the Mineralogical Record

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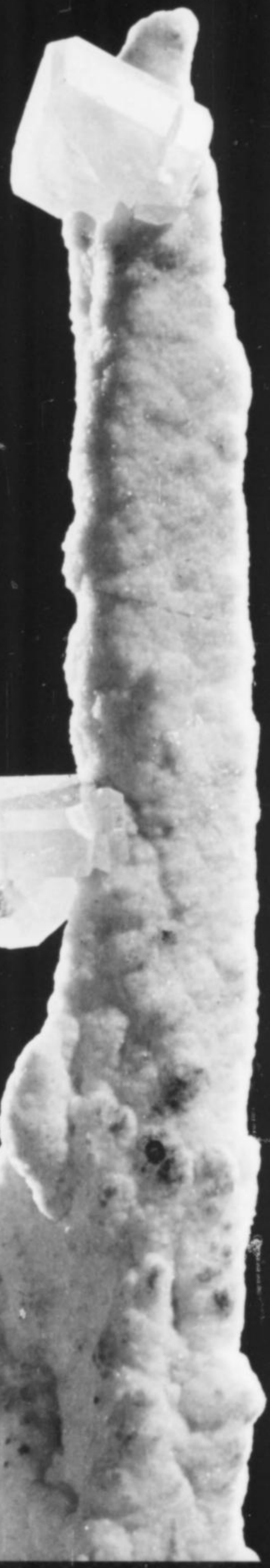

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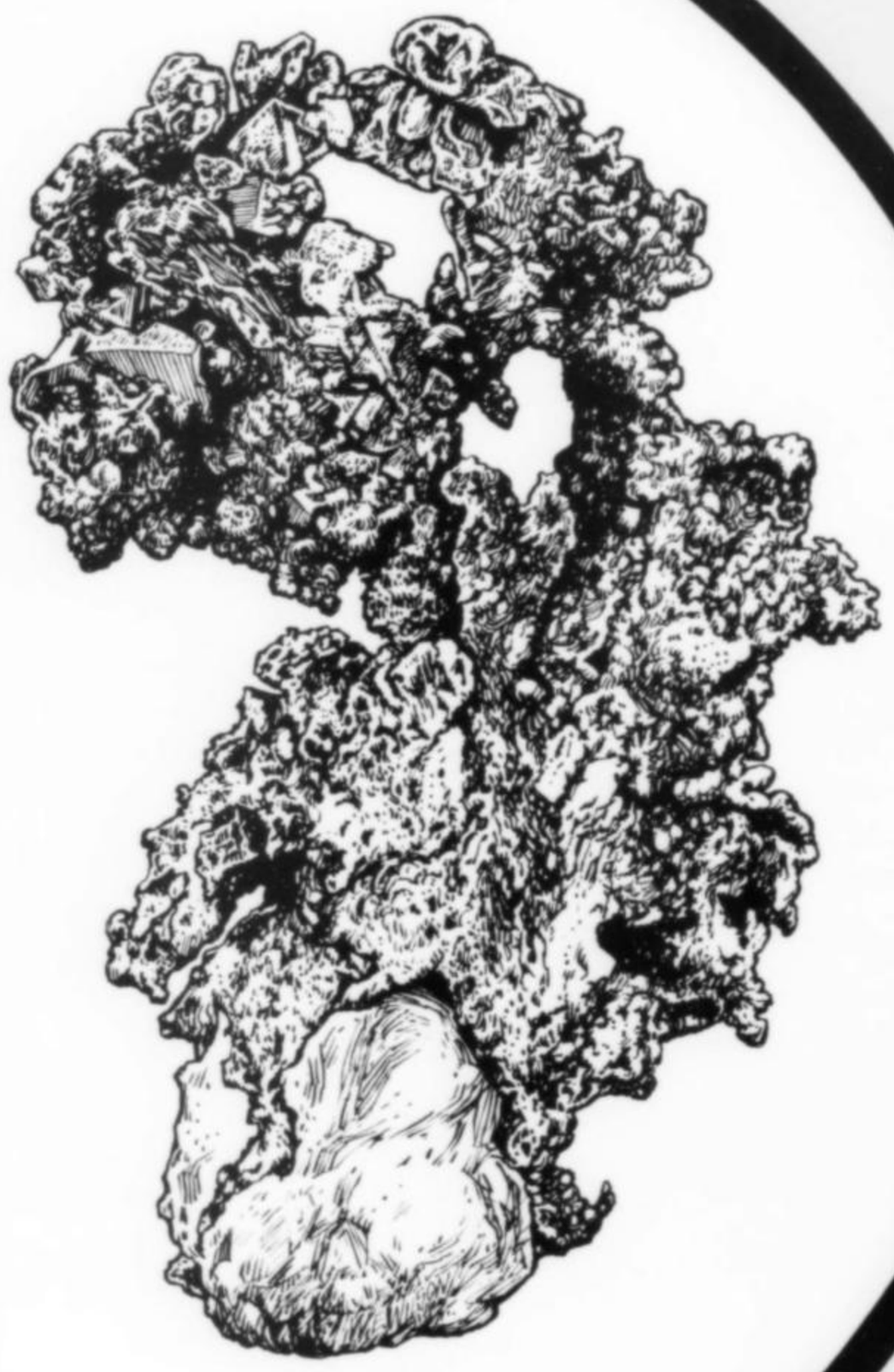

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Feature articles

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notes from the EDITOR

SLIDE COMPETITION

With the Tucson Show coming up in February it's time once again for all you mineral photographers to look through your photo files and send us your best two slides. Once again, Richard Webster will provide prize money for the winners, and the winning slides will be published in the *Mineralogical Record*.

Rules:

1. You must write the following information on *each* slide:
   a. Mineral name
   b. Location
   c. Your name and mailing address
   d. "AM" (for "Amateur") **if** you have never been paid for photography, and have never before won first place in the *Mineralogical Record* slide competition.
   e. "PRO" if you do not qualify as an amateur as defined above.
2. Maximum of two entries per person.
3. All slides must be 35 mm original (not duplicate) transparencies in cardboard mounts.
4. All slides must be of mineral specimens; all such photos are eligible except photos of minerals under fluorescent light.
5. The entrant must be the sole owner of copyright for the entries and must agree to allow the *Mineralogical Record* to publish the entries at no charge, at the discretion of the editor.
6. All entries should be sent to **Dr. Arthur Roe, 85 Calle Primarosa, Tucson, Arizona 85716**. (You need not include a self-addressed, stamped return envelope.)
7. All entries must be received by Saturday, February 10, 1979.
8. All entries will be returned after the show.

Prizes:

Amateur category

First prize: **$100**

Second prize: $25

Professional category

First prize: **$100**

Second prize: $25

All slides received which are not indicated by "AM" will be placed in the professional category. From the entries received, 10 semi-finalist slides will be selected from each category. These 20 slides will then be shown to the audience during the program Saturday night; the audience will vote by ballot for their favorite slide in each category, and the ballot count will determine the winners.

MINERALOGICAL RECORD FOREVER

Did I not once say (vol. 9, p. 3) that "this is a (relatively) democratic magazine"? The mail we've been receiving on the proposed name change for the *Mineralogical Record* (announced here in the July–August issue) has been running 100% opposed to the change. We think readers may be trying to tell us something. As a direct result of this response, the publisher has authorized me to announce that plans to change the name are hereby cancelled.

It was interesting to note that most people who commented on the "elitist" tone of the title were quite *pleased* with it as such. Another commented that the present name is "long enough to sound academic and arcane enough to sound funky." (Who could argue with that?) Still another advised, "Stick with it. It says what it is." As to the name being a tongue-twister, no one seemed to realize that the reason we were concerned about most European's inability to pronounce *Mineralogical Record*, was that we felt it hindered word-of-mouth advertising in Europe. The main objections to a change seemed to reflect a concern for future bibliographic confusion and also, quite simply, a strong liking for the name as it is.

Our recommendation is that people adopt "the *Record*" as the shortened form for personal or conversational use (eliminating such other possibilities as "*Mineral Record*," "*Min-Record*," "*the M.R.*," and "*that American mineral magazine*"). In most instances everyone will know exactly which magazine is being referred to. In situations where the uninitiated are present it would be best to use the full title *Mineralogical Record*.

Our sincere thanks to all who took the time to let us know their opinion on the matter.

Incidentally, speaking of "the uninitiated," I have another request for suggestions from readers. Among science fiction enthusiasts there is a term used to describe all people *not* yet interested in science fiction; they are called "mundanes." What term might *we* use to refer to all those people who are as yet insufficiently enlightened to be mineral collectors?

"CLASSIFIED" ADS

Many people suggested to us, "Why don't you have classified ads? Little ones that don't cost much, like some of the other magazines have?" So we tried it, as you have been seeing for more than a year now. Unfortunately it turns out that classified ads are only economical (for the publisher) if a large number are received and can be typeset all at once. We never received that many, and ended up having them typeset individually as they came in. As a result we've lost money on a great many of them. That's no way to stay in the magazine business, so we are forced to discontinue the half-inch "classified" ads. Those contracts and orders we have already received will be allowed to run their designated course but after that, I regret to say, there will be no more. Our least expensive ad will now be the one-inch box (if purchased six at a time and paid for all in advance they are $20.80 each, with a possible additional charge for artwork). A complete listing of our ad rates is available upon request.

MILESTONES

George Bideaux, 79, Died August 16 following surgery. The operator of *Bideaux Minerals* in Tucson, publisher of the Bisbee *Brewery Gulch Gazette*, and a respected water-color artist, George was an authority on Arizona mineral localities, an interest he acquired through his son. He was the father of Richard A. Bideaux, long-time associate editor, author and columnist for the *Mineralogical Record*. A personality sketch of George is planned for a future issue.

GET DOUBLE MILEAGE. . .

. . .from your Christmas money this year. Give a *Record* subscription to some lucky person and help to support your favorite mineral magazine at the same time! We'll send his (or her) first copy by **first class mail** within three days of receiving your order, and we'll include a **gift card** in your name, all at no extra charge. This means that if you can put your order in the mail to us no later than **December 12**, we can almost certainly assure delivery before Christmas (allowing 4 days for first class delivery). Do someone a favor they'll never forget. $13 for one year; $24 for two years.

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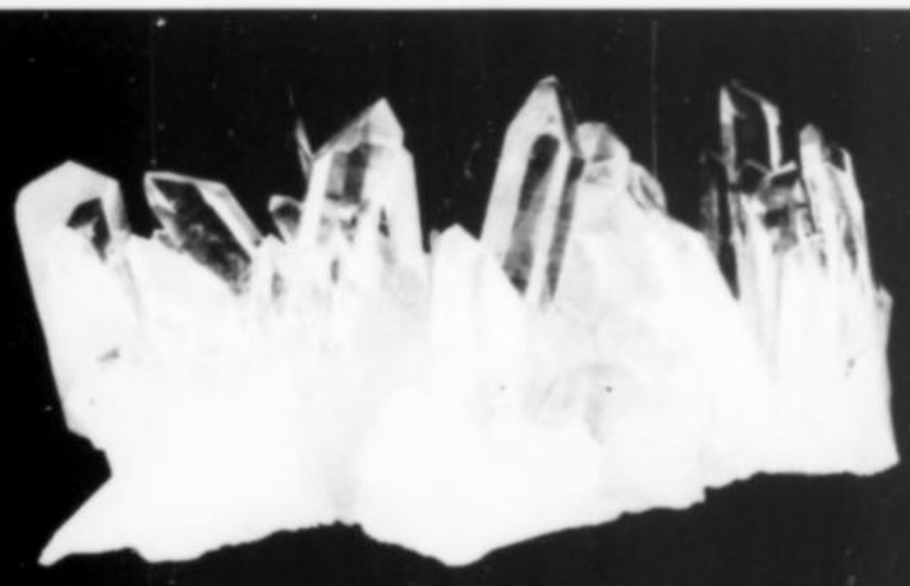

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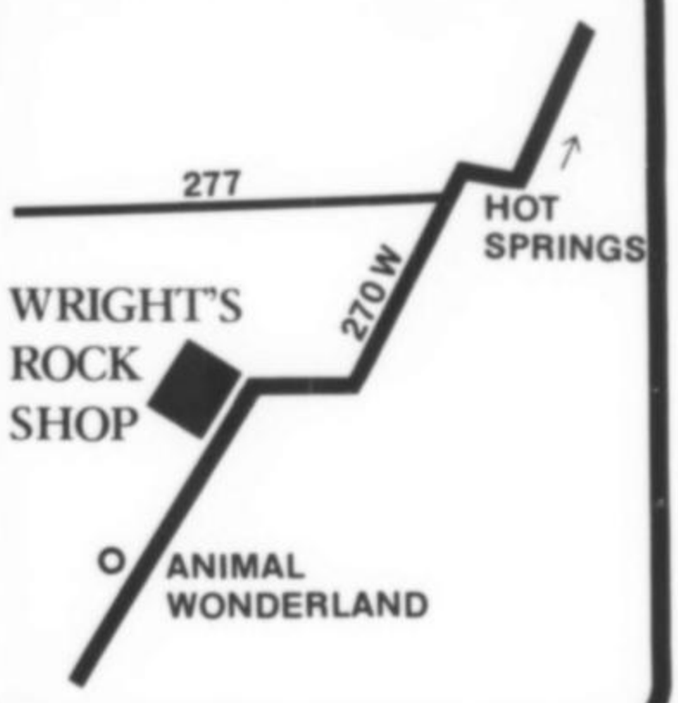

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LIBETHENITE
from the Rokana Mine, Zambia

by **Stanley P. Korowski** and **Cor W. Notebaart**
Research and Development Department
Nchanga Consolidated Copper Mines Ltd. and
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Libethenite occurs sparingly, but fairly widespread, in the oxidation zones of many copper orebodies throughout the world. It was first discovered at Libethen, (now Lúbietová), Solvensko, Czechoslovakia, during the early nineteenth century. In 1975 two small occurrences were uncovered in the two open pits of the Rokana mine, Zambia, which contained libethenite crystals of exceptional size, in a variety of crystal habits.

INTRODUCTION

Libethenite, $Cu_2(PO_4)(OH)$, is well-known to collectors as occurring in small, olive-green crystals, generally less than 0.5 cm, and often well-developed. The orthorhombic crystals show few forms; typical are the prism {110} and the dome {011}. The crystal habit is usually short prismatic or elongated along the a axis; occasionally the two dominant forms are similar in size and combine into a pseudo-octahedron. The chemical composition is generally close to the ideal formula. Dana (1951) mentions that a small amount of arsenic may replace phosphorus, but that no metals substitute for the copper. However, Guillemin (1956) found that a substantial portion of copper can be replaced by zinc. Zincian libethenite occurs very rarely in the oxidized zone of the Pb-Zn orebody at the Broken Hill mine, Kabwe, Zambia, and differs considerably in appearance from its copper equivalent; it has a characteristic pale greenish blue color and occurs mainly as minute spheres and incrustations. The typical type of libethenite has been found in most open pits and several underground workings in the Zambian Copperbelt. However, the specimens recently discovered at the Rokana mine are extraordinary in their size and variety of habits.

GEOLOGY AND OCCURRENCE OF LIBETHENITE

The Zambian copperbelt (see Fig. 1) covers an area of about 50 by 250 km and, together with the adjacent area in Shaba Province (formerly Katanga) in Zaire, forms one of the richest copper mining regions in the world. Many of the mines in this region have a history of ancient copper mining going back as far as 400 A. D. Copper was discovered by European prospectors in the early years of this century and two mines started production before the First World War: Kansanshi and Bwana Mkubwa. Production at Roan Antelope, Rokana, Mufulira and Chingola did not start until the early 1930's. Since then expansion has been very rapid and presently Zambia's yearly copper production of 750,000 tonnes is the fifth largest in the world. A total of 11 underground mines and eight open pits are operated on the Copperbelt by the two large mining companies, Nchanga Consolidated Copper Mines Limited and Roan Consolidated Mines Limited.

The copper orebodies are stratiform and occur in the Lower Roan group of Katanga system of sediments which were deposited during Precambrian times. These Katanga sediments were folded and regionally metamorphosed, forming mineral assemblages representative of the greenschist facies. Typically the orebodies occur in carbonaceous shales, argillites, quartzites and dolomites. **Chalcopyrite** and **bornite** are the major primary copper sulfides and **carrollite** is the main source of cobalt. In the oxidation zones of these orebodies the major oxide copper minerals are **malachite, chrysocolla, pseudomalachite, cuprite, cupriferous wad** and **azurite.** Generally a zone of supergene enrichment with **chalcocite** as the major copper sulfide lies intermediate between the primary sulfide mineralization and oxidation zone.

The Rokana deposit consists of the Mindola, Central and South orebodies. Underground mining produces sulfide ore. Two relatively small open pits in the oxidation zone of these orebodies are presently in operation: Area E and Mindola, both near the town of Kitwe and approximately 10 km apart (Fig. 2). Additional open pits may be developed in this area in the future. The sequence of sedimentary rocks is rather similar at both localities, a typical stratigraphic section being:

1. Hangingwall argillite
2. Porous sandstone
3. Cherty ore
4. Banded sandstone
5. Low-grade argillite
6. Schistose ore
7. Footwall conglomerate
8. Ore formation: Approximately 10 meters thick with an average copper grade of 2.4%

The strata have an approximately northwest strike and dip to the southwest at 30⅓. The Mindola and Area E pits follow the strike over lengths of 1.0 km and 0.5 km and have been excavated to depths of 120 m and 65 m respectively.

Libethenite has been fairly common in the upper levels of the Ore formation in both open pits. Generally it occurred in vugs as small, but well-developed short prismatic crystals or as groups of thin, blade-shaped crystals on massive malachite and pseudomalachite, which lined the walls. When mining progressed to deeper levels the two remarkable occurrences of libethenite were encountered in the Hangingwall argillite. The host rock has since been largely removed as waste during continuing mining operations. Although libethenite is still encountered occasionally in the deeper levels, it is generally of inferior quality compared to that found in the higher levels. The Hangingwall argillite has an average thickness of about 10 m in both pits. It is a fine-grained, medium to dark grey rock, which is hard and difficult to work, if unweathered, as is generally the case in the Area E pit. The argillite in Mindola is softer and can be more easily cleaved parallel to the bedding. The rock is composed of fine-grained quartz, microcline and oligoclase (in places weathered to kaolinite), green biotite and smaller quantities of muscovite, dolomite and anhydrite. Tourmaline, rutile and zircon are accessory minerals. Some sections contain concentrations of dolomite, usually as lenses but sometimes as bands parallel to the bedding planes. The libethenite occurs in vugs of widely different dimensions (1 to 10 cm across) scattered throughout the argillite. The origin of these vugs is still largely a matter of conjecture. As indicated above, the argillite in certain sections, notably the underground mine at Mindola and the northern part of the nearby open pit, contains lenses of dolomite. Leaching of the dolomite by acidic solutions, percolating downwards from the higher levels in the oxidation zone of the orebody, could have formed the vugs. Many of the vugs are empty; others, particularly at Mindola, are partially filled and the small ones completely filled with a white clay-like material composed of kaolinite (60-80%) and residual rock-forming minerals (20-40%) such as quartz, iron oxide, tourmaline, rutile, and mica (generally weathered to vermiculite). It is possible that this white filling is a weathering product of the argillite, surrounding the original carbonate aggregations, the feldspar being transformed into kaolinite and the other mineral constituents largely unaltered (except mica). A more detailed study of the profiles of the weathering zones in both localities would be required to provide further evidence as to the origin of these vugs.

