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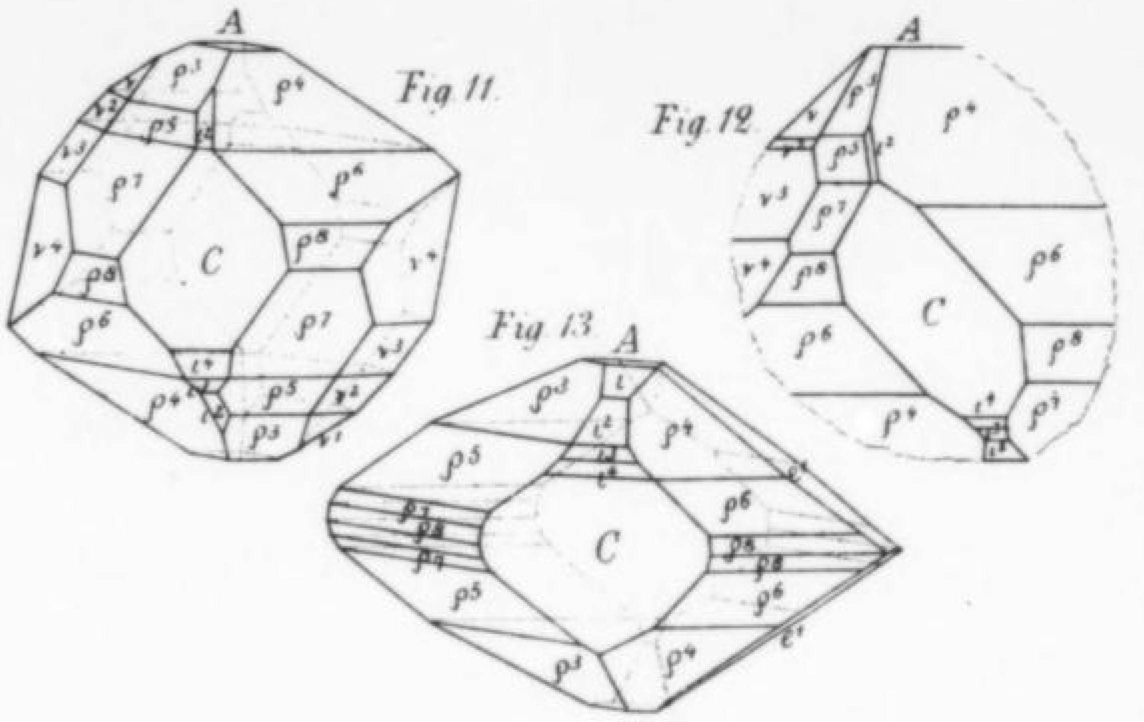
* Continued on page 383

Articles

Departments

COVER: VANURALITE from Mounana, Gabon. The crystal-filled seam is about 4 mm thick. For a review of the vanadium-containing minerals see the article by Evans and White in this issue. For more on the Mounana occurrence specifically see the article by Cesbron and Bariand in vol. 6, no. 5, p. 237–249. Photo by Nelly Bariand; specimen in the collection of the Sorbonne, Paris.

notes from the EDITOR



MINERALOGICAL RECORD TO PUBLISH TUCSON SHOW CATALOG!

For the forthcoming Tucson Show in February the Mineralogical Record will publish *The Official Tucson Show Catalog,* a magazine-size guide to dealers in the various motel shows *and* the main show at the Tucson Community Center! Approximately 25,000 copies will be distributed free around Tucson, beginning a couple of weeks before the TGMS show opens. Readers who will not be attending the show may reserve a souvenir copy by sending $5 to the Circulation Manager; these reserved copies will be mailed out following the show.

The Tucson Show is special to us, and we intend to make this catalog a beautiful, useful, well-organized, collectible publication. A full-color cover with color articles and color ads is planned. It should serve as an invaluable reference to dealers long after the show is over.

Only display ads will be accepted (*no classified ads*). Prices are as follows for black & white ads:

Full page	$550
½ page	$275
⅓ page	$185
¼ page	$140
⅙ page	$95
1/12 page	$50

A product index will be included at no charge. For full-color work add $300 per color photo ($200 if advertiser supplies color separations).

Typesetting and design services available free of charge. **Submit your ad copy by October 15!** Payment must accompany your order.

Tucson Show Catalog
The Mineralogical Record
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DANA PLATES DISCOVERED

Recently a stack of original offprint plates came to light when the Connecticut Academy of Arts and Sciences moved their offices. The plates were published 111 years ago by Edward Salisbury Dana in the academy's transactions for 1876, accompanying an article "on the chondrodite from the Tilly Foster iron mine, Brewster, New York." Two of the plates show 21 complex, finely drafted crystal drawings of chondrodite, and one plate shows a stereographic projection of the crystal forms. About 70 sets of the three plates were found.

The President and Council of the Academy hope to get these plates into the hands of mineralogists who will appreciate them and their historical significance. Consequently they have decided to present a set of the three plates to each person making a donation of $50 or more to the Connecticut Academy of Arts and Sciences, as a way of saying thank you, for as long as the supply lasts.

The Connecticut Academy is among the country's oldest and most venerable institutions. Founded in the late 1700's, the Academy has produced many famous papers in its Memoirs, Monographs, and Transactions.

Donations should be sent to the Connecticut Academy of Arts and Sciences, Box 93-A Yale Station, New Haven, CT 06520. (Mention this offer of the Dana prints.) Gifts to the Academy are tax-deductible.

NOTICES

Curatorial appointment, Joel A. Bartsch, 25, to the gem and mineral collection, Lyman House Memorial Museum, Hilo, Hawaii. Bartsch began collecting minerals in Houston, Texas, at the age of ten. He attended the Colorado School of Mines and served as student assistant in the Geology Museum (see vol. 16, p. 239). He earned a degree from Concordia College in Austin in 1984, and worked as assistant to Paul Desautels during installation of the Sams mineral collection at the Houston Museum of Natural Science (see vol. 17, p. 293). The Lyman Museum (see vol. 12, p. 89) contains between 25,000 and 28,000 mineral specimens, about 5000 of which are on public display. The earliest specimens recorded were acquired in 1882 by Levi Lyman, who was succeeded by his son, Orlando Lyman. Smithsonian curator John S. White has ranked the Lyman collection among the top ten in the United States.

Curatorial appointment, Jennings (Beau) Gordon, 46, at the Weinman Mineral Museum, Cartersville, Georgia. Gordon began collecting minerals as a teenager, eventually becoming a micromounter and a phosphate specialist. He went on to earn a Bachelor's Degree in geology at West Georgia College, and a Master of Business Administration at the University of Mississippi. Since then he has worked as a geological consultant and as a mineral dealer (*Jendon Minerals*). The Weinman Mineral Museum was founded in 1983 by the Weinman family in honor of William Weinman, founder of the Georgia barite industry which is today centered in Cartersville. Fine blue barite crystals to 7 cm have come from the local mines. In 1985 Frank Mayo donated $500,000 for a new wing (just completed, formally opening in November). The museum features fossil, gemstone, mining and mineral exhibits, with about 1800 mineral specimens representing about 500 species. Highlights include a large collection of Argentinian rhodochrosites, excellent Georgia amethyst specimens, Illinois fluorite and specimens from local occurrences.

CLASSIFICATION UPDATE

Systematic collectors interested in classification have no doubt been putting James Ferraiolo's 1982 work (*A Systematic Classification of the Nonsilicate Minerals*) to good use. It was reviewed in vol. 14, p. 59–60. Now, after five years, he has prepared a 33-page update which is available from the author at $4 postpaid. Write to James Ferraiolo, 2206 Harwood Lane, Bowie, MD 20716.

The Peking Geological Museum China

中华人民共和国 地质部地质博物馆

Peter Bancroft
3538 Oak Cliff Drive
Fallbrook, California 92028
in collaboration with **Huang Zhengzhi** and **Wang Furui**, Peking

Photography by Peter Bancroft except as noted

Since 1916 the Peking Geological Museum has been accumulating superb examples of China's extraordinary mineral wealth. Today the large museum staff is active on many fronts, and an impressive array of new, modern display cases is being installed to better exhibit the museum's outstanding collection.

INTRODUCTION

Throughout its history China has been an enigma for Westerners. Chinese art forms, culminating in highly sophisticated gemstone carvings, have been cherished worldwide yet little was known about the artisans who crafted these treasures or how they had learned to transform intractable masses of hard rock into works of great beauty.

The People's Republic of China is often referred to as being mysterious. Possibly "different" would be more accurate. China is unlike any other country due to a combination of attitudes and traditions: a nearly inflexible Chinese culture established over thousands of years, a self-imposed isolation, a continuing series of tortuous attempts at modernization, and an ongoing disinterest in foreign influences – to name but a few. The Chinese have traditionally shared precious little information about their mineral resources; crystals and gemstones were practically unavailable on the world specimen market.

The Cultural Revolution which ended in 1976 opened many doors to China. Tourists were made welcome in cities with adequate accommodations, and industrial and cultural exchanges with foreign countries were arranged. Chinese geologists began attending international mineral symposia and foreign mining experts were invited to visit Chinese mines. China began to enter the world's mainstream of culture, business and industry.

Newly released geological reports have revealed China as a veritable storehouse of minerals and gemstones. Mineral reserves include the world's largest deposits of antimony and tungsten, as well as major deposits of copper, aluminum, mercury, molybdenum, iron, tin, lead, manganese and zinc. Many of these orebodies con-

Figure 1. **Gemologist Wang Furui (left) and Zhang Jun Cai, chief of the museum's program division, at the entrance to the Peking Geological Museum.**

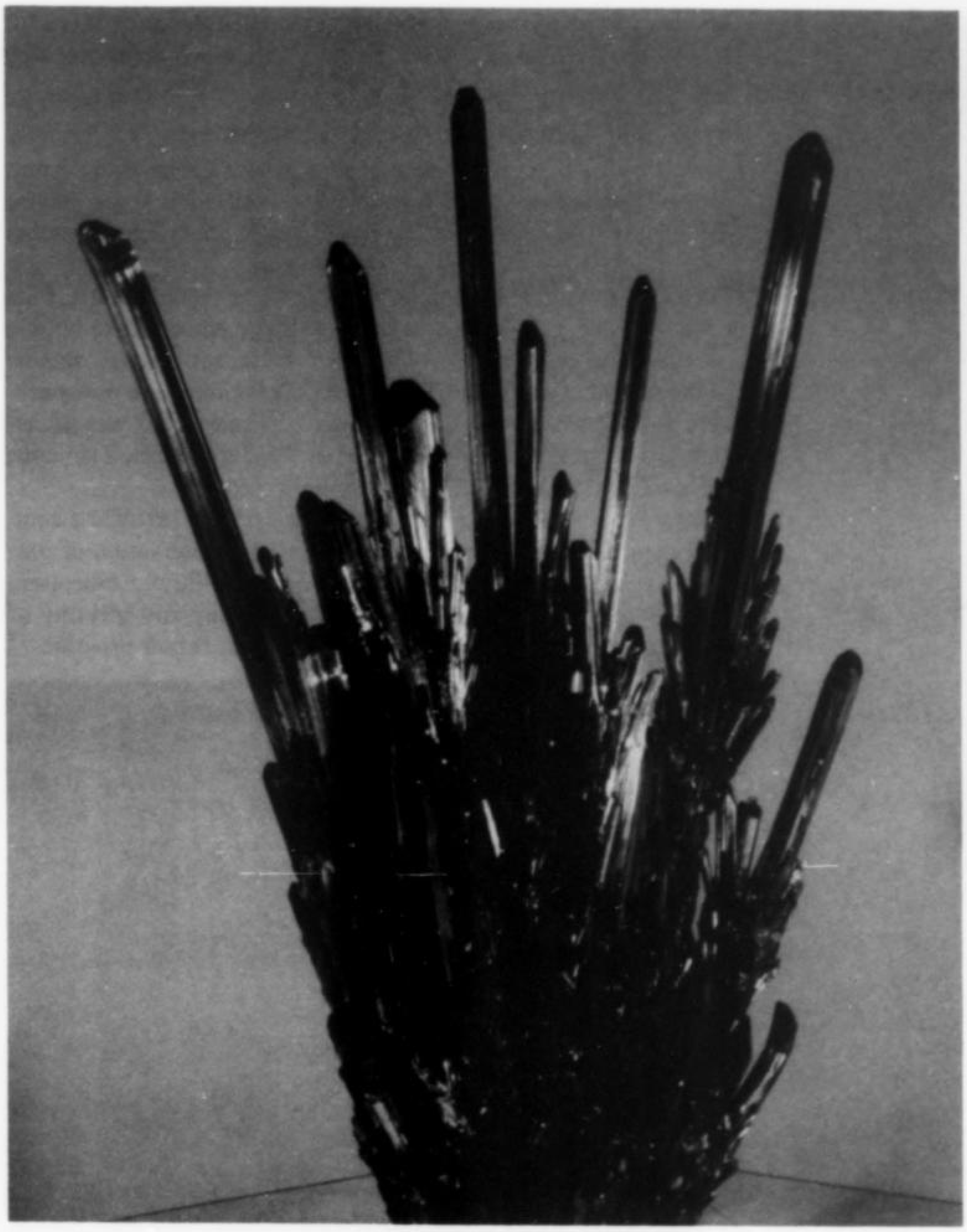
tain unworked primary and oxide zones, areas which are capable of producing interesting crystals.

Considering the volumes of ore being processed, only a few noteworthy crystals have survived. Miners have not been trained to collect crystals nor have they had much interest in conserving specimens. Even today reports indicate that considerable quantities of scheelite, fluorite, calcite and cassiterite crystals, among others, end up in crushers. And cinnabar crystals are still being reduced to powder for use as pigments and medicines.

MINERAL OCCURRENCES

Extensive prospecting has located many new orebodies and gem fields. Sapphire deposits on windswept Hainan Island are under investigation. In 1976 the first major kimberley-type diamond deposit was found, and now diamond-bearing districts are being developed, the most important being at Changma in Shandong Province. Here the Victory No. 1 mine annually produces 1500 carats of gem quality diamonds. The largest diamond crystal found to date at Changma is a beautiful 119-carat octahedron in kimberlite matrix. Well-formed scheelite crystals, some a lively purple, occur in Jiangxi Province. Turquoise in solid blue shades from Hubei Province equals the best from Iran, the Soviet Union and America. Outstanding stibnites from Xikuangshan in Hunan Province nearly rival those from Saijo, Japan. The Altay region is crisscrossed with promising gem-bearing pegmatite dikes which presently remain largely undeveloped. Interesting aquamarine, spodumene, garnet and tourmaline crystals have been found near Altay. The mercury deposits at Wan-Shan-Ch'ang, on the provincial borders of Guizhou and Hunan, are well known as the source of the world's finest cinnabar crystals. While these mines reportedly are no longer being worked by the government, local miners continue to search for remaining bits of mercury ore and cinnabar crystals. There are

Figure 2. **Large diamond crystal, 28 carats, from Liagsu County, Shangdong Province, China. (All specimens pictured in this article are from the collection of the Peking Geological Museum.)**



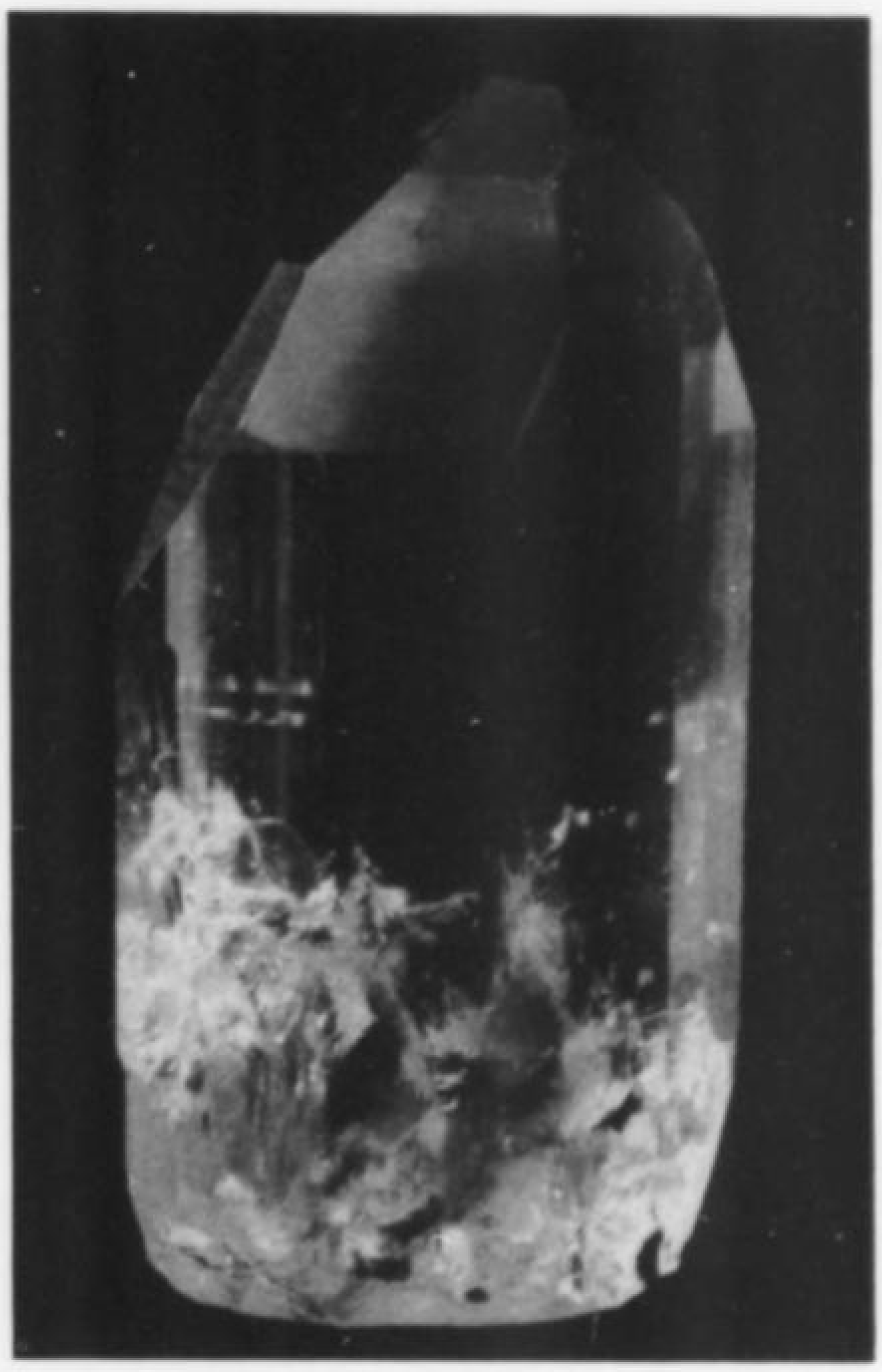


Figure 3. **Topaz crystal, 17.5 cm, from Inner Mongolia, China.**

Figure 4. **Stibnite crystal group, 24 cm tall, from Xikvangshan, Xinhua County, Hunan Province, China.**

many other significant gem and crystal producing deposits in China but limited space here precludes their inclusion. Readers fortunate enough to have obtained a copy of the rare book *Minerals in China,* published a few years ago in Shanghai, have been amazed by the wide scope of China's mineral wealth.

THE PEKING GEOLOGICAL MUSEUM

The Chinese Academy of Geological Sciences directs 18 research institutions devoted to geology, geological engineering, mineral resources, mineralogical research and field geology. One of these institutions is the Peking Geological Museum. First established in 1916, the Peking Geological Museum existed under the direction of the Minister of Agriculture and Commerce. Little is known of its early days, but around 1956 Professor Gao Zhenxi became director of the museum and since that time has been the major force in the museum's progress. Personable and known for his organizational abilities, the Honorable Director has been awarded membership in the Sinica Academy Earth Science Center.

In 1959, a new building designed expressly for the Geological Museum was opened in Peking (Beijing). It is seven floors tall and constructed of reinforced concrete; the top five levels are devoted to exhibits depicting the mineral resources of China, history of the earth, botany, minerals and rocks, gemstones, and mineral deposits in China. A new display, "Chinese achievements in geology since 1949," will be completed next year. The museum maintains a staff of 130 workers.

The Peking Geological Museum directs China's natural history museums and assists 38 mineralogical and geological museums scattered throughout the country. The Museum also gives technical support to 40 Chinese colleges of geology and other colleges with geology departments.

The Peking Geological Museum has divided its research department into four sections: (1) gems and gemstones, (2) vertebrate paleontology, (3) history of the geological sciences, and (4) minerals, rocks and mineral deposits. Scientists from all over China funnel geological data to the Museum.

One of the Museum's most appreciated efforts is its program of popularizing the geological sciences. Working with administrators of the 29 provinces and many cities, summer camps are established in key locations where teenage students study geology first-hand. In 1986, 13 summer camps were operating ten-day sessions for more than 10,000 students. Camp directors are provided by the Museum.

The Museum sets aside a time each year as Geology Popularization Month. Primary and high school students visit the Museum in droves. Museum staff members do the teaching and, in addition, conduct inservice workshops for visiting classroom teachers. The Museum also publishes a 34-page bimonthly booklet, *The Earth,* which is sold throughout China for the equivalent of about 10¢. This little magazine is devoted to geology, mineralogy, paleontology and geography with special emphasis on prospecting and field trips.

and knowledge of the mineral sciences as well as his enthusiasm for exploring and digging in the Himalaya were much appreciated by the rest of the visiting party.

THE GEM AND MINERAL COLLECTION

Upon receiving an official invitation to visit China, and permission to photograph the gem and mineral collection at the Peking Geological Museum, I arrived at the Museum in early October 1986.

The Museum's main mineral hall was being reconstructed. Piles of lumber and glass were everywhere. Staff members were putting the finishing touches to new labels, charts and display stands. Minerals and crystals, which had been on exhibit, were now packaged away in storerooms for safe keeping. The gem hall was still intact, as were rooms devoted to a mineral gallery tunnel, a tin mine diorama, and a review of China's mineral deposits.

Interviews with various Museum staff members revealed a common dedicated interest in the acquisition and preservation of outstanding mineral and fossil display materials. Without exception, curators predicted a bright future for the quality and quantity of specimens still to be unearthed by China's vast search program.

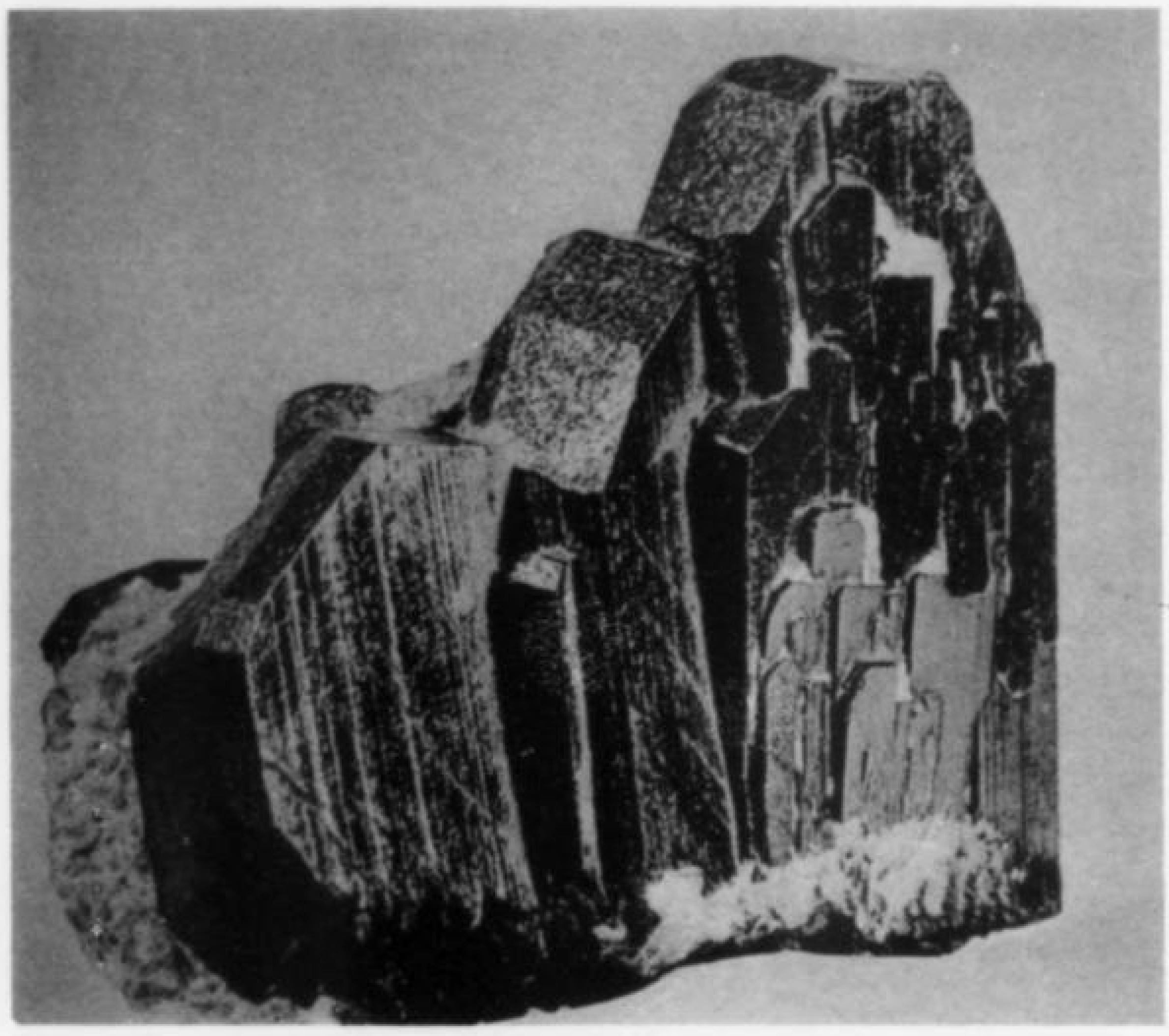


Figure 5. **Columbite crystal group, 5 cm, from Xinjiang Uygur Autonomous Region, China. Photo by Guo Ke-yi.**

Figure 6. **Glass display cases under construction in the Mineral Hall, 1986.**

Dr. Huang Zhengzhi, the Museum's able Deputy Director, is a man on the go. Rushing from one meeting to another, he still finds time to greet visitors. Fluent in French and English, Dr. Huang has done graduate work in geology in Peking and Paris.

Dr. Huang is proud of his country's progress in field geology. He compared the 14 core drilling rigs operating in 1949 to more than 12,300 drilling machines working today. During the same time span the number of field geologists had increased from 200 to more than 300,000. He gave much credit for the astounding increase in trained geological technicians and machinery to Professor Li Si-Guang, the Minister of Geology.

In July 1986 Dr. Huang came to the United States to attend the International Mineralogical Association conference at Stanford University. While in California Dr. Huang spent a day in *Pala International*'s Himalaya gem mine at Mesa Grande. His interest in

Dr. Wang Fuquan, Curator of Gemology, was excited about the newly developed diamond, nephrite, garnet, aquamarine and sapphire deposits. Equally promising were the largely unexplored pegmatites of the Altay area in Xinjiang Uygur Province. Paleontologist, Dr. Pan Jiang, pointed with pride to a long list of Chinese fossils which were unique and which represented "just the beginning of our collection. We have discovered a whole new endemic group of Agnatha (tiny primitive vertebrates of the Middle Silurian period) which are new to China and possibly to the world." Staff photographer Guo Ke-Yi said, "We are finding small crystals in samples sent to us which we have been unable to identify as yet. We anticipate some new species." And Deputy Director Huang added: "Our museum is taking great care to study and preserve the many gems and crystals which are being sent to us. We already have numerous new important specimens."

Figure 7. **Huang Zhengzhi, Deputy Director of the Peking Geological Museum, digging for tourmaline in the Himalaya mine, Mesa Grande, California (1986).**

In the gem hall, neatly arranged glass wall cases are separated by a row of see-through cabinets in the center of the room. Gems are arranged in groups according to species. Of particular interest are diamond crystals up to 24 carats (the Museum's largest, a brown 52-carat octahedron, is kept in a vault). Diamonds receive special attention from Chinese visitors whose ancestors referred to them as *Ye Ming Zhu* ("pearls sparkling at night"). A few well-terminated, prismatic, white topaz crystals, the largest of which is 17.5 cm tall, are shown alongside flatly terminated sea-green aquamarine crystals up to 15 cm in height. An exceptional vug of velvet malachite stalactites from Guangdong measures 42 cm in width. Predictably, gemstone carvings are among the finest treasures in the collection. Nine carved lions adorn a spectacular 3000-gram turquoise vase. There is a water-clear quartz carving standing 31 cm tall. In a cabinet on the east wall is a 23-cm carving of a brown limestone urn with three radiating clusters of white "chrysanthemum-flower stones" (calcite pseudomorphs after celestite crystals) enhancing the front surface. And there is a substantial collection of beautifully carved nephrite and jadeite bowls, fish, turtles, vases and a spectacular horse.

PHOTOGRAPHY

The Museum has a photo laboratory and a darkroom but photographic facilities were set up for me in the "greeting room" on the Museum's main floor because of convenience to the mineral and gem collections. Various backdrop materials were provided by the Museum. I brought my own lights, cameras and a power transformer. A list of species to be photographed was developed. Each specimen was selected by the Museum staff and was hand-carried from a storage vault to a large table where it was unwrapped and placed before the camera. The parade of shining rare crystals, some being photographed for the first time, was indeed exciting. Many eager hands assisted with every detail of the photographic process.

The minerals presented for photography are spectacular and represent some of China's major crystal deposits. First was a small matrix with a 9-mm hsianghualite crystal, an extremely rare mineral found only at Hsianghualin, Linwu County, Hunan Province, China. There followed a very large (40 x 42-cm) cluster of 1-cm golden yellow orpiment crystals offset with a few white calcite crystals; next was a 3553-gram solid gold nugget (which was not photographed because of a large gash in its front reportedly made by a digging tool at the time of discovery); then an exceptional crystallized specimen of the mercury oxide mineral, montroydite, which measures 4.5 x 5.5 cm; a 17 x 35-cm malachite geode containing velvet malachite stalactites – a specimen of great beauty; a superb spray of stibnite crystals, 13 x 24 cm, with individual crystals measuring 1 cm thick and up to 17 cm in length; and of course a number of cinnabar matrix pieces from the world-famous Wan-Shan-Ch'ang mines near Tung-Jen. The largest cinnabar crystal measures 3.7 x 6.5 cm and is perched on a dolomite matrix. Another specimen features five doubly terminated cinnabar crystals averaging 2 cm, each separated by snow white dolomite crystals on a bright gray drusy quartz base. Many specimens brought to our table were not photographed, but one cinnabar deserves special mention. It is a particularly aesthetic matrix specimen measuring 13 x 20 cm. More than 20 brilliant carmine-red cinnabar crystals up to 2 cm are scattered about a bed of flesh-colored dolomite crystals. This spectacular piece is completely without damage.

I did not visit specimen storage rooms and therefore am unable to comment on the extent of the reserve collections.

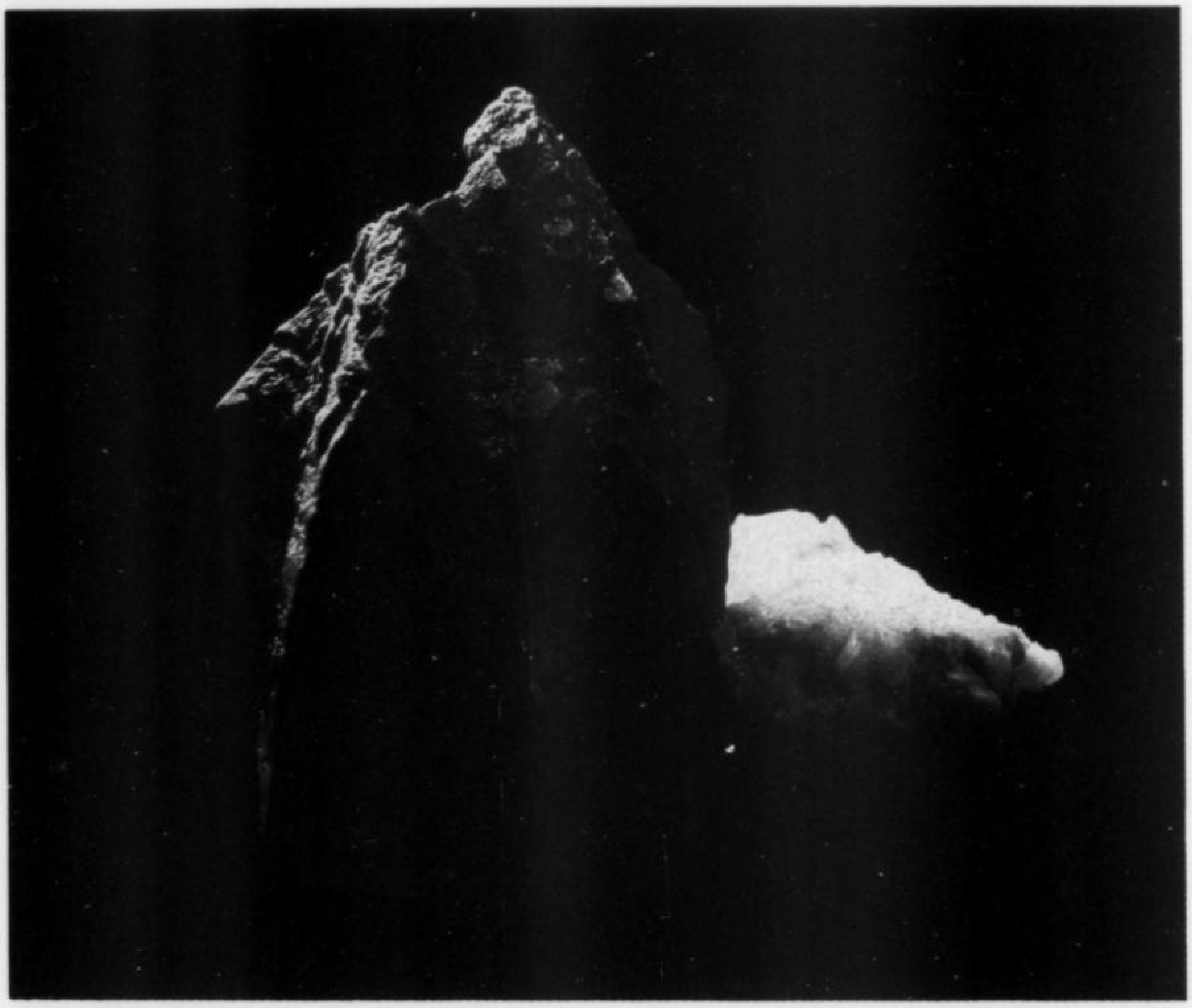


Figure 8. **Giant cinnabar crystal, 6.5 cm (over 2½ inches) on dolomite matrix, from the Yanwuping mine, Wanshan County, Guizhou Prov-ince, China. (Ed. Note: This specimen and the stibnite in Fig. 4 have been pictured on Chinese postage stamps; see page 375.)**

Figure 9. **Cinnabar crystals to 2 cm on quartz and dolomite matrix, 14 cm, from Wan-Shan-Ch'ang, China.**

Figure 10. **Large, green beryl crystal, 15 cm in height, from Altay, Xingjiang Autonomous Region, China.**

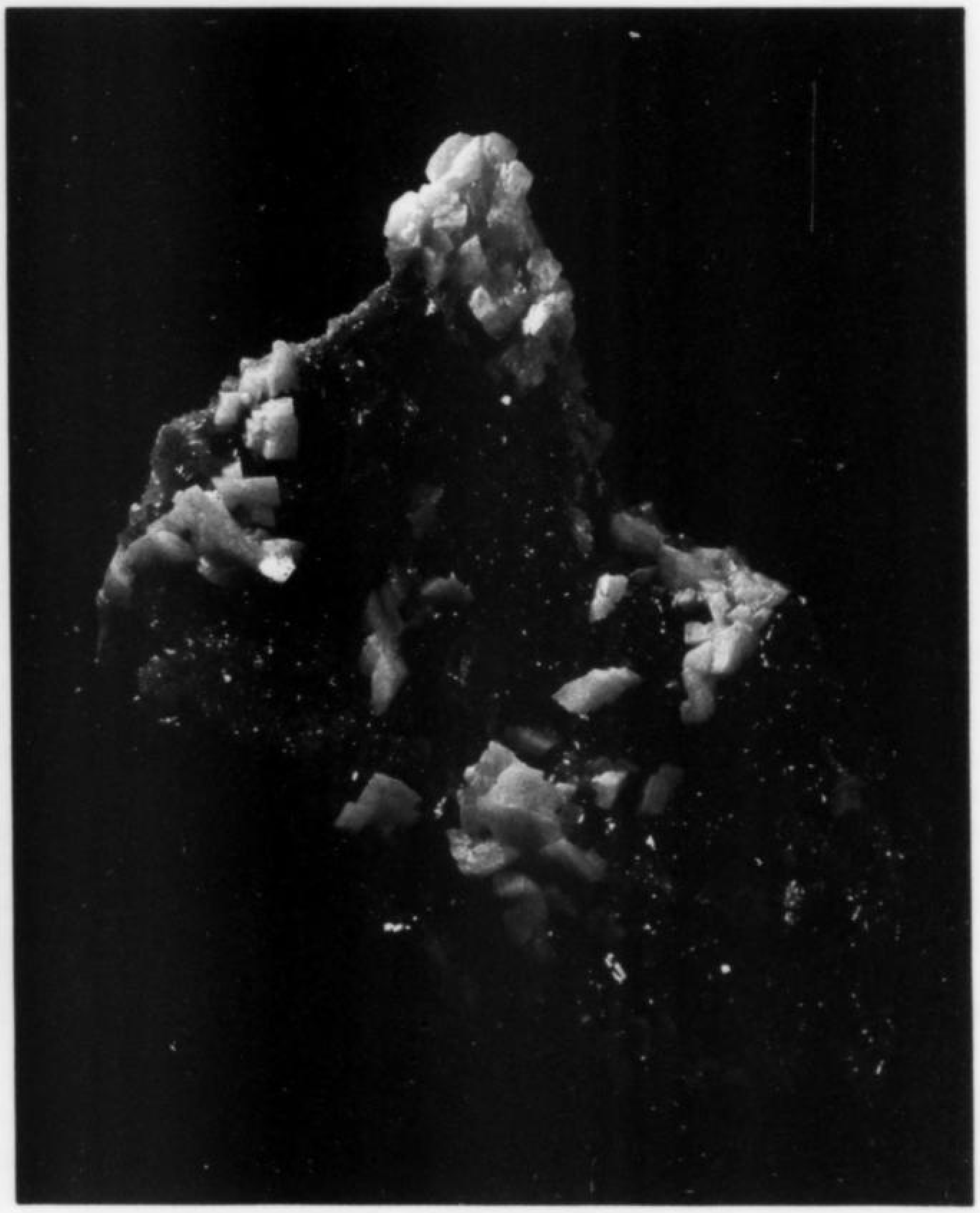


***Figure 11.* Velvet malachite vug, 35 cm across, from Guangdong Province, China.**

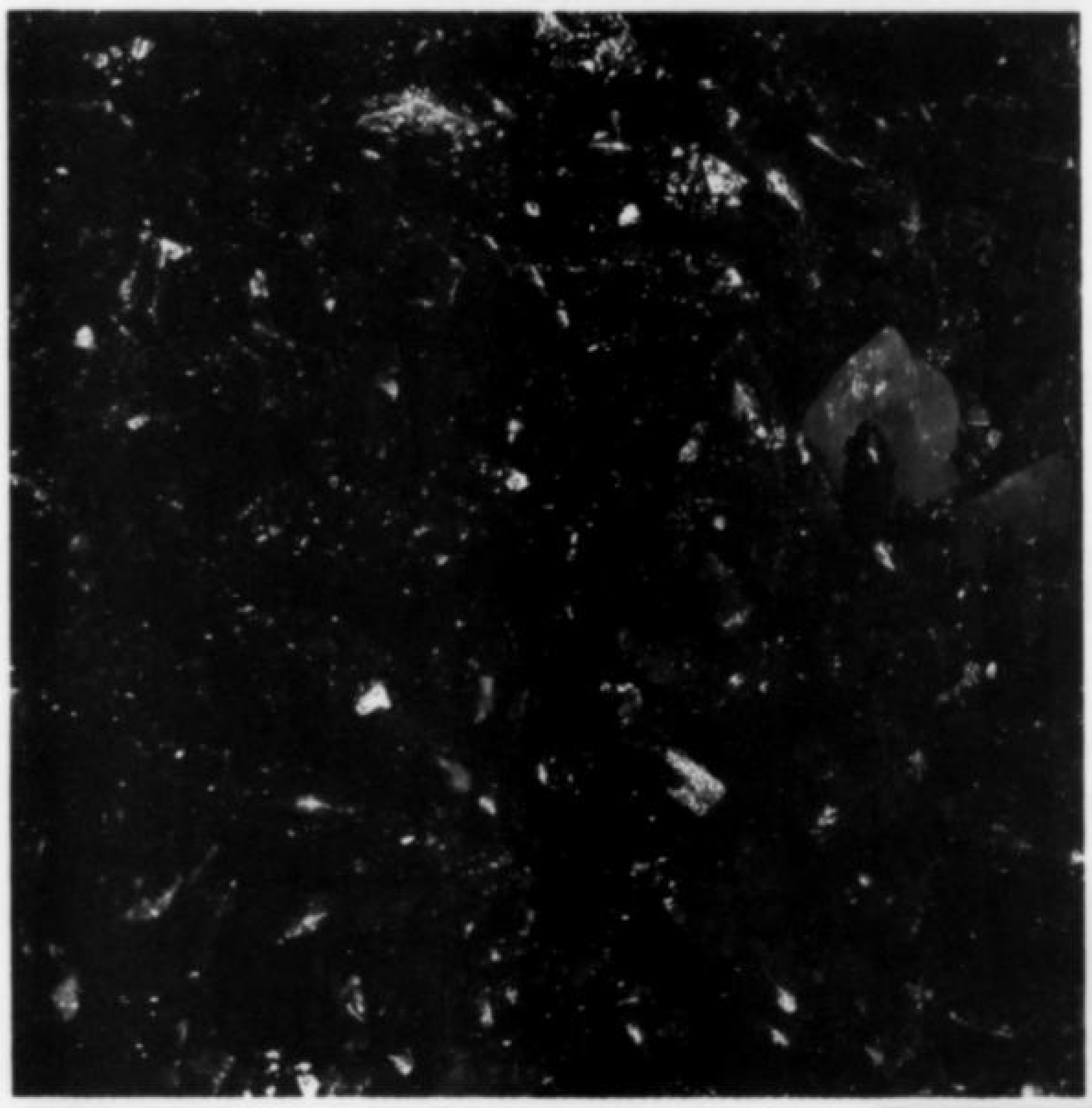


***Figure 12.* Orpiment crystals with calcite, from Hunan Province, China. The section of the specimen shown measures 42 cm (16½ inches).**

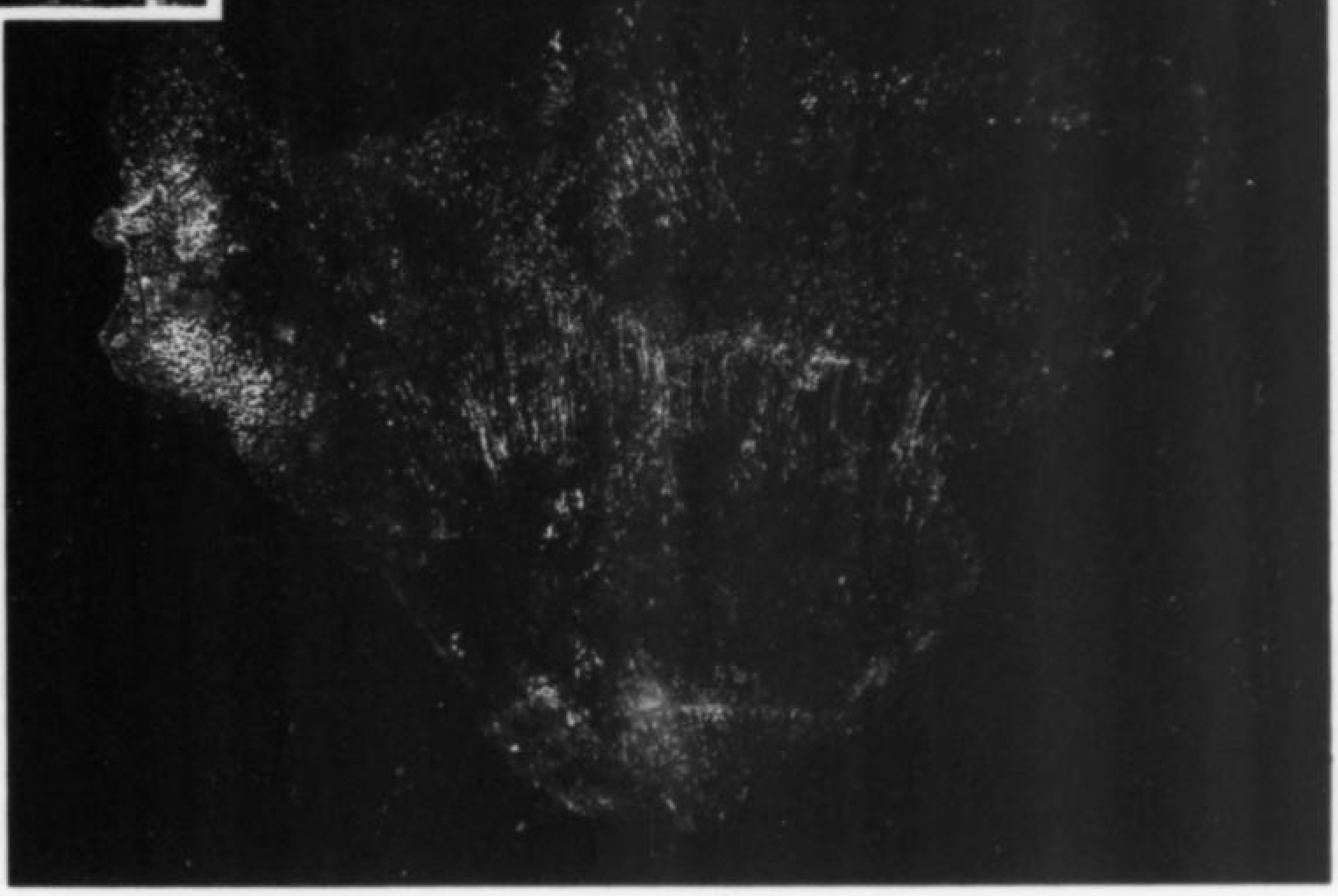
CONCLUSION

The Peking Geological Museum is not mentioned in most listings of major mineral museums worldwide. Consequently few foreigners are aware that a truly fine mineral museum exists in Peking. Display specimens range in quality from "acceptable" to "world class." When unfinished displays are completed and additional gems and minerals arrive, an already interesting and fine mineral museum will attain even greater status. The Peking Geological Museum is well worth a visit and should be on the itinerary of every mineralogist and mineral hobbiest who contemplates traveling to China.

ADDED NOTES

Nearby the Forbidden City, a 250-acre enclave which was home to 20 emperors and empresses and now is a vast museum, currently

***Figure 14.* Montroydite (HgO), 5.5 cm specimen, from Guangxi Province, China.**



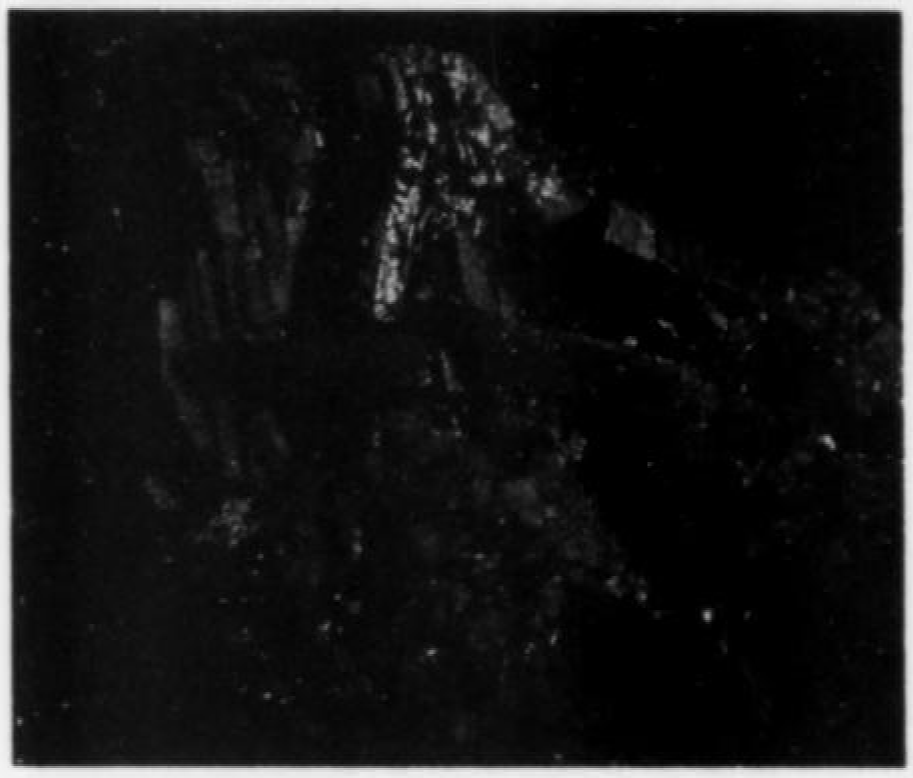


***Figure 13.* Wulfenite, 5 cm across, from Guansu Province, China. Photo by Jin Bao-yuan.**

houses a fabulous collection of antique gold, jade and gemstone jewelry.

Visitors who seek the "differences" in China will find them in abundance. Even a taxi ride can be different. A charming sign affixed to the dash of one taxi states:

> "Ladies and gentlemen: Welcome you take the cars of our company. Thanks for hire our taxi usually. We get the car fare according to the meter. If you found the sum unproperly, you have the power to inspect and dispaid. We highly appreciate your checkment and cooperation."
>
> The Capital Car Company, Second Branch

I wish to thank the following Peking Geological Museum personnel for their technical assistance and many kindnesses during my visit to China: Associate Director Dr. Huang Zhengzhi, Gemologist Wang Furui, Paleontologist Dr. Pan Jiang, Staff Photographer Guo Ke-yi, and the many helpful museum assistants.

SUGGESTING READING

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The Colorful
VANADIUM MINERALS:
A brief review and a new classification

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Vanadium is often considered to be an uncommon element, but actually its abundance in the earth's crust is comparable to or greater than that of nickel, zinc and copper. It combines to form over 100 different mineral species, many of them quite colorful.

INTRODUCTION

Vanadium was first discovered in 1801 by Andrés Manuel del Rio, a professor of mineralogy at the School of Mines in Mexico City. He refined an oxide of an unknown element, which he provisionally named *erythronium,* from brown vanadinite collected at Zimapan, Hidalgo, Mexico. Upon further study, however, he decided that the new element was merely chromium; and that is what he called it in his paper of 1801. There the matter rested until, in 1831, the Swedish chemist Nils Gabriel Sefström rediscovered vanadium in the iron ore of the Taberg mine, Smaland, Sweden. It was immediately recognized as being identical to del Rio's erythronium, but since del Rio had refuted his own discovery of 30 years earlier, Sefström received the credit and the privilege of naming the new element, which he called vanadium after the Norse goddess of beauty and love, Vanadis (Weeks, 1968).

Vanadium has long been important in steel metallurgy and, more recently, as a catalyst (in oxide form) for various synthetic processes. Until the 1950's the chemical and mineralogical behavior was generally considered to be parallel to that of phosphorus, as the tetrahedral $(VO_4)^{-3}$ group is preeminent in alkaline solutions, and in secondary minerals such as vanadinite.

Following World War II an intensive search for uranium ores in this country concentrated on the Colorado Plateau region. There, vanadium plays a major role in the mineralization of sandstones, and appears in a wide variety of minerals. This rich diversity was revealed in the early 1900's by the work of such mineralogists as D. Foster Hewett, Waldemar Schaller and Edward P. Henderson, but the intense studies of the 1950's greatly increased our knowledge of the mineralogy and also the chemistry of vanadium (Garrels and Larsen, 1959).

Figure 1. **Mexican postage stamp honoring Del Rio; School of Mines in the background.**

At that time the chemistry of vanadium was rather poorly understood – the chemistry of some of the synthetic elements heavier than uranium was much better described. Now we know that vanadium, as an early transition element, shares with molybdenum and tungsten its profound sensitivity to two environmental conditions: acidity and oxidation state. While molybdenum and tungsten in nature are to some extent locked up in highly insoluble sulfide and oxide compounds, vanadium responds freely to changes in both conditions (Evans and Garrels, 1959). Thus, although it is usually deposited originally in relatively simple compounds, it con-

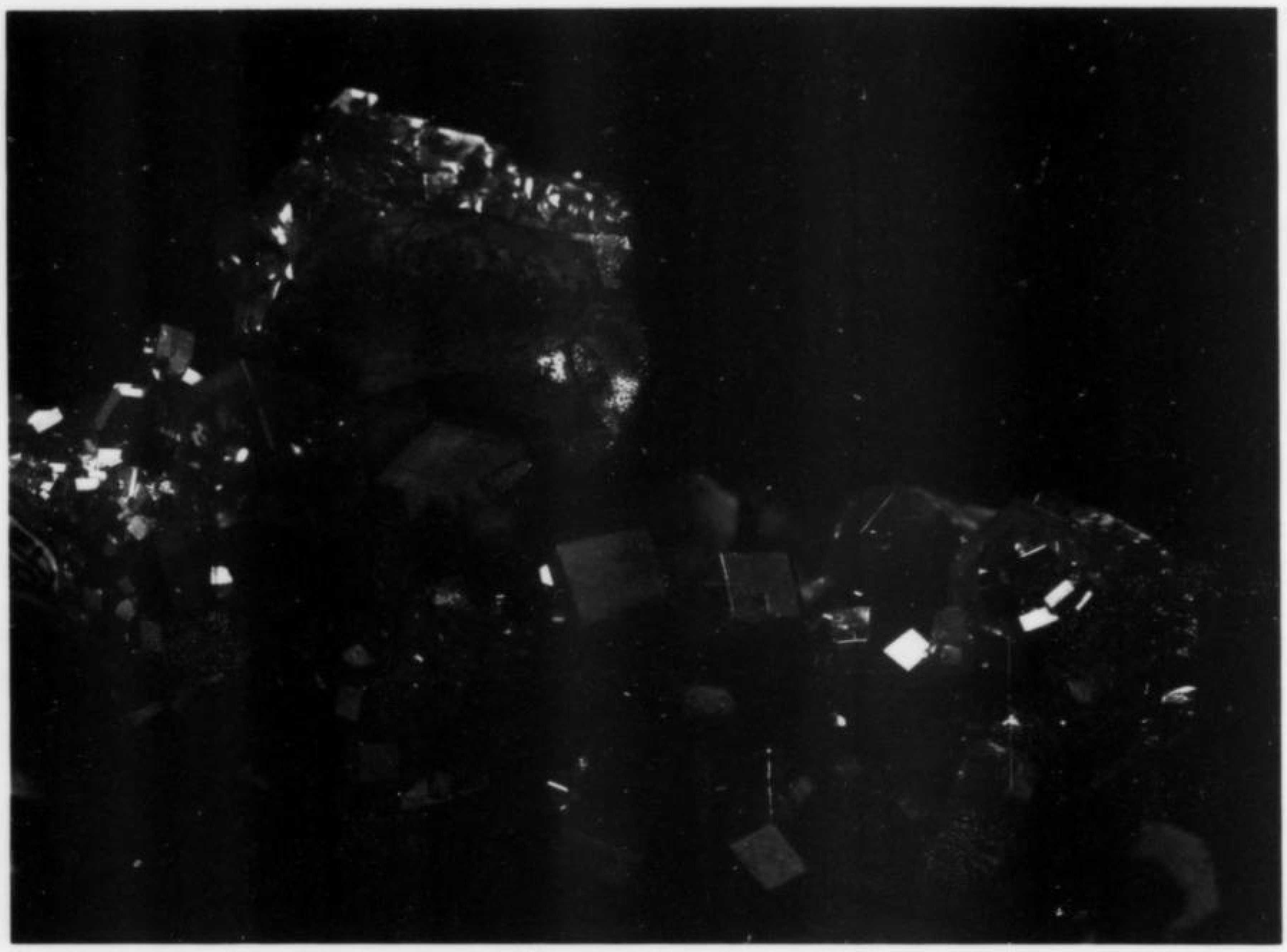


Figure 2. Vanadinite crystals to 1.3 cm from Mibladen, Morocco. Victor Yount specimen.

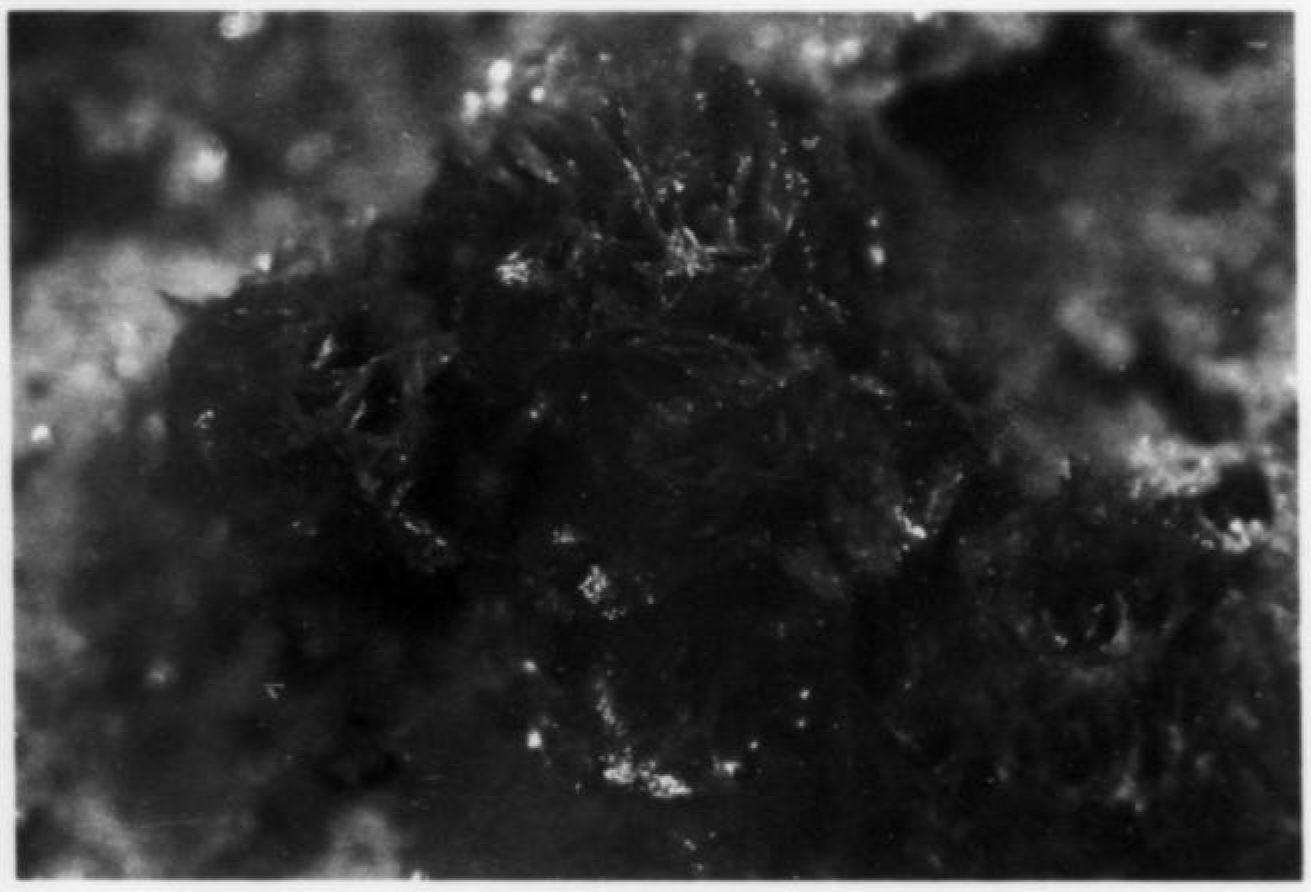


Figure 3. Calciovolborthite group 2 mm across from Monument Valley, Arizona. Photo by Dan Behnke.

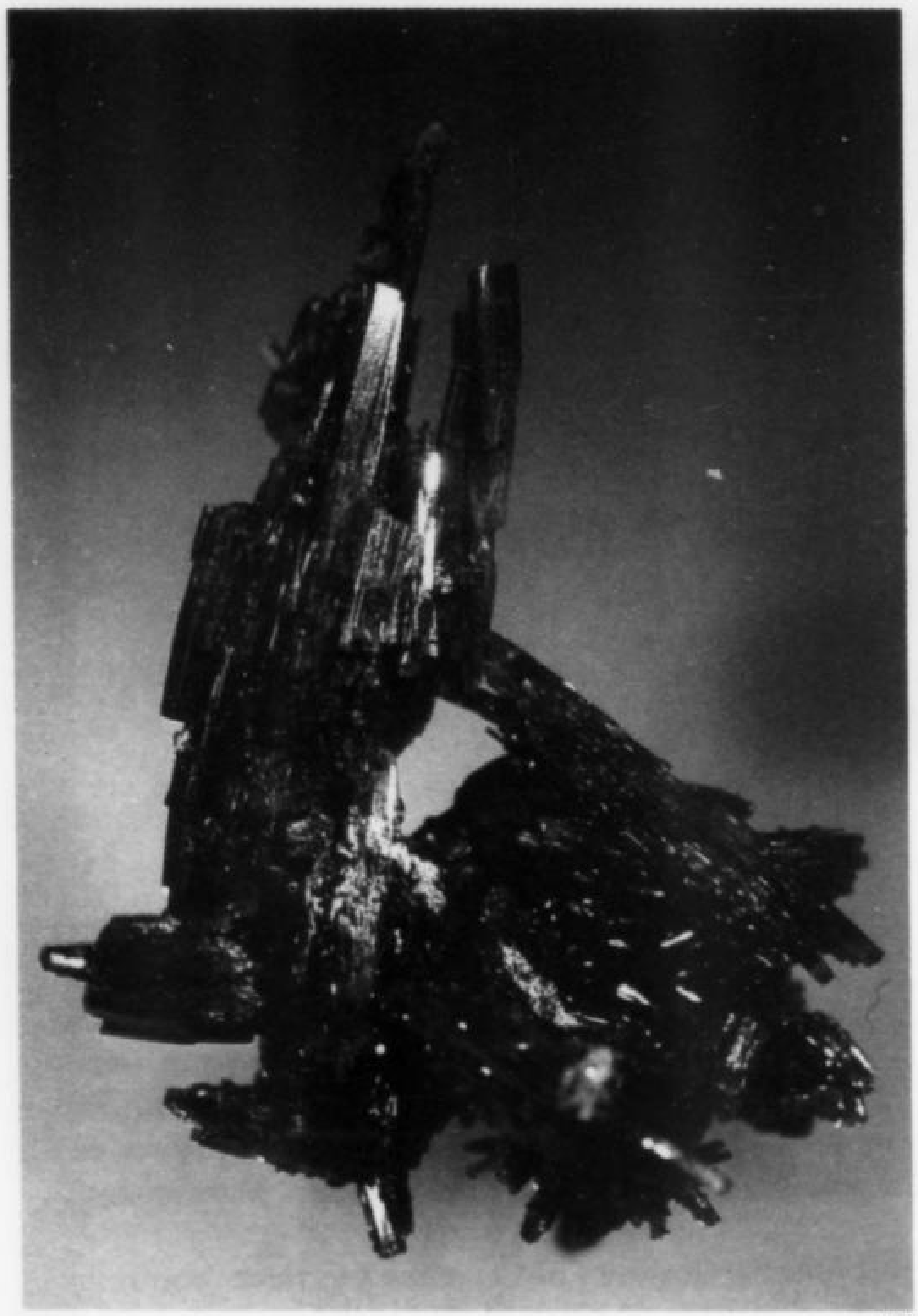


Figure 4. Vanadinite, variety _endlichite,_ from Los Lamentos, Chihuahua, Mexico. The crystal group is about 3.2 cm tall. Western Minerals specimen.

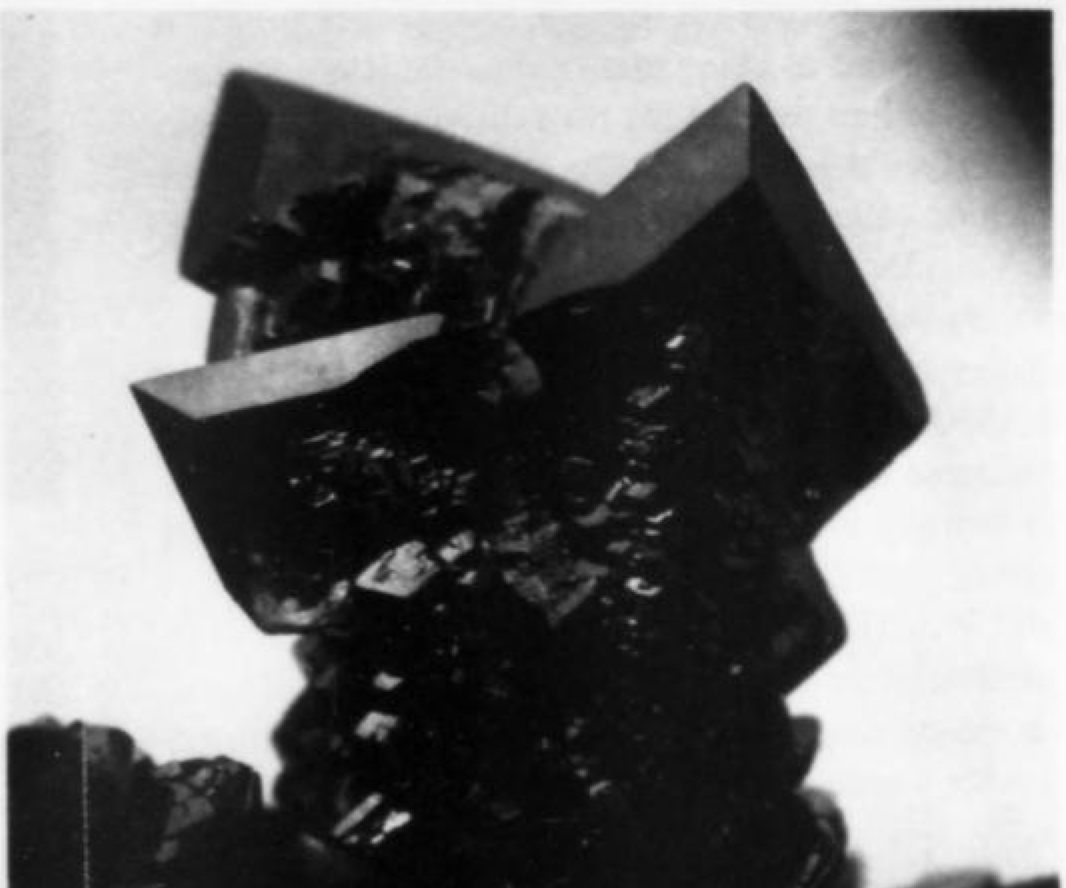


Figure 5. Descloizite crystal group about 1 cm tall from Tsumeb, Namibia. Photo by Eric Offermann.

Figure 6. **Metatyuyamunite with malachite, about 2 mm across, from Mashamba, Shaba, Zaire. Photo by Dan Behnke.**

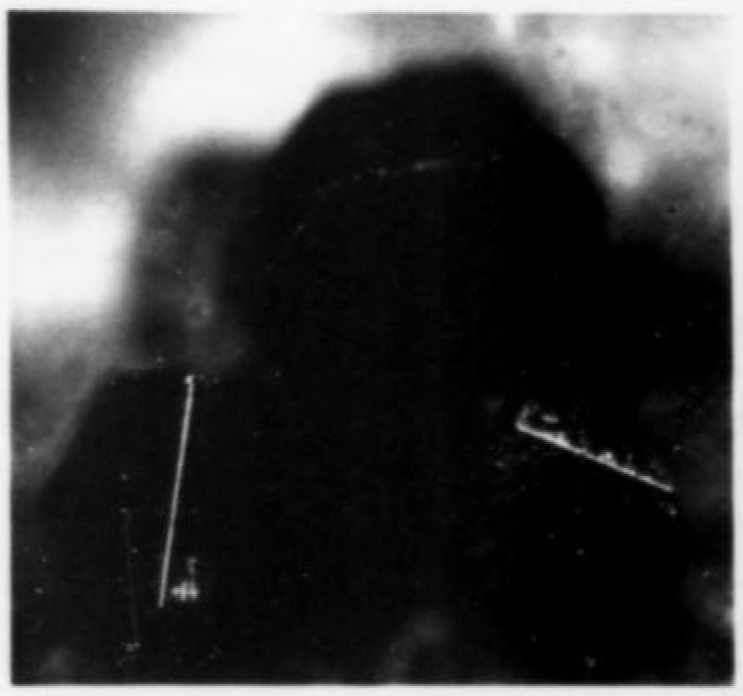


Figure 7. (above) **Pucherite from the Pucher mine, Schneeberg, East Germany. Equant crystals 0.5 mm in diameter. Photo by Norma Jaxel.**

Figure 8. (below) **Mottramite from Tsumeb, Namibia. Dendrites up to 2 cm in length. Photo by Norma Jaxel.**

Figure 9. (above) **Tyuyamunite from Fergana, Tyuya Muyun Hills, USSR. Books of plates 0.4 mm in diameter. Photo by Norma Jaxel.**

verts to a bewildering variety of highly colored mineral phases as it is released and oxidized by weathering processes.

There have been few reviews of vanadium mineralogy published, and this offering does not pretend to be such, but only a brief summary. Fisher (1970), in a bibliographic review, listed 62 accepted species plus 47 varietal and doubtful phases. Landergren (1974) listed 70 valid species. In Table 1 we list 119 established mineral species that contain vanadium as an essential constituent, and at-

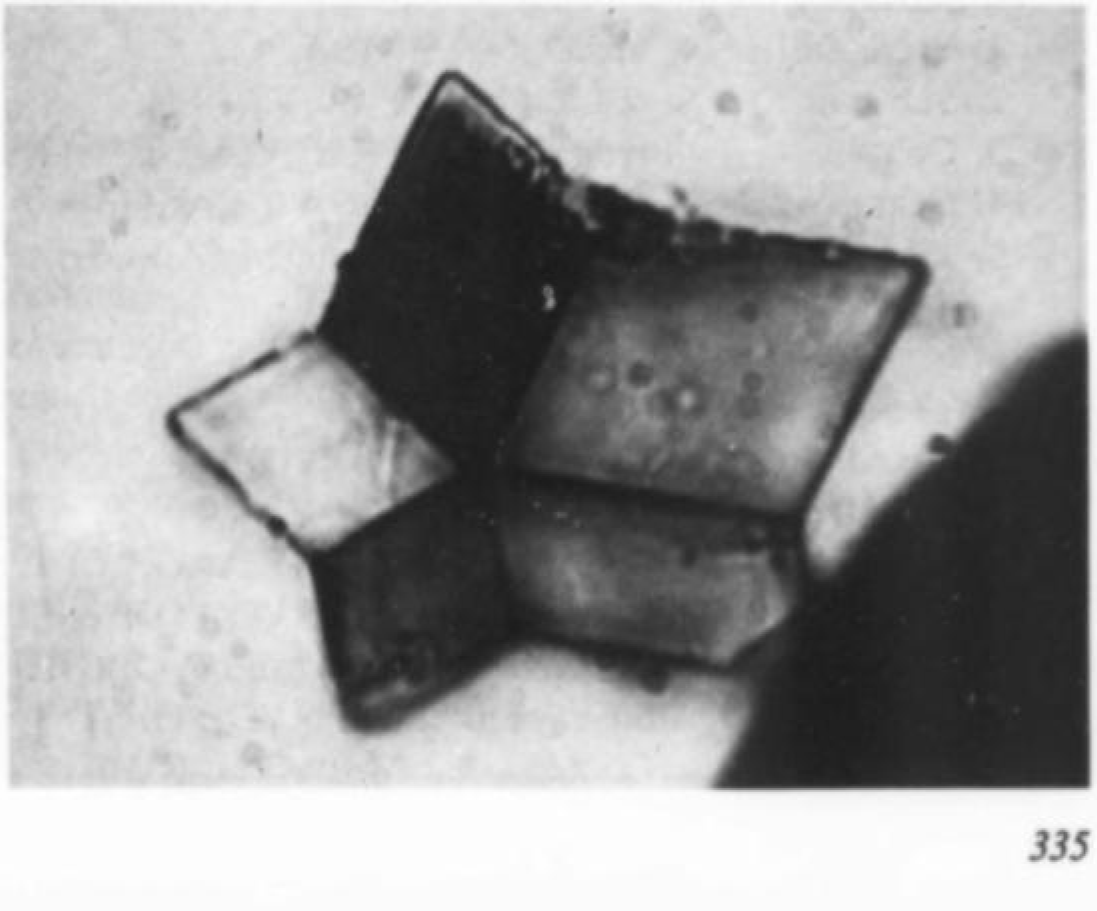


Figure 10. **Pentagonite fiveling prism from near Owyhee Dam, Malheur County, Oregon, seen on end in polarized light to show pleochroism. (In oil, with polarized plane vertical; crystal diameter 0.15 mm.) Evans photo.**

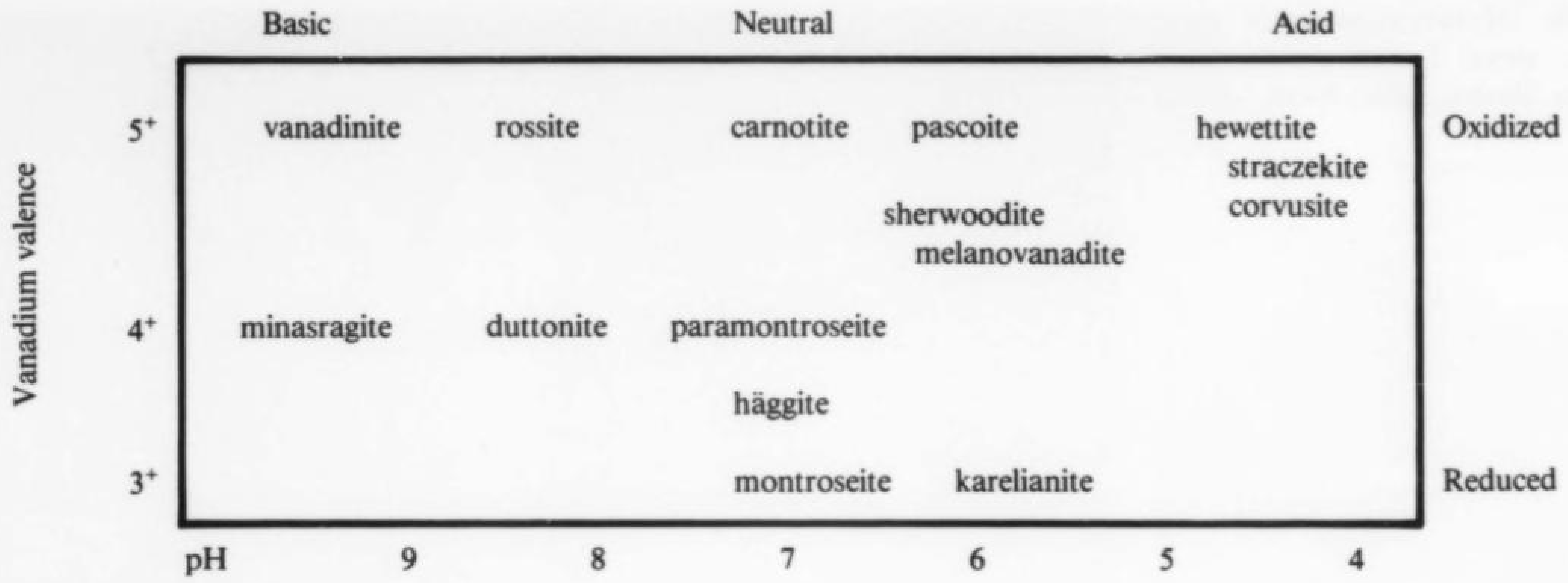


Figure 11. **Diagram showing formational environment in the acidity-valence potential field for some vanadium minerals.**

tempt a preliminary classification based mainly on crystal chemistry. Except for five sulfide species, all are oxygen-containing compounds. Much of the present understanding of the character of these minerals depends on our knowledge of their crystal structures, which reveal how vanadium is linked to oxygen in the solid mineral phase. The oxygen coordination may range from tetrahedral through square pyramidal or trigonal bipyramidal to octahedral, usually in highly distorted configurations. These groups may be isolated, or linked into combinations by sharing corners and edges.

The oxidation state may be trivalent, tetravalent or pentavalent, with mixtures of these in many compounds and minerals. The colors of phases in the pentavalent state range from colorless for purely tetrahedral types to yellow, orange, red or brown for the higher coordinations (modified by the presence of other color-producing elements). Hydrates in the tetravalent state are blue (e.g., pentagonite); trivalent vanadium compounds and also most compounds and minerals having mixed valence states are very dark colored or black. The crystal chemical behavior of vanadium in minerals has been summarized briefly by Evans (1969).

Table 1 lists the known vanadium mineral species, subdivided according to the properties mentioned above and other more particular characteristics. Every effort has been made to include all vanadium minerals described in the literature and accepted as valid species.

OCCURRENCE, FORMATION AND STABILITY

The primary source of vanadium is found mainly in titanomagnetite deposits in which vanadium is present as a minor replacement for iron. Most of the world's supply of vanadium today comes from such ores. Large amounts of vanadium are disseminated in mica and clay mineral deposits, and hydrothermal action on these, probably under neutral or slightly basic conditions, commonly produces oxidized secondary vanadium minerals containing tetrahedral VO_4^{-3} groups similar to phosphate, such as vanadinite, mottramite, descloizite, etc. (Table 1, group B).

At lower temperatures, the conditions of acidity and oxidation state under which a few typical species are stable in aqueous systems are estimated approximately (especially for pH) in Figure 11. In the eastern portions of the Colorado Plateau sandstones the primary deposition is mainly montroseite, together with uraninite, pyrite and other accessory minerals. In the subsequent weathering process the course of geochemical change depends on the amount of pyrite present (which creates strongly acid conditions) and the degree of exposure to atmospheric oxygen.

Thus, at the Peanut mine in Bull Canyon in southwestern Colorado, exposure to oxygen was low and solutions nearly neutral so that vanadium minerals in intermediate oxidation states such as duttonite and simplotite are found (Roach and Thompson, 1959). More commonly, as at the J. J. mine in the Jo Dandy area, Montrose County, Colorado, weathering proceeds to more acid, more oxidized conditions with the formation of such minerals as carnotite and hewettite (Elston and Botinelly, 1959). For these sand-

Table 1. **Classification list of vanadium mineral species**

A. Sulfides		
1. Patronite	black	$V(S_2)_2$
2. Sulvanite	reddish bronze	Cu_3VS_4
3. Colusite	reddish bronze	$Cu_{13}V(As,Sn,Sb)S_3S_{16}$
4. Nekrasovite	pale brown	$Cu_{13}V(Sn,As,Sb)_3S_{16}$
5. Yushkinite	pinkish violet bronze	$VS\cdot n[(Mg,Al)(OH)_2]$
B. Species with isolated tetrahedra, $(VO_4)^{-3}$ or $(V_2O_7)^{-4}$		
1. Vanadinite (apatite type)	red to brown	$Pb_5(VO_4)_3Cl$
Endlichite (var.)	yellowish green	$Pb_5[(V,As)O_4]_3Cl$
2. Descloizite	brown	$ZnPb(VO_4)(OH)$
3. Cechite	brown	$(Fe,Mn)Pb(VO_4)(OH)$
4. Mottramite	olive green	$CuPb(VO_4)(OH)$
5. Pyrobelonite	fire red	$MnPb(VO_4)(OH)$
6. Calciovolborthite	green	$CuCa(VO_4)(OH)$
7. Volborthite	dark green	$Cu_3(VO_4)_2\cdot 3H_2O$
8. Pucherite	brownish red	$Bi(VO_4)$
9. Dreyerite	orange-yellow	$Bi(VO_4)$
10. Clinobisvanite	yellow	$Bi(VO_4)$
11. Wakefieldite-Y (xenotime type)	brownish gray	$Y(VO_4)$
12. Wakefieldite-Ce	black	$(Ce,Pb)(VO_4)$
13. Mounanaite	brownish red	$Fe_2Pb(VO_4)_2(OH)$
14. Brackebuschite	dark brown	$Pb_2(Mn,Fe)(VO_4)_2\cdot H_2O$
15. Gamagarite	deep red	$Ba_2(Fe,Mn)(VO_4)_2\cdot H_2O$
16. Vesignieite	olive green	$BaCu_3(VO_4)_2(OH)_2$
17. Stoiberite	black	$Cu_5O_2(VO_4)_2$
18. Fingerite	black	$Cu_{11}O_2(VO_4)_6$
19. Ziesite	black	$Cu_2(V_2O_7)$
20. Blossite	black	$Cu_2(V_2O_7)$

21. Chervetite	colorless	$Pb_2(V_2O_7)$
22. Heyite	yellow-orange	$Fe_2Pb_5(VO_4)_2O_4$
23. Duhamelite	yellow-green	$Cu_4Pb_2Bi(VO_4)_4(OH)_3\cdot 8H_2O$
24. Schumacherite	yellow	$Bi_3[(V,As,P)O_4]_2O(OH)$
25. Turanite	green	$Cu_5(VO_4)_2(OH)_4$

C. Silicates

1. Roscoelite (muscovite type)	olive green	$K_2V_4(Si_6Al_2O_{20})(OH,F)_4$
2. Chernykhite (muscovite type)	dark green	$(Ba,K)_{0.4}(V,Al)_{2.3}Si_4O_{10}(OH)_2$
3. Goldmanite (garnet type)	deep or brownish green	$Ca_3(V,Fe,Al)_2Si_3O_{12}$
4. Cavansite	greenish blue	$Ca(VO)(Si_4O_{10})\cdot 4H_2O$
5. Pentagonite	blue	$Ca(VO)(Si_4O_{10})\cdot 4H_2O$
6. Haradaite	bright green	$Sr(VO)(SiO_3)_2$
7. Suzukiite	bright green	$Ba(VO)(SiO_3)_2$
8. Almbosite	blue	$Fe_9V_4Si_3O_{27}$
9. Kurumsakite	yellow	$(Zn,Ni,Cu)_8Al_8V_2Si_5O_{35}\cdot 27H_2O$
10. Nagashimalite	greenish black	$Ba_4(V,Ti)_4Si_8B_2O_{27}Cl(O,OH)_2$
11. Natalyite (pyroxene type)	dark green	$Na(V,Cr)(SiO_3)_2$
12. Medaite	brown	$(Mn,Ca)_6(V,As)Si_5O_{18}(OH)$
13. Saneroite	deep orange	$Na_{2.3}Mn_{10}(V,Si)Si_{10}O_{34}(OH)_4$
14. Ardennite	yellow	$Mn_4(Mg,Al)_6(SiO_4)_2(Si_3O_{10})[(As,V)O_4](OH)_6$
15. Franciscanite	cherry-red	$Mn_6V_{2-x}Si_2(O,OH)_{14}$

D. Isolated vanadate chains $(VO_3)_n^{n-}$ (metavanadates)

1. Rossite	pale yellow	$Ca(VO_3)_2\cdot 4H_2O$
2. Metarossite	colorless	$Ca(VO_3)_2\cdot 2H_2O$
3. Delrioite	pale yel. green	$CaSr(VO_3)_2(OH)_2\cdot 2H_2O$
4. Metadelrioite	yellow	$CaSr(VO_3)_2(OH)_2\cdot H_2O$
5. Munirite	pearly white	$NaVO_3\cdot 2H_2O$

E. Square pyramid $(VO)^{+2}$ species (excluding silicates)

1. Minasragrite	deep blue	$(VO)SO_4\cdot 5H_2O$
2. Stanleyite	deep blue	$(VO)SO_4\cdot 6H_2O$
3. Sincosite	green	$Ca(VO)_2(PO_4)_2\cdot 5H_2O$
4. Simplotite	dark green	$Ca(VO)_2(VO_4)_2\cdot 5H_2O$

F. Uranyl divanadite $(V_2O_8)^{-6}$ layer complexes

1. Carnotite	yellow	$K_2(UO_2)_2(V_2O_8)\cdot 3H_2O$
2. Tyuyamunite	yellow	$Ca(UO_2)_2(V_2O_8)\cdot 9H_2O$
3. Metatyuyamunite	yellow	$Ca(UO_2)_2(V_2O_8)\cdot 3H_2O$
4. Strelkinite	gold-yellow	$Na_2(UO_2)_2(V_2O_8)\cdot 6H_2O$
5. Margaritasite	yellow	$(Cs,K,H_3O)_2(UO_2)_2(V_2O_8)\cdot H_2O$
6. Fritzscheite	yellow	$Mn(UO_2)_2(V_2O_8)\cdot 10H_2O$
7. Sengierite	green	$Cu(UO_2)_2(V_2O_8)\cdot 6H_2O$
8. Curienite	yellow	$Pb(UO_2)_2(V_2O_8)\cdot 5H_2O$
9. Francevillite	yellow	$(Ba,Pb)(UO_2)_2(V_2O_8)\cdot 5H_2O$
10. Vanuralite	lemon-yellow	$Al(OH)(UO_2)_2(V_2O_8)\cdot 11H_2O$
11. Metavanuralite	yellow	$Al(OH)(UO_2)_2(V_2O_8)\cdot 8H_2O$
12. Vanuranylite	yellow	$(H,Ba,Ca,K)_{1.6}(UO_2)_2(V_2O_8)\cdot 5H_2O$

G. Iso- and heteropoly molecular complexes

1. Pascoite	orange	$Ca_3(V_{10}O_{28})\cdot 17H_2O$
2. Hummerite	orange	$K_2Mg(V_{10}O_{28})\cdot 16H_2O$
3. Huemulite	yellow-orange	$Na_4Mg(V_{10}O_{28})\cdot 24H_2O$
4. Sherwoodite	bluish black	$Ca_{4.5}(AlV_{14}O_{40})\cdot 40H_2O$

H. Octahedral low-valence oxides hydroxides

1. Montroseite (goethite type)	black	$VO(OH)$
2. Paramontroseite	black	VO_2
3. Häggite	black	$V_2O_2(OH)_3$
4. Duttonite	pale brown	$VO(OH)_2$
5. Doloresite	brown	$V_3O_4(OH)_4$
6. Lenoblite	blue	$V_2O_4\cdot 2H_2O$
7. Mannardite	black	$(Ba\cdot H_2O)V_2Ti_6O_{16}$

I. Anhydrous oxides

1. Schreyerite	reddish brown	$V_2Ti_3O_9$
2. Kyzylkumite	black	$V_2Ti_3O_9$
3. Berdesinskiite	black	V_2TiO_5
4. Tivanite	black	$VTiO_3(OH)$
5. Coulsonite (spinel type)	black	FeV_2O_4
6. Vuorelainenite (spinel type)	black	$(Mn,Fe)(V,Cr)_2O_4$
7. Nolanite	black	$(Fe,V)_4V_6O_{16}$
8. Karelianite	black	V_2O_3
9. Stibivanite	yellow-green	Sb_2VO_5

J. Vanadium bronzes

1. Hewettite	red	$Ca(V_6O_{16})\cdot 6H_2O$
2. Metahewettite	brownish red	$Ca(V_6O_{16})\cdot 3H_2O$
3. Barnesite	deep red	$Na_2(V_6O_{16})\cdot 3H_2O$
4. Hendersonite	greenish black	$Ca_{1.3}(V_6O_{16})\cdot 6H_2O$
5. Grantsite	dk. olive green	$Na_2Ca_{0.4}(V_6O_{16}\cdot 4H_2O$
6. Straczekite	greenish black	$(Ca,K,Ba)(V_8O_{20})\cdot 3H_2O$
7. Corvusite	black	$(Ca,Fe)(V_8O_{20})\cdot 8H_2O$
8. Fernandinite	green	$Ca_{0.6}(V_8O_{20})\cdot 10H_2O$
9. Bariandite	black	$V_{10}O_{24}\cdot 12H_2O$
10. Navajoite	black	$V_2O_5\cdot 3H_2O$
11. Bannermanite	black	$Na(V_6O_{15})$
12. Melanovanadite	black	$Ca_2(V_8O_{20})\cdot 10H_2O$
13. Namibite	dark green	$CuBi_2O_3(VO_3)$
14. Shcherbinaite	yellow-green	V_2O_5

K. Aluminous layer vanadates

1. Alvanite	bluish green	$Al_6(VO_4)_2(OH)_{12}\cdot 5H_2O$
2. Gutsevichite	yellow to olive	$(Al,Fe)_3[(P,V)O_4]_2(OH)_3\cdot 8H_2O$
3. Rusakovite	yellow	$(Fe,Al)_5[(V,P)O_4]_2(OH)_9\cdot 3H_2O$
4. Satpaevite	greenish yellow	$Al_6(VO_4)_4(OH)_3\cdot 24H_2O$
5. Steigerite	yellow	$Al(VO_4)\cdot 3H_2O$
6. Schoderite	orange-yellow	$Al_2(PO_4)(VO_4)\cdot 8H_2O$
7. Metaschoderite	orange-yellow	$Al_2(PO_4)(VO_4)\cdot 6H_2O$
8. Vanalite	bright yellow	$NaAl_8V_{10}O_{38}\cdot 30H_2O$
9. Bokite	brown. black	$K(Al,Fe)_9V_{26}O_{76}\cdot 30H_2O$

L. Vanadates of uncertain type

1. Pintadoite	green	$Ca_2(V_2O_7)\cdot 9H_2O$
2. Rauvite	dk. purplish red	$Ca(UO_2)_2(V_{12}O_{32})\cdot 16H_2O$
3. Fervanite	light brown	$Fe(VO_4)\cdot 5H_2O$
4. Schubnelite	black	$Fe(VO_4)\cdot H_2O$
5. Santafeite	black	$(Ca,Sr,Na,Mn)_5Mn_2V_4O_{14}(OH)_{10}$
6. Rankachite	dark brown	$CaFeV_4W_8O_{36}\cdot 6H_2O$
7. Tomichite	black	$(V,Fe)_4Ti_3AsO_{13}(OH)$
8. Uvanite	brown. yellow	$U_2V_6O_{21}\cdot 15H_2O$
9. Vanoxite	black	$V_6O_{13}\cdot 8H_2O$
10. Kolovratite	yellow	hydrous Ni,Zn vanadate

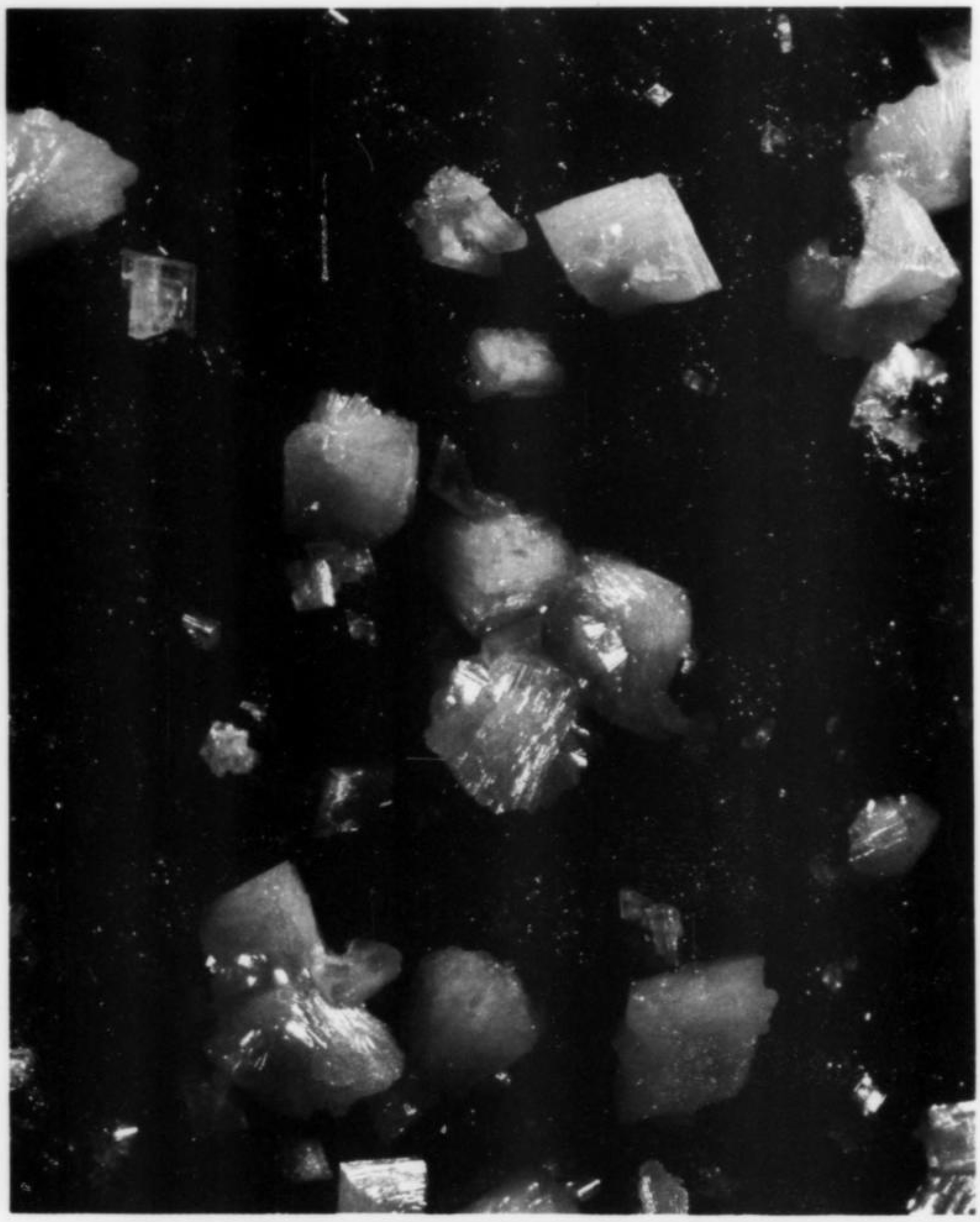
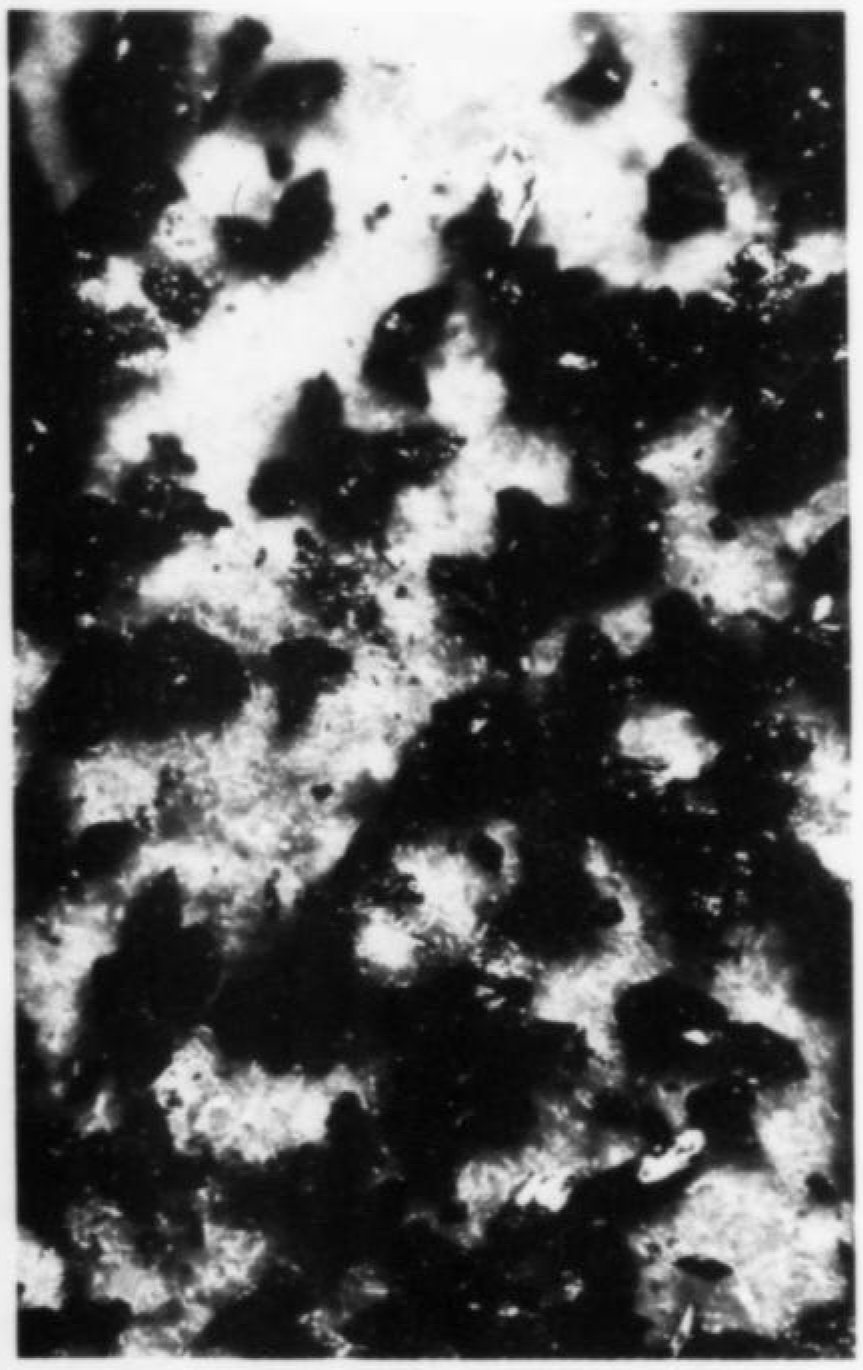


Figure 12. **Francevillite from Mounana, Gabon; crystal groups up to 5 mm in diameter. Photo by Nelly Bariand.**

Figure 13. **Sherwoodite on carnotite from the Peanut mine, Montrose County, Colorado. Crystals average 0.12 mm in length. Evans photo.**



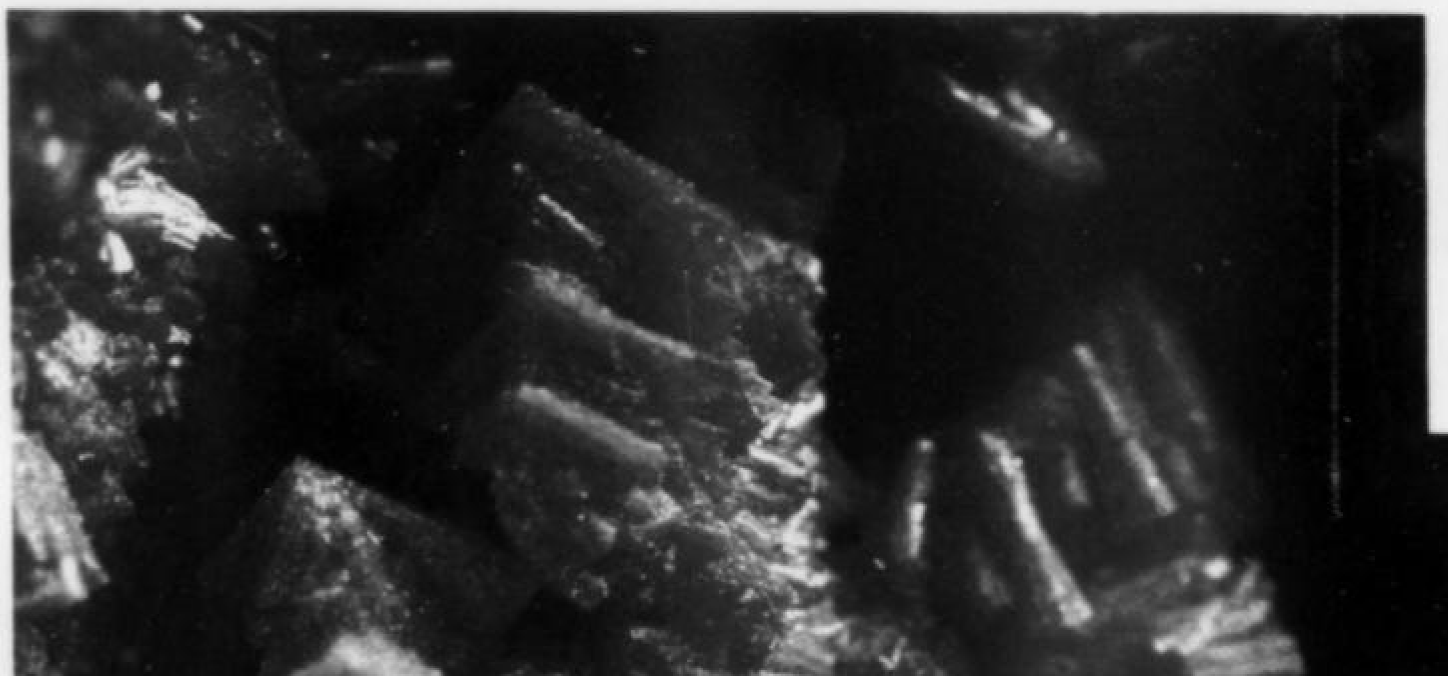


Figure 14. **Curienite with francevillite from Mounana, Gabon. The crystals are 1 mm on an edge. F. John Barlow collection.**

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stone horizons some insight about their geochemical history was gained by the researches of the U.S. Geological Survey, the Atomic Energy Commission, and various university groups, but such information is incomplete for other deposits and terranes.

Another uranium-vanadium deposit that is rather similar to that of the Colorado Plateau is at Mounana, Gabon. This occurrence has been described by Cesbron and Bariand (1975), with many fine color photographs by Nelly Bariand. They carefully compare the Colorado and Gabon deposits, and conclude that the latter was confined to a much narrower acidity range (pH 2.5 to 4) than the former, with calcium completely lacking.

In a nonaqueous environment, an unusual group of vanadium minerals has been found as sublimates in fumaroles at the summit of Izalco volcano in El Salvador, Central America (Stoiber and Rose, 1974). These include fingerite, stoiberite, blossite, ziesite, shcherbinaite and bannermannite.

Some of the distinctive structural features of the mineral groups of Table 1 are briefly described in the following sections.

CRYSTAL CHEMICAL PROPERTIES

A few of the species listed could be placed in two groups on the basis of particular structural features. For example, cavansite and pentagonite are basically silicate layer structures, with the layers held together by square pyramid $(VO)O_4$ groups (as found in mineral group E) in which the four basal oxygen atoms are contributed by silicate groups in the adjacent layers, two from each layer. Simplotite is a layer complex of (VO_4) tetrahedra (as in group B) and (VO_5) square pyramids in an arrangement similar to the sheet structure of autunite, $Ca(UO_2)_2(PO_4)_2 \cdot 10H_2O$. In this case, we see vanadium playing the role of a uranyl group (UO_2) and a phosphate group (PO_4) in the same structure.

Fully oxidized vanadium minerals

Group B constitutes a fairly large number of minerals that contain simple tetrahedral $(VO_4)^{-3}$ groups, somewhat analogous to phosphate $(PO_4)^{-3}$ (compare isostructural vanadinite, mottramite and chlorapatite). For many other oxovanadate minerals the analogy is overemphasized and formulations containing (VO_4) units probably do not reflect the true crystal chemistry of the compound (e.g., fervanite, schoderite, santafeite, etc.). Nevertheless, where structural information is lacking, the original formulation is shown in Table 1.

The water-soluble minerals rossite and pascoite (groups D and G) are analogous to well known synthetic compounds (Evans, 1969). Rossite is a typical metavanadate consisting of zig-zag chains of edge-shared trigonal bipyramids. Pascoite, hummerite and huemulite contain the decavanadate $(V_{10}O_{28})^{-6}$ molecular ion (Fig. 15) which colors its compounds bright orange. The decavanadate salts are soluble and leach freely out of black oxide-sandstone ores to form crystalline crusts on the exposed surfaces. In a mine stope in such deposits a miner's lamp beam projected down the stope into the darkness returns bright flashes of orange color reflected from these crusts (coated with water droplets), like reflecting road signs.

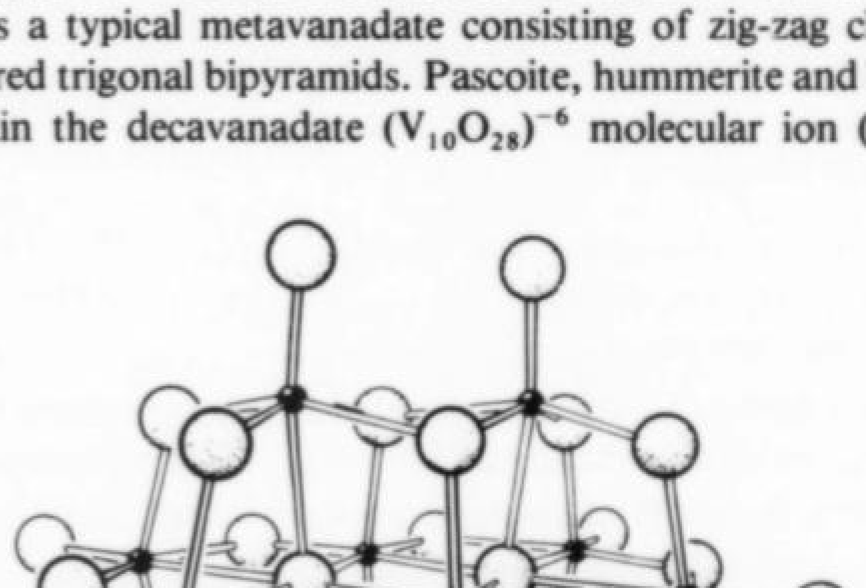

Figure 15. **The decavandate $(V_{10}O_{28})^{-6}$ molecule ion in pascoite, hummerite and huemulite.**

The carnotite series (group F) forms a special structure class, based on a sheet structure of dumbbell-shaped uranyl groups (UO_2) linked to double square pyramidal divanadate groups (V_2O_8) (Fig. 16). Uranyl salts (resulting from acid oxidation of uraninite and coffinite) and acid vanadate salts are both very soluble and quickly lost in groundwaters, but when they come together in the same solution the highly insoluble carnotite-type layer minerals are formed and the elements becomes fixed and potentially exploitable.

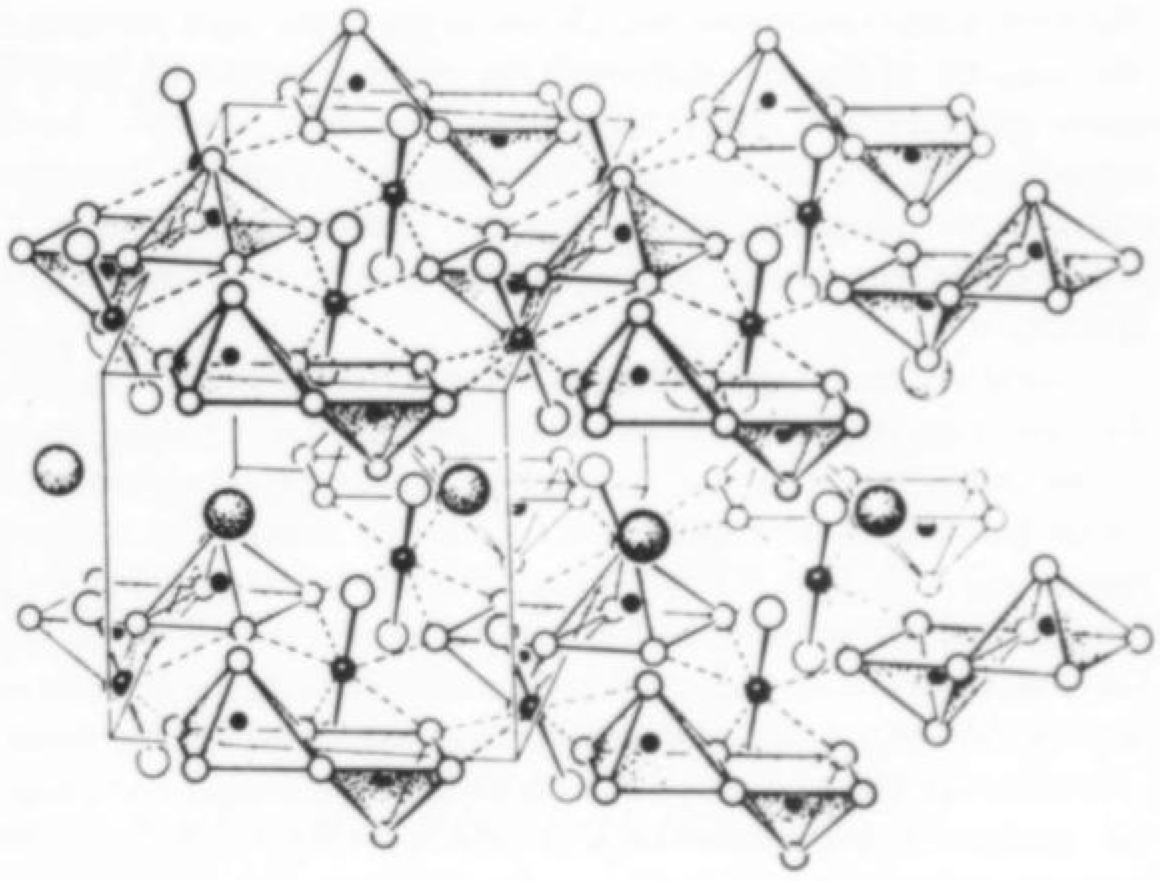

Figure 16. **The layer structure of the synthetic cesium analog of carnotite, showing linkage of double V_2O_8 groups and dumbbell-shaped UO_2 groups into sheets (large spheres are Cs atoms).**

Lower and mixed valence oxide species

In the low-valence oxides (group H) vanadium behaves much like trivalent iron or manganese in octahedral coordination. The structures consist of parallel linkages of octahedral chains (as in manganite), or double octahedral chains (as in goethite or groutite), with the resulting sheets held together with hydrogen bonds contributed by hydroxyl groups in the layer. Nolanite, coulsonite, schreyerite and vuorelainenite are anhydrous phases which have

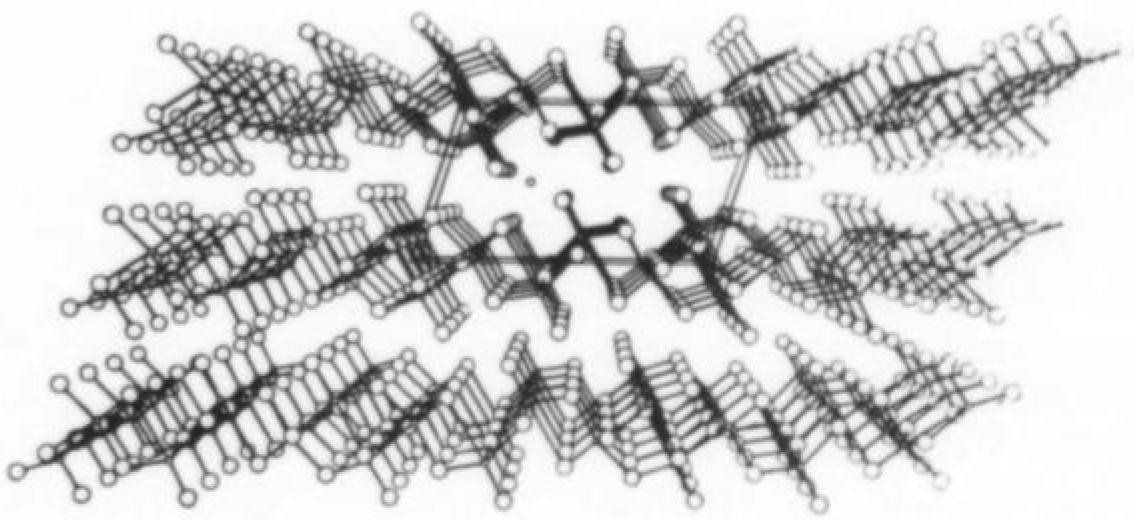

Figure 17. **Edge view of layer structure of synthetic $Li_3V_6O_{16}$, analogous to the hewettite group of minerals. A single Li atom is shown, but the interlayer region can expand to accommodate other cations and water molecules.**

spinel-like structures. These anhydrous oxide types often contain mixed trivalent and tetravalent vanadium. Most all of these low-valence oxides are opaque and black in color.

The "vanadium bronzes" are a series of synthetic compounds that have been extensively studied by Hagenmuller and his colleagues, and others (Hagenmuller, 1973). They consist generally of chains of octahedra joined laterally into sheets, which are interleaved with cations and water molecules (Fig. 17). The negative charges on the sheets may vary by mixing V^{+4} and V^{+5} cations in different proportions and these charges are balanced by appropriate amounts of cations (usually Ca^{+2}), often not stoichiometric, in the interlayer region. The crystals have perfect cleavage, and are typically fibrous and very soft. Because of the mixed valances of vanadium they are dark-colored or black and highly lustrous – hence the term "bronze." These structurally highly condensed phases form under the most acidic conditions and cluster in the upper right portions of the diagram in Fig. 11. Although the oxide minerals of group H have characteristic layer structures that may contain mixed valences, they are distinct from the bronzes of group J. Interlayer cations are generally absent (except hydrogen) in group H, although Fe may substitute for V to a considerable extent in both groups.

Several different types of layer structure have been found among the vanadium bronze minerals, which are reflected to some degree by the formulations shown. A common one is typified by hewettite, which has a layer arrangement analogous to that of the synthetic compound $Li_3V_6O_{16}$. A new type has recently been found in the old mineral melanovanadite (Konnert and Evans, 1987). This mineral has a layer structure that does not contain distinct chain elements but consists of a linkage of regular tetrahedra and double square pyramids like those of group F. Otherwise, the physical and chemical properties of melanovanadite are like those of the other minerals in group J.

Vanadosilicates

In several minerals tetravalent vanadium plays a special role giving rise to unique crystal structures. In cavansite and pentagonite, VO_5 square pyramids cross-link silicate layer structures, while in haradaite and suzukiite they join silicate chains laterally. On the other hand, in the micaceous minerals such as roscoelite and vanadium clays trivalent and tetravalent vanadium simply replaces aluminum in the octahedral layers. In other silicate species, such as almbosite and kurumsakite, the role of vanadium is still unknown.

GENERAL OBSERVATIONS

The crystal chemistry of vanadium can thus be seen to vary widely with chemical and physical environment (Fig. 11). In the fully oxidized pentavalent state vanadium in basic conditions forms structures containing VO_4 tetrahedra like phosphate (vanadinite, descloizite, etc.), but as acidity increases in aqueous surroundings the tetrahedra first link into chains (rossite) and then condense into polynuclear groups of square pyramids or distorted octahedra giving predominantly orange or red compounds (pascoite). The size of the vanadate group (coordination number) generally increases from left to right in Figure 11. Finally, in the most acidic conditions the octahedra condense further into chains and sheets forming less soluble compounds (hewettite), which may be easily reduced to mixed tetravalent and pentavalent vanadates (bronzes). Tetravalent vanadium in aqueous medium is usually found in square pyramid coordination (minasragrite, cavansite, duttonite), but this state is often transitory in the weathering process, except in the micaceous silicates where it is locked in the aluminum-like octahedral layers. In reduced primary deposits trivalent vanadium behaves like iron and forms similar, dark-colored structures based on fairly regular octahedral coordination (montroseite, nolanite, karelianite). Again, admixture of tetravalent vanadium in such phases readily occurs in slightly oxidizing conditions (häggite).

In the presence of such wide diversity of behavior the element vanadium plays many different roles, and with its electronic structure readily interacting with visible light wavelengths (transition element *d* orbitals) produces highly colored compounds. It sometimes imitates other elements like iron or phosphorus, but it usually appears in structures that are unique to vanadium. As Table 1 was being compiled it grew at a surprising rate as more recent discoveries were uncovered. It will be interesting to follow new developments in the rich and fascinating field of vanadium chemistry and mineralogy.

ACKNOWLEDGMENTS

It is a pleasure to acknowledge the invaluable help of Richard C. Erd and Michael Fleischer of the U.S. Geological Survey in making the list of vanadium minerals (Table 1) as complete as possible, and improving this contribution. Photographs were kindly supplied by Nelly Bariand, Dan Behnke, Norma Jaxel, Eric Offermann and Wendell Wilson. We are extremely grateful to them for the fine illustrations shown in these pages.

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INESITE

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from the Hale Creek mine, Trinity County, California

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The Hale Creek manganese deposit has afforded some of the largest and finest examples of crystallized inesite in the world. In addition, the discovery of several new inesite crystal forms makes this occurrence especially interesting.

INTRODUCTION

Fine crystallized samples of inesite, $Ca_2Mn_7Si_{10}O_{28}(OH)_2 \cdot 5H_2O$, were first recovered from the abandoned Hale Creek manganese mine in 1971. Although the mineral was recognized from the deposit as early as 1941 (Trask *et al.*, 1943), the well-formed pink crystals were not generally known to the mineral community until mineral collectors first etched them out of surrounding calcite with acid.

Since many mineral collectors now possess fine samples of Hale Creek inesite, we decided to describe this interesting locality in the light of new observations on the crystal morphology made by the authors during an optical study of a number of crystals. Our study resulted in the discovery of several new crystal forms not previously known to exist on inesite found at other world localities (Ryall and Threadgold, 1968).

While most inesite from various world locations is commonly described as forming aggregates of radiating acicular crystals, the Hale Creek inesite forms rare terminated crystals. Inesite with visible crystal faces has so far been reported from Långban, Sweden (Hamberg, 1884; Flink, 1900, 1916); Durango, Mexico (Farrington, 1900); Nazenbach, West Germany (Schneider, 1887); Rendaiji, Japan (Takasu, 1955); Broken Hill, Australia (Ryall and Threadgold, 1968); the Crescent mine, Washington (Cannon, 1975), and the Wessels mine, South Africa (Wilson and Dunn, 1978). Additional U.S. localities for inesite have been described by Glass and Schaller (1939); Van Loenen (1980), and Pemberton (1983).

LOCATION

The Hale Creek mine is located within the rugged Six Rivers National Forest in NW¼ sec. 23, T15S, R6E, about 90 km northeast of Eureka, California. A poorly graded road fords the Mad River near Ruth Dam and ascends a ridge parallel to Hale Creek for about 3 km, terminating at the mine.

The topography of the area is typical of the northern California Coast Ranges which consist of rugged mountains, largely inaccessible, separated by narrow, long valleys. Dense brush and timber cover much of these northwest-southeast trending ranges. Heavy rainfall is common during the winter months which, over time, has resulted in chemical weathering and the formation of a heavy soil mantle that obscures the underlying rocks in many places. The summer months can be relatively hot. Hale Creek is one of the largest tributary streams in the area and flows into the Mad River.

HISTORY

Most of the California manganese deposits occur in chert of the Franciscan Formation which is extensively exposed in the Coast Ranges of northwestern California. Trinity County contains the largest number of manganese deposits of any county in California, with over 100 localities having been recorded (Trask *et al.*, 1943).

The Hale Creek manganese deposit was discovered and located by S. Hutchins and H. T. Moore of Ruth, California, before 1941 and subsequently leased to W. Doty and S. Killingsworth of Mad River, California. It was not actively developed until manganese

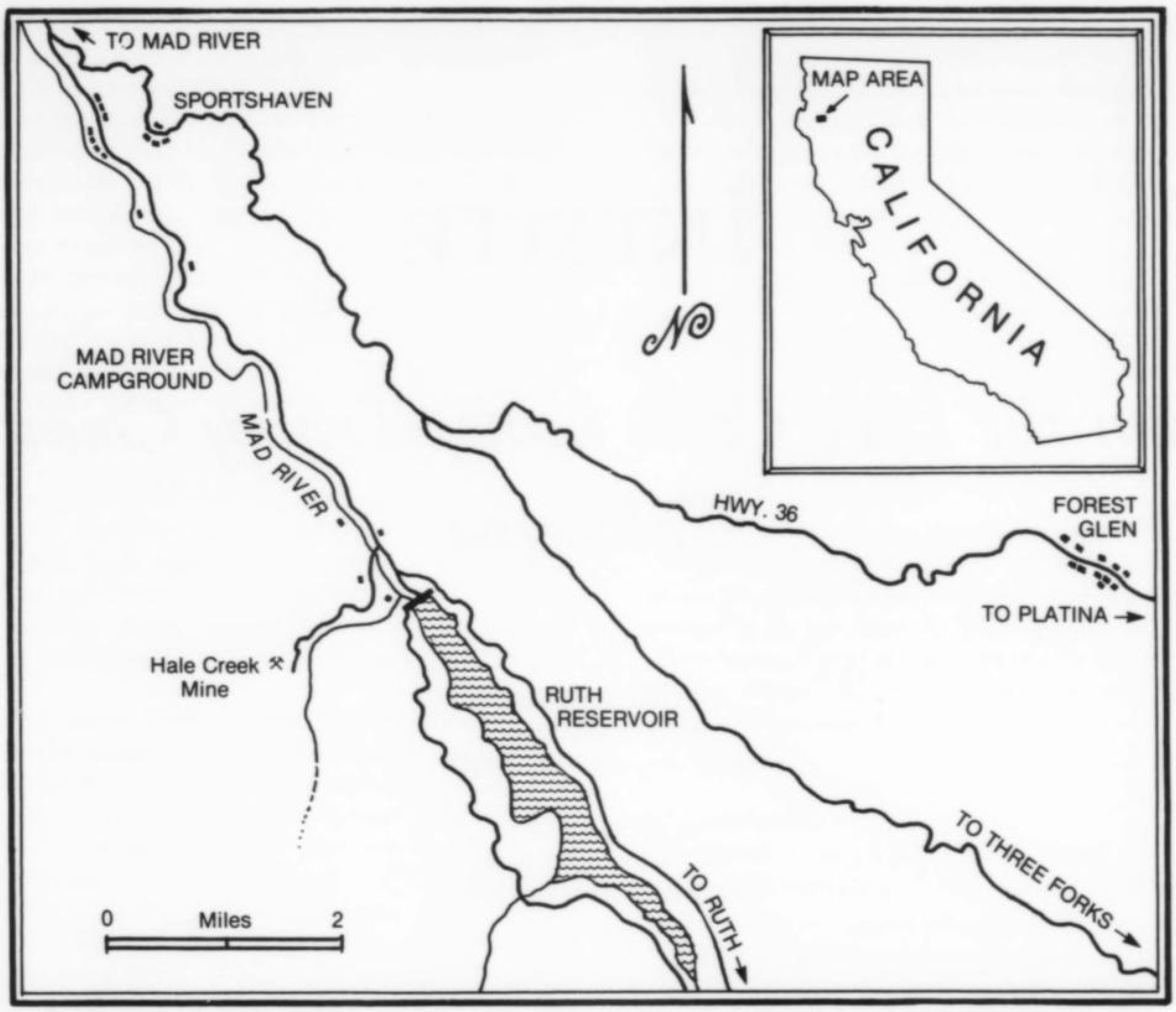


Figure 1. **Location map.**

prices increased during World War II, making mining profitable. Trask (1950) states that during the summer of 1941 about 600 tons of rhodochrosite ore had been mined and stockpiled beside the deposit. At that time the carbonate ore could not be marketed because of government ore restrictions.

When the site was revisited in August of 1944 by M. D. Crittenden of the California Division of Mines nearly 4,000 tons of ore had been mined since 1943 by W. H. Snyder and R. F. Helmke. The ore at that time averaged 42% manganese, 1% iron, and 21% silica (Trask, 1950; O'Brien, 1965). By the end of 1944, the tabular orebody had been depleted and mining ceased.

The massive manganese orebody occurred near the crest of a flat-topped spur which made stripping of the chert and sandstone overburden relatively simple. Mining was done by open-cut methods, using a bulldozer to remove the sandstone from above the orebody. After removal of the overburden, the exposed ore was blasted and then stockpiled for loading into trucks via a wooden hopper to be taken to the shipping point at either Carlotta or Alton on the Northwestern Pacific Railroad, a distance of 88 km (Trask, 1950).

The orebody measured 50 meters long and 1 to 4 meters thick in 1944 and was lying nearly horizontally in a sequence of thin-bedded white chert encased in sandstone.

Both Trask *et al.* (1943) and Trask (1950) recorded the presence of inesite in the deposit as occurring in veins of silky radiating crystals between 1 and 1.5 cm in size associated with small amounts of chrysocolla, native copper and cuprite. The inesite and calcite veins were nearly vertical and followed along fractures in the orebody above a greenstone intrusion.

The first specimens of crystallized inesite were collected in 1971 by A. L. McGuinness and J. Parnau, both affiliated with the Bay Area Mineralogists, Menlo Park, California. Their trip to the Hale

Figure 2. **Inesite crystals to 7 mm lining a vug in manganese ore. G. Dunning specimen.**

WEW

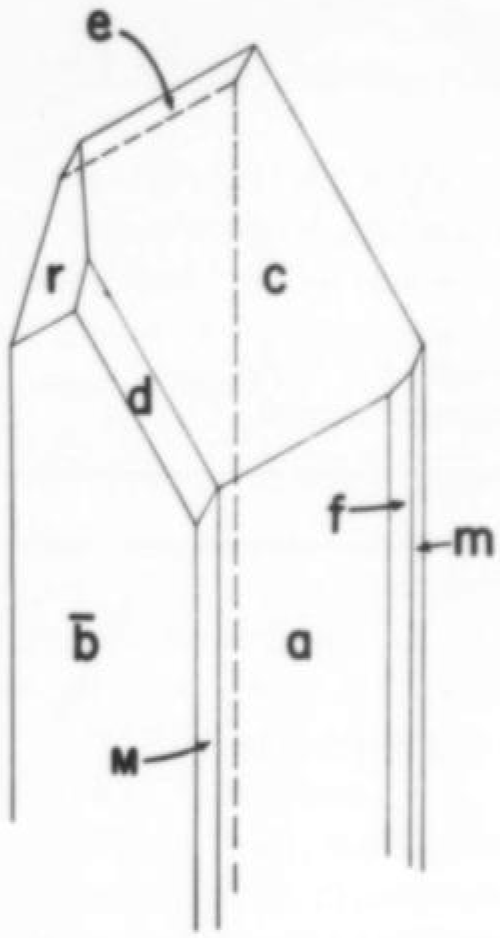
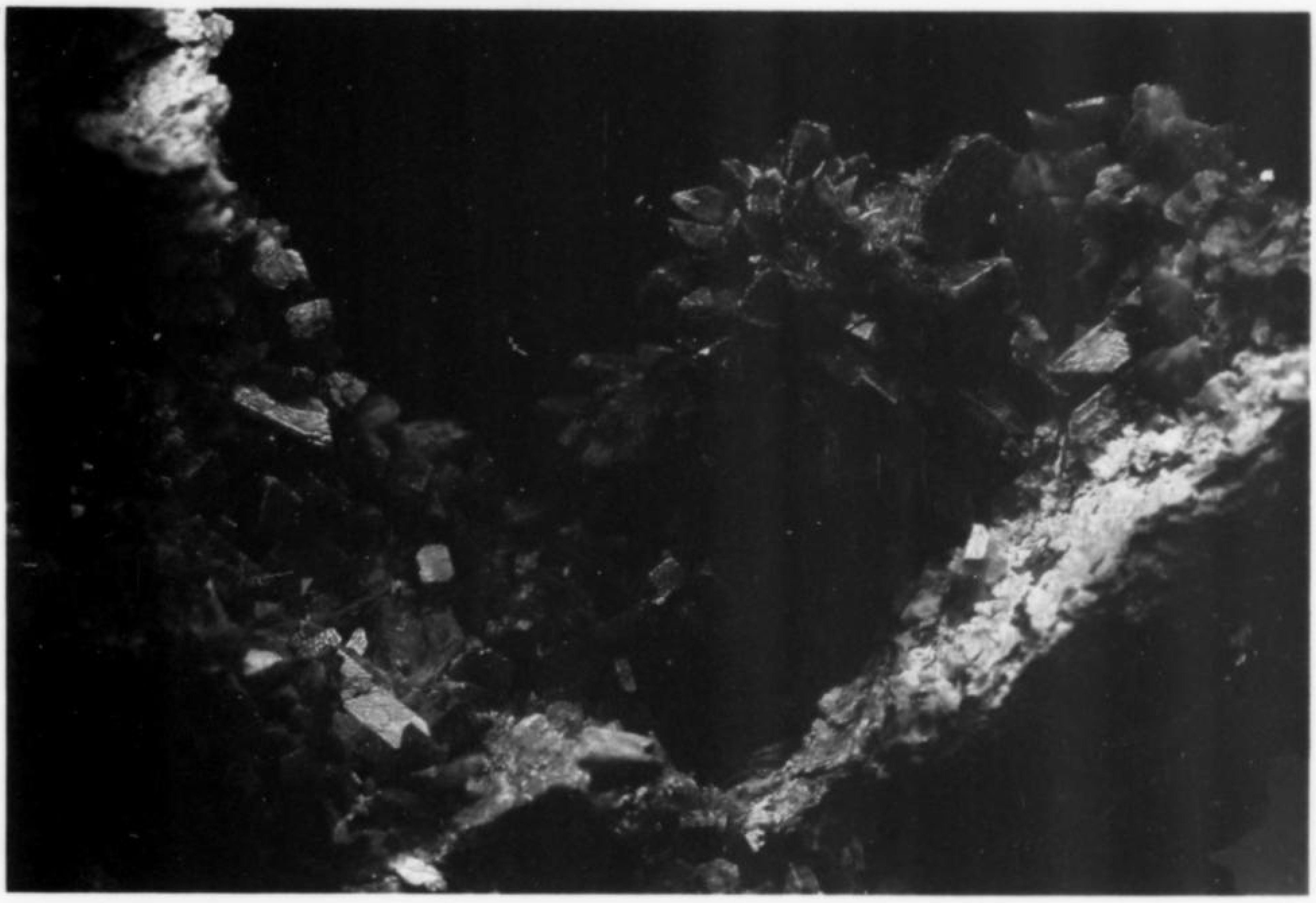


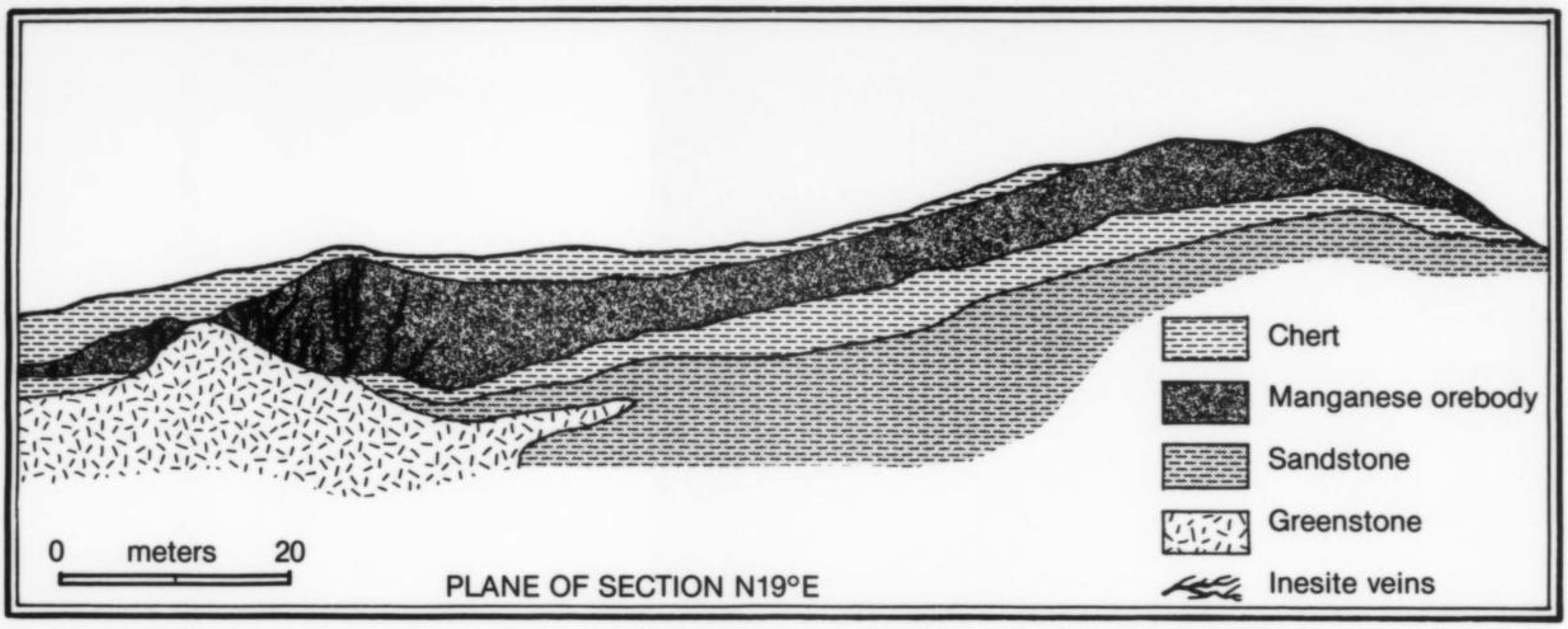
Figure 3. **Crystal drawing of inesite showing several of the forms including the new form** $r\{\bar{1}\bar{1}1\}$.

Figure 4. **Inesite crystals to 2.2 cm lining a vug in manganese ore. G. Dunning specimen.**

Figure 5. **Inesite crystals to 1 cm lining a vug in manganese ore. G. Dunning specimen.**

WEW





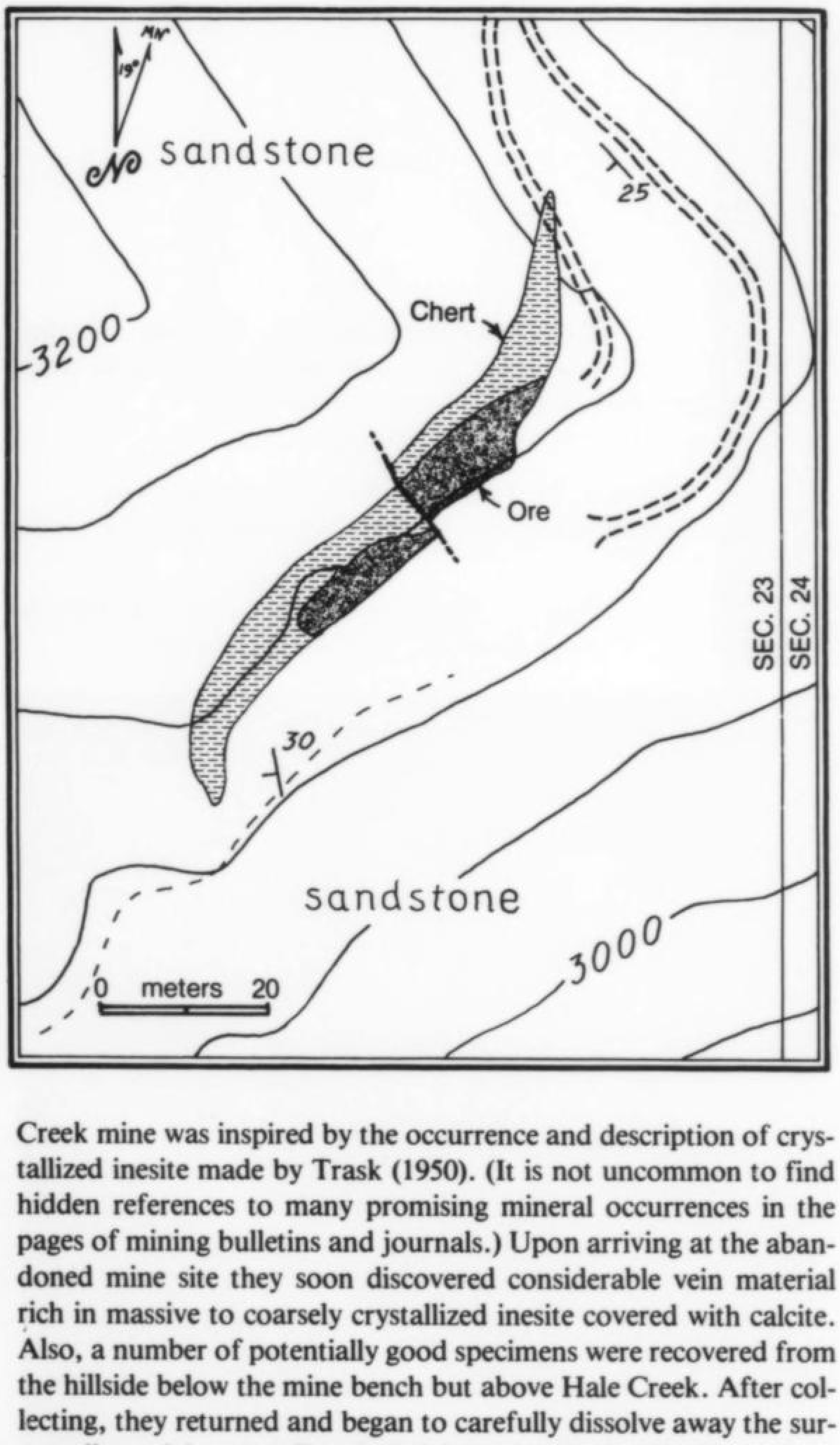


***Figure 6.* Geologic map (left) and section of the Hale Creek mine, Trinity County, California (after Trask, 1950). The section runs about 100 feet northwest of the outcrops as shown on the area map.**

Creek mine was inspired by the occurrence and description of crystallized inesite made by Trask (1950). (It is not uncommon to find hidden references to many promising mineral occurrences in the pages of mining bulletins and journals.) Upon arriving at the abandoned mine site they soon discovered considerable vein material rich in massive to coarsely crystallized inesite covered with calcite. Also, a number of potentially good specimens were recovered from the hillside below the mine bench but above Hale Creek. After collecting, they returned and began to carefully dissolve away the surrounding calcite, revealing the bright pink euhedral inesite crystals, many up to 2 cm in size. Occasional subhedral barite crystals, secondary copper minerals, and several copper sulfides were also discovered. Many of the inesite crystal groups were then made available to the public.

Since the original discovery in 1971, the authors have made trips to the Hale Creek mine in 1972, 1973 and 1975. Samples which we collected formed the basis for the current morphological study.

The current ownership and collecting status of the Hale Creek mine is not known but from time to time since 1975 collectors have visited the abandoned site unhindered and have obtained a few specimens (quantity unknown).

Today many fine inesite crystal groups can be found in private and museum collections. Although a large number of inesite specimens have been recovered from this locality, one can only wonder how much material was lost to the ore crusher after mining.

GEOLOGY

The geological features of the Coast Ranges, and more specifically the genesis of manganese deposits contained therein, have been described by Taliaferro and Hudson (1943); Trask *et al.* (1943); Trask (1950); and Page (1966). These Coast Ranges are composed of late Jurassic, Cretaceous, Tertiary and Quaternary sediments, volcanics and shallow intrusive bodies.

The rocks exposed at the Hale Creek mine are typical of the Franciscan-Knoxville group of late Jurassic age and consist of sandstones, shales, cherts, greenstones, and graywackes. Page (1966) describes this formation as a vast, diverse assemblage of eugeosynclinal rocks with unsystematic structure.

Trask (1950) described the Hale Creek manganese orebody as a nearly flat-lying massive tabular lens enclosed in chert and sandstone. Unlike most Franciscan manganese deposits, which occur within chert lenses 10 to 100 times the thickness of the ore, the chert here formed only a thin envelope separating the orebody from the sandstone. Near the western end of the orebody 2 meters of buff to greenish chert occurred interbedded with thinly laminated red shale; near the eastern end of the orebody, it was separated from the sandstone above by 15 cm of white chert. A greenstone intrusion occurs near the western end of the orebody and cuts across the chert and sandstone. Trask (1950) states that this intrusion caused marked hydrothermal alteration of the orebody near the contact.

The ore in the original exposure consisted largely of fine-grained manganiferous chert and some manganese carbonate. As mining progressed, dark reddish brown hausmannite began to appear, and constituted about 30% of the exposed ore in 1944. Trask (1950) found that the earliest minerals to form were dark reddish brown hausmannite in irregular aggregates, surrounded by light-colored bementite and rhodochrosite. These minerals were then cut by veins of calcite, rhodochrosite, bementite and barite. For a distance of 1 cm from the boundary of these veins, the hausmannite was altered to a cloudy mass of bementite in which the form of the original hausmannite aggregates was preserved.

Post-ore fracturing related to the greenstone intrusion provided ideal channelways for ascending hydrothermal solutions which deposited inesite followed by calcite which filled the remaining voids of the fracture system. These veins extended nearly vertically for about 8 meters.

Oxidation of the manganese minerals did not extend more than 1 meter from the original surface, except along open fractures, and even then only thin films of oxides were observed (Trask, 1950).

Taliaferro and Hudson (1943) have concluded that the manganese deposits of the Coast Ranges are syngenetic chemical sediments formed at the same time and in the same marine environment as the cherts with which they are associated. They also concluded that the iron, manganese and silica had a common origin, because there is a close association both in time and space between the basic volcanics of the Franciscan group and the cherts.

MINERALOGY

Inesite is by far the most interesting of the manganese minerals found at the Hale Creek mine. Although it occurs rather sparingly in most other manganese deposits, it is relatively abundant and unusually well crystallized at Hale Creek.

In addition to inesite, other manganese minerals at Hale Creek include rhodochrosite, bementite and hausmanite. Accessory minerals include barite, bornite, calcite, chalcocite, chrysocolla, cuprite, digenite, julgoldite, malachite and native copper.

Inesite $Ca_2Mn_7Si_{10}O_{28}(OH)_2\cdot5H_2O$

Physical Description

Taliaferro and Hudson (1943) state that inesite is of common occurrence in veins cutting deposits that have been rather strongly recrystallized or subjected to weak hydrothermal action. At Hale Creek, inesite crystallized along fracture surfaces in the rhodochrosite-bementite-hausmannite orebody just above the greenstone intrusion. These fractures, which become veins for ascending solutions, ranged from 3 to 10 cm wide, with local enlargements to 15 cm. They were lined with dark pink crystalline inesite which graded into subhedral to euhedral prismatic crystals, often complexly intergrown. Local enlargements provided for the formation of larger crystals often exceeding 2 cm in length. On rare occasion, doubly terminated crystals formed in the masses of flattened subhedral crystals.

The prismatic habit closely resembles the habit of crystals from Nanzenbach, West Germany; Långban, Sweden; and Durango, Mexico (Ryall and Threadgold, 1968). In contrast, the crystals from Rendaiji, Japan, and Broken Hill, Australia, exhibit a characteristic "chisel-shape" developed by the $g\{201\}$.

Hale Creek inesite crystals vary from a light to dark pink. Exposure to light and weathering have resulted in thin, dark, manganese oxide films on the faces. Occasionally small crystals, less than 3 mm, can be found which are transparent and gemmy and can be recognized by their high reflectivity. They are either colorless or very light pink or light ginger-brown in color, depending on the degree of oxidation.

Crystal Morphology

Preparatory to studying the unknown crystal forms, we reviewed the inesite crystal morphology compiled by Ryall and Threadgold (1968). In their research, they reported 16 crystal forms for inesite from various world localities, including a new form from Broken Hill, Australia. To further identify the Hale Creek forms, individual crystal drawings were constructed along each of the crystallographic axes using the crystallographic data of Wan and Ghose (1978).

Inesite is triclinic, space group $P\bar{1}$, and belongs to the pinacoidal class. Its symmetry consists of only a center and, therefore, all crystal forms are pinacoids consisting of only two similar and parallel faces. Aside from the common front, side and basal pinacoids, various first, second, third and fourth-order pinacoids with different axial intercepts are possible. The presence of a positive pinacoid in no way indicates that the corresponding negative form will be present.

In general, the Hale Creek inesite crystals are well-developed but only rarely doubly terminated. Intergrowth of two or more crystals is very common and may obscure many of the smaller forms. The larger crystals exhibit parting planes along the *c* axis which is the result of one of the two cleavages in inesite.

The axial pinacoids $a\{100\}$, $b\{010\}$ and $c\{001\}$ are present on all crystals examined. Other forms common to Hale Creek inesite include $d\{0\bar{1}1\}$, $e\{\bar{1}01\}$, $M\{\bar{1}10\}$ and $g\{201\}$, although the latter form was observed on only one crystal. The rarer forms $m\{110\}$ and $f\{210\}$ were also observed on a few crystals. All of these forms were found to be quite narrow and not of high quality. None of the rare forms $h\{3\bar{1}1\}$, $i\{\bar{7}47\}$, $j\{301\}$, $l\{101\}$, $n\{30\bar{1}\}$, $o\{532\}$ or $s\{9\bar{4}6\}$ were identified on the Hale Creek inesite.

Identification of the first, second, and third-order pinacoid forms was made by a comparison of SEM photographs oriented along each of the principal axes and compared to the corresponding drawings of the known forms tabulated by Ryall and Threadgold (1968). However, during the optical examination a majority of the crystals showed the development of a negative left fourth-order pinacoid face (see Hurlbut, 1956 for a description of triclinic crystal form nomenclature) at the approximate intersection of the zone $[\bar{1}1\bar{1}]$, which contains the faces $\bar{m}(\bar{1}\bar{1}0)$ and $e(\bar{1}01)$, with the zone $[0\bar{1}\bar{1}]$, which contains the faces $d(0\bar{1}1)$ and $\bar{a}(\bar{1}00)$. Preliminary estimation of the interfacial angles of this face with adjacent known faces suggested that its index might be $\{\bar{1}\bar{1}1\}$, a form not previously noted on inesite crystals from other localities (Ryall and Threadgold, 1968).

To confirm our tentative findings we submitted three small single crystals containing the forementioned forms to Dr. A. Pabst who graciously consented to examine them using an old but very reliable Stoe two-circle reflecting goniometer. Because of the triclinic symmetry of inesite the crystallographic settings of Ryall and Threadgold (1968) were used in orienting the crystals. Dr. Pabst was able to establish the presence of the three axial pinacoids, $a\{100\}$, $b\{010\}$, and $c\{001\}$; the first-order pinacoid $d\{0\bar{1}1\}$; the third-order pinacoids $M\{1\bar{1}0\}$ and $f\{210\}$, and the fourth-order pinacoid $\{\bar{1}\bar{1}1\}$. We have designated this latter new form as *r*, one found on many triclinic pinacoidal minerals, especially the sulfates.

Using the information kindly provided by Dr. Pabst on inesite form development, the authors examined nearly 100 additional crystals using a binocular microscope. During the course of this rather time-consuming examination, four additional forms which appeared to be new were observed on several small crystals. These are: a first-order positive similar to $d\{0\bar{1}1\}$ but intersecting the positive *b* axis; a second-order negative similar to $g\{201\}$ but intersecting the negative *a* axis; a third-order negative similar to $f\{210\}$ but intersecting the negative *b* axis, and a fourth-order negative right similar to the newly discovered $r\{\bar{1}\bar{1}1\}$ but intersecting the positive *b* axis. Because of the small face size, poor reflective quality, and intergrowth with other crystals, the crystals containing these possible new forms were not suitable for goniometric measurements.

Identification of these forms was based solely on SEM photographs and comparison to individual drawings along each axis containing these possible new forms.

We have concluded that the four additional forms observed compare favorably with the forms {011}, {$\bar{2}01$}, {$2\bar{1}0$} and {$\bar{1}11$}, and we have designated them as *D, G, F,* and *R* respectively, following convention. If single crystals become available which are suitable (small and not complexly intergrown) for goniometric measurements, these forms should be confirmed and their interfacial angles established.

The frequency of form development was found to vary with each sample containing a group of crystals. The first, second, and third-order forms generally were found only on crystals less than 3 mm in size and gemmy in appearance. One exception was the development of the two fourth-order forms *r*{$\bar{1}\bar{1}1$} and *R*{$\bar{1}11$} on nearly all crystals, even those 1 cm or larger. The three axial pinacoids occur on all terminated crystals and are usually well developed despite the presence of multiple cleavage partings along {010} which tend to easily spall off. The first and second-order pinacoids *d*{$0\bar{1}1$}, *D*{011}, *g*{210}, *e*{$\bar{1}01$} and *G*{$\bar{2}01$} are quite rare and were observed on fewer than five crystals. Forms *g*{201} and *G*{$\bar{2}01$} were the least developed of all, although the former, however, is quite common on the Broken Hill and Rendaiji crystals and forms a characteristic "chisel-shape" habit (Ryall and Threadgold, 1968). The third-order pinacoids *m*{110}, *M*{$1\bar{1}0$}, *f*{210} and *F*{$2\bar{1}0$} are present on less than 5% of the crystals examined and were found to be very narrow, pitted, and not well-formed. The two fourth-order pinacoids *r*{$\bar{1}\bar{1}1$} and *R*{$\bar{1}11$} are the most common except for the axial pinacoids and occur on at least 80% of the examined crystals. The *r*{$\bar{1}\bar{1}1$} was found to be more abundant than the *R*{$\bar{1}11$}, and no crystal was observed which was developed by both forms simultaneously.

It can be argued that the presence of the *R*{$\bar{1}11$} is equivalent in form to the *r*{$\bar{1}\bar{1}1$} and that it only represents a visible lower terminated development of a doubly-terminated crystal with the upper half being the base. In fact, this argument can be extended to include several of the new forms found, namely the *D*{011}, *G*{$\bar{2}01$}, and *F*{$2\bar{1}0$} which have not been observed with the corresponding *d*{$0\bar{1}1$}, *g*{201}, and *f*{210} forms.

Since visible doubly-terminated crystals are quite rare at Hale Creek (we observed only two), it would be difficult to state with any degree of certainty that this is not the case. However, until further observations are made of doubly terminated crystals to determine the form development, we propose that the new forms identified here be considered individual forms, and that the condition of single form development on a crystal is due to a crystal growth phenomenon.

Table 1 is an extension of Table 2 of Ryall and Threadgold (1968) and compares the Hale Creek crystal form development with those of other world localities. Table 2 lists those forms identified by goniometer with their associated angles. The angles A, B and C were calculated from the observed ϕ and ϱ values determined by Dr. Pabst using the triclinic crystallographic formulas listed by Palache *et al.* (1941).

Table 1. **Comparison of inesite crystal form development.**[a]

Form	Långban Sweden	Durango Mexico	Nanzen-bach Germany	Rendaiji Japan	Broken Hill Austral.	Hale Creek USA
a{100}	X	X	X	X	X	X
b{010}	X	X	X	X	X	X
c{001}	X	X	X	X	X	X
m{110}	X					X[c]
M{$1\bar{1}0$}			X	X	X	X[c]
f{210}				X	X[b]	X
F{$2\bar{1}0$}						X
g{201}	X	X	X	X	X	X
G{$\bar{2}01$}						X
e{$\bar{1}01$}	X	X	X	X		X
l{101}	X		X			
n{$30\bar{1}$}	X					
j{301}	X					
d{$0\bar{1}1$}	X	X	X	X	X	X
D{011}						X
r{$\bar{1}\bar{1}1$}						X
R{$\bar{1}11$}						X
h{$3\bar{1}1$}					X	
o{532}			X			
i{$\bar{7}47$}			X			
s{$9\bar{4}6$}		X				

[a] Non-USA localities compiled by Ryall and Threadgold (1968).
[b] Face (210) absent but face ($\bar{2}\bar{1}0$) present.
[c] Both $\bar{m}$($\bar{1}\bar{1}0$) and $\bar{M}$($\bar{1}10$) also present.
X – Form present.

Table 2. **Angle table for Hale Creek inesite crystal forms.**

Forms[a]	ϕ	ϱ	A	B	C
a{100}	82°	90°	–	82°	46°
b{010}	0°	90°	82°	–	83°
c{001}	80°	43°	45°	83°	–
M{$1\bar{1}0$}	121°	90°	39°	121°	59°
f{210}	65°	90°	17°	65°	49°
d{$0\bar{1}1$}	143°	54°	67°	131°	48°
r{$\bar{1}\bar{1}1$}	–147°	59°	124°	136°	91°

[a] Forms observed but not measured by goniometry *e*{$\bar{1}01$}, *g*{210}, *m*{110}, *D*{011}, *G*{$\bar{2}01$}, *F*{$2\bar{1}0$}, *R*{$\bar{1}11$}.

Crystal Structure

Richmond (1942) determined the chemical composition of inesite as $Ca_2Mn_7Si_{10}O_{20}(OH)_2 \cdot 5H_2O$, and placed it in the rhodonite group of pyroxenoids on the basis of its cleavage characteristics and unit-cell dimensions. Ryall and Threadgold (1968) concluded that inesite contains a single silicate chain with a five-tetrahedral repeat based on infrared absorption spectra of several pyroxenoids, including inesite.

Recently Wan and Ghose (1978) solved the crystal structure of inesite using samples from both the Crescent mine, Washington, and Hale Creek, California. This crystal structure provides the first example of double silicate chains with a periodicity of five tetrahedra. The structure contains two components: (a) a polyhedral band, composed of a sequence of seven edge-sharing Mn octahedra and two Ca pentagonal bipyramids, connected to two similar sequences on either side by edge-sharing; and (b) double silicate chains with a five-tetrahedral-repeat period, which contains alternating six- and eight-membered rings. These silicate double chains knit the adjacent Ca and Mn polyhedral bands into a three-dimensional framework.

Bementite $Mn_8Si_6O_{15}(OH)_{10}$

Massive bementite occurred as one of the ore minerals comprising the orebody. It is light brown with a distinct fibrous habit. Rounded masses still remaining at the site are commonly coated with black oxides of manganese.

Hausmannite $Mn^{+2}Mn_2^{+3}O_4$

Dark reddish brown hausmannite comprised about 30% of the orebody and in many places was surrounded by bementite and rhodochrosite.

Neotocite $(Mn,Fe^{+2})SiO_3 \cdot H_2O$ (?)

The only reference to neotocite is found in the description of the manganese orebody by M. D. Crittenden in 1944 (Trask, 1950). He describes veinlets of pink rhodochrosite and resinous neotocite cutting the other ore minerals.

Rhodochrosite $MnCO_3$

Massive to crystalline rhodochrosite was qutie common when mining first began. Trask (1950) records over 600 tons having been mined in 1941. Although no crystals were recorded by either Trask (1950) or O'Brien (1965), some probably existed. Remnant samples of rhodochrosite at the site show typical surface oxidation in the form of black manganese oxides.

Barite $BaSO_4$

Trask (1950) reports barite veins in the orebody cutting older hausmannite, bementite and rhodochrosite. Subhedral to euhedral, pale salmon-pink barite crystals, commonly reaching 4 cm in length, were found associated with inesite in the veins.

Julgoldite $Ca_2Fe^{+2}(Fe^{+3},Al)_2(SiO_4)(Si_2O_7)(OH)_2 \cdot H_2O$

Julgoldite, the ferrous-ferric analog of pumpellyite, occurs rarely as minute dark green to black masses of subhedral prismatic to acicular crystals on the wall rock along the inesite veins (Pemberton, 1983).

Copper Minerals

Small amounts of copper sulfides and native copper were found associated with inesite and were introduced into the orebody during the hydrothermal activity related to the greenstone intrusion. These minerals include native copper, bornite, chalcocite and digenite. Oxidation of these minerals has produced small films and veins of malachite and chrysocolla.

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Table 3. **Minerals identified from the Hale Creek mine.**

Ore Minerals	
Bementite	$Mn_8Si_6O_{15}(OH)_{10}$
Hausmannite	$Mn^{+2}Mn_2^{+3}O_4$
Inesite	$Ca_2Mn_7Si_{10}O_{28}(OH)_2 \cdot 5H_2O$
Neotocite	$(Mn,Fe^{+2})SiO_3 \cdot H_2O$ (?)
Rhodochrosite	$MnCO_3$

Accessory Copper Minerals	*Other Minerals*
Bornite	Barite
Chalcocite	Calcite
Chrysocolla	Julgoldite
Copper	Quartz
Digenite	
Malachite	

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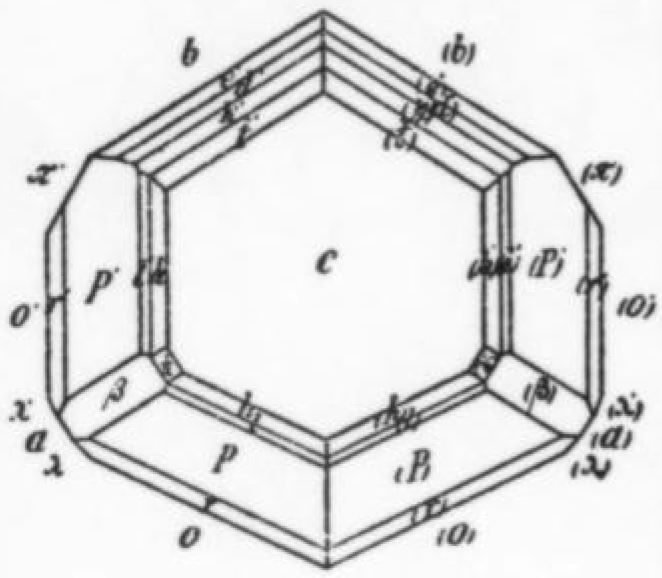

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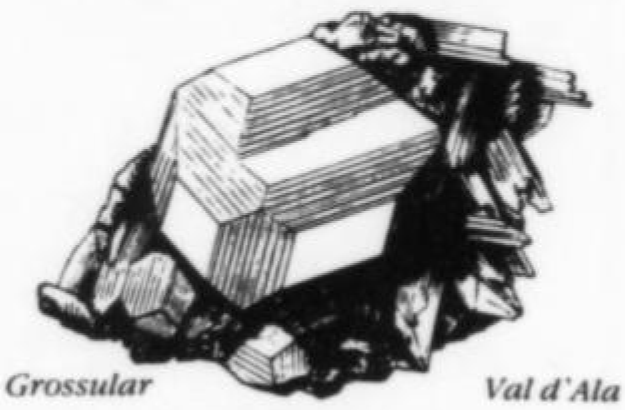

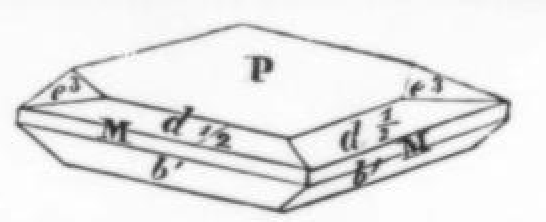

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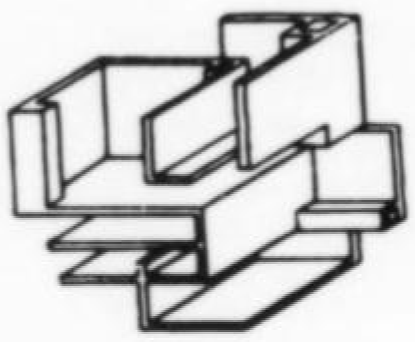

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Notes from Germany

by Thomas P. Moore

Bad Ems Show 1987

The spring mineral show season in Europe is at last upon us, and I can now report on a first spring foray to a *Börse* – the semimajor, 8-year-old show at the old mining and spa town of Bad Ems, in the Hessen-Nassau region (check your old Danas) just east of the Rhine city of Koblenz. As my wife and I set out from Kaiserslautern, the weather (against the odds for an April weekend in the Rhineland) was as amazingly cool, blue and clear as the gemmy heart of my prize Afghan aquamarine; and when we arrived we found little Ems, former watering place of nobility from all ends of Europe, of a similarly gentle, calm, Easter-egg-blue-and-sparkling-white disposition. The genteel whiteness came from the two facing lines of massive old hotel and *Kurhaus* buildings along the Lahn River; at a prominent point along one of these surf-fronts, as seen from one of the footbridges over the Lahn, the deep blue onion domes of the Czar-haunted Russian Orthodox chapel glittered in bright sunlight. As usual, strolling old people ruled the crisscrossing, neat gravel paths in the manicured park behind the big *Kurhaus* building, where the show was held, on the main street. To one side of this building a familiar Ems landmark, a small round pavilion, sheltered the tap where for 30 pfennigs one might drink a plastic cupful of the foul-smelling "waters" of a mineral spring. Though the Romans had drunk from this same spring, and though powerful BMWs and Mercedes Benzes now clog the narrow streets, the year in Bad Ems always seems to be about 1870 – which was, in fact, its one world-historical year (when the Prussian king Wilhelm I sent out from this same Kurhaus building, at Bismarck's instigation, the notorious Ems Telegram to Napoleon III, bringing on war with France and, about a year later, Wilhelm's own coronation as German Emperor, and the modern Reich's unification).

But, of course, it's not pompous old scrubbrush-chopped Wilhelm (as memorialized by the white statue in the Kurhaus park) that the mineral devotee thinks of when Bad Ems is mentioned, but pyromorphite – in those marvelous oldtime brown or green, sometimes immense crystal clusters. As I have remarked in an earlier Note, and as Dietrich's and Bode's article in vol. 15 no. 6 certainly shows, this is the best of the world's older localities for this mineral. And in my own opinion, the finest Ems pyromorphites surpass not only their Wilhelmine-age rivals from the old Wheatley mine in Pennsylvania, but also even the best recent offerings from the Les Farges mine in France and the Bunker Hill mine in Idaho. Such anyway is my love for the stout, bulging, cavernously terminated hexagonal prisms that when, during our drive up there, I saw on a Rhine hillside the round ruin of a castle tower, I thought, I swear, of a gigantic *Emser tönnchen* perched up there hallucinatorily to guard the pilgrim's passage.

Since Dietrich's and Bode's cheering report in 1984 that Ems pyromorphite, long unavailable on the mineral market, was having a renaissance thanks to dealers' renewed interest, I have indeed been spotting at shows many very respectable specimens of the stuff – and here at the source too, appropriately, there were many pieces around, though almost all of the brown kind rather than of the rarer greens, and very few really of first quality. But old German minerals in general, plus a few newer German finds, were well enough represented to more or less dominate the Ems show this year. As at Munich last fall, the two dealers who had the best were Siegbert Zecha (Windeckerpfad 1, 6369 Schöneck 2) and Herbert Becker (Rheinpreussenstr. 14, 4130 Moers 1). Becker's case was especially impressive, featuring such Erzgebirge classics as fine

Figure 1. **The Lahn River where it passes through Bad Ems. (Photos by the author.)**

Figure 2. **Old Kurhaus, site of the Bad Ems show.**

miniatures and small cabinet specimens of wire and arborescent silver; one specimen of native bismuth in sharp rhombohedra to 1 cm stacked on a 6 x 8-cm matrix (this one for about $1000); a Schlema proustite, 3 x 4 cm, with very bright red, shapely crystals for $900; large manganites from Ilfeld, Harz; a great gray mass of native arsenic from St. Andreasberg, Harz; and some of the new golden barites from the Pöhla mine, Crottendorf, East Germany (the only ones of these at the show). Many other dealers had German classics, including *Emser tönnchen,* at fairly reasonable prices though never in such qualities as these of Becker's. There would appear to be high mobility now, for some reason, in the remarketing of old collections, or the release of old hoards, so that a U.S. traveler to the European show scene (assuming that he's undeterred by the horrorshow dollar exchange rate) can hope not too unreasonably to acquire a fine one or two of these venerable Harz, Erzgebirge, Ems etc. pieces.

And it is by no means only the high-budget, museum-quality things that he may find. At the stand of Uwe Krautworst (Platenenstr. 2, 6200 Wiesbaden), I found a most courteous and knowledgeable-seeming fellow of no more than sixteen who was selling smaller, humbler, though still often very good, German venerables, e.g., thumbnails of cerussite, sphalerite and copper, as well as pyromorphite, from Ems; little dark ferny groups of copper from Rheinbreitbach, Rhineland; and small but exquisite thumbnails of millerite, with thick golden crystals in jackstraw groups, from the old Friedrich mine near Wissen, Siegerland.

Further, collectors here know how to make the most of whatever opportunities for field collecting are offered by old mine dumps, or by presently viable mineral sites. One very proud field collector was selling a large tablefull of recently dug zeolites from the Zilsdorf quarry in the Eifel region of the Rhineland; these were mostly miniature-sized gas pocket specimens of acicular natrolite in typical white tufts, very fair pale green prehnite, gismondine and round white colloidal balls of thomsonite to 1.5 cm across. American collectors who like the brilliant black gas-pocket hematite groups from the rhyolite of the Thomas Mountains, Utah, should be aware, too, of the similar and equally nice hematites from the old lava flows of the Rhenish Eifel: tiny flattened rhombohedra stacked in flamboyant bonsai-tree-like arrangements. These, never expensive, and more plentiful this year at Ems than at any previous show I've visited, are by far the most commonly available macrospecimens among the great number of Eifel species – most of them in strictly micromount sizes – listed by Gerhart Henschel in his Eifel article in vol. 8 no. 4.

Finally, once again in the category of *old* German goodies, there were the spectacular contents of a flat glass-topped case at the stand of one of Germany's very best dealers in topnotch specimens, Helmut Brückner (recently moved to a new address: Buggingerstr. 19, 7840 Müllheim-Britzingen). Reposing majestically in this case were a 4 x 6-cm St. Andreasberg pyrargyrite with brilliant crystals to 2 cm; a textbook-trim, translucent brown 1 x 2-cm anglesite crystal sitting nicely in an open cavity, from Müsen, Siegerland; and two very pricey but admittedly outstanding bournonites from the famous Georg mine in the Westerwald.

I must mention in passing also Brückner's huge dreamboat of a Hotazel rhodochrosite, and his 8-cm Brazilian chrysoberyl sixling . . . but the most impressive gaggle of contemporary material was to be found in the distinctive wooden display cases of Horst Burkard's "Morokko Mineralien" (Dornheckenstr. 20, 5300 Bonn 3). Spectacular large vanadinites, of course, were here, and fishtail cerussites from Touissit, and, also from Touissit, about twenty representative samples of what is undoubtedly the finest occurrence of anglesite ever found in the world. These pale yellow to strong yellow-orange, transparent crystal groups are, I'm pleased to note, not only still flowing out of the mine and to Europe but also coming down somewhat in price: for an average-sized (about 6 x 6 cm) one of Burkart's specimens an average price was about $200. Here too, besides the Moroccan material, there was a good array of Veracruz amethyst (slightly pale), about ten miniature-sized gold crystal groups on quartz from Michigan Bluff, California, and, most surprisingly, two knockout large miniatures of the Chinese cinnabars that have lately been emerging. The lesser of these was a 1 x 2.5 x 2.5-cm twinned rhomb on a 4 x 4 quartz druse matrix for $650; the better, and in my opinion the best single specimen for sale at the show, was a 2 x 3-cm twin on a 5 x 5 quartz matrix, the twin very sharp though slightly corroded and glazed, with vivid red internal color, for $2800.

The Bad Ems show is thoughtful and conscientious enough to feature, as many larger German shows don't, a modest calendar of educational side "events." For example, there was a guided tour (*Wanderung*) among some of the old mines of the Ems region, and there was a small display of some of the best known specimens from the old Hilfe Gottes zinc mine at Bad Grund, Harz – supplemented by a talk on the mine by Rainer Bode. But the really ex-

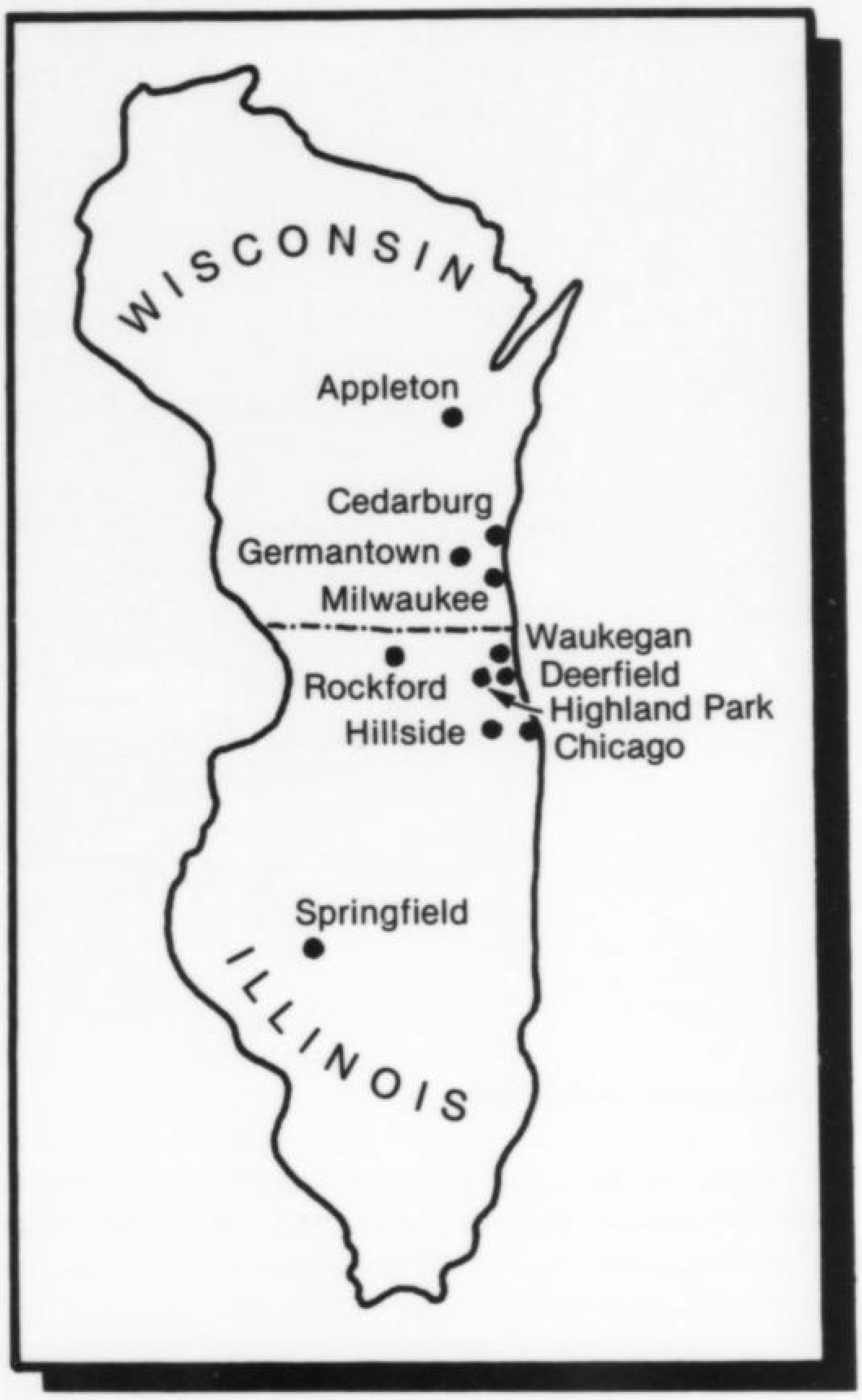
Figure 3. **Small sidewalk mineral water dispensary in Bad Ems.**

traordinary highlight of this show was the special exhibit (*Sonderausstellung*) devoted to the minerals of Greenland. This very first roadshow-tour for many of these truly superstar-quality specimens was escorted to Ems by some friendly people from the Geological Museum of Copenhagen, the party led by Museum curator Dr. Ole V. Petersen. In Burchard and Bode's *Mineral Museums of Europe* I had already read about the Copenhagen museum and its accumulation, the world's best, of Greenland minerals; I had already gaped at the photo of the best Ivigtut pachnolite in existence, and now in one of the cases of Ems I could see this remarkable, orange, spiky beast in the so-to-speak flesh. Among its more remarkable neighbors were a giant group of Ivigtut cryolite crystals; a brilliant black, terminated uvite prism 15 cm long, from the Godthåb district; a huge matrix crystal of kornerupine, beside which nestled a deep green faceted gem kornerupine, also from Godthåb; wonderful epididymite and neptunite from Narssarssuak; and an 8-cm group of sharp black perovskite octahedra from the Gardiner Complex (see the article on this new locality in vol. 16, no. 6). Also, the museum was selling off at the show a small number of unusual Greenland specimens, some from old stocks and some from a 1981 collecting expedition. This was a rare chance to fill in holes that one didn't even know one's collection had, since one could pick up such peculiar things as eudialyte, astrophyllite, perovskite and steenstrupine, in very nicely developed examples.

Best of all, one could buy from the Copenhagen people at the show's main entrance, for only about $8, a handsome 81-page booklet, *Grönland: Mineralien, Geologie, Geschichte,* which, if you don't mind the German text, is surely the best one-volume reference on Greenland minerals you could hope to find. Not only the famous cryolite body at Ivigtut, but a dozen other much less well-known localities, all as mineralogically interesting as their names are unpronounceable, are shown, on the book's geologic map, dotted along the thin fringe of exposed rock that rings the great central ice sheet (with its cruelly buried secrets). All of what the museum has learned about these strange localities and their minerals is discussed at gratifying length, and the chapters are decorated with beautiful photos of specimens and arctic scenery alike. From the chapter on Ivigtut I had the pleasure of learning something about a thumbnail specimen I'd had for a long time without fully understanding it: a shard of weathered cryolite with an open vug displaying small orange-stained primatic thomsenolite crystals and, in a tight clump, what was previously for me an unknown – in ice-clear though also slightly orange-stained, distinct octahedra. These tiny crystals, I now know, can only be *ralstonite,* described in the booklet as occurring intimately intermixed with thomsenolite-pachnolite in altered cryolite; a photomicrograph nailed the identification and caused me to intone with Neil Yedlin, wherever he may be, the wise litany "Buy and use a good mineral book." Anyway, a copy of this good booklet – by Ole V. Petersen and Karsten Secher – just may be available to anyone who writes to the publisher, Rainer Bode, Krokusweg 13, 4630 Bochum 7, W. Germany.

Until next Note – by which time I might finally have hit on a good grabber of a sign-off line – a cordial if unoriginal *auf wiedersehen.*

Thomas Moore
Karlstalstrasse 9
D-6751 Schopp
West Germany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Appleton
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Germantown
Milwaukee
Waukegan
Deerfield
Rockford
Highland Park
Hillside
Chicago
Springfield
ILLINOIS

What's New in Minerals?

by Wendell E. Wilson

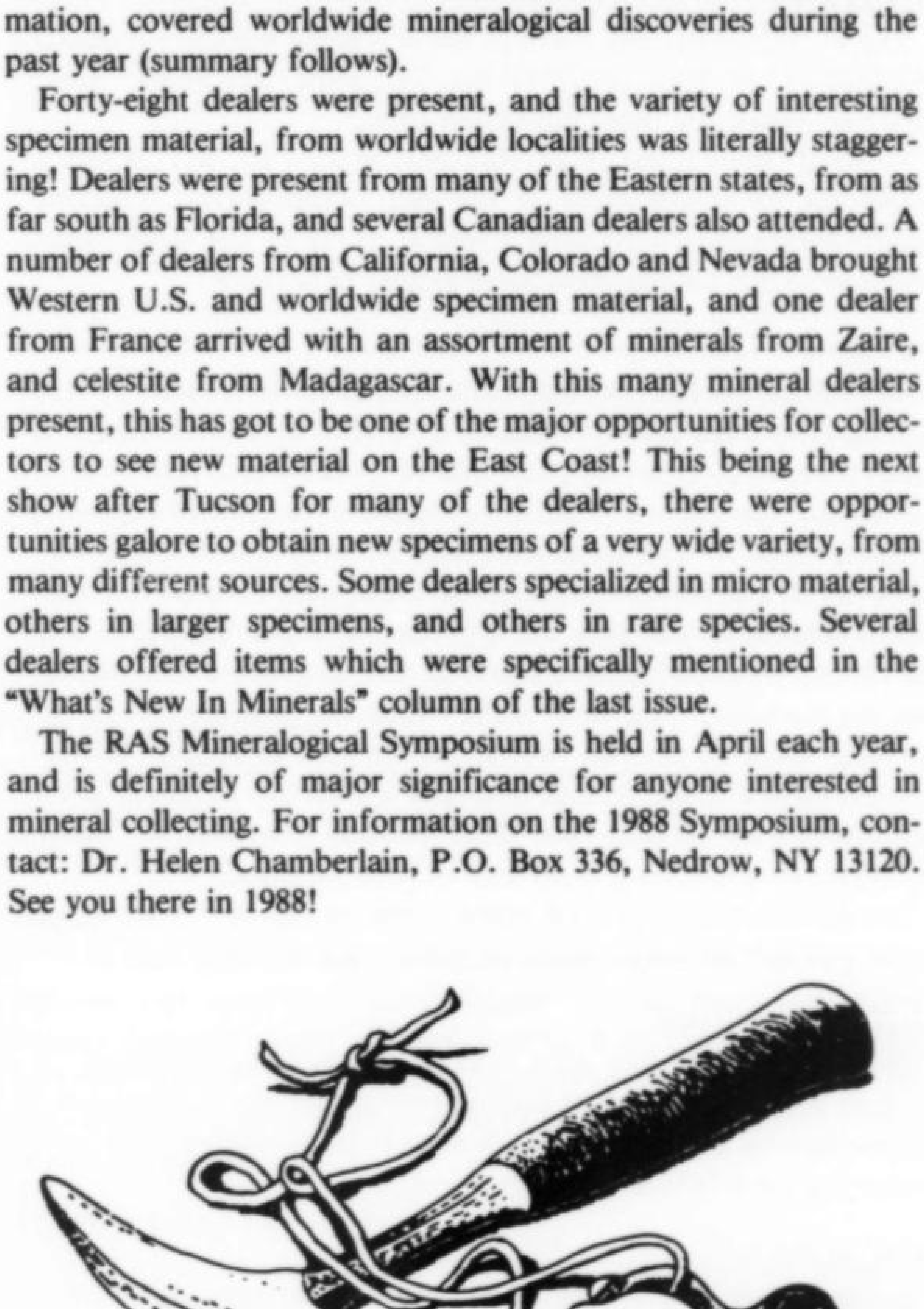
ROCHESTER SYMPOSIUM 1987

[The following note was provided by Sharon Cisneros of Mineralogical Research Co. Ed.]

The 14th Annual Rochester Academy of Science Mineralogical Symposium was held from April 9 through 12, 1987, at the Hilton Inn on the Campus, Rochester, New York. Ten guest speakers delivered short papers on new mineralogical occurrences and related topics, with information presented on localities in the eastern U.S., Canada, Greenland, and Mexico. Two films, one covering mineral collecting in Morocco, were presented by Victor Yount. These films provided a very lively and informative new approach to sharing mineral collecting activities. The "What's New in Minerals" discussion, always a very important source of new information, covered worldwide mineralogical discoveries during the past year (summary follows).

Forty-eight dealers were present, and the variety of interesting specimen material, from worldwide localities was literally staggering! Dealers were present from many of the Eastern states, from as far south as Florida, and several Canadian dealers also attended. A number of dealers from California, Colorado and Nevada brought Western U.S. and worldwide specimen material, and one dealer from France arrived with an assortment of minerals from Zaire, and celestite from Madagascar. With this many mineral dealers present, this has got to be one of the major opportunities for collectors to see new material on the East Coast! This being the next show after Tucson for many of the dealers, there were opportunities galore to obtain new specimens of a very wide variety, from many different sources. Some dealers specialized in micro material, others in larger specimens, and others in rare species. Several dealers offered items which were specifically mentioned in the "What's New In Minerals" column of the last issue.

The RAS Mineralogical Symposium is held in April each year, and is definitely of major significance for anyone interested in mineral collecting. For information on the 1988 Symposium, contact: Dr. Helen Chamberlain, P.O. Box 336, Nedrow, NY 13120. See you there in 1988!



FOURTEENTH ANNUAL RAS MINERALOGICAL SYMPOSIUM

WHAT'S NEW IN MINERALS?*

George W. Robinson
National Museums of Canada
Ottawa, Ontario K1A 0M8

Vandall T. King
P.O. Box 90888
Rochester, NY 14609

Once again we are greatly indebted to the cooperative effort shown by our invited speakers, collectors, and dealers, without whose help this compilation of information would have been impossible. Since last year's symposium, many individuals have given continued support and freely supplied information, slides or specimens for photography. We are particularly grateful to Wendell Wilson, William Pinch, John Medici, William Panczner, Jim McGlasson, Gilles Haineault, Frank Melanson, Herb Obodda, Steve Rose, Ken Silvy, Fred Bailey, Rod Tyson, Pierre LaVille, Renato Pagano, Richard Whiteman, Robert Gault, László Horvath, Steve Chamberlain and many others who will undoubtedly provide us with a wealth of last minute details and regrettably cannot be included here.

To facilitate this year's presentation, we have tried to incorporate many of the suggestions and ideas we received last year, and welcome any new ones this year. In this light, this year's program will be presented in three parts, based on geography, with greatest emphasis on truly new finds made since last year's symposium rather than those which represent a continuing supply of specimens. Because of the broad collecting interests of our audience, our coverage will range from common to rare species and from large specimens to micromounts.

Part I: United States

ALASKA

Several flats of white quartz crystal stalactites were offered for sale in Tucson by Gary McWilliams of Wrangell, Alaska. A few specimens had small, tabular, white stilbite crystals on the quartz, and appear to have come from cavities in a volcanic rock. The only locality information available was Kuiu Island, Alaska.

ARIZONA

From Bisbee were some new hetaerolite crystals in calcite from the White Tailed Deer mine. These were available from Sid Williams (Box 872, Douglas, AZ 85607). Sid and Betty also offered some gormanite from Bisbee. Sid was going to submit the material as a new species when gormanite's description appeared. This material is composed of radial aggregates of a dark green mineral on a fracture surface in a granodiorite-like matrix.

Bill Hawes of Tucson recently mined some outstanding 2-cm-on-an-edge wulfenite crystals from the Old Yuma mine. One superb orange cluster is 4 x 8 cm and contains just wulfenite. Bill also uncovered some very good botryoidal blue aurichalcite-rosasite on black tenorite from the Silver Bell mine in Tucson.

David Shannon has some nice quartz scepters from the Fat Jack mine and superb blue-green micro crystals of osarizawaite from the Silver Hill mine in Pima County. Other new finds of interest in-

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*Ed. Note: Each year at the Rochester Symposium in April a morning is devoted to a discussion of new mineral discoveries made during the preceding year. Panel Chairmen George Robinson and Vandall King prepared a handout for the audience and were kind enough to permit reprinting of extracts here. Most sections which simply refer to write-ups in previous issues of the *Mineralogical Record* have been deleted, as have the addresses for *Mineralogical Record* advertisers.

clude prosopite from the Grand Reef mine, twinned micro crystals of tridymite from Big Lue Mountain, Greenlee County, and cream-white, platy micro crystals of bismutite from the Comstock mine, Dos Cabezas Mountains, Cochise Co. (Contact Jim McGlasson, 7387 S. Flower St., Littleton, CO 80123 for specimens.)

CALIFORNIA

Over the last year the Little Three mine in the Ramona District of San Diego County has produced some more of the spessartine-schorl-albite combinations for which the locality has become so famous. Thomas Schneider (861 Sixth Avenue, Suite 517, San Diego, CA 92101) and several other dealers had specimens for sale at Tucson. Specimens of this material are not often seen on the market, and the better pieces will surely disappear quickly to California collectors.

The Himalaya mine at Mesa Grande is continuing to produce very nice elbaites, as shown by the fine display of recently mined crystals by Bill Larson at the Tucson Show. Some very fine stibiotantalite and hambergite specimens have also been recovered.

There were also some other interesting California minerals to be had at the Tucson show. Harvey Gordon and Steve Rose got a few more of the lustrous, dark brown andradites from Garnet Hill, Calaveras County, and Walter Lombardo (Southern Nevada Mineral Co., P.O. Box 18432-319, Las Vegas, NV 89114) had a good selection of nice woodhouseite crystals from the Champion mine, Mono County. Hallowell Minerals had a large supply of jonesite crystals on crossite from the Dallas Gem mine in San Benito County. The 1-3 mm clusters of clear crystals are hard to spot and might prove to be even more common than previously supposed. While not recently collected, Mark and Jeanette Rogers had a few of the seldom seen corundum crystals from the Mt. San Jacinto area in Riverside County. These crystals form elongated individuals that taper to a point at each termination.

COLORADO

Some items of interest that surfaced at the Tucson Gem and Mineral Show were cabinet-sized specimens of native copper and domeykite from the Cashin mine, Montrose County (available from Mike Madson, 3201 Snowberry Ct., Grand Junction, CO 81506), blue-to-green micro crystals of sidwillite from Lake Como, San Juan County, which were available from Jim McGlasson, and a new world occurrence of bazzite at Mt. Antero. The bazzite forms blue crystals less than 1 mm perched on transparent bertrandite crystals.

CONNECTICUT

There have been several interesting new finds in Litchfield County, including good specimens of ilmenite, hematite, plagioclase, and staurolite crystals.

ILLINOIS

The Annabel Lee mine in Hardin County has continued to be a major producer of exquisite fluorite and calcite crystals, in addition to beautiful galena, sphalerite, and barite specimens. Neal Pfaff (M. Phantom Minerals, P.O. Box 12011, Columbus, OH 43212) and Sandy Ludlam (What on Earth, 6262 Busch Boulevard, Columbus, OH 43229) both had a fine selection of specimens at very reasonable prices at the Detroit show.

INDIANA

Some very bright pyrite nodules have been collected at the American Aggregate Quarry near Indianapolis. The nodules average 5-10 cm in diameter with cuboctahedral crystals up to 2 cm. They occur in the New Albany shale (Devonian) and some appear to be fossil replacements of pelecypods.

MAINE

Several of Maine's famous pegmatites are once again open to collectors on a fee basis. These include the Dunton mine at Newry, Black Mountain quarry near Rumford, the Tamminen and Bennett mines near Buckfield, and the Mount Mica mine near South Paris.

The Gunner Bjareby collection still shows up with new items when they can be located. Sid Williams, who purchased much of Dave Garske's stock, found a specimen Gunnar had collected in 1958 and had correctly labeled hurlbutite. The 2 mm equant crystal was completely coated by tiny botryoidal hydroxyl-herderite and associated with eosphorite, roscherite, and glassy hurlbutite in cleavelandite from Black Mountain, Rumford.

MARYLAND

John Ertman of Rockville visited a quarry in his area and collected a lot of hessonite grossular crystals. Some intergrown crystals were up to 3 cm in plates up to 20 cm. Several productive field trips have been made to the area.

MICHIGAN

Richard Whiteman (Red Metal Minerals, P.O. Box 45, Hancock, MI 49930) is continuing to operate the Caledonia mine in Ontonagan County, which has provided more nice specimens of native copper, silver, adularia and epidote in addition to two unknowns that may prove to be new species. Richard also has been recovering some huge (2 meter) sheets of native copper from the White Pine mine, Ontonagon County. These are remarkably light for their size and make interesting and decorative specimens.

MONTANA

The PC (Crystal) mine north of Basin is being worked for quartz crystals by Chris Van Laer (P.O. Box 337, Butte, MT 59703). Some very fine Japan law twins have been found.

Howard (Bud) Ehrle (P.O. Box 293, Miles City, MT 59301) is continuing to collect more of the nice orange-brown stalactitic calcite specimens from Carter County. Some of the large pieces Bud had at the Tucson show were indeed impressive.

NEVADA

Steve Rose and Harvey Gordon have a new fluorite locality in the Montgomery Pass area of Mineral County. The crystals range in color from light green to pale blue or purple, and form lightly frosted multiple cubes and octahedrons somewhat resembling some of the specimens from the Rock Candy mine in British Columbia. Some are zoned with several colors in one crystal. Only a few pieces were available at the time of the Tucson show, but Steve and Harvey hope to collect more material this year. Steve also reports that the Fortitude mine near Battle Mountain produced a few interesting vivianite crystals several centimeters in length. Unfortunately most of these formed in cracks too narrow to permit good terminations to develop, but there is some potential for better specimens to come, as it is an area of active mining.

Spessartine crystals are still being found at Ely, and Walt Lombardo was able to obtain some very good specimens.

NEW HAMPSHIRE

The Government Pits near North Conway have continued to produce some very good microcline and smoky quartz specimens. Collecting is **by permit only,** which must be obtained from the local Forest Ranger's Office.

NEW JERSEY

Sid and Betty Williams have been recently interested in Franklin-Ogdensburg. From Ogdensburg they recently X-rayed and chemically analyzed fluckite as pale pink etched crystals in granular, naturally etched franklinite-calcite (no willemite) matrix. Mark Feinglos reports he received an otavite from Sid from Franklin. He notes "it was a miracle anyone would have even wondered what the thin, discontinuous pale gray coating on a fracture was." The specimen was X-rayed and chemically analyzed (less the carbonate portion).

NEW MEXICO

Ray DeMark of Albuquerque has been finding hopper gold crystals in dendrite patterns from the San Pedro mine in Sante Fe County. Glenn Hales (7000 Cortez Drive, Las Cruces, NM 88001) recently collected white to colorless hemimorphite from the Stephenson-Bennett Mine, Doña Ana County. Individual crystals are up to several cm. Glenn and Tom Hales have also collected more excellent green and purple zoned fluorite in octahedral crystals up to 2 cm on edge from the T & G Prospect, Grant County.

NEW YORK

Once again, the Herkimer diamond collecting area at Middleville has produced some incredible specimens of quartz. Ken Silvy (4 Mountainview Road, Bath, NY 14810) and John Medici (7272 Macbeth Drive, Dublin, OH 43017) were able to collect some of the best specimens to have been found in many years. Some of the clusters of clear, doubly terminated crystals that Ken collected contain over a hundred individuals! Ken also came up with two rather unique specimens: a 15-cm pink calcite rhomb with Herkimer diamonds and a single quartz crystal with a perfect, randomly oriented Herkimer diamond inclusion within. Both collectors deserve a lot of respect for their persistence and hundreds of man-hours spent facing the formidable 4-meter-high ledge of hard dolostone at the locality.

Gouverneur Talc Company has made a new open pit above the old Reynolds mine at Talcville, St. Lawrence County. For a short time there was an area of sheared diopside-tremolite schist exposed that produced a few pockets containing crystals of calcite, tremolite, diopside and quartz. Adjacent to the pockets, bright blue apatite crystals were frozen in a calcite-tremolite matrix. The apatite crystals are relatively small (up to 3 cm) and rather scarce, yet their color and transparency make them very desirable specimens. This pit is presently being worked and has been posted against trespassing, and collecting is **not** permitted. The best material is gone, and there is little sense for collectors to aggravate the situation by trying to sneak into a locality at which they will likely wonder why they bothered once they get there.

Ed Grew of the University of Maine at Orono has found hyalophane with serendibite and sinhalite from Johnsburg. We've asked Ed to write a hand specimen description of sinhalite as one does not exist for this material despite two scientific publications about it.

NORTH CAROLINA

Sid and Betty Williams have fully characterized brown masses of steacyite up to 4 x 5 cm from Henderson County from the Dave Garske stock.

OHIO

Ohio field collector John Medici has collected some very unusual acicular and sheaf-like brown fluorite crystals from the Suever Stone Company quarry at Delphos, Van Wert County in addition to some very fine, large, brown fluorite crystals at Lime City. John also collected a large number of very good pyrite specimens from Ross County last year.

PENNSYLVANIA

At the Tucson show, Neal Pfaff had a nice selection of some recently collected calcite crystals from the Thomasville Lime and Stone quarry (an underground limestone mine!) near Thomasville, York County. The crystals form colorless, semitransparent individuals up to 10 cm on a matrix of brecciated limestone and appear a pleasing golden brown due to a fine patina of iron oxide. Many are twinned on the basal pinacoid. The specimens were all collected by Pennsylvania collector Bryon Brookmyer.

There is a new mineral from Pennsylvania. It is an Na-Cu oxalate and was named wheatleyite in honor of the Wheatley mines near Phoenixville, Chester County. The mineral was first noticed by Bill Pinch on a specimen consisting of massive galena, sphalerite and quartz. While the published description implies the type specimen was collected from the dumps at the mine, Bill assures us that information is in error, as the specimen he supplied for study was indeed from an older collection in circulation for many years. The wheatleyite itself forms aggregates of pale blue acicular crystals up to 2 mm that somewhat resemble kroehnkite visually. The mineral is described by Rouse *et al.*, in the *American Mineralogist,* **71**, 1240–1242.

SOUTH DAKOTA

Sid and Betty Williams, not content at believing unsubstantiated names on labels, analyzed an unusual red brown cluster of equant to elongated crystals and found them to be cyrilovite. The matrix of whitlockite and "montgomeryite" on feldspar was provocative enough to inspire analysis of the bright orange "montgomeryite" and they proved to be a different member of the group: kingsmountite. The analyzed specimens are from the Tip Top quarry in Custer.

TENNESSEE

The Elmwood mine near Carthage is continuing to produce beautiful specimens of calcite, sphalerite, fluorite and barite. Both Sandy Ludlum and Joe Kielbaso (Gemini Minerals, P.O. Box 52, Tipp City, OH 45371) had excellent specimens at very reasonable prices at the Detroit show. It isn't often these days that one can find nice display specimens for under $10.

UTAH

James and Rita Lewis (P.O. Box 62, Hanksville, UT 84734) had some remarkably large (meter-length!) crystals of gypsum from Deep Creek Wash, Caineville, Wayne County. Some of the crystals form nice fishtail twins, comparable in size and quality to those from the famous Cave of Swords in Mexico. They were extremely reasonably priced (most were *under* $100!) and were definitely one of the best buys at the Tucson show. The Lewis's also had some very attractive azurite and malachite specimens from the Apex mine near St. George at equally reasonable prices.

Mike Madson had some interesting, large, bladed, pale blue celestite crystal groups from the Bluebird mine, San Rafael Swell, Emery County and nice azurite and malachite specimens from the Blue Jay claim, San Juan County.

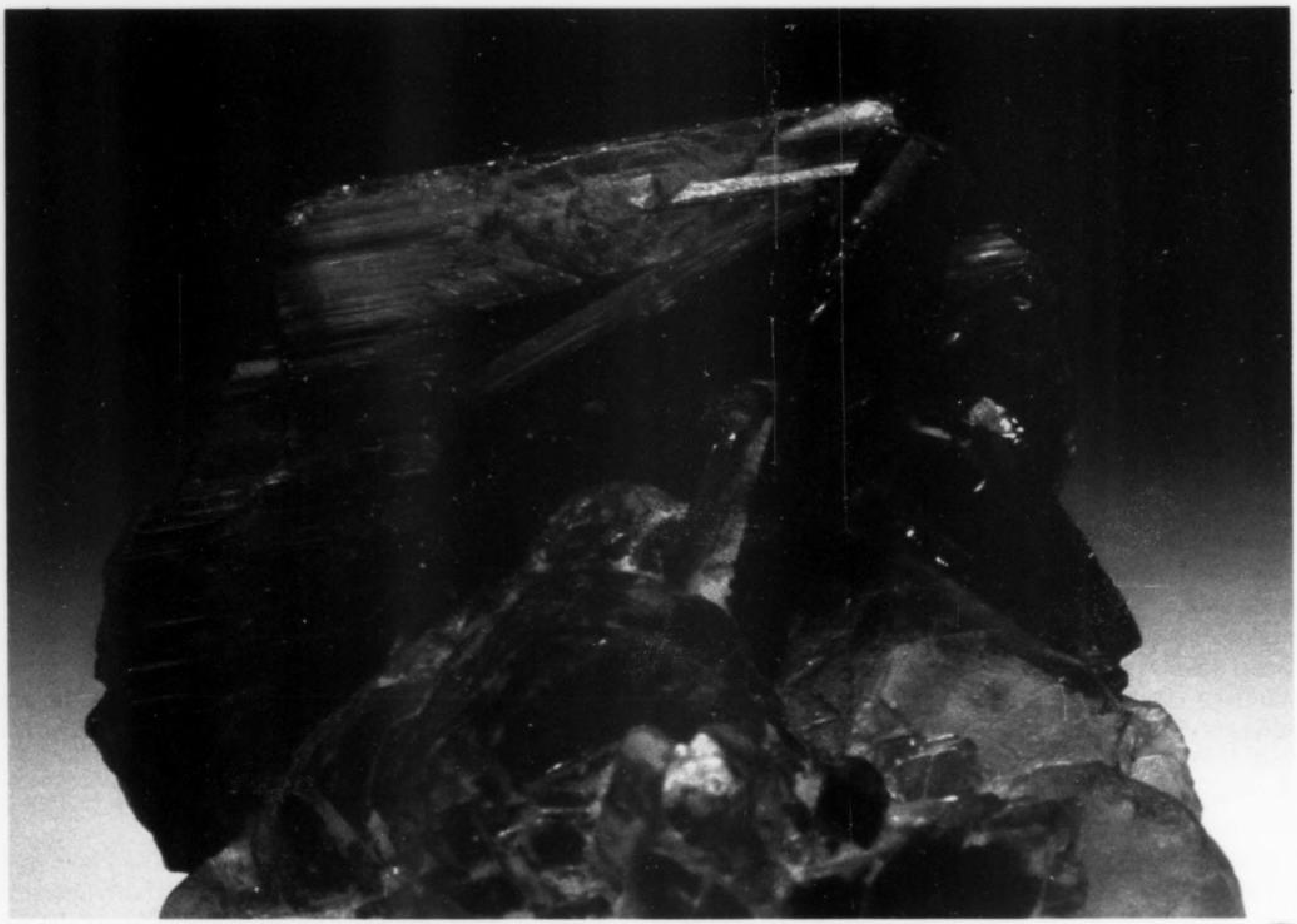
WASHINGTON

Some quite attractive acicular natrolite balls up to 5 cm in diameter have been collected by Raymond Lasmanis from the Robertson quarry in Mason County. These were being offered for sale by Jim McGlasson in Tucson at very reasonable prices. Jim also had some interesting micro gold in quartz specimens from the Lucky Break mine in Skamania County.

Dr. Russ Boggs of the University of Washington has found an unusual mica in Washington Pass, Okonogan County. The mica is rhythmically zoned masutomilite and zinnwaldite with masutomilite as an outer zone. Sharp crystals over 1 cm were found.

WISCONSIN

Al Falster reports a new occurrence of the rare mineral, rhodizite, in a lithium-rich pegmatite in Florence County. The rhodizite forms small, yellowish grains associated with tourmaline, albite, beryl, and other species.



WEW

Figure 1. **Stibiotantalite crystals to 1.4 cm from the Himalaya mine, San Diego County, California. Tim Sherburn collection.**

Part II: Canada

BRITISH COLUMBIA

A quantity of pale yellow to white, twinned calcite crystals were collected from a large vug in a marble quarry near McBride. The crystals attain a maximum size of about 10 cm, and appear to be twinned on $\{10\bar{1}1\}$ or $\{01\bar{1}2\}$. The specimens were collected and are being distributed by Rod Tyson.

The Van Silver deposit across from Whistler Mountain on Howe Sound has yielded an interesting suite of silver sulfosalt minerals that are presently under investigation at the Geological Survey of Canada. Identifications at the time of this writing are only tentative, but it appears that some very nice micro specimens of diaphorite, pyrostilpnite and other species are likely present.

Also under investigation at the Geological Survey is a new carbonatite deposit, the Aley carbonatite east of Williston Lake. In addition to a large suite of rare-earth-element fluorcarbonate and pyrochlore group minerals, the deposit has also produced crystals of fersmite and the rare species, huanghoite, which represents the first occurrence of that mineral in Canada.

NEW BRUNSWICK

There has been a major discovery of fluorite and other minerals at Mount Pleasant, Charlotte County. Lac Minerals is currently reevaluating this former tungsten property for its potential tin reserves, which is presently known as the Lac-Billiton tin project. Last August a kaolinized zone was encountered along the 950 exploration drift in which a large vug (originally about 5 m long) was laid open during a routine blast. Unfortunately, many specimens were unavoidably destroyed by the blast, as were many others by miners lacking experience in proper specimen collecting techniques. What is fortunate, however, is that chief geologist and project manager, Gustaf Kooiman, recognized the significance of the discovery and permitted access for the National Museum, Geological Survey, and Tyson's Minerals to extract what was left. Not only these parties, but the entire collecting community as a whole owes much to the efforts shown by Lac Minerals to permit the preservation of these important Canadian specimens. Among the specimens preserved from this find include a 10 x 15 cm wolframite crystal (the largest and best ever found in Canada), several blue-green octahedral fluorite crystals up to 12 cm on an edge, and many hand-sized specimens showing numerous combinations of quartz, galena, sphalerite, siderite and fluorite. Many of the quartz and fluorite specimens have a gray, drusy coating of microscopic crystals of chalcocite, sphalerite, wulfenite, what appears to be jeanbandyite and/or natanite. This occurrence is the first in Canada for the last-named species.

NORTHWEST TERRITORIES

The Nanisivik mine on the northwest end of Baffin Island has continued to supply some superb specimens of pyrite. This is largely due to the fact that Rod Tyson has successfully negotiated a contract with Strathcona Minerals permitting him to mine and market specimens. Again we owe our thanks to all concerned for the good of specimen conservation! The number of crystal habits of pyrite in association with all possible combinations of dolomite, calcite, quartz, and sphalerite that are available truly boggles the mind. Some of the recently found specimens consist of bright pyrite pseudomorphs after twinned marcasite blades which in turn are overgrown with clear-to-smoky Herkimer diamond-like quartz crystals and dolomite, a combination that most collectors would kill for!

Richard Herd, curator at the Geological Survey of Canada, collected some very good crystals of sapphirine last summer on Somerset Island, south of Resolute. The crystals form tabular, pseudohexagonal, blue-gray individuals several centimeters across and are probably the best ones ever found in Canada.

ONTARIO

Rod Tyson was able to acquire a lot of nice bright leaf silver specimens from the Silversides mine in Cobalt. The specimens range in size from miniatures to larger cabinet-sized pieces and are very typical of the Cobalt district specimens, which are now becoming difficult to obtain.

QUEBEC

Certainly no other province produced a greater abundance and variety of new mineral discoveries last year than did Quebec. As usual, no small part of these discoveries are attributable to Mont St-Hilaire, and the active collecting there by the National Museum and dedicated, hard-working private collectors like Gilles Haineault (2266 St-Alexandre, Longueuil, Quebec J4J 3T9). Since last April, many significant finds have been made, which we will attempt to summarize in chronological order. Unless otherwise noted, all these finds were made in the Poudrette quarry, which through the kindness of the Poudrette family, was made accessible to collectors throughout last year. Without their generous cooperation, there would have been nothing new to report.

April: Some of the best rhodochrosite and leifite specimens to have been found in recent years were collected by Gilles Haineault. The rhodochrosite is of a good, dark pink color, and forms rhombohedral crystals up to 2–3 cm across. The leifite occurs on the rhodochrosite as silky, white, hexagonal prisms up to 1 cm. A few specimens are associated with sharp, opaque, smoky-gray quartz crystals, which make very aesthetic specimens. About the same time Gilles found another pocket that produced some very fine serandite crystals. Some of these are twinned, and others are penetrated by long, prismatic, lustrous crystals of acmite, which make unusual specimens. An additional characteristic of this pocket was its freshness, no dirt or oxide coatings. In addition to all this, good specimens of ilmenite, elpidite, pyrite and other species were also found.

May: Near the end of April and into early May, there were a number of large marble xenoliths uncovered that hosted numerous pockets containing well-formed crystals of pectolite, apophyllite, carletonite, datolite and vesuvianite. Pods of dark blue, cleavable carletonite several cm across were relatively common. At the same time, a small zone of brecciated hornfels was uncovered, and produced good specimens of lorenzenite, steacyite and leucosphenite. Some exceptional catapleiite rosettes up to 5 cm were collected elsewhere in the quarry, while in the DeMix quarry, along the upper bench that separates it from the Poudrette quarry, a large pipe was discovered that produced many kilograms of large analcime, etched serandite, arfvedsonite, eduialyte, acmite and mangan-neptunite specimens.

June: Unquestionably the finest leucophanite crystals ever found at Mont St-Hilaire were recovered from a single, relatively small pocket by Gilles Haineault last June. The largest of these is approximately 3 cm across, and is in the mineral collection at the National Museum. Many of the smaller specimens, however, are equally impressive and consist of lustrous, transparent, yellow-green tabular crystals perched on and penetrated by terminated crystals of equally lustrous black acmite. A few even have crystals of polylithionite or serandite associated.

July-August: Relatively little was found during these months, as the area of active quarrying was largely confined to dense syenite and hornfels, with neither hosting any significant pockets. A few small cavities in some of the hornfels, however, did yield some micro gmelinite.

September-October: By September, the hornfels suddenly became more interesting, as some very good narsarsukite crystals began to turn up. The best of these form sharp, tabular, yellow, tetragonal crystals about 2 cm across. A few very fine, twinned crystals of eudidymite and a large pyrite pseudomorph after pyrrhotite were also collected by Gilles Haineault during this time period.

November-December: Just before the quarry closed down for the winter, an interesting contact zone was encountered surrounding a large mass of hornfels. The contact contains several kinds of altered xenoliths, and some very unusual species were collected from some of the sodalite and ussingite-rich xenoliths. Among some of the more interesting finds were some very good, rich specimens of villiaumite, thermonatrite, steenstrupine, lueshite, vuonnemite and griceite, along with nearly 40 additional species. Griceite is a new mineral named in honor of Dr. Joel Grice, curator of minerals at the National Museum of Natural Sciences in Ottawa. It is a naturally occurring lithium fluoride, and appears as white powdery coatings and microscopic steep pyramidal pseudomorphs (after an unknown mineral) which fluoresce pale yellow in ultraviolet light. A description of griceite will likely be forthcoming in the *Canadian Mineralogist*. Of additional interest was an occurrence of some well-formed nepheline crystals up to 4 cm in a natron-filled pocket in the adjacent syenite. Some very nice bright red crystals of eudialyte were also collected.

Lastly, another mineral from Mont St-Hilaire has been accepted by the IMA as a new species: poudretteite, named in honor of the Poudrette family. It is a new member of the osumilite group, occurs in marble xenoliths associated with pectolite and apophyllite, and somewhat resembles crystals of vitreous, rounded quartz. It is transparent and colorless to pale pink, and forms roughly equant, etched, barrel-shaped prisms up to 5 mm. All of the seven known specimens were collected in the mid-1960s and are part of the Bradley collection, purchased years ago by the Canadian National Museum. Hopefully, careful inspection of older pectolite specimens in many private collections will turn up more. A formal description has been accepted for publication in the *Canadian Mineralogist*. All things considered it has been a great year at Mont St-Hilaire.

There have been a number of interesting finds in the Sherbrooke area over the past year. First, new construction for highway 10 east of interchange 56 north of Sherbrooke resulted in several new roadcuts that produced literally thousands of pyrite crystals. Most of these were simple cubes, averaging 1 to 3 cm in a matrix of dark gray slate. Although some of the best areas are now inaccessible, there should be reasonable opportunity to collect good specimens from the roadfill for at least a few more years.

Many of the roadcuts in the area between Sherbrooke and Richmond have quartz veins that have sporadically produced reasonably good quartz crystals. However, last summer some exceptionally good specimens were collected from one such occurrence along highway 55, about 9 km north of Windsor. Very fine specimens of quartz, albite, anatase, fluorapatite and calcite were recovered.

Last summer, the National Museums of Canada conducted a field project at the old Lac Nicolet antimony mine in Ham Sud (South Ham) Township, Wolfe County. Collecting from both surface exposures and in the old underground workings provided numerous good specimens of native antimony, kermesite, stibnite, valentinite, gudmundite and other species. Clearly the best specimens collected were some of the kermesites, the best of which show sprays of acicular, red crystals up to 2 cm. Most of the other species occur in much smaller crystals and make very attractive micromounts. The area surrounding the mine is posted against trespassing, but permission to collect minerals is usually given if asked for in advance. The land is owned by the church in Sts-Martyrs-

Minerals New to Mont St-Hilaire Since May 1986 *

compiled by Bob Gault and Les Horvath

Actinolite – dark green to black acicular crystals to 5 mm in length associated with brookite, anatase, quartz, etc. in igneous breccia.

Barytolamprophyllite – pale to brownish yellow, fibrous and foliated blades to 12 mm in length, zoned with lamprophyllite, associated with many species of sodalite xenoliths.

Bavenite – transparent, colorless to beige, radiating, thin, stacked tabular crystals to 5 mm in length. Associated with pectolite and apophyllite in marble xenoliths.

Beudantite – yellow-green to olive-green crusts and crystalline druses, associated with sphalerite in altered pegmatites.

Celestite – white to tan compact spherical aggregates to 1 mm in diameter. Found at the contact of altered pegmatite and hornfels.

Cerite – rose-red to pink, thin, transparent, hexagonal plates to 1 mm in diameter in pegmatite.

Chamosite – dark brownish green spheres and micaceous plates to 15 mm in diameter in pegmatites and marble xenoliths.

Chkalovite – colorless, transparent, blocky crystals to 1 mm in diameter in sodalite xenoliths.

Clinochlore – brown, pale tan, colorless to white tiny plates to 0.1 mm forming rosettes. Associated with taeniolite in marble xenoliths.

Cryolite – colorless to white, pseudo-octahedral crystals to 2 mm in diameter in sodalite xenoliths.

Edingtonite – extremely tiny colorless pseudo-tetragonal prisms to 0.1 mm in length with poor terminations. Associated with ilmenite in pegmatite.

Epidote – lustrous, dark brown to red-brown tabular crystals to 3 mm in length. Associated with grossular in a contact zone between marble xenoliths and hornfels.

Epistolite – Formerly UK46, formerly murmanite. Beige, pink, yellow-gray, platy crystals and cleavage masses to 5 cm in length with a pearly to silky luster. Associated with eudialyte-rich pegmatites and with sodalite-rich xenoliths.

Gersdorffite – dull, dark gray, fine-grained intergrowths with calcite associated with loellingite.

Griceite – pure white to greenish yellow, dull, compact, powdery, botryoidal masses and as pseudomorphs after minerals with dodecahedral, cubic, and tapering prismatic habits. Found in sodalite xenoliths with many associated species. New species – LiF.

Halotrichite – white, silky fibers to 1 mm in length associated with pyrite pseudomorphs after pyrrhotite in carbonate-rich pegmatites.

Hydrocerussite – tiny white, opaque prisms and crusts on galena in altered pegmatite.

Jarosite – thin yellow powdery coatings in weathered fractures in sodalite syenite.

Lepidocrocite – brick-red granular to powdery masses in altered pegmatite.

Lizardite – green, fine-grained alteration after an unknown hexagonal mineral.

Magadiite – pure white powder associated with pectolite, bavenite, etc. in marble xenoliths.

Magnesite – light grayish green, transparent, modified rhombohedra to 2 mm in length in narrow seams in hornfels.

Mimetite – tiny white needles to 0.2 mm in length in altered pegmatite with galena.

Natron – colorless, transparent masses to 4 cm in diameter filling cavities in sodalite syenite. It reverts rapidly in air to thermonatrite.

Neighborite – orange-brown, transparent, pseudo-octahedra and pseudo-cuboctahedra to 0.5 mm in diameter in pegmatite.

Paraumbite – grayish, tiny nondescript equant crystals to 0.5 mm associated with gaidonnayite in altered pegmatite.

Poudretteite – colorless to very pale pink, transparent, roughly hexagonal, deeply etched, barrel-shaped crystals to 5 mm in length. Found in marble xenoliths associated with pectolite and apophyllite. New species – $KNa_2B_3Si_{12}O_{30}$.

Rosenbuschite – light yellow-orange divergent groups of acicular crystals to 3 mm in length in a miarolitic cavity associated with analcime, burbankite and woehlerite.

Senaite – black, submetallic, equidimensional twins (trillings) to 0.5 mm in diameter in pegmatite.

Spessartine – brownish, rounded phenocrysts to 5.5 cm in diameter in fine-grained albite associated with hornfels.

Tadzhikite – formerly UK39. Radiating aggregates of pale yellow to yellowish brown platy crystals to 0.2 mm in diameter forming balls and rosettes to 1 mm in diameter. Found in pegmatite and in marble xenoliths.

Taeniolite – grayish brown, tapering hexagonal prisms to 1 cm in length.

Terskite – formerly UK49. White, powdery to porcelaineous replacement of pseudo-dodecahedral lovozerite crystals. Found in sodalite xenoliths.

Thornasite – formerly UK27. Dull white, fluorescing very bright green under shortwave ultraviolet light. Tiny irregular grains and powdery masses to 1 mm, in an altered pegmatite associated with analcime, yofortierite and steacyite. New species – $(Na,K)ThSi_{11}(O,H_2O,F,Cl)_{33}$.

Thorogummite – yellowish brown to red resinous masses to 0.5 mm.

Vitusite – pinkish tan to black, poorly defined radiating prisms to 5 mm in length in sodalite xenoliths.

Wurtzite-4H – a rare polymorph of wurtzite, found as dull, apple-green, partially etched and skeletal hexagonal prisms to 3 mm in length in sodalite xenoliths.

Canadiens. There is no "easy collecting" underground. The old, partially flooded workings are very dangerous and should be avoided by those not properly equipped for or experienced in underground collecting.

There are still some amazing specimens of fluorapatite being collected from the Yates Uranium mine near Otter Lake, Pontiac County. Over a ton of specimens was removed by various collectors last summer, including a 25-cm bright green crystal in pink calcite that now resides in the National Museum in Ottawa.

Sid and Betty Williams have found some interesting species at the well documented Evans Lou Pegmatite in Wakefield. One nice item is tan needles of vyuntspakhite on tan feldspar. It is amazing what a brilliant mineralogist and his brilliant and energetic wife can do when they have two microprobe-like machines, an X-ray unit and fully equipped thin section facilities in their own home.

As a final note, for those collectors with a dedicated interest in Mont St-Hilaire and Francon quarry minerals, the descriptions for two recently discovered species, montroyalite and hochelagaite, appeared in the *Canadian Mineralogist,* **24**, 449–459.

Part III: Other World Occurrences

AUSTRALIA

There have been some very nicely crystallized native silver specimens recovered from the Alura mine, Cobar, N.S.W. The crystals, which form arborescent and herringbone-like aggregates, appear to have formed in a fine quartz sand. Excellent thumbnail and miniature-sized specimens are available from Frank and Wendy Melanson (Hawthorneden).

Some very good specimens of native gold from the Golden Triangle area, near Victoria, were available from John and Val Tunzi (Box 129, Kyneton, Victoria, Australia 3444) at the Tucson show. The Worturpa mine in the North Flinders Range, South Australia, has also recently produced some good melonite with native gold. Robert Noble (J. K. McLachlan & Co., 119 Greenhill Road, Unley, South Australia) had specimens at Tucson.

BOLIVIA

A number of dealers at both Detroit and Tucson shows had some very fine specimens of extremely lustrous cassiterite crystals from Viloco, La Paz. There were also a few very fine vivianites available from Huanuni, Oruro Department. One of the best of these could be seen at Frank Melanson's booth at the Tucson Gem and Mineral Show. The piece consists of a 10 cm fan-like spray of transparent, blue-green crystals on matrix. It is a very striking specimen.

BRAZIL

Pierre LaVille (P.O. Box 699, Station P, Toronto, Ontario M5S 2Y4) is actively engaged in geological exploration in Minas Gerais and has provided a considerable amount of information regarding some important finds in Brazil over the last year. Most of these are in the gem pegmatite district of Minas Gerais and include the following discoveries:

Sapucaia mine, near Divino das Larangeiras: Some superb shiny crystals of schorl up to 15 cm have recently been found at this pegmatite in addition to some large crystals of herderite/hyroxylherderite. The latter occurs as chalky white crystals several cm across associated with citrine.

Virgem da Lapa: Shortly after last year's symposium, a pocket was uncovered that produced some very good aquamarine crystals, including a doubly terminated, tabular crystal approximately 15 cm in diameter. This habit is normally shown by morganite crystals, but is rather unusual for aquamarine.

Lavra da Campolina, near Medina: Certainly one of the most exciting recent finds in Minas Gerais was the pocket of sherry-colored apatite crystals at Lavra da Campolina. Almost all of these crystals are quite gemmy, and many appear to be twinned (perhaps on $\{11\bar{2}1\}$. Most averaged 2–5 cm, but a few clusters up to 10 and 20 cm were found. The Rocksmiths, Pierre LaVille and Bill Larson have most of the better material available.

Cruzeiro mine: Near the end of August last year, a huge water-filled pocket was encountered that produced nearly two tons of very clear quartz crystals. Unfortunately, most of what could have been some fantastic specimens were badly damaged by the garimpeiros during the course of their removal. There were also a few very fine, long, prismatic crystals of green elbaite produced.

Luis Alberto Dias Menezes of Jacupiranga, Sao Paulo, was selling some very attractive "Tieras" of "cockscomb" quartz crystals arranged in snaking clusters from Santa Rosa, Minas Gerais. Some of the quartz terminations were smoky due to tiny inclusions. Luis also had a good quantity of the fabulous monazite twins from Buenopolis. Most of the attraction in Luis's room at Tucson were the new indicolites from Golconda, Minas Gerais. The matrix clusters were deep blue with almost black tips. The clusters were very attractive as fine-grained white mica crystals covered the base of the tourmaline.

CHILE

Jim McGlasson has micromounts of lavendulan crystals from Guanaco, Tal Tal.

CHINA

There seems to be an ever-increasing number of interesting minerals surfacing from The People's Republic of China. Tony Jones (California Rock and Mineral Co., P.O. Box 86, Brea, CA 92622), Forrest Cureton and quite a few other dealers were offering good Chinese minerals at the Tucson show. These included dark honey-brown topaz crystals from Yunan Province; more bright blue azurite rosettes from the Yang Chweng mine, Guangdong Province; more large, twinned cinnabar crystals, quartz, and dolomite from Guizhou Province; turquoise from Hubei Province; orpiment, fluorite, and various others.

COSTA RICA

Costa Rica does have mineral specimens! Ron Boyd (APDO 151, 2350 SN.FCO. 2 Rios, Costa Rica) has been able to obtain some interesting specimens of native copper, sulfur crystals, thomsonite, and other minerals. The sulfur is from the Turrialba volcano and resembles the more familiar Steamboat Springs, Nevada, material. The copper forms flattened sheets of dendritic crystals, and comes from Bajo Claras. The thomsonite, which is from Puente La Garita, Rio Puas, consists of white, crystallized botryoids lining cavity walls in a volcanic rock.

FRANCE

Sid and Betty Williams came up with another astonishing rarity. They X-rayed and chemically analyzed pale lemon-yellow abernathyite on sandstone from Lodev, Herault. The crystals are thin wafers with rhombic outline.

GERMANY

Chalconatronite, as micro blue blebs on rock, was available from Jim McGlasson in Tucson. The locality is Bad Ems, West Germany. Ralph Hermanspann of Regulshausen collected some gem quality crystals of haüyne in a quarry near Mendig in the Eifel District. Small crystals and cut stones were available from him at the Munich Show (see *Canadian Gemologist,* **VII**, 100, for more information).

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* **Note:** The following names should be deleted from the list of Mont St-Hilaire minerals: almandine, ferrocolumbite, chlorite, antigorite, murmanite, manasseite.

Figure 2. **Fluorapatite crystal, 5 cm, from Lavra da Campolina, Medina, Minas Gerais, Brazil. National Museum of Canada collection; photo by George Robinson.**

Figure 3. **Epidote crystal group, 2.5 cm across, from Tomiq, Pakistan. Tim Sherburn collection.**

GREECE

Gilbert Gauthier (7, Avenue Alexandre III, 78600 Maisons Laffitte, France) has a large selection of newly collected quartz crystals from Mega Xhorio on the island of Seriphos. These crystals, which reach a length of 7–8 cm, form tapered, doubly terminated individuals and are light green due to inclusions of actinolite (based on thin sections). Reasonably good andradite specimens were also available from this occurrence, but in fewer numbers. The site is reported to be a few kilometers distant from the celebrated ilvaite locality.

ITALY

About two years ago, there were some incredible anhydrite specimens collected at the Campiano pyrite mine in the Boccheggiano district, Tuscany. Perhaps a few hundred specimens appeared at various Italian shows, but few if any seemed to reach the western market. The crystals are white and form sharp, tabular individuals several centimeters long, associated with quartz, dolomite, and pyrite. More recently, some clear, modified crystals of fluorite were also found. Renato Pagano (Via S. Anna 1B, I-34074 Monfalcone, Italy) has a few of these left. There are few localities in the world that have produced any better large crystals of anhydrite.

Julius and Miriam Zweibel (Mineral Kingdom) had some new calcite specimens from Montaltodi, Castro, Tuscany. This calcite forms yellow-brown hemispheres up to 3 cm in vesicles in basalt, greatly resembling "sphaerosiderite."

JAPAN

Lothar Otter of West Germany went collecting with Hidimichi Hori of Tokyo and found a 15-cm Baveno twin microcline in the Naegi District of Gifu Prefecture.

MEXICO

Whereas there was no single major find of historic proportion in Mexico last year, there were certainly a number of significant smaller ones worthy of mention. Carl Faddis (Tierra Minerals, 3651 E. Marginal Way S., Seattle, WA 98134) has handled some very nice new specimens over the past year. Among these are included some fine ludlamites from Santa Eulalia, Chihuahua, and some interesting amethyst crystals on galena from Naica. Gene Schlepp (Western Minerals) and several other dealers also had good specimens of this material.

There were a few more good acanthites from the Reyes mine in

Guanajuato. Carl Faddis had an exceptionally brilliant specimen at Tucson, consisting of a gleaming, black arborescent growth of crystals on a matrix of etched, platy polybasite crystals.

There was an excellent selection of amethyst specimens on display at Tucson. Carl Faddis had some very nice groups from Amatitlan, Guerrero and Rough and Ready Gems (P.O. Box 10404, Denver, CO 80210) had some choice groups from Las Vigas, Veracruz.

Joe Diamond (Universal Gems and Minerals, 5951 Greims Court, El Paso, TX 79905) had a rather "large" lot of gypsum crystals from Santa Eulalia, Chihuahua in the wholesale section at the Tucson Gem and Mineral Show. The lot consisted of eleven clear, single crystals, each a meter or more in length!

Jim McGlasson had some very fine micro specimens of what had tentatively been identified as natanite from Mina el Potosi in Santa Eulalia, Chihuahua. A few of the larger crystals, however, appear decidedly more tetragonal than cubic, and hence may be jeanbandyite. An X-ray investigation is presently underway.

Microscopic crystals of braunite have been found in placer deposits associated with an evaporite sequence northwest of Monterrey, Nuevo Leon.

NAMIBIA

Tsumeb is once again producing some great new specimens due to reactivated mining in some of the upper levels. Rob Smith and Anthony Malakou (African Gems and Minerals, 404 Silbro House, 225 Jeppe Street, Johannesburg, South Africa) had some recently collected azurite crystals up to nearly 10 cm, reminiscent of "the good old days" at Tsumeb. The Zweibels were able to acquire the contents of a new scorodite pocket that included matrix specimens with 1 cm blue-gray crystals, also similar to material from the earlier days. The Zweibels also had a few choice mimetite specimens both from Tsumeb, and the Kombat mine in the Otavi Mountains. The latter specimens somewhat resemble the familiar, yellow, botryoidal material from San Pedro Corallitos, Chihuahua, Mexico. On the rare species market, good specimens of phillipsbornite and hidalgoite were available from Sid Pieters of Windhoek and from Jim McGlasson.

African Gems and Minerals had some new barites and epidotes from Namibia, too. The barites are all single, lightly frosted, prismatic crystals that average 5–10 cm long. They are a pale honey-yellow color, and come from hydrothermal veins associated with a volcanic exhalative deposit in the Brukoros Mountains. The epidotes are also single crystals and greatly resemble the specimens from Pakistan or Mineral County, NV. The locality is near Rehoboth.

NIGERIA

There were quite a few topaz crystals from the Jos River near Delimi, being offered for sale at the Tucson show. Most of the better specimens could be viewed at Bill Larson's booth at the main

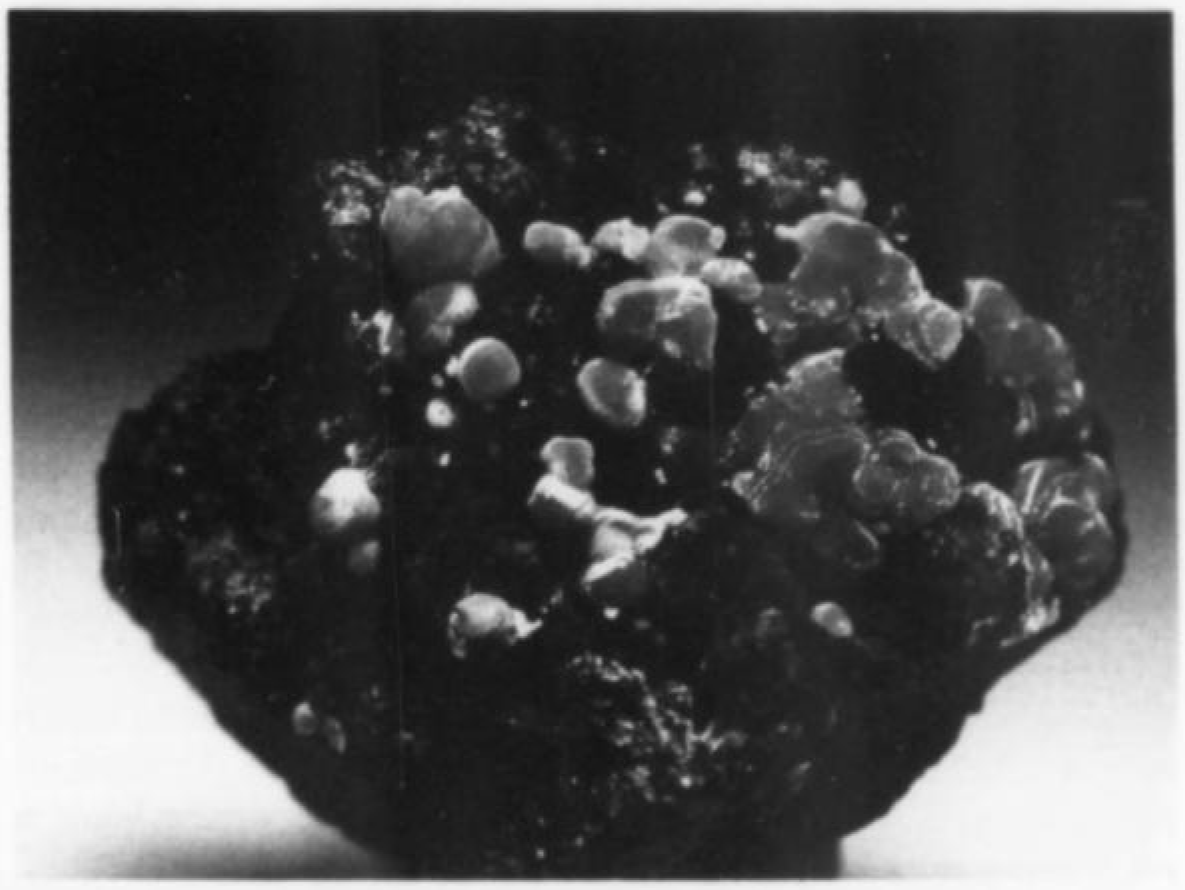

Figure 4. **Strengite on rockbridgeite, 5 cm across, from Suappavaava, Sweden. National Museum of Canada collection; photo by George Robinson.**

Figure 5. **Chalcopyrite with quartz, 5 cm across, from the Huaron mine, Huaron, Ancash Province, Peru. Brad Van Scriver specimen.**

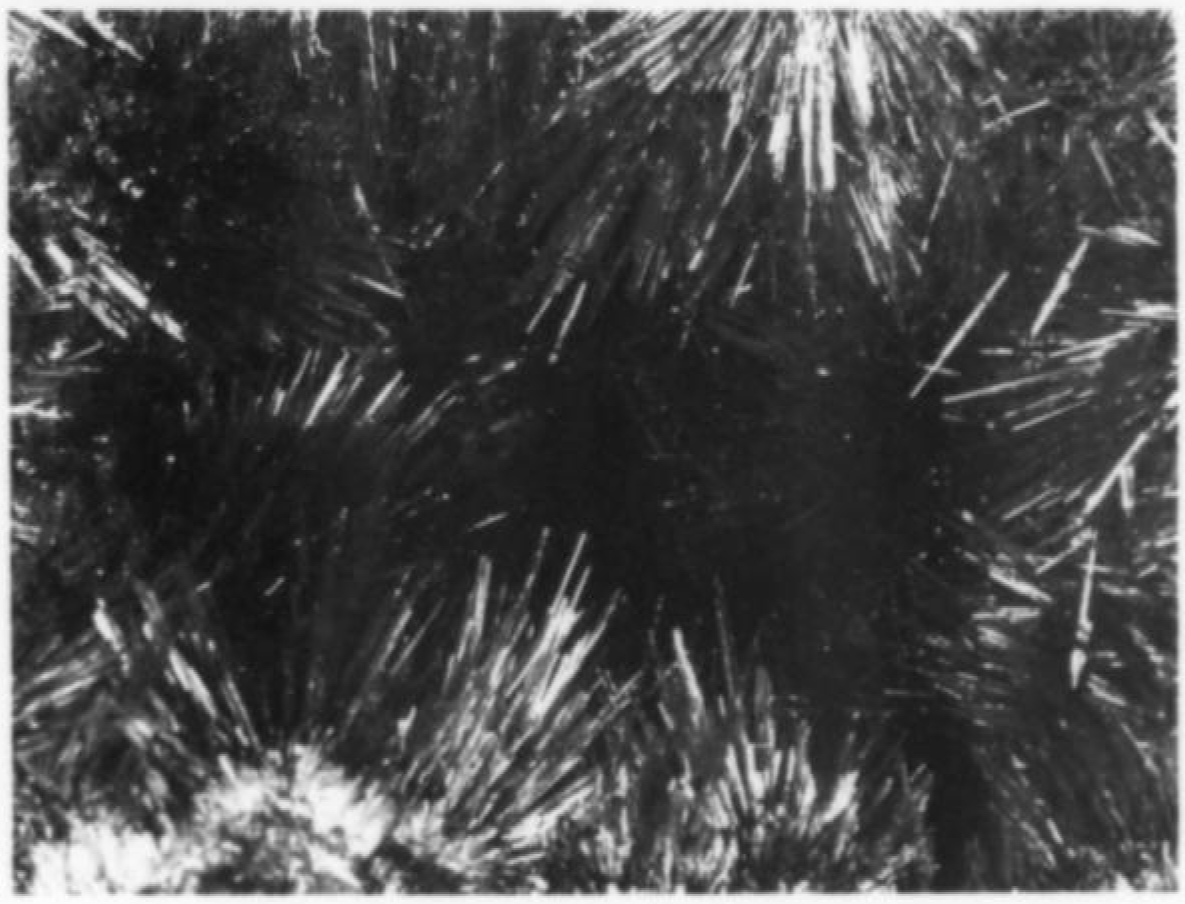

Figure 6. **Cuprosklowdowskite cavity, 7 cm across, from the Musonoi mine, Kolwezi, Zaire.** ***Kristalle*** **specimen.**

show. There were also a few gem elbaites seen at the show, and although they were incredibly beautiful specimens, their prices were largely based on their gem value, placing them far out of reach for most collectors. Gilbert Gauthier was the original source for these.

NORWAY

Frank Melanson was able to obtain some very good single crystals of brookite from Hardangervidda. The crystals are up to 2 cm long and form thin, transparent, orange-brown wafers. Some show black sector zoning, and all make nice thumbnails to compliment the more familiar anatase specimens from this now famous locality.

PAKISTAN

Herb Obodda reports there have been more new finds of various minerals from Pakistan. Among these was a superb, sharp, 2 cm crystal of pollucite from the Gilgit area; more and even better quality epidotes from Tomiq, some of which are beginning to rival the famous Austrian crystals; new titanite and adularia specimens from an alpine-type deposit near the village of Hanuchal; fine crystals of emerald from a pegmatite mine at 16,000 feet elevation; new pink to apricot-colored topaz crystals from Shamozi; and a continuing supply of good aquamarine, tourmaline and spessartine.

PERU

While not as prolific as in the past, Peru does continue to supply new material to the mineral market. Good specimens of chalcopyrite from Huaron and bournonite from Casapalca were evident at the Tucson show.

PORTUGAL

Once again there has been a reasonably good supply of Panasqueira minerals available over the last year, although it is difficult to know just how much is new material. Luis Leite of Lisbon, however, did have some new panasqueiraite with thadeuite available at Tucson.

There are some new libethenite specimens from near Estremoz. This libethenite occurs in sharp, dark green 1-3 mm crystals on a gray gossan-like matrix. Specimens were available from A. L. McGuinness at the Tucson show.

SOUTH AFRICA

The N'Chwaning mine in the Kalahari manganese field is continuing to supply interesting specimens to the mineral marketplace. Larry Introna (P.O. Box 4147, Cape Town 8000, South Africa) had some very fine sturmanite, pink datolite, sugilite, bultfonteinite, calcite and other species in his room at the Sheraton Inn in Tucson. Some of the calcite crystals were of an extremely unusual habit, elongated in a direction perpendicular to the $(10\bar{1}1)$ and at the same time flattened at right angles to the direction of elongation producing crystals that looked a great deal more like gypsum than calcite. In fact, positive identification was ascertained only by X-ray means. African Gems and Minerals also had very good and extremely reasonably priced sturmanites and gaudefroyite crystals in addition to more of the attractive blue quartz crystals with ajoite inclusions from the Messina mine in Northern Transvaal.

SRI LANKA

Bill Larson currently has a very good selection of sapphire crystals from Ratnapura. The crystals are quite sharp in spite of their alluvial provenance, and range in color from yellow to blue and in size from 2 to 8 cm. Bill also had a few good spinel crystals and an unusual, rectangular danburite crystal.

SWEDEN

At the Detroit show last October, Don Knowles (Golden Minerals) had some very fine specimens of strengite and rockbridgeite from a new find in Sweden. The pink and green color contrast displayed by these specimens make them particularly attractive, as demonstrated by the cover photo on November 1986 issue of *Lapis*. There seems to be a degree of uncertainty, however, as to the correct spelling of the locality, as it has been given as both "Suappavaava" and "Slappavaara," neither one of which appear in any of the five world gazeteers we have been able to consult. The correct version may be Svappavaara, a small village 60 km north of Gällivare, in northern Sweden. Sid Williams had good johnbaumite, tilasite, and heliophyllite from Långban available at the Tucson show. Sid and Betty have also discovered a dark resinous alteration of keivyite and yftisite after fergusonite-Y from Ytterby.

SWITZERLAND

The famous Legenbach quarry at Binnental, Valais, has recently produced a few specimens of the rare sulfosalts hatchite and wallisite, in addition to some of the more commonly encountered species such as sartorite and realgar.

THAILAND

Terrence Coldham (Sapphex Pty Ltd., GPO Box 4525, Sydney, N.S.W. 2001 Australia) had some interesting new mineral specimens from Thailand at the Tucson show. The specimens are apparently recovered from fluorite quarries as a byproduct. The most spectacular of these new finds is the fluorite encrusted stibnite crystals from Chaing-Mai Province. The stibnite crystals themselves look a great deal like those from Rumania. The fluorite that covers them is a pale mauve-gray color and usually sufficiently transparent to see the individual stibnite needles inside. There were also a few small specimens of tabular, gray-white barite crystals on iridescent "turgite" from a barite quarry near the village of Phrae, Phrae Province.

TURKEY

There were a few more very choice crystals of diaspore from Mugla Province (?) that showed up in Munich last October. Herb Obodda was able to obtain some very choice thumbnail-sized single crystals. There is apparently more very fine kammererite still coming out of Erzurum, as well. Claus Hagemann (P.O. Box 1217, D-5828 Ennepetal 1, West Germany) had a nice lot available in Tucson.

U.S.S.R.

Gilbert Gauthier had an amazing cube of gold (symmetrical 7 mm) from Kowcha in the Urals on sale at Tucson.

YUGOSLAVIA

Claus Hagemann brought one of the finest selections of Trepca minerals with him to Tucson that we have ever seen available. These were generally older pieces from a private collection, rather than newly mined material. The many combinations of sparkling sphalerite, quartz, calcite, arsenopyrite, and rhodochrosite provided a truly dazzling display. There were also several good bournonite and ludlamite specimens available.

ZAIRE

Zaire is continuing to be the source of some very fine minerals. Gilbert Gauthier had more good cobaltian calcite with malachite from Mupine, Shaba Province at last October's Detroit show, along with very good malachite crystals on chrysocolla from Mashamba and sphaerocobaltite and kolweziite from Musonoi. Wayne Leicht was also able to acquire a major collection of Shaba Province minerals just before the Tucson show, and was offering superb specimens of plancheite, pseudomalachite, libethenite, torbernite, cuprosklodowskite and other species. Gilbert Gauthier provided some quartz crystals from Midingi, Shaba which on crystallographic study show the first scalenohedral modifications on quartz that are known.

HISTORICAL NOTES ON MINERALOGY

Lawrence H. Conklin

Figure 1. **Fred M. Sickler, discoverer of kunzite at the White Queen mine, Pala, California.**

On Kunz & Kunzite

The pink or lilac-colored variety of spodumene is today universally known as kunzite, in honor of George Frederick Kunz. But it might well have retained any one of several other names instead. It is generally agreed that pink, gem-quality spodumene was first discovered by Frederick M. Sickler. At least it was Sickler who sent the first specimens to George Kunz at Tiffany & Company in December of 1902, thinking that they were possibly a variety of tourmaline. The exact locality was not furnished to Kunz at the time, but it was later revealed to be the White Queen mining claim on what was later known as Heriart or Hiriart Mountain, near Pala, San Diego County, California.

At that time credit for the discovery was disputed because coevally with the Sickler discovery Frank A. Salmons, another miner from that area, made an independent find of the same material nearby at his Pala Chief mine, and many considered *him* to be the discoverer. In a letter[1] to Kunz dated September 26, 1904, Sickler states:

> . . . A short time ago mention was made in a San Diego paper of Frank Salmons, terming him the "discoverer of Kunzite." George H. Hazzard immediately published an open letter calling attention to the facts of my discovery and contradicting the statement giving credit to Mr. Salmons. Mr. Hazzard's article was unchallenged. For this reason I wish you to make it clear in your report[2] the various dates of the discovery of Kunzite ledges or mines and thus relieve me from the annoying and malicious attacks of my disappointed competitor. Remember that no matter what may be said or rumored, that I have the written vouchers and correspondence showing I brought the stone before all local lapidists and experts a year before the Pala Chief yielded any Kunzite, and further that I made a sale to Tiffany & Co. before any work was done on the Pala Chief. I regret to mention that Salmons & Ernsting, who are handling the Kunzite output of the Pala Chief mine, are advertising to the trade that they have the only Kunzite deposit in the world!

Kunz must have had a bit of trouble with this message because Salmons and the Pala Chief mine were Kunz's source for the really fine, large and gemmy crystals of kunzite that yielded the beautiful, giant-sized faceted stones which had so impressed the jewelry fraternity. In his report Kunz wrote a few paragraphs on the discovery of kunzite, but finished by stating only that Sickler's discovery "seems" to be entitled to priority. Ah well, commerce, as well as science and history, must be served.

H. C. Gordon, who was an important long-time correspondent of Kunz's, and who supplied Kunz with much data and many photographs for the report, wrote to him on October 24, 1902:[3]

> Thinking you may like to know the history of the gem spodumene "Kunzite" I will let you know its location in this country, where first found, name of discoverers, etc. The discoverers are named Pedro Peiletch and Bernardo Heriart, Frenchmen. They first discovered it on section 24, T9S R2W, on a mine [the White Queen] located by themselves and Mr. Fred Sickler. This was at least 9 months prior to them finding it in a mine [the Pala Chief, in section 14, located May 1903] owned by themselves and Frank Salmons and John Giddens.

---

[1] Letter in the library of Richard Hauck.

[2] The "report" referred to is Kunz's *Gems, Jewelers' Materials and Ornamental Stones of California,* 1905. Even the publication of this work evoked controversy. Kunz's name does not appear on the title page nor on the outside of the book. However, Lewis Aubury, State Mineralogist of California, does give Kunz a thank you in print for all his efforts. Kunz, although he must have been upset by this snub, promptly obtained a quantity of the reports for personal distribution, had them bound in kunzite-pink cloth, and had his name stamped on the title page and the cover!

[3] Letter in the author's collection.

Here were two more "discoverers," perhaps the real ones. Kunz was wise to hedge his bet.

Obviously confusion reigned, as exemplified by a photograph of Sickler,[4] on the back of which is written (in Sickler's hand) the following inscription:

> *To Hon. Lewis Aubury State Mineralogist. Compliments of Fred M. Sickler Co-discoverer with M. M. Sickler of the mineral and gem lilac spodumene known as Sicklerite but also as Kunzite & Salmonite.* [sic]

Presumably he should have added the names of Peiletch and Heriart to his list of honorees!

Charles Baskerville, a chemistry professor at the University of North Carolina and later the City College of New York, named kunzite in honor of George Kunz in 1903, but not without much input from Kunz himself. Exactly how the whole matter originated has not been recorded; nevertheless we can be sure that it was Kunz who began it. There is much reference to the matter in the Kunz-Baskerville file of correspondence at the American Museum of Natural History library in New York, which I quote from below.

Baskerville was still working on the analysis of kunzite when he wrote to Kunz on November 24, 1903:[5]

> Perhaps it may be necessary for me to have a little more of the kunzite. I prefer the colored pieces, the small refuse pieces from the cutting will answer. Will push along the analysis as fast as we can.

Baskerville got much more than "small refuse pieces" for analysis from Kunz, for in the early 1950's I was shown a fine cut and polished prism of kunzite while attending an optical mineralogy course at City College of New York. Professor Kurt E. Lowe stated that it was the very same specimen worked on by Charles Baskerville in 1903. I certainly hope that it has survived the years with its history intact.

In a somewhat later offprint of his original published work on kunzite in the *American Journal of Science* in 1903, Kunz warned us twice of what was to come. After describing several small crystals of pink spodumene, he said, "As this is an entirely new gem of peculiar beauty, a name will be given to it shortly." And also, "If sufficient differences are found to exist between this spodumene and the other known varieties a new name will be given to it." When the official publication ("Kunzite: a new gem," *Science,* September 4, 1903) finally came out Baskerville states: "The observations of Dr. Kunz sufficiently characterize this mineral of peculiar beauty as a new gem, which he has not named. . . . I propose the name Kunzite, for reasons unnecessary to give to American and European scientific men." This publication (which included ten lines quoted from Sir William Crookes on the phosphorescence of kunzite) initiated the following exchange:

Kunz to Baskerville, December 19, 1903:[5]

> Our article looks fairly well in *Science.* Wait until they pull it to pieces – Who?

Figure 2. **(Left to right:) Bernardo Heriart, Frank A. Salmons and Pedro Peiletch at the White Queen mine where kunzite was first found.**

Baskerville to Kunz, January 13, 1904:[5]

> By the way, you know I rather prefer leaving out Crooke's verification of our work in his letters. Think better publish our *own* and send reprint; think we would be glad to have him make public *his* observations himself. It then doesn't give appearance of bolstering one's work.

Kunz to Baskerville, January 16, 1904:[5]

> . . . Quite agree with you in regard to the reference about Sir Williams Crookes. I quoted him myself and although I knew the facts, felt that coming from him it might seem as if I was using his thunder and he has been and I believe will continue to show us courtesies in the future.

Somewhere in the correspondence is a reference to Crookes's acknowledging a faceted kunzite for his wife.

Things were obviously handled (perhaps manipulated is a better word) very carefully as again is shown by a note from Baskerville to Kunz in 1903:[5]

---

[4] Original photograph in the library of Richard Hauck. The photo is undated, but Sickler looks quite young; it must predate 1912 when two unrelated species (neither of them spodumene) were formally named salmonsite and sicklerite by Waldemar Schaller.

[5] Letter in the American Museum of Natural History library.

> When [kunzite] analysis is complete will make another paper – brief one with anal. & send to Dana. Prefer to have things in better shape for him. Whereas in *Science* things need not be too specific.

In the *Mineral Collector,* April 1906, W. S. Valiant, a professor of geology at Rutgers College in New Jersey, wrote the following somewhat cryptic comments, in which I have inserted some clarifying notes in square brackets:

> A beautiful gemstone was found a few years since in California. This was examined by several supposed experts; one called it topaz, another tourmaline. Finally a fine sample was handed to Dr. W. V. Nichols of Oceanside, Cal., who sent it to New Jersey [i.e., to Valiant] for determination. This was returned [by Valiant] the same day it came, labeled "Spodumene of fine gem quality." Another letter was sent [by Valiant] to New York [i.e., to Kunz] on the same day, reporting the find. This received a kindly reply, which stated that the same mineral was under examination there and the results would be published soon. In the meantime our letter

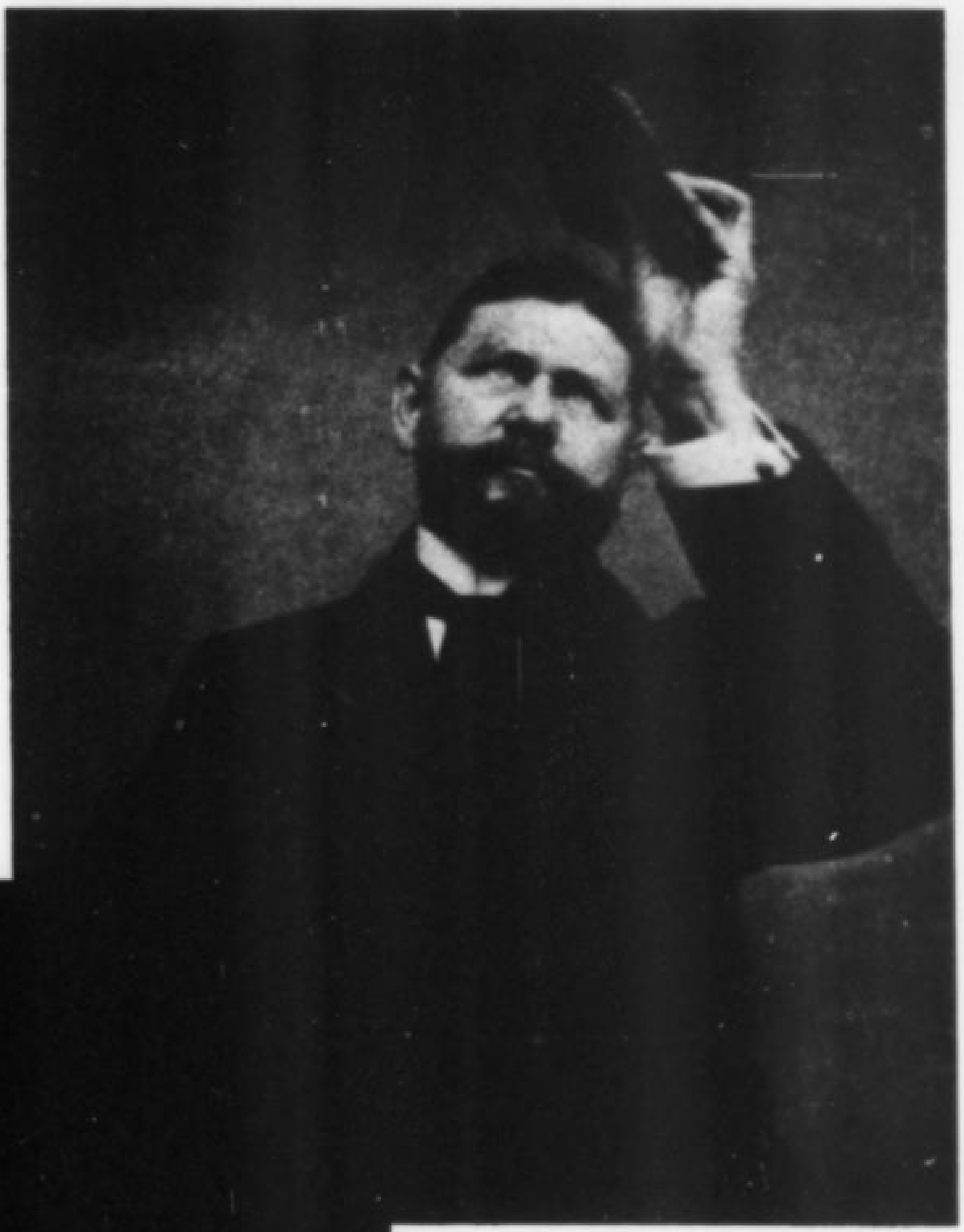

Figure 3. **George Kunz examining what may be the crystal of kunzite shown here in Figure 4.**

Figure 4. **Superb crystal of kunzite from the Pala Chief mine; 14 cm. Photo by Harold and Erica Van Pelt. It was originally sold to J. P. Morgan by Kunz around 1903, then was donated to the American Museum of Natural History in New York. In the 1960's it was traded out to Peter Bancroft, and is now in the collection of William Larson. (This photo first appeared in *Letters to George F. Kunz* (1986)).**

> and sample reached California, and in the same mail a letter asking for samples, etc. from New York. The results of the examination in New York were published nearly three months later [Baskerville's article], verifying our determination, and giving it a variety name, after the "discoverer" [sarcastic quotation marks?]. The naming was eminently proper [a gracious bow to Kunz anyway?].
>
> In due time a letter came from California [from Sickler or Salmons?], to the present writer, stating that the correct name of the mineral was first given to Californians "in your letter of June 23d, 1903." Also that in California it was called "Salmonite."
>
> Long stories have been published, one in the *Mineral Collector,* about this matter, but the question as to who first "discovered" it is still at large. A man in California claims to be the first, but did not know what he had discovered, and could find no one to tell him. What did he "discover"? Finding and discovering are sometimes different matters.
>
> Later on letters were received from New York [Kunz] by the writer, fully explaining the apparent discrepancy, but still leaving the question of priority as to correct locality and naming of the mineral, as far as Californians knew, to the present writer. We should have published the discovery at once; why we did not, will not be given at this time.

Nor was Valiant's reason ever given. What would he himself have chosen for a name if he had published promptly? No one knows.

As late as 1915 controversy still surrounded "kunzite," when George Otis Smith, director of the United States Geological Survey, wrote to Kunz as follows:[6]

> Mr. Parker has stated that you were not pleased with the manner in which the gem mineral spodumene was discussed by Mr. Sterrett in the report on the production of gems and precious stones for the years 1913 and 1914. I regret that you take this view of the matter, as I am sure no affront was meant. Mr. Sterrett was simply carrying out the policy he started several years ago of mentioning different *trade* [italics mine] names applied to certain gem minerals in the Survey reports. This has been done in order that the general public in purchasing such minerals under those trade names, might have some place to look up the character of those minerals. Mr. Fenton, Secretary of the Pala Chief Gem Mining Co., wrote at some length on the subject of the California iris, and was particularly anxious to let that name be known also, since he stated the gem spodumene was being sold in Europe under that name and in the Western part of the United States also. A change in wording has been made under spodumene to appear in the bound volume *Mineral Resources for 1914,* which I hope will prove more satisfactory.

Please note that "kunzite" is not mentioned once in Smith's letter, and imagine how Kunz must have felt upon hearing "kunzite" called a trade name! Surely an affront was meant.

The report that originally upset Kunz started out satisfactorily enough:

> Spodumene. Kunzite and Hiddenite. The production of spodumene gems in 1912 was confined to the kunzite variety.

Then it goes on to discuss Frank Salmons's report of two large kunzite specimens with measurements and descriptions. Kunz was certainly pleased. But then:

> . . . Although the spodumene has heretofore been called kunzite as a compliment to Dr. George Kunz, the owners of the mine have given their permission to European jewelry firms to sell it under the name "California iris" as being appropriately descriptive of its native home and its remarkable coloring. Mr. R. Fenton, secretary of the Pala Chief Gem Mining Co., states that the mineral is being well received under this name in many countries of Europe. Much of this spodumene will be sold as "California iris" in the United States also, especially in the West where the name is considered especially appropriate.

George Kunz was no doubt angered by all this disrespect, and found little to soothe his feelings as promised by Smith in the "bound volume" for 1914. Here "California iris" was deleted, but so was "kunzite." Only the species name spodumene was retained.

By 1919 things had obviously cooled down, and Frank Salmons, as president of the Pala Chief Gem Mine, wrote[6] Kunz that he had "a half dozen fine specimens of kunzite. If you will be interested in same, I will be glad to send them on for your inspection."

Kunz felt quite secure, as well as casual, about his beloved kunzite when he said the following in his memorial to his kunzite collaborator, Charles Baskerville, in 1922:

> About 1903 a variety of spodumene was identified as new by the writer, and it was his intention to name it after J. Pierpont Morgan. It was, however, impossible to get in touch with Mr. Morgan at that time, and Dr. Baskerville then named this mineral after the writer.

It seems amazing to me what a person can say with 17 years of perspective. I have often thought that the above quotation might instead have read:

> It was impossible to get in touch with Mr. Morgan at that time because he was in the bath, or because he was having lunch.

In fairness it must be pointed out that in 1911 Kunz had the opportunity to name the recently discovered pink variety of beryl, and he called it "morganite" after his distiguished patron.

The name "kunzite" for the pink variety of spodumene, like all varietal terms, carries no scientific weight. The acceptance or rejection of such terms is, in the end, determined solely by popular usage. It is, however, still a universally recognized varietal term along with others such as hiddenite, tanzanite and emerald that will surely survive. Sicklerite and salmonsite are today valid species unrelated to spodumene. J. P. Morgan is remembered in morganite. But "California iris" is long abandoned, and Messrs. Heriart, Peiletch, Valiant, Giddens and Nichols have yet to be honored with any mineral names. The spirit of George Frederick Kunz can rest easy . . . his namesake is secure.

Lawrence H. Conklin
17 St. John Place
New Canaan, CT 06840

* * *

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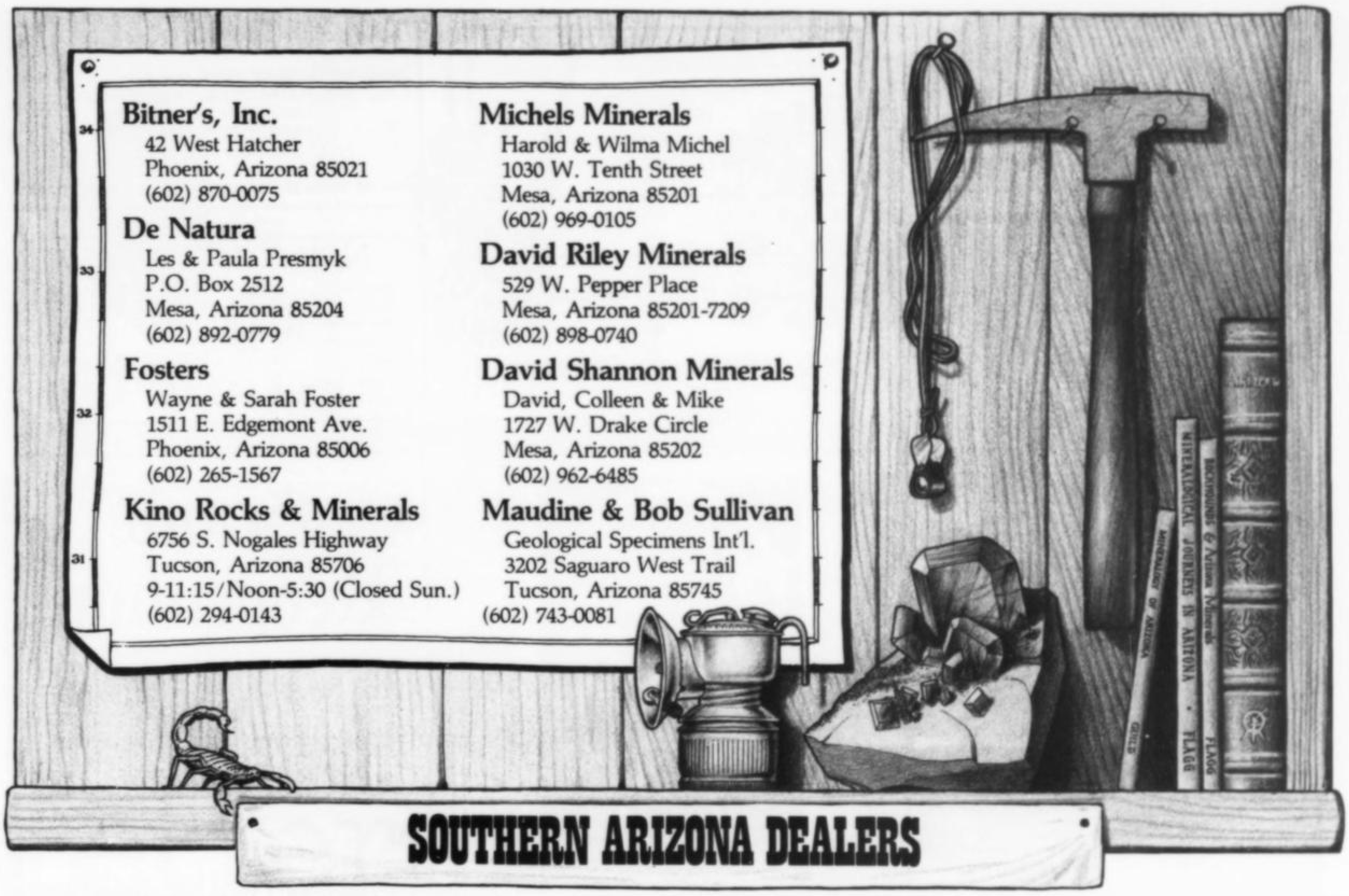
[6] Letter in the author's collection, published in *Letters to George Frederick Kunz* (1986).



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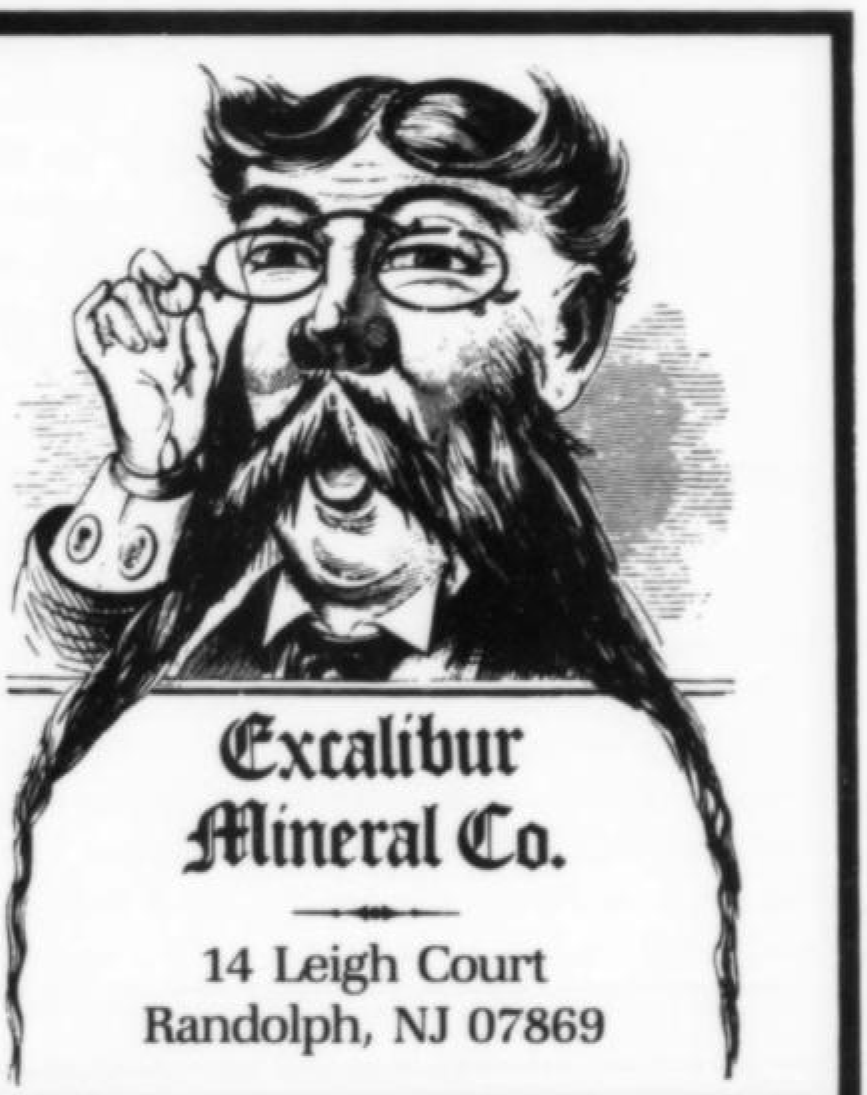

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Letters

BRITISH GOLD

Thank you to all concerned with the publication of the Gold-II issue (vol. 18, no. 1); what a marvelous companion it makes to my recently purchased Gold-I.

May I point out that in Werner Lieber's review of European gold localities in Gold-I (vol. 13, no. 6) no mention is made of the rich deposits in Wales which, between 1843 and 1935, produced about 4000 kg of gold, approximately twice that of England, Scotland and Ireland together.

Of chief importance is the Dolgellau gold belt in North Wales which fringes the eastern and southern sides of the Harlech Dome, a complex anticline of locally metamorphosed Cambrian arenaceous and argillaceous sediments. Almost all major gold deposits occur where the mineralized quartz veins, which post-date Caledonian (Middle Devonian) folding, intersect black, pyritic mudstones – the Clogau Shales. The gold, which usually contains about 10% silver, is generally disseminated amongst the sulfide veins of sphalerite and galena or pyrite and chalcopyrite, with quartz as the chief gangue mineral. Gold has occasionally been found as rich masses with quartz and sulfides, finely crystallized on quartz, as small nuggets and as gold tellurides. These deposits were exploited by several mines, the principal ones being Clogau (or St. David's), Vigra, Cefn Coch and Gwynfynydd. Some gold has also been won from the river gravels of the Mawddach estuary, along whose valley many of the mines lay.

Roughly 12 km east of the gold belt, near the village of Llanuwchllyn, fine gold specimens were produced from the Castell Carn Dochan mine, which worked a quartz vein of low sulfide content in Ordovician strata.

Small occurrences of gold have also been reported from Moel Famau west of Mold, and from Gamallt east of Aberystwyth.

The only gold mine in South Wales was Ogofau (later named Roman Deep mine), at Dolaucothi near Pumpsaint. Gold was mined from both a quartz vein yielding free gold and auriferous sulfides, and shales impregnated or replaced by auriferous pyrite. Mineralization of these Landovery (Lower Silurian) rocks is thought to have occurred during the Hercynian.

P. G. Taylor
Manchester, England

IRRADIATED ROSE QUARTZ

I am co-author of two papers concerning rose quartz from the Sapucaia mine, Minas Gerais, Brazil (Cohen and Makar, 1984, 1985). I am writing to bring your attention to the artificial deepening of the color of rose quartz crystals by ionizing radiation (X-rays, gamma rays, etc., from Cobalt-60), probably as a result of these two recent publications.

At the 1987 Tucson Show I saw a large, multi-thousand-dollar specimen of Brazilian rose quartz that had been altered to a deep red color and marked up in price to about 2½ times its original value. To my eyes, at least, the beauty of the specimen had been destroyed. I hope this letter will alert dealers and collectors to the practice, and prevent more rare and beautiful specimens from being ruined. By the way, massive rose quartz turns smoky from radiation; only the crystals turn a deeper pink.

Alvin J. Cohen
Professor of Geochemistry
University of Pittsburgh

REFERENCES

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COUSIN JACKS

I would appreciate hearing from "Cousin Jacks" in America. Cousin Jacks were hard-rock miners from Cornwall who emigrated to mining districts in the United States and Mexico. I live in the heart of West Cornwall, where there are many old tin and copper mines; I buy, sell and exchange minerals and mining books.

Neil Plummer
New Road
St. Stythyans
near Truro, Cornwall, England

DANA-SIX TO BE REPRINTED

I thought that you and the readers would like to know that work has already been started on a reprint edition of the sixth edition of Dana's *System of Mineralogy*. At this stage I do not know how the supplements will be handled but they will somehow be incorporated in the reprint.

Lawrence Conklin
17 St. John Place
New Canaan, CT 06840

PHOTOGRAPHER'S GUIDE

Thank you so much for the article on mineral photography (vol. 18, no. 3, p. 229–235). It was of considerable help in my current work. I am a volunteer at the Burke Museum and have, for the past four years, been taking identification photos of the approximately 4000 American Indian baskets in their collection. Recently I was asked by the Geology Department to photograph a number of gems and uncut crystals soon to be exhibited. They wanted true color and good representation of the shapes and faceting. Until reading your article I was using the wrong approach and getting nowhere. But now the Geology Department is very pleased with the results and I am comfortable that I am on the right track. Thanks – your article was the turning point.

John Putnam
Thomas Burke Memorial
Washington State Museum
Seattle, WA

MINERAL MUSEUMS OF EUROPE

My copy of *Mineral Museums of Europe* arrived a week before my husband and I left for three weeks in Europe. The book was an invaluable source of information.

Beverly L. Tansky
Port Huron, Michigan

QUALITY MINERAL LECTURES

Congratulations to you and Pete Dunn on your editorial, "Quality mineral lectures," in vol. 18, no. 2. When I was first into minerals (1939) it was not uncommon for our club to pay a lecturer $25, and sometimes $50, at a time when the minimum wage was about 35¢/hour!

A. L. McGuinness
San Mateo, California

MORE ON USHKOVITE

I am employed as a chemical engineer by the company which owns the Hagendorf Süd pegmatite. I have examined four laueites from there and one from the Palermo mine, utilizing semi-quantitative X-ray fluorescence analysis and X-ray diffraction analysis. In four of the samples I found MgO values less than 0.3 wt. %, and one sample (from Hagendorf) yielded an MgO content of 3–4%, suggesting that at least four of these five samples are laueite and not ushkovite. Clearly the Mg-rich sample requires a more precise analytical technique to establish its end-member identity.

Erich Keck
Etzenricht, West Germany

CROSS WORDS

A crossword puzzle! Tacky, tacky.

Lisa T. Evick
Calgary, Alberta

I really enjoyed the crossword puzzle, though I did have to use Fleischer *et al.* to help. Quite challenging.

Dana Morong
Wicasset, Maine

SPEAK OUT!

The *Mineralogical Record* welcomes letters from readers. Comments on previously published articles, new data, helpful hints and observations, historical notes, complaints, exchange offers and so on will all be considered for publication. All letters are subject to editing and condensation.

The Editor

Carousel

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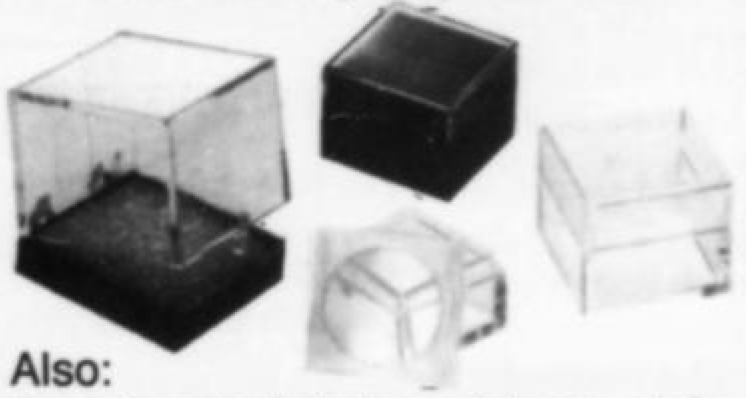

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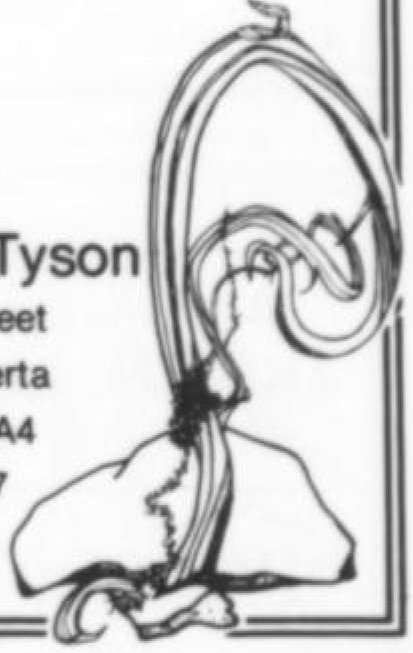

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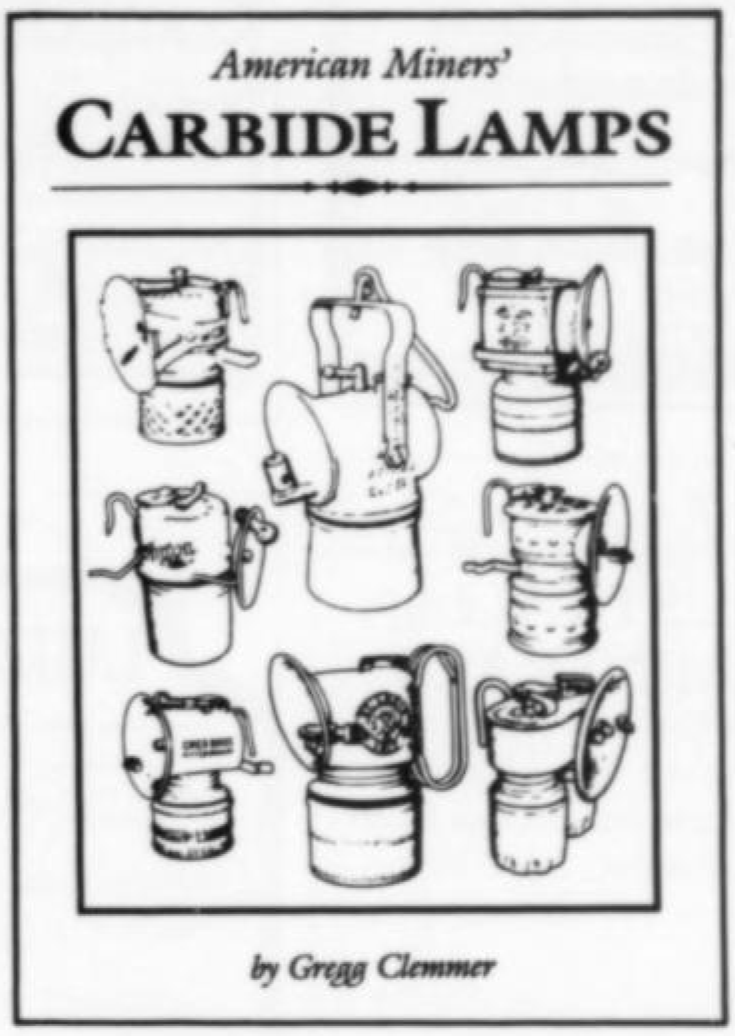

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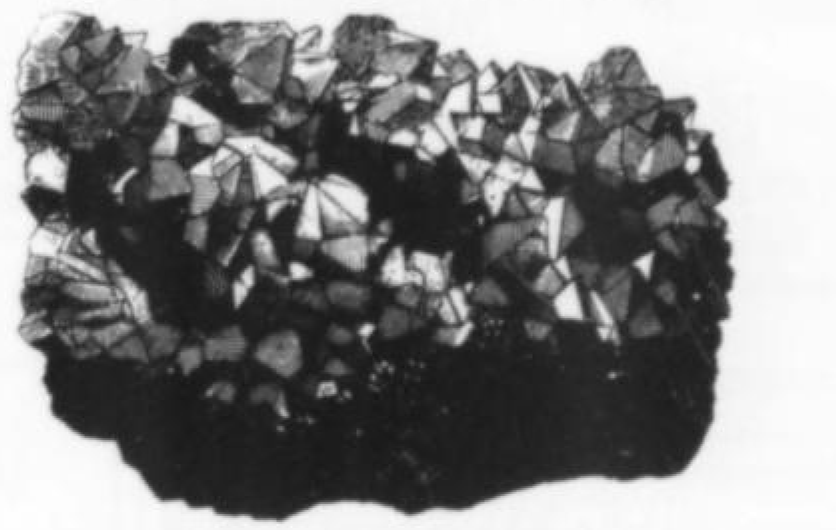

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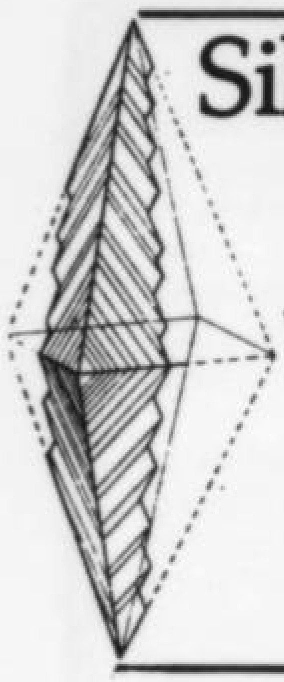

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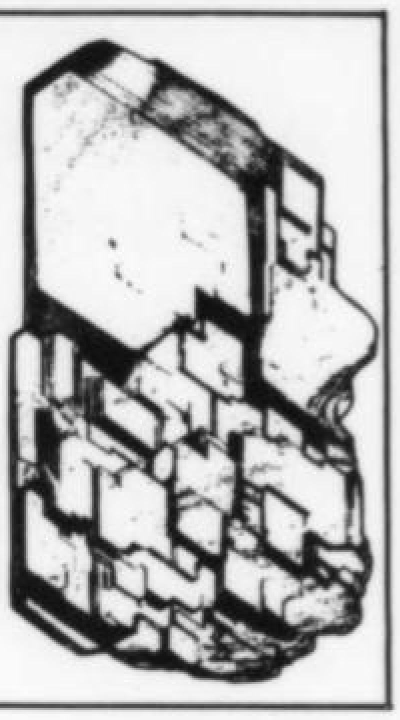

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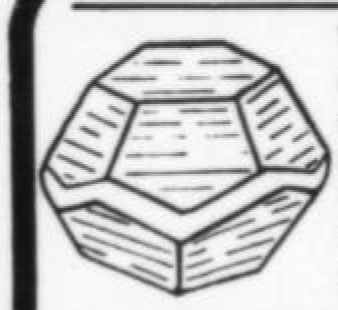

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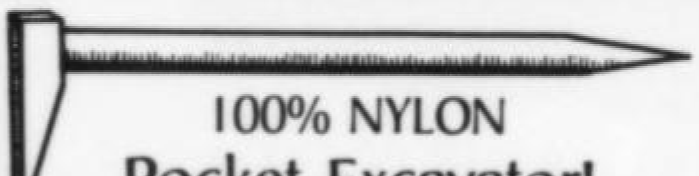

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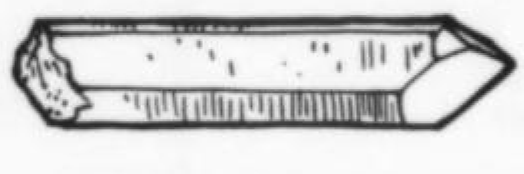

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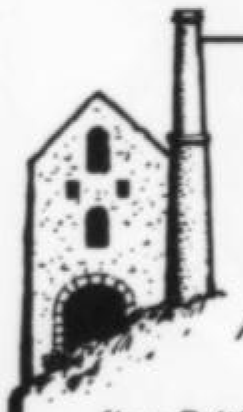

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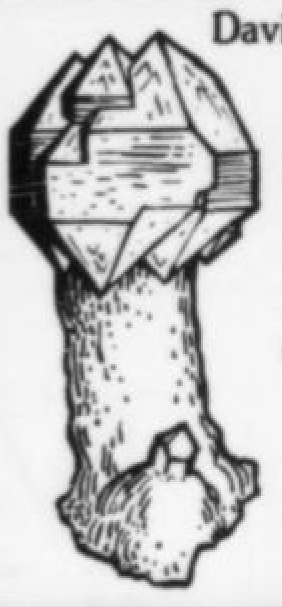

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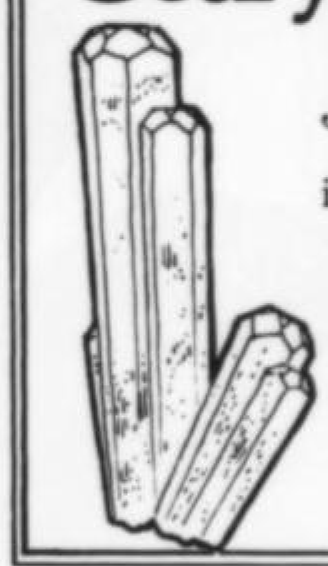

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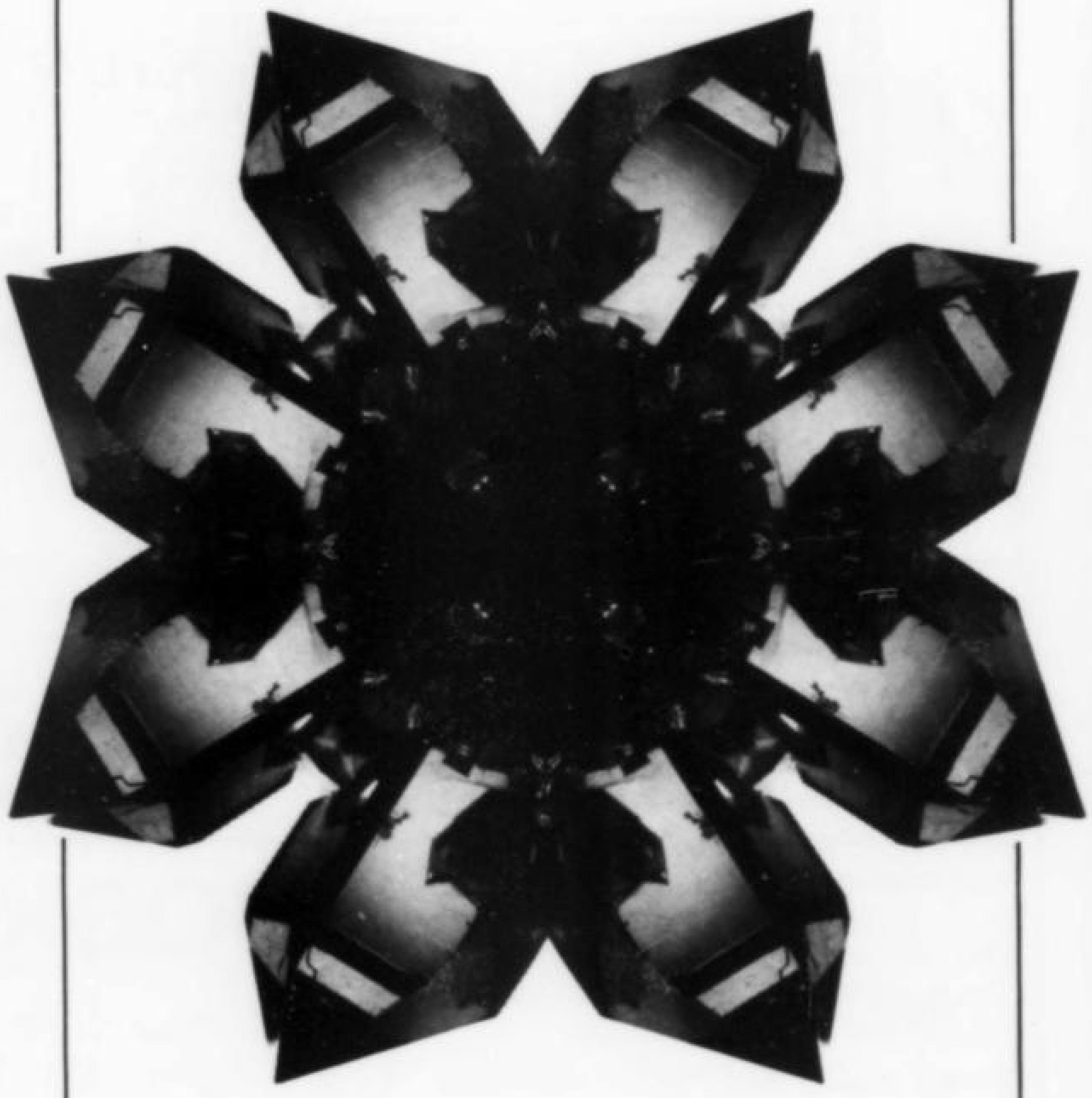

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