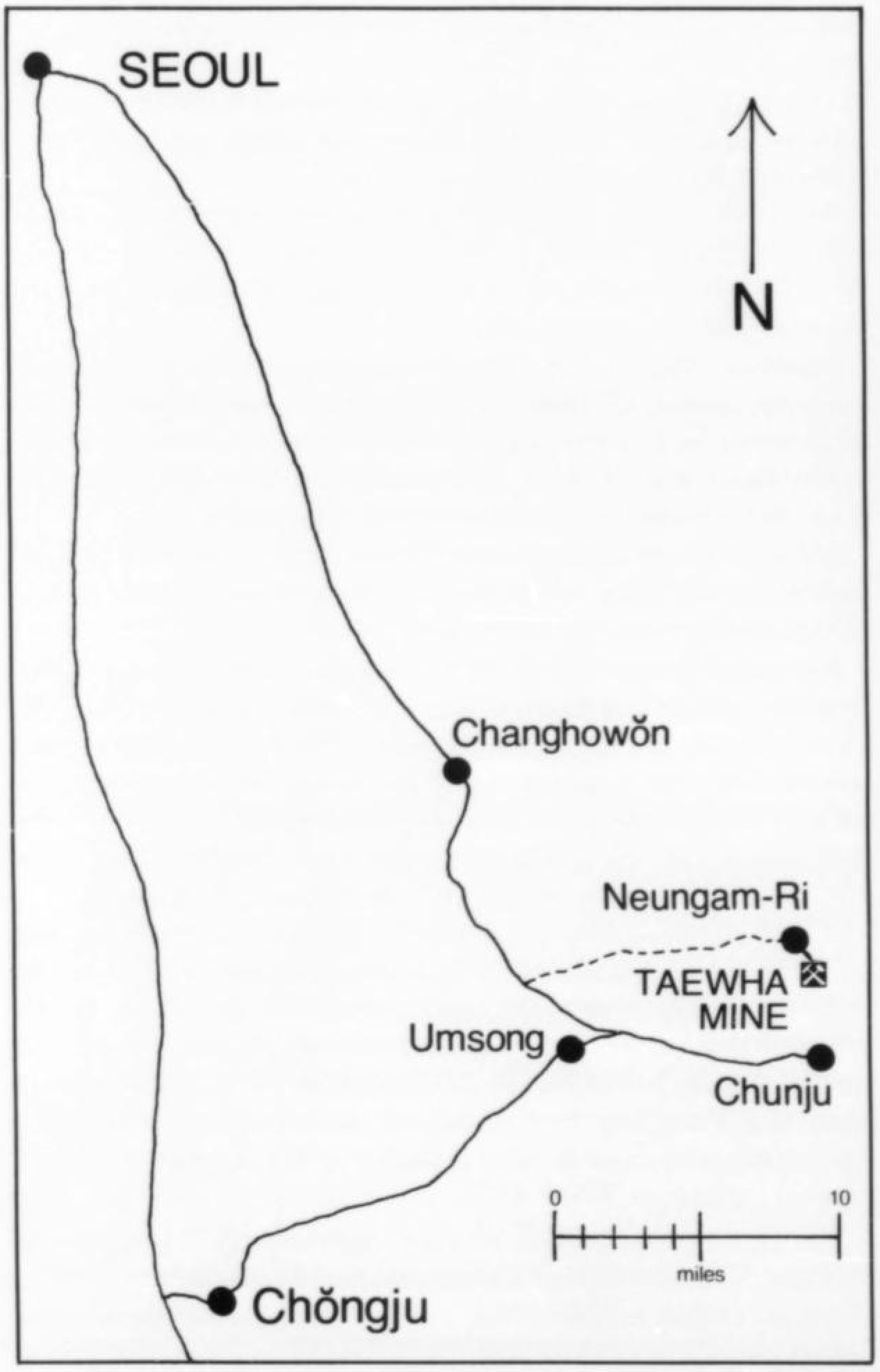
Figure 2. **Japanese miners hand-working the tungsten concentrate at the Taewha mine in 1917.**

a canyon flanked by brush covered hills. As we entered the little mining village of Neungam-Ri, our rented taxi was forced to slow down to a crawl through the narrow cobblestone streets in order to avoid countless dogs and children. Up the hill and to the south came the first view of the mine dumps. The road to the mine was little more than a goat trail; continued insistence by Inshik was necessary to convince our taxi driver that we were determined his cab would reach its destination.

The Taewha mine was not at all pretentious as most mines go. As a matter of fact, Jae Choon Um, the mine manager, told us little had changed at the mine since its early days, with the exception that each year the dumps got a little bigger.

According to Mr. Um, the Taewha mining region was probably first prospected in the 1890's. Around 1902 a quartz vein containing wolframite, scheelite and molybdenite was discovered as an outcrop near Tongmak-ch'i just east of Poryon-san. The Koreans then opened the deposit, initiating a long and turbulent history. Over the years operational mining was carried on, first by the Koreans, then the Japanese, and finally the Koreans again, who still work the mine today. As a result the mine has served under many names: Taika, Nungdong, Poryon, Kodo, Mitsui, Hungdong; in 1927 it was given its enduring title, Taewha.

Tungsten was the chief product of the Taewha mine, from its opening



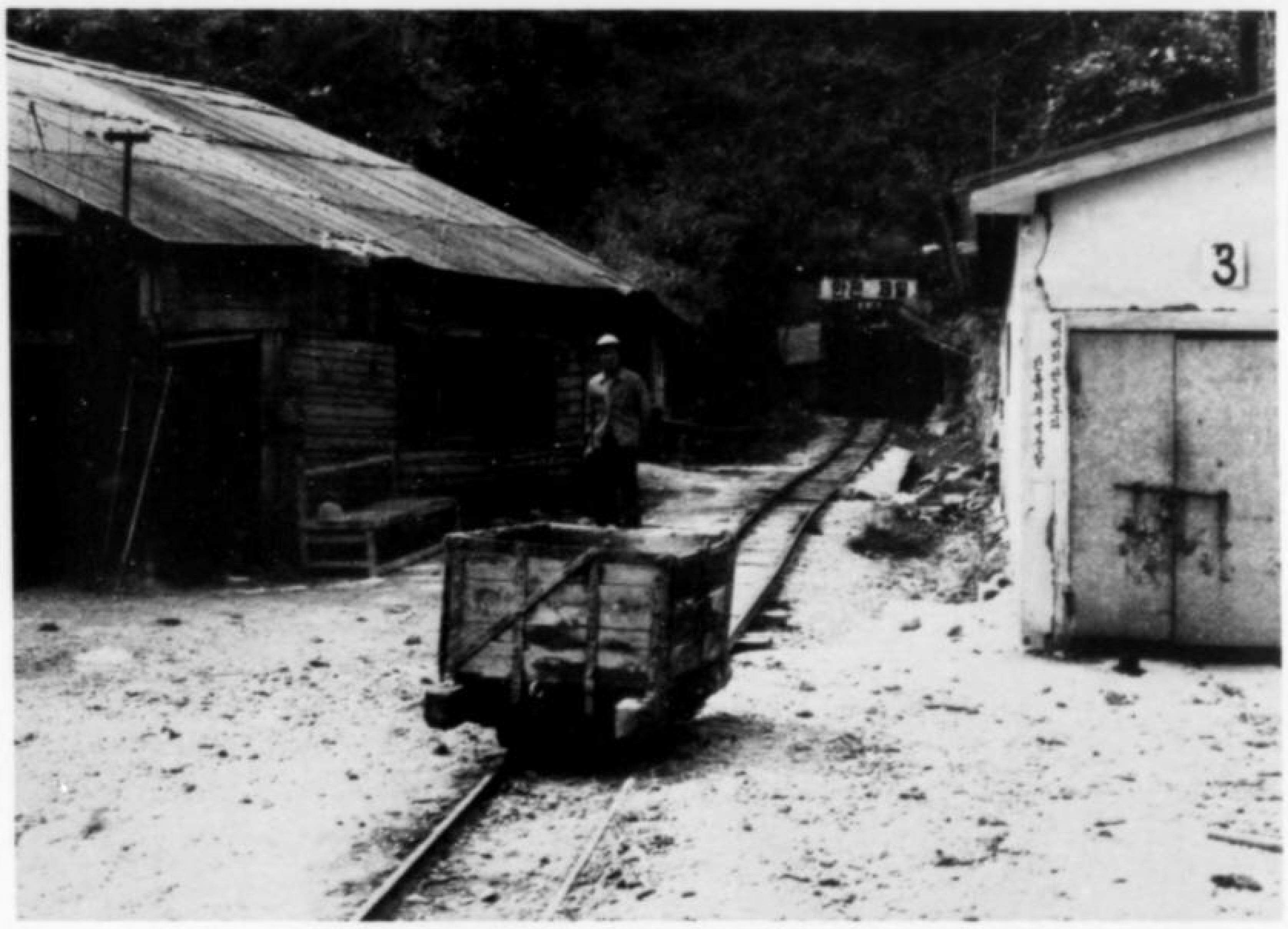


***Figure 3*. An antique ore car, still in use, at the main entrance adit of the Taewha mine. (Photo by the author.)**

***Figure 4*. Ore cars being hand pushed to the great dumps of the Taewha mine. (Photo by the author.)**

***Figure 5*. Quartz crystals in place in a quartz vein vug. (Photo by the author.)**

in 1902 until 1938, when molybdenite was first produced. By 1944 the Taewha mine had become Korea's largest producer of molybdenite.

Ore veins are narrow, ranging in width from 1 cm to 40 cm, but many are quite long, reaching a maximum of about 750 meters. Technically the veins are described as "pegmatitic quartz veins." Molybdenite crystals are usually a part of the mass, and are easily sheared during removal, thus making good crystal specimens a rarity. The scheelite crystals, however, form in open vugs frequently lined by terminated, clear quartz crystals. It is relatively easy to remove the quartz crystal groups from the pocket wall. When the brown mud is washed away from the quartz clusters it is not uncommon to find scheelite crystals attached to the quartz. The scheelite crystals most often form tetragonal bipyramids although intergrowth and modification are not uncommon. It is the frequency of clean, sharp, straight lines on the edges that singularly catches the eye. Of course the fact that Taewha scheelite has markedly bright faces, in contrast to the velvety luster of crystals from most other localities, also enhances its appeal to the collector. Added bonuses include the large size—some crystals measure up to 10 cm on an edge—and the wide variety of colors which include white, gray, black, brown, orange, yellow and a reddish brown. But probably the

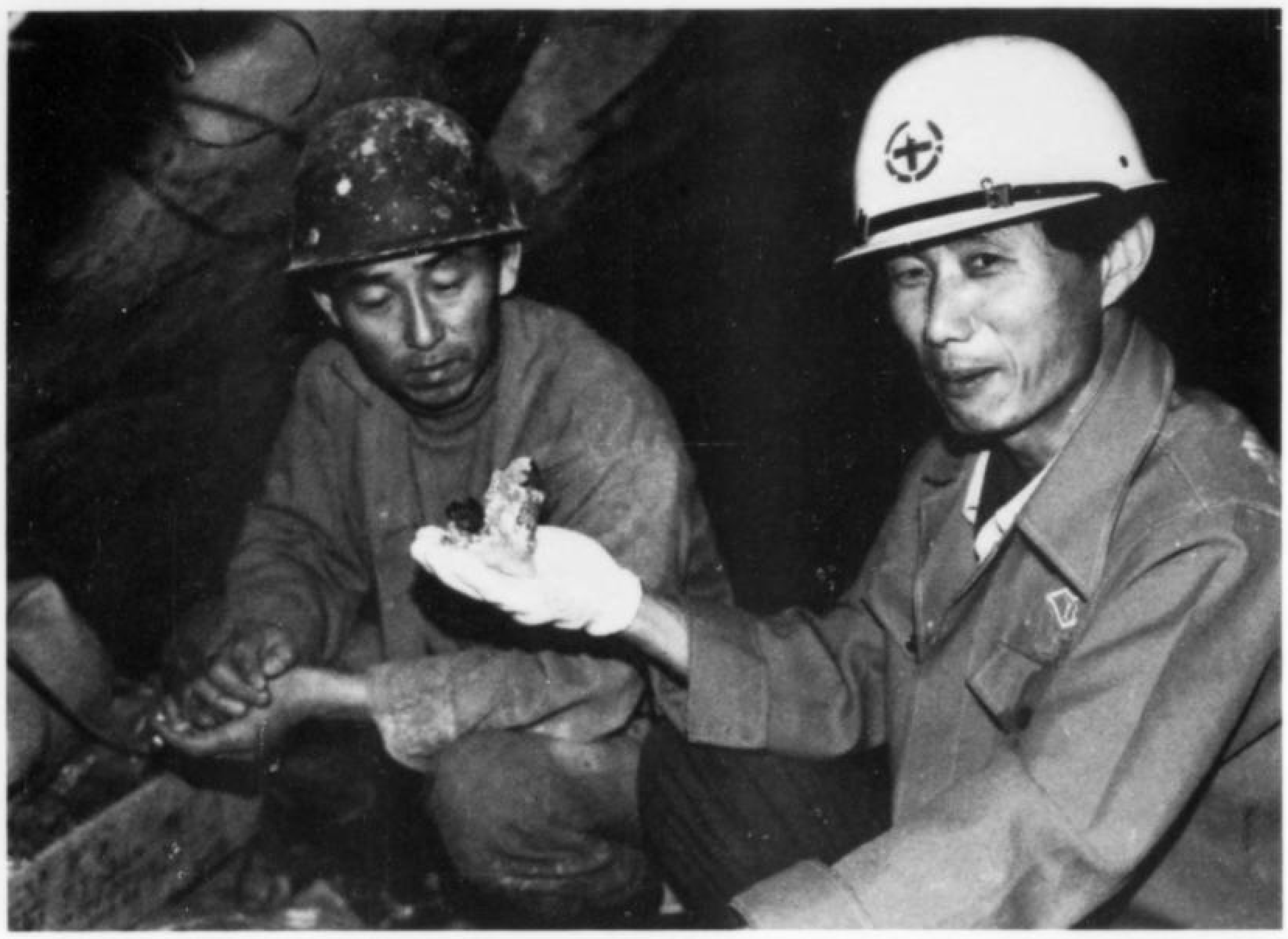


***Figure 6*. Mine manager Jae Choon Um, meticulously dressed for our visit, shows off a fine scheelite matrix specimen. (Photo by the author.)**

***Figure 7*. Korean miners on a lunch break at the Taewha mine. (Photo by the author.)**

most appealing trait of Taewha scheelite is its ability to form on quartz crystal matrix; when cleaned and trimmed such specimens make handsome additions to the collector's cabinet.

The mine proved to be quite safe, even in the areas which had been blasted the previous day. The ventilation was excellent. (In 1927 the Japanese had driven a 460-meter tunnel completely through the mountain and, by leaving both entrances unobstructed, a continual and adequate source of cool, fresh air was assured.) At the working faces we encountered 15 to 35-cm-thick white quartz veins spaced between layers of Precambrian biotite and granite gneiss; the veins carried pockets every meter or two; but only infrequently did these vugs contain scheelite crystals. The largest scheelite crystal mined during my visit was a 2.5-cm brown octahedron, not affixed to the quartz crystals of the pocket.

Associate minerals at the Taewha mine include wolframite, chalcopyrite, pyrite, calcite, beryl, muscovite, fluorite (which occasionally is found as light green 6 to 13-mm cubes attached to scheelite-quartz matrix) and orthoclase.

The mine has no mill so the highgrade molybdenite, scheelite and wolframite are cobbed out by hand. Nippers (lady workers) perform much of this task at the surface.

A fond remembrance will be the "chopsticks only" luncheon, seated with the shift bosses and management staff on *tatami*-like mats on the floor of a fifty-year-old brick building. Rice, fish, pork and tropical fruits comprised the meal—what a feast! And it was here I learned a little of the mine's lore. *Taewha*, it turns out, means *100,000 steps,* and after climbing the hills one is convinced the place is well named.

The miners worship their mountain (Po Ryun). They believe there is a land god within, and the god is feminine. Therefore, the sacrificial food must be masculine, and is designed to appeal to this great "lady." Offerings of pig, fruit and dried fish are made at least twice a year. In addition, the miners place incense and candles before their mountain each Thanksgiving Day (August 15) on which they pray for prosperity and safety. One miner told us that his crew did not like women, dogs or deer around the mine, but that rats didn't bother them.

1968–1971 were the "golden years" of Taewha for during this span of time the international prices of molybdenum and tungsten were high and a large quantity of high-grade ore was mined. Unfortunately of late, neither the price structure nor production seem to warrant continued operation and mine foreclosure is "just around the corner." Should this prediction be true, then another major world source of fine crystal specimens will be permanently lost to the serious collector.

The Occurrence of Japan-Law Twinning in Quartz

by
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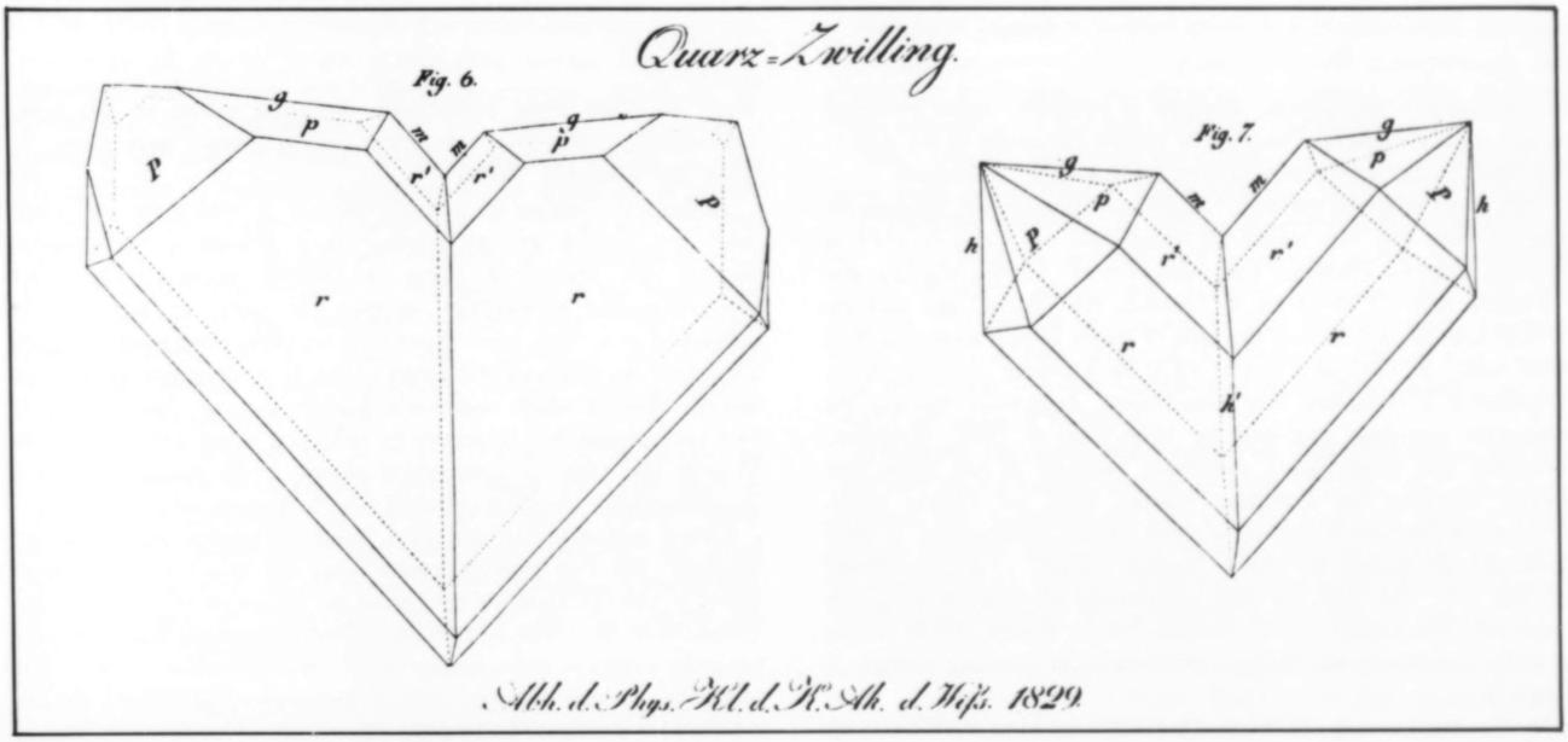
Quartz twins having a characteristic V-shaped aspect have been known for more than 150 years. The individuals, which always meet at an angle of 84°30′, can also form flat plates without re-entrants, crossed twins in which the members are doubly terminated, and multiple twins of various types. The abundance, variety and worldwide distribution of Japan-law quartz twins have made them collector favorites.

INTRODUCTION

With the exception of naturally occurring precious metals, perhaps no other mineral is as generally familiar as quartz. Its physical properties, unusually wide distribution and pleasing appearance in the coarsely crystalline state resulted in early usage of quartz for both utilitarian and ornamental purposes. Quartz has been studied in great detail by modern techniques due to its importance as a rock-forming mineral and its useful optical and piezoelectric qualities. Today quartz still holds many secrets for the crystal chemist and crystallographer. And, despite the voluminous data available on quartz, its status as a collector's mineral leaves open certain avenues for the descriptive mineralogist as well.

Specimen-quality quartz is, of course, quite common and in many instances represents the first treasure acquired by the novice collector. Indeed, some collections are ultimately built entirely

Figure 1. **Sketches of Japan-law quartz twins from the 1829 paper by C. S. Weiss.**



around this single species. A list of the more desirable crystallized quartz specimens might include such items as: well-crystallized rose quartz from Brazil and Maine; Swiss quartz in its many varieties and habits; quartz geodes; American, Brazilian, and African amethyst; Arkansas groups; quartz with unusual inclusions such as chlorite, rutile, tourmaline, mud and water; peculiar crystals such as scepters; and twins. Of the various twin laws exhibited by quartz, few are more desirable or interesting to the collector than the Japan law. Such specimens are generally attractive, normally available from only a few locations worldwide, and often expensive.

The purpose of this article is to present a discussion and tabulation of reported locations for Japan-law twins and to briefly describe the previously unreported occurrences at Charcas, Mexico, and Chambillaya, Bolivia. The list of occurrences (Table 1) is unavoidably incomplete, although it represents those described in the readily available literature or known personally to the author. Additions to this list subsequent to its publication are welcomed.

The exact origin of the term "Japan law" is unknown although the general twin law was apparently recognized by Weiss in 1829 in crystals from La Gardette, Dauphiné, France. Initially the law was variously referred to as the la Gardette law, Weiss' law and the $\{11\bar{2}2\}$ law. A specimen of this type of quartz twin is known to have been taken to Germany around 1870 by Mohnike who reportedly acquired it at Hakodate, Hokkaido, Japan. Apparently this was the particular specimen described by Vom Rath in 1875. Abundant, beautiful and large quartz specimens twinned on the Japan law began reaching the European market from the Otome mine, Yamanashi Prefecture, Japan, in about 1895. Consequently, in 1905 Goldschmidt applied the name "Japaner Gesetz" to quartz twinned on this law. The term has been perpetuated by many investigators including Klockmann (1912), Zyndel (1913), Brauns (1919), Heide (1927), and Bragg and Bragg (1933), as well as many authors of textbooks.

In his classic work, Goldschmidt (1922) represents line drawings of what are interpreted as Japan-law twins from 11 European locations. An interesting paper dealing with the types of quartz twins which incorporate and are combined with the Japan law was presented by Kozu in 1952. An excellent discussion and review of the Japan law is presented in the 3rd Volume of *The System of Mineralogy* (Frondel, 1962). A general discussion and locality data were presented by Nambu in the *Introduction to Japanese Minerals* (1970).

A Japan-law twinned crystal is illustrated as Figure 600 in the *Complete Mineral Catalogue*, 12th Edition, of A.E. Foote (1909, p. 69). The price for the specimen was $3.00. Perusal of advertisements in collectors' magazines, particularly the earlier issues of *Rocks and Minerals*, indicates that Japan-law twinned quartz was occasionally available and has been generally known to American collectors since the 1930's. Comprehensive published lists such as those of Hugh Ford periodically contained quartz of this type. Unfortunately, only general localities such as "Japan" were given.

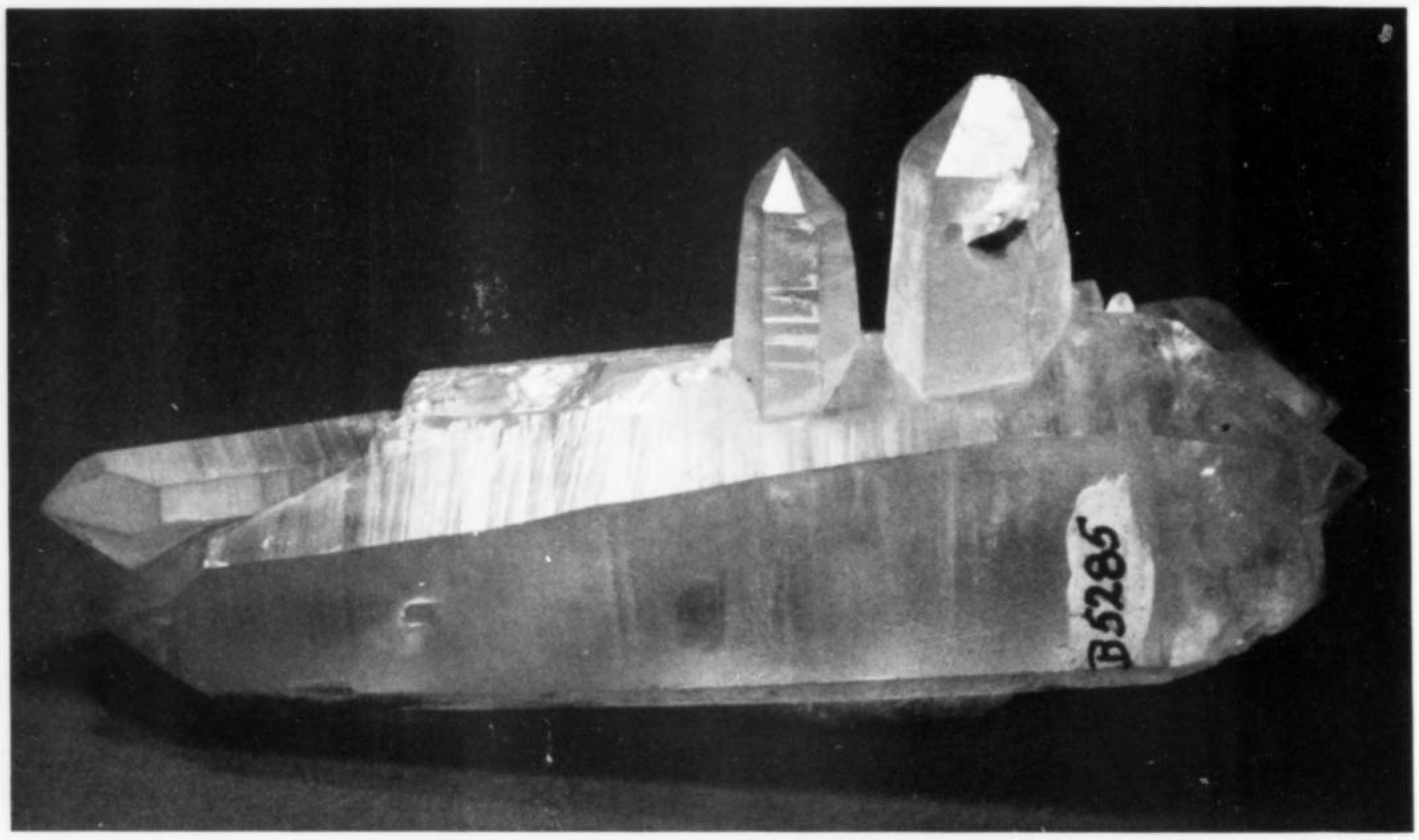


***Figure 2*. Japan-law quartz twin with one member represented by two individuals; colorless; 9.2 cm long; from Brusson, near Verres, Valle d'Aosta, Italy; Smithsonian specimen (USNM #B5285). Photo by Wendell Wilson.**

THE JAPAN LAW TWIN

Composite crystals of a single mineral in which the individual parts are related to one another in a definite crystallographic manner are known as twins or twinned crystals. The exact crystallographic relationship between the parts, or members, is expressed as a "twin law." Such laws are often given specific names related to the characteristic shape of the twin, dominant locality, or mineral species which commonly displays the law. The individuals of a twin crystal may be related by reflection across a plane common to both (the twin or composition plane), or by rotation around a crystallographic direction common to both (the twin axis).

Quartz may twin in several ways, and in fact most quartz crystals are twinned. The two most important types are Brazil twins ("optical twins") with $(11\bar{2}0)$ as the twin plane and Dauphiné twins ("electrical twins") with the *c*-axis as a twin axis. Twinning on the Brazil law may be quite complex and combine right- and left-handed crystals into attractive, though at times difficult-to-decipher, specimens. Quartz twinned by the Japan law, on the other hand, is usually quite readily recognized due to the sharp "V" shaped divergence and generally flattened nature of the members.

In quartz twinned on the Japan law, two individuals are combined to form a contact twin with $\{11\bar{2}2\}$ as the twin plane. The *c*-axes of the individuals intersect at an angle of 84° 33′. The net effect is that one pair of prism faces is common to both members of the twin and so forms an apparently continuous face across the twin boundary. The trigonal symmetry of quartz dictates that there are six crystallographic planes corresponding to $(11\bar{2}2)$. The relations between twin members, taking into account combinations of these possible composition planes with hand (right and left) of the individual members, will result in ten distinct types of Japan-law twins, all of which may appear identical under all but detailed observational circumstances (Kozu, 1952). Similarly, one may consider that there are four major types of Japan-law twins based on the combination of hand of individual members. Four types of Japan-law twins may be further considered as resulting from basic operations of 180° rotation around the normal to $(11\bar{2}2)$ which appear either alone (Type 1), in combination with Dauphine-law twin orientation (Type 2), in combination with the Brazil-law twin operation (Type 3), or the combined law twin operation (Type 4). Detailed descriptions and illustrations of the variety of Japan-law twin subtypes are given by Kozu (1952) and Frondel (1962). The relative frequency of occurrence of subtypes is unknown and distinction between them is often difficult.

Morphologically, individuals of Japan-law twinned quartz crystals are typically flattened parallel to the coplanar prism faces, the ratio of the width of prism faces being on the order of 1:3 or 1:4. The most usual habit is that in which members appear joined to give an acute-angle V-shaped appearance. The twins are often attached to matrix at the apex of the V and are generally larger than coexisting single crystals within a given pocket. Unflattened twins are known from a number of localities, as are twins that exhibit unusual prismatic development. Multiple twinning is reported from several occurrences. The largest known Japan-law twins are thought to be those from the Otome mine, Suisho Pass, Yamanashi Prefecture, Japan, where crystals reportedly reached maximum dimensions of 45 cm.

The paragenetic conditions for Japan-law twinning in quartz are unknown, although some generalizations may be made relative to its occurrence. The majority of localities listed in Table 1 are related to moderately high temperature, hydrothermal ore mineralization near the margins of plutons. Most occurrences are associated with tin and tungsten ore deposits or are in veins or replacement deposits of the more common sulfides. A few occurrences are in granitic pegmatites or are in simple quartz veins cutting relatively undeformed sedimentary rock. Those occurrences related to hydrothermal ore mineralization for the most part represent a generally late stage of several periods of quartz mineralization. This mineralization is typically subsequent to the deposition of coarse-grained sulfides, oxides, or tungstates. Inclusions such as tourmaline and chlorite are relatively common, are generally restricted to the portions of the members in near-proximity to the composition plane, and are in many instances restricted only to those quartz crystals twinned by the Japan law. Associated minerals are commonly apatite, manganese-bearing silicates and carbonates, fluorite and occasionally gypsum.

It should be stressed that, in view of the unusual abundance and wide distribution of crystalline quartz, Japan-law twins must be considered exceptionally rare. It is the suspicion of this author, however, that many occurrences have gone unnoticed, due to the lack of careful study of individual mineral occurrences and perhaps the occurrence of Japan-law twins that do not exhibit the characteristic flattened morphology.

OCCURRENCES

Bolivia: Japan law twins are relatively uncommon at Llallagua (Bandy, 1944). Attractive specimens consist of individual flattened members up to 5 cm in length perched on flat plates of slender prismatic quartz crystals. Cassiterite and wolframite are rare accessories. Specimens observed by the author in 1975 were attractive plates partially coated by wavellite. The rarer phosphates for which Llallagua is noted were not observed on any specimens exhibiting Japan-law twins.

Similar Japan-law twins were found at the Chambillaya tungsten mine near Quime. Individual members reach 6 cm in length and are occasionally associated with arsenopyrite, siderite, ferberite and exceptional pink fluorapatite crystals up to 3 cm in diameter. Twins are characteristically flattened and occur sparsely with transparent, prismatic quartz crystals generally in plates coating sulfides. Specimens are not often recovered from this occurrence and the few observed were saved by an engineer because of the transparency and perfection of the associated untwinned quartz.

Brazil: Exceptional examples of Japan-law twinned quartz have been produced sporadically from a small number of the many quartz crystal occurrences in Brazil. A find containing unusually attractive crystals to 26 cm was made in the magnesite occurrence at the Pirajá mine, Brumado district, Bahia (Cassedanne and Cassedanne, 1978). Specimens from this occurrence are particularly noteworthy due to their abnormal thinness and, in some instances, almost complete lack of re-entrant angles. Other occurrences include Gouvia, Diamantina, Minas Gerais; Serra do Cristais, Goyas; and Cristalina, Goyas.

France: With the exception of the well-known Japanese occurrences, perhaps the best known and certainly the most historically significant occurrence of Japan-law twinning is La Gardette, Bourg d'Oisans, Dauphiné. Twinned quartz from this location has been known and profusely described since the early 19th Century. Dauphiné or La Gardette quartz is comprehensively illustrated in the classic work of Goldschmidt (1922). Of ten twins from this location considered to represent the Japan law as illustrated by Goldschmidt (1922), five are of the typically flattened habit while five show relatively equal development of prismatic faces. Specimens from this occurrence are seldom available today and are highly prized.

Germany: Of the several German localities given in Table 1, Japan-law twins from Wolfsberg, Harz, are the most interesting and may in fact represent the ultimate development of this twin law. As illustrated by Goldschmidt (1922), unflattened, equally developed crystals are joined in the center instead of the apex to yield crosses. Alternate re-entrant angles are 84°34′.

Hungary: Japan-law twinned quartz is still occasionally available from the famous mines of Felsobanya and Kapnikbanya. An occurrence at Kapnikbanya described by Tokody (1958) contained rather unusual Japan-law twins with sceptered members.

Italy: Quartz twinned on the Japan law has been collected for many years at a number of Italian localities. Perhaps the best known is Traversella, Piemonte. In addition to several rather typical Japan-law twins of both flattened and unflattened habits, Goldschmidt (1922) illustrates an unusual, multiple Japan-law twin from this location. The specimen consists of two flattened twins symmetrically joined at their apices as if sharing a common twin plane. The larger twin is further complicated by multiple members on one side of the composition plane.

Interesting Japan-law twins were once found at Brusson and San Marcello in the copper district of Valle d'Aosta. The twins from Brusson are significant in that there is typically unequal development between the members. In these unusual crystals, the larger or major member's prism faces extend to termination well beyond the composition plane, thus destroying the "V-shaped" aspect.

Japan: At least 21 occurrences of Japan-law twinning in quartz have been reported from Japan. There seems little doubt that the Otome (Otomezaka) mine, Kurobera, Yamanashi Prefecture, is the

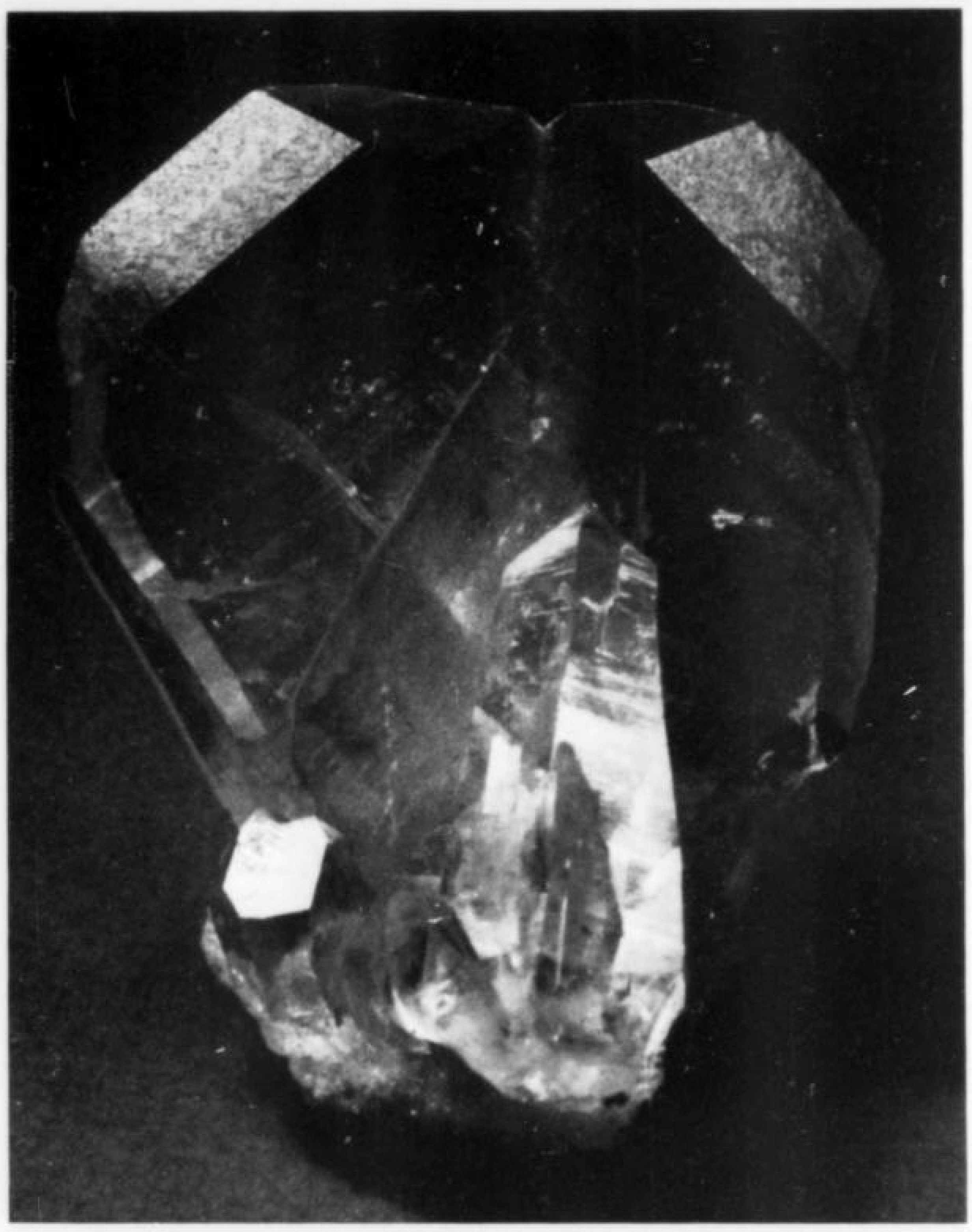


Figure 3. **Japan-law quartz twin; colorless; 4 cm wide; from the Otome mine, Yamanashi Prefecture, Japan; Smithsonian specimen (USNM #R14944). Photo by Wendell Wilson.**

premiere occurrence with respect to quality and quantity of specimens produced. Twins occur here in pegmatites associated with topaz, tourmaline, feldspar, and apatite, or rarely in quartz pegmatites without other minerals. In some portions of the pegmatites, twins are accompanied by the ore minerals molybdenite, wolframite, chalcopyrite, galena and sphalerite (Kuzo, 1952). As previously mentioned, crystals as large as 45 cm across are recorded from this occurrence. A superb example measuring approximately 30 cm across is in the Wada collection and has been illustrated in the *Introduction to Japanese Minerals* (Nambu, 1970). Twins from the Otome mine are noted for well-developed trapezohedral forms that allow distinction between hand. Similar extremely fine specimens from the general Kurobera vicinity are exhibited in the National Science Museum of Japan.

Another exceptional Japanese occurrence that has furnished large quantities of specimens to the collector market is on Narushima Island, Nagashaki Prefecture. Japan-law twins occur here abundantly in cavities in quartz veinlets and networks cutting Tertiary sandstone. The percentage of twinned crystals at this locality is much higher than in most, although the crystals are smaller, ranging from 1 to 3 cm. They are typically quite flattened, limpid, and are unusually well-developed. Most individuals are additionally twinned according to the Dauphiné or Brazil laws.

Eighteen additional Japanese occurrences are given in Table 1. Most are vein deposits related to plutonic margins and would be generally classed as contact metasomatic.

Korea: An exceptional example of Japan-law twinned smoky quartz with amethyst overgrowths from Onyang, Gyeong, Sang Buck Do, is in the Smithsonian Institution collections. Japan Law twins similar to those of the classic Japanese occurrences are known from Moonam.

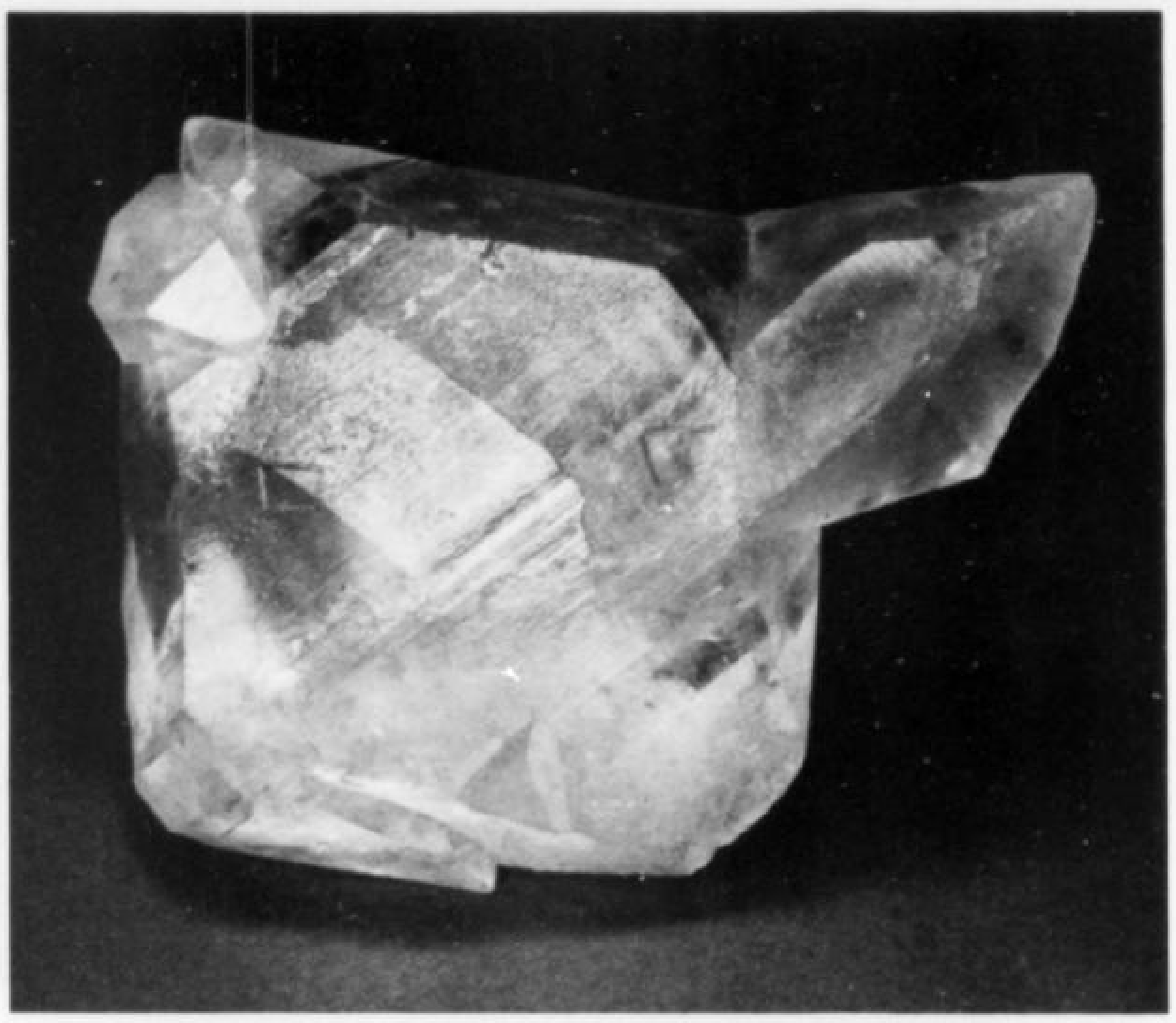


Figure 4. **Japan-law quartz twin; colorless; 6.8 cm wide; from Japan; Smithsonian specimen (USNM #R17600). Photo by Wendell Wilson.**

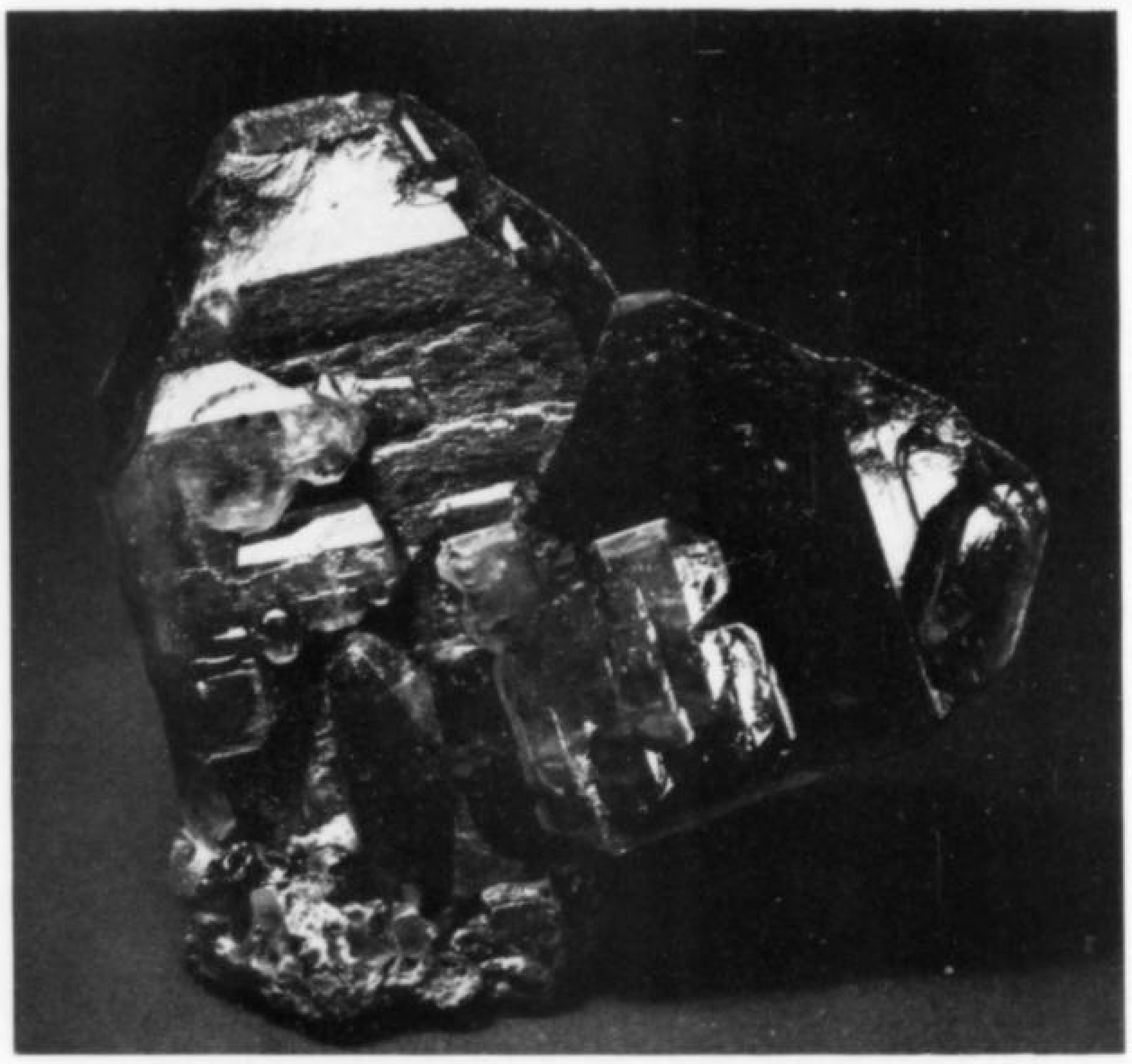


Figure 5. **Japan-law quartz twin; purple amethyst is present as parallel overgrowths on the smoky quartz twin members; 8.2 cm wide; from Onyang, Gyeong, Sang Buk Do, Korea; Smithsonian specimen (USNM #C6754). Photo by Wendell Wilson.**

Madagascar: Quartz twinned on the Japan law has been known from Madagascar since the early twentieth century. Although occurrences are mentioned in several reference sources, details and specific locality descriptions are lacking. An exceptional example in the Smithsonian Institution collections exhibits amethyst scepters on both members.

Mexico: Quartz twinned by the Japan law is known from two similar occurrences in Mexico. Crystals are rare and typically small at both locations, generally not exceeding 3 cm in member length. Quite small twins have been noted in the San Antonio mine in the

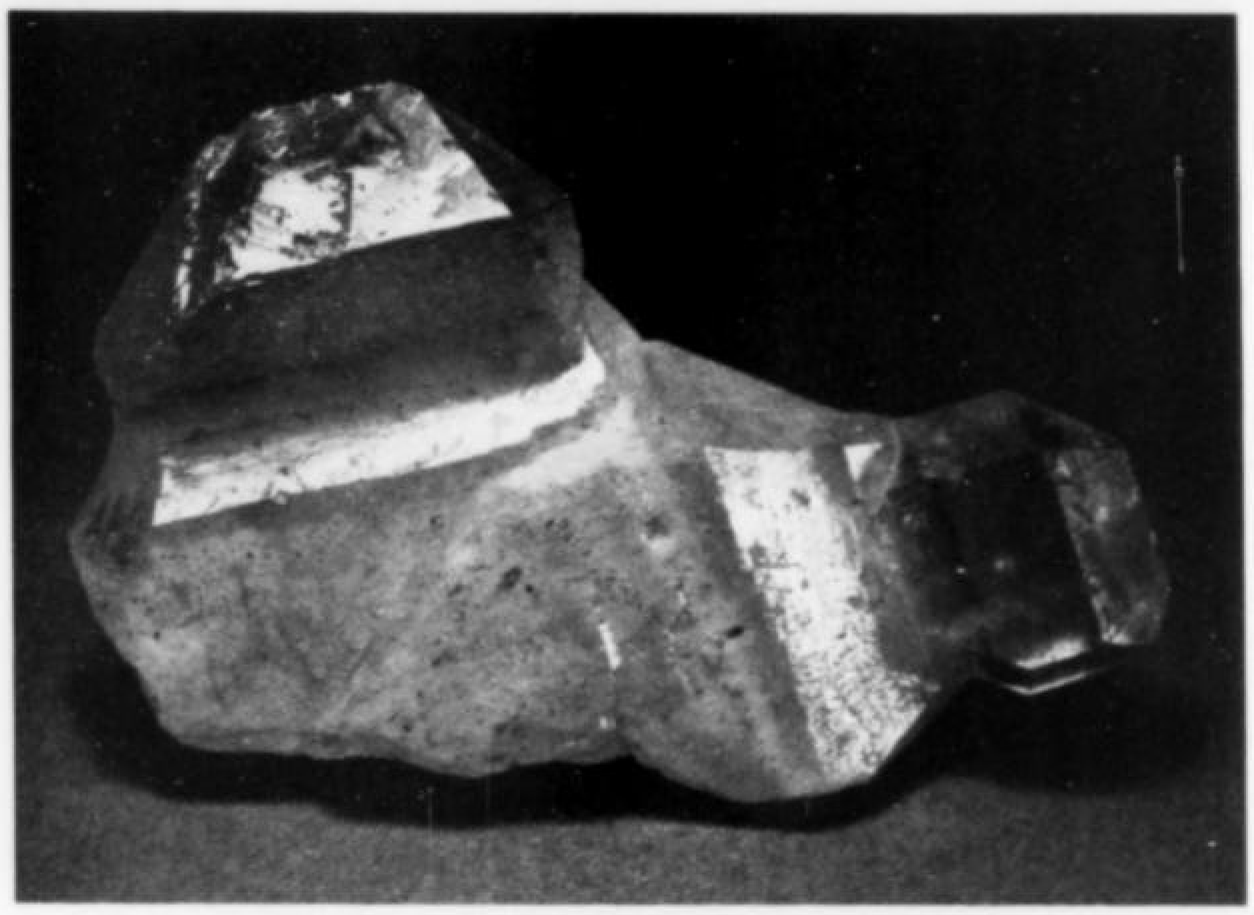


Figure 6. **Japan-law quartz twin; a "reverse scepter" with purple amethyst terminations and milky bases; 4.5 cm wide; from Madagascar; Smithsonian specimen (USNM #133879). Photo by Wendell Wilson.**

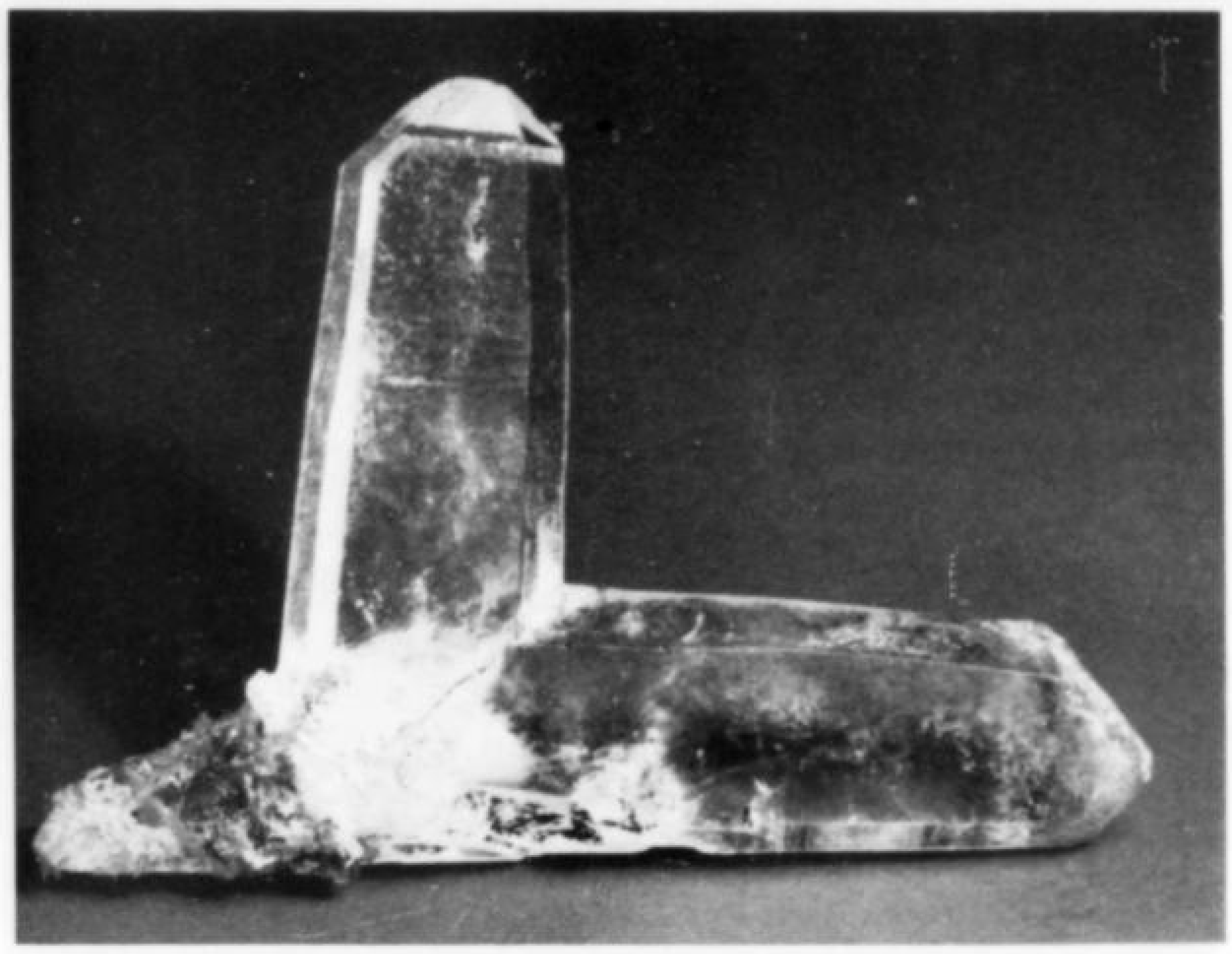


Figure 7. **Japan-law quartz twin; colorless; 2.9 cm wide; from Charcas, San Luis Potosi, Mexico; collection of the author. Photo by Wendell Wilson.**

well-known Santa Eulalia district, Chihauhua, where they occur with a variety of sulfide minerals in hydrothermal vein and limestone replacement ore bodies. Similar though somewhat larger crystals were once recovered from an apparently unique occurrence at Charcas. All Charcas samples observed by the author were free of matrix and exhibited elongate, flattened members. The relationship of these twins to the more well-known danburite and calcite mineralization of Charcas is unknown. All specimens were acquired (by the author) as a small lot and apparently none have been recovered since the intitial find in 1968.

Norway: Two possible examples of Japan-law twins are mentioned by Griffin, *et al.* (1977) from the exceptional anatase find at Matskorhae, Ullensvang Statsallmenning, Hordaland Fylke. The occurrence apparently represents a hydrothermal, open-space vein filling in phyllite and is notable for the relative abundance of rutile, brookite and anatase.

Peru: Excellent specimens of Japan-law twinned quartz associated with striking huebnerite, fluorite, and rhodochrosite crystals are occasionally available from the Huallapon mine, Pasto Bueno, Ancash Province. The Santa Isabell vein of this mine, well known as a recent source of exceptional rhodochrosite, has been the origin of numerous Japan-law twins.

Switzerland: Japan Law twins are occasionally found associated with the famous Swiss-Italian "needle" quartz at Val Bedretto (canton Tessim) and nearby Val Formazza (in Italy), at Chrützbachtobel, near Vattis (St. Gallen) and at Windgällen (Uri). Typical specimens consist of one or two twins dispersed among 2- to 6-cm long, densely packed, transparent, needle-like quartz crystals. Specimens are unusually fragile and undamaged examples seldom reach the United States collector market.

United States: The United States boasts a number of exceptional Japan-law twin occurrences. Perhaps the best known are those of the famed Prince of Wales Island, Alaska, epidote occurrences and the Holland mine, Santa Cruz County, Arizona. Specimens from these localities are inconsistently available on the collector market. Several new domestic occurrences offer the promise of exciting material. In addition, multiple Japan-law twins have been reported from three occurrences.

Figure 8. **Japan-law quartz twins; white and colorless on dark green epidote; the largest twin is 3.2 cm wide; from Green Monster Mountain, Prince of Wales Island, Alaska; Smithsonian specimen (USNM #126654). Photo by Wendell Wilson.**

Relatively small though exceptional specimens containing one or more Japan-law twins on matrix occur at both Copper and Green Monster Mountains on Prince of Wales Island, Alaska. Specimens from these locations rarely exhibit members exceeding 3 cm in length, yet are particularly desirable due to the association with coarsely crystalline epidote and the common phantom-like inclusions of murky chlorite. Excellent specimens of this type of material were available at the 1978 Tucson show. The deposits have been recently described in detail by Leavens and Thomssen (1977) and are considered classic contact metasomatic occurrences.

***Figure 9*. Japan-law quartz twin; green due to inclusions; one member doubly terminated; 4 cm tall; from Green Monster Mountain, Prince of Wales Island, Alaska; Smithsonian specimen (USNM #R7781). Photo by Wendell Wilson.**

***Figure 10*. Japan-law quartz twin; white; 7 cm wide; from Washington Camp, Arizona; Smithsonian collection (USNM #107424). Photo by Wendell Wilson.**

Japan-law twinned quartz is known from six occurrences in Arizona. The Holland mine, Washington Camp, Santa Cruz County, was perhaps America's leading occurrence. A remarkable quartz-crystal-filled cavity broken into a number of years ago was choked with opaque, translucent quartz crystals, many exceeding 30 cm in length, and associated calcite crystals up to 5 cm in diameter. The pocket contents were cemented with drusy quartz and a later coating of a brown carbonate mineral. Many crystals within this pocket were exceptionally large, typically flattened Japan-law twins. Several twins measured over 30 cm, tip to tip. An exceptional matrix specimen from this occurrence, in which the largest member measures 23 cm in length, is in the Bideaux collection, Tucson. A remarkable though broken specimen containing over 20 twins and a multiple Japan-law twin is reported from this location. Small Japan-law twins have been collected on a mine dump near the Yankee Boy mine near Mayer, Gila County. An interesting multiple Japan-law twin was described in detail by Bideaux (1969) in the initial issue of the *Mineralogical Record*. Other Arizona occurrences of Japan-law twins include mines at Johnson Camp, Cochise County and those at Bagdad, Yavapai County (Anthony, Williams and Bideaux, 1977).

Quartz twinned on the Japan law has been reported from time to time from several of the better known crystal occurrences near Hot Springs, Arkansas. The earliest reference to Japan-law twinned quartz from this general location is in *Guide to the Mineral Collections in the Illinois State Museum* by Crook (1920), in which an attractive 12 x 18-cm matrix specimen is illustrated.

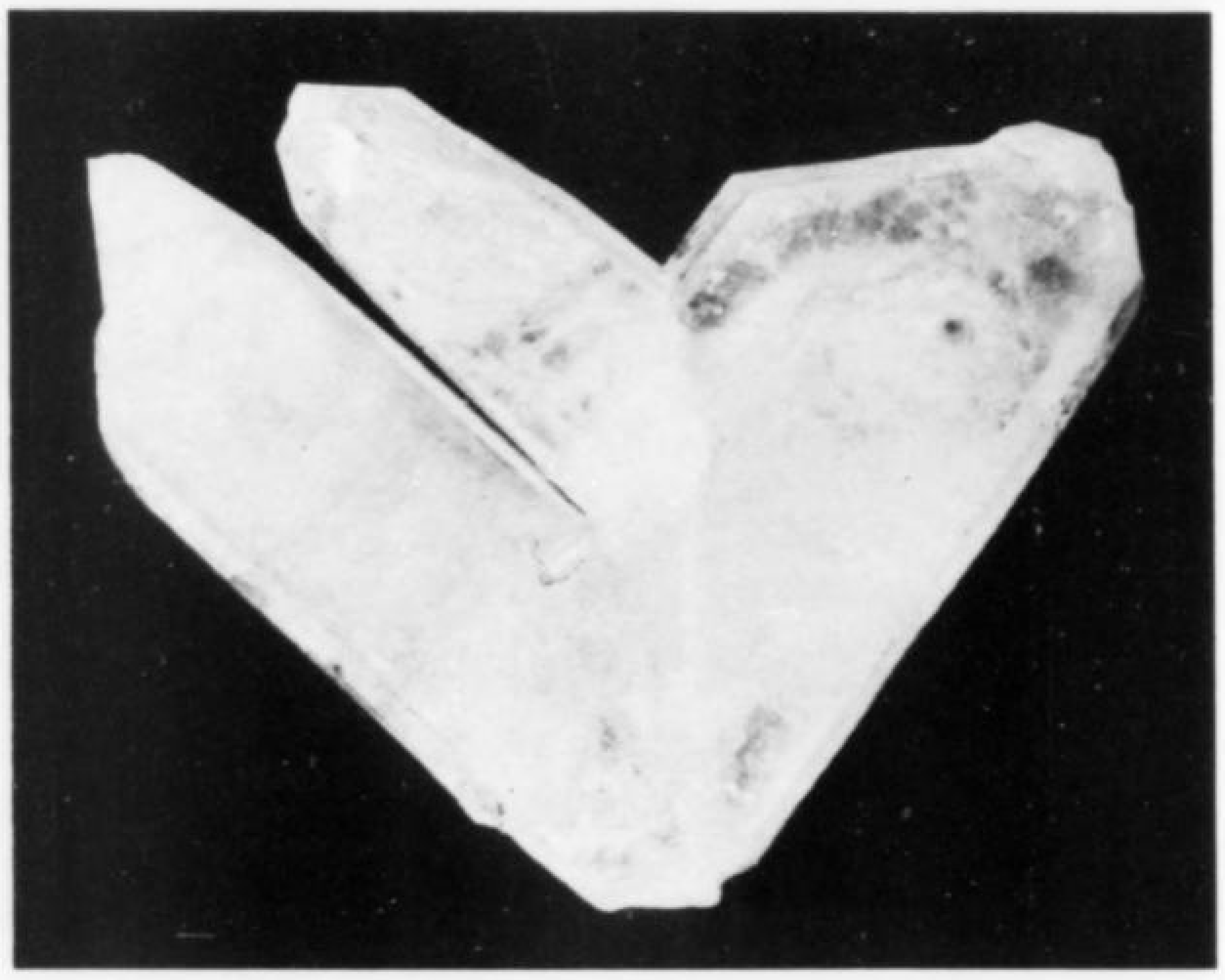


***Figure 11*. Japan-law quartz twin with one member represented by two individuals; white; 9.2 cm wide; from New Mexico; collection of Victor Yount. Photo by Wendell Wilson.**

Several specimens from the famous camp of Leadville, Colorado, containing quartz crystals twinned on the Japan law are in the collections of the Smithsonian Institution. The specific occurrence is unknown and specimens from this location should be considered exceptionally rare. In passing, the similarity in mineralogy and apparent paragenesis between the huebnerite-fluorite-rhodochrosite-quartz occurrence previously described at Pasto Bueno, Peru, and several famous rhodochrosite occurrences in Colorado should be mentioned. The similarity with the famous Sweet Home mine at Alma is particularly striking.

An interesting occurrence of apparent multiple Japan-law quartz twins has been recently described (Taggart and Grigsby, 1976) from a pocket in the San Pedro mine near Golden, New Mexico. The crystals are small, seldom exceeding 3.5 cm in length, and do not normally

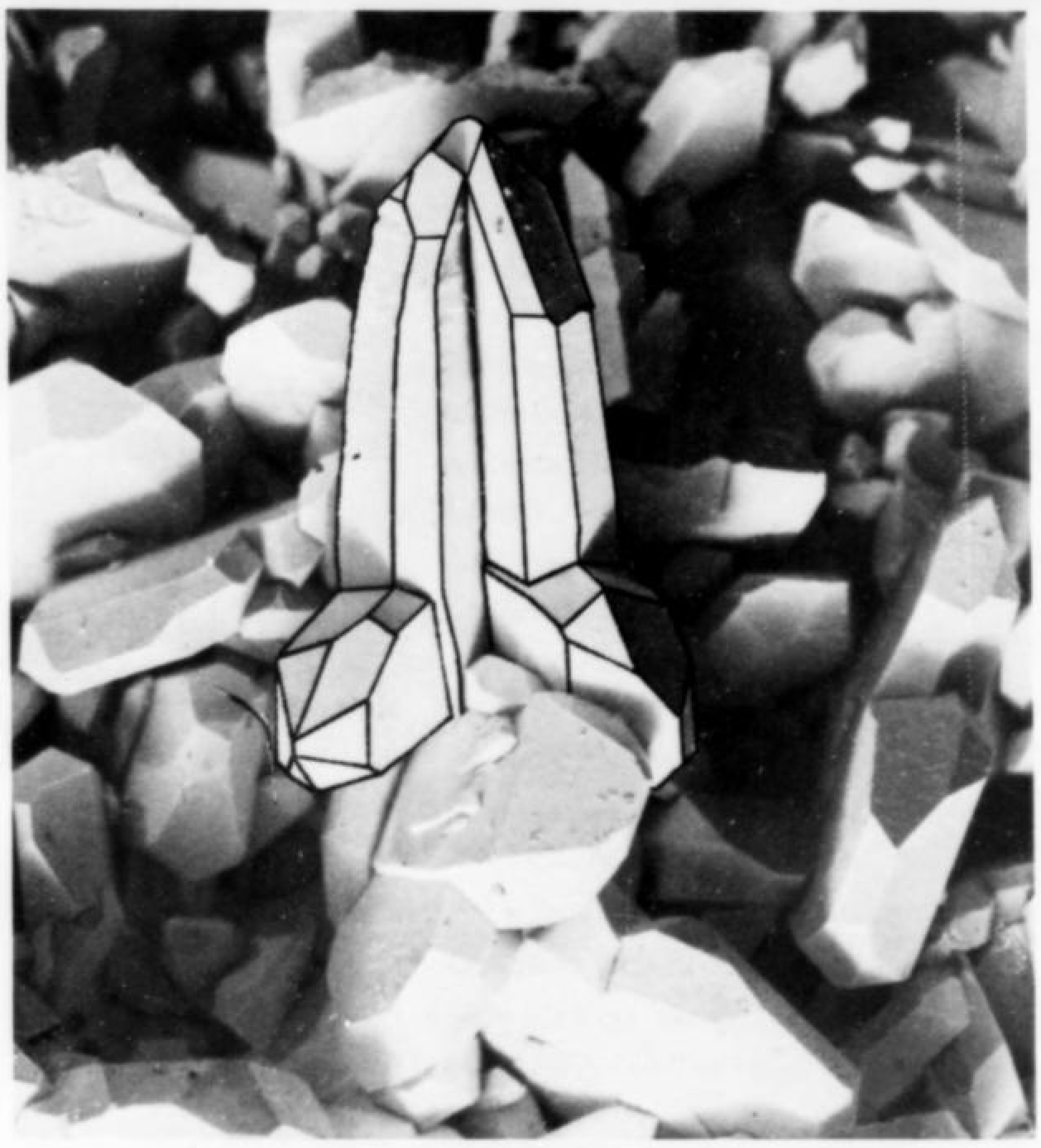


Figure 12. **Combined dauphine-law (vertical reentrant) and Japan-law quartz twins; coated with NH_4Cl to show form; from the San Pedro mine, Golden, New Mexico. Photo by Steve Hook (from Taggart and Grigsby, 1976).**

exhibit the typically tabular aspect of normal Japan-law twins. An exceptional specimen containing two parent crystals twinned on the Dauphiné law, each with a satellite Japan-law twin member, is illustrated. A small number of unusually attractive, smoky, Japan-law twins have been recently recovered from Mina Tiro Estrella, El Capitan Mountains, Lincoln County, New Mexico. Crystals are generally in the miniature range (under 3 cm) and are occasionally perched on an attractive matrix of white feldspar. Associated minerals are allanite, titanite, microlite, actinolite, and hematite.

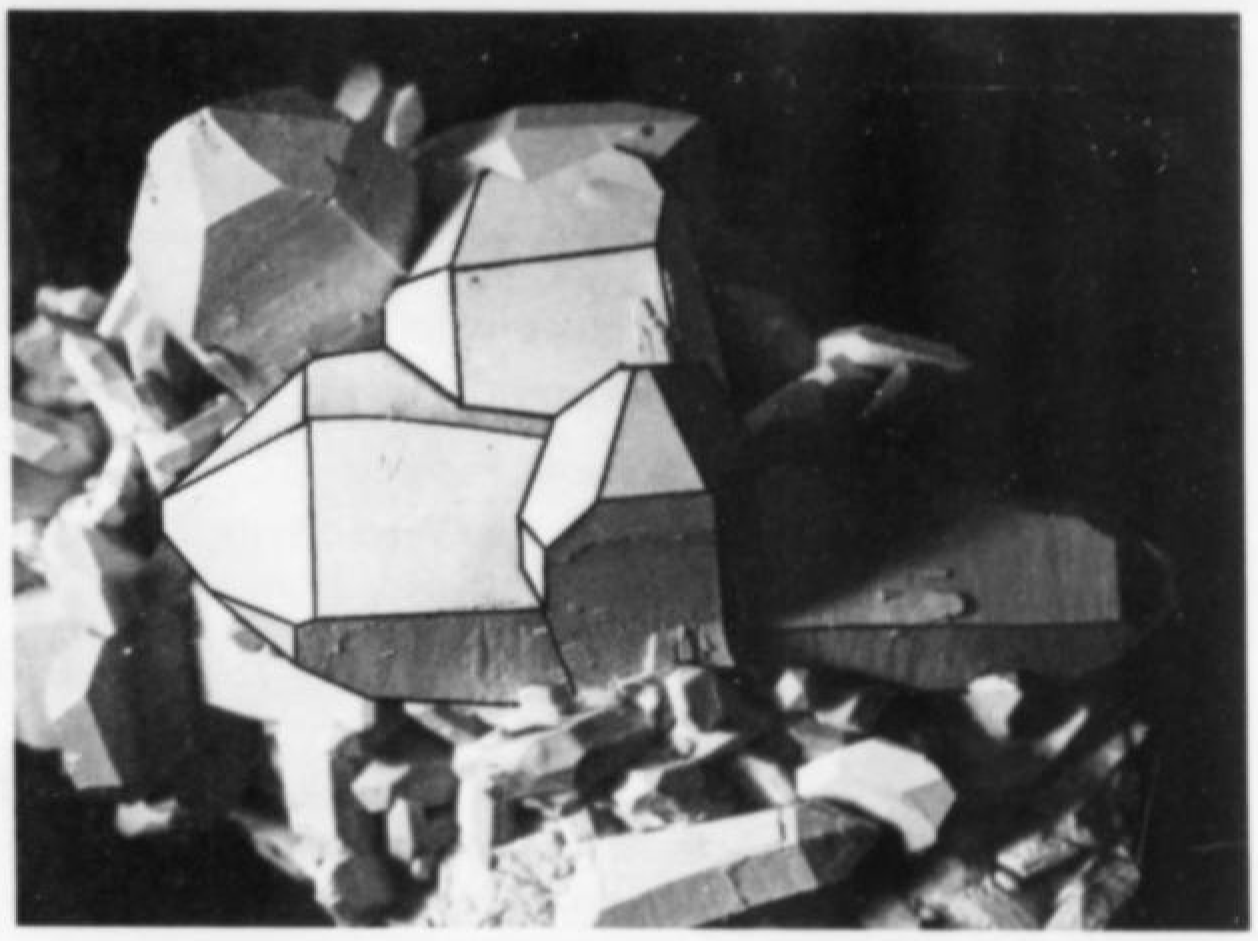


Figure 13. **Multiple Japan-law quartz twin; coated with NH_4-Cl to show form; from the San Pedro mine, Golden, New Mexico. Photo by Steve Hook (from Taggart and Grigsby, 1976).**

A number of fine Japan-law twinned quartz groups have been recovered from the King County, Washington, pyrite location. At least one specimen is both twinned and sceptered (Medici, *et al.*, 1978).

U.S.S.R.: Several exceptional Japan-law twins reaching 26 cm high and 6 kg in weight are reported from Gudzhivass in the Pamirs. Japan-law twins from the Sanarkamine are illustrated by Goldschmidt (1922).

Acknowledgements

Special thanks are due to John S. White of the Smithsonian Institution who freely gave of his time in supplying difficult to acquire references as well as adding substantially to the list of known Japan-law twin occurrences through his detailed knowledge of the Smithsonian and other major collections. The helpful comments, corrections and additions of reviewers Peter G. Embrey, Richard C. Erd, Richard V. Gaines, Donald R. Peacor and Wendell E. Wilson are gratefully acknowledged.

Table 1. Occurrences of Japan-law twinned quartz

Country	Locality	Comments	Reference
Austria	—Eckriegel, near Mallnitz	Alpine cleft	Weninger (1976)
	—Pebell Alpe, near Praegraten	Alpine cleft	Fruth (1975)
	Grabspitze, near St. Jakob	Alpine cleft	Fruth (1975)
Belgium	—Quenast		Goldschmidt (1922)
Bolivia	—Llallagua	Hydrothermal veins with cassiterite, apatite, wolframite; in clays in vein centers only	Bandy (1944)
	—Chimbillaya, near Quime	Hydrothermal veins with ferberite, apatite, arsenopyrite	Collection of the author
Brazil	—Minas Gerais; Gouveia		Lucio (1971)
	—Minas Gerias; Diamantina		Lucio (1971)
	—Bahia; Piraja mine, Brumado	Hydrothermal veins in massive magnesite with topaz and beryl	Cassedanne (1978)
	—Goyas; Cristalina	Cavities in itacolunite	Frondel (1962)
France	—La Gardette, Bourg d'Oisans		Smithsonian specimen
Germany	—Saubach	Cavities in quartz porphyry	Heide (1928)
	—Wolfsberg, Harz	Silver-lead-antimony sulfide veins	Goldschmidt (1922)
	—Munzig (Meissen)		Goldschmidt (1922)
	—Künstlich		Goldschmidt (1922)

Table 1. Occurrences of Japan-law twinned quartz (cont'd)

Country	Locality	Comments	Reference
Hungary	—Felsobanya	Sulfide veins	Goldschmidt (1922)
	—Kapnikbanya	Sceptered, with fluorite	Tokody (1958)
Italy	—Traversella, Piemonte		Goldschmidt (1922)
	—Brussons, near Verres, Valle d'Aosta	Hydrothermal Cu deposit	Goldschmidt (1922)
	—San Marcello, near Pistoja, Val d'Aosta	Hydrothermal Cu deposit	Goldschmidt (1922)
	—Val Formazza	Alpine clefts with "needle quartz"	Sullivan (1978)
Japan	—Otome (Otomezaka) mine, Kuroberra, Yamanashi Pref.	Cavities in granite pegmatite with topaz, molybdenite, apatite, wolframite	Kozu (1952)
	—Obi, Yamanashi Prefecture	Cavities in granite	Nambu (1970)
	—Kuroberra, Yamanashi Pref.		Nambu (1970)
	—Narushima Island, Nagasaki Pref.	Quartz veins cutting sandstone	Kozu (1952)
	—Kawahage, Nagano Pref.	Quartz-adularia-calcite vein	Kozu (1952)
	—Iwato, Miyazaki Prefecture		Kozu (1952)
	—Ade mine, Ishikawa Pref.		Kozu (1952)
	—Kiura, Miyazaki Prefecture		Kozu (1952)
	—Ofuku mine, Yamaguchi Pref.		Kozu (1952)
	—Kimpozan, Kai Prefecture		Bosch catalog, Smithsonian
	—Miyamoto, Kai Prefecture		Smithsonian collection
	—Kurasawa, Kai Prefecture		Bosch catalog, Smithsonian
	—Suisho Toge		Smithsonian collection
	—Kurokura, Kanaga Pref.	Apatite-zeolite-quartz vein in gabbro	Nambu (1970)
	—Horado mine, Gifu Pref.	Skarn zone	Nambu (1970)
	—Asuka, Hiroshima Prefecture	Pegmatite	Nambu (1970)
	—Yamato mine, Yamaguchi Pref.	Contact metasomatic deposit	Nambu (1970)
	—Kiura mine, Oita Pref.	Contact metasomatic deposit	Nambu (1970)
	—Hoei mine, Oita Pref.	Contact metasomatic deposit	Nambu (1970)
	—Obira mine, Oita Pref.	Hydrothermal veins	Nambu (1970)
	—Itaya, Miyazaki Prefecture	Quartz veins cutting sandstone	Nambu (1970)
Korea	—Onyang, Gyeong Sang Buk Do	Smokey quartz with amethyst overgrowths	Smithsonian specimen
	—Moonam	Contact metasomatic deposit	Wakabayashi collection, Tokyo
Madagascar	—(locality unknown)	Amethyst scepters	Smithsonian collection
Mexico	—San Antonio mine, Santa Eulalia, Chihuahua	Hydrothermal sulfide replacement deposit	Collection of the author
	—Charcas, San Luis Potosi	Hydrothermal sulfide replacement deposit	Collection of the author
Norway	—Matskorhae, Hordaland Fylke	Hydrothermal vein in phyllite with anatase	Griffin, *et al*, (1977)
Peru	—Huallapon mine, Pasto Bueno, Arcash Province	Hydrothermal veins with huebnerite, fluorite, rhodochrosite, sulfides	Wilson (1978)
Poland	—Crummendorf		Goldschmidt (1922)
Romania	—Desakna		Goldschmidt (1922)
	—Verespatak		Goldschmidt (1922)
Switzerland	—Val Bedretto, Tessin	Alpine cleft pockets with "needle quartz"	Sullivan (1978)
	—Chrützbachtobel bei Vattis, St. Gallen		Wagner (1978)
	—Windgallen, Uri		Wagner (1978)

Table 1. Occurrences of Japan-law twinned quartz (cont'd)

Country	Locality	Comments	Reference
United States	—Alaska; Prince of Wales Island	Contact metasomatic deposit with epidote	Leavens and Thomssen (1977)
	—Arizona; near Yankee Boy mine, Gila County	Hydrothermal with sulfides	Bideaux (1970)
	—Arizona; Hamburg, Cochise County		Anthony, *et al.* (1977)
	—Arizona; Johnson Camp, Cochise Co.	Hydrothermal with sulfides	Anthony, *et al.* (1977)
	—Arizona; Holland mine, Santa Cruz Co.	Pocket in hydrothermal vein with calcite	Anthony, *et al.* (1977)
	—Arizona; Bagdad, Yavapai County		Anthony, *et al.* (1977)
	—Arizona; Galiuro Mountains, Pinal County	In limonite with tourmaline	Anthony, *et al.* (1977)
	—Arkansas, near Hot Springs		Crook (1920)
	—Colorado; Leadville	Hydrothermal veins with sulfides	Smithsonian specimen
	—New Mexico; San Pedro mine near Golden, Santa Fe Co.	Contact metasomatic	Taggart and Grigsby (1976)
	—New Mexico; Mina Tiro Estrella, Lincoln County		Wilson (1977)
	—Washington; Denny Mtn., King County		Ream (1977)
	—Washington; Spruce Peak deposit, King County		Medici, *et al.* (1978)
	—Washington; Bald Hornet claim, North Bend, King Co.		Bart Cannon mineral list, December 1978
	—Washington; Devil's Canyon near North Bend, King County		Cannon (1975)
	—Washington; Blue Myn. Saddle, King County		Cannon (1975)
	—Washington; north side of Mt. Teneriffe, King County		Cannon (1975)
	—Washington; middle fork of the Snoqualmie River, King County		Cannon (1975)
U.S.S.R.	—Gudzhivass, Pamir Mountains		Frondel (1962)
	—Sanarka mine		Goldschmidt (1922)

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Hureaulite *and* Barbosalite

from Lavra do Criminoso, Minas Gerais, Brazil

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A notable new discovery of hureaulite has been made at the Criminoso mine, some 151 years after the original description of the species by Alluaud. The crystals are in superb large groups, and may well be the second best hureaulite ever found.

INTRODUCTION

A new find in Minas Gerais has produced about 125 specimens of superb pink hureaulite crystals liberally sprinkled with minute, nearly black (actually very dark blue) barbosalite crystals. The specimens were alleged to have been found at the Lavra do Criminoso, São Jose da Safira in Minas Gerais, Brazil. In fact, the Criminoso group of pegmatites is in the municipality of Agua Boa, about 35 km north or north-northwest of São Jose da Safira. The initial discovery was made in the autumn of 1977, the entire lot of specimens having been sold by a garimpiero from São Jose da Safira. The first specimens to reach the United States were sent by one of the authors (CPB), and were called to the senior author's attention by Charles Key and John S. White Jr. Since the appearance of the initial lot no new material of this type has appeared on the market, suggesting that the occurrence was an isolated pocket.

A visit to the supposed locality by Richard V. Gaines and Carlos Barbosa in March of 1978 showed that the name *Criminoso* is applied to a group of at least a dozen pegmatites, all within a few kilometers of the north bank of the Surubim River near the Fazenda "Colonião." All of the pegmatites were worked by adits for the recovery of tourmaline, beryl and other gemstones. These adits are for the most part abandoned and the workings are now inaccessible. The one lavra which was examined, a working mine, did not show any trace of phosphate mineralization, either underground or on the dump; the soft, damp, highly altered nature of the feldspars would have precluded the existence of unaltered hureaulite or other minerals characteristic of the assemblage.

Hureaulite is typically found in complex, phosphate-rich pegmatites. It can only be presumed that either the specimens came from another pegmatite in the same area which, in contrast to the one we saw, was hard, fresh and unaltered, or that the information about the source of the specimens was incorrect. If further material is uncovered, it is hoped that the precise locality will be revealed.

The specimens are composed of groups of hureaulite crystals

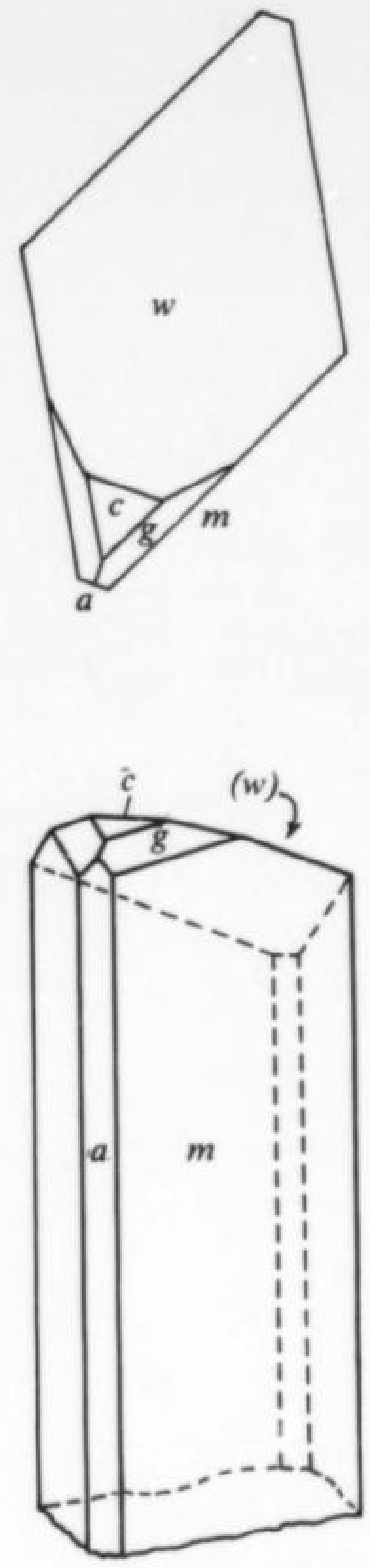


***Figure 1.* Crystal drawing of Criminoso mine hureaulite showing both a view looking down the *c*-axis and a standard clinographic projection.**

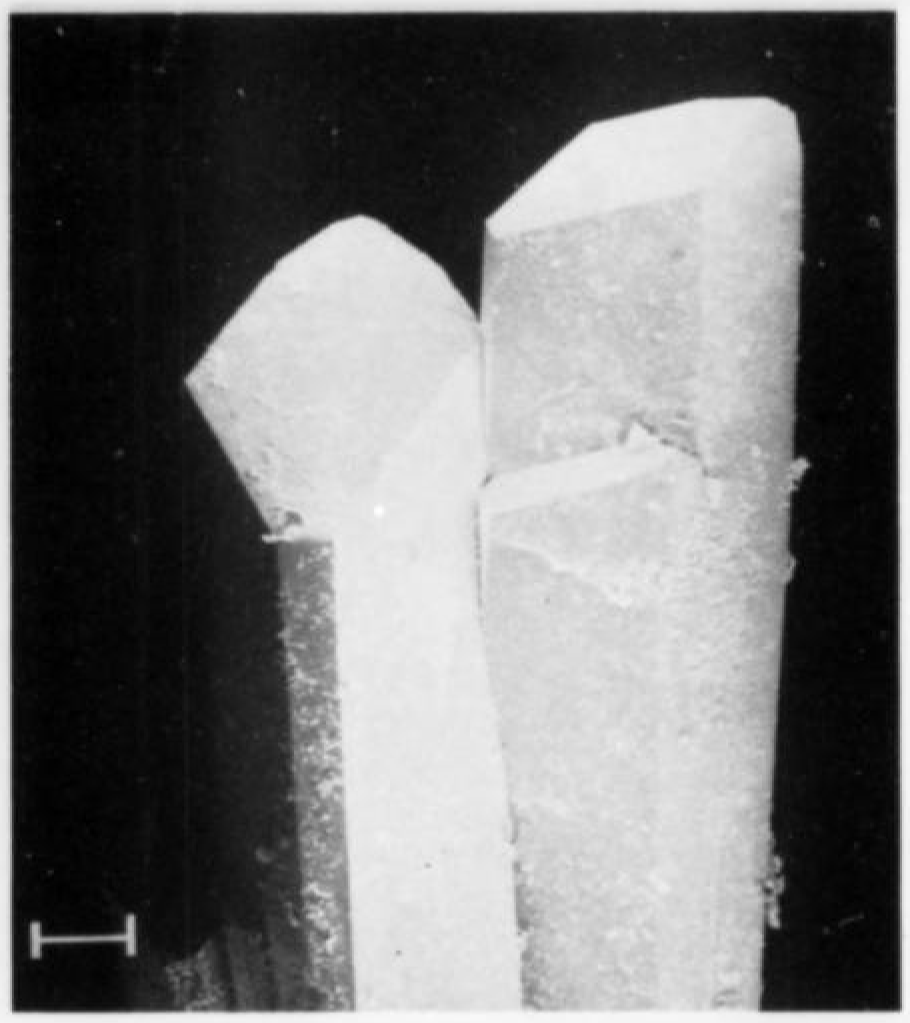


***Figure 2.* Scanning electron photomicrograph (SEM) of Criminoso mine hureaulite. Scale bar is 0.1 mm.**

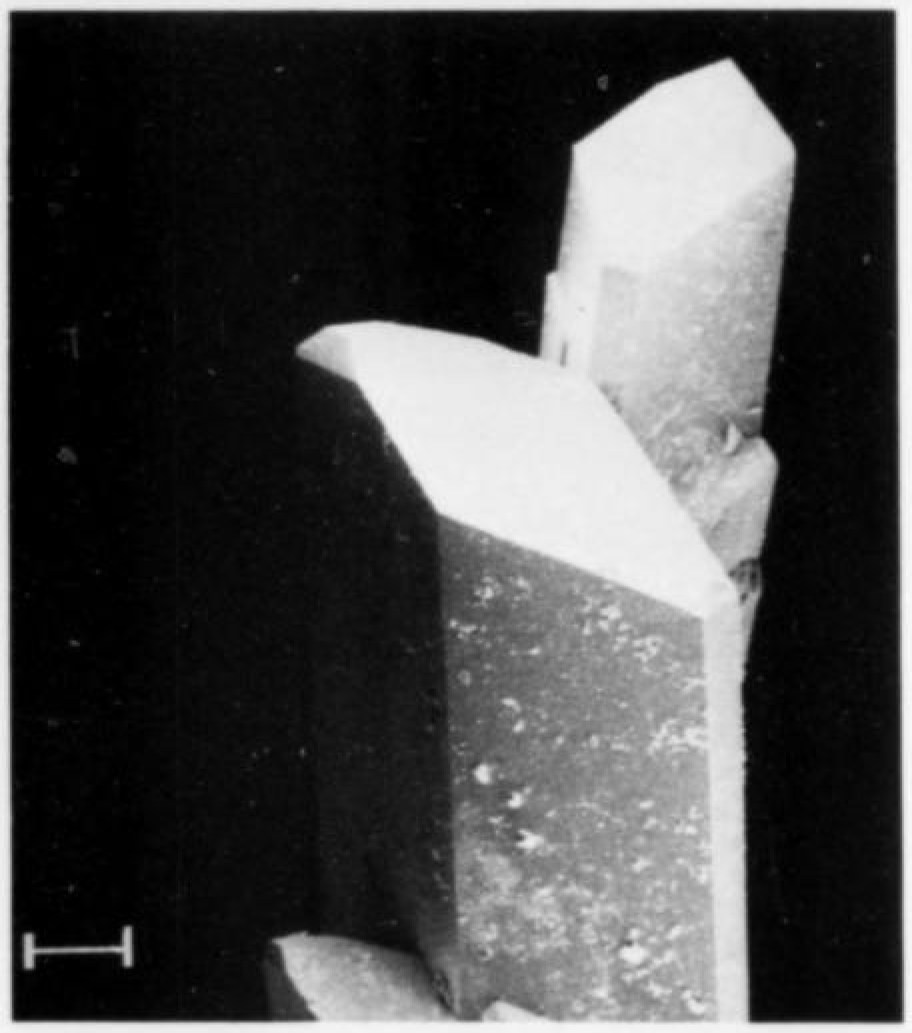


***Figure 3.* SEM photomicrograph of hureaulite. Scale bar is 0.1 mm.**

(Figures 4a, 4b, 4c) up to 10 cm across. The associated minerals include very dark blue barbosalite both on hureaulite and intergrown with and encrusting rockbridgeite which occurs as massive, compact material composed of radiating green needles up to 3 cm. Other associated species include roscherite in green spherules up to 1 mm across, massive white quartz, and very small, distorted, yellow sphalerite crystals no larger than 0.5 mm.

HUREAULITE

The hureaulite occurs as subparallel groups of euhedral crystals. The color of the material is slightly orange-pink, slightly lighter in hue than the hureaulite from Hagendorf in Germany. The Criminoso mine specimens are superb, second only in quality to the Hagendorf crystals for "best of species" and certain to become collector's classics.

The Criminoso mine hureaulite is simple in morphological development. The simple habit of these crystals is quite unlike that of the more complex crystals described from Branchville, Connecticut (Brush and Dana, 1890); Hureau, France (Dufrenoy, 1828); La Vilate, France (LaCroix, 1910) or Pala, California (Murdoch, 1943). The Criminoso mine crystals are prismatic in habit and up to 7 mm in length. Most are singly terminated and are gathered into bundles in a manner slightly similar to the fascicles of stilbite. However, even in bundles, the crystals retain much of their individuality.

The crystals are elongated on *c;* the forms present are *m*{110}, $w\{\bar{1}01\}$, *a*{100}, *c*{001}, and *g*{111}. The crystals are terminated with a new form for hureaulite, a very dominant $\{\bar{1}01\}$ pinacoid which is severely striated parallel to *b*. The forms {001} and {111} are very small and not easily visible on casual examination. Crystal drawings of the Criminoso hureaulite are shown in Figure 1, and several photographs are shown in Figures 2, 3, and 4.

Optically, the Criminoso hureaulite is biaxial negative, with $\alpha = 1.657(2)$, $\beta = 1.667(2)$, $\gamma = 1.671(2)$; $2V_{\times} = 61(1)^\circ$ measured, 64° calculated. There is strong to moderate crossed dispersion of the optic axes, with $r < v$. The orientation of the indicatrix is X parallel to *b*, $Z \wedge c = 61(1)^\circ$ in the obtuse angle between the crystallographic axes *a* and *c*. The mineral is colorless to light pink in thin fragments under the microscope. The orientation of the indicatrix is shown in Figure 5.

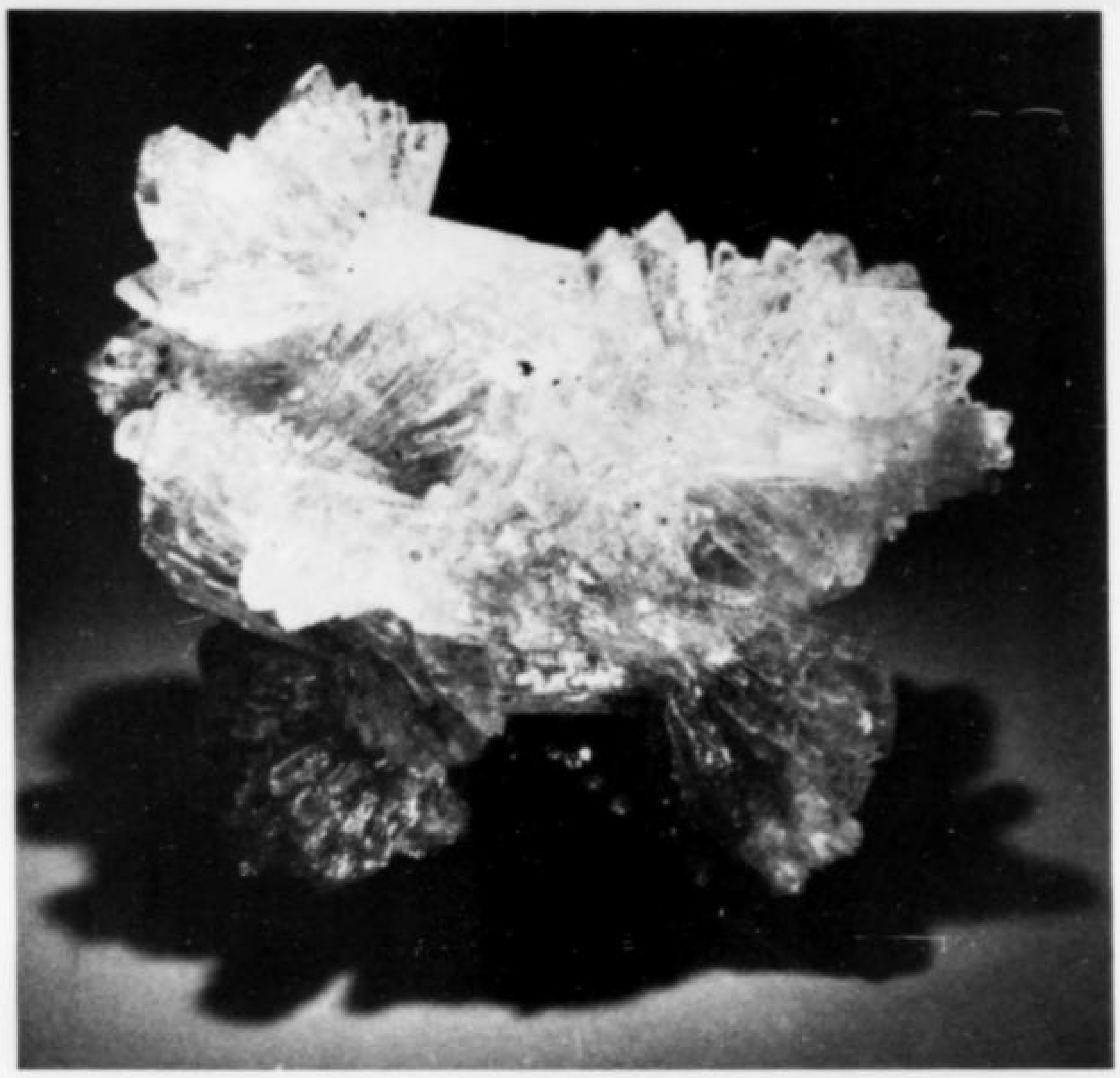
BARBOSALITE

The other important mineral on the specimens, barbosalite, occurs both as massive material intimately intergrown with rockbridgeite and as a second generation of lustrous, psuedocubic crystals up to 0.1 mm, sprinkled on the hureaulite crystals. The barbosalite crystals occur in a random fashion on the hureaulite, and there is no evidence of epitaxy or twinning. The barbosalite adds to the interest and quality of the specimens and, because many of the barbosalite crystals occur as isolated euhedra with excellent color contrast against the underlying hureaulite, this barbosalite also has excellent micromount potential. It is interesting to note that this apparently black mineral is actually a deep blue. The streak is a pleasing shade of dark blue, and the mineral might make a nice paint pigment; since most of the iron in barbosalite is in the oxidized (ferric) state, the powdered mineral should be stable in contact with the atmosphere. Photographs of the barbosalite crystals are shown in Figures 6, 7, and 8, and demonstrate the peculiar mosaic surface texture of these crystals, similar to that commonly seen on fluorite.

CHEMISTRY

The samples here described were analyzed with an ARL–SEMQ electron microprobe using an operating voltage of 15 kV and a beam current of 0.15 μA. Wet-chemically analyzed arrojadite was used as a standard for all elements. The data were corrected using a computer program. The resultant analyses are given in Table 1.

Chemically, the Criminoso mine hureaulite is most interesting. The structural formula of hureaulite is $\mathrm{Mn}_5^{2+}(\mathrm{H_2O})_4[\mathrm{PO_3OH}]_2[\mathrm{PO_4}]_2$(Moore and Araki, 1973) and it can contain some iron in substitution for manganese. This hureaulite contains up to 21.88% FeO, the highest amount ever reported for this mineral. Valence states cannot be determined with the microprobe, but microchemical tests have confirmed that most of the iron is in the ferrous state, as required by the formula of hureaulite. The Fe:Mn ratio is as high as 43:57, much greater than the 35:65 ratio reported by Klement *et al.* (1970).



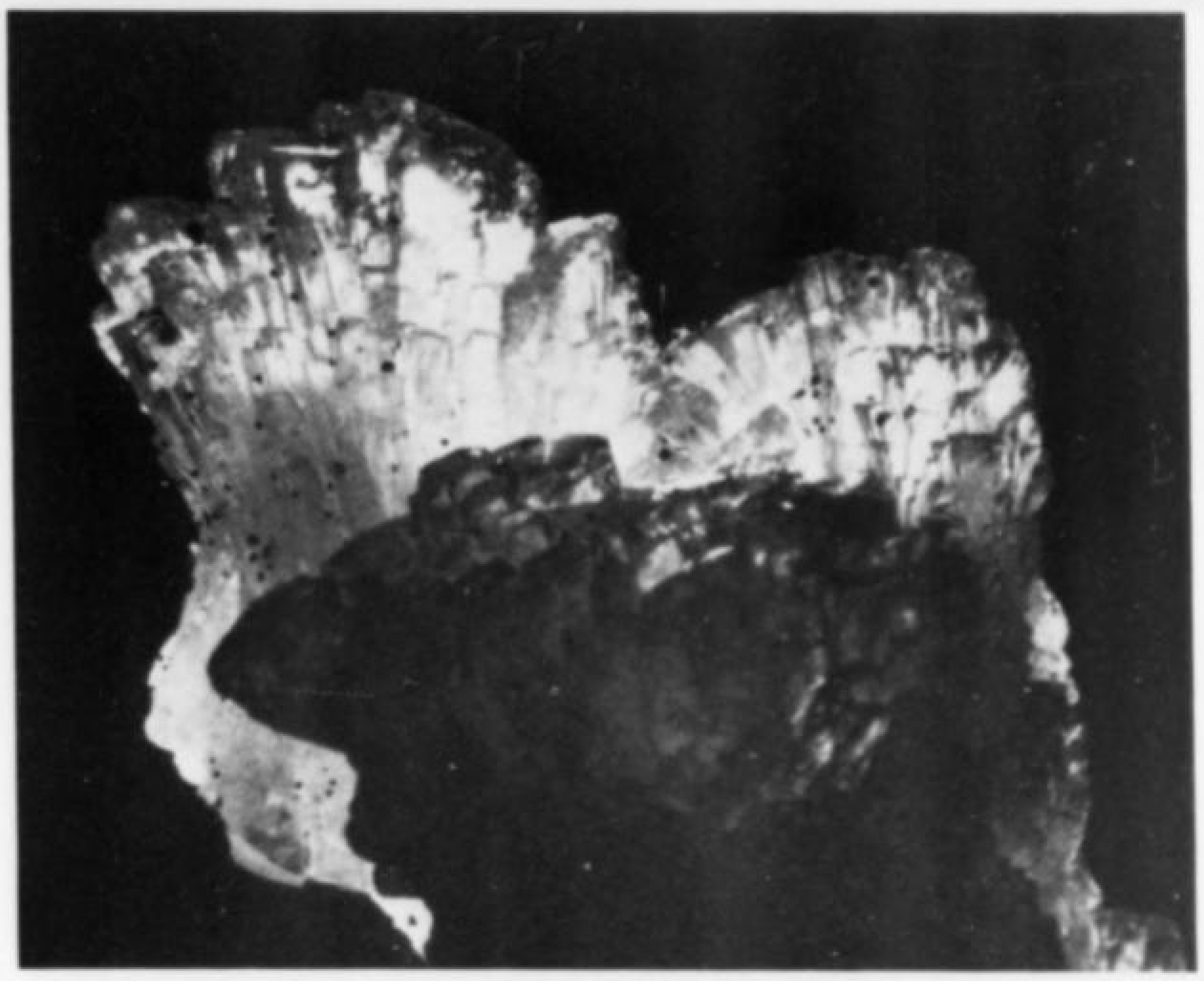


Figure 4. **Hureaulite with tiny barbosalite crystals. Specimen from the collection of William Pinch. Photographs by Wendell Wilson; a = 3 cm, b = 2 cm, c = 3.5 cm.**

The composition of the barbosalite is very close to the theoretical composition (see Table 1.). It has very little manganese in substitution for Fe^{2+}, although barbosalite can accept small amounts of MnO: 2.46% in the original material from the Sapucaia pegmatite (Lindberg and Pecora, 1955) and 1.35% in Moroccan material (Cech and Johan, 1972). Microchemical tests gave a strong reaction for ferric iron and a weaker one for ferrous iron. This conforms with the known oxidation states of iron in barbosalite, and the iron content in Table 1 was calculated at two-thirds ferric and one-third ferrous iron based on the known formula and the microchemical tests.

Although substitution of Mn^{2+} and Fe^{2+} is complete or extensive in a number of silicates and in the high temperature pegmatite phosphates lithiophilite-triphylite, it is limited in most of the hydrated secondary phosphates, which form at low temperatures. Hureaulite shows a greater range of substitution than do laueite, stewartite, or strunzite, three other low temperature manganese phosphates from pegmatites, although the paucity of chemical analyses of these minerals may well be a factor. Hureaulite typically occurs in association with rockbridgeite and other iron phosphates, so the high iron content of the Criminoso hureaulite cannot be explained merely by the presence of iron during its formation. Other factors besides total iron in the system must be important.

PARAGENESIS AND FORMATION

Only small amounts of other minerals are present on the Criminoso hureaulite specimens inspected, and very few specimens were examined, so we are unable to report a detailed paragenesis. In brief, rockbridgeite appears to be the first mineral to have formed, followed by massive barbosalite, then in turn by a mixed zone of barbosalite-hureaulite; this was followed by pink hureaulite crystals, and finally by

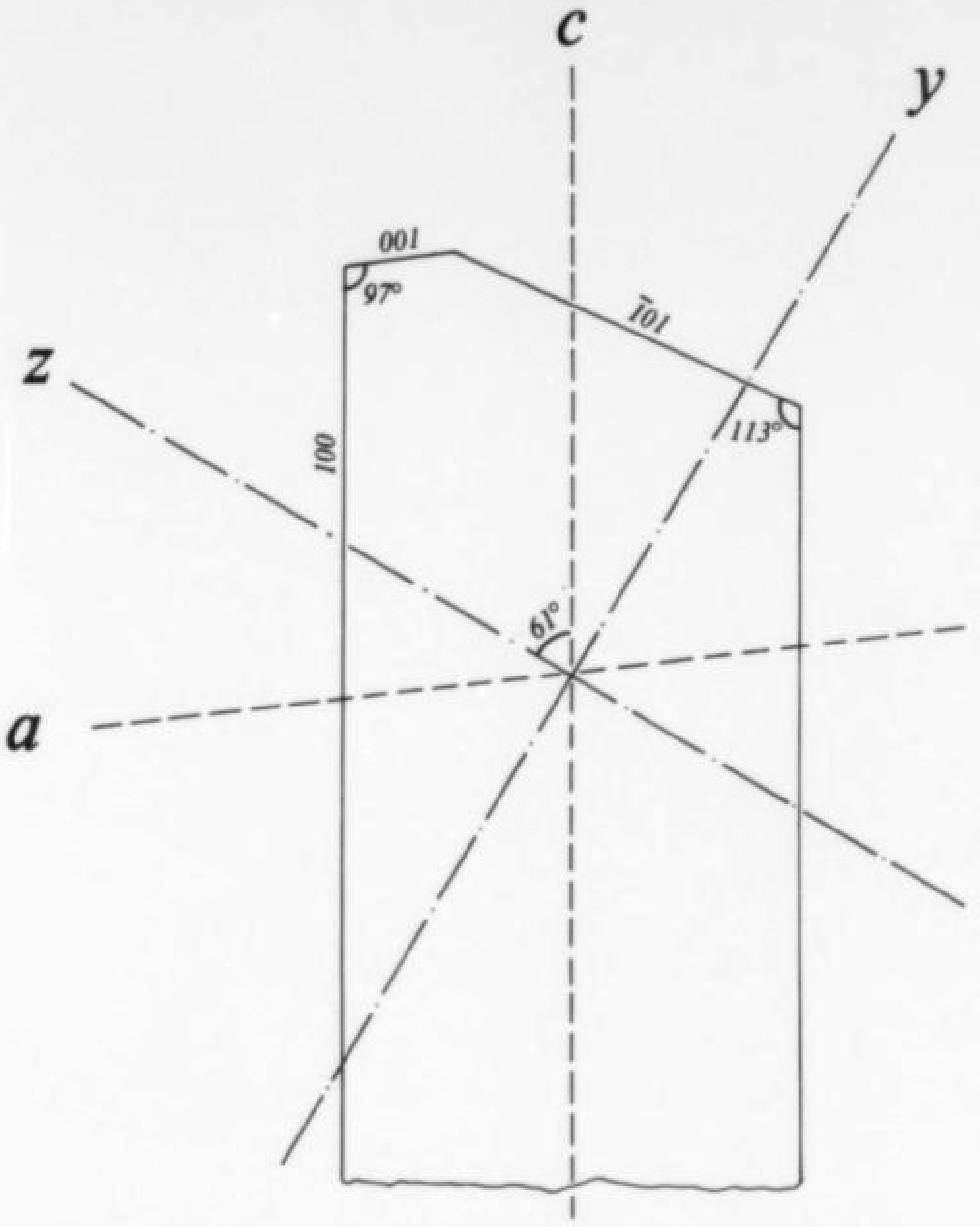


Figure 5. **Optical orientation of hureaulite; projection parallel to {010}.**

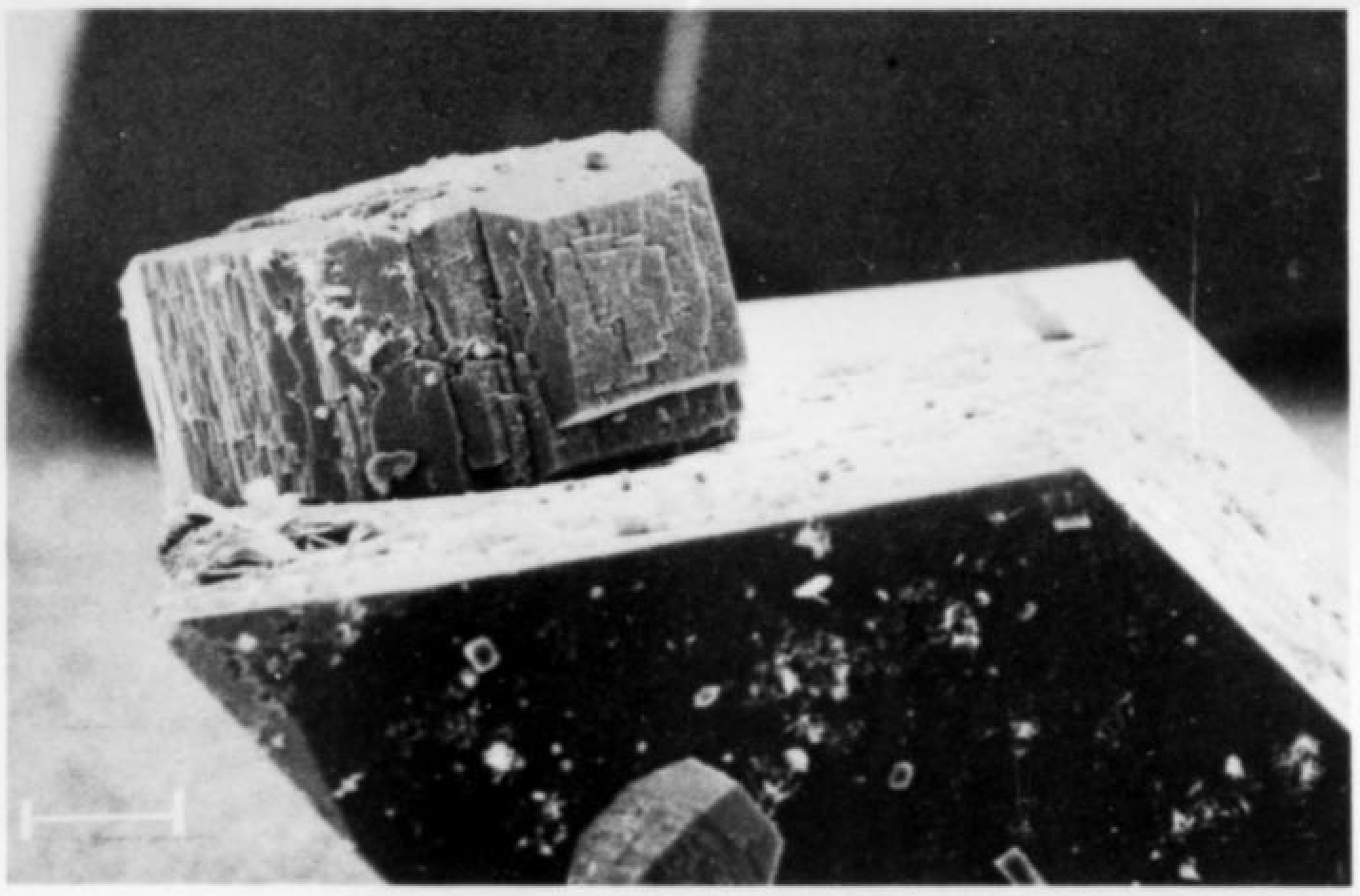


Figure 6. **Hureaulite on Barbosalite from the Criminoso mine. SEM photomicrograph; the scale bar is 20 microns (0.02 mm).**

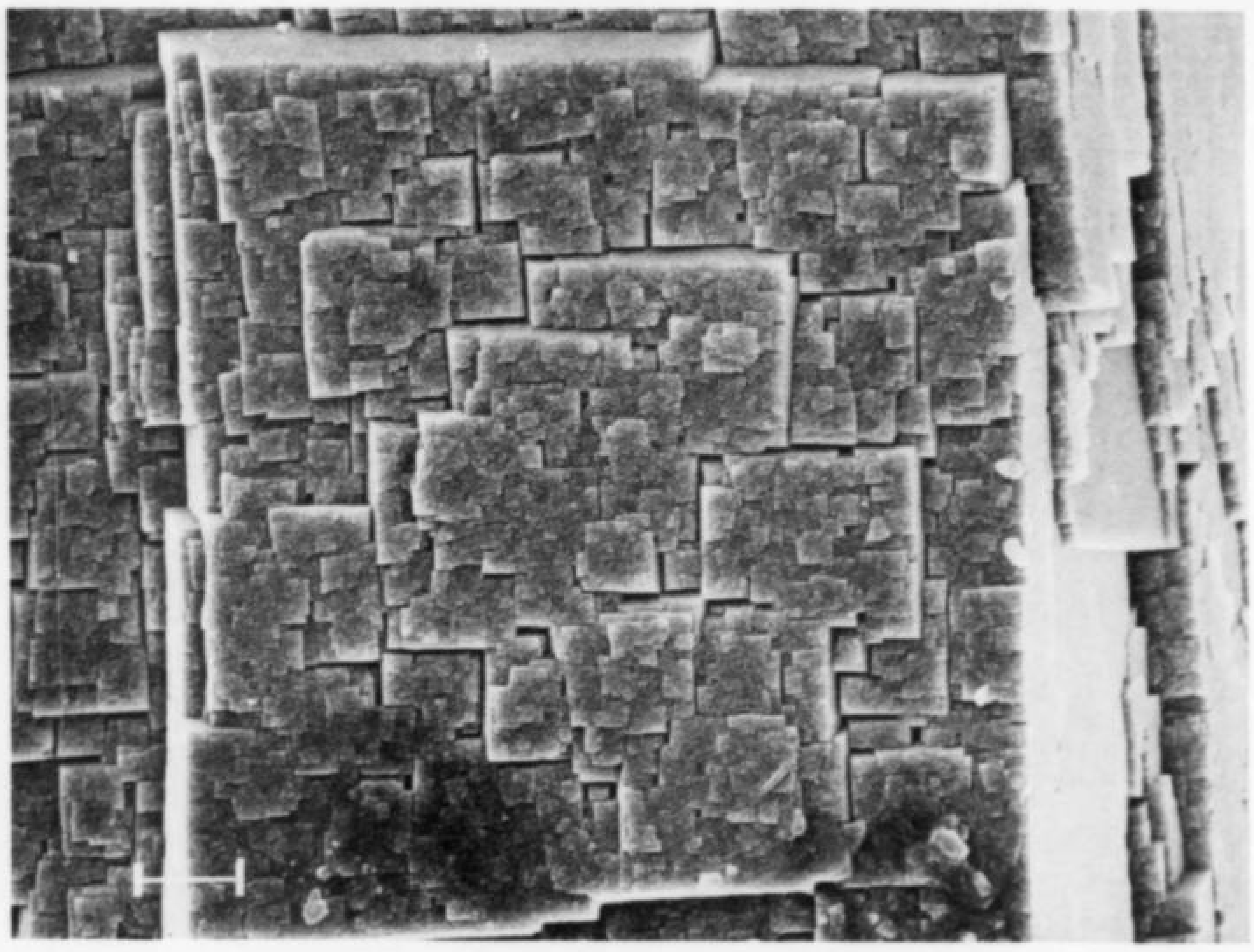


Figure 7. **SEM photomicrograph of the surface on a barbosalite crystal. The scale bar is 5 microns (0.005 mm).**

Table 1. **Microprobe analyses of hureaulite and barbosalite from Brazil.**

Species	Locality	MnO	MgO	CaO	FeO#	Fe_2O_3#	P_2O_5	H_2O	total
Hureaulite	*Theory*	48.68	—	—	—	—	38.95	12.37	100.00
Hureaulite	Brazil	28.26	0.18	0.16	21.88	—	37.25	12.27*	100.00
Hureaulite	Brazil	28.73	0.21	0.37	20.38	—	38.31	12.00*	100.00
Hureaulite	Brazil	29.17	0.50	0.62	19.69	—	38.71	11.31*	100.00
Barbosalite	Brazil	0.30	tr	tr	18.38	40.92	36.07	4.33*	100.00
Barbosalite	Brazil	—	—	—	18.36	40.79	36.25	4.60	100.00

#calculation of the oxidation state or iron discussed in text.

*H_2O calculated by difference.

Accuracy of data - ±3% relative.

NMNH # R18272 for all analyses.

euhedral barbosalite. The sequence of deposition of the quartz, sphalerite, and roscherite are not clear, but some sphalerite is imbedded in the hureaulite, and clearly formed near the end of crystallization of hureaulite. This group of phosphates typically forms by the low-temperature hydrothermal or near-surface leaching, hydration and oxidation of triphylite-lithiophilite or some other primary iron-manganese phosphate, and is inferred to have done so in this case.

ACKNOWLEDGEMENTS

The authors are indebted to the Creator for making such magnificent crystals; to Charles Key and John S. White Jr. for calling their attention to the mineral; and to Ms. Mary-Jacque Mann for assistance with the SEM photography.

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Some Interesting Radioactive Minerals from the Bancroft Area, Ontario

by **Irwin Kennedy**
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M1P 2B7 Canada

The area within 50 km of Bancroft, Ontario, has produced specimens of at least 150 mineral species. More than 25 of these species are moderately to strongly radioactive. This paper describes well-known occurrences of nine of these radioactive species which are found as exceptionally fine crystals and are common in collections. Detailed locality data provided for these occurrences may be helpful in amending or correcting existing labels for specimens in private or institutional collections.

REGIONAL GEOLOGY

The collecting region is situated within the Grenville geological province, a broad area of highly metamorphosed rocks that forms the southernmost band of the Precambrian Shield. Rock types in the region are extremely varied. Elliptical areas of granite with minor quartz diorite occur as islands in assemblages of Precambrian metasediments. The perimeters of these nearly circular granite intrusions are presently being explored for economic deposits of uranium.

The Bancroft region is pervaded by well-defined rock units trending northeast-southwest. The largest such trends include:

Bancroft lies 220 km northeast of Toronto and 190 km west of Ottawa (Fig. 1). Major access roads are paved. The town of 3300 serves a large summer resort area and, while accommodations are sufficient, advance reservations are necessary from June to September.

At least 100 specimen locations are readily accessible in the Bancroft area. Many are defunct quarries for industrial materials such as feldspar, quartz and mica, several are simply exploration pits and trenches near mine shafts, while others are outcrops isolated from immediate access. Most of the localities are on private land where collecting requires the permission of the owner. There is currently one producing mine in the area, the Madawaska mine (formerly the Faraday mine). In order to aid the collector in accurately labeling specimens, the lot number, concession number, and township name have been included for each locality.

1) marble, or crystalline limestone, derived from metamorphism of pre-existing limestone
2) paragneiss, derived from shales and sandstones
3) metavolcanics (e.g. amphibolite) which are, for the most part, flat-lying

This last rock type is the oldest in the Bancroft region (circa 1.3 billion years) although it is still much younger than the rocks of the adjoining Superior geological province to the north (circa 2.7 billion years).

Mafic intrusives (commonly gabbro and diorite) constitute a fourth rock type. They occur as oblate plutons and, like the granite and the metavolcanic rocks, do not yield many mineral specimens.

A fifth rock type is alkaline syenite. This is the least common in areal extent but the most important economically and the most interesting mineralogically of all the rocks in the Bancroft region. Most of the operating mines in the region are located in nepheline syenite. The syenite is plutonic, quartz deficient, and occurs as intermittent wisps and swirls among the other four rock types. Small outcrops indicate that the syenite is semi-continuous in a narrow (10 to 15 km) belt over a distance of 100 km from Gooderham northeast through Bancroft to Quadeville.

Approximately 60 readily accessible mineral occurrences have been explored by the author within the Bancroft region, including at least 15 properties that have produced radioactive specimens. Following are descriptions of nine species which are known to occur as fine specimens.

RADIOACTIVE MINERALS

Betafite $(Ca,Na,U)_2(Nb,Ta)_2O_6(OH)$

To collectors, betafite is one of the most familiar minerals from the Bancroft region. As a trace component of radioactive prospects it has been identified from several localities (Traill, 1970). Betafite is known particularly for its cuboctahedral crystals and crystal

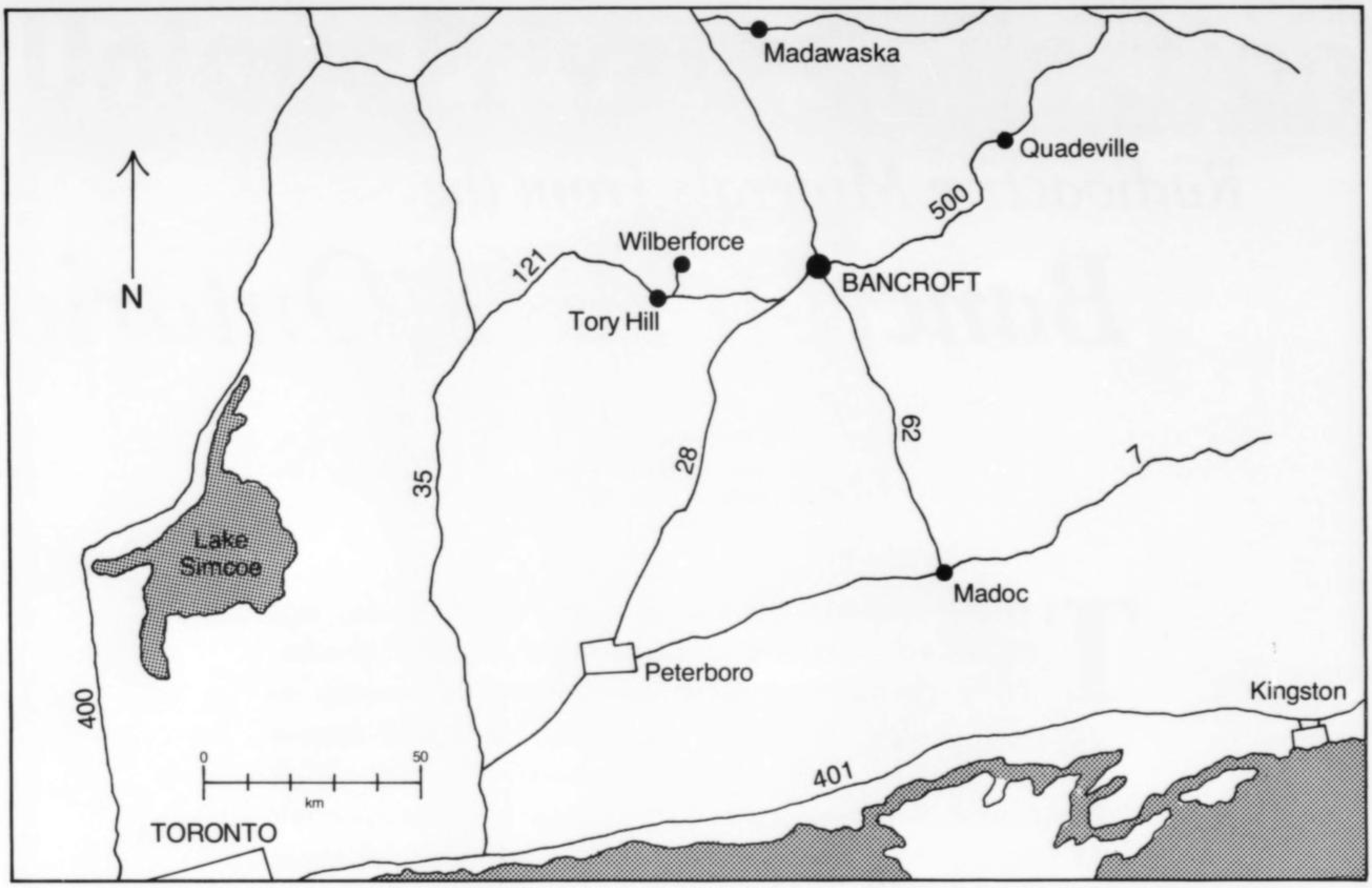
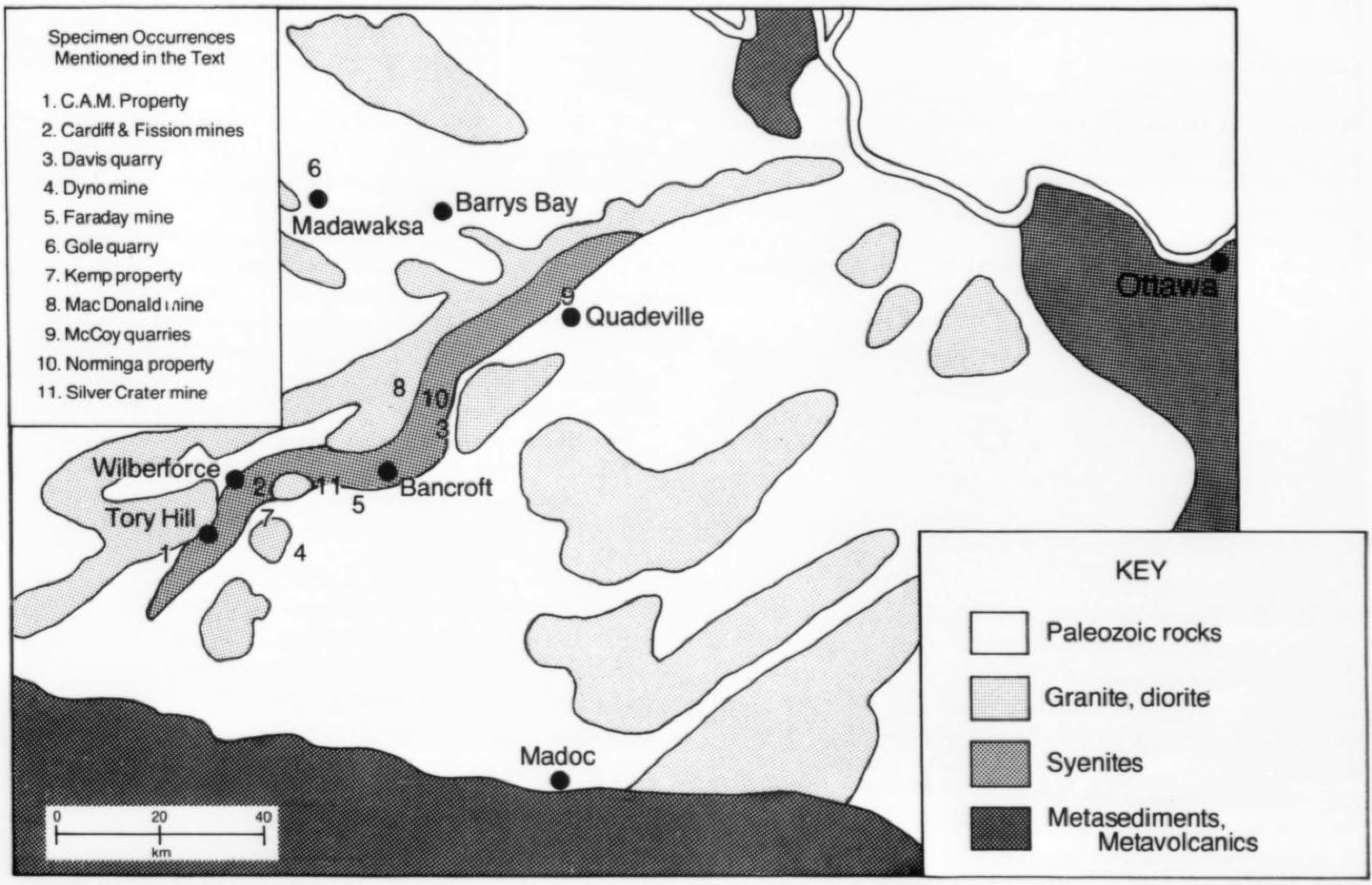


Figure 1. **Location map showing Bancroft and neighboring towns.**

Figure 2. **Location map showing several of the mines and quarries in the Bancroft area in the context of local geology.**



groupings from the Basin property of Silver Crater Mines Limited. Two typical specimens are illustrated in Figures 3 and 4. The locality is generally referred to simply as the Silver Crater mine. The charter for the owner company was cancelled in August, 1965, and the property is presently inactive.

The Silver Crater "mine" consists of an adit 70 meters long, intersecting a lens of coarse-grained calcite exposed for 140 m on a south-sloping hillside. The adit is driven approximately 17 m through biotite-amphibolite schist into the calcite, where there is minor drifting. An associated pit, cut in a hornblendite facies of mafic gneisses has yielded hornblende crystals in excess of 3 m in length, biotite plates greater than 1 m in diameter, and albite crystals up to 30 cm in greatest dimension. The calcite core may possibly be of carbonatite origin (H.R. Steacey, private comm.). The coarse grained, highly strained calcite matrix contains the following accessory minerals in descending order of abundance: large crystals of green apatite; books of biotite to 15 cm in diameter; groups of euhedral hornblende crystals; cuboctahedra of betafite; doubly terminated, prismatic zircon; crude crystals of plagioclase; irregular masses of pyrrhotite; small flakes of molybdenite; and grains of pink fluorite. The country rock surrounding the amphibolite consists of syenitized gneisses, locally rich in nepheline or other alkaline minerals.

Figure 3. **Betafite crystals, 3.2 by 4.5 cm, from the Silver Crater mine. Collection of the author; photo by Wendell Wilson.**

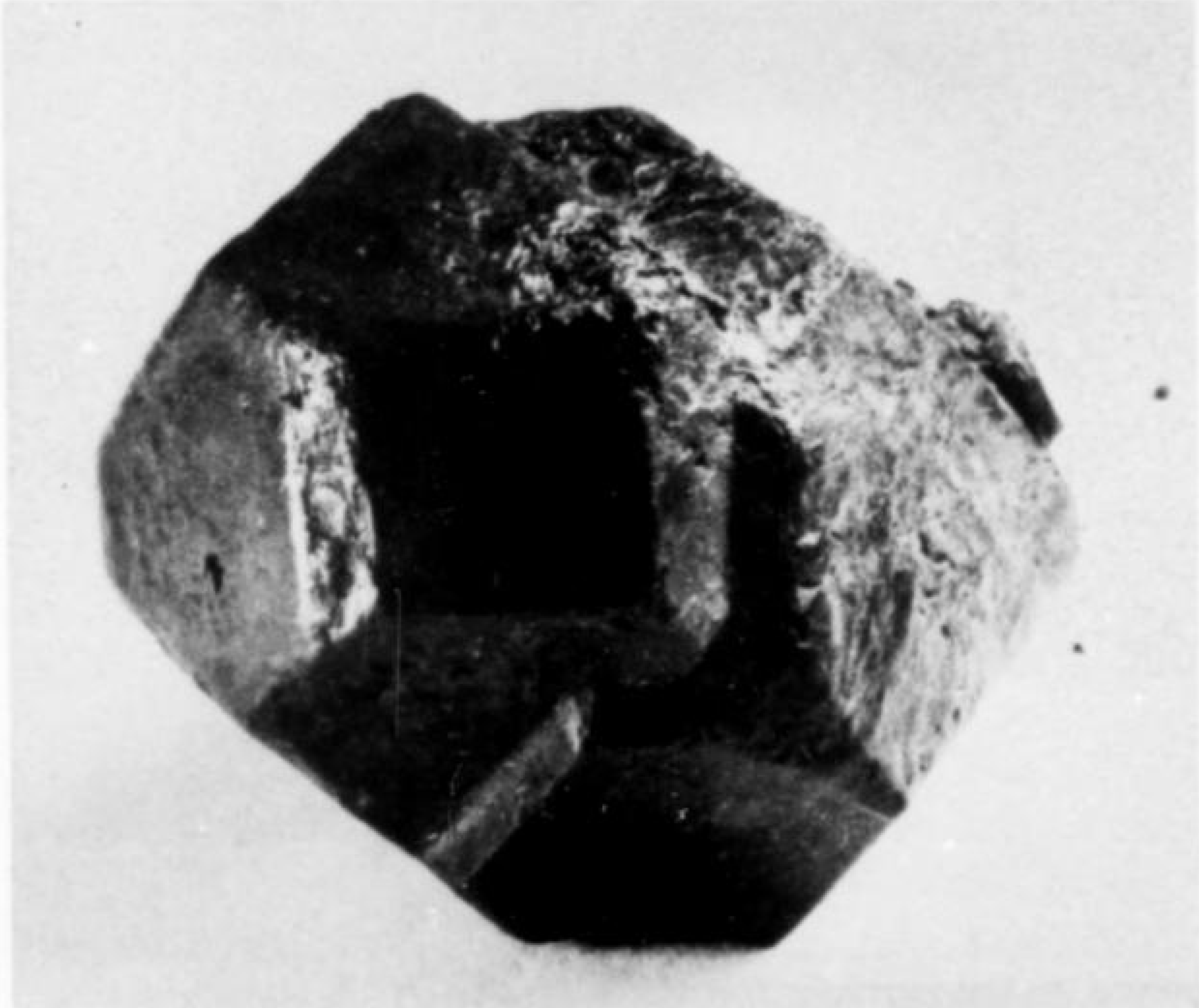


Figure 4. **Betafite crystal, 2.8 by 3.4 cm, from the Silver Crater mine. Collection of the author; photo by Wendell Wilson.**

The Silver Crater mine is located near the center of Lot 31, Concession XV, Faraday Township. Access is by an extremely rough road 2.7 km long, leading north from Monck Road village. This is on the historic Monck Road, 13 km west of Bancroft. The property was first explored in 1927 for sheet mica and produced intermittently until 1951. Between 1953 and 1955 it was explored for betafite by cutting the adit, by stripping the surface above, and by diamond drilling 1500 meters.

The best betafite specimens collected by the writer were "floaters" recovered from a thin layer (2 to 10 cm) of humus mantling the eroded surface of the calcite body and below an average thickness of 40 cm of bulldozed rubble. Most of the large, near-perfect crystals were collected in the late 1950s. One exceptional specimen (7x6x6 cm) is on display in the mineral gallery of the Royal Ontario Museum, Toronto. The betafite is metamict but exhibits little surface alteration in contrast to type specimans from Betafo and vicinity, Madagascar, which are much more highly weathered and exhibit a hydrous, buff-colored veneer. Also, Betafo specimens are octahedral, simpler in form than the Silver Crater mine specimens.

Beta-Uranophane (see Uranophane)

Euxenite $(Y,Ca,Ce,U,Th)(Nb,Ta,Ti)_2O_6$

Members of the euxenite-polycrase series are minor constituents of pegmatites at more than 20 locations across Southern Ontario (Traill, 1970). Euxenite is by far the most common member. Normally, it occurs as red-brown masses which exhibit a rich resinous luster; unlike betafite, it rarely occurs as euhedral crystals.

Two quarries in the vicinity of Quadeville, a village 64 km northeast of Bancroft, have produced good specimens of euxenite. Both quarries are developed in pegmatite. Possibly the more interesting one is the McCoy beryl mine 2.5 km north of Quadeville and 300 m east of a gravel road in Lot 23, Concession XV, Lyndoch Township.

The mine is the type locale for "lyndochite," a variety of euxenite low in uranium and high in thorium, calcium, and niobium. It has been collected here as sharp prisms up to 4 cm in length with chisel-shaped terminations. The crystals were recovered from vugs around the northern perimeter of the body of potash feldspar. The McCoy mine was developed for beryl between 1935 and 1949 and is presently owned by *Wal-Gem Minerals* of Quadeville. An open cut 76 by 15 m and from 2 to 11 m deep exposes the mineralized pegmatite dike. The mine was made popular during the 1960s by its stockpile of beryl crystals in red perthite as well as abundant, though mediocre quality, green microcline. The stockpile has long since been exhausted.

The other euxenite occurrence is at a rose quartz quarry in Lot 30, Concession XV, Lyndoch Township, 2.1 km north of Highway 515 at a point 3 km west of Quadeville. The euxenite forms highly lustrous blebs butting against the edges of bladed compound crystals of columbite. The above two minerals are slightly radioactive and are contained in partially decomposed, blood-red perthite feldspar. There is an envelope of graphic granite as well as a core of high quality rose quartz. The latter was being quarried as recently as September, 1976. This is an unusually simple pegmatite and few other accessory minerals are present.

Euhedral, doubly terminated euxenite crystals, commonly 2 cm and up to 4 cm, have recently been collected by the author at the fergusonite locality described below.

Fergusonite $YNbO_4$

Excellent, euhedral crystals of fergusonite have been collected at the Gole quarry near Madawaska, 50 km north of Bancroft. The locality is in Lot 14, Concession XI, Murchison Township, 4.3 km north along a logging road from the intersection of Highway 60 and Highway 523. The quarry was operated for feldspar from 1941 to 1944, producing nearly 10,000 tonnes. A few thousand tonnes of white quartz were recovered during the summer of 1976.

The quarry consists of two semi-continuous open cuts 180 m long, 10 m wide, and from 3 to 9 m deep which are exposed on the south face of a low hill. The cuts follow a zoned pegmatite dike striking N50°E and dipping vertically. Nearly all of the quartz core and the coarsely crystallized feldspar of the pegmatite have been removed. However, the plagioclase wallrock retains large, vertical "dishes" of biotite interlayered with red plagioclase and smoky quartz. It is within these biotite segregations that the accessory minerals fergusonite, zircon (variety cyrtolite), samarskite, allanite, and pyrochlore are found (Hogarth *et al.*, 1972).

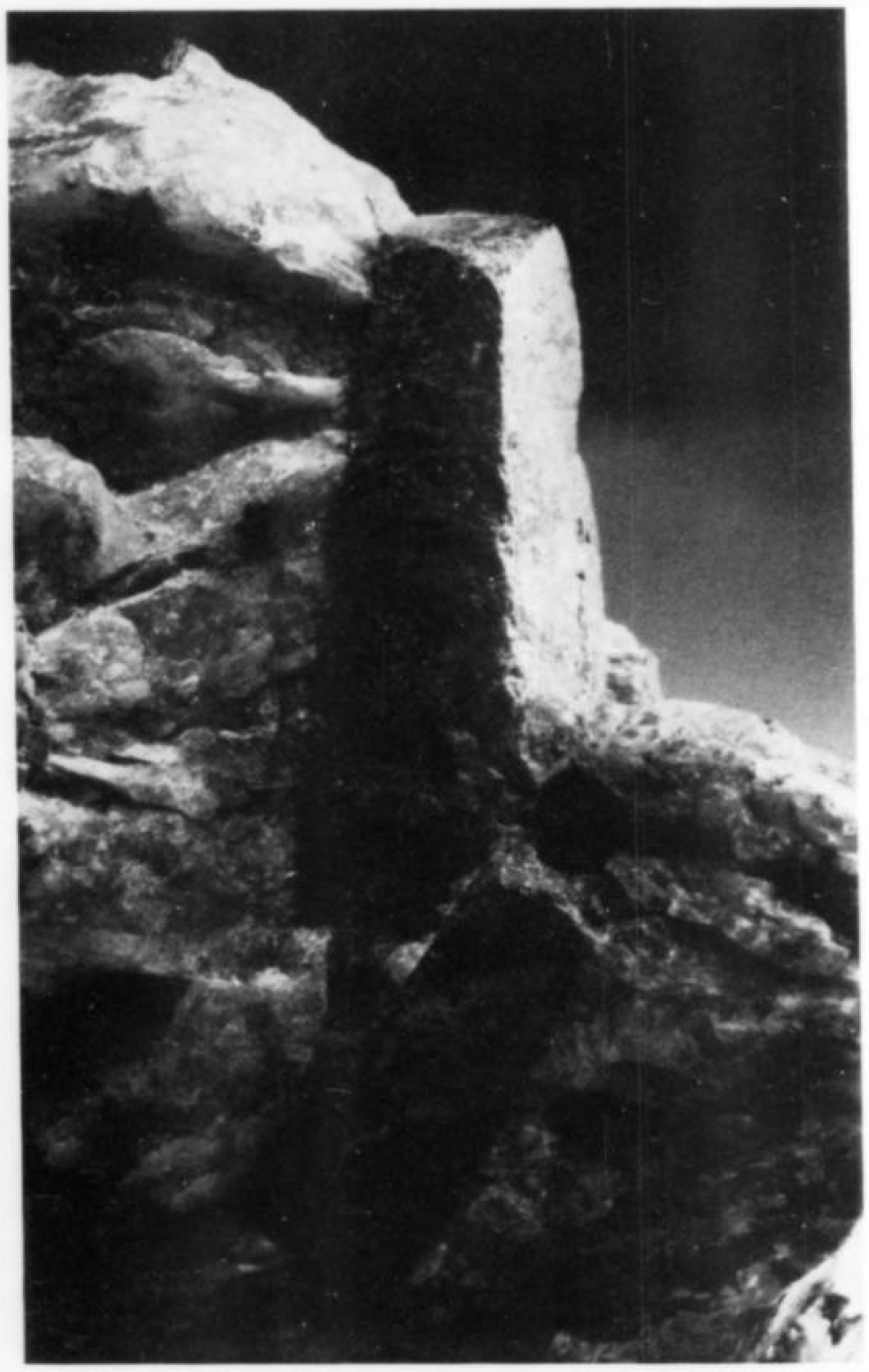


Figure 5. **Fergusonite crystals in matrix, about 7 mm wide, from the John Gole quarry, Madawaska. Collection of the author; photo by Wendell Wilson.**

Fergusonite typically occurs as brown-coated, black crystals having steep, tetragonal dipyramids and prominent pinacoidal terminations (Fig. 5). These range up to 7 cm in length and 2 cm in width. Madawaska specimens compare favorably in size and quality with the crystals from southern Norway.

Thorianite ThO_2

Thorianite forms a continuous series with uraninite, the division between the two occurring at the midpoint in the series when Th:U equals 1:1. A common diagnostic property of thorianite at Bancroft is that it typically occurs as interpenetrating twins, whereas uraninite normally occurs as cubes or modified cubes. Also, thorianite is found in salmon-colored calcite with pale green diopside and phlogopite while uraninite at Bancroft usually occurs in veins of white calcite, with dark purple fluorite, hornblende, and apatite.

Small, euhedral crystals of thorianite have been collected from at least three different townships in the Bancroft region. The Canadian All Metals (CAM) property is located in Lot 6, Concession IX, Monmouth Township and lies 2.7 km north of Highway 503 at a point 6 km west of Tory Hill. Access is by an old cinder railroad bed which comes to an abrupt halt at a washed-out bridge on the McCue River, 1.1 km past a hillside turn-off to the workings. Sharp penetration twins (to 4 mm) of thorianite occur in vein-dikes of pink calcite. The property was explored during 1955 for uranium by trenching, bulldozing, diamond drilling, and by an adit. It is currently (November, 1978) being drilled by Esso Minerals Canada. Three showings have produced radioactive anomalies, namely: the north (adit) area; the south showing, immediately adjacent to the Canadian National Railway right-of-way; and the central showing, a pit 30 m north of the tracks. The author has found crystals only at the last-mentioned pit.

Figure 6. **Fergusonite crystals, about 1.3 cm wide, from the John Gole quarry, Madawaska. Collection of the author; photo by Wendell Wilson.**

Thorianite has also been collected on the dumps of the Canadian Dyno Mine Limited, in the south half of Lot 12, Concession VIII, Cardiff Township. The property lies 300 m east of the Dyno Road, 5 km north of Highway 28 at a point 27 km southwest of Bancroft. It was explored for uranium in 1954 and underground development was carried out during 1955. The shaft is 300 m deep. There are 6 levels but only the first (at 60 m) was developed with a total of 835 m of drifting and cross-cutting. The host rock here is deep red, hematized microcline pegmatite. Accessory minerals include abundant magnetite, minor allanite, titanite, zircon, and pyrite. The ore was situated near the contact of a small body of syenitic gneiss and the surrounding metasediments.

In a third occurrence, thorianite is found with the typical matrix of salmon-pink calcite, diopside, and phlogopite at the Normingo property in Lot 14, Concession XVI, Dungannon Township. The showing can be reached from Bancroft by travelling 2.4 km east on Highway 500, then along gravel roads 8.6 km north and east past Vardy settlement to a bulldozed area 30 m west of the road. Trenching was done in 1954 to expose radioactive minerals in micaceous marble near the contact of leucogranite with syenite gneiss (Satterly, 1956). The thorianite crystals collected by the author from this trench are exceedingly small and fall free of the matrix.

Thorite $ThSiO_4$

Thorite has been collected as well-developed pyramidal crystals on the Kemp property in the north half of Lot 5, Concession XIV, Cardiff Township. All the crystals are surficially altered to a chocolate brown and are usually on the order of 2 cm across. The reference collection of the Royal Ontario Museum contains a single crystal 8x7x5 cm. One of the author's specimens is illustrated in Figure 7. Single and aggregate crystals occur as "floaters" rather abundantly in a shallow layer of humus near a calcite vein-dike cutting pyroxene skarn. The immediate collecting area is exhausted of specimens.

Exploration consisted of stripping overburden and trenching the skarn. This was carried out in 1954 by the owners, J. Kemp and H. Hogan (Hogan, private comm.). The bulldozed area is a strip 20 m long in an east-west direction. The area straddles a logging road 1.8 km from Highway 121 at a point 8.1 km east of Tory Hill.

An approximate chemical analysis on the thorite from the Kemp property indicates: SiO_2–54%; ThO_2–31%; Fe_2O_3–7%; H_2O–6%; U_3O_8–1%; CaO–1% (Satterly, 1956).

Figure 7. **Thorite crystals, 3.5 cm, from the Kemp property, Tory Hill. Collection of the author; photo by Wendell Wilson.**

Uraninite UO_2

Near perfect cubes and modified cubes of uranite have been collected from several exploration trenches in the vicinity of Wilberforce. Crystals occur in a matrix of dense, banded calcite and fluorite containing transparent green to yellow apatite.

The most prolific specimen producer has been the Cardiff mine in Lot 1, Concession XVII, Cardiff Township. The mine was developed at intervals between 1943 and 1955, first for fluorite, then for uranium, but was not brought into production. The property is presently under option to Esso Minerals Canada. Many of the uraninite specimens were collected from a large single trench cut into a calcite-fluorite vein-dike, part way up a steep slope north of the headframe and east of the main adit. Some also came from the waste dump south of the shaft along with crystals of chondrodite, graphite, and phlogopite in a white marble matrix. The rare cerium borosilicate, melanocerite, was discovered in a small trench immediately east of the headframe (Satterly, 1977). It was subsequently also recovered from the shaft and from the south adit, along with tritomite-(Y) (Hogarth *et al.*, 1972).

Uraninite also occurs in good crystals at the Richardson property of Fission Mines Limited on Lot 4, Concession XXI, where it was discovered by W.M. Richardson in 1922 (Hogarth *et al.*, 1972). By 1931, a large pit and adit were excavated on the adjacent Lot 5. In 1955, Fission Mines Ltd. did further surface exploration, but the property has been inactive since. The occurrence is 4.5 km to the northeast along strike from the Cardiff mine and has similar mineralogy. The largest uraninite crystal recovered (7 kg) from the Richardson property is on display at the Royal Ontario Museum (Gait, private comm.).

Uranophane, Beta-uranophane $Ca(UO_2)Si_2O_7.6H_2O$

The Faraday mine near Bancroft has produced many of the world's finest specimens of uranophane and beta-uranophane. Radiating sprays of canary-yellow uranophane needles in a brecciated and hematitized granite matrix (see Fig. 8) were collected in moderate abundance between 1957 and 1964. Beta-uranophane is far more rare and occurs as yellowish-orange botryoidal micro-crystals. An unusual specimen in the author's collection consists of discrete fibers of uranophane, up to 2 cm long, encased in a 7 x 2 x 1 cm fracture-filling of transparent gypsum in corroded granite.

The mine was inactive from June, 1964, until July, 1976. It is presently being operated by a new Ontario charter company, Madawaska Mines Limited, which is owned jointly by Federal Resources Corporation, Salt Lake City (51%) and Consolidated Canadian Faraday, Toronto (49%).

The mine is situated 8 km west of Bancroft on the north side of Highway 28 in Lots 16 and 17, Concession XV, Faraday Township. There are two shafts to a maximum depth of 330 m and two adits with more than 6,000 m of drifts and cross-cuts. Uranophane specimens are being encountered in the re-opened mine. Additional radioactive

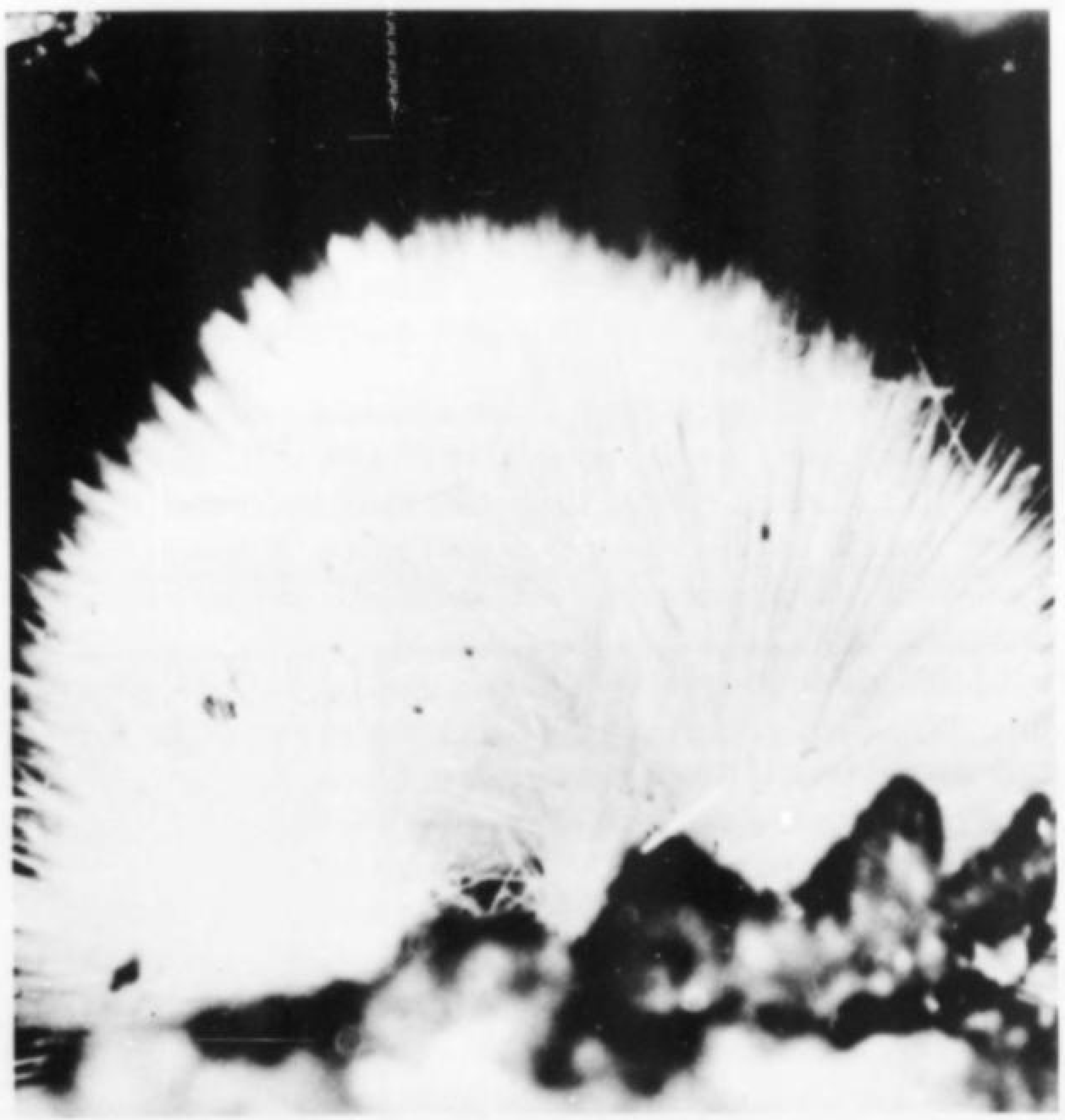


Figure 8. **Uranophane spray, bright yellow, about 1 cm across, from the Faraday mine. Collection of the author.**

species include: uraninite, allanite, thorianite, and uranian thorite. Excellent crystal specimens of calcite, datolite, anhydrite, schorl, gmelinite, chalcopyrite, molybdenite, and emerald-green fluorite octahedra were collected. Other accessory minerals include: microcline, quartz, plagioclase, augite, magnetite, forsterite, biotite, zircon, titanite, pyrite, marcasite, hematite, goethite, epidote, gypsum, and hornblende (Satterly, 1977). From a trench 400 m northeast of the tailings pond in Lot 15, Concession XII, the writer recently collected superb ilmenite crystals and anatase (R.I. Gait, private comm.) pseudomorphs after ilmenite.

Uranpyrochlore $(U,Ca,Fe)_2(Nb,Ti)_2O_6OH,F)$

Uranpyrochlore is one of the classic minerals of the Bancroft region. It was first described from Alno, Sweden, by Holmquist in 1896. J.D. Dana (1944) considered it to be identical with the earlier identified "hatchettolite" (Smith, 1877) from Spruce Pine, North Carolina; and with the later described "ellsworthite" (Walker and Parsons, 1923) from Hybla, Ontario. Until 1977, these three were considered members of the pyrochlore-microlite series (Fleischer, 1975). In the revised classification and nomenclature of the pyrochlore group, hatchettolite and ellsworthite have been redefined as uranpyrochlore (Hogarth, 1977).

The type locality for ellsworthite is the MacDonald mine, 3 km east of Hybla in Lot 18, Concession XII, Monteagle Township. The Pennsylvania Feldspar Company opened the mine in 1919 and more than 32,000 tonnes of feldspar were recovered before 1935. During 1955–56 the Philips-Doubt Syndicate bagged at least 36 tonnes of radioactive dike rock grading 3.5% U_3O_8 and carried out underground development of the feldspar workings (Satterly, 1956). The property has been inactive since November, 1956.

The MacDonald mine was developed along a well-defined zoned pegmatite near the contact of paragneiss and hybrid granitic rocks. The easily visible zones include: (1) a core of massive quartz; (2) an intermediate zone of coarsely crystallized quartz and perthite; (3) a wall zone of medium-grained albite-quartz-microcline; (4) a border of fine grained granite. To date, 22 species have been described from the two intermediate zones. The "ellsworthite" is highly resinous, generally reddish-black, but occasionally amber-yellow in color. It occurs mainly as massive blebs in grey to pink calcite or in radially fractured quartz and feldspar. Other radioactive minerals are allanite, in masses up to 30 cm in greatest dimension, and cyrtolite, in aggregates of blood-red crystals. There are four additional quarries near the MacDonald mine that have produced small quantities of uranpyrochlore.

Zircon, variety "Cyrtolite" $ZrSiO_4$

The cyrtolite variety of zircon occurs at several sites in the Bancroft region. The mineral usually contains 1 to 2% UO_2 or U_3O_8 as well as 4 to 5% H_2O (Satterly, 1956). The crystal faces are characteristically curved and the color is lighter than most zircon. It appears to have crystallized contemporaneously with associated, strongly radioactive minerals.

A highly hematitized variety occurs in abundance at the MacDonald mine. Well-developed crystals are found with fergusonite at the John Gole quarry. Doubly terminated crystals to 1.5 cm accompany betafite in the black humus at the Silver Crater mine. One exceptional cyrtolite group 25 x 25 x 10 cm (see Fig. 9) is on display in the mineral gallery of the Royal Ontario Museum. It was collected during the late 1950's by W.F. Take at the Davis nepheline quarry in Lot 3, Concession I, Monteagle Township. This quarry is easily accessible along a well-used dirt road that leads north 4 km from the York River bridge, 12 km east of Bancroft. The Davis quarry is popular among collectors of fluorescent minerals as the major source of the photoreversible sodalite, "hackmanite." Many small cyrtolite crystals were collected in association with "lyndochite" at the McCoy beryl mine.

***Figure 9.* Zircon (variety cyrtolite) crystals, 19 cm across, from the Davis nepheline quarry. Specimen and photo: Royal Ontario Museum.**

CONCLUSION

Radioactive minerals, generally considered to be dull and unattractive, can often be showy additions to any collection. The Bancroft region of southeastern Ontario has provided superb examples of a variety of these minerals.

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Contributions to the Mineralogy of Franklin and Sterling Hill New Jersey

by
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INTRODUCTION

The recent examination of a number of specimens from the Franklin-Sterling Hill mineral deposit has revealed the occurrence of a number of species not formerly known to occur there. Brief descriptions of these minerals, together with various notes gathered over the last few years, are presented here to give the reader increased knowledge of the variety of minerals from the deposit, and to remind the collector of the enormous potential of this still-producing mineral locality, the most remarkable one in America.

AUSTINITE $CaZn(AsO_4)(OH)$

The specimen containing austinite (NMNH #142698) was called to the author's attention by Fred Parker of Livingston, New Jersey, who noted the uniqueness of some brown spherules. The specimen is from the Sterling Hill mine in Ogdensburg, New Jersey, and consists of a plate of calcite encrusted on one side with kraisslite (Moore and Araki, 1978) and, on the other side, sparse hemimorphite, followed by kraisslite and finally by austinite.

The austinite occurs as brown spherules and hemispherules up to 0.2 mm which occur both isolated and as continuous encrustations. The color is a uniform medium brown. The most striking characteristic of the spherules is the radial texture and the splintery fracture along the fibers composing the spherules. This is easily observed when the spherules are broken (Fig. 1), and also serves to distinguish between the austinite and light brown spherules of carbonate minerals (which lack this fibrosity) in the Sterling Hill arsenate assemblage.

The density, measured by flotation in heavy liquids, is 4.1 (± 0.1) g/cm^3. Optically, the fibers composing the spherules are length-fast with a refractive index of nD = 1.755 parallel to the fiber axis. The austinite was chemically analyzed with an electron microprobe using an operating voltage of 15 kV and a beam current of 0.15 μA. The data were corrected using the Magic-4 computer program. The standards used were synthetic ZnO for zinc, manganite for manganese, synthetic olivenite for arsenic, and hornblende for all other elements. There is no appreciable strontium ($\geq$0.3%), lead or sulfur in this austinite. The resultant analysis, given in Table 1, indicates that this austinite contains small amounts of iron and magnesium and appreciable manganese. Hence it is properly termed a manganoan austinite.

Table 1. Microprobe analysis of austinite from Sterling Hill

$CaZn(AsO_4)(OH)$		
	Theoretical	**Sterling Hill**
CaO	21.46%	20.20%
ZnO	31.13	28.51
FeO	0.00	0.47
MgO	0.00	1.26
MnO	0.00	3.89
As_2O_5	43.96	43.22
H_2O	3.45	3.45*
Total	100.00	101.00

*water from theoretical composition
Accuracy of data: ±3% of the amount present.

ADELITE $Ca(Mg,Zn)(AsO_4)(OH)$

The rare arsenate, adelite $CaMg(AsO_4)(OH)$, has been found in an old specimen from the Franklin mine. It occurs as medium yellow tabular crystals, up to 5.0 mm, enclosed in hodgkinsonite which is coated with barite, allactite, rhodochrosite, franklinite, and a second generation hodgkinsonite. The matrix of the specimen is a layered, granular, willemite-franklinite ore. The morphology of the crystals

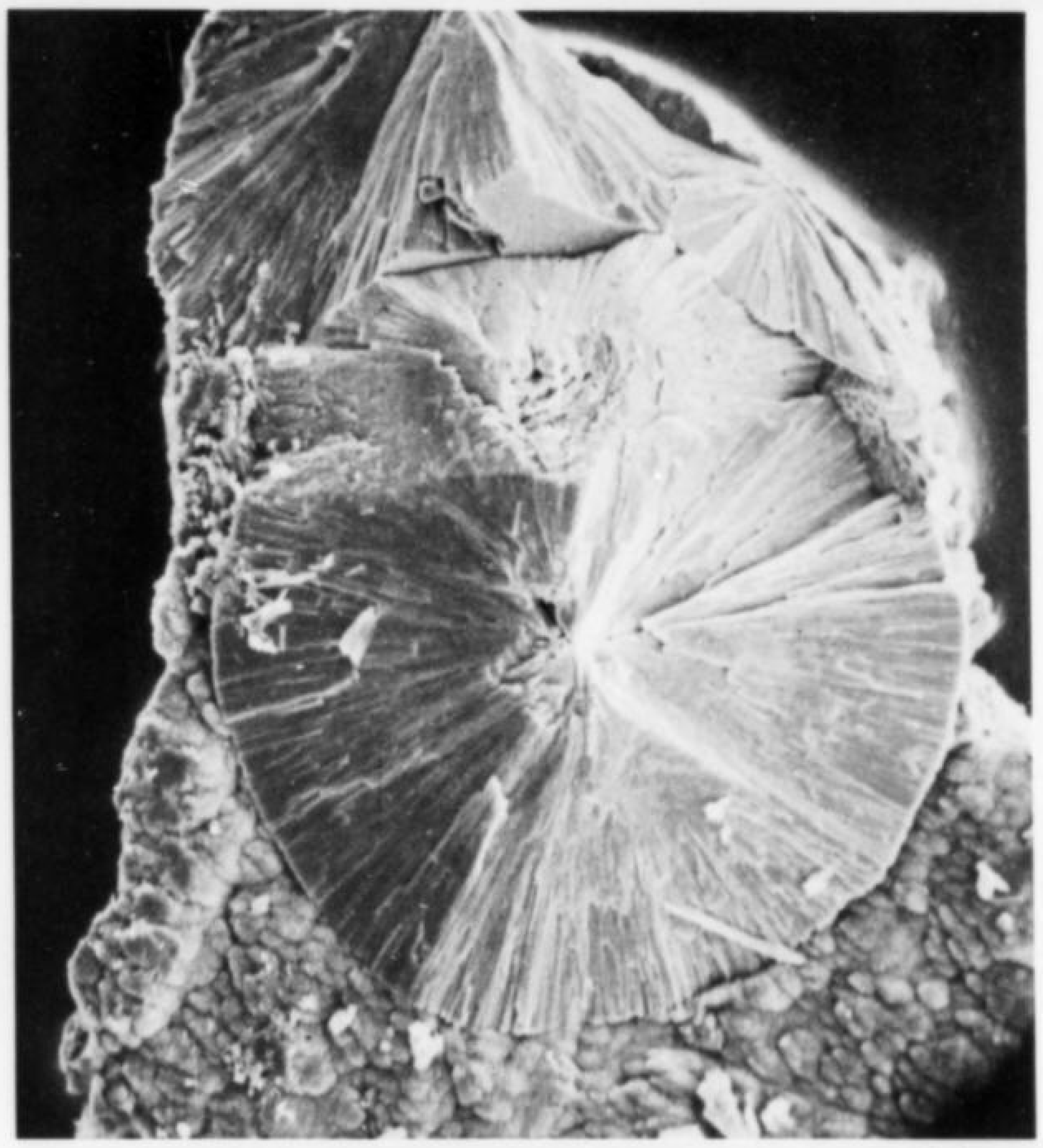


Figure 1. **SEM photomicrograph of a cross-section of Sterling Hill austinite showing the radial habit and fibrosity (315X).**

could not be determined with reliability inasmuch as they are imbedded in hodgkinsonite and are brittle, precluding their removal intact. The adelite does not fluoresce in ultraviolet radiation.

The adelite was chemically analyzed by electron microprobe using the same standards as were used for the austinite described above. The material is a zinc-rich adelite but magnesium is greater than zinc, in atom-percent. The formula should be expressed as $Ca(Mg,Zn)(AsO_4)(OH)$; the analysis is given in Table 2. The sample is in the Smithsonian collection under catalog #R5412.

Table 2. Electron microprobe analysis of zincian adelite

$Ca(Mg,Zn)(AsO_4)(OH)$

	Theoretical**	**Franklin**
CaO	23.60	24.63
ZnO	14.39	14.23
MgO	9.85	9.74
MnO	0.00	1.60
FeO	0.00	tr
As_2O_5	48.38	46.36
H_2O	3.78	3.44*
Total	100.00	100.00

*H_2O by difference
**calculated for Mg:Zn = 58:42.
Accuracy of data: ±4% relative.

ARSENIOSIDERITE $Ca_3Fe_4(AsO_4)_4(OH)_6\cdot 3H_2O$

Arseniosiderite was initially reported from the Taylor mine in Franklin by Palache (1935), based on optical determinations by E. S. Larsen and a microchemical test by E. V. Shannon. A re-examination of this material by Frondel (1972) showed it to be a manganese calcium silicate and not arseniosiderite.

This mineral, in the Canfield collection at the Smithsonian (NMNH C4222), has been examined by the author. The material is composed of dark brownish-red rosettes and agrees well with Palache's description. A wavelength-dispersive microprobe scan indicates only manganese, calcium, silicon and possibly sulfur as essential contituents with traces of barium, zinc and iron. The mineral is very likely a new species but cannot be characterized at this time due to the facts that it is chemically inhomogeneous and single-crystals could not be found, despite arduous searching. The strongest lines in the X-ray diffraction pattern are: 11.2 (100), 2.58 (80), 3.58 (40), 2.92 (40), 3.58 (40) and 9.50 (40), in Å with intensities visually estimated.

At the time of the koettigite-pharmacosiderite find at Sterling Hill some 5 or 6 years ago, a light brown mineral was noted on some specimens. It occurs as thin crusts and the material occasionally comes in very small rosettes. No single crystals of the mineral were found, but the X-ray diffraction pattern is very similar to that of arseniosiderite; the only differences are some diffuse extra reflections and an overall broadening of the reflections. A wavelength-dispersive microprobe scan indicated that the mineral contains only calcium, iron and arsenic as essential cations. However, this "arseniosiderite" is also chemically inhomogeneous and a definite characterization is not possible. The mineral may be an impure arseniosiderite or a related unknown mineral. The specimen is in the Smithsonian collection under catalog #143363.

HYDROTALCITE $Mg_6Al_2(CO_3)(OH)_{16}\cdot 4H_2O$

Hydrotalcite, reportedly from the Franklin orebody and not from Sterling Hill, forms tabular, soft, hexagonal crystals associated with spinel, hodgkinsonite, calcite, willemite, and serpentine. The sequence of formation is: a 5 mm band of brown serpentine, followed by a 3 mm layer of willemite, followed by spinel crystals, then hodgkinsonite crystals, then hydrotalcite and calcite. The hydrotalcite crystals as an unknown were called to the author's attention by Alice Kraissl.

Optically, the crystals of hydrotalcite are seen to exhibit an anomalous birefringence and have $n\omega = 1.520$, measured in sodium light. Semi-quantitative microprobe analysis indicates that the crystals contain no iron, and contain only magnesium and aluminum as essential cations. The presence of carbonate was determined by effervescence in hydrochloric acid. Small amounts of zinc and manganese substitute for magnesium.

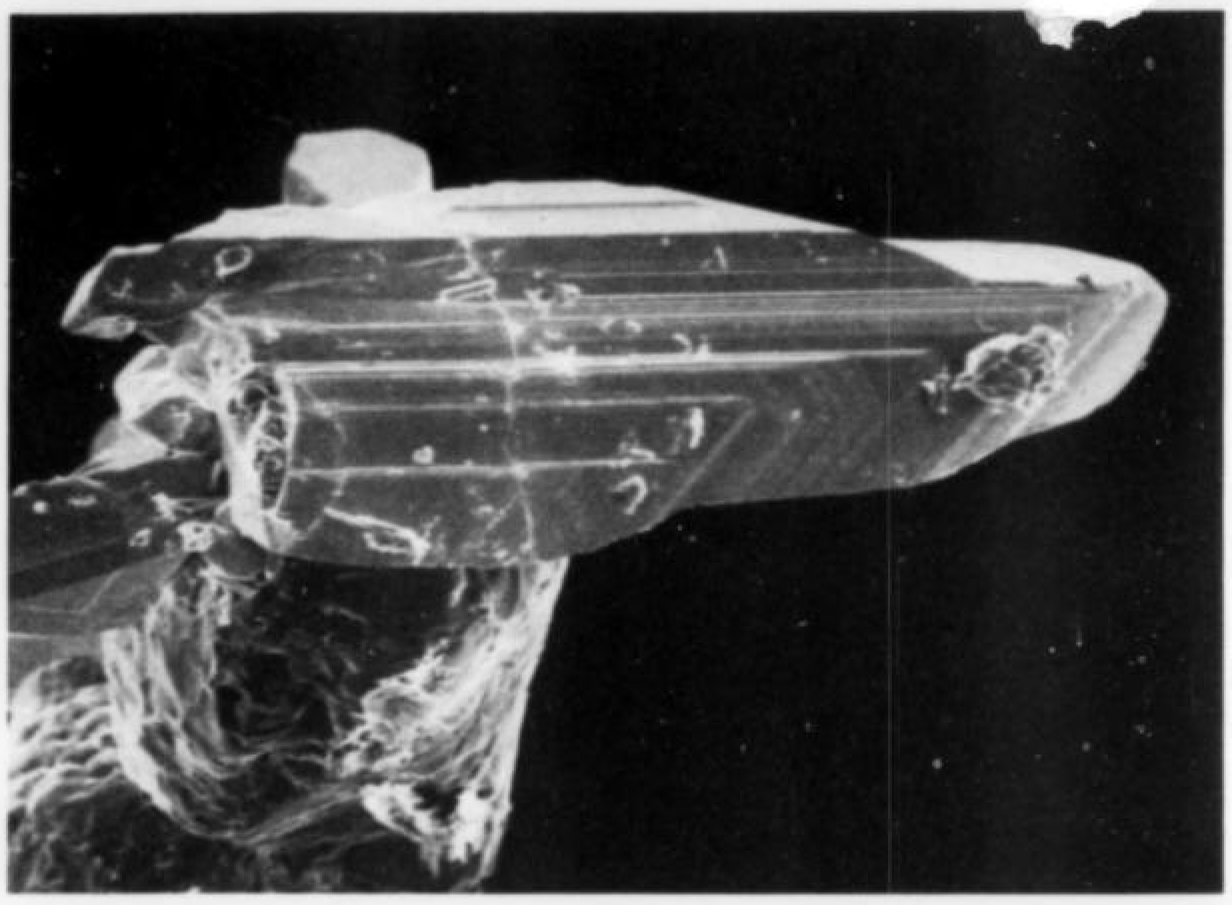
The X-ray diffraction pattern of the Franklin hydrotalcite is in good agreement with the published data for the species (JCPDS #14–191) except for the absence of the unindexed reflection at 1.85 Å in the JCPDS data. The sample is in the Smithsonian collection under catalog #143397. Duplicate material is in the mineral collection of Alice Kraissl of River Edge, New Jersey.

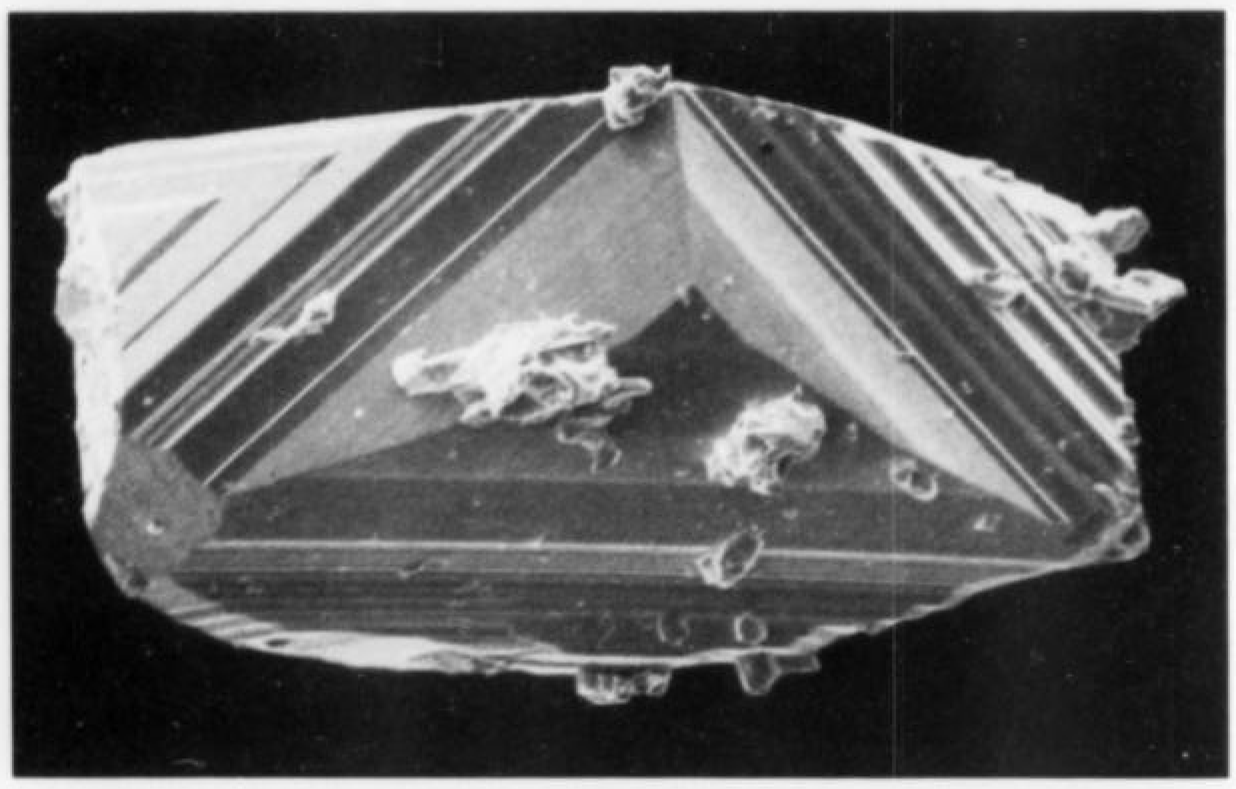
ARSENOPYRITE FeAsS

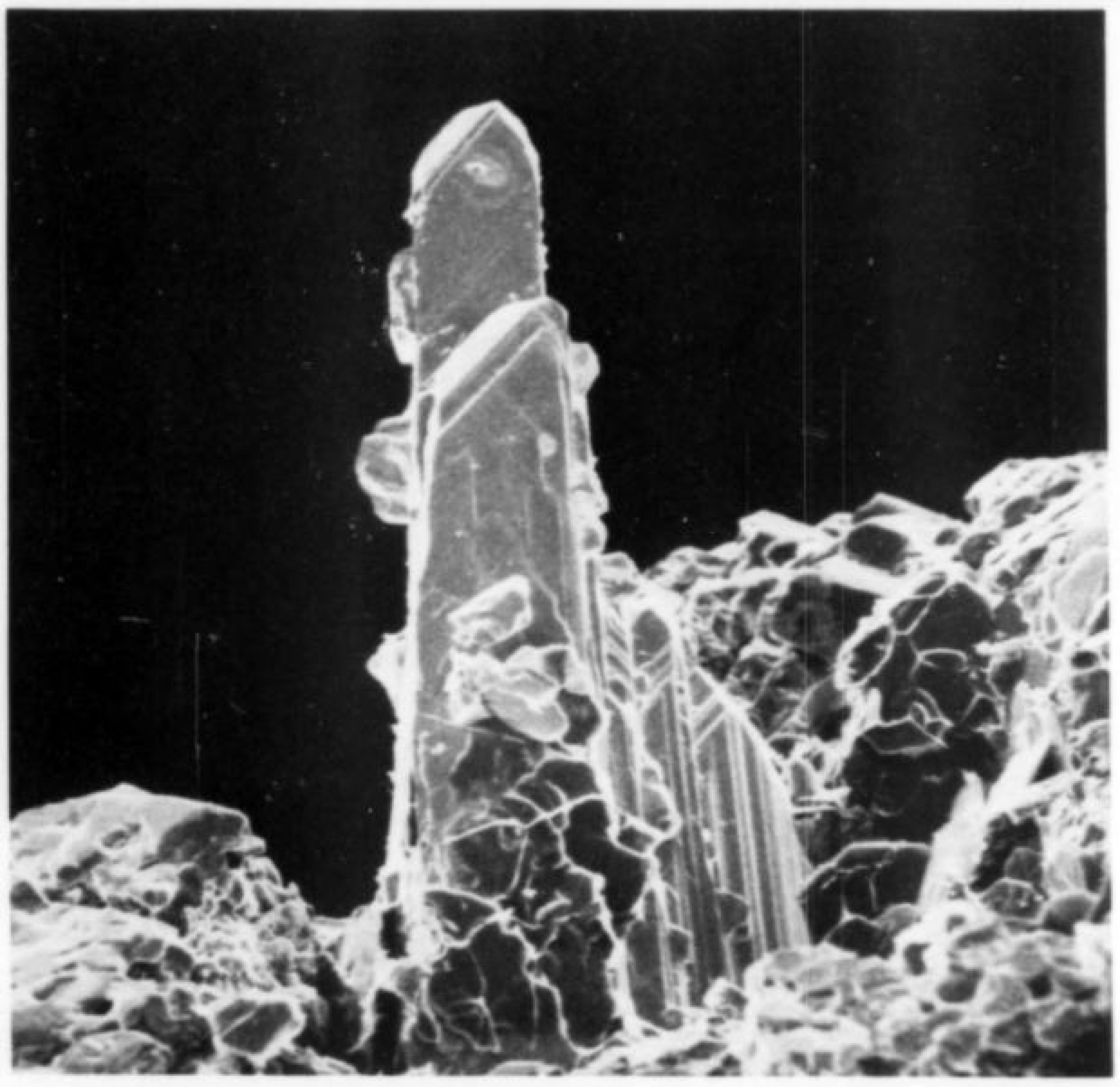
In early 1978, mining at Sterling Hill encountered a zone of calcite and realgar at the 1100-foot level. The realgar occurs as very small crystals (up to 1.0 mm) in vugs in calcite. However, it should be noted that dissolution of the calcite in acid does not yield euhedral realgar crystals, but only formless blebs. The crystals are restricted to the vugs in the calcite and apparently were the last mineral to form in the assemblage.

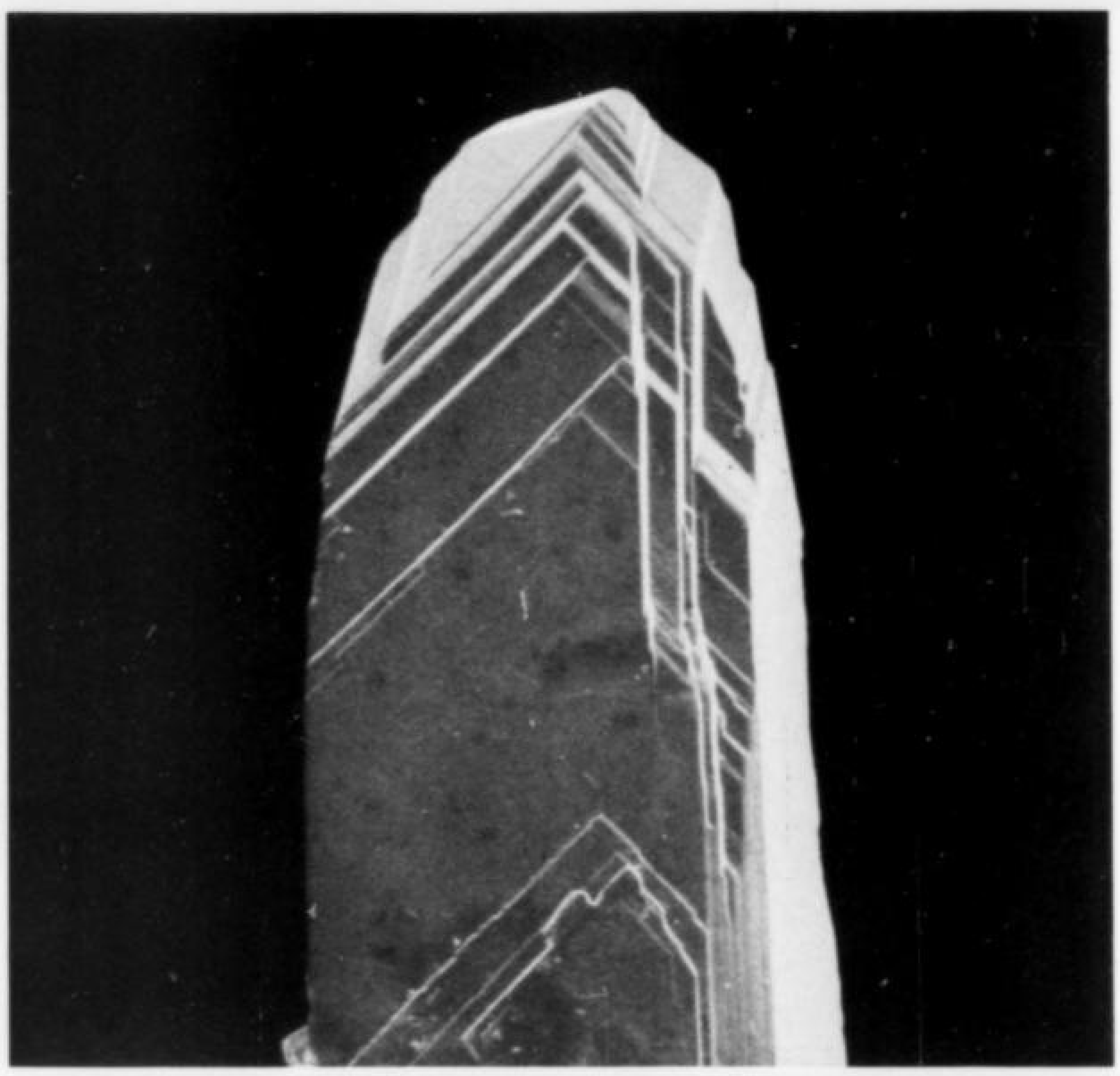
To gain some knowledge about the nature of the other minerals seen as microscopic blebs in the calcite, a 20-gram piece was dissolved in HCl and the insoluble residue examined by X-ray diffraction and SEM (scanning electron microscope). The results are most interesting. The dominant mineral in the assemblage is arsenopyrite which occurs in beautiful crystals of prismatic habit (see Figures 2, 3, 4, 5, and 6). Several crystals of a bladed prismatic habit were observed. At first glance, they appeared to be stibnite but X-ray diffraction proved them to be arsenopyrite. Blebs of an orange colored mineral proved to be microcline with realgar inclusions. Other minerals present include quartz, graphite and a clinopyroxene. The specimen is in the Smithsonian collection under catalog #143055.

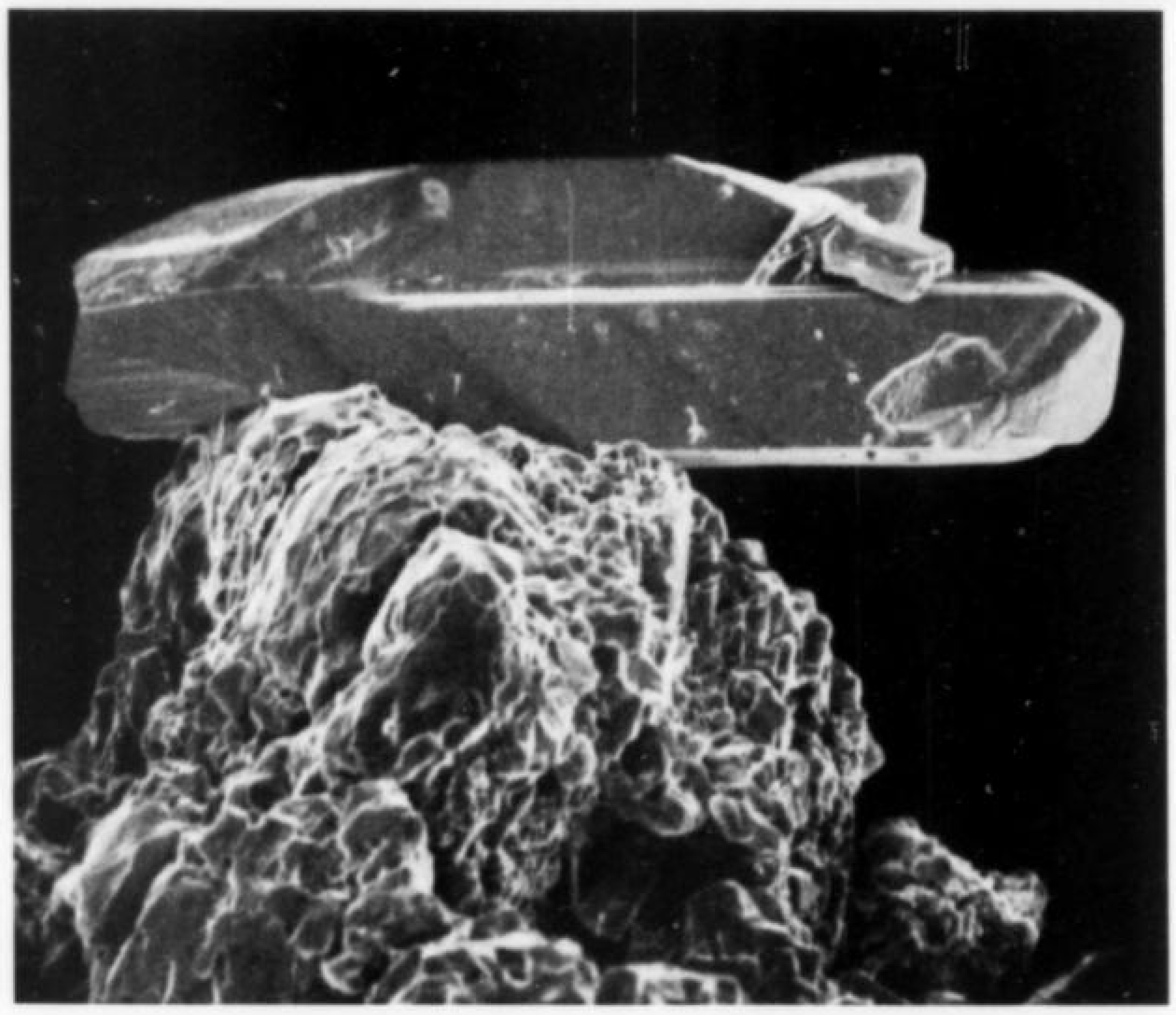
The paragenesis and occurrence of these species is remarkably similar to that noted by Palache (1941). The specimen examined here is



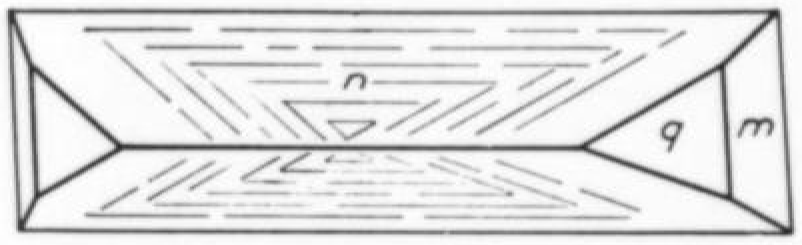


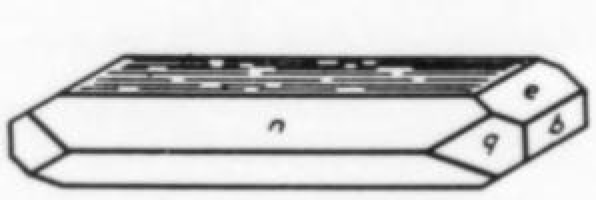


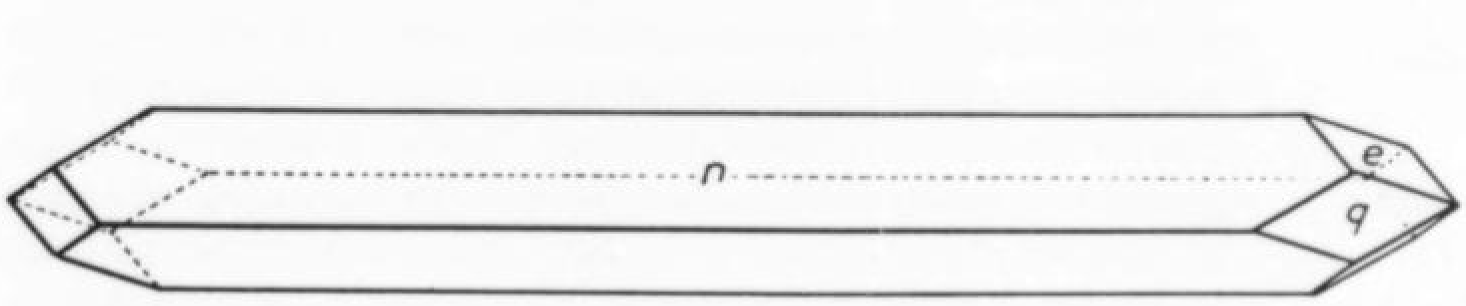




Figures 2, 3, 4, 5, and 6. **Scanning Electron photomicrographs of arsenopyrite from Sterling Hill, Ogdensburg, New Jersey (100X, 77X, 120X, 95X, 105X).**







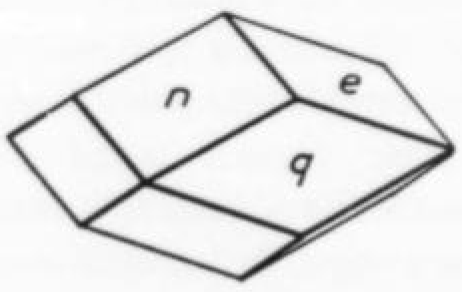


Figure 7. **Crystal drawings of Sterling Hill arsenopyrite (from Palache, 1941).**

reported from the 1100-foot level at Sterling Hill, whereas the assemblage noted by Palache was from the 900-foot level.

ZIRCON $ZrSiO_4$

A re-examination of the Sterling Hill specimens of ruby corundum with margarite resulted in the observation of tiny, light brown zircon crystals and dull green blebs of titanite, both verified by X-ray diffraction. The zircon crystals are euhedral and sharp, but are sparse on the specimens, in contrast to the much more abundant dark red rutile. A SEM photomicrograph of this zircon is shown in Figure 8.

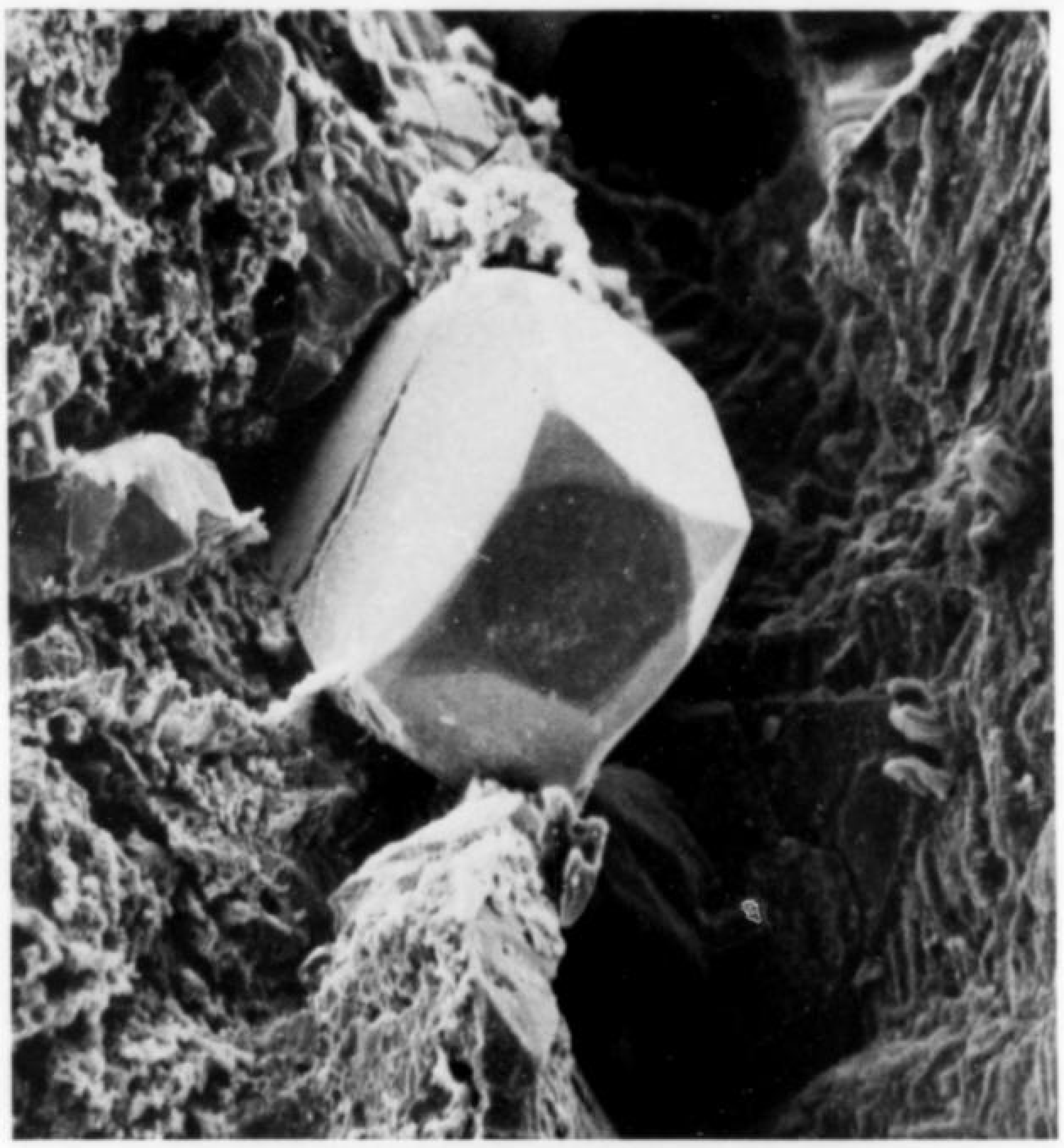


***Figure 8.* SEM photograph of zircon from Sterling Hill, Ogdensburg, New Jersey. (234X) NMNH #C6101.**

MONOHYDROCALCITE $CaCO_3 \cdot H_2O$

A very light green mineral encrusted on calcite was called to the author's attention by John MacDonald of Hope, New Jersey. The light green mineral resembles hyalite opal at first glance, but a closer inspection reveals the opacity and fibrous nature of this mineral, which effervesces in hydrochloric acid. The X-ray powder diffraction pattern is in excellent agreement with that of Marschner (1969) for monohydrocalcite. Semiquantitative analysis by electron microprobe revealed only calcium with no detectable magnesium, iron, manganese or zinc in substitution for calcium. The lack of magnesium is notable in that other described monohydrocalcites do have small amounts of magnesium and some investigators have postulated that it might be an agent in the formation of the species. Monohydrocalcite occurs most often in a spherical habit (Taylor, 1975) and the surface of this Sterling Hill occurrence is slightly rounded, the surface being the tips of fibrous crystals. The Sterling Hill monohydrocalcite is fluorescent in ultraviolet radiation and the response colors are medium, dull-green in shortwave and medium dull yellowish green in longwave ultraviolet. The monohydrocalcite described by Taylor (1975) fluoresces also, but without the green color. Hence, the property of fluorescence may be an essential one of monohydrocalcite, but the resultant color may depend on different chemical impurities. There is no phosphorescence in the Sterling Hill sample. For an interesting discussion on the stability of monohydrocalcite, and an altogether delightful and readable paper, the reader is referred to the work of Taylor (1975). The specimen from Sterling Hill described herein is in the Smithsonian collections under catalog #144032.

STRONTIANITE $SrCO_3$

Strontianite has been verified by X-ray diffraction on some specimens from Franklin. The mineral occurs as white acicular crystals in radiating bundles on calcite in vugs in a calcite-franklinite ore. The crystals are easily differentiated from chlorophoenicite by effervescence in hydrochloric acid and a strontium flame test. The most striking characteristic of this Franklin strontianite is its snow-white color. The mineral is not fluorescent in ultraviolet radiation.

PICROPHARMACOLITE $H_2Ca_4Mg(AsO_4)_4 \cdot 11H_2O$

A fan-like array of white acicular crystals up to 5 mm, occurring on calcite, was called to the author's attention by John Kolic. The X-ray diffraction pattern is in good agreement with that for picropharmacolite. Semi-quantitative chemical analysis by electron microprobe revealed that it is essentially a magnesium calcium arsenate with MgO about 2.5% by weight. This Sterling Hill picropharmacolite is fluorescent in ultraviolet radiation. The response colors are medium yellowish white in longwave and weak yellowish white in shortwave ultraviolet. There is no phosphorescence. Other picropharmacolite samples in the Smithsonian collections also responded to ultraviolet with similar colors, and fluorescence may be a characteristic of the species. The studied sample is in the Smithsonian collections under catalog #143981.

MANGANAXINITE $Ca_2MnAl_2BSi_4O_{15}(OH)$

The yellow manganaxinite from Franklin, New Jersey, is well known as a collector classic. The color of the mineral is an unusually (for axinite) rich yellow rivaled only by tinzenite from the Cassagna mine, Liguria region, Genova, Italy. The crystals are sharp and the morphology, described by Palache (1935) and Aminoff (1919), adds to the appeal that these specimens have to collectors.

Many axinite specimens were studied to determine their correct nomenclature (Dunn *et al.*, 1979) and a large number of Franklin specimens (36) were included to ascertain if there were any occurrences of tinzenite among the Franklin axinites and to determine the range of composition of the available specimens.

Of the thirty-six specimens analyzed, all were manganaxinite. The samples with the highest and lowest manganese contents are noted in Table 2 (analyses #1 and #3). Incidentally, the specimen with the lowest manganese content was also the one with the highest zinc content. There is little solid solution towards ferroaxinite or magnesioaxinite (Jobbins *et al.*, 1975) in the Franklin axinite; iron is present only up to 1.75% FeO and magnesium only up to 0.50% MgO. In general, the composition of most Franklin manganaxinite is rather constant and the manganese content of 31 samples fell between the limits given in Table 3 (analyses #1 and #2).

Some of the Franklin manganaxinite is known to fluoresce under short and longwave ultraviolet illumination with a medium to intense red color and no phosphorescence. Most of the well-crystallized, bright yellow manganaxinite does not fluoresce at all, but some of the very light yellow and granular whitish yellow material does fluoresce. Of the 10 specimens in the Smithsonian collection which were analyzed, only two fluoresced and both were the lighter colored material.

SCORODITE $Fe^{3+}(AsO_4) \cdot 2H_2O$

The crystals described herein were first noted by George Pigeon of New York City, who correctly identified them as belonging to the scorodite-mansfieldite series on the basis of microchemistry and determination of the optical properties.

The crystals are associated with pharmacosiderite and were found in July, 1972, in the Sterling Hill mine. This scorodite occurs in light yellow euhedral crystals, up to 1.0 mm in size, and resembles in habit the crystals from Djebel Debar in Algeria which are depicted by crystal drawings in *The Dana System of Mineralogy* 7th Ed., *2*, 764. The X-ray diffraction pattern of this scorodite is in excellent agreement with published data given by Dasgupta *et al.* (1966). Partial microprobe analysis of this Sterling Hill scorodite indicates that it is essentially end-member scorodite in composition, with no aluminum present, and

Table 3. Microprobe analyses of manganaxinite from Franklin

	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	ZnO	MnO	B_2O_3	H_2O	Total	Museum #	Analysis #
Manganaxinite (theory)	42.25	17.92			19.70		12.46	6.11	1.56	100.00		
Franklin, New Jersey	42.13	15.52	0.83	0.12	16.10	1.20	16.68	6.11*	1.56*	100.25	HU# 89930	#1
Franklin, New Jersey	42.25	15.91	0.11	0.11	19.62	2.82	10.83	6.11*	1.56*	99.32	HU# 109397	#2
Franklin, New Jersey	42.28	16.33	0.22	0.30	19.17	4.49	8.81	6.11*	1.56*	99.27	HU# 114594	#3

#Total iron calculated as Fe_2O_3 in accordance with the determinations published by Palache (1935).
*B_2O_3 and H_2O given as the theoretical value.
Operating conditions and standards given in Dunn *et al.* (1979)
Accuracy of data: ±3% relative.

no solid solution to mansfieldite. There are very small amounts of manganese, but only as traces. The samples are in the collections of George Pigeon and the Smithsonian Institution (NMNH #143795).

GREENOCKITE CdS

The greenockite crystals described here were found in the Sterling Hill mine in late 1977 and called to the author's attention in January of 1978 by Fred Parker of Livingston, New Jersey. The greenockite crystals are bright yellow in color, elongated up to a length to width ratio of 6:1, and are approximately 0.2 mm in maximum dimension. The crystals are associated with a botryoidal light brown sphalerite, galena and pyrite, all on calcite (Fig. 9).

The order of deposition is calcite followed by sphalerite, then followed by galena and greenockite which may have formed at the same time. The greenockite occurs as color bands varying from deep to light orange-yellow. Although nothing is known of the exact placement of the specimen *in situ,* the greenockite appears to have been responsive to a water table or fluid level and the variation in color of the greenockite resembles color bands obtained during chromatography experiments or Liesegang rings. The greenockite is prismatic in habit (Fig. 10) and the crystals, although not euhedral, appear to be composed of a steep pyramid as the dominant form.

Analysis by electron microprobe using synthetic greenockite and synthetic zincite as standards indicated that the crystals are inhomogeneous over very small (5 micron) areas, and are zincian greenockite. Semi-quantitative analysis indicates a Cd:Zn ratio of 3:2 and the ratio varies but slightly from crystal to crystal. The described specimen is in the Smithsonian collection under catalog #142896. The X-ray diffraction pattern of this zincian greenockite is very similar to the published data for greenockite but has slightly smaller *d* values, likely reflecting the smaller size of the zinc atom in substitution for cadmium.

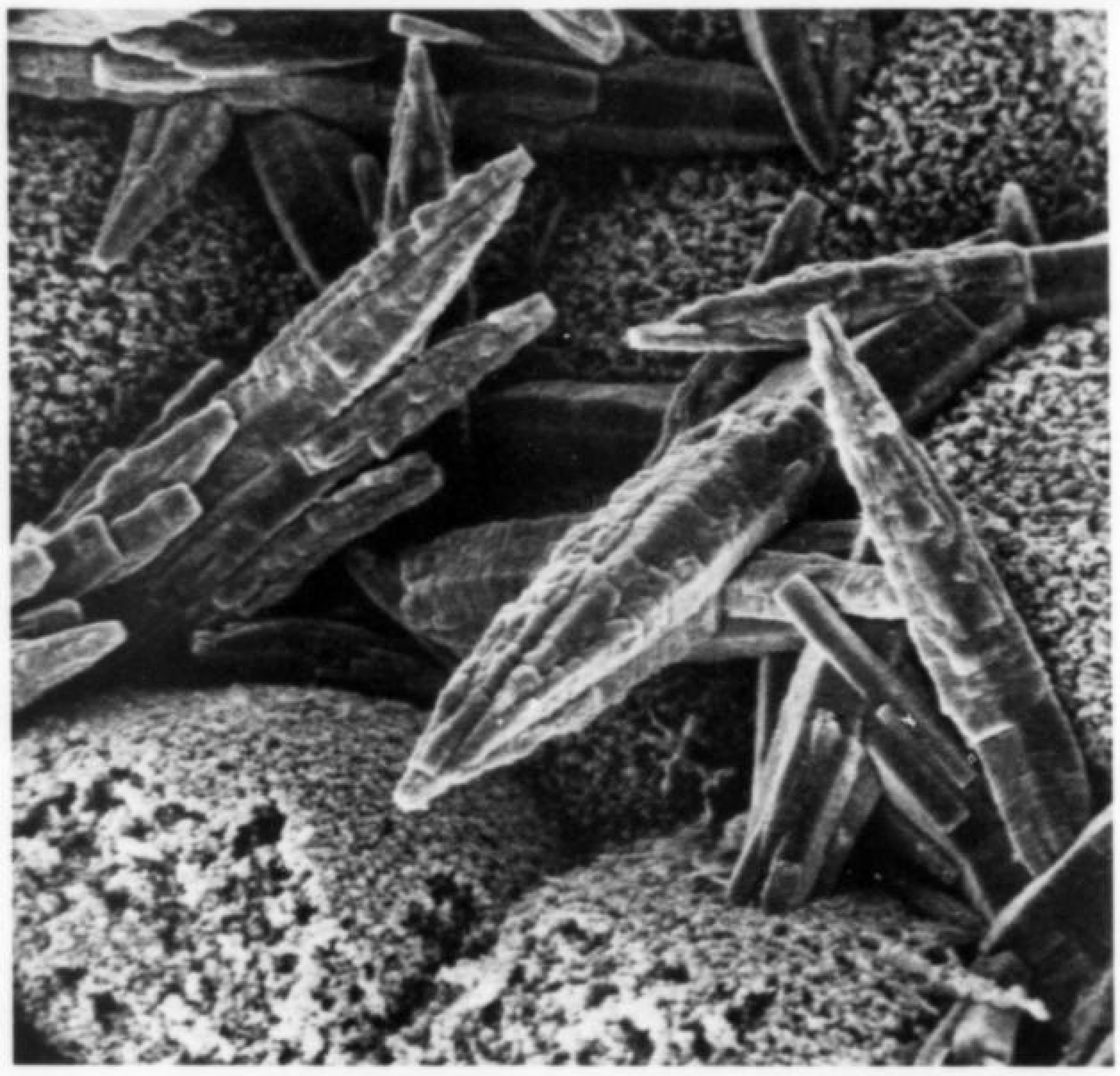


***Figure 10.* Acicular greenockite on sphalerite from Sterling Hill. (SEM photomicrograph at 600X).**

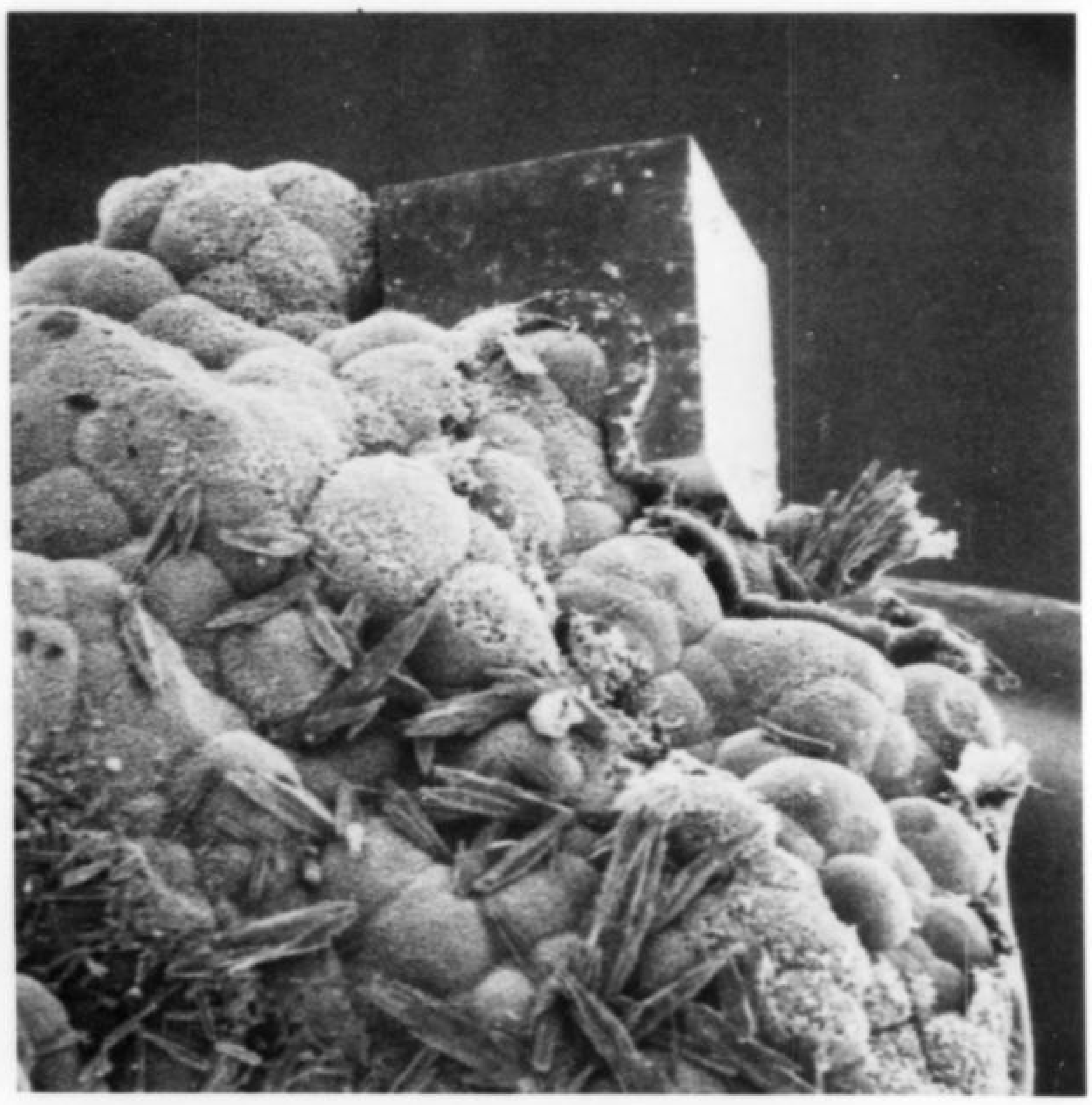


***Figure 9.* Scanning electron photomicrograph of botryoidal sphalerite, galena, and acicular greenockite from Sterling Hill (127X).**

HUEBNERITE $MnWO_4$

Huebnerite occurs on a small specimen owned by Mrs. Elna Hauck of Bloomfield, New Jersey. No specific locality information is available for the specimen, but it appears to have come from the Franklin deposit. The huebnerite crystals are associated with willemite crystals which were formed before the dark red huebnerite, and with franklinite, the latter in small (0.2 mm) crystals which are composed of the cube and tetrahexahedron. The franklinite was the last mineral to form in the assemblage.

The huebnerite crystals are of simple morphology. Removal of the best crystals was not advisable, but a visual examination of form development allows some observations. The crystals, up to 1.0 mm in size, are for the most part equant, but some crystals are elongated on [010]. The forms present are {010}, and {*h*0*l*} pinacoids which compose most of the surface area of the crystals.

The huebnerite was identified by X-ray diffraction. The powder pattern matches that of the Pasto Bueno, Peru, huebnerite and is in good agreement with the published data for the species. Both the huebnerite and associated franklinite were analyzed with an electron microprobe utilizing an operating voltage of 15 kV and a beam current of 0.15 μA. Synthetic scheelite was used for a standard for calcium and tungsten, synthetic ZnO for zinc, manganite for manganese, and hornblende for iron. The resultant data were corrected using the MAGIC-4 computer program. The analysis yielded: MnO 24.19%, FeO 0.24%, ZnO trace, WO_3 77.16%, sum = 101.59%. The lack of zinc in the mineral is somewhat surprising.

Huebnerite is to be expected at Franklin in view of the abundance of manganese in the deposit and the previously reported occurrence of scheelite. Further investigation might possibly find an occurrence of sanmartinite, $ZnWO_4$, in view of the abundance of zinc in the orebody. The associated franklinite was also analyzed to determine if it is jacobsite, the manganese end-member of the series. It is franklinite, with some enrichment of manganese at the margins of the crystals.

DYPINGITE $Mg_5(CO_3)_4(OH)_2 \cdot 5H_2O$

The specimen containing dypingite was found in the north orebody of the Sterling Hill mine by Richard Bostwick, who called it to the author's attention. The dypingite occurs as white hemispherules up to 0.5 mm which coat the surface of a calcite-zincite-sussexite rock in a random fashion. The spherules are bright white with a pearly luster. When broken, a fibrous texture is seen and the spherules are composed of acicular crystals radiating from a common origin. The pattern that the hemispherules make on the surface of the rock is most interesting. Although they are in part randomly distributed, there are long, irregular stringers of side-by-side "chains" of these hemispherules which wander over the surface of the specimen like meandering lines of colons ::::::::::::::::. This feature was not noted in the original occurrence in Norway (Raade, 1970) and was not present on a specimen from San Benito County, California, which was examined by this author. The cause of the irregular and disjointed lines of hemispherules is not explained; they do not seem to follow inter-mineral boundaries in the rock on which they are deposited.

***Figure 11*. Scanning electron photo-micrograph of a spherical aggregate of dypingite from Sterling Hill (425X).**

The identity of the dypingite was confirmed by X-ray diffraction; the pattern is in good agreement with the data given by Raade (1970). Optically, Sterling Hill dypingite is length-fast with parallel extinction and the mean refractive index is $\bar{n} = 1.515$. This dypingite fluoresces in ultraviolet radiation. The response colors are: weak light grayish blue in shortwave ultraviolet and medium light blue in longwave ultraviolet. It is interesting to note that there is no phosphorescence and that the same responses were observed on the San Benito specimen. However, the original material from Dypingdal in Norway, although also fluorescent with a light blue color, was also phosphorescent. The absence of this characteristic in the Sterling Hill material and that from San Benito may indicate that the phosphorescence is not a true characteristic of the species but due to some impurity or activator in the Dypingdal material. Semiquantitative analysis by electron microprobe indicated that only magnesium is present in addition to the carbonate determined by acid test, and that there is little or no substitution by other cations.

PUMPELLYITE $Ca_2MgAl_2(SiO_4)(Si_2O_7)(OH)_2 \cdot H_2O$

In his monograph on the Franklin-Sterling Hill mineral deposit, Palache (1935) mentioned the occurrence of a mineral similar to zoisite as pseudomorphs after a feldspar, likely microcline. Several of these crystals are in the Smithsonian collection. One of them, NMNH #C2353, was examined by X-ray diffraction and found to be composed of pumpellyite, likely replacing the original feldspar crystal. A preliminary analysis of this pumpellyite indicates that it contains approximately 2.8% MgO and only 1.7% FeO. It is pumpellyite with but minor substitution of iron in solid solution toward the iron-bearing end-member, ferropumpellyite.

ACKNOWLEDGEMENTS

The author is indebted to the following people who provided much of the stimulus for these individual studies and whose perspicacity and familiarity with the Franklin-Sterling Hill minerals was largely responsible for noting the occurrence of many of the minerals described here. Special thanks to Jenny Areson, Lee Areson, John Baum, Richard Bostwick, Vic Cianciulli, Ewald Gerstmann, Elna Hauck, Richard Hauck, John Kolic, Bernie Kozykowski, Fred Kraissl, Alice Kraissl, John MacDonald, Warren Miller, Fred Parker, George Pigeon, Steve Sanford, Bob Svecz and Nick Zipco. This research was supported, in part, by a grant from Mrs. E. Hadley Stuart.

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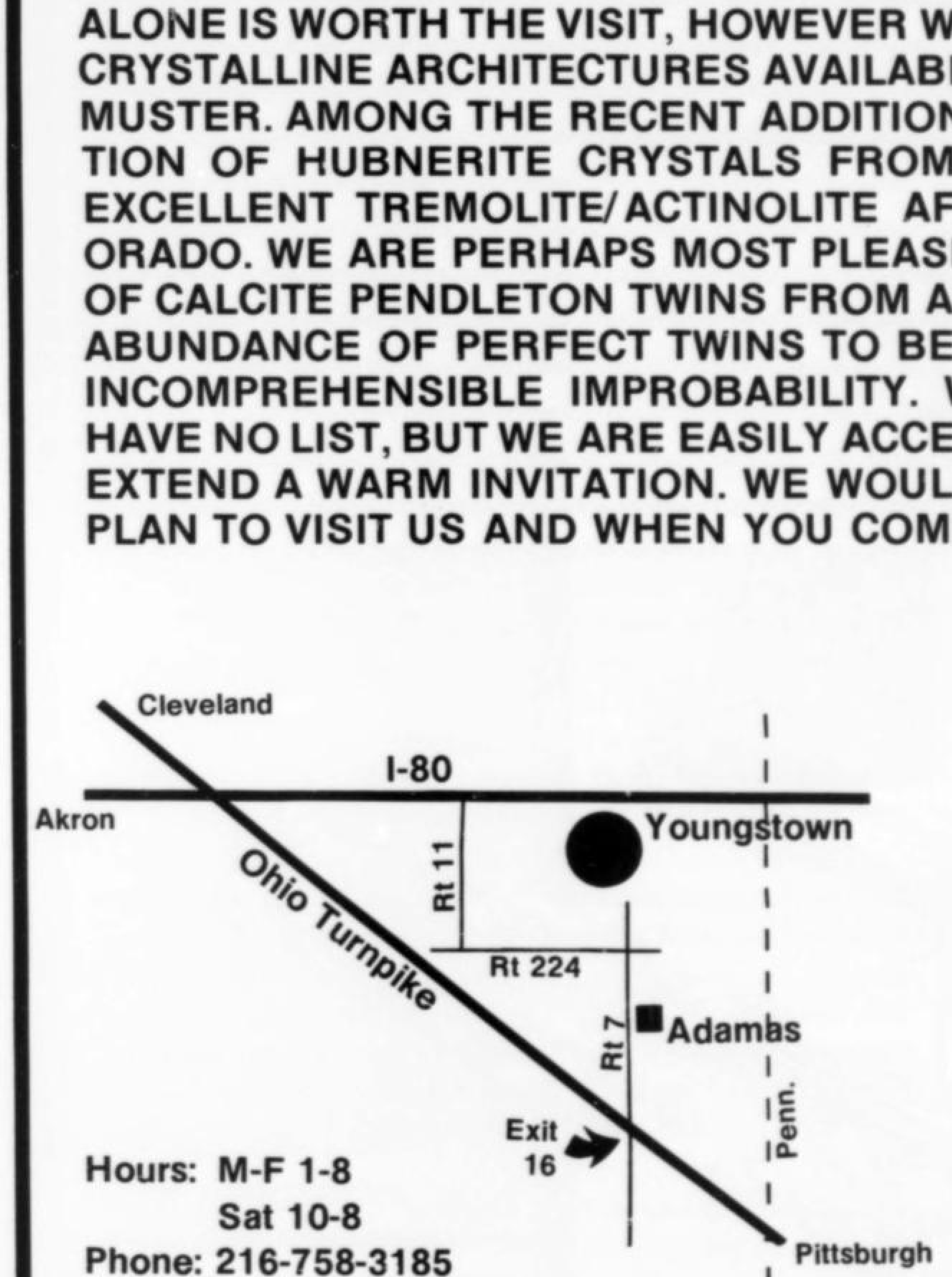

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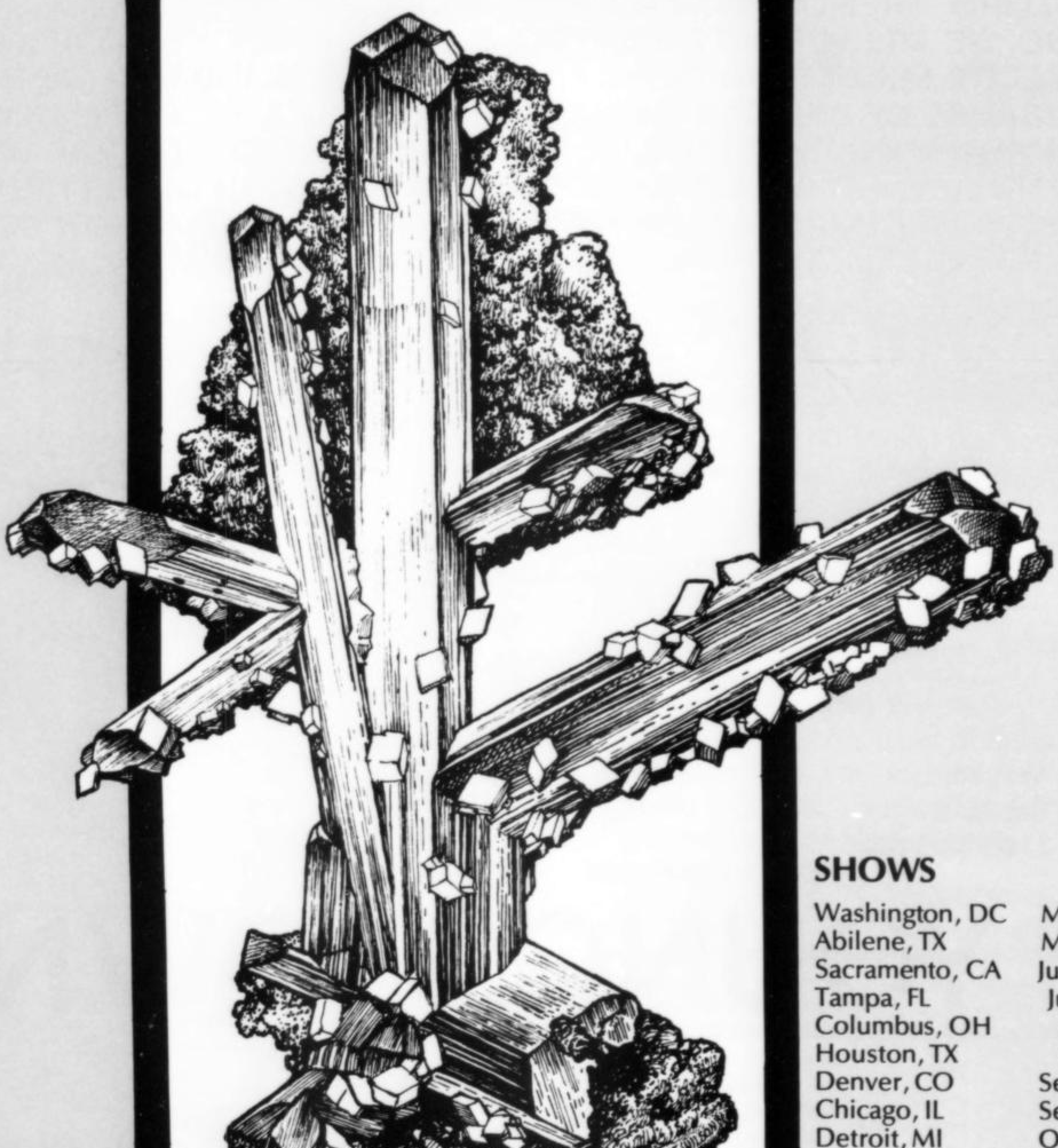

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Part III: Minerals of Mexico

by **Wendell E. Wilson**
P.O. Box 783
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INTRODUCTION

Part I of this series covered general mineralogical references (January–February 1978); part II dealt with geographically organized references for minerals of the United States (January–February 1979). The purpose of this part is to provide references and sources dealing with the minerals of Mexico.

Future issues of the *Record* will carry compilations for other geographical areas. Readers are invited to contribute listings of useful references for the minerals of other countries. If subscribers, particularly those outside the United States, can provide the best references for areas they know, the resulting compilation will be of great value to everyone.* Persons wishing to recommend additional references for Mexico are invited to do so and we will publish an addendum.

There are only two reasonably comprehensive references to the minerals of Mexico. **Field Guide to the Gems and Minerals of Mexico** (1965), by P. W. Johnson, is still in print and is available from the *Lapidary Journal* Book Department, 3564 Kettner Boulevard, San Diego, California 92138, or from *Gems and Minerals* magazine book department. The cost is $2 plus 50¢ postage. This reference is relatively short (97 pages) but has some up-to-date (as of 1965) information, an easy-to-read popular approach, photos, and a good bibliography.

The title of the other, older, but far more comprehensive reference (translated) is **The Systematic Catalog of the Mineral Species of Mexico.** This little-known work, although over 50 years old, is a must for the collector or mineralogist seriously interested in Mexican minerals. Original copies are very rare, and the only method of obtaining a personal copy for most people will be the Xerox. Most large libraries, especially university libraries, should have a copy available for this purpose. Ask for:

> **Catalogo Sistematico de Especies Minerales de Mexico y sus Aplicaciones Industriales** (1923) *Instituto Geologico de Mexico boletin numero 40*.

. . . and also the following, probably already bound together with the above:

> **Catalogo Geographico de las Especies Minerales de Mexico** (1923) *Instituto Geologico de Mexico boletin numero 41*.

Bulletin 40 consists of two parts. The first is a list of all mineral species known as of 1921, arranged according to Dana, with those found in Mexico indicated and numbered. The second part, the part of unique value, consists of a breakdown by individual minerals of all the localities where each has been found in Mexico. For each mineral these are listed by state, county, town, mining district, and mine.

For most readers of the *Record* there will be a tendency not to use this reference because it is in Spanish. However, one of the purposes of this article is to help overcome that barrier, and make this reference easily useable by non-Spanish-speaking collectors, curators and researchers.

The locality names are simple to read because they require hardly any translation. There are designations for geographical divisions similar to counties. The only such term still in use today in Mexico is *Municipio* which roughly equals a county. However, the divisions used in pre-revolutionary Mexico were somewhat confused and unstandardized. The terms *Cantón, Partido (Part.), Distrito (Dist.),* and *Departamento (Dep.)* were apparently all analogous to counties, and the term *Municipio* designated something similar to a township rather than a county. The term *Mineral (Mral.)* indicates a mining district, and *mina*, of course, is a mine within the district. Be careful not to confuse *Distrito* (County) with *Mineral* (mining district). Town names are not preceded by any terms, but the *Ciudad* is sometimes used for city.

Some of the common connecting words and their English equivalents: *de* = of, *del* = of the, *la, el, los* = the, *y* = and.

Part two of bulletin 40 would be ideal to have xeroxed for a personal library (177 pages). Part one is lengthy and largely superfluous. I have compiled an index for part two which may be xeroxed and included for easy reference. I have anglicized the mineral names for the index, although their Spanish counterparts are usually easy to recognize, and even where they are somewhat obscure they can be identified by the accompanying chemical composition.

Bulletin 41 is a cross-reference of all the data in bulletin 40 but is arranged by state, with all the minerals and their exact localities listed under each state.

The only other section requiring translation is the preface, which some readers might find interesting, so I have prepared one and included it here to be copied along with the index. My thanks to Miguel Romero for checking the translation.

A new publication has been proposed which would deal comprehensively with the minerals of Mexico and would update the systematic and geographical catalogs of 1923. This monumental task, still in the planning stage, is being undertaken by Miguel Romero with the help of William Panczner of the Arizona-Sonora Desert Museum near Tucson. Completion of the work is expected to take at least five years. People wishing to assist should contact the Desert Museum (P.O. Box 5607, Tucson, Arizona 85703).

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* Please cite all author names fully, year of publication, full title, publisher and city wherein published if a book, and journal title, volume number and pages if an article.

PREFACE

Twenty-four years ago the Geological Institute of Mexico published its bulletin number 11 containing the *Systematic and Geographic Catalog of the Mineral Species of the Republic of Mexico*. The work was compiled from material that had been dispersed in various books, among them the *Outline of Mineralogical Species (Cuadro de Especies Mineralogicas)* by Sr. Ing. Dr. Antonio del Castillo, *Catalog of the Mineral species of Jalisco* and *Mineralogical Synopsis*, both documents by Sr. Ing. Dr. Carlos F. de Landero and Sr. Dr. Andres del Rio, *The Mineral Wealth of Mexico* by Sr. Ing. Dr. Santiago Ramirez, and finally the *Treatise on Mineralogy* by Dana.

Since that time a great deal of information has been accumulating, in large part gathered during expeditions undertaken by the staff of the Geological Institute. The opportunity was taken to refine some of the data previously published and it was deemed opportune to provide a new catalog eliminating certain vagueness concerning the locations of occurrences from which the previous catalog suffered.

Various members of the Geological Institute have collaborated in this laborious work which has occupied our attention for more than two years. Sr. Dr. Gonzalo Vivar, who began the editing, contributed principally to its formation; the Senior Engineer of Mines, Dr. Manuel Santillan, perfected the format; Sr. Dr. Carlos G. Mijares made careful revision of the manuscript; finally the Sr. Engineers of Mines Dr. Carlos F. de Landero who made numerous additions and corrections, and Dr. Jose Dovalina, who performed the final check and to whom the conclusion of this work is very special.

Sr. Ing. Landero, in addition, compiled a general catalog designed to serve as the introduction to the former catalog, which includes all of the species recognized as of Sept. 1921, or at least all of the species cited in the following works:

The *System of Mineralogy* of James Dwight Dana, 6th ed., 1892.

E. S. Dana, *First Appendix to the 6th edition of Dana's System of Mineralogy*, New York, 1899.

E. S. Dana and William E. Ford, *Second Appendix*. New York, 1909.

William E. Ford, *Third Appendix*. New York, 1915.

American Journal of Science, volumes from 1915 to Sept. 1921.

Hintze, *Handbuch der Mineralogie*. Leipzig, 1897–1921.

Comptes Rendus hebdomadaires des seancesde l'Academie des Sciences. (Proceedings of the weekly meetings of the Academy of Sciences.)

The successive systematic classification in this catalog, as well as that used in the introduction, is that of Dana with only very minor modifications. The exception to the rule is that some numbers properly correspond to varieties, a continuation of the respective species.

After the number for each species and name,the chemical composition is given, expressed nearly always by means of the corresponding formula; also given are the hardness, density and form of the mineral. In several cases the formula given has been computed by Dr. Landero.

For the minerals consigned to this latest edition, rather than citing them as usually noted in Dana, the number of order that every species carries precedes the names. No number precedes any species not consigned (to Mexico) but described in general previous to the year of this latest edition; only a dotted line is given. The minerals whose numbers go in running order have, as of this writing, been found in Mexico; those first discovered in this country are preceded by an asterisk.

The knowledge gathered by the geological service of Mexico, set down in this catalog, fills a great need through the entries concerning the applications of the various mineral species.

Subsequently the Geographical Catalog (bulletin 41) will be published, in the expectation that both books will constitute a contribution that will be of great benefit to the scientific knowledge of the mineral products of Mexico.

Mexico, Distrito Federal, 10 February 1922.

L. Salazar Salinas

MINERAL INDEX

to the *Systematic Catalog of Mineral Species of Mexico* (Bulletin 40)

ADDITIONAL REFERENCES

The following list of references is far from complete, but should serve to provide access to literature on a number of Mexican localities. Most published references to Mexican mineral localities are to be found in the hobbyist magazines as brief, nonprofessional discussions, or in very old publications, many in Spanish, that are not available in most libraries. My thanks to Arthur Smith for bringing some of these references to my attention.

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Microminerals

by Violet Anderson

So I did not get to the Zeolite Symposium at Clark, N.J., in October, so I did not hear Rudy Tschernich speaking on "The Zeolites of Northern Ireland and Scotland," so I am an anticlimax with my news of Irish zeolites for micromounters, so—but just so.

Harry Foy of Belfast sent me a parcel of micro zeolites, largely from County Antrim, Ireland, and you should know you can trade with him for a suite of these. Unfortunately, your trading cannot be on the usual basis, unless we can all convince Harry Foy to become a micromounter. He is a cabinet-specimen collector, so you either must find a cabinet specimen or two for him, or you must ask him to price the material he sends you.

Quote from his letter reads: "Largely I keep to the local basalts, about 1000 square miles or so of them in this northeast corner of Ireland." Apparently he finds more than enough there. He continues: "The lack of visitors and local interest has meant I had no competition in any of the quarries and other localities and in 9 years of collecting I have not yet seen one single collector on any of my visits." (Consider ye some of our Club Field Trips.)

In the same area he collects the well-known associations of the zeolites: apophyllite and gyrolite, for example. Rusty Kothavala has crystals of apophyllite, gyrolite, and okenite, along with his zeolites from Poona, Bombay, and Nasik. But perhaps one should not think of those magnificent specimens of Rusty's at this moment; they tend to make a micromounter disappear.

As a micromounter, you should have a suite of zeolites and their associates, and Ireland is an interesting locality to have represented. However, zeolites are ubiquitous, found almost anywhere. In the United States, Oregon and New Jersey come quickly to mind, although many other states could be named; in Canada, the Maritime Provinces and British Columbia. Zeolites have a tricky way of using different faces in conjunction, differing from one locality to another, so one can expect surprises. Likewise with their associates. Apophyllite crystals from India, with high pyramidal faces in beautiful shades of green (transparent pale green to a rich darker green, and not microscopic) are not exactly like the pseudocubic colorless crystals we find in so many other localities.

The Irish **apophyllite** (and I shall be speaking only of what I have seen) is quite simply tetragonal, verging towards the cubic in appearance, with the occasional bipyramidal face on a corner. The pearly basal pinacoid may be slightly saucer-shaped. On the other hand (and I have Max Wirth of Culross in Fife, Scotland, to thank for this specimen) micro apophyllite can also occur with large bipyramidal faces, but looking much more architectural than the Indian apophyllite. The basal pinacoid is small and clean-cut, the prism may show up only as little diamond-shaped faces, almost pushed out of existence by a shining bipyramid. The latter is sometimes truncated below the tiny prism faces, and then you have an interesting distorted crystal.

Irish **analcime** crystals are similar to those we all know so well, sometimes with inclusions and appearing as attractive as garnets. Harry Foy has sent me one specimen, however, labeled "radiating analcime," which looks as if too many analcime crystals had tried to grow from one point and must go streaking to the far reaches of the vug, trying to complete their forms. I have never before seen analcime behaving this way.

The rhombs of **chabazite** are most often beautifully water-clear, though occasionally a pale orange, not as rich a reddish orange as those from Nova Scotia, but attractice in their clarity. Penetration twins may occur.

Phacolite, a variety of **chabazite,** is really a twinned version, rhombohedron penetrating rhombohedron, to form a somewhat blurred hexagonal outline. The result resembles fat half-moons when the other half of the moon is lost in matrix. Seen as a whole, the crystal is longer in one direction than another (not a very good moon) and is described in orthodox terms as lenticular. Ireland provides some light amber colored *phacolite,* a color which Harry Foy says is rare for the mineral. Otherwise, the Irish colorless *phacolite* does not reveal its crystals easily, since they are rather jammed up. The best *phacolite* I have comes from Tasmania. Here one can see re-entrant angles all across the equator of the small half-moons, indicating the heavily twinned nature of the crystals.

Cowlesite occurs in spheres, unopened except at the edges of a vug where half-spheres reveal the radiating white crystals.

I am moving through these minerals largely by way of the alphabet, since any other grouping would depend either on setting up an order based on the inner structural variation among the silicate rings, or on one based on their slight differences in chemistry. Chemically, there is little more than varying amounts of calcium, sodium, potassium, aluminium, silicon, and oxygen to choose from in most zeolites. Rudy Tschernich has found magnesium in the offretite and the erionite he has analyzed, but otherwise these zeolites which contain significant amounts of magnesium, barium, strontium, or cesium are not those that I have from northern Ireland. However, zeolites can easily make some substitution in their cations, so one is never completely sure what one has, chemically, except by some probing analysis.

Next—garronite, gismondine, and gmelinite. **Garronite** comes from Garron Point, the type locality for this mineral. It appears as radiating white crystals, packed into fans. Not too interesting. My specimen from Oregon shows tiny spheres. The spheres, if ever complete in Ireland, must be indeed large.

Irish **gismondine** (monoclinic) has two habits. Small, extremely white spheres occur in vugs broken open and showing half-spheres on the edges. And, secondly, this mineral, which is pseudotetragonal bipyramidal when twinned, shows the crystals as if squashed flat, crystal packed on crystal in a chalky white group perched on colorless transparent chabazite. The vivid white of gismondine helps to distinguish it from cowlesite, the latter showing some signs of translucence here and there, if not too ostentatiously.

Gmelinite ("closely related to chabazite both chemically and structurally" according to Deer, Howie, and Zussman) is the show-piece of county Antrim zeolites so far as I am concerned. The *Encyclopedia of Minerals* states that the crystals are hexagonal, of the holosymmetric class, but may be "rhombohedral in aspect"; further, that "penetration twins are common" and that crystals are "striated vertically." I have some difficulty putting it all together here, since I do not understand the twinning.

There are, first, rather simple, hexagonal, thick platy crystals, sandwich-like. The pinacoid is pinkish white, sometimes cloudy white, while between these faces the mineral is colorless, transparent. Similar

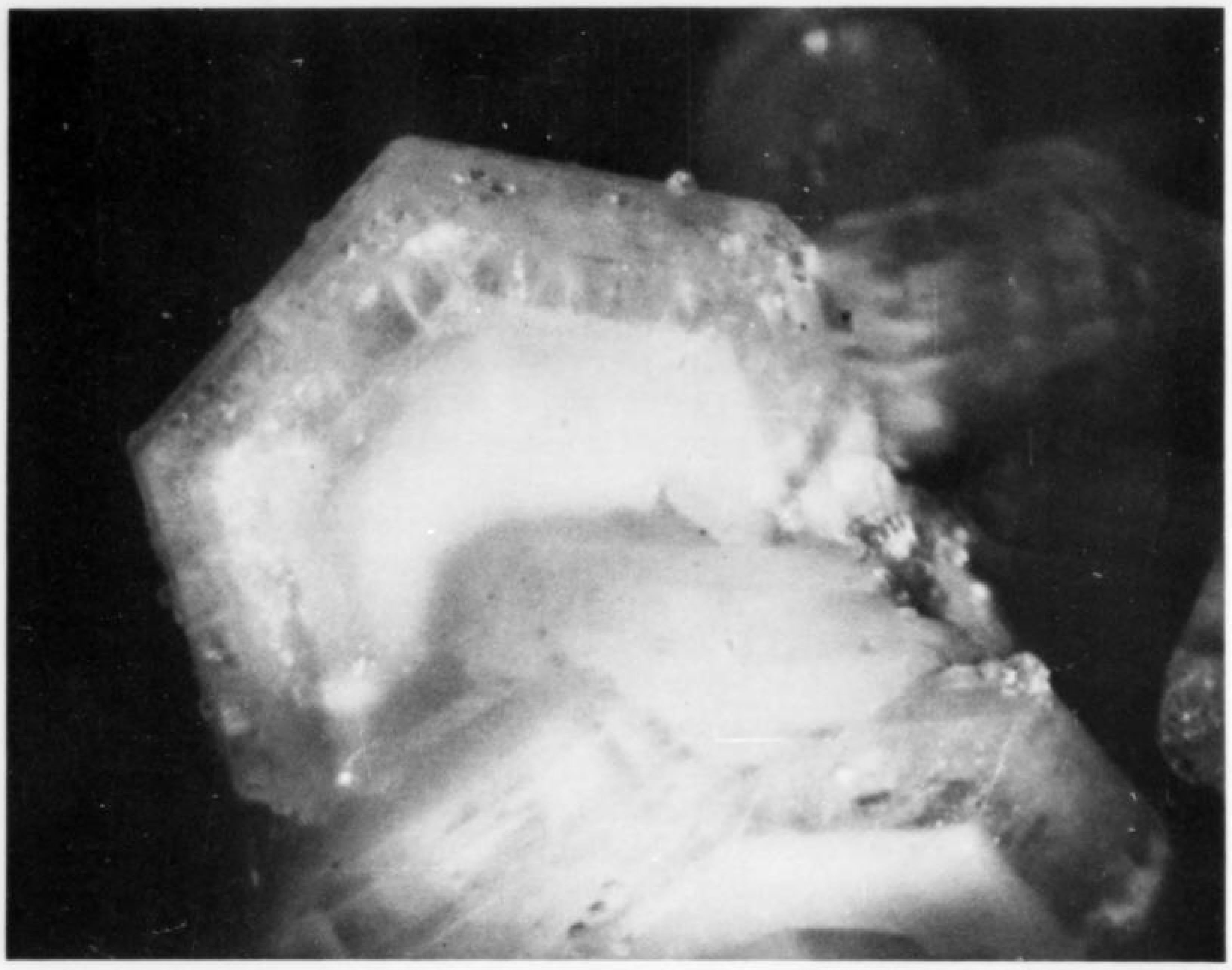

***Figure 1.* Gmelinite, from the Magheramorne quarry, near Larne, County Antrim, Ireland. Color: pinkish white, colorless, and pink. Main crystal about 2.0 mm across. Violet Anderson specimen.**

***Figure 2.* Gmelinite scepter, from the Magheramorne quarry, near Larne, County Antrim, Ireland. Colorless; length of crystal seen in photograph about 1.3 mm. Violet Anderson specimen.**

to these crystals are those which have gently sloping faces blocked off by fairly large pinacoid faces. Peering through the sloping faces one can see alternating pinkish and colorless layers. A photograph (Fig. 1) shows this type, unfortunately not in the pink.

The second habit resembles small, bipyramidal crystals which are almost as sparkling as *Herkimer "diamonds"* but have faint suggestions of pink coloring inside. The prism is not a strait-laced affair. It is horizontally striated (not vertically), the prism faces sloping to and away from a graceful waistline, suggesting a re-entrant angle.

The third habit is scepter-like (again, see a photograph, Fig. 2), both the prism and the scepter horizontally striated. In some cases the scepter is truncated (Fig. 3). Not shown here are those scepter crystals where the striations are so rugged as to seem etched.

I could become quite unmineralogical about these crystals; they demand more than an analytic viewpoint.

Gyrolite (not a zeolite, but found with them) shows radiating fans of tiny white crystals, the fans side by side in spheres. The spheres are not smoothly surfaced but show the varying arcs made by the little fans. Since so many zeolites or their companions shows spheres of crystals, it is a relief to find some feature that helps distinguish one species from another.

Heulandite crystals from Ireland are not particularly unusual. They are quite colorless, transparent, many showing interesting offsets in growth.

The next mineral most likely to succeed among micromounters is **levyne.** It is a rhombohedral mineral, occurring in pseudohexagonal colorless plates, rather fat, as gmelinite is. Levyne crystals arouse interest largely because they are so often coated with **erionite.** The erionite is white and silky, a spread of minute crystals too small to see well. There are two points to be made. One is that the erionite could be **offretite,** for all the difference in their outer appearance (and they are not so far apart internally either). Secondly, the levyne and erionite/offretite seem often laid down in layers, rather than producing a simple sandwich. I have tried to show this in a photograph but it is difficult (Fig. 4).

Free-standing tiny crystals of offretite made up of little bundles of white fibers are not in my group of Irish zeolites, but in some vuggy matrix from Greenlee County, Arizona.

Irish **natrolite** crystals are simple, appearing tetragonal rather than orthorhombic, and in attractive groups. They can also be had in extremely slender needle-like crystals and, finally, in hairs beyond the microscope's reach to discern forms, so that they could as well be mesolite. Mesolite does occur in northern Ireland in fine hairs. Whether the macro collector would find larger crystals there I cannot say.

Phillipsite comes in sturdy little crystals, again transparent, colorless, probably simply twinned, so that their monoclinic nature becomes pseudo-orthorhombic. These may be relatively distinct from their neighbors. But in some cases such crowding occurs that crystals block

Figure 3. **Gmelinite scepter, truncated, from the Magheramorne quarry, near Larne, County Antrim, Ireland. Colorless; length of crystal in photograph about 0.6 mm. Violet Anderson specimen.**

each other's growth and all you can see are partial faces covered with striations running in every which direction. In my Oregon specimen, the pseudo-orthorhombic twins are small, but form discreet clusters, the individual crystals heading off in three or four directions from a single center. One is reminded of harmotome.

The word "phillipsite" can cause a small tremor of discomfort; you know you'll never make out what is really going on with this mineral. Twinned, but how much?

I suppose one could panic with **stilbite** also, but it has been seen so often, in such large crystals, that one has become used to it and never stops to ask what makes it tick. The stilbite crystals in the specimens from Ireland are stacked in parallel, rather flattened fashion rather than in sheaf-like bunches. They display a small fanning out, however, and are not arranged in such a rectangular manner as those of stellerite, the orthorhombic relative of stilbite. (My stellerite comes from Oregon.)

Thomsonite (variety *faroelite*) is the third high point reached by the zeolites of Ireland, along with gmelinite and levyne *cum* erionite. It is an orthorhombic mineral, and in this case shows two types of rather long blades: those extremely sheer with ragged terminations, appearing in clusters in different orientation to each other, and easily mistaken for acicular crystals if one sees only a side view; and those less sheer, with abrupt narrow-faced pinacoid terminations. The latter are shown in the accompanying photograph (Fig. 5).

That finishes the zeolites from northern Ireland, although no doubt more could be found there than I have included. I know Irish scolecite and mordenite occur, for they were mentioned, but my scolecite is not from Ireland and not a micromineral but represents one of the times (against all common sense) when I fell for the beauty of Poona.

If you take your *Glossary* and tick off those you need to round out a complete suite of zeolites, you will find that most of those I have not mentioned are quite easy to obtain. The challenge will come in obtaining barrerite, mazzite, merlinoite, svetlozarite, tetranatrolite (try Mont St. Hilaire for this), wairakite, wellsite, and yugawaralite.

Figure 4. **Erionite on levyne, from the Parkgate quarry, Templepatrick, County Antrim, Ireland. Colorless and white; no crystal here is larger than about 2.0 mm wide. Violet Anderson specimen.**

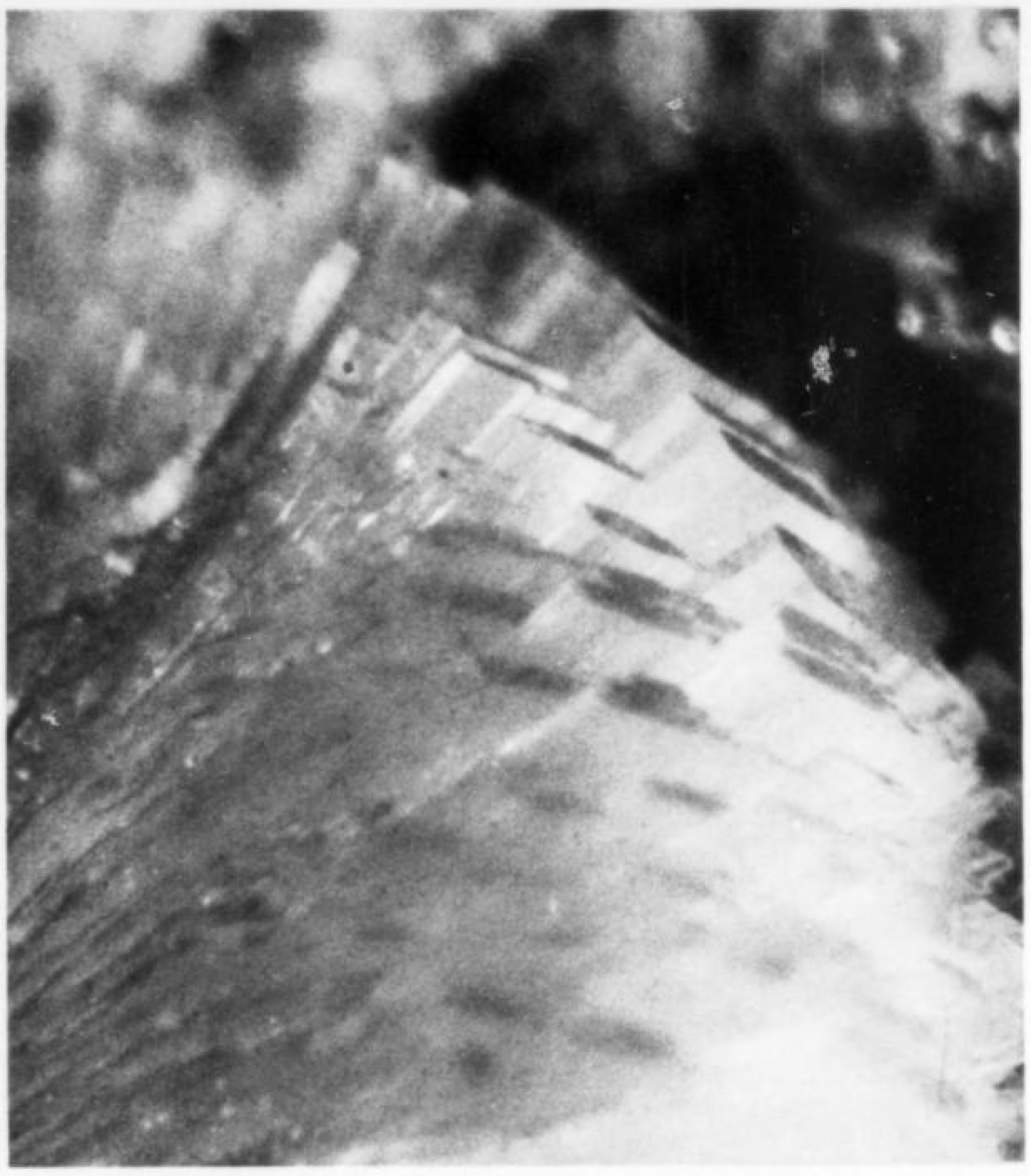

Figure 5. **Thomsonite, variety *faroelite,* from the Parkgate quarry, Templepatrick, County Antrim, Ireland. Colorless; crystals are about 2.0 mm to 2.5 mm long. Violet Anderson specimen.**

Well—every collector likes a challenge. Meantime, here is Harry Foy's address: 19 Wynard Park, Belfast BT5 6NS, Ireland. At the shows, there is Rudy Tschernich. Les Horvath also has some of Harry Foy's minerals for sale.

Odds and ends. Randy Rothschild has sent me a paragraph from a letter sent to him in German (translated by Randy) by a young Austrian micromounter, Karl Kotal, who is looking for micromounters willing to trade with him, and "who would be able to correspond with me in German since I do not know the English language. Up to now I have only Alpine minerals from the mountains of my country, and there is plenty for trading—including some rare ones. Massive material I'm not interested in, but I am looking for undamaged crystals from the U.S.A., Canada and South America. Perhaps you can help me increase my collection in this manner." Karl Kotal's address is Wipplingerstrasse 18, A 1010 Vienna, Austria. Al Falster is already trading with him, says his material ranks at the top of the list.

An irate correspondent has objected to my remarks about Mt. Mica in the January-February issue of the *Mineralogical Record,* tempering his indignation by a gift of three lovely specimens: tourmaline from Mt. Mica, Paris, Maine, purple apatite and tourmaline from Harvard mine, Greenwood, and some phenakite crystals from Lord Hill, Stoneham. His experience of the Mt. Mica dumps has differed from mine (which was somewhat brief), and certainly has been richer. He lists eleven mines in Oxford County which are open to collectors, the last three only being subject to a fee for obtaining permission to enter:

Harvard mine
Whispering Pines mine
Tiger Bill mine
Waisanen mine
Deer Hill
Nubble mine
Diamond Ledge
Mt. Mica

and the last three: Bumpus mine, Tamminen mine, and Bennet mine.

It would seem I should make an extended visit to Maine, although the opportunity to do so seems slim.

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BOB SULLIVAN'S

LETTER from EUROPE

By mid-December the 1978 European mineral season had pretty much ground to a halt. The Paris bourse on December 3 and 4 closed the season for the French and the Basel bourse December 10 and 11 did the same for the Swiss.

I missed the Paris bourse this year but I must confess it is one of my favorites, not only for the show itself, but for the chance to visit some of our favorite restaurants to enjoy the fabulous French cooking, or simply relax and knock around in our favorite European city. Its beauty and charm are difficult to match anywhere in Europe, particularly if you are able to communicate with the French in their own language, which incidentally changes their attitude quite completely from *cherchez la tourist* to a much more tolerant one. There are over 25 mineral shops in the Paris area should "silver picking" be your choosing. Although the Paris bourse officially closes at 8 pm on Sunday, I swear nearly half the total business done is in the following two hours. In the midst of breaking down and packing up a lot of wheeling and dealing is done mostly between dealers and late bargain shoppers. I have never been quite able to understand this but suspect that since it is the year's end, there is a strong desire on the part of many French dealers to close out their old material, pull in some ready cash for new purchases (at Tucson for example) and some of the bargains available in those two hours are quite unbelievable. I remember back in 1977 the efforts of one visiting Paris decorator shop owner to purchase several very large, polished slabs of beautiful Arizona petrified wood from one mineral dealer who repeatedly refused his offer of 7500 FF for his 10,000 FF specimens. The dealer was confident to the end he would sell them to collectors at his asking price but an hour after the show closed the shopkeeper got the lot for 5000 FF (about 1100 dollars) with further agreement that they be delivered to his shop the next day!

By the time the Swiss Basel bourse comes around most everything "new" has already been shown at preceding bourses but nonetheless it is a very fine show. Basel, which bills itself as "the elite bourse," limits itself to about 100 top dealers with the emphasis strictly on mineral specimens. The city of Basel sits strategically on the Rhine River on the borders of three countries, France, Germany and Switzerland, and draws a fairly international group of visitors and at a very timely period just before the Christmas season.

There were a couple of show-stoppers this year at Basel, including a fresh offering by a Swiss dealer of that fantastic crystallized sulfur on calcite or aragonite from Sicily, Italy. The specimens first showed up at the Munich bourse and, to some visiting Americans, were considered to be the best of the group offering mineralwise. The sharply formed bipyramidal and ball-like crystals ranged from 1 to over 5 cm in diameter, were very gemmy and a brilliant yellow color. The groups were most esthetic as the crystals were nicely scattered over a contrasting white aragonite or calcite matrix. They were mostly fist-size and up including a huge museum piece 45 by 60 cm (1½ by 2 feet) priced at about $3000. Prices were generally moderate with a good representative specimen available at between $100 to $200. The specimens were from one of the several sulfur mines in the Agrigento area of Sicily and reportedly came from a level 1000 meters deep. Unfortunately for the collectors, an early-bird dealer bought the entire lot, with the exception of the large museum piece, on the first morning for subsequent shipment to Australia. However they were left on display for the balance of the show for everybody to drool over—which they did!

A first-time offering by a Swiss dealer at Basel caused quite a stir amongst crystal collectors, faceters, and rare cut stone collectors as well as visiting jewelers. It was a collection of exceptional colored blue euclase from Miami, Rhodesia, in the form of small, sharply terminated prismatic crystals and crystal clusters, faceting rough and cut stones, all very gemmy. Color varied from light to dark sapphire-blue and in many of the crystals the shades were mixed. Prices were steep with crystals and faceting rough running from $20 and up per carat and cut stones upwards of $275 per carat. The best of these, pure dark blue German-cut stones, were offered at about $1500 per carat but their beauty was remarkable and sales were brisk. The cause of the rare blue color in euclase is presently under study by the German Gemmological Institute.

Perhaps one of the most interesting tables at Basel was that of a Swiss dealer who specializes in Brazilian minerals, making several trips there per year to keep up with what's new and replenish his supplies of some of the standards. Outstanding was a collection of single floater chrysoberyl crystals all in the rare, flat, sixling twin form varying from 5 to 15 mm in diameter. Color was mostly a light to medium shade of yellow and some of the smaller crystals were completely gemmy. A few crystals were light olive green but all were moderately priced. Europeans sometimes refer to the gem variety of yellow chrysoberyl as *cymophane* and most of us refer to the gem variety of green (by daylight) chrysoberyl as *alexandrite* which, when viewed under artificial light, appears reddish. Source was not stated but was suspected to be Espirito Santo.

Another unusual mineral was a group of mostly doubly terminated crystals of the scapolite group. They ranged in size from stubby 25 by 25 mm to 50 mm long prisms from 12 to 20 mm in diameter and mostly squarish in cross section. The crystals were heavily striated along the *c*-axis and the flat terminations were clean though not very sharp, with rather bubbly surfaces. Color ranged from a deep golden to yellow-orange and a few were a dark champagne hue, all when viewed along the *c*-axis. They were exceptionally clean crystals and it was obvious that they would yield some rather fine, large faceted stones. Source was stated as simply Minas Gerais. There was also an abundance of single, very gemmy euclase crystals, pure white in color, tabular in form, some with minor attachments of mica, and sharply terminated, many doubly. Like the chrysoberyl they were on the smallish side, 7 to 15 mm in length, too big for the micromounter, mostly too small for thumbnails but probably of principal interest to the growing fraternity of macro collectors. Both the chrysoberyl and euclase crystals were very reasonably priced. Again the locality was stated as Minas Gerais and I suspect most of the above described material came from Brazilian dealers specializing in gem rough. They are not so fussy about the preservation of locality information which is so important to the collector. With a little effort I believe I can pin down the locality on the above specimens and I will report back if successful.

Perhaps the showiest of the dealer's Brazilian minerals consisted of a fine selection of beautiful, deep blue, slender, doubly terminated aquamarine crystals averaging 10 to 15 mm in diameter and ranging to nearly 60 mm in length. Most aquamarines I have seen from Minas Gerais have a single, flat, terminated end but all of these were classical prisms with sharp, 6-sided points on one end and flat terminations on the other. Their rich blue color and high degree of gemminess made them fine collector items, but they were not cheap. Some of the brazilianites were also outstanding and for the first time some really gemmy specimens seem to be escaping the claws of facet rough dealers in Brazil. Sharply terminated single crystals up to 3 cm in length containing gemmy areas up to 30 to 40% of their volume, were available but at a very steep price, obviously because of their gem rough value which ranges to around $10 per carat these days. Source was Linopolis in Minas Gerais. For the amateur faceter the dealer offered some really clean, white petalite up to 50 grams in weight and at moderate prices. Though not particularly popular for jewelry, it is an elusive one for the rare cut stone collector, and even more difficult for the crystal collector to latch onto.

Basel, which is somewhat limited in floor space, generally does not offer any displays but many of the dealers cooperate by bringing outstanding specimens from their own collection to show, usually in small glass cases set up on their own tables. Good smoky quartz clusters are a rare find these days in Switzerland but one Swiss *strahler* displayed two very fine museum-size groups marked "father" and "daughter" he found back in 1963 in the Lukamania Pass region. Unfortunately they were marked *unverkauflich* meaning not for sale. Many of the offerings of Zurich were repeated at Basel and a good selection of minerals from the U.S.A., Mexico and Brazil plus more of those fine alexandrite specimens from Rhodesia were available. Prices in general tend to be a bit more moderate than at Zurich and a few year-end bargains are around if you can make this fine show next year.

One of my favorite bourses in Switzerland has always been in the town of Solothurn which lies on the beautiful Aare River in the southern foothills of the Jura Mountains in the canton of the same name. Said to be the oldest town in Switzerland and dating from Roman times, one of the oldest structures is a clock tower dating from the 5th or 6th century. It is one of the best preserved medieval towns I have ever visited. The Solothurn bourse usually takes place the second weekend in December and about 25 select dealers set up in the picturesque main hall of the old brick *Landhaus* right on the Aare River. From one of the back windows of the *Landhaus* it is possible to drop a fishing line straight into the Aare for one of the fine 2 to 6-pound rainbow trout that inhabit the river, but I've never dared try it! The town's merchants cooperate enthusiastically with the club and as you wander through the narrow streets of the inner town a fine display of mineral specimens can be seen in almost every shop window. Since the town by bourse time is also decorated in full regalia for the Christms season its charm and quaintness go quickly to your heart. This year the Solothurn bourse took place on the same weekend as Basel but, since it is less than an hour's picturesque drive between the two towns, visitors had the opportunity to make it a very pleasant double for their mineral shopping.

Sometime back I mentioned having heard numerous interesting stories from various people who have gone to various countries to search out mineral specimens. There is one I would like to tell you now and it concerns a young student mineralogist and collector who decided several years ago to really go after some "Reneville, Congo" dioptase. People in Europe still call it by that name, by the way, although it is correctly known today as the Republic of the Congo. Reneville is 14 miles northwest of Brazzaville.

He flew to Zaire, made his way successfully to the Renneville area, this a task in itself as the location is rather remote. There he found the mine was completely surrounded by a very high fence and the one entrance gate well guarded with no chance of a "sneak in." He had been tipped off that on each Friday afternoon, precisely at 5:00 o'clock, all of the mining personnel including the guards formed long lines in front of four small wooden shacks near the gate to receive their weekly pay. At that moment the mine was unguarded for about 10 minutes and there was a chance to climb the fence and scoot into the mine. He was fully prepared for the possibility, had all the necessary equipment to work in the mine and enough food to last for a week. At exactly 5:05 pm, with some great difficulty, he managed to make it over the fence and down into the mine. Since the mine was closed over the weekend, but still heavily guarded, he was able to use the first two days to get familiar with the mine, locate prospective dioptase areas and find places to hide in the days that were to follow.

On weekdays while the miners were working in the mine he hid and slept. Nights he spent removing dioptase, sorting and grading it and storing it for his eventual departure. At exactly 5:05 pm on the following Friday, having abandoned all his equipment, he managed to make his way out of the mine, over the fence and safely into the bushes carrying some 50 kg of top dioptase specimens.

We happened to see his fantastic collection of dioptase displayed at one of the bourses late that summer and hear his story. It was truly a fine collection and, as he said, "a most memorable experience." Agreed!

Thanks to Rainer Bode for his informative letter announcing the forthcoming first mineral and fossil bourse in Bad Ems, Rhineland, Germany. It will take place April 7 and 8 and will feature museum and university displays of a number of unique and old-time specimens from this classic locality. Mining in the Bad Ems areas has been going on for over 800 years and one of its most famous minerals is pyromorphite, which has been found in various shades of brown, yellow, orange and green at Grube Rosenberg. The bourse will also feature an exhibition of various old mining implements, mining lamps, uniforms, historical documents and photos and even an old mining locomotive. It should be great.

As I write this we are still in the midst of winter but, as you read this, spring will be upon us. I'm having a difficult time getting the 1979 show dates in time for publication and would appreciate hearing directly from any European show chairman regarding their plans. Write to either my Swiss or Tucson address. Here are some of the major ones as I have them for 1979. Switzerland, **Lausanne,** April 28 to 29; **Lugano,** May 12 to 13; **Bern,** October 14; **Winterthur,** (National show) October 30; **Zurich,** November 10 and 11; **Brussels,** Belgium, September 15 and 16; **St. Marie Aux Mines,** France, July 7 and 8 (we'll see you there); and **Munich,** Germany, September 28 through 30. Munich takes place during the *Oktoberfest* this year and hotel space is usually reserved a year in advance for Europe's biggest beer bust. If you're planning on this one, you had better move fast. Until next time, keep your eyes open (for good minerals) and

Cheers,

Bob Sullivan

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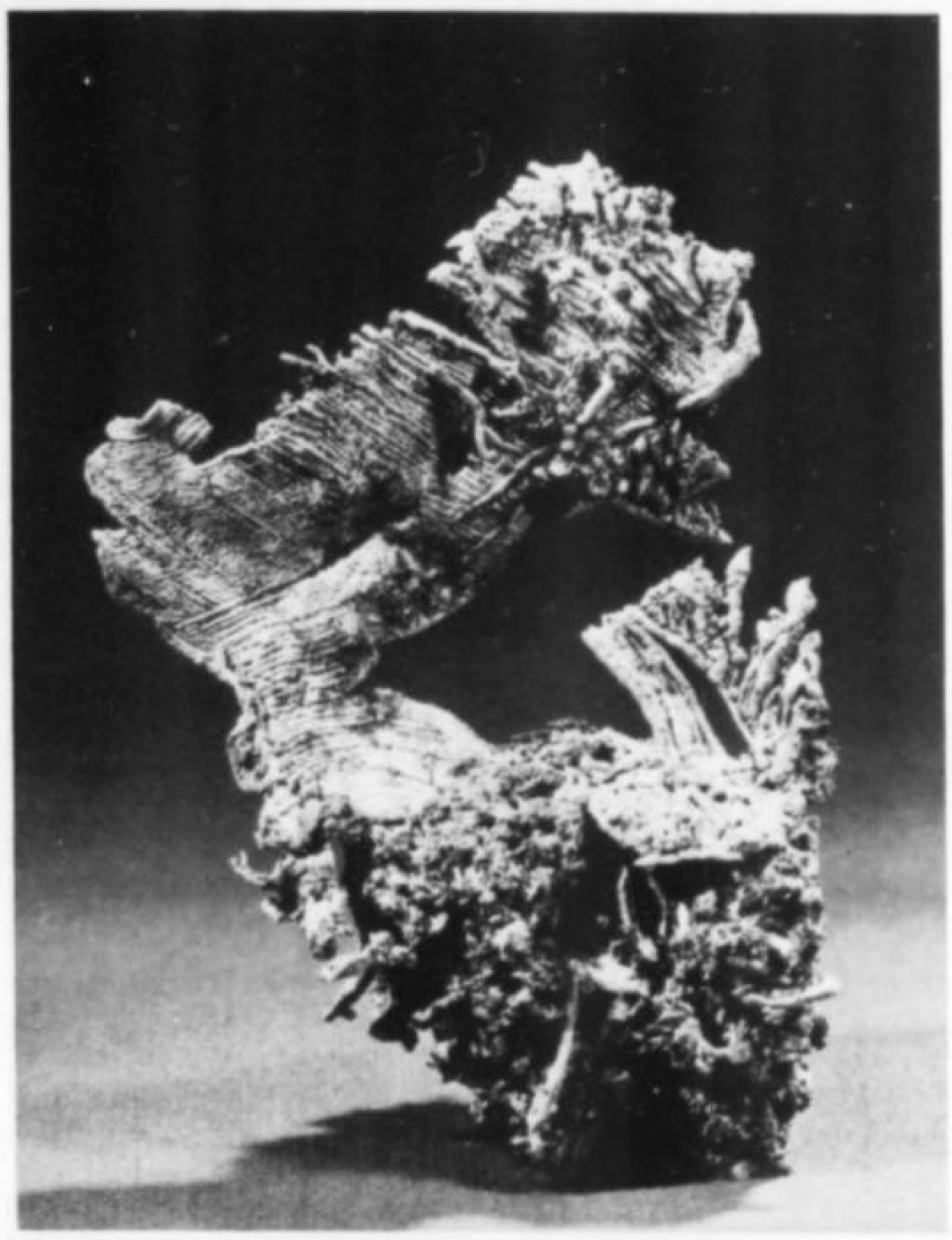

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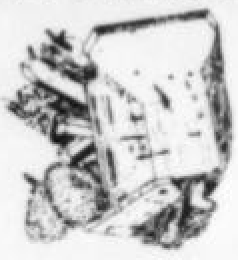

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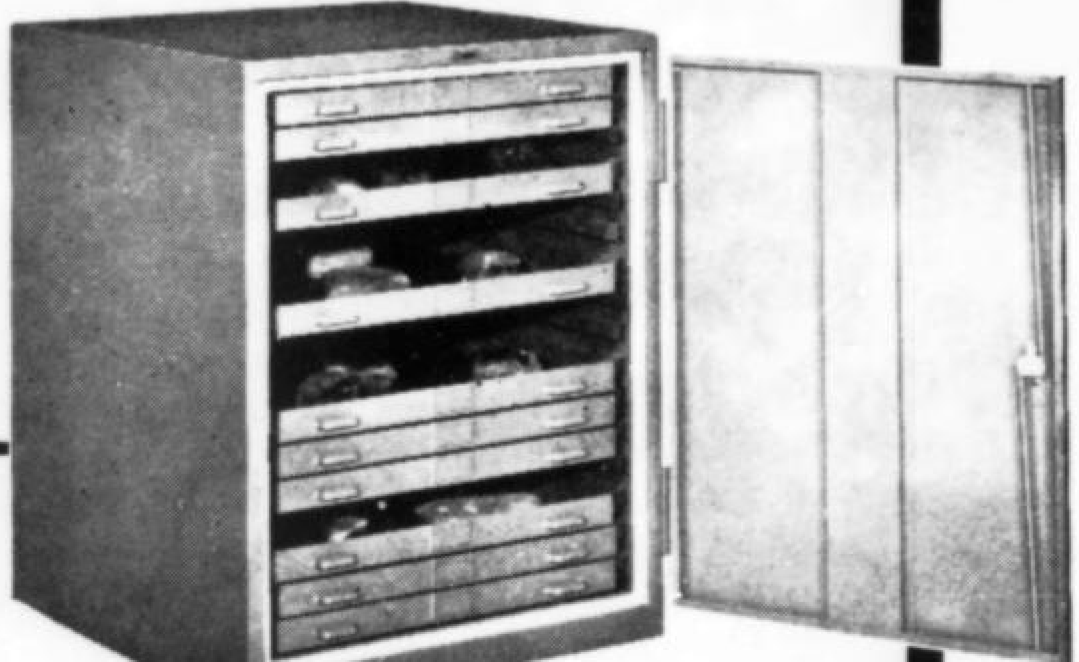

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THE HISTORICAL RECORD

by

Ron Bentley
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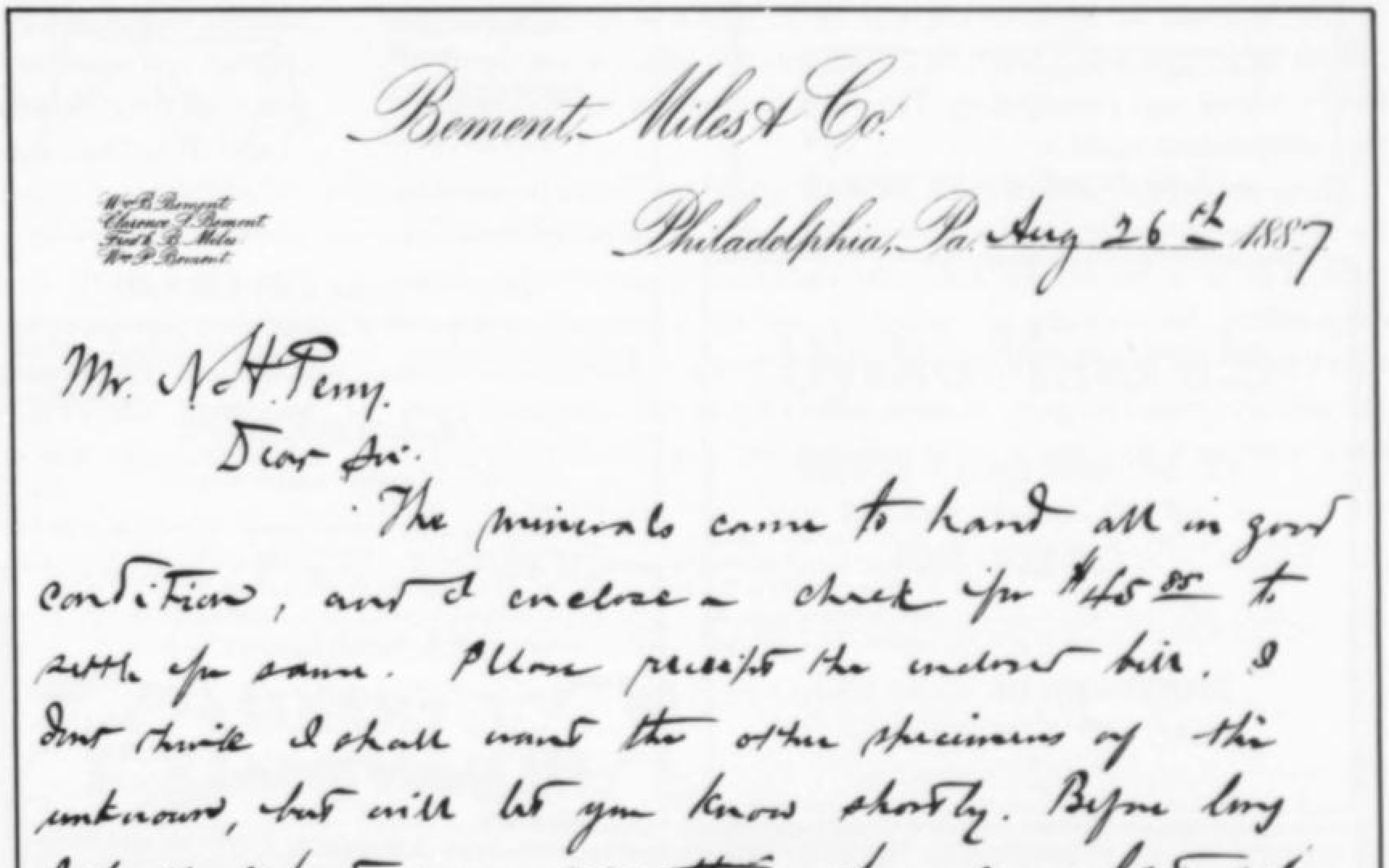
I'd like to start this month's column with an apology to those interested readers who asked for some of my duplicate labels. After my offer, not only was I overwhelmed with requests, but I was also fortunate to obtain another collection of labels which hampered my efforts at classifying duplicates and "keepers." In total I now have close to 5000 labels to process. Anyway, hang in there, and I'll get those duplicates in the mail.

For those of you who didn't get to Tucson this year—it was great as usual. The weather turned warm (70–75°) for the crowds touring the many motels full of dealers. Motel selling started even earlier this year with many of the rooms open by the Friday *before* the Friday opening of the official Tucson Gem and Mineral show at the Community Center. As usual, mineral specimen buying and selling concentrated around the Desert Inn and the Newton Travelodge across the street, until the main show opened at noon on Friday. Major attractions of the show, aside from the dealers' stocks, included the numerous museum and competitive displays. Silver was the main theme of the show this year and many of the exhibits reflected this theme in beautiful silver specimens from all over the world. Another of the major attractions was the annual Saturday night auction held for the benefit of the *Mineralogical Record*. Specimens donated by interested dealers and collectors were auctioned off to a capacity hall by Al McGuinness and Gary Hansen. Bidding was brisk and laughs were numerous. One of the most interesting aspects of the Historical Record at the show was the creation of an instant "collector's item." About three years ago Bob Jones had foreseen the advent of the Tucson Show's 25th (silver) anniversary this year. In conjunction with the show committee, Bob started collecting photos and histories of the show from its earliest years. The result was a special publication, *The Silver Anniversary History of the Tucson Gem and Mineral Show*. Only 1500 copies were printed and Bob Jones kept very busy during the show asking for the autographs of everyone who was mentioned or pictured. The autographed copy was then donated to the auction and brought a very decent $225, far above its earlier $3 price tag! Anyone wishing to purchase one of these mementos for $3.00 plus $1.00 postage should contact the Tucson Club to see if any are still available (400 were left at show's end). If you can't get to Tucson, it's the next best thing.

Several issues back I ran the text of a letter penned by A. E. Foote and now in the possession of Larry Conklin. Following the publication I received a number of letters from people regarding similar collections of letters. The three that are illustrated here are in the collection of Dr. Benjamin Shaub, well known author and lecturer from Northampton, Massachusetts. Many thanks for his loan of the originals so they could be photographed directly. The evidence seems to lead one to believe that there are numerous collections of such letters in the hands of individuals. This then leads one to the question of whether these letters from our past could be better preserved than on an individual and scattered basis. Could not a central repository be found for such remnants of our historical past? And could not this repository serve to hold the letters and records of some of today's mineralogists, as in time they will become important to the Historical Record, also? I recognize that this would involve a lot of time and effort but would like to throw it out to you to comment on. Is such a repository feasible? Where could the correspondence be housed? Who would decide who could see it and whether it could be used for reprint without fear of misprint? Could such a repository be set up so mineralogists, amateur and professional alike,



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Wm B. Bement
Clarence S. Bement
Fred'k B. Miles
Wm P. Bement

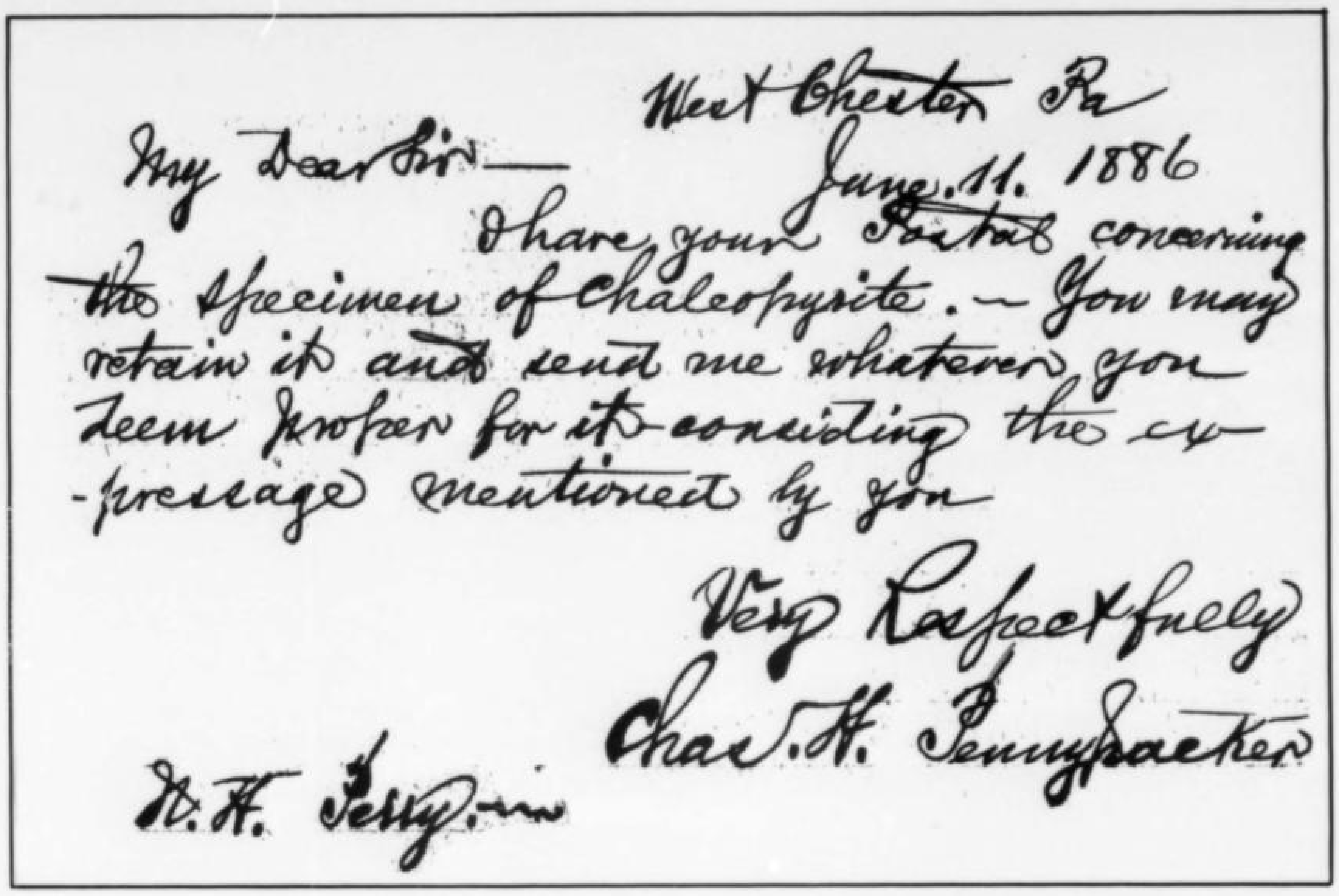
Philadelphia, Pa. Aug 26th 1887

Mr. N. H. Perry.

Dear Sir.

The minerals came to hand all in good condition, and I enclose a check for $45.00 to settle for same. Please receipt the enclosed bill. I don't think I shall want the other specimens of the unknown, but will let you know shortly. Before long I shall expect some nice things from your last collecting trip!

Yours very truly
Clarence S. Bement.



West Chester Pa
June. 11. 1886

My Dear Sir—

I have your Postal concerning the specimen of Chalcopyrite. — You may retain it and send me whatever you deem proper for it considering the expressage mentioned by you

Very Respectfully
Chas. H. Pennypacker

W. H. Petty.

could put a request in their wills that their papers be placed there? If you have any ideas regarding such a repository, I would be glad to hear them.

As I continue to peruse my copies of *The Mineral Collector,* I am repeatedly astounded at the applicability of comments made some 75 years ago to problems of today. One author of yesteryear who continually stands out is Charles H. Pennypacker of West Chester, Pennsylvania. Some of the more apropos essays may be of interest to you and I will try to toss one in from time to time, such as the following.

Vol. IX, No. 9, November 1902.

What Can We Do With It?

When the collector of sundry and various objects of natural history "has passed from works to rewards" this question is asked by one or another of his distressed family, because, in nine cases out of ten, this accumulation of specimens is about all the property left—real, personal, or mixed. Daniel Webster defined a lawyer to be "a man who works hard, lives well, and dies poor." That description fits many of the sons of science. Because he is fair, because he extracts the best there is in life, because he lives by the way as he journeys through life, he cannot be a hypocrite, cannot be a skinflint, and joins the vast army of toilers who do not save money. The monument of his improvidence is his cabinet of minerals.

There are certain laws of trade and taste which are "more honored in the breach than in the observance." The collector does not have the judicial poise of the chess player, who endeavors to see all sides of the proposition. He consults his own taste. He has a personal theory of selection which may be objectionable to every one of his friends. Some one can see grace and glory in some small chip or sliver mounted upon some stand and so gives it some standing and respectability. Another will regard a mass of rock like the islander his idol:

"I know that he is ugly,
But *I feel* that he is great."

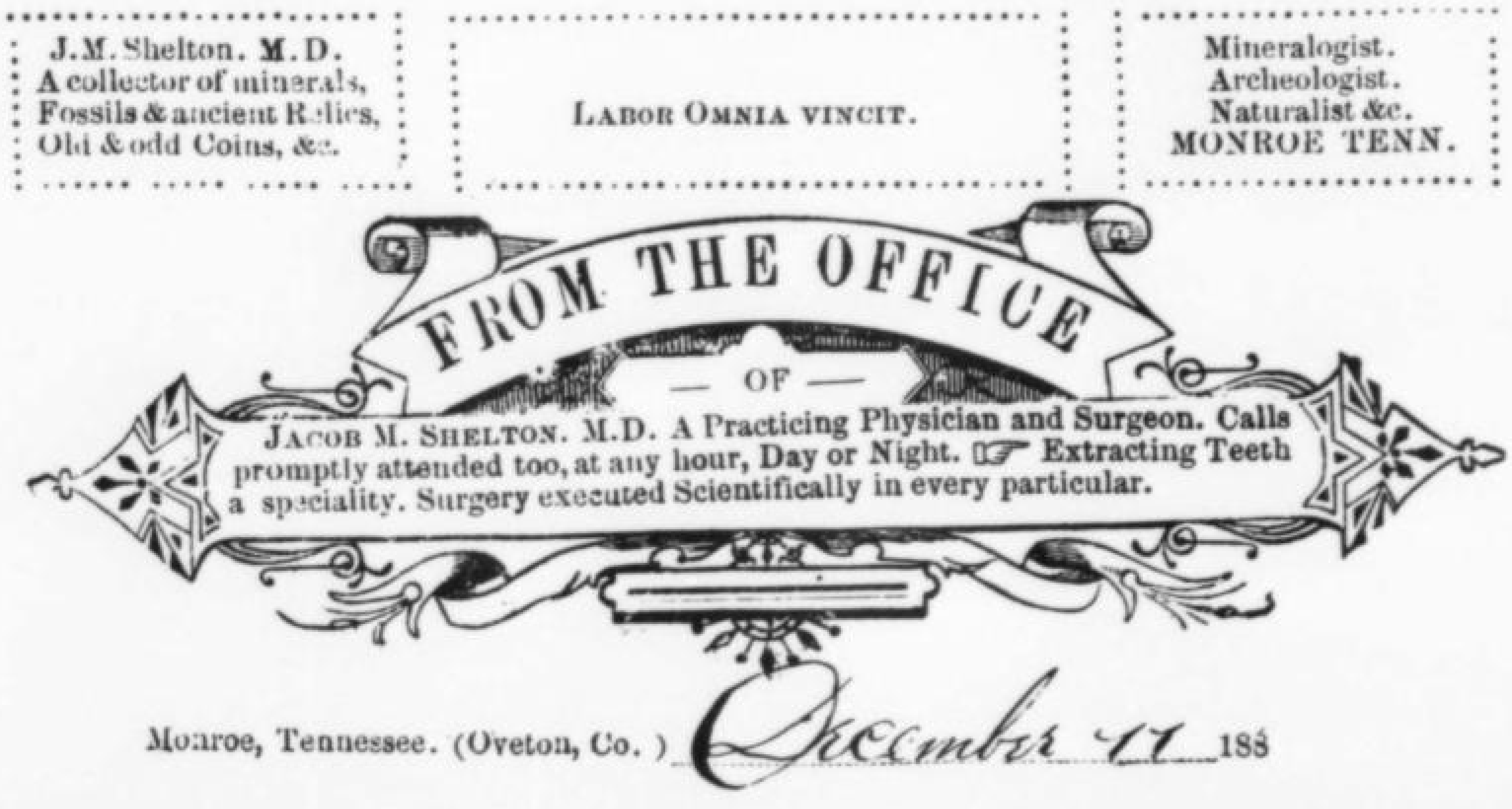
These vagaries of taste are at fault with the cold facts of business. When the result comes to be examined the criticism is disheartening. There is no demand. Why are there so many specimens of the same thing? These are back numbers. Who cares for labels marked "shorl" or "lodestone" or "asparagus stone?"

This man did not keep step with modern improvements. He ought to have taken a few lessons from Prof. Ward of Rochester, in the art of blending youth with old age. I am sorry for his family, but who wants this collection? Why did he not follow the example of William Jefferies and keep up with these "young spuds" who are invading all sections of the United States day unto day and finding new localities?

If collectors would so direct their plans, such comments as I have cited would never be heard. There are two rules which may be followed to this end.

1. Die your own executor! Sell your collection, or disperse it, or dispose of it in some way while yet living. Don't bury it in a school or a college or a seminary, especially if it is known to be under the care of some religious denomination. The strongest line of the Lord's Prayer is "Lead us not into temptation!"

2. Make a collection of minerals so good, so grand, or so comprehensive, that it will grow in grace like a long-term government bond. Don't be a crank, or a fool, or a vegetarian, or a one-meal-a-day man, because popular opinion demands that you have these notions as fingerboards along the highway to insanity. Instead, when you select a specimen, ask what other people think about it. Consider its probable value ten years hence.



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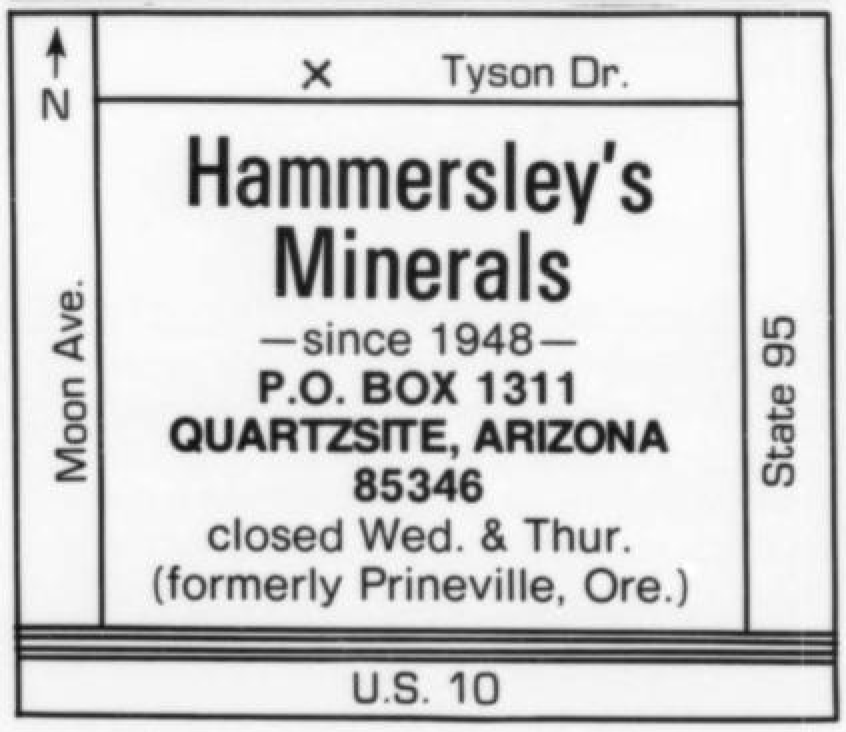

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What's New in Minerals?

TUCSON SHOW 1979

Sunshine and turquoise-blue skies greeted more than 14,000 visitors to the 25th annual Tucson Gem and Mineral Show this February. Enthusiasm never seems to wane for this show, universally considered the world's premier event in minerals. Organized tour groups abounded, including several from France and Germany (one led by *Monde et Mineraux*'s Anne Voileau). Thirty retail dealers and 16 wholesale dealers had booths at the main show in the Community Center, and many hundreds of other dealers were set up in the various motels nearby. A rough calculation suggested that as many as 6 miles (10 kilometers) of table-space were covered with minerals in and around the Community Center this year. Many additional dealers attended without opening up to sell; perhaps the best indication of how many full-time dealers, part-time dealers, semi-dealers and quasi-dealers were present is given by the registration at the wholesale room (where only dealers were admitted to buy): 1461 firms were recorded from 49 states and 23 foreign countries.

Displays at the show this year focused on silver, in honor of the Tucson Show's silver anniversary. Remarkable exhibits of fine silvers were presented by the A. E. Seaman Mineralogical Museum *("Silvers from the Keweenaw Peninsula")*, Miguel Romero *("Silvers from Mexico")*, the Denver Museum of Natural History *("Colorado Silvers")*, the Harvard University Mineral Museum *("Arizona Silvers")*, the Los Angeles County Museum of Natural History *("Silver from Classic Localities"* and *"The Silver Sidewalk from Cobalt, Ontario")*, the National Museums of Canada *("Canadian Silvers")*, and the Smithsonian Institution *("Silvers from Classic Localities")*. In addition there were the single-species competition cases (this year's species being—what else?—silver) which contained more incredible silvers, and the many other competitive and non-competitive cases which contained their share of fine silver specimens. All in all, a dazzling and perhaps once-in-a-lifetime gathering of silver.

The private collections displayed were too numerous to mention here in their entirety, but one interesting concept stood out. Ken and Betty Roberts organized a case containing nothing but fine green pyromorphite specimens from the big discovery a couple of years ago at the mine des Farges, Corrize, France. The specimens, brought together from various private collections for this occasion, were probably all originally part of a single pocket or pocketing vein in the mine, and it was interesting to see them reunited. Response to the idea of such a "family reunion" was so encouraging that the Roberts are planning something similar for next year . . . wait and see!

Other activities at the show included the usual spate of good lectures, Si and Ann Frazier's "Meet the Authors" session, the open meeting and lectures of the Mineral Museums Advisory Council, and of course the Saturday night activities sponsored by the *Mineralogical Record*.

Saturday evening commenced with an interesting and frequently amusing slide show and lecture by Rock Currier of Jewel Tunnel Imports, covering some of his worldwide excursions for minerals. Then came the annual slide competition; well over 100 entries were received, and the audience chose the winners from the 20 semifinalist slides.

1st place winner (Amateur): *Alexis Berset*
2nd place winner (Amateur): *Tim Hanson*
3rd place winner (Amateur): *Norman Pellman*
1st place winner (Professional): *Delbert Oswald*
2nd place winner (Professional): *Louis Perloff*
3rd place winner (Professional): *Breck P. Kent*

Some of these winning slides will be published in the Record as opportunities for color usage present themselves. The slide competition will be held again next year, with prize money again donated by Dr. Richard Webster.

The winner of the McDole Trophy (for "best rocks in the show") was Keith Proctor, and everyone agreed it was well-deserved. This was Keith's second victory in the McDole competition.

Finally the now-famous Saturday night auction to benefit the *Mineralogical Record* was held, with Al McGuinness and Gary Hansen as auctioneers. This event was originated years ago as a simple, modest fund-raising operation, but seems to have taken on a life of its own. Many people now consider it to be the entertainment high-point of the show, and regale their unbelieving friends with near-legendary tales of Vince Manson bidding against himself in the excitement (and losing), of patently obscene but natural specimens bringing outrageously high bids, of *Rock & Gem* cover proofs bought and redonated several times in one evening (acquiring signatures along the way), of fantastically fake specimens manufactured by understandably anonymous donors, and so on. Next year will be our 10th anniversary auction, and some additional surprises will undoubtedly be in store. Make your plane reservations now.

If we take 6 miles of table-space as a working figure (as mentioned in the first paragraph), and presume each 8-foot table to be capable of holding an average of 250 specimens, it is a simple matter to calculate that approximately (*very* approximately) one million specimens were

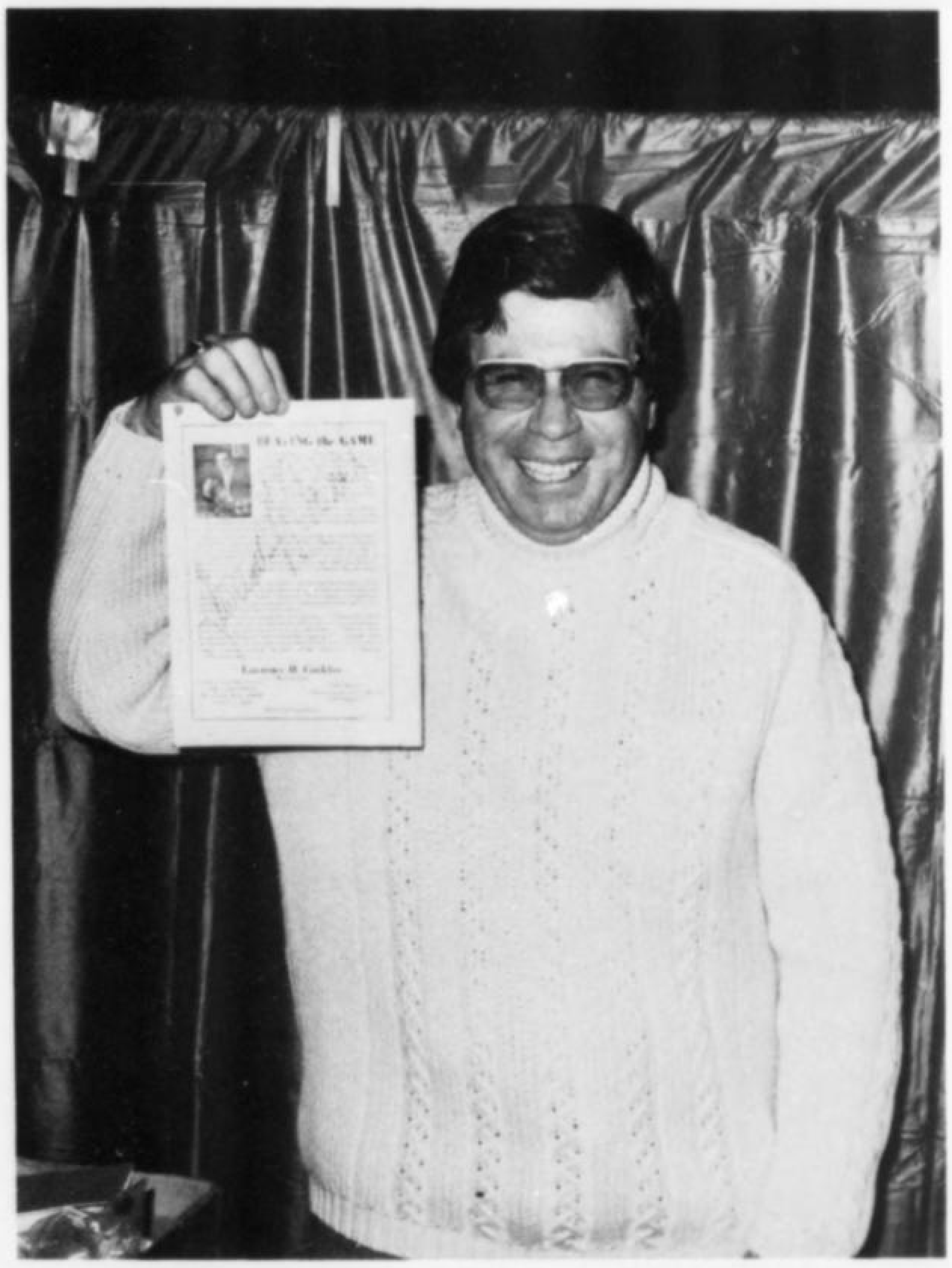


Figure 1. **It fits almost! A happy David Wilber holds his autographed ad and wears his Larry Conklin official mineral dealer's sweater, bought at the *Record* auction Saturday night. Photo by Wendell Wilson.**

Figure 2. **Large leaf gold specimens from the Red Ledge mine in California were displayed in the case of Wayne and Dona Leicht of Kristalle, along with some of their collection of mining books and memorabilia.**

available in and around the show. Unfortunately the task of examining and reporting on all of those million specimens is far beyond the time and capabilities of your editor (next year I will have to use Bob Sullivan's technique of utilizing volunteers to canvas a show and report on publishable new items). However I can at least report on those items that caught my eye, or that were pointed out to me by friends or by the dealers themselves as perhaps being worthy of mention here.

Wayne and Dona Leicht (of Kristalle) came through again this year with a real show-stopper, another batch of gold, this time from the Red Ledge mine in California (Fig. 2). The gold is of the leaf type, occurring in brilliant yellow, twisted and curled sheets to several inches in size, usually with rows of tiny crystals like lace along the edges. Most specimens are free-standing but a few have white quartz matrix. The Leichts seem to be acquiring a reputation for gold, what with last year's incredible specimens from the Colorado Quartz mine (see color photo in vol. 9, no. 3, p. 194), and the 13-pound Mojave Nugget (pictured in their ad in the same issue, and now on loan to the Los Angeles County Museum of Natural History).

Several dealers including Beth Gordon, Gene Schlepp, Artrox, and probably others, were carrying a new find of mimetite from Chihuahua, Mexico. The specimens are solid crusts without matrix, composed of pure, heavy mimetite nearly an inch thick. The roughly botryoidal shape of the crusts is composed of small terminations of individual mimetite crystals of a pleasant yellow color. These are among the largest mimetite crystals ever found in Mexico. Specimens range up to several inches across and up to a few hundred dollars in price.

Ken and Betty Roberts at the Desert Inn had a stunning lot of superb crocoite specimens recently freed from enclosing gibbsite (Fig. 3). This is the first large, fine lot since that of Pala Properties a couple of years ago. As with the Pala lot, these came from the National Museum of Victoria before they were etched out. About 25 specimens were available, most in the 3 to 6-inch range but a few smaller, all brilliant red, with crystals up to 1½ inches long and ⅓ inch in diameter. Some include matrix, and nearly all of the crystals are more or less hollow. At prices from several hundred to a couple of thousand dollars for the best pieces, the specimens sold well. After the show the Roberts went home and etched out what proved to be a *second* fine batch of specimens, this time with more specimens in the smaller sizes, and these are now available although they are too fragile to mail.

After spending about 5 hours in airport customs at Tucson, Victor Yount succeeded in bringing back to his room at the Desert Inn about a dozen boxes of minerals shipped directly from Europe where he recently completed a trip through France, Spain and Morocco. Your editor was among the fortunate few whom Vic allowed to help him unpack, and for a couple of hours it was like Christmas in his room, with packing paper knee-deep on the floor and fine minerals emerging every minute. After the unpacking was finished, every table and bed in the room was covered with minerals, except for a small space occupied by Vic's new baby Virginia and wife Renée. Included were about a hundred very fine vanadinite specimens from Morocco, the first such lot seen in several years (Fig. 4). Some of the platy to blocky crystals exceed half an inch, with color from reddish brown to the finest brilliant red. One specimen, when held up to the light, revealed its crystals to be fully transparent and ruby red in color, although seeming a little dark in reflected light. Everything from excellent thumbnails and miniatures to superb cabinets was there. These specimens were recently mined, according to Vic.

Another lot of Vic's specimens was composed of fine Moroccan cerussite, and yet another of very nice, opaque, yellow Moroccan wulfenite crystals to nearly a half inch on matrix. This is the first lot of Moroccan wulfenite to reach the U.S., as far as I know, and the specimens were modestly priced.

Aside from various other aragonites, pyrites, and so on, Vic's other major acquisition was a large lot of fine French pyromorphite from Corrize. Most of the specimens are an olive-green, some with bright yellow terminations and some with bright green terminations, ridges and frills. The crystals are well-formed hexagonal prisms with flat terminations, sometimes reaching half an inch across. Most are miniatures and thumbnails. The best of the lot was sold to Chris Wright of Wright's Rock Shop (see his ad), so there's where to go it you would like one of these pyromorphites.

Following the pyromorphites to Wright's room, I saw some interesting new Mexican topaz crystals and groups from Zacatecas. The crystals are mostly an inch in size and smaller, sherry-brown to colorless, and are characterized by the unusual termination composed only of the flat pinacoid. Were it not for this termination they would look like the well-known crystals from Tepetate. No, it is definitely not a cleavage face, although the termination is parallel to the basal cleavage.

The one pyromorphite of Vic's that was *not* in the group sold to Chris Wright is a truly superb, 4-inch tall group of brilliant green crystals essentially without matrix. Although the individual crystals are not quite as large or well-formed as they are on the miniatures from the same mine, this spectacular group is probably the finest such cabinet piece in existence.

Several dealers this year carried Spanish pyrite; probably the largest selection was that of J. Chaver (Breton de los Herreros 11, Madrid-3, Spain) at the Travelodge. Hundreds of brilliantly lustrous cubes were available in all sizes up to about 4 inches. Many excellent (repaired) multiple crystals were priced in the $20 to $150 range. Some multiple crystals were composed of three, four, and even five individuals. Although I cannot specifically recall seeing any at Chaver's room, there were several groups at the show that were fraudulent repairs . . . some crystals were glued together in a way in which they had not grown so as to make a larger and more spectacular group.

Another of the show-stoppers worth noting was hiding under Mike Sprunger's bed in his room at the Travelodge. The specimen is an Arizona hematite from the general area of the Veta Grande claim near Quartzsite, Arizona. But what a hematite! The main crystal is a quarter-inch thick hexagonal plate a little over 2½ inches across, with a mirror luster on the big face, resting on a nest of white quartz crystals and smaller hematites. This could well be the finest hematite specimen in the world. Mike collected it himself about 5 years ago, and hasn't shown it to anyone until recently; he's apparently not interested in selling.

Bill Pinch has been making trips to the Soviet Union lately trying to set up an arrangement whereby Soviet specimens can be properly collected and efficiently marketed to the West. He brought along a satchel full of interesting samples, some very rare, to illustrate the potential. One startling group of specimens consists of fine, twinned cinnabar crystals to nearly a half inch which are identical to the old and revered Chinese specimens! Both loose crystals and matrix specimens attested to the specimen potential of the locality, which is near Hydercahn in the Fergana Basin, Kazakstan. Two Soviet officials attended the show with Bill to get some first-hand knowledge of the mineral market.

Throughout the show and the days preceding, Pete Dunn was circulating, taking notes and information from people regarding his study with Ron Bentley for a major article on mineral fakes and forgeries. He went home with 50 pages of notes and writer's cramp. Still, if anyone has information and/or photographs they would like to contribute they should contact Pete at the Smithsonian Institution (Dept. of Mineral Sciences, Washington, DC 20560). This promises to be a major study of great significance, unlike anything ever published, so don't hesitate to write. All assistance is appreciated.

Numbered among the other significant specimens at the show would have to be Bart Cannon's beautiful realgar crystal, a single, bright red crystal ⅝ inch long, perched on a small pinnacle of matrix projecting from a plate of rock. The crystal is undamaged and complete all the way around, with many interesting faces. Although I've seen a few crystals larger, nothing approaches this crystal for perfection of form and esthetics. The locality is the well-known one in King County, Washing-

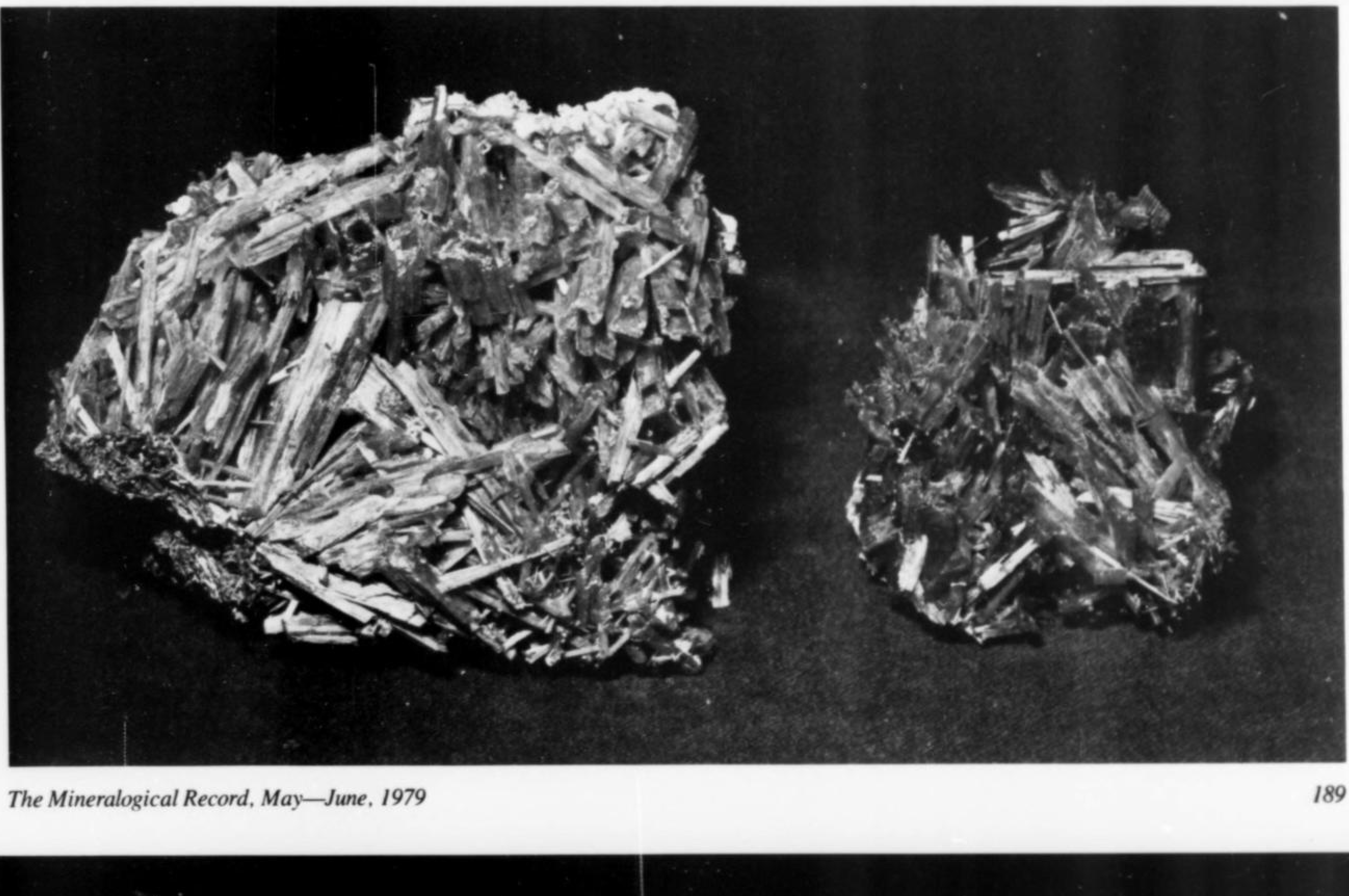


***Figure 3.* Brilliant red crocoite crystal groups from the Adelaide mine near Dundas, Tasmania. The specimens (the one on the left is 3¾ inches wide; the one on the right is 2⅔ inches tall) are from a lot recently etched out of enclosing gibbsite by Ken and Betty Roberts.**

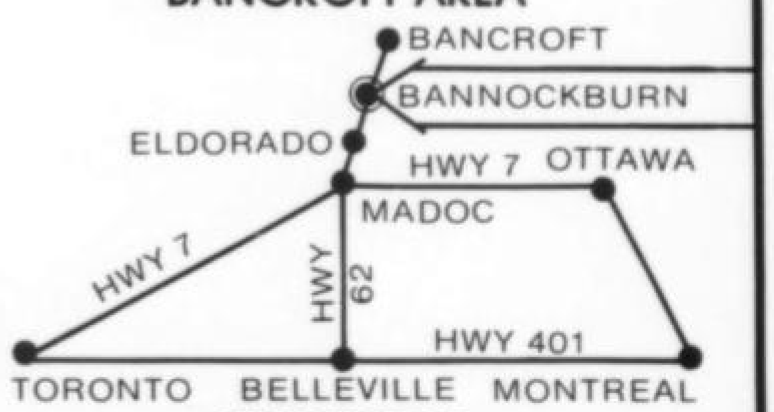
Figure 4. **Red vanadinite crystals on matrix from Morocco. The large block at upper right measures 7 inches diagonally. Victor Yount specimens.**

ton. Bart, incidentally, was the one who collected the realgar, from the same locality, which is pictured in Bancroft's *World's Finest Minerals and Crystals*.

As an aside it should be mentioned that this year at Tucson was by far the best yet for the fossil collectors. Significant numbers of top museum-quality specimens of trilobites, crinoids, starfish, ammonites, and various vertebrates were available from several dealers at very reasonable prices and sales were brisk. One dealer, Black Hills Minerals, leased a large room at the Sheraton and posted a sign giving the exact hour at which they would open for business. When the hour arrived, a veritable mob had formed at their door. Before admitting people, the dealers passed out reservation cards on which buyers could write their name, then leave the cards on specimens they select so that they can keep looking without having to carry around the specimens. Then, when finished examining the entire room's stock, the buyer may go back and pick up those pieces he claimed with his cards and pay for them. Some collectors and dealers are accustomed occasionally to doing this using their own business cards, but this is the first time I've seen the seller provide the cards . . . a courteous touch.

All things considered, inside the show and out, it was an exciting and enjoyable week. The indispensable core on which all of this event depends is the Show Committee of the Tucson Gem and Mineral Society. These people, who work all year 'round and without pay to produce the event of the year for us all, deserve credit for a difficult and monumental job well-done. To illustrate the size of the task, the Show Committee has 29 *chairmen*, each of whom has help from other society members. Special exhibits chairman Milly Schupp personally traveled across the country arranging for the unprecedented selection of silver displays that were gathered for the show. The title of the world's number one mineral show is indeed well earned.

W.E.W.



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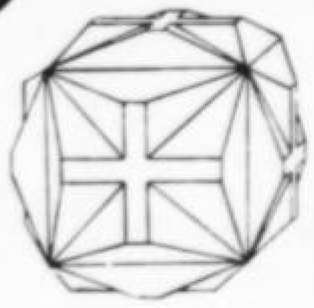

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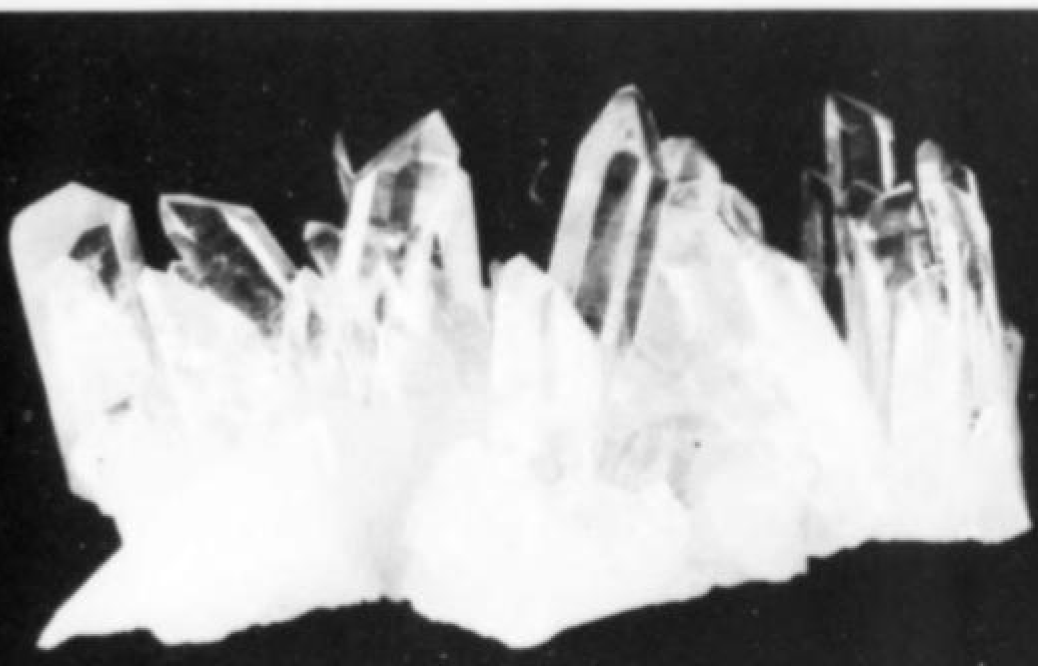

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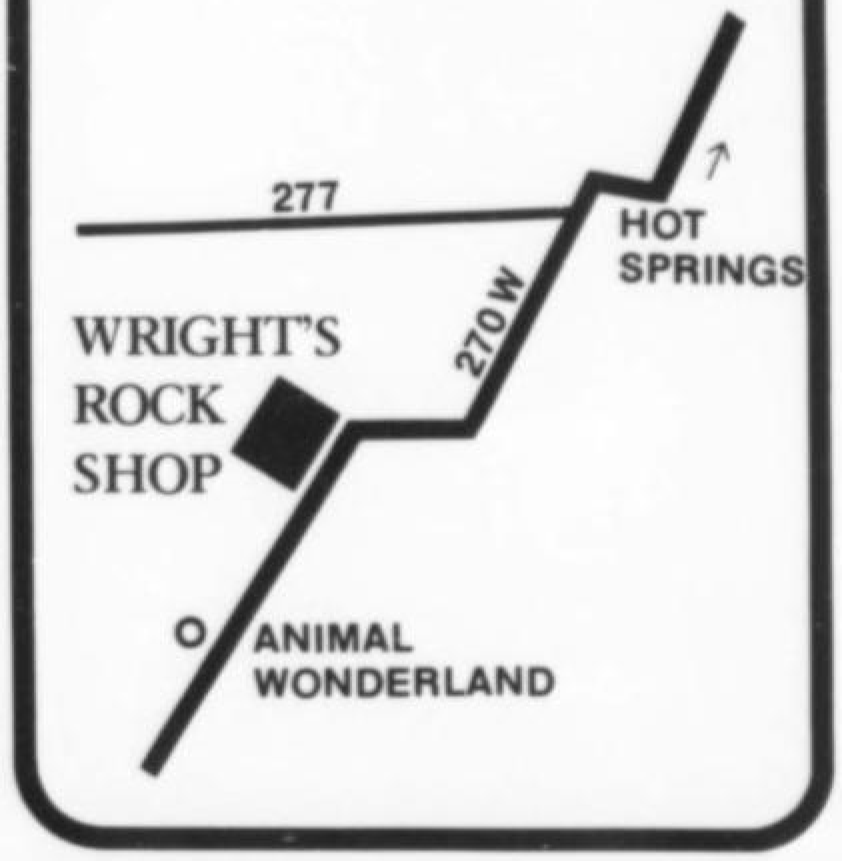

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Mineral World

Amethyst — Las Vigas, state of Vera Cruz, Mexico, 2 x 3 x 2; four large xls. and several smaller ones radiating from a base of drusy quartz and chlorite. Very fine display specimen **$75.00**

Wavellite — near Pencil Bluff, Montgomery County, Arkansas. 3 x 3 x 1½ ; good showing of radiating xls. on exposed seam in brecciated novaculite **$32.00**

Dioptase — Tsumeb, near Otavi, Namibia (South West Africa). Great display material, 1½ x 1½ x ¾ pearly dolomite base covered with small bright green xls. **$47.00**

Dioptase — Tsumeb, near Otavi, Namibia (South West Africa). 2 x 1½ x 1 matrix of white calcite xls. coated with bright green xls. **$47.00**

Dioptase — Tsumeb, near Otavi, Namibia (South West Africa). 2 x 1½ x 1¼ cluster of large showy xls. **$125.00**

Adamite — Ojuela mine, Mapimi, state of Durango, Mexico. 2¾ x 1¾ x ¾; light green xls. on a base of white adamite and limonite **$34.00**

Adamite — Ojuela mine, Mapimi, state of Durango, Mexico. 3¼ x 2½ x 1 matrix of limonite covered with golden brown xls. of various sizes **$65.00**

Adamite — Ojuela mine, Mapimi, state of Durango, Mexico. 2½ x 1¾ x 1¾; blue xls. covering brown adamite xls. on limonite matrix **$100.00**

Gold — Pilgrim's Rest mine, Province of Transvaal, Republic of South Africa. ½ x ½ x ¼ ; twisted mass with no matrix **$120.00**

Gold — Farncomb Hill, near Breckenridge, Summit County, Colorado. 1⅜ x ⅝ x ⅛ thin plate with equilateral triangle markings **$67.00**

Galena — Naica, state of Chihuahua, Mexico. Extremely showy with pale blue fluorite and minor amounts of pyrite, 3 x 3 x 1½; **$92.00**

Galena — Tulsa Quapaw mine, Treece, Cherokee County, Kansas. 2¼ x 1¾ x 1½; two steel grey interlocking xls. **$12.00**

Rock crystal quartz — Idarado mine, near Ouray, Ouray County, Colorado. 4½ x 4 x 1½ cluster coated grey and dusted with pyrite **$32.00**

Rock crystal quartz — near Charcas, state of San Luis Potosi, Mexico. 5 x 4½ x 3 matrix of large cream colored danburite xls. coated with small brilliant quartz xls. **$400.00**

Smoky quartz — Hot Springs, Garland County, Arkansas. 2¼ x 1½ x 1, showing fine phantom zoning and no matrix on two sharp single attached xls. **$67.00**

Calcite — Egremont, Cumberland County, England. 4 x 2½ x 1¼ group of clear xls. on a grey and white matrix **$180.00**

Calcite — Tsumeb, Namibia (South West Africa). 5 x 4½ x 3½ mass of xls. containing red colored inclusions of hematite **$125.00**

Calcite — San Carlos, state of Chihuahua, Mexico. 2½ x 2½ x 2 bright red xl. cluster containing inclusions of hematite **$67.00**

Aragonite — Krupp Iron mine, Erzberg, near Eisenerz, state of Carinthia, Austria. 5 x 3½ x 2¾ flos-ferri type with no matrix **$40.00**

Copper & silver — Painesdale, Keweenaw Peninsula, Houghton County, Michigan. Half — breed type with no matrix 2 x 1½ 1 **$37.00**

Copper — Emke mine, near Onganja, Namibia (South West Africa). 1¾ x 1 x 1 superb little dendritic specimen with attached calcite xls. **$18.00**

Copper — New Cornelia pit, Ajo, Pima County, Arizona. 3¼ x 2¼ x 1¼ bright, clean specimen with no matrix, fine xl. definition **$32.00**

Amethyst — Denny Mountain, King County, Washington, 1⅞ x ½ x ½ single scepter xl. resting on a single milky quartz xl. **$45.00**

Rose quartz — Island of Lavra da Ilha, Jequitinhonha River, near Taquaral, state of Minas Gerais, Brazil. 1¾ x 1½ x 1⅛ excellent display specimen with no matrix, brilliant xls. **$175.00**

Enargite & pyrite — Quiruvilca mine, near Trujillo, La Libertad Department, Peru. 2¼ x 1½ x 1½ with minor amounts of quartz **$52.00**

Pyrite — region of Tuscany, Italy. 2½ x 2¼ x 1¾; very well xld. show winning type of specimen with no matrix, truly a superb piece **$100.00**

PLEASE INCLUDE A MONEY ORDER OR CHECK WITH YOUR ORDER. CALIFORNIA RESIDENTS PLEASE ADD 6% SALES TAX (SAN FRANCISCO, ALAMEDA AND CONTRA COSTA COUNTIES 6-1/2%) TO ALL ITEMS. ALL SPECIMENS ARE WELL PACKED, INSURED AND SHIPPED POSTPAID. YOUR PURCHASE MAY BE RETURNED FOR CASH OR CREDIT IF YOU ARE NOT COMPLETELY SATISFIED.