The occurrence of libethenite in the vugs is very erratic and its crystal habit may change dramatically over short distances, both horizontally and down the dip of the argillite. In large sections of the exposed argillite the vugs are completely devoid of libethenite, but may contain some malachite, pseudomalachite and chrysocolla. The occurrence of libethenite and the other copper minerals does not seem to be related to

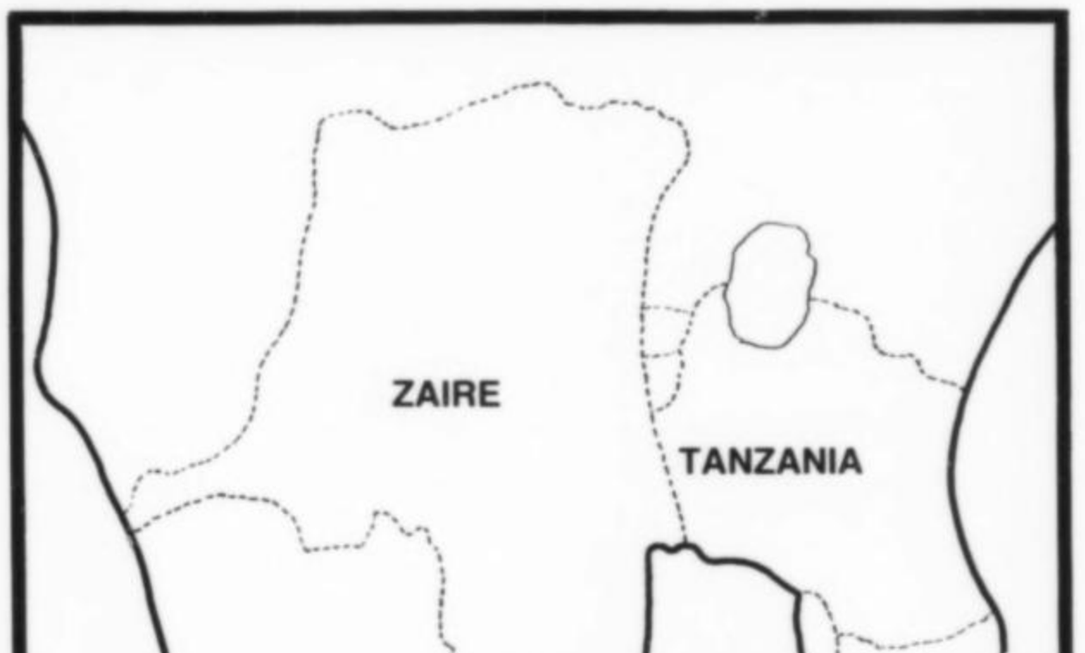


Figure 1. **Location map showing the location of Zambia and the Zambian Copperbelt.**

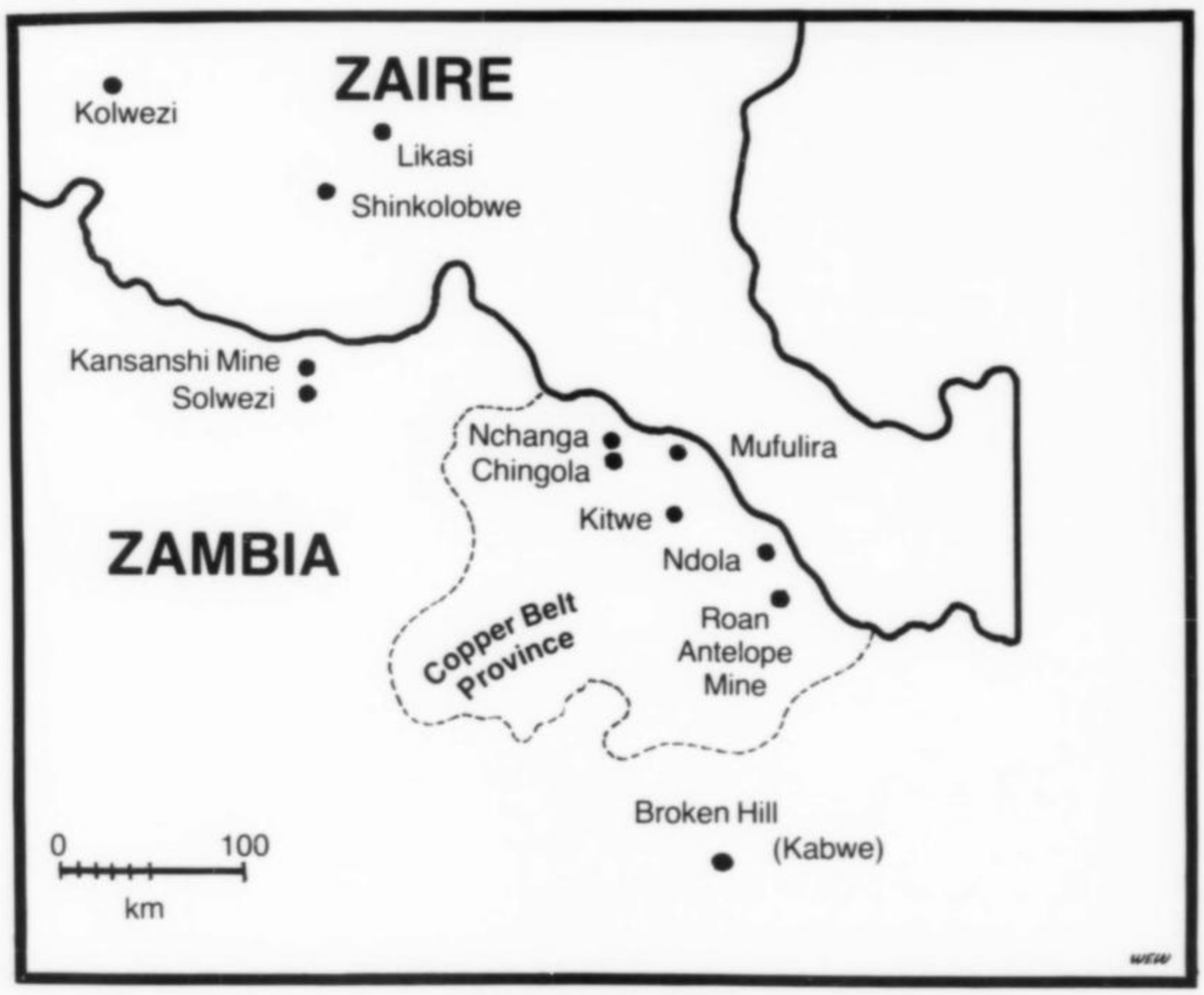


Figure 2. **Location map showing important mines and towns in the Zambian Copperbelt, as well as other nearby famous localities such as Kolwezi, Shinkolobwe and Broken Hill. The Rokana mine is located near Kitwe.**

the size of the cavity or texture of the argillite. The secondary copper minerals do appear to be restricted to a few meters of argillite, immediately above the top ore member -- the Porous sandstone. The upper portion of the argillite, although it may be vuggy, is notably barren.

CRYSTAL MORPHOLOGY

The libethenite crystals in both open pits show the simple basic forms: the prism *m* {110}, the dome *e* {011}, the bipyramid *s* {111} and the pinacoids *a* {100} and *b* {010} (Fig. 3). The different relative development of these forms, combined with certain parallel growth phenomena, results in the remarkable variety of crystal habits in these two localities. The typical olive-green libethenite color is manifested mainly on the very thin, acicular and blade-shaped habits, while others are greenish black to black in hand specimens. Crystals generally are between 0.5 and 1.0 cm; the larger crystals (1.5 to 3.0 cm) shown in some of the photographs are exceedingly rare.

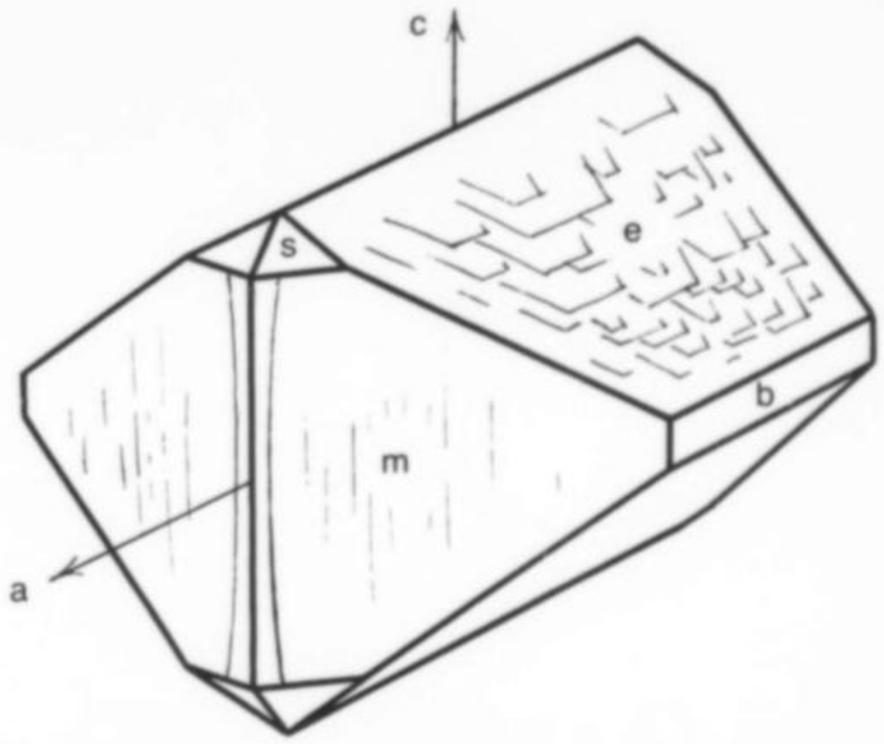


Figure 3. **Crystal drawing of one habit of libethenite from the Rokana mine. Forms: *m* {110}, *e* {011}, *s* {111} and *b* {010}. The form *a* {100}, present on other habits from this locality, is not shown here. Note the elongation along [100].**

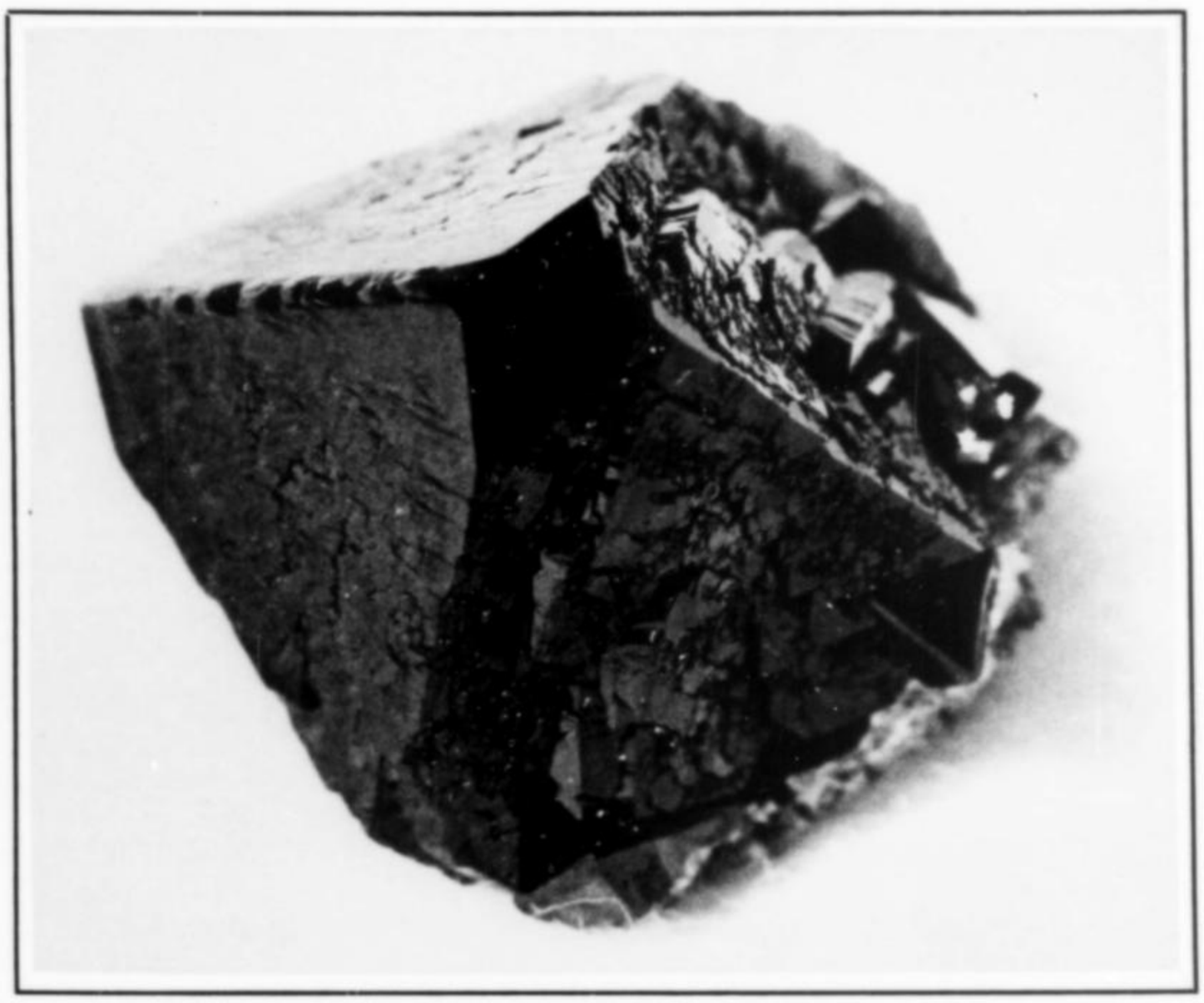


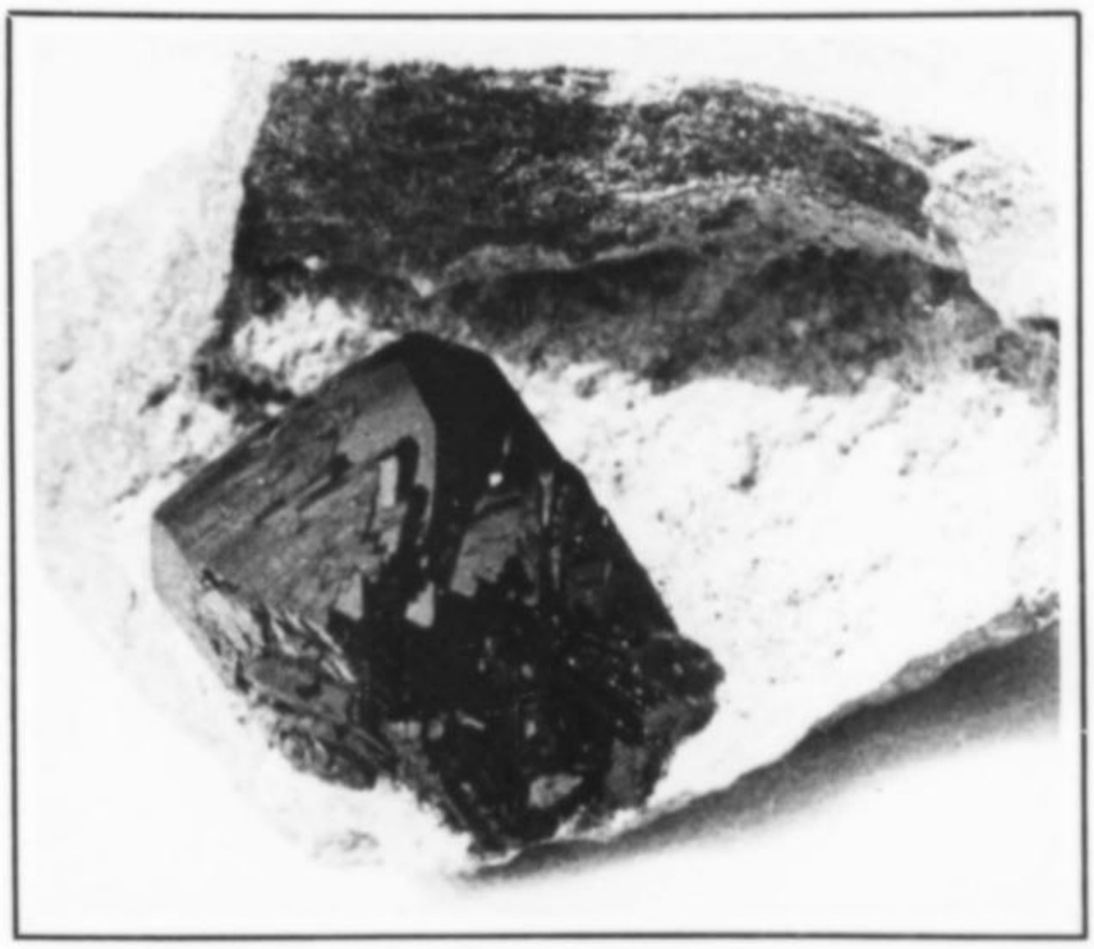
Figure 4. **A pseudo-octahedral crystal of black libethenite, 1.5 cm across, with pronounced stepping on the *e* {011} faces (right side) from the Mindola open pit of the Rokana mine. (Collection of SPK.)**

Figure 5. **A short stubby crystal of black libethenite, elongated along the *a* axis, in a cavity on argillite. The crystal is 1.5 cm in length; from the Mindola open pit of the Rokana mine. (Collection of CWN.)**

The most characteristic libethenite crystals in the Mindola open pit occurrence are the pseudo-octahedron and short, stubby types, elongated along the *a* axis. The pseudo-octahedron (Fig. 4) is formed by equal development of the dominant forms 011} and {110}, the apex being modified by the small, but sharp {111} plane. A characteristic feature is the slight, smooth curvature of the prism faces, which reduces the luster, even in small crystals. The {011} plane usually shows a bright reflection although in the larger crystals the surface is rough due to development of sub-parallel individuals (Fig. 4). On the crystals elongated along the *a* axis the {011} faces dominate. Double termination by prism faces results in a "saddle" type which is restricted to the Mindola open pit. Well-developed "saddles" possess a length to width ratio of 2:1. The {011} faces are composed of sub-parallel individuals which are slightly rotated around the *a* axis. A fine example is the large crystal (2.5 cm long) in Figure 7.

Crystals which resemble an octahedron are found occasionally in Area E. A very large crystal (3 cm across) with prominent stepping and curvature of the prism faces is shown in Figure 8.

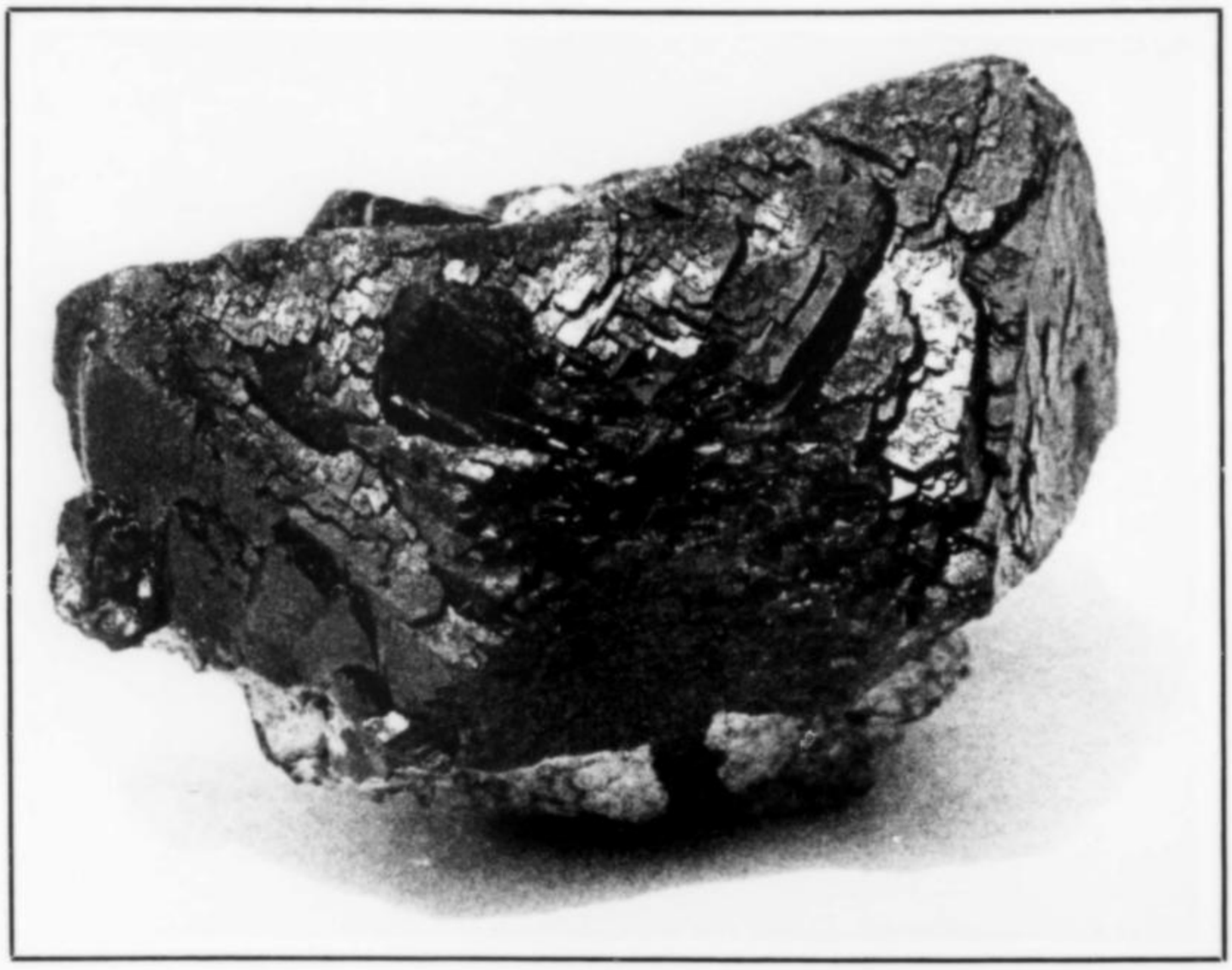
In 1974 some 30 by 50 meters of bedding surface of the argillite was exposed in the north end of the Mindola open pit. The rock was flaggy and closely spaced cavities were common, which frequently contained delicate sprays of acicular libethenite crystals not more than 1 cm in



length (Fig. 9). There was a period then, when this habit was practically the only type to be found. More recently, as mining has progressed to lower levels, the acicular habit has become more scattered in the argillite. Closer examination of these sprays reveals that the needles are actually blade-shaped, this becoming more pronounced with an increase in size. The blades are elongated along the *c* axis, usually taper near the top, and are terminated by two small, sharp dome faces. The elongated vertical plane is slightly curved and striated; it is probably not the prism {110}, but a poorly developed pinacoid {100}. Toward the base of the small blades the vertical surface becomes progressively more disrupted or deeply striated and rounded, often exhibiting a pale olive-green, mantle-like coating. A group of interconnected clusters of blades is shown in Figure 10. The larger blade-shaped crystals (Fig.

Figure 6. **A 2-cm crystal of black libethenite similar to the crystal shown in Figure 5; from the Mindola open pit of the Rokana mine. (Collection of CWN.)**

Figure 7. **A "saddle" shaped crystal of black libethenite, showing curved and stepped *e*{011} planes. This crystal, the second largest ever found, measures 2.5 cm in length; from the Mindola open pit of the Rokana mine. (Collection of CWN.)**



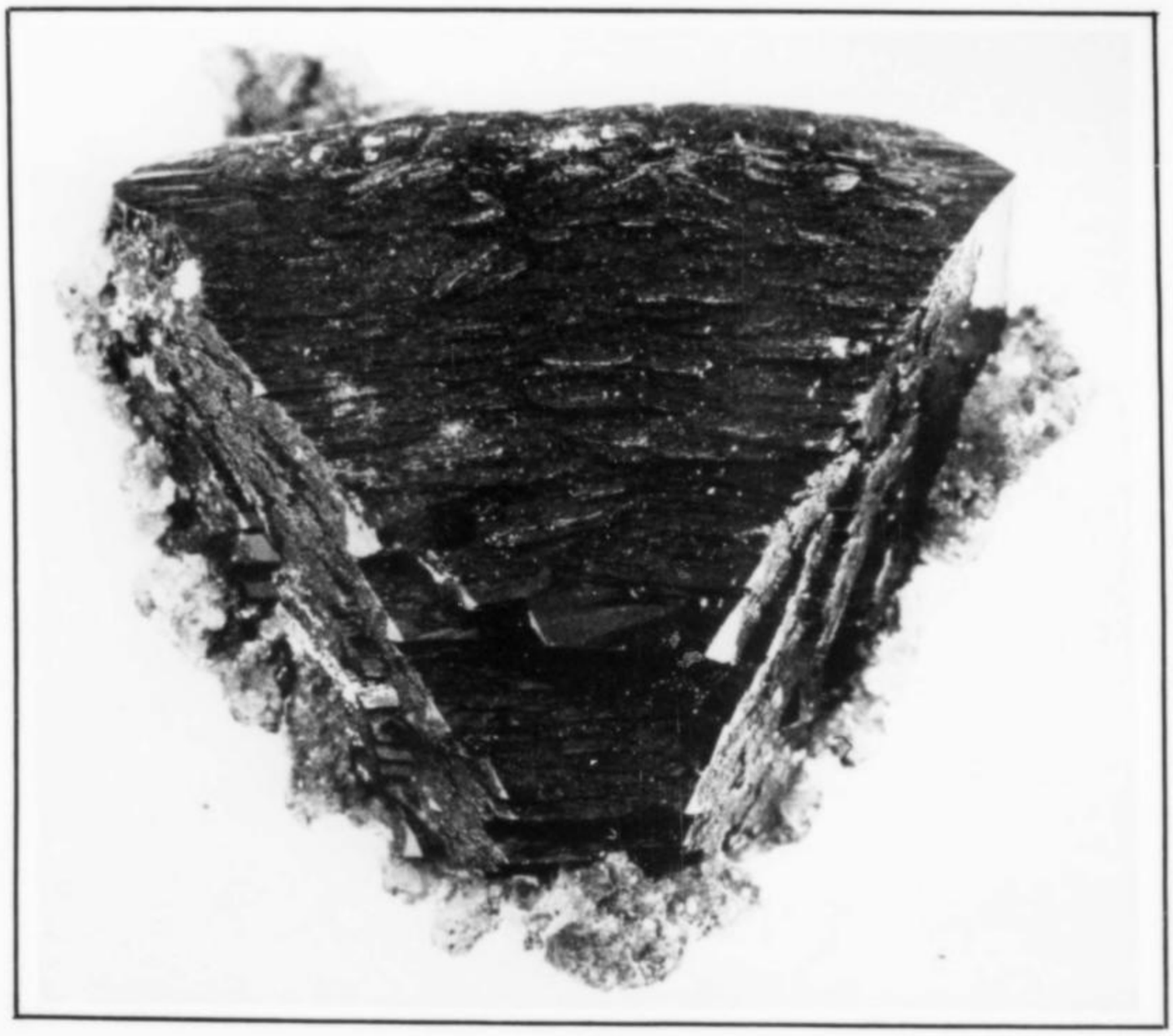


Figure 8. **This crystal of greenish black libethenite, measuring 3 cm across, is the largest ever found at the Rokana mine. It shows curved *m* {110} faces, and was collected in the Area E open pit. (Collection of SPK.)**

11), typical of Area E, are better characterized as prismatic. In the Area E open pit double-terminated, blade-shaped or long prismatic crystals are occasionally found with a typically grooved and lighter colored central portion (Fig. 12).

An unusual pear-shaped habit (Fig. 13 has been found in the Area E pit. It appears to be composed of densely packed, very thin blades, which are rotated around a common *c* axis, resulting in a fairly smooth surface with an almost circular cross-section. In cases where the crystal is attached to the wall of the cavity in the argillite by a flat base, the resulting shape is a cone. Similar, but smaller, more elongated and spindle-shaped crystals with small, well-developed dome faces, sometimes at both ends, are encountered more frequently in this locality. Another type consisting of a tapering base of packed blades topped by

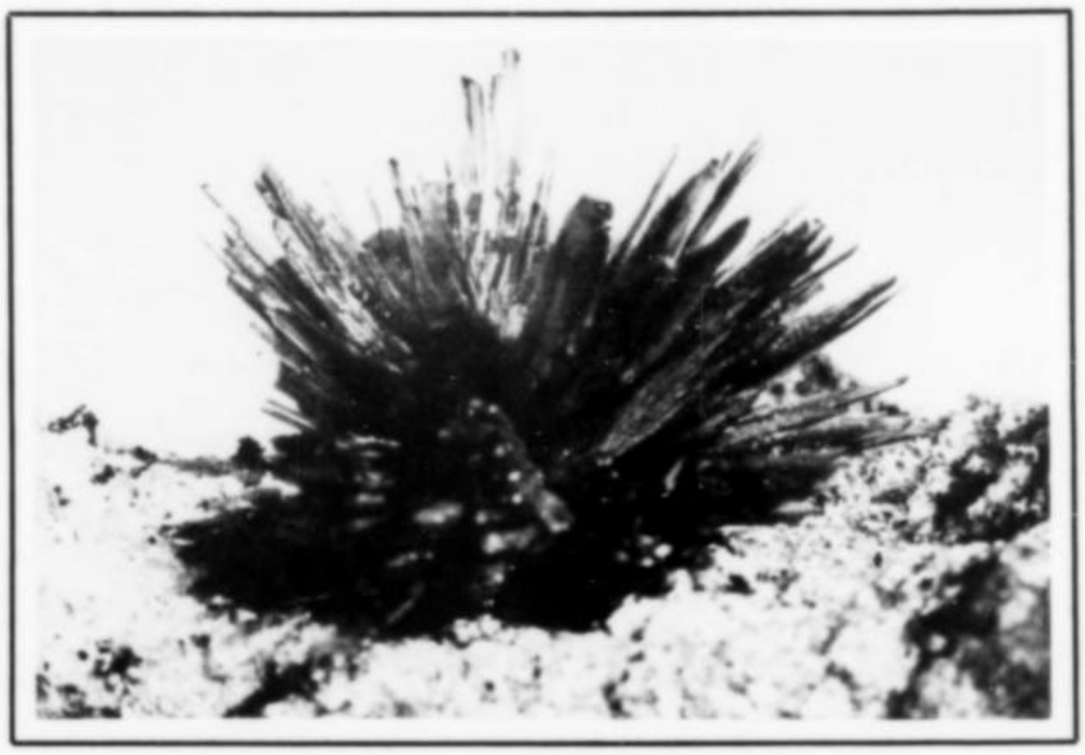


Figure 9. **A spray of bladed libethenite crystals 1.0 cm tall, in a cavity in argillite. The central area of the spray is pale green; the terminations are dark olive-green. From the Mindola open pit of the Rokana mine. (Collection of SPK.)**

Figure 10. **A 2-cm specimen of pale olive-green libethenite composed of interconnected clusters of minute blades. From the Mindola open pit of the Rokana mine. (Collection of SPK.)**

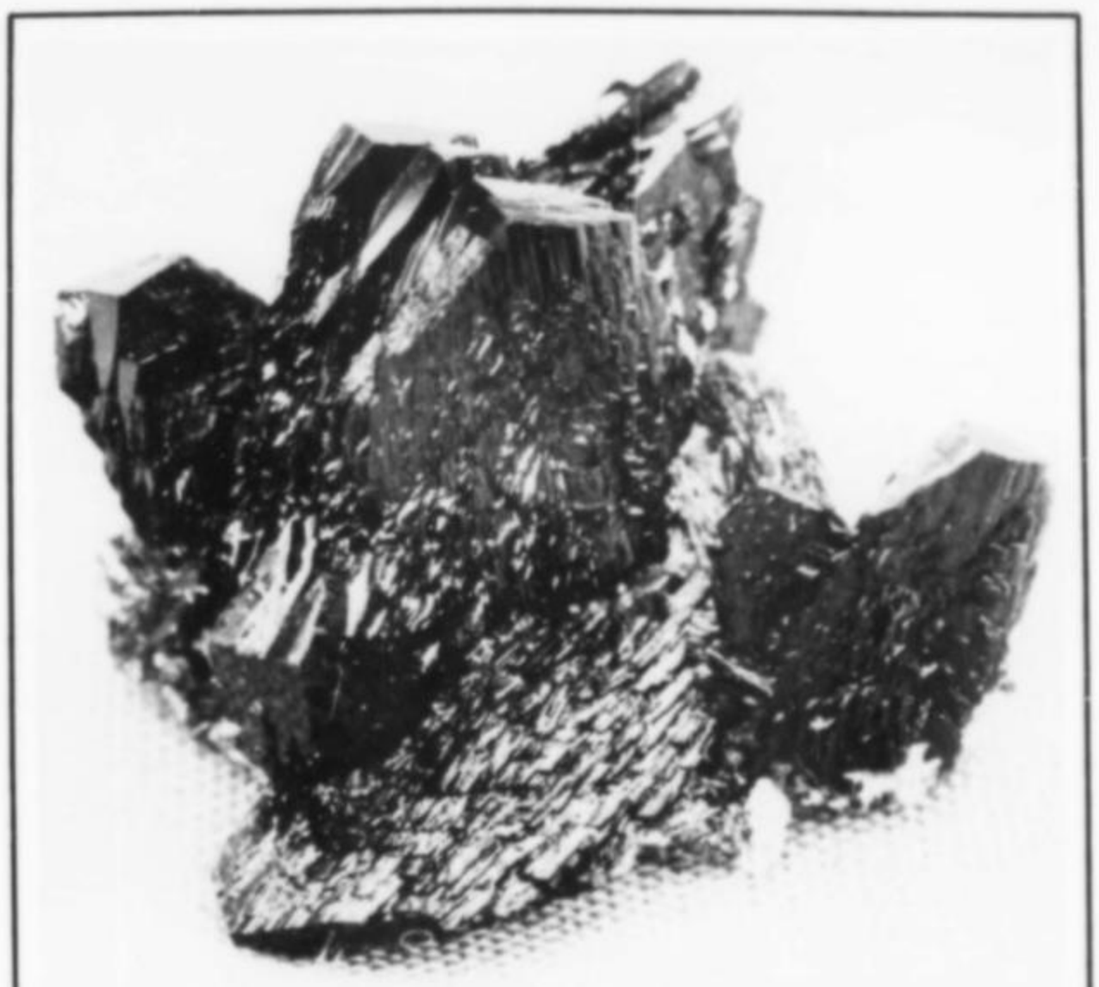


Figure 11. **A 2-cm cluster of relatively large, blade-shaped crystals of black libethenite from the Area E open pit of the Rokana mine. (Collection of SPK.)**

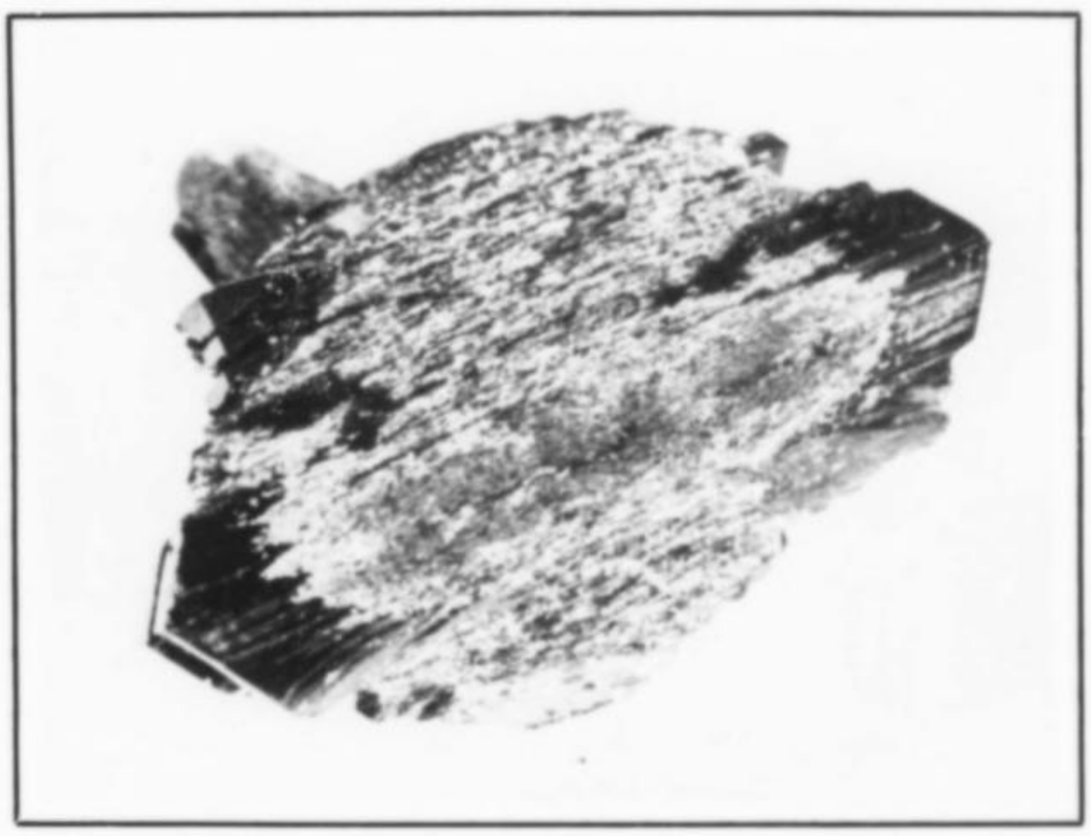


Figure 12. **A doubly terminated crystal of black libethenite with a pale green, mantle-like central zone. The crystal is 1.5 cm long and was found in the Area E open pit of the Rokana mine. (Collection of SPK.)**

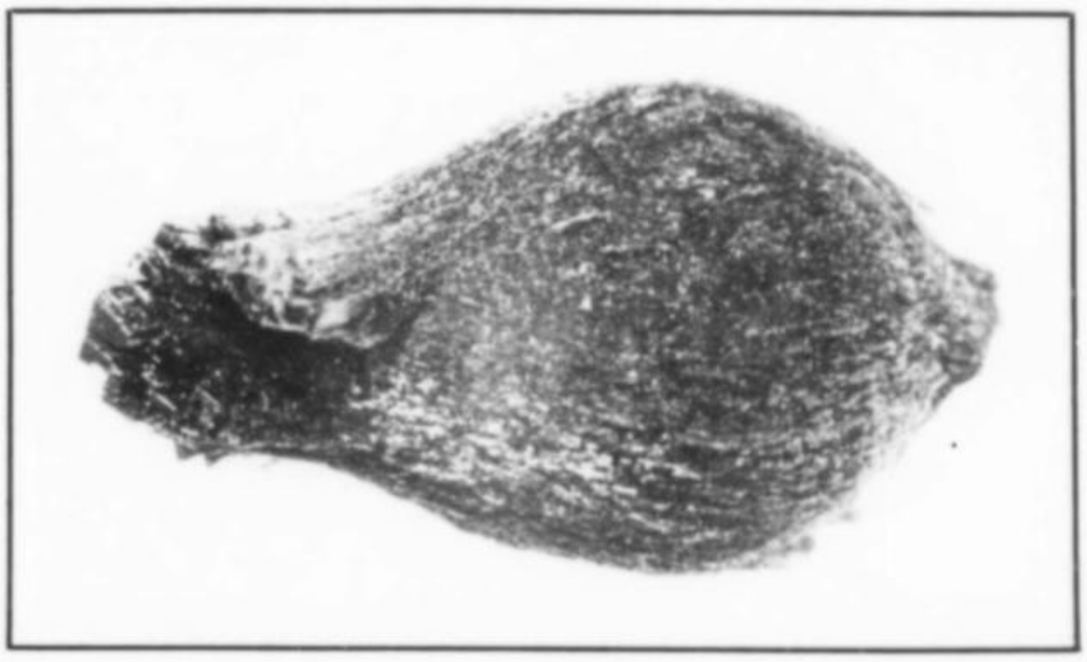


Figure 13. **A libethenite crystal, 1.5 cm in length, exhibiting a pear-shaped habit. The termination is black, while the rounded central portion is blackish green. From the Area E open pit of the Rokana mine. (Collection of SPK.)**

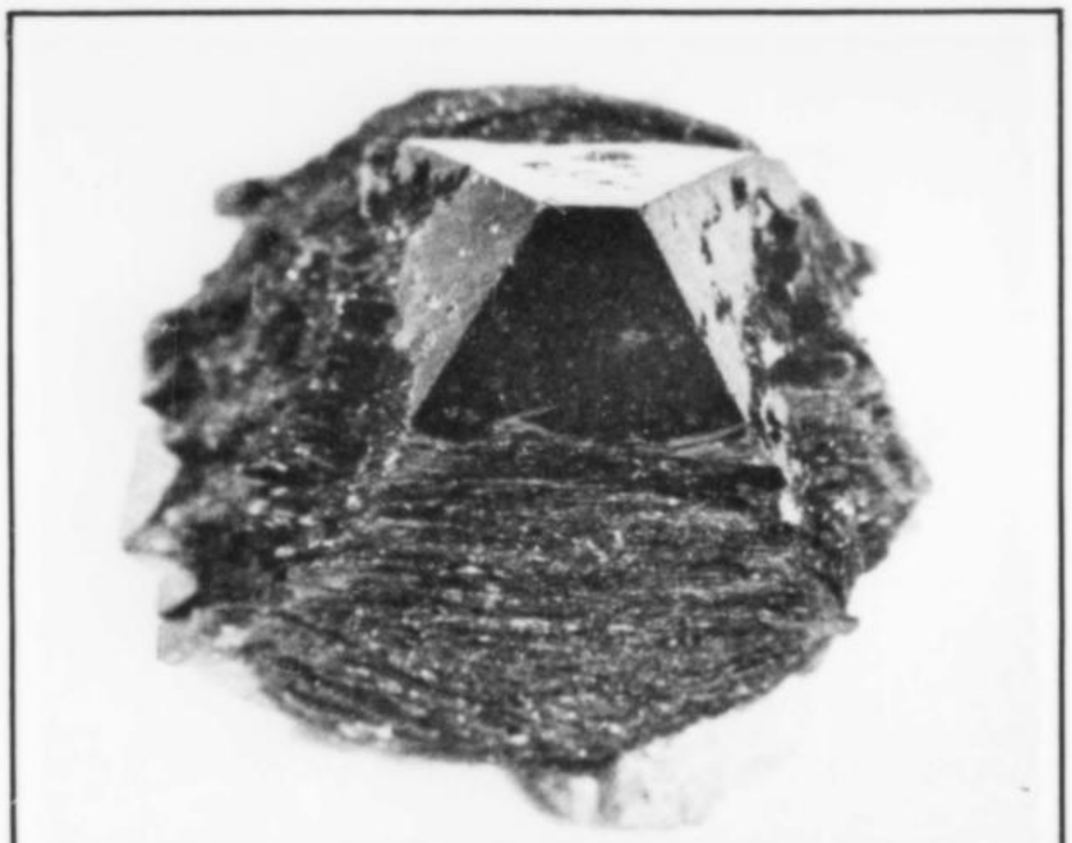


Figure 14. **A black libethenite crystal 1 cm across, composed of flat prism and dome faces protruding from a tapered base of finely packed blades. From the Area E open pit of the Rokana mine. (Collection of SPK.)**

Figure 15. **A 2.5-cm malachite nodule topped by clusters of short, prismatic, dark olive-green libethenite crystals. From the Mindola open pit of the Rokana mine. (Collection of SPK.)**

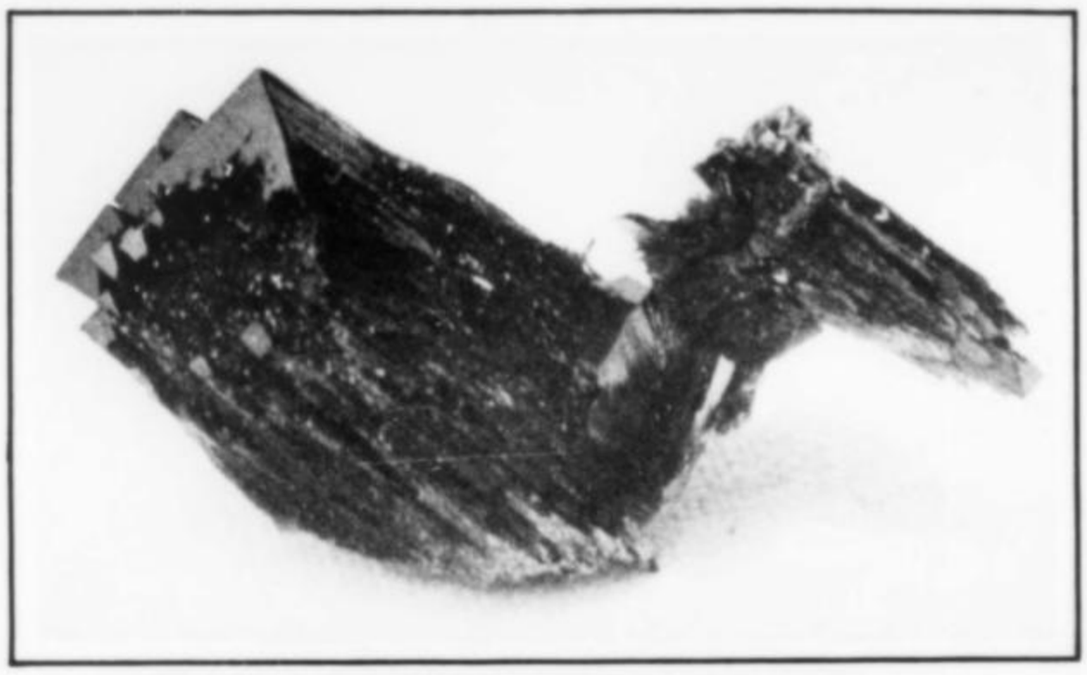


Figure 16. **Deeply grooved prismatic crystals of black libethenite in parallel growth; the large crystal is 2.0 cm long. From the Area E open pit of the Rokana mine. (Collection of CWN.)**

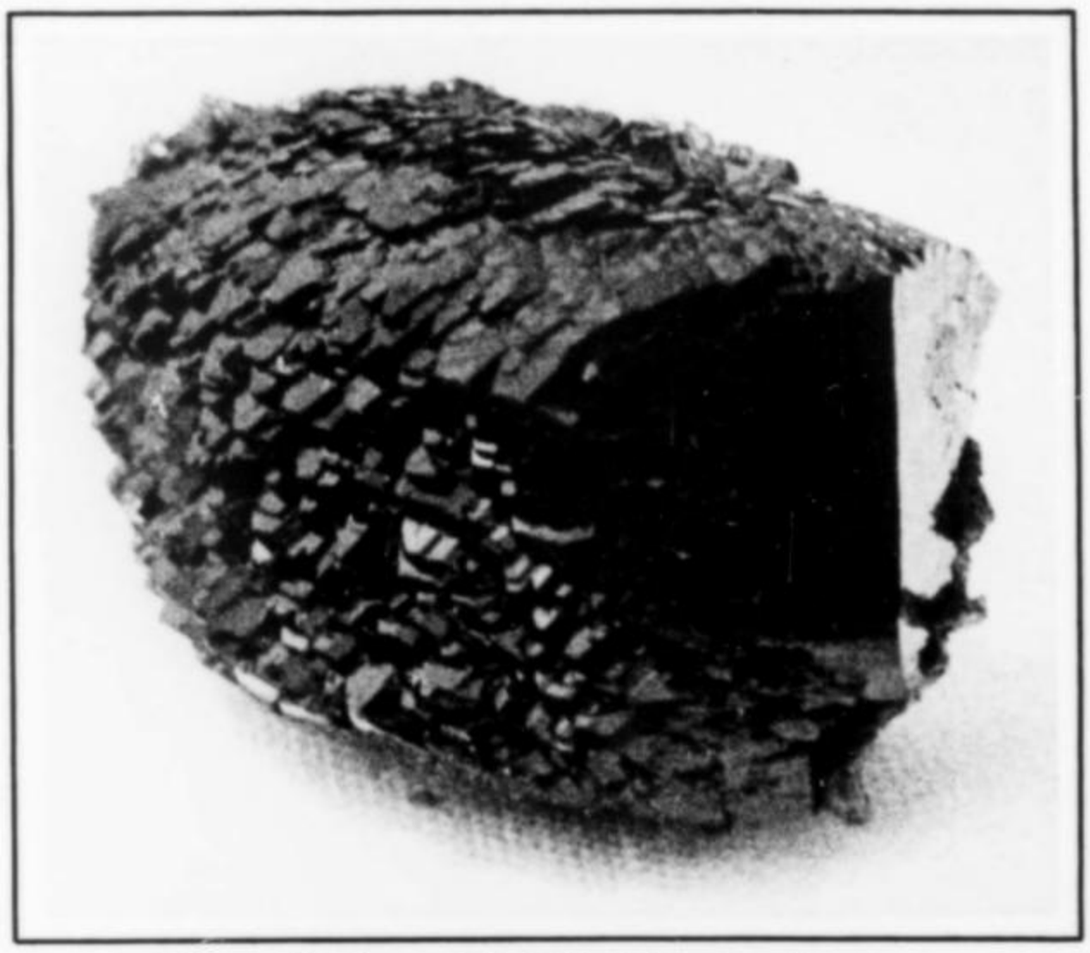


Figure 17. **A crystal of black libethenite, elongated along the *c* axis, showing many sub-parallel individuals rotated about the *c* axis. The specimen is 2.0 cm long. From the Area E open pit of the Rokana mine. (Collection of CWN.)**

well-defined terminal forms, found in Area E, is illustrated in Figure 14.

Prismatic crystals with an almost square cross-section are found in both localities, and usually occur in clusters (Fig. 15). A larger prismatic type, found in Area E, shows a very typical, deep grooving of the prism, extending into the dome faces, which gives the impression of the crystal being strongly weathered (Fig. 16). The grooves are due mainly to spacing between sub-parallel individuals.

A characteristic crystal habit for Area E, which indeed is restricted to this locality, is illustrated in Figure 17. The crystals are elongated along the *c* axis and show well-developed, sharp dome {011} faces. The prism faces, however, are composed of smaller individuals, which are rotated around the *c* axis with a sub-parallel arrangement of the {110} faces, resulting in a very characteristic curved form (Fig. 17). Reflections from the small prism faces of these sub-individuals are relatively sharp and result in a sparkling appearance of these crystals. Some of the largest specimens found had crystals of this peculiar habit. A group of 3 to 4 individuals can be as much as 5 cm across, but these are rare. The large, sharp dome faces in Figure 17 are not always well-developed, and in fact are often absent; the crystals are then tapered at both ends.

ACKNOWLEDGEMENT

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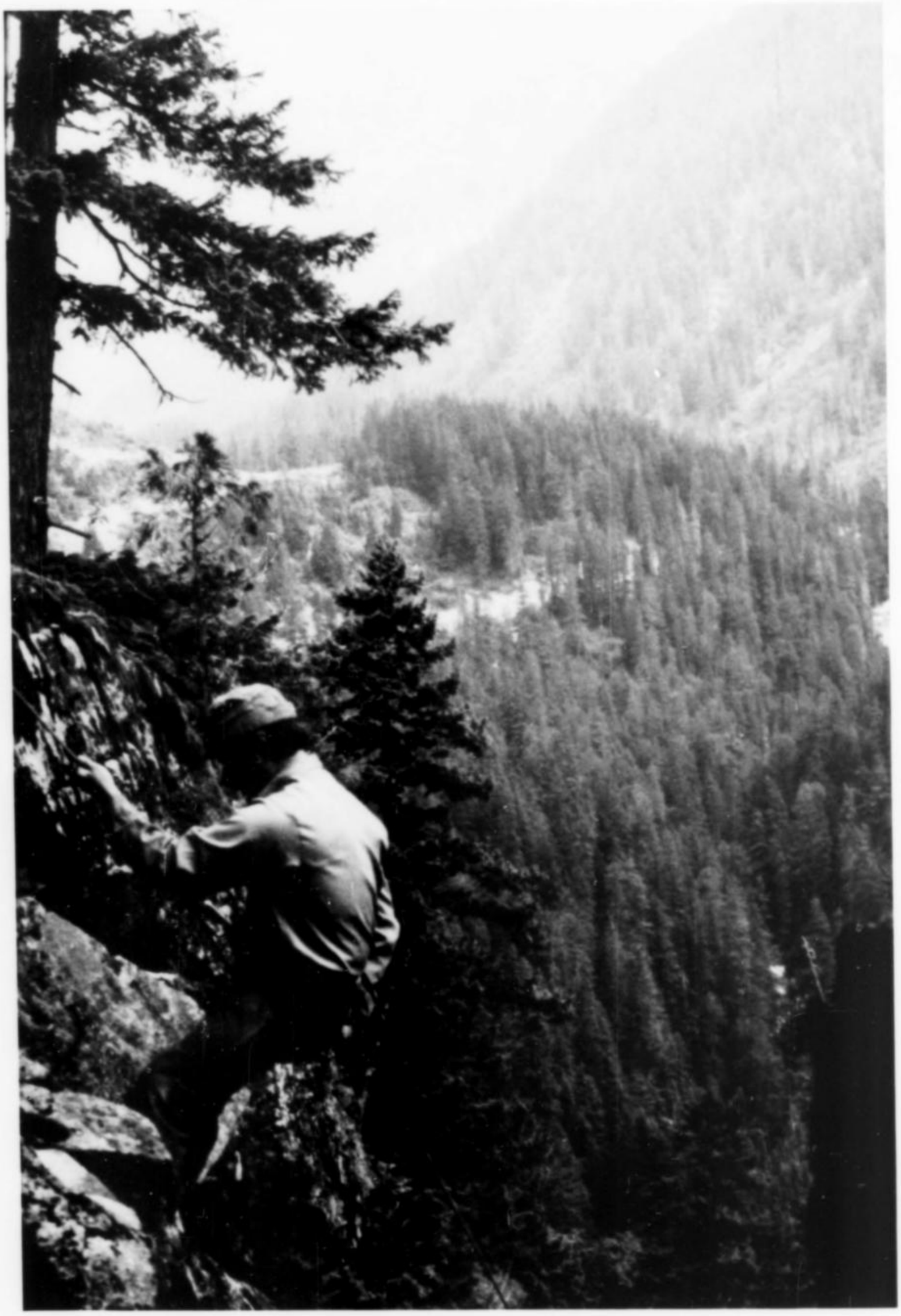
Quartz & Pyrite

from King County, Washington



by
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How did an Ohio-based company decide on Washington state for its first major mineral collecting expedition? It started during an all-night gab session at the October '76 Detroit Gem and Mineral Show. At that time *What On Earth, Inc.*, of Columbus, Ohio, was contemplating some field collecting. So, when John Medici (a partner with Nathaniel (Sandy) Ludlum in *What On Earth*) was discussing mineral collecting with another old-time field collector, William Hawes from California, some of the productive areas in Washington were mentioned as possibilities for a cooperative hunt. After further talks at the February '77 Tucson Gem and Mineral Show, followed by correspondence and a little research on the climate, geology and topography of the region, it was decided that the Spruce Peak pyrite-quartz locality, known by local collectors for 20 years or more, would be a good locality at which to start.

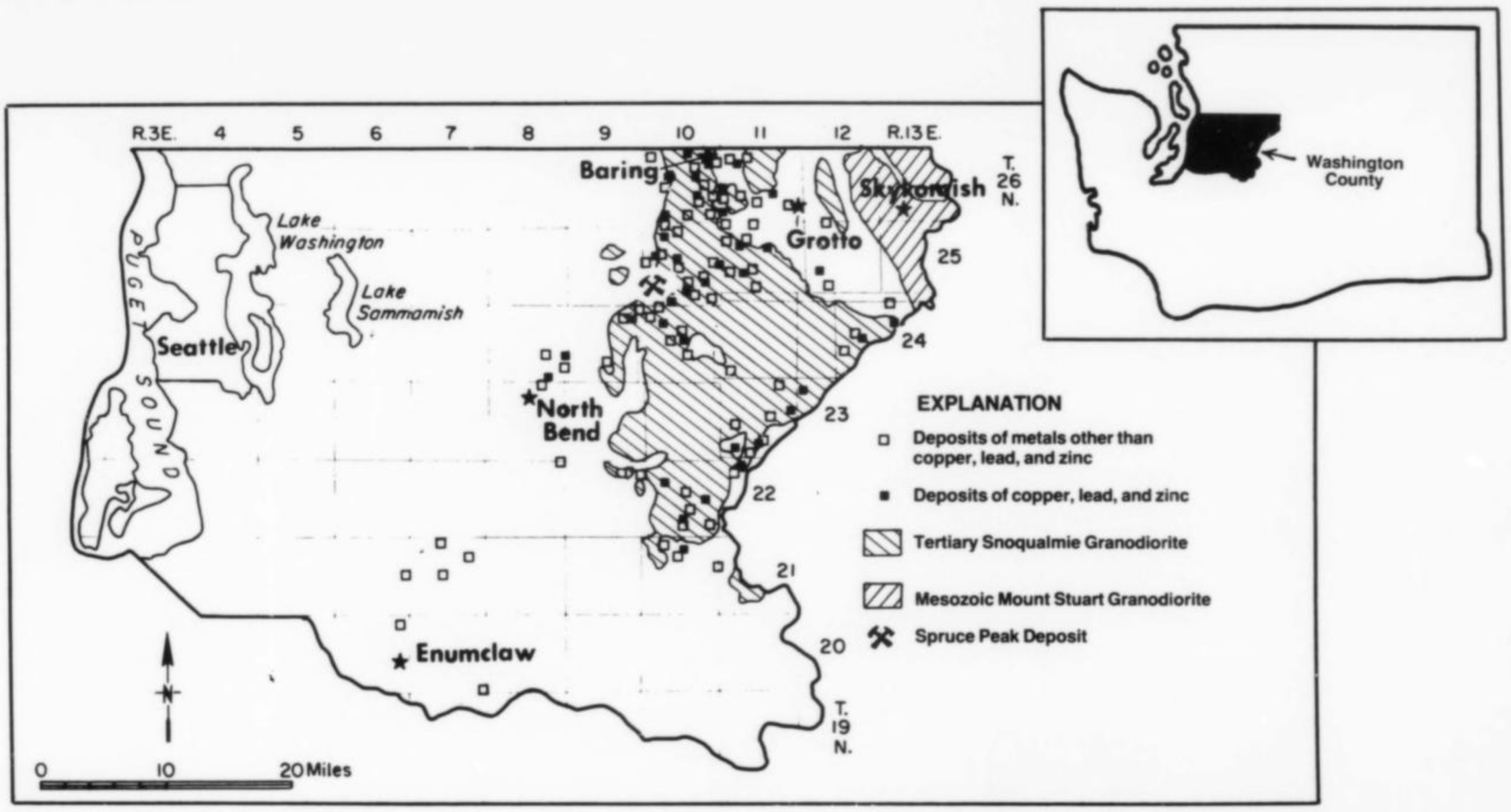

Figure 2. **The location of the Spruce Peak deposit relative to the general geology and ore deposits of eastern King County (compiled by W. S. Moen). Inset: the location of King County in the state of Washington.**

GEOLOGY

The Spruce Peak deposit occurs in King County, Washington, in the Northern Cascades physiographic province. Rocks in this province, ranging in age from Mesozoic to Pleistocene, have been described by several investigators (notably Smith and Calkins (1906), Plummer (1964), and Lipson *et al.* (1961), whose findings are briefly outlined here). There are two major batholithic bodies in the area, both having a general granodiorite composition. The older (Mount Stuart) is Mesozoic in age and the younger (Snoqualmie) Miocene. It is in this younger granodiorite that the quartz and pyrite deposit occurs. These batholiths are associated with Cenozoic volcanics and are overlain by younger Tertiary volcanics and Tertiary to Pleistocene sedimentary rocks. During the Oligocene, prior to the emplacement of the younger batholith, the area was intensely folded into a mountain range. Subsequently the younger batholith was formed at depth both by intrusion and by granitization of pre-existing rocks. At some later time, probably late Pliocene to early Pleistocene, the entire Cascade Range was uplifted. It was during this uplift that faulting and brecciation occurred, forming channels for hydrothermal fluids from which the quartz and pyrite precipitated.

The age of the younger granodiorite has been dated at 17 million years by the potassium-argon method. The deposition of the quartz and pyrite has not been dated except that it must post-date the granodiorite in which it occurs.

Numerous breccia pipes occur in the Snoqualmie granodiorite. Many of these contain low-grade metalliferous deposits, primarily sulfides of copper. Although the first prospects date back to the late 1800's, little mining has been done because of the rugged terrain, remoteness, heavy forest cover, and early and heavy snowfalls.

CLIMATE

The North Cascades are steep mountains ranging 1200-2100 m in height within King County and reaching 3000 m just north of King County. These mountains have a rain forest-like atmosphere due to warm air from the Pacific Ocean (approximately 74 km away) rising over them. Constant rain for periods of a week or more is not uncommon. The only snow-free months at higher elevations are July and August. However, many bowls in the mountains contain snow year-round. The origin of the name Cascades is quite evident to anyone visiting the area. Nearly all river and stream beds have precipitous gradients, which provide many rapids and waterfalls. Snow melting in the spring swells all waterways. Even in the summer water is everywhere, producing prolific crops of mosquitoes and black flies.

Figure 1. ***(previous page)*** **The extraordinary scenery of the Northern Cascades in King County, Washington, must sometimes be temporarily ignored. The pyrite and quartz locality can be reached only by rappelling up and down treacherous cliffs. (Photo by Bill Hawes.)**

PRELIMINARY WORK

Around the first of May, 1977, Bill Hawes and Neal Pfaff (a field collector from Columbus, Ohio) took a rock-climbing course in Colorado, did a little high-altitude collecting in California, and then met John in Seattle on May 7. After two days of rounding up equipment, camping gear, dynamite and food, Bill and Neal hiked approximately 20 km to the Spruce Peak area. John took a helicopter in with the remaining 180 kg (400 lbs.) of gear and landed on a small temporary bridge over a river near the locality. A temporary base camp (plastic-covered lean-to with food and equipment stashes) was set up at this point, near the base camp of a company which was leasing the block of over 250 claims in the region for the purpose of exploring for copper.

Having obtained permission to do some exploratory work, Bill, Neal and John, on a rainy May 10, climbed to the collecting area which outcrops above a narrow V-shaped talus slope nearly 800 m in length. Climbing was treacherous on the rain-soaked slopes and rocks, and work was slow at the outcrop, the slope of which is nearly vertical. It rained and snowed all day, and more time was spent building, tending, and keeping warm by a fire than mineral collecting. The single occurrence of interest that first day was the sighting of three mountain goats on the descent from the digging locality. This was the only observation of large animals other than an occasional deer during the entire summer. However, evidence of goats was everywhere on the mountain.

The temperature during the first week fluctuated between 25° and 40°F. The second morning we found that snow had fallen during the night. The snowline came to within about 150 m of the base camp.

This day, May 11, was to provide one of the group's most exciting experiences. In the rain and sleet some hikers attempting to start a fire accidentally ignited a tank containing 750 gallons (2839 liters) of propane which belonged to the mining company. The tank, located about 100 m from our base camp, burned like a jet engine, blew all its valves and openings, and eventually burned all the buildings of the mining company's base camp. The tank itself burned for over two hours. Had this occurred later in the drought-ridden summer, a major forest fire certainly would have resulted.

May 12 was the only sunny day during that week and proved excellent for taking photographs. The rest of the week was overcast and wet, although the scenery was occasionally spectacular with clouds coming into or leaving the valley. By the end of the week, a summer mineral collecting trip to the Spruce Peak area was beginning to look feasible. The soggy Friday evening was topped off with a bath in a nearby hot spring, the temperature of which is approximately 111°F. The helicopter arrived Saturday morning through a break in the clouds and was able to take everyone out in two trips. Bill's dog, Sam, a young Labrador retriever, was last to leave, weathering his first helicopter ride very well on John's lap.

Figure 3. **The pyrite and quartz discovery was made in the face of a near-vertical cliff; much work had to be done while suspended by ropes. (Photo by Mike McCormac.)**

THE DIGGING

The results of the exploration were studied carefully after John and Neal returned to Ohio. After much discussion we decided to go ahead with a major effort. Personnel and equipment were assembled and permission was obtained from the Forest Service, the claim owners, and the lessee of the claim. We hired Mike McCormac, one of Sandy's geology students from Capital University (Columbus, Ohio) and an experienced hiker and camper. In mid-June, Neal, Sandy and Mike left Ohio for Washington. On the way out they picked up Andy Petefish, an instructor of mountain climbing from Colorado.

Bill was met in Seattle, and with supplies and equipment the group drove directly to the base camp area on an old Forest Service road, the last 25 km of which required a great deal of care and patience. A permanent base camp was set up about 2 km from the collecting site. We had two two-man tents and two plastic tarps, one for storage and one in which to cook.

From the road we had to negotiate a 550 m climb (part of it on ropes) each morning to the collecting site. Andy's rock climbing expertise was immediately useful as the site is an almost vertical cliff and much of the work had to be done while suspended from ropes. By the time we started collecting it was late June. We planned to collect for about 3½ weeks and return to Ohio in mid-July.

Figure 4. **Here a large mass of granodiorite has been broken loose from the cliff wall in order to gain better access to the pockets. Judicious use of small dynamite charges and much hand labor were required. (Photo by Sandy Ludlum.)**

Figure 5. **Bill Hawes proudly displays a superb group of wet, mud and rust-covered pyrite and quartz crystals just removed from the pocket. (Photo by Sandy Ludlum.)**

Collecting was done using two gasoline-powered portable drills, small amounts of explosives and a large amount of hand labor. The rock, a very firm granodiorite, was first fractured with small explosive charges and then pried apart with hand tools to expose the pockets.

The deposit occurs in a fault breccia and/or breccia pipe in the granodiorite. The passageways for the hydrothermal fluids which deposited the quartz and pyrite were the openings between the fractured blocks of granodiorite. The separate blocks range in size from about 20 cm up to 2 m or more. The blocks were cemented together by the deposition of quartz and pyrite. The pockets occur as openings in the veins and, in general, range from about 10 cm wide to a few as large as 2 m. Most of the pockets, however, are smaller than about 25 cm. The larger pockets occur in the area of the larger breccia blocks.

On the first day we encountered one pocket at about dusk that yielded one very fine cabinet specimen of quartz and pyrite. Needless to say, our spirits were quite high that night and our speculations around the campfire about what we might encounter the next day were quite fanciful. The next three weeks were spent moving a lot of rock in the rain, hunting for firewood in the rain, cooking in the rain, eating in the rain, and watching the rain. Probably the only thing that kept moss and mildew from growing on us was that it was too cold for germination. On occasions when the rain did cease we were plagued with mosquitoes and gnats. During this time we encountered a large number of small pockets containing mostly limonite-coated quartz crystals up to 4 cm and a few badly weathered pyrites. A few pockets did yield some nice small 3 to 4-cm sceptered quartz crystals. By this time we were reasonably disappointed, and home and a dry bed were beginning to sound very appealing.

On July 9, Mike and Andy took the truck to town for supplies and two days of hiking and climbing on Mt. Rainier. The following morning the rest of us hiked to the site in the rain and decided to work in an area where we had noticed a trickle of water for the last several days and had heard some interesting gurgling sounds. After about an hour's work we encountered a small opening in a pyrite vein from which water flowed. About a half hour of work enlarged it enough for Bill to try inserting his hand. We thought it might be a large pocket but we were not prepared to see Bill's arm disappear up to the shoulder. Our excitement became almost uncontrollable when Bill announced that he couldn't reach any of the other sides inside the pocket. After several minutes of howling, and dancing as best we could on our precarious perch, we fell to work with greatly increased vigor. It wasn't long before we had enlarged the

hole enough to accept our bodies to the waist. What we found quite amazed us. The walls of the pocket were bare! Lying on the muddy floor of the pocket, however, were plate after plate of large pyrite cubes (up to 10 cm on an edge) and quartz crystals, some sceptered, in beautiful combinations.

We suspect that the fluids which deposited the quartz and pyrite had also altered and dissolved the granodiorite to some extent. Over a period of time the plates on the walls may have become too heavy for the weakened granodiorite and fell to the bottom of the pocket. This could have been disastrous except that the alteration products of the granodiorite had formed mud in the bottom of the pocket which, along with the water in the pocket, sufficiently cushioned their fall and prevented excessive damage. For the next 6 hours we took turns reaching into the mud pulling out quartz and pyrite. By the time it got dark the hillside was littered with specimens.

Figure 6. **All specimens were carefully wrapped and packed for the difficult trip down the mountain. Not a single major specimen was damaged in transportation from the site back to Ohio. (Photo by Sandy Ludlum.)**

We greeted Mike and Andy on their return with a great deal of enthusiasm. Our next problem was to get the material down from the mountain without damaging it. Our problem was compounded because many of the best pieces were heavy *and* fragile. The next morning Sandy went into Seattle to get boxes and packaging material while the others went to the site for further collecting. We carried the boxes and packing material up to the site where we wrapped the specimens for shipment, reinforced a few with water soluble glue where necessary and sealed the boxes. Andy spent the day clearing and setting a rappel route down the mountain so that we could carry the boxes with as little jarring as possible. This all took extra time, but not a single major specimen was damaged in transportation from the site back to Ohio.

On July 20 we broke camp and Andy, Neal, Mike and Sandy left with the truck and a U-Haul for home. Bill remained at the site to clean up and do a little more digging. Andy had his bicycle shipped to him; we dropped him off in Montana and he cycled home to Colorado.

We got back to Ohio, unpacked the truck, amazed John with what we had brought back, and rested for about a week. Our adventure, however, was not yet over. We received a letter from Bill imploring us to return as he had opened a side pocket and a rearward extension that had been "gushing water for a week" and he needed help. We received the letter in the morning and the next day Neal and Sandy left for Washington.

We collected the pocket for three more weeks, exploring all extensions. During this time, we recovered some of the finest specimens of the find (bright sharp pyrites, some of unusual habit, and a number of fine pyrite-quartz combinations). Work, however, was very slow because we could use only hand tools due to the cramped quarters in the back of the pocket. Also, the pocket was continually filling with 37°F (3°C) water and the air in the back of the pocket became seriously depleted in oxygen after anyone had worked about 15 minutes there.

When we finally quit in late August, the small hole we opened on July 10 had been extended into the mountainside about 7 meters, and the entrance measured 1½ by 2 m. The expedition had lasted nearly 4 months from exploration to completion.

CLEANING AND PREPARING

Since very few of the recovered specimens were not coated with limonite, and many were brought home enclosed in the clay-like pocket debris, an extensive cleaning job remained. According to microscopic

Figure 7. **Andy Petefish spent a day carefully clearing and setting a rappel route down the mountain so that specimen boxes could be brought down with as little jarring as possible. (Photo by Sandy Ludlum.)**

Figure 8. **A large group of striated pyrite crystals about 20 cm across. (Photo by Wendell Wilson.)**

Figure 10. (opposite page) **Pyrite crystals (the largest is 3 cm) perched on and in a plate of quartz crystals. (Photo by Wendell Wilson.)**

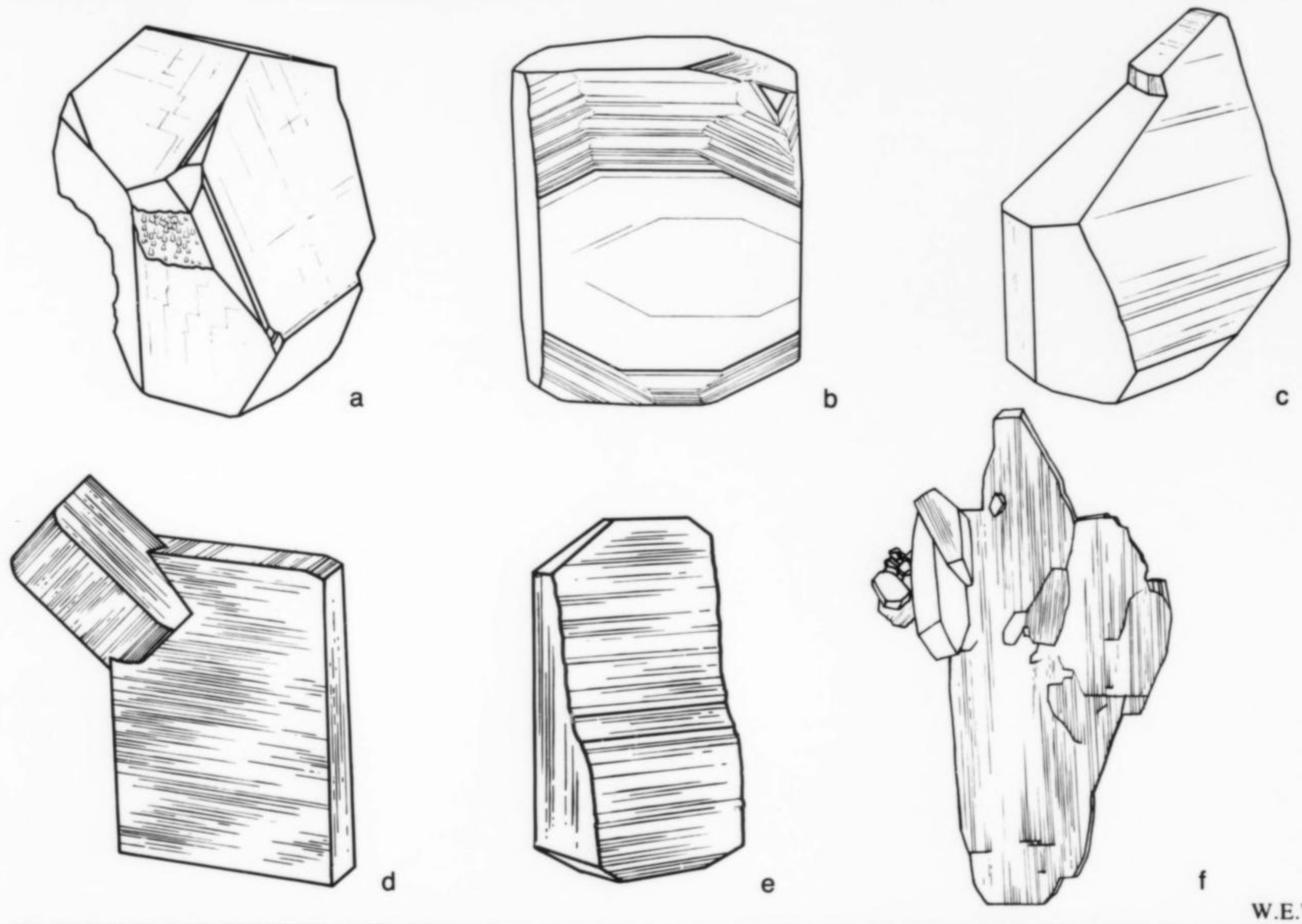

Figure 9. **Sketches of several pyrite crystals found at the King County, Washington, locality. *(a)* 3-cm crystal showing the predominant pyritohedron modified by a small octahedron face and narrow diploid faces. *(b)* 1-cm cube modified by the octahedron (triangular faces) and oscillatory pyritohedron and diploid faces (striated areas). *(c)* Distorted, 5-cm pyritohedron. *(d)* Tabular crystals 8 cm tall, with striations due to cube-pyritohedron oscillations. *(e)* Near-tabular 2-cm crystal composed of cube and pyritohedron. *(f)* Complex, generally tabular, distorted crystal 4.5 cm tall.**

examination, 5% or somewhat stronger HC1 was best for cleaning the pyrite, and was satisfactory for the quartz. Hot oxalic acid was quicker overall, and many of the quartz specimens were cleaned with this acid under a hood vent. Most of the best pyrite-quartz combinations were cleaned with HC1, normally for 1 to 10 hours, but sometimes longer for specimens heavily encrusted with limonite plus clay. The clay was very difficult to remove, even with a heavy duty ultrasonic cleaner, and often the best method was to scrape the material off with a toothpick or dental tool, with periodic ultrasonic treatment. A good method was to manually remove heavy debris, sonicate, soak in an acid bath, and sonicate again, sometimes with more manual scraping, and in some instances a repeat of the whole operation.

Many of the pyrites were soaked in a baking soda solution to remove excess acid after the acid treatment. This neutralized the acid, but not the yellow iron oxalate stain, which sometimes required several soaking-drying steps for complete removal.

THE MINERALS

The most interesting characteristics of this locality are the large variety of pyrite crystal forms and habits, the sceptered quartz, an occasional quartz Japan-law twin, and especially the occurrence of relatively large pyrite and quartz crystals together. Although pyrite and quartz occur together at many localities worldwide and often in great quantities, they are usually present as either crystals of pyrite with much smaller (often drusy) quartz crystals or vice versa.

The large pocket which we found was considerably larger than most other pockets previously found in the general area. We observed that the crystal size generally increases with pocket size at this locality. The pyrite crystals that we found are some of the largest ever recovered there. The largest pyrite measured 12.6 cm on an edge and the largest complete cube of pyrite weighed about 4.5 kg (10 lbs.) and measured 10 cm on an edge.

Although pyritohedrons and modified pyrite cubes were prevalent in the rest of the pockets we opened, the large pocket contained mainly sharp cubes, most with striations formed by multiple pyritohedron modifications on the cube faces (Fig. 8). Some of the pocket extensions contained pyrite with unusual habits: tabular striated crystals, columnar striated crystals, complex intergrowths, half cube-half pyritohedron, and broken-regrown crystals (Fig.9).

Unfortunately for collectors, very few top quality thumbnail, miniature, and small cabinet specimens of quartz-pyrite combinations were found. The few that were found, however, were very fine specimens. Although quite a few of the pyrites at this locality are found cracked, a number of unfractured pyrites were found, ranging from a 22-cm group down to a few of thumbnail size. Most of the outstanding quartz-pyrite combinations were of museum size, generally 17 to 35 cm. One large specimen had a 3-cm pyrite

perched on quartz crystals (Fig. 10); another unusual group contained 34 randomly oriented quartz scepters surrounding a 6-cm pyrite (Fig. 11); and a large, blocky group of pyrite crystals (largest crystal edge 10 cm) had a quartz spray attached. Several large groups had pleasing arrays of quartz crystals interspersed among the pyrite crystals (Fig. 12).

One of the more unusual quartz crystals was a doubly terminated scepter 8.5 cm long. Very few other doubly terminated scepters were found; most were 3 to 4 cm in length.

Two conventional Japan-law twins of quartz were found. Both were matrix specimens, the larger twin being 10 cm on an edge (Fig. 15) and the smaller twin 4.5 cm on an edge. One very unusual specimen was a sceptered Japan-law twin (Fig. 16).

Very few of the quartz scepters were found on matrix; most occurred in smaller pockets and were dislodged either during weathering or in the collecting process. A number of these scepters are quite transparent. An interesting feature of many of the less transparent scepters is an elongated scepter tip. The majority of the quartz crystals found, however, are simple hexagonal and tapered crystals, although a couple of bent crystals were found.

Several specimens of lesser interest also were found at the locality, including specimens of barite, ankerite, calcite, quartz with pyrite inclusions, and quartz pseudomorphs after pyrite.

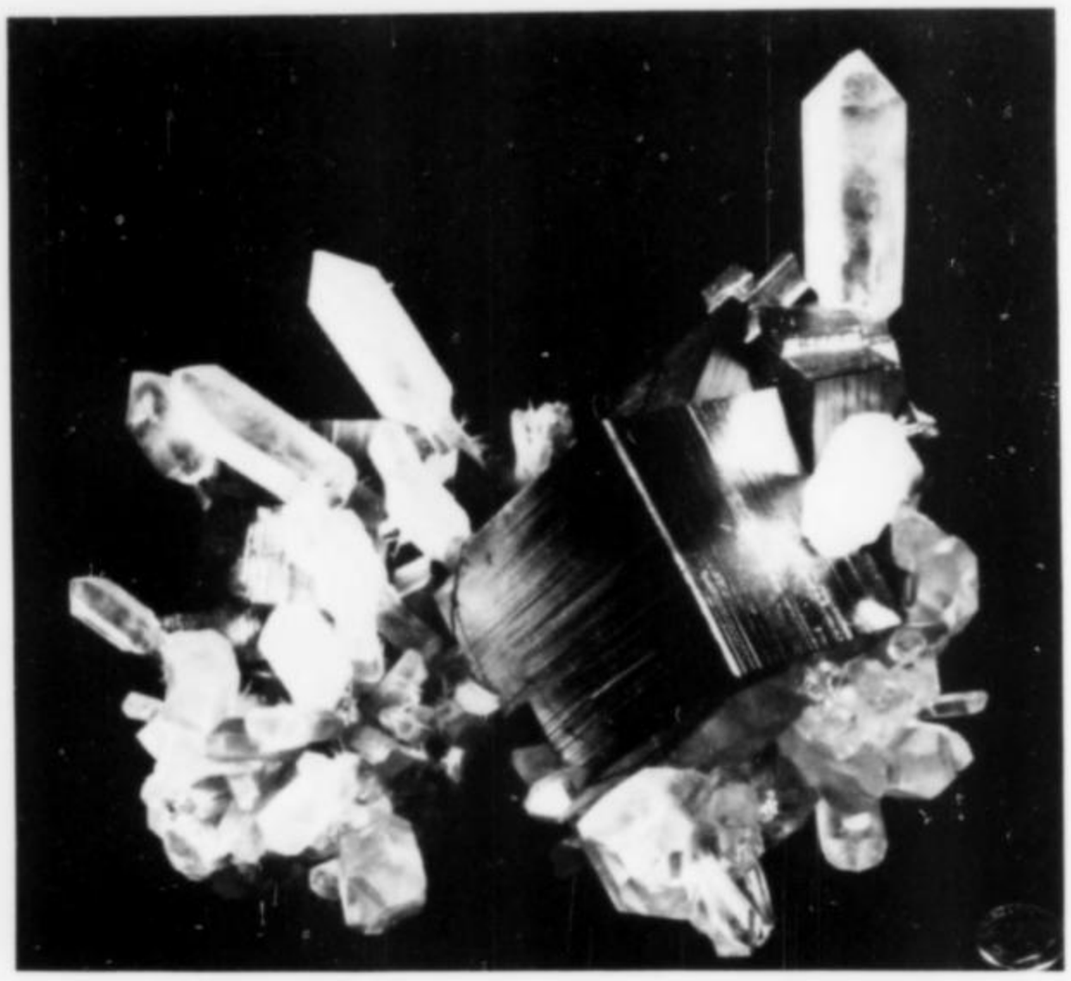

Figure 11. (top) **A magnificent group of large, lustrous pyrite crystals and quartz scepters. The large pyrite is 6 cm across. (Photo by John Medici.)**

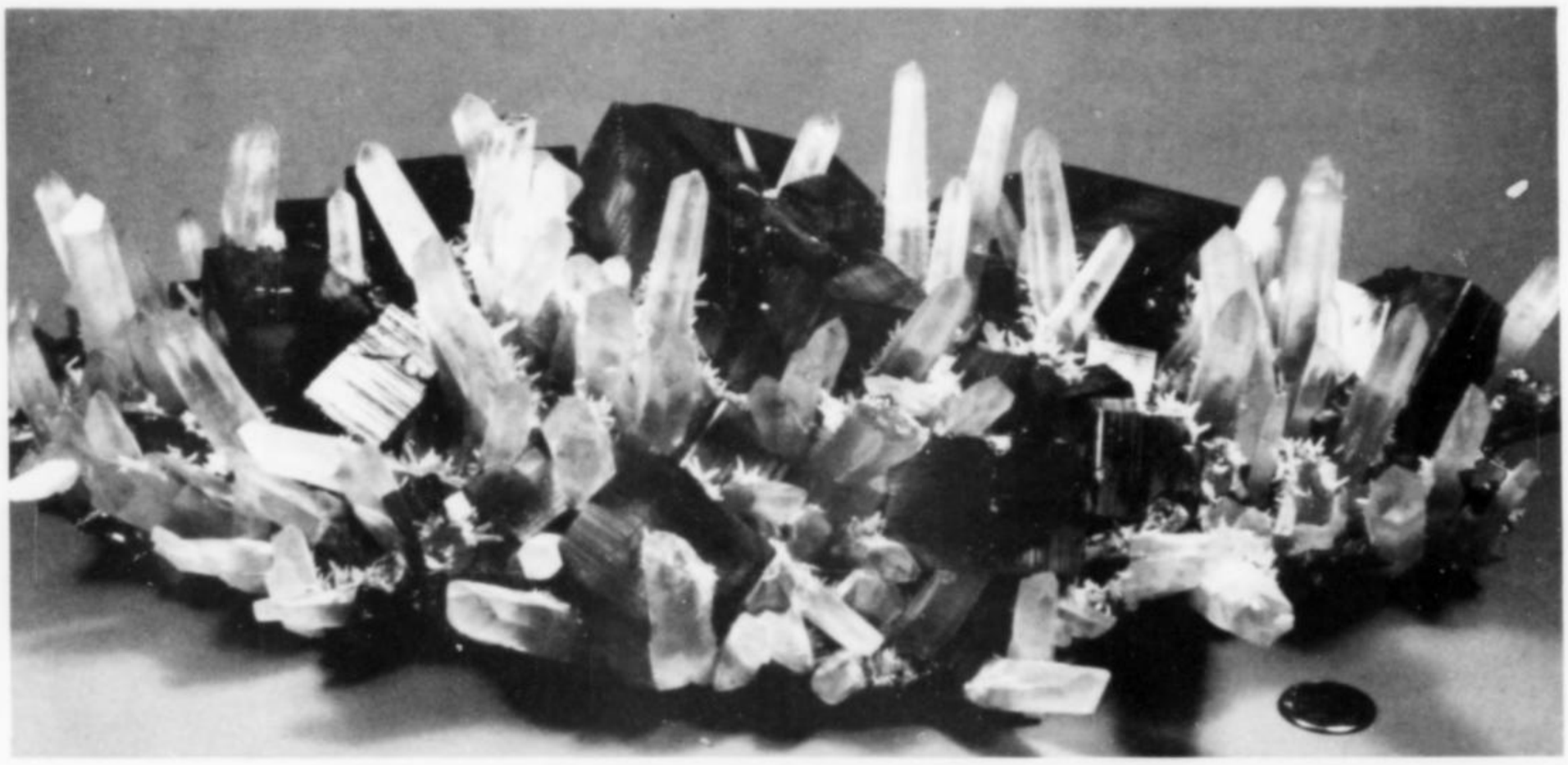

Figure 12. (above center) **A large slab, 28 cm across, of fine pyrite and quartz crystals. (Photo by John Medici.)**

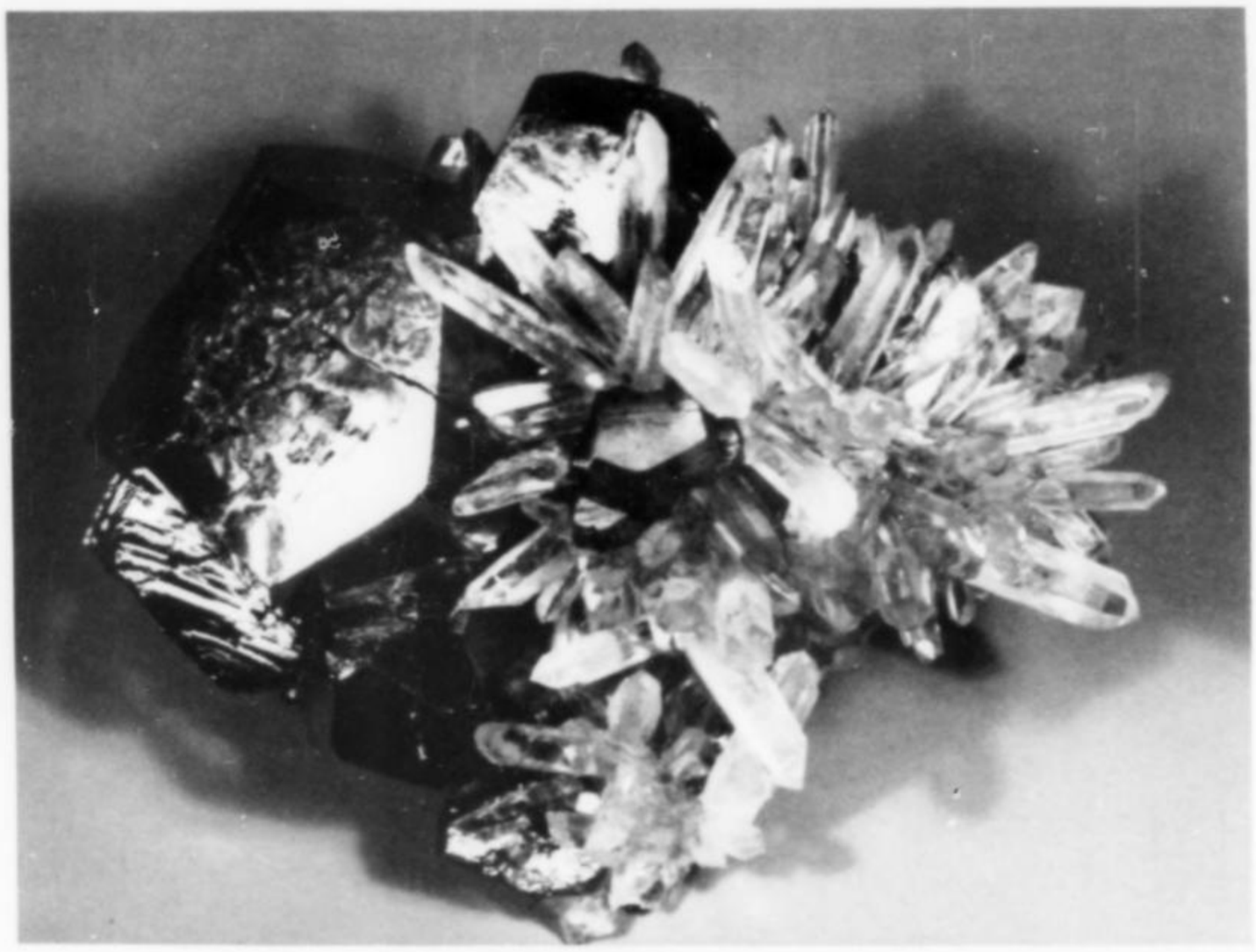

Figure 13. (right) **Pyrite pyritohedrons, the largest 10 cm across, with a large spray of fine quartz crystals. (Photo by John Medici.)**

Figure 14. **A remarkable quartz specimen, a cross composed of a scepter pierced by a doubly terminated crystal 1 cm long. (Photo by John Medici.)**

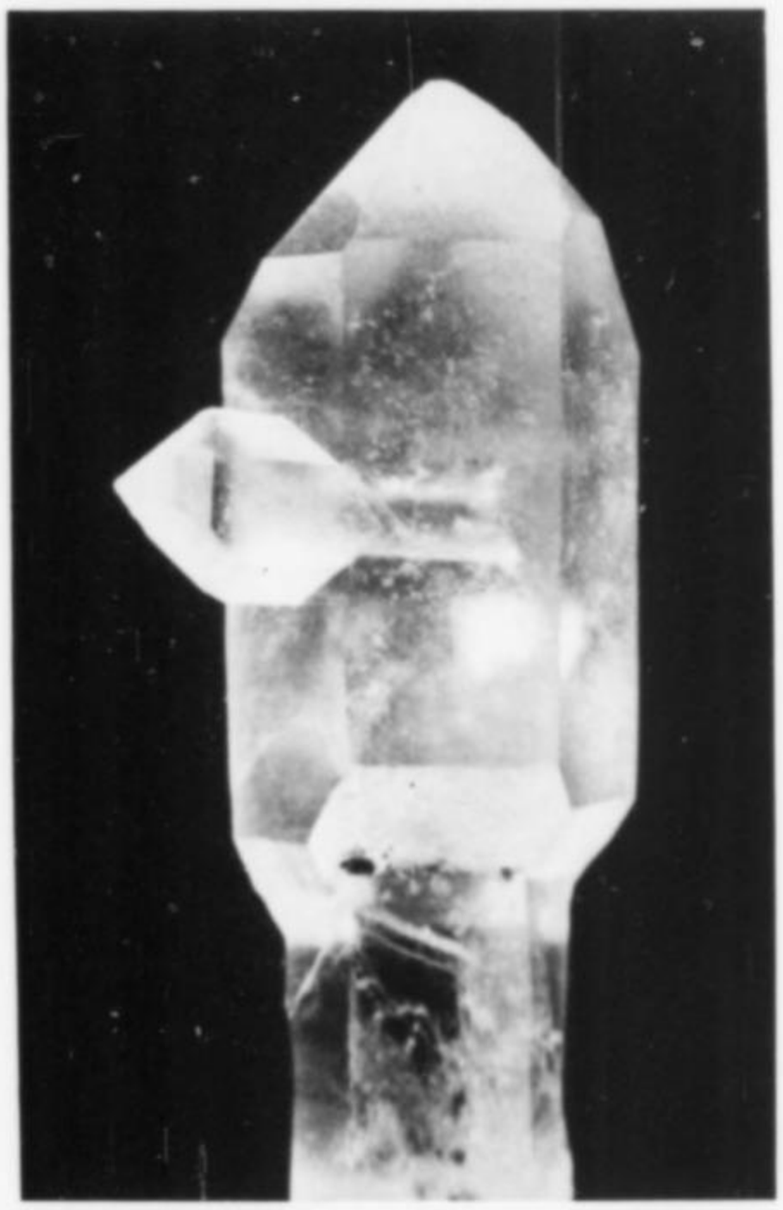

Figure 15. **Another remarkable quartz specimen, an apparent Japan-law twin on a scepter 5 cm tall. (Photo by John Medici.)**

Figure 16. **A large Japan-law quartz twin measuring 14 cm from tip to tip of the two twin members. (Photo by John Medici.)**

The barite specimens range from 1 to 6 cm in size and are growth-zoned with alternating white and colorless bands. The crystals are tabular on {001} with {210} and {101}. The surfaces of the crystals have an etched appearance. Barite crystals occurred on the tips of quartz crystals or intergrown in plates up to 7.5 by 12.5 cm (Fig. 17). Several limonite-coated plates were found lying unattached on large pyrite cubes in the rear of the large pocket. Fewer than a dozen good barite specimens were found.

Ankerite and calcite were the only carbonates found and the specimens were generally of poor quality. The two partial crystals of calcite found are severely etched. Groups of pale yellow curved rhombohedrons of ankerite(?) up to several cm were found associated with quartz in unweathered pockets. Weathered pockets yielded a few limonite pseudomorphs after ankerite(?) but these were very soft and crumbly; few survived.

Pyrite was also found as inclusions in quartz. All included pyrite occurs as modified pyritohedrons, even in the large pocket which otherwise contained cubes and modified cubes of pyrite. The largest included pyrite found is around 3 mm. Other inclusions we have recognized are mud and an occasional chalcopyrite crystal.

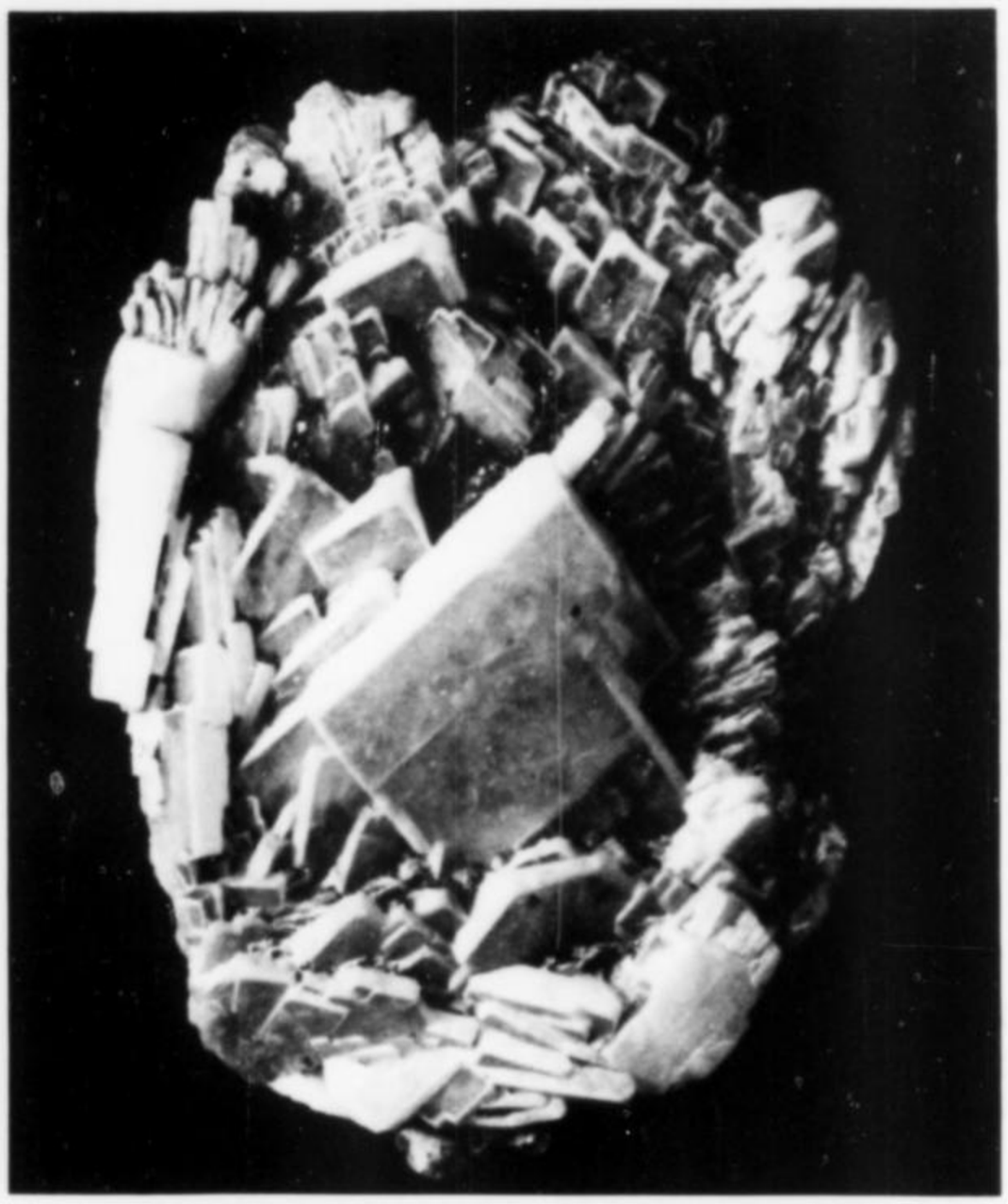

Figure 17. **A group of white barite crystals, the largest of several such specimens found at the pyrite locality, measuring 7.5 by 12.5 cm. (Photo by John Medici.)**

Three interesting pseudomorphs were found in a small pocket just below the major pocket. These were groups of free-standing quartz crystals with pyrite crystals up to 7 cm scattered among them. The pyrite, however, had been entirely replaced or coated by quartz.

ACKNOWLEDGMENTS

We wish to gratefully acknowledge the invaluable help provided by the U.S. Forest Service and the Houston Oil and Mineral Company in this project. Thanks also to Gloria Ludlum and Christine Pfaff for their efforts in cleaning and preparing the minerals and in setting up and arranging displays, and to Wendell Wilson for his help with graphics and his advice on manuscript preparation.

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Editor's note: *What on Earth* sent another collecting expedition to the Cascades this past summer, 1978. Author John Medici and his son Jay were nearly killed in a helicopter crash while flying supplies to the base camp. All food and survival gear were burned but, fortunately, a group of men on a fishing trip witnessed the crash. They gave the Medicis food, warm clothing and a map to help them make the 14-mile trek out of the wilderness. Their safe arrival brought an end to a two-day, 20-plane search for the missing collectors.

THE HISTORICAL RECORD

by Ron Bentley
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Windsor, Connecticut 06095

Recently I was fortunate enough to attend one of the best (in my opinion) East Coast mineral shows. The show, held in the spacious student center at Seton Hall University in South Orange, New Jersey, is put on each year by an association of New Jersey gem and mineral clubs. This cooperation between neighboring clubs has resulted in such a successful show that the procedure seems a viable alternative to each club having its own smaller show. Good organization was evident everywhere, from more than 90 first-class exhibits to a fine banquet Saturday evening where Bob Jones entertained all with slides of Southwest mineral collecting. Of special interest to me were four cases of mineral memorabilia. Very rarely can one attend a show these days where there isn't at least one dealer selling specimens with old labels, old books, mining lamps or mining tools. A disadvantage of the increased popularity, however, has been the appearance of fake mining artifacts, so be sure to buy only from a reputable dealer.

The type of mining artifact enjoying the greatest popularity is the mining lamp. Surprisingly, mineral collectors are not the first to have taken an interest in mining lamps; there are many collectors of Americana in general who own sizeable sub-collections of mining lamps. In fact, it was the great popularity of mining lamps at antique shows and flea markets (rather than at mineral shows) which inspired the recent manufacture of reproductions and fakes. (Reproductions are intended to be sold as such, whereas fakes are purposeful misrepresentations of the originals.)

Any number of books about domestic and industrial lighting can be found. For a general overview of domestic lighting you might consult *Flickering Flames* by Leroy Thwing (published by the Charles Tuttle Company, Rutland, Vermont). Thus far, however, I have found only one book specializing in underground mining lamps: *Early Underground Mining Lamps* (1974) by Henry A. Pohs. Happily for the collector of mining lamps, this book is still available for only $6 from the publisher (the Arizona Historical Society, 949 East Second Street, Tucson, Arizona 87519). This is an excellent and invaluable reference aid which I strongly recommend. I am indebted to Mr. Pohs and the Arizona Historical Society for permission to use information and illustrations from the monograph in this column. I would also like to thank John Shannon, director of the Geology Museum at the Colorado School of Mines in Golden, for permission to use the following brief history of mine lighting; the synopsis was originally printed as a brochure to accompany their exhibit of the Thomas Allen mine lamp collection, and is so interesting that it deserves to be widely read.

A SHORT HISTORY OF MINE LIGHTING

The earliest forms of underground mine illumination were torches made with grease-soaked reeds or thin strips of wood soaked in animal fat. The first improvement over this was a candle made with a cotton wick in the center of a stick of tallow. Wax soon replaced the tallow because it burned brighter and longer.

Figure 1. **Earliest known lamp, a flame-wick utensil dated at 10,000 B.C., found in an English chalk mine.**

Simple oil lamps—open clay bowls filled with oil or animal fat with some sort of fiber wick set in them—were used as far back as 10,000 B.C. (Fig. 1), and by 3,000 B.C. such oil lamps were in use in Greek and Roman metal mines (Fig. 2). However, as the coal mining industry developed in England, the candle was favored. An early practical development was the candle holder which hooked on the miner's hat, leaving both hands free to work (Fig. 3).

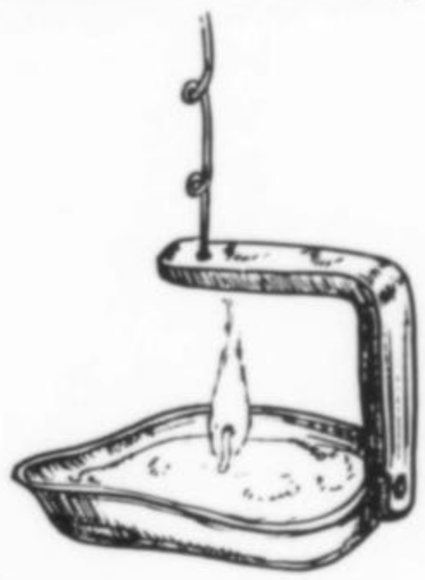


Figure 2. **Roman brass oil lamp.**

Figure 3. **Classic miner's candleholder.**

Coal mining undoubtedly started with the use of loose or easily accessible coal found along the outcrops of coal seams. On the east coast of England, pieces of loose coal — washed up on shore from coal seams exposed under the sea—were used very early. With the gradual increase in England's population and a resultant shortage of wood for fuel, it became necessary to increase coal production. Mines were extended into the coal seams, beneath the surface. This early growth took place between 800 and 1200 A.D., and coal mining was recognized as a national industry before the 15th century.

The early coal miners were exposed to endless hazards as they tunneled deeper into coal seams. One of the most serious of these dangers was the methane gas which seeps from coal. If it built up to certain concentrations it would explode when ignited by the miners' open flame lights. The earliest recorded death by such an explosion is in the parish register of St. Mary's Church Gateshead-on-Tyne, which reads simply, "Richard Backas burnt in a pit October 14, 1621." This is in the region of Newcastle-on-Tyne, the famous northern England coal mining center which began coal production in the 12th century.

Different methods of ventilation to prevent a buildup of the explosive gases met with varying degrees of success, and other means of pre-

venting explosions were sought. One of the most remarkable of these was the "fireman." This courageous soul wrapped himself in wet cloth and went into the mine well ahead of the other miners. He carried a candle or oil lamp at the end of a long pole, which he thrust out in front as far as he could to ignite any gas that might be present. Sometimes he would crawl along the floor or in a shallow trench for "added safety." As can be expected, the death rate for these firemen was relatively high and the position was not eagerly filled.

A general shortage of labor in the coal mines, due to the dangerous nature of the job, necessitated finding an effective way of handling the problem of explosive gases in mines. Smaller lights and candles were tried, to no avail. "Eternal lights" were kept burning all the time to consume the gas as it was given off. Miners even attempted to work with the phosphorescent glow given off by decayed fish skins as their only source of light.

Finally, in 1750, a mine mechanic by the name of Carlisle Spedding invented the Steel Mill — a metal wheel which was rotated rapidly on a flint, creating a shower of sparks for light (Fig. 5). It was a cumbersome machine, and each miner had to employ a boy to operate the wheel. The same principle was later applied to lighting carbide lamps, and is used now in cigarette lighters. It was believed that the sparks did not generate enough concentrated heat to ignite the methane gas. However, in May 1812, a violent explosion occurred in the Felling Colliery, Newcastle-on-Tyne, where only steel mills were being used for light. Ninety miners were killed.

The publicity caused the British government to employ Sir Humphrey Davy, a prominent scientist, to try to discover a safer means of mine illumination. After some experimentation, he came up with the Safety Lamp Gauze, an extremely fine wire mesh which encircled the flame of the gas lamp. The gauze apparently dissipated enough of the heat from the flame so that it remained inside the gauze and was less likely to cause an explosion (Fig. 6). Any gas that got into the lamp was burned off gradually.

At about the same time, two other men invented "safety lamps." One was George Stephenson, the inventor of the train locomotive. His lamp had a glass cylinder inside the safety gauze with a gauze cap on top, more completely isolating the flame (Fig. 7). The other was a mine physician, Dr. Clanny. His version had a glass cylinder around the flame with gauze above it, and provided more light than either of the other two (Fig. 8). The Davy and Clanny safety lamps were most widely used of the three designs. They remained in use for mine lighting in almost their original formsuntil about 1915. The basic fuel they used was oil, such as kerosene, but other more volatile fuels were also used. The lamps were imported to this country and were used throughout the coal fields of East and West, including Colorado. A common safety practice was the identification tag on each lamp, which was assigned to a certain miner. If an accident occurred, the man could be identified by his tab number. It also allowed the superintendent to determine who had damaged a lamp, for which the miner was responsible (Fig. 9).

The American hard rock miner in the gold and silver mines was not faced with an explosive gas problem and continued to perfer the candle for light throughout the 1800s and 1900s. The unique style of candle holder that evolved was especially suitedto his needs. A long spike allowed it to be stuck into a crack in the rock face or mine timber, it could be hung up by its side hook or even hooked onto the miner's hat if he wished. One of the most practical variations on the basic idea was the folding holder which would fit neatly into a miner's pocket. Although the most common form was a simple bent wire fashioned by the mine blacksmith, over 70 patents for elaborate designs and variations were issued in Colorado alone! (Several such designs are shown in Fig. 10.)

Figure 4. **Candle mounted on a mouse cage for illumination and poison gas detection in one.**

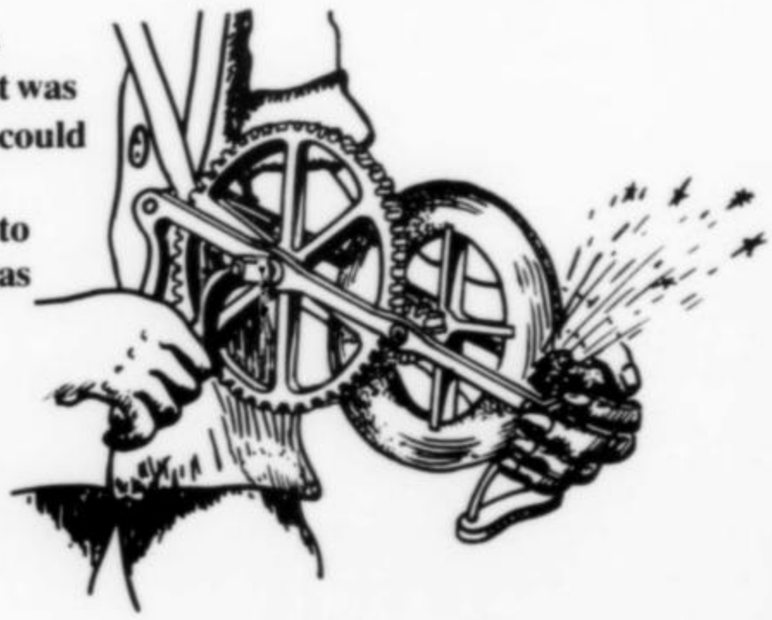


Figure 5. **Spedding's "steel mill"—1750. It was thought the sparks could give light while not being hot enough to ignite a methane gas explosion.**

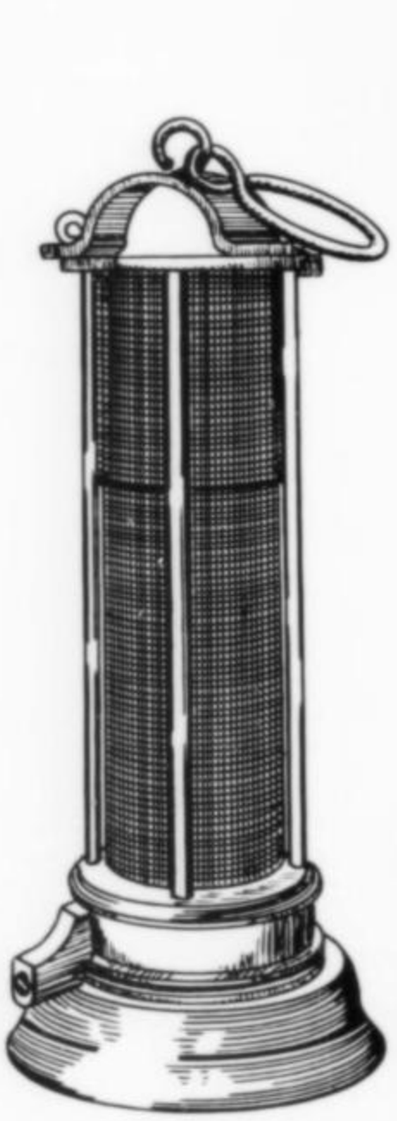


Figure 6. **A Davy lamp.**

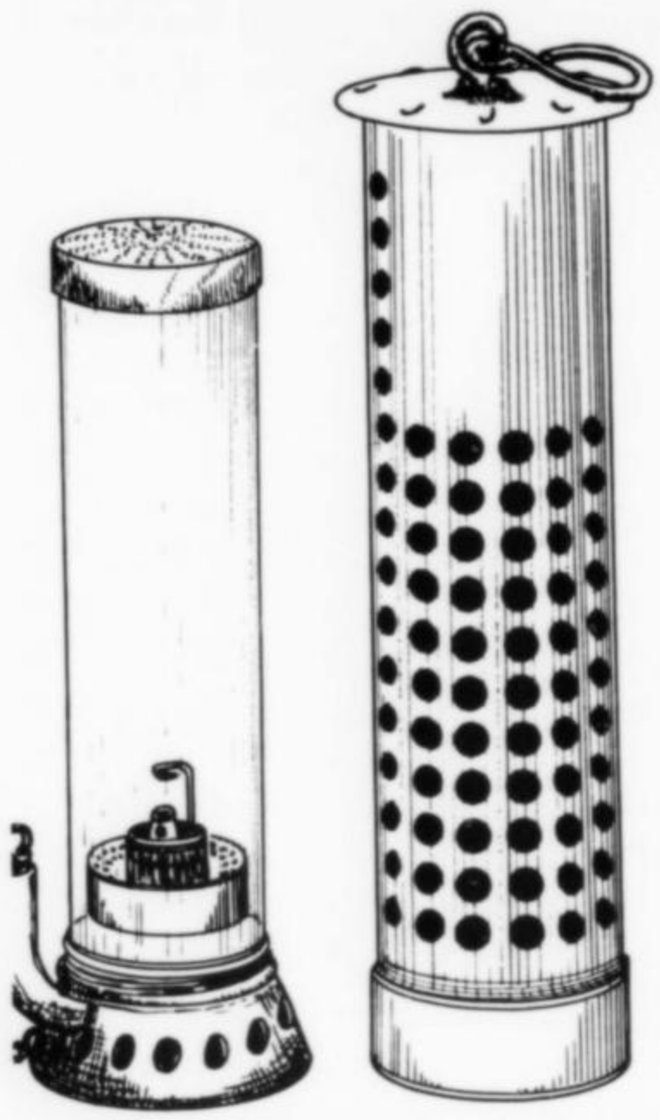
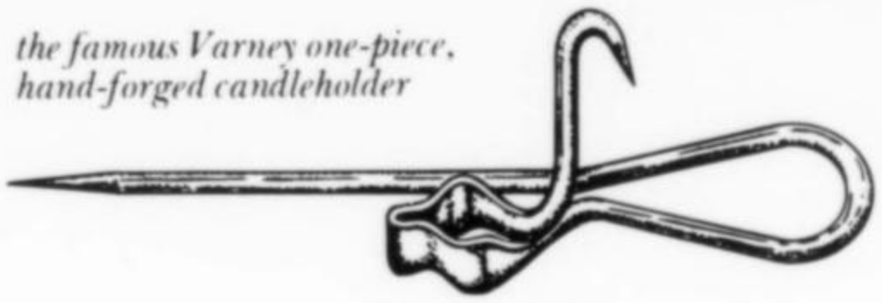
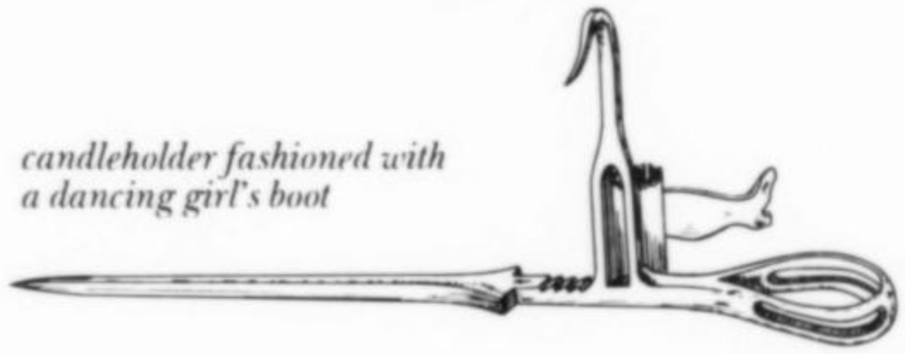


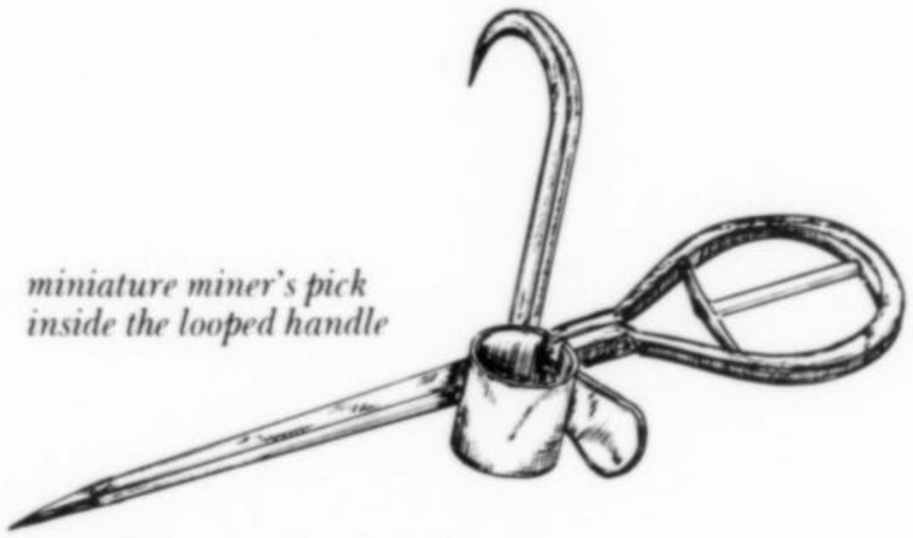
Figure 7. **Stephenson's "Geordie" lamp, ca. 1815.**



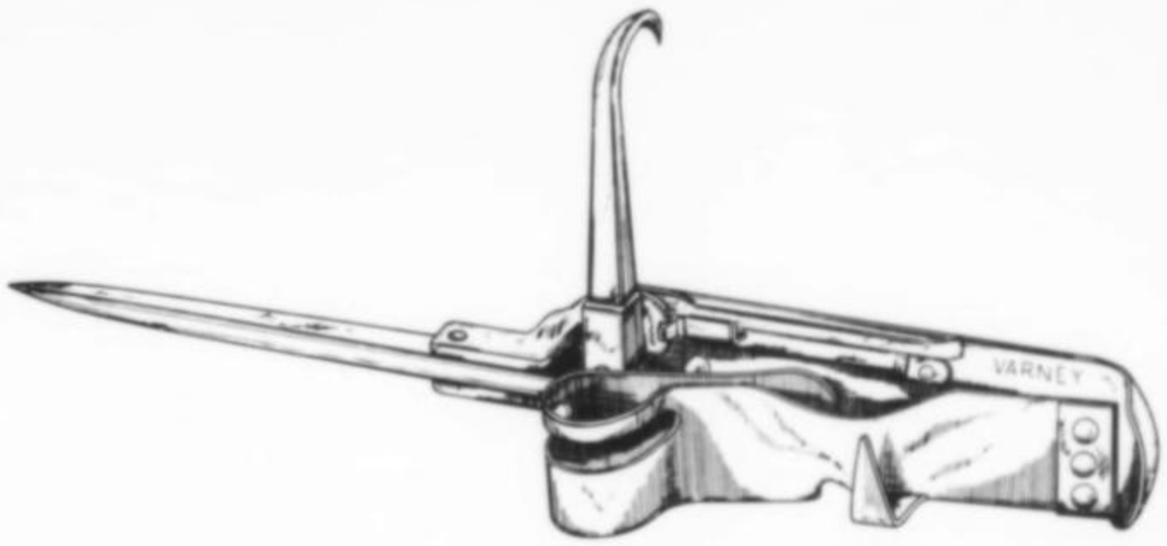
the famous Varney one-piece, hand-forged candleholder



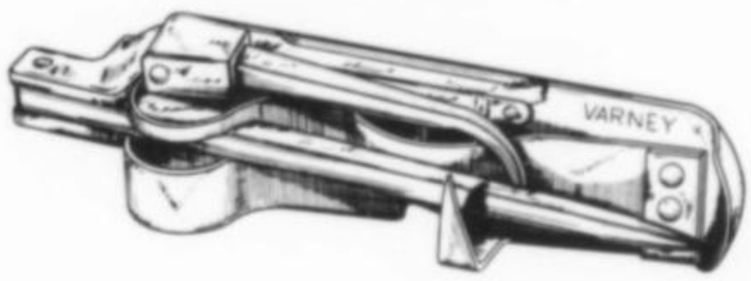
candleholder fashioned with a dancing girl's boot



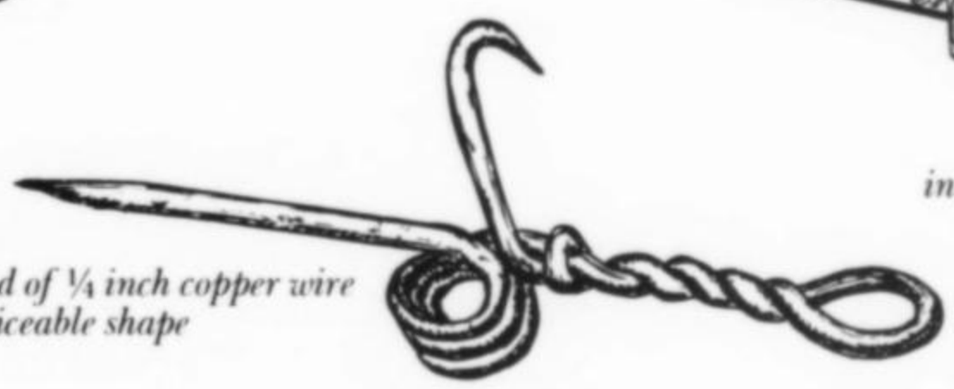
miniature miner's pick inside the looped handle



the patented Varney folding candleholder



inlaid German silver, 12 inches long



a single strand of ¼ inch copper wire bent into serviceable shape

Figure 10. **Candleholders of various designs.**

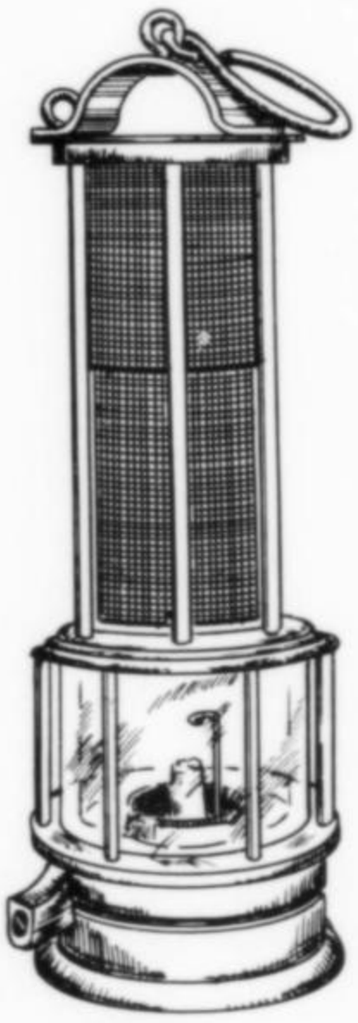


Figure 8. **A Clanny lamp.**

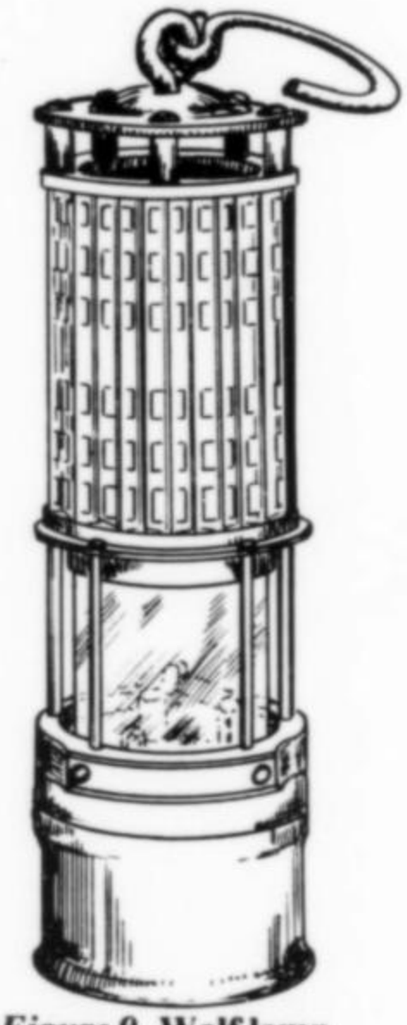


Figure 9. **Wolf lamp of the kind in use today.**

Elkhorn cap lamp, brass body 3½ inches tall, nickel-plated reflector

Justrite cap lamp, 16 candlepower

Justrite "Victor" cap lamp ca. 1920

Figure 11. **Carbide lamps.**

The carbide lamp started to replace the oil lamp and candle for light in mines around 1906. It had been copied from the bicycle lamps the miners carried to the mines when they had to report to work before sunrise. This lamp contains two chambers. The upper one holds water which drips into carbide in the lower chamber and creates acetylene gas, which is easily ignited and burns efficiently and brightly (Fig. 11).

However, electric lights appeared at about the same time and werein widespread use before World War I. The electric cap lamp had appeared in the anthracite coal mines of Pennsylvania as early as 1908. Although the early ones gave off little more light than a candle, the electric light was soon the most popular method of mine illumination. Now, battery-powered cap lamps or other electric lamps are the only legal lights in coal mines and are almost universal in all other kinds of mines. The old oil safety lamps were in use until just a few years ago as gas detectors, and carbide lamps are still sometimes used as back-up lights or in small one-man operations.

Carbide lamps are still in use today by a few mineral collectors in the Southwest. Wendell Wilson pointed out in his article on underground collecting back in 1974 (the *Record*, vol.5, no.3, p.133) that the carbide lamp, although less convenient to use than battery-powered electric light, still provide the brightest light at the least cost per hour, and provided more light per ounce, than battery systems. And, despite the inconveniences, the use of carbide lamps can lend an enjoyably historical feeling, giving one a sense of kinship with the miners of old.

In my next column we'll take a brief look at some of the lamps which evolved, for the most part, here in the United States, especially the Sunshine lamps.

New Minerals 1973-1977: A Perspective

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INTRODUCTION

Many new mineral species are discovered every year and the process is continuing unabated. As our technology becomes even more sophisticated, mineral scientists will be able to work tomorrow on crystals that are still too small for the techniques we use today. Over the last five years (1973 – 1977), there have been 272 new minerals approved by the I.M.A.* This is a rate which yields better than one new mineral each week! To gain a perspective on the overall nature of these new species, a brief statistical study was in order, and the results are presented here.

The data on the new minerals were tabulated according to composition, crystallography, locality, and the derivation of the new name. Many other categories were begun but later abandoned since the sample (272) was so small that overly-narrow categories had no perceivable significance. The nature of the task involved subjective decisions on the part of the author and these are noted where pertinent. A tabulation of the countries in which the describers of the new species worked was discarded since it simply reflects the predominance of the industrialized nations in research of this nature.

CHEMICAL COMPOSITION

The 272 new minerals were categorized according to anionic group as in the Dana system of mineral classification. Some groups were combined. For example: sulfides, tellurides, arsenides, selenides, and antimonides are all gathered under the heading *sulfides*. Similarly, oxides and hydroxides are gathered together under the heading *oxides*. Several species (4) have two anionic groups and could be classified under either. These species were listed under both anionic groups.

The results of this chemical tabulation are presented in Table 1 and clearly demonstrate that silicates, sulfides and phosphates were the dominant anion groups described in the past five years. Silicates are probably dominant because of the predominance of silicon and oxygen in the crust of the earth. Many of the sulfide species were the result of electron microprobe technology which permitted the characterization of little blebs and crystals included in ores. The large number of phosphates is in no small part due to the energetic efforts of Paul Brian Moore and Takaharu Araki of the University of Chicago. Few other conclusions can be firmly drawn from the data except to say that mineral species are being found in all the major anionic groups and the growth of our knowledge about mineral chemistry is booming.

CRYSTAL SYSTEM

The 272 new species, tabulated by crystal system, are presented in Table 2. The column marked unknown is for amorphous and metamict minerals and for those for which the crystal system could not be determined. In those cases where single-crystal examination could not be performed, but the powder diffraction data were indexed on a given unit cell, the crystal system of the unit cell used in the indexing was designated in the table. Rhombohedral minerals are included with hexagonal minerals under the heading *hexagonal*.

As would be expected, new minerals were found in all the crystal systems. The percentages in each crystal system are noted and these figures can be compared with those of Strunz (1970) who published a tabulation of 1710 minerals. The only major differences between the older data and that from the last five years is a decrease in the number of isometric minerals and an increase in the number of hexagonal minerals.

LOCALITY

Of the 272 species discussed here, only one was without a specific locality and it was described as a gemstone. Uncommon occurrences include one new mineral found in a meteorite and one found on the ocean bottom. The other 269 new minerals came from 47 countries. The eleven countries in which the most new minerals are found are listed in Table 3. Where several localities are given for a new species, only the type locality is considered here.

The United States clearly leads in new species with 61 new minerals for a stunning 22% of the world total. The Soviet Union is close behind with 41 new species and 15% of the total. In addition, those countries marked with an asterisk (*) are those in which new minerals were found in every one of the last five years, indicating their potential as steady suppliers of new species.

Of the 50 United States, new minerals were found in only 20 of them, and California and Nevada led the way with seven each, closely followed by Arizona and South Dakota with six each.

The countries listed in Table 3 contributed 201 new species: 74% of the 5-year total.

MINERAL NAME

The new minerals (1973–1977) were named for various persons, places, gods, and other good things. An attempt to sort this potpourri of designations into an orderly presentation of data resulted in some arbitrary decisions and subjective judgments on the part of the author. Those who do things not done before may be totally correct and incorrect at the same time but, anticipated criticisms aside, the *mineral name* categories are defined as follows:

Person-Scientist — Individuals who have been or are employed as scientists.

Person-Collector — All mineral collectors and dealers (since most dealers collect as well as sell, or at least began as collectors).

Person-other — Used for miners, field assistants, mine managers, etc.

Place — Used when a mineral is named for a place whether or not the mineral was found in that exact place.

*International Mineralogical Association Commission on New Minerals and Mineral Names.

Composition — Used only when the mineral name was derived *directly and totally* from the words used to represent the chemical elements or the symbols of the elements. (Example: *zinalsite, zincsilite.)*

God — Deity of some sort. (Example: *quetzalcoatlite.*)

Class — A class of people or animals, or an organization or company. (Example: *tsumcorite* for the Tsumeb Corporation.)

Relationship — Used when the new name relates to another mineral name. (Examples: *clinohumite, ferrotantalite, paradamite.*)

Characteristic — Used when a mineral name is derived from some characteristic of the mineral. (Examples: *pyrophyllite, pyrargyrite.*)

Other — For the few left over!

The breakdown of the 272 mineral names is presented in Table 4. A perusal of the data shows several features of interest. Most obvious is the lack of many species named for characteristics of the mineral. Whether the demise of this practice, used extensively in the past, is fortunate or not is a matter of opinion, but the near total absence of such mineral names in the last five years is notable.

A five year sample is too small to use as a data base from which to draw firm trends, but it is interesting to note that:

1. The number of minerals named with the names or symbols of the chemical elements is decreasing.

2. The number of minerals named for scientists stays fairly constant at 38–44% for the last five years.

3. Collectors have had 10% of the new minerals named for them in recognition of their efforts and contributions. (This is five times as many as were named for gods and may signal the rise of the mineral collector as a deity!)

4. Diversity in the naming of minerals, long a hallmark of mineralogists, is still in vogue and will likely continue.

It is also worth noting that Fleischer (1969) observed that the I.M.A. Commission approved 205 new minerals for the years 1962–1966. Hence, there are now about 11 more new minerals being discovered every year, on the average, than during a comparable period ten years ago.

In summary, a study of new minerals over a period of five years shows the vitality and diversity of our science, the continued variety of chemical components found, the widespread occurrence of new species, and the various perversities of those naming new minerals. A growth rate of about 2% per year bodes well for the science. Onward!

ACKNOWLEDGEMENTS

The author is indebted to Michael Fleischer, Mary Mrose, Joseph Mandarino and John S. White for critical readings of the manuscript and suggestions which led to improvements. Special thanks are due to Wendell Wilson for the drawing and to a nameless red-capped elf who suggested the project.

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Table 1. **New minerals 1973–1977 arranged by anion group.**

	1973	1974	1975	1976	1977	5-Year Total	5-Year Percent
Silicates	21	18	11	11	18	79	29%
Phosphates	8	7	8	10	10	43	16%
Arsenates	1	1	2	3	3	10	4%
Sulfates	2	2	1	7	3	15	5%
Carbonates	0	4	1	7	8	20	7%
Borates	2	1	1	0	2	6	2%
Oxides	3	5	6	2	2	18	6%
Sulfides	18	9	1	15	7	50	18%
Halides	2	1	1	1	2	7	3%
Others **	8	13	1	4	2	28	10%

Others **

1973: Vanadates(2), organics(2), native element alloys(2), tellurites(2).

1974: Organic(1), native element alloys(3), tellurites(4), tellurates(2), chromate(1), native elements(2).

1975: Carbide(1).

1976: Vanadate(1), native element alloy(2), arsenite(1).

1977: Tellurite(1), selenite(1).

Table 2. **New minerals 1973–1977 arranged by crystal system.**

	1973	1974	1975	1976	1977	5-Year Total	5-Year Percentage	Strunz (1970) Percentage
Isometric	3	6	3	2	1	15	6%	12%
Tetragonal	4	4	3	5	3	19	7%	9%
Hexagonal	9	11	10	10	7	47	17%	10%
Orthorhombic	18	18	11	19	13	79	29%	22%
Monoclinic	20	17	8	14	22	81	30%	31%
Triclinic	5	0	5	4	3	17	6%	8%
Unknown	5	4	2	2	1	14	5%	-

Table 3. **Countries in which the most new minerals occurred during 1973–1977.**

Country	Total number of species during 5-year period	Percentage of 5-Year total
Australia *	13	5%
Canada *	17	6%
Czechoslovakia	9	3%
France	7	3%
Germany	10	4%
Japan *	18	7%
Italy	9	3%
Mexico	9	3%
Southwest Africa *	7	3%
U.S.S.R. *	41	15%
United States *	61	22%
Total	201	74%

*Countries in which new minerals occurred in every one of the last five years.

Table 4. **New minerals 1973–1977 arranged to show the way they were named.**

	1973	1974	1975	1976	1977	5-Year Total	5-Year Percentage
Person-Scientist	28	24	16	21	19	108	40%
Person-Collector	4	8	4	4	7	27	10
Person-Other	1	1	5	2	3	12	4
Place	14	18	7	19	12	70	26
Composition	8	6	4	3	2	23	8
God	2	1	1	0	0	4	2
Class	1	0	0	3	1	5	2
Relationship	3	1	5	4	4	17	6
Characteristic	1	0	0	0	0	1	0
Other	2	1	0	0	2	5	2
Total	64	60	42	56	50	272	100%

BOB SULLIVAN'S LETTER from EUROPE

A really interesting development in Europe has been the appearance of some rather promising Russian minerals at a number of bourses. Perhaps the Russians are serious this time, for the quality and quantity of minerals has improved—also the diversity. Nothing in the spectacular class, however, and most of the old classics remain amongst the missing. There have been a number of rare minerals offered but I have notes only on some of the more attractive ones. There have been some fine and rather unusually attractive, gemmy, pale amethyst groups in short stubby crystals very much resembling the ones from Guerrero, Mexico. The locality was stated as Sverdlovsk, Russia. Similarly, some very pretty octahedral green fluorite specimens—slightly "etched" but somewhat less so than the Rock Candy mine, Canadian ones, but a deeper green color. Crystals ranged to 2 cm and were labeled Tetiukhe, Russia. There have been shown some fine celestine crystals in geodes similar to the Madagascar specimens but the crystals are contained in what appears to be a red rhyolite matrix. The color combination was especially pleasing as the rather gemmy blue celestine crystals, 1 to 2 cm in length, contrasted nicely with the light to dark pink geodes. The geodes were on the smallish side, being from 6 to 18 cm in diameter. Source was stated as Kirghistan, Russia. A few emerald specimens, mostly crystals and of fair to pretty good quality, comprised another offering and one large, doubly terminated crystal 6 cm in diameter by 9 cm length, labeled Miask, Russia, was the best of the lot at a moderate price. The last of the more attractive minerals, these all on one dealer's table, were some rather good apatite crystals contained in a calcite matrix, semi-gemmy and up to 3 or 4 cm in length, labeled simply Russia. They resembled very much the Ontario, Canada, apatite except the colors varied from an attractive deep green to blue-green. Some of the crystals were definately of faceting quality. A selection of other specimens included prehnite, magnetite, sphaerosiderite and andradite all marked simply "Russia." The dealer did explain that he was having trouble with the Russians as far as labeling was concerned. For the most part, the latter specimens were average or below average in quality, some moderately damaged, but prices did run on the cheaper side.

At one show there was a single specimen of dioptase on another dealer's table that was somewhat startling. It was labeled Kirghese Steppes, Siberia, U.S.S.R., a locality well documented in the literature. It appeared to be an almost exact duplicate of a Tsumeb specimen with its bright, densely packed, 1 to 2 mm gemmy green crystals and was most attractive. It also appeared to have been freshly mined. When questioned the owner was rather positive of the source but suspected it was "an older piece." Can any of you readers shed any further light on Russian dioptase?

While on the subject of Russian minerals I should mention that for about a year now there have been a few offerings of diamond crystals in kimberlite matrix labeled either Myr pipe, Yakutsk, Russia, or Adolfskoi River, Ural Mountains, Russia. I am not sure if they are the same or different sources and I have only had the opportunity to examine some dozen or so Myr pipe specimens offered by a dealer from London, which is apparently the Russian dumping ground for all of these specimens and certainly the cheapest source. For sure they appear to be genuine (unglued) matrix specimens, this in itself a rarity.

Although the prices of each specimen were the same, the quality was widely variable from fair to very good. The single white octahedral diamond crystal contained in each matrix ranged in size from ½ to 1½ cts, gemmyness from fair to good and at least two of the crystals were beautifully twinned. The cubic diamond crystals are the tough ones to find, by the way, in or out of matrix. Prices were (to me) somewhat expensive so I passed up the opportunity to do some profitable highgrading. Incidentally, in discussing these specimens with members of the ETH (University of Zurich) mineralogical staff sometime later, I was informed that over a period of many years, to date, they had examined 146 "diamonds in matrix" submitted by various parties, (but not this new Russian material), and all had proved to be fake.

It was a sort of ho-hum summer in Europe as far as minerals were concerned but the big fall season is just about to descend upon us as I write this. Yet, there is some "news" which, while unspectacular, will (I hope) be of interest. France's St. Marie Aux Mines show was well attended and the dealers, mostly French and Belgian, did have some fresh offerings, mostly from overseas. One of the surprises was a bit more of that fine rich green pyromorphite from France's Mine des Farges (the *Record*, vol. 8, p. 404), but prices have gone out of sight and at least one American dealer who was offered a few specimens passed them up. They appeared to be from the original pocket found early in 1977 (possibly held back or recirculated specimens but no one is talking about it). The world can certainly use more of them—an estimated 100+ specimens came out of the original pocket—but it will take a sizable "hit" again to bring the prices in line with weak U.S. dollars.

At St. Marie there were some very fine Madagascar tourmalines, principally single crystals. Cut and polished slabs were also available from the single French dealer who seems to be the only person I know of who can manage to annually "get a few of them out" of Madagascar. The removal of gem rough from that country is reportedly prohibited. Crystals were generally small, ranging from 1 to 3 cm in diameter and 2 to 6 cm in length with colors from deep red to dark green and combinations thereof. There was one particularly striking combination called "raspberry" tourmaline. The top halves of the crystals were a rich raspberry color while the bottom halves were a dark green, giving a rather startling effect even though the crystals themselves were more or less opaque. The cut and polished slabs were simply gorgeous, ranging to all color combinations, including yellow-green and pink and up to 20 cm in diameter. They had been cut and polished in Madagascar and were presumably exported legally as this is the only way, i.e. as a finished product, that Madagascar, as well as some of the other African countries, want to utilize their native gem minerals. It was rather obvious that they had yet to invest in suitable machinery and develop a better skill to satisfy the jewelry trade, but most were quite acceptable as collector slabs. All of the slabs were richly color-zoned and many showed the rarely seen internal rounded triangular shape characteristic of a crystal which progressively grew from this exterior shape to the more common hexagonal form.

A bit more of that fabulous "cranberry tourmaline" from Itatiaia (say that fast!), Minas Gerais, Brazil, (the *Record*, vol. 9, pages 298 and 317) has appeared on the European scene, this the result of second-round trips to Brazil by several dealers. Unfortunately for the collector and the faceter, the prices in Brazil for this material are even higher than shortly after its discovery and good facet-grade rough is now more than double the original price. I am told that most of the material remaining in Brazil is being held off the market in anticipation of even higher prices when the material becomes better known and the demand builds up. The descriptions of the several large specimens removed intact seem to be many and varied, as was rather obvious in the write-ups in the last *Record*, including mine. The dimensions of the so called "rocket," according to the latest word I have

(sorry, still no photos allowed), are 1.07 meters long by approximately 30 cm average diameter—truly a monster crystal! Pushing my calculator a bit I come up with the fact that this giant crystal weighs approximately 235 kgs (518 pounds) or 1,175,000 carats. Therefore the price of a million dollars for the specimen calculates to be about 85 cents per carat—certainly very cheap if it is as gemmy as it is said to be. Wouldn't it be great if some benefactor were to step forward, put up the million dollars and lodge this one at the Smithsonian? Any takers?

Japanese minerals have only occasionally shown up on the European circuit but are now being offered in increasing numbers and varieties, stimulating considerable interest, particularly from species or historical specimen collectors. Some rather attractive specimens from the "Tanaka collection" (Tokyo) are around and consist mainly of good examples from now defunct mines—some, indeed, quite ancient by our thinking. They include marvelous groups of quartz (most of "Tessin habit") with extremely bright, sharply cubic pyrite, large brassy chalcopyrite (many twinned) and very attractive, well-formed, shiny black, sphalerite (marmatite) crystals up to 5 cm across from the Oppu mine, Aomori Prefecture. Also from the same mine are really attractive drusy coatings of rich, deep red rhodocrosite, often partially coating ½ to 1 cm bright chalcopyrite crystals, sometimes on marmatite. The Germans call this rhodocrosite *himbeerspat* which, loosely translated, means raspberry spar, and prize them very highly. Incidently, one of the most expensive Japanese minerals is galena which is very rare there. The main source was the Oizumi mine, in Yamagata Prefecture, which produced small plate-like groups of ½ to 2½ cm blocky crystals, most on the dullish side, occasionally semi-bright. A few are available over here. On the rare minerals side, specimens such as sugilite and the rare zeolite yugawaralite (the *Record* vol. 9, p. 296) are sometimes available.

Should you ever visit Japan you will find it a fine place for rare minerals, also for trading. The Japanese are very serious collectors and tend to treat all mineral specimens the same regardless of their condition. I remember a day in Tokyo several years ago when I was trying to fathom the price structure of two groups of Oppu mine pyrite from a shopkeeper. The two groups were nearly identical in size and shape, one was bright and undamaged while the other was on the dullish side with quite a few dings—yet both were the same price. His answer to my question "why" was simply "but both are from the same mine." Obviously I bought the "best" piece. It was on this trip that I managed to trade one of those other Japanese rarities, a pale amethyst quartz group about 30 cm across with 2 to 5-cm, sharply tapered crystals which were, in turn, studded all over with tiny, sharp, milky-white, 1 to 2 mm quartz crystals. The piece was from the famous old Tomii mine in Tochigi Prefecture and had been extracted around the year 1760. It took a whole night of haggling to trade it from the private collector who initially did not want to part with it.

The preservation of the history of mineral specimens in Japan simply amazes me, particularly among the amateur collectors. During subsequent trips to Japan I was able to trade a vial of about 50 approximately 2 mm calcite spheres taken from the Yumata hot springs in Honshu over 90 years ago. Similarly I acquired a pair of rare, 2-cm, floater pseudo-rhombohedral crystals of pyrite from the old Akatami mine, Fukui Prefecture, extracted over 85 years ago, and several giant sphalerite crystals including one weighing over 700 grams (Over 1½ lbs.) taken from the old Ari mine in Akita Prefecture about 1850. The rediscovery of these crystals was an amazing piece of detective work. The mineralogy teacher from whom I obtained some of these sphalerite crystals usually spent his summers roaming the districts of Japan searching for minerals, this a task in itself. While perusing some 100-plus year old newspapers in Tokyo's central library he ran across a story that intrigued him. It concerned an old miner (whose name was mentioned) who, back around 1850, discovered a mysterious, large, isolated, hollow geode about a meter in diameter deep in the then working Ari mine in Akita Prefecture. When the geode was subsequently hauled to the surface and broken open about 20 huge sphalerite crystals were found which, at the time, were among the world's largest. It appeared that the miner had been allowed to keep most of the crystals and, though long dead, the mineralogist figured that certainly the crystals would have been preserved by the miner's survivors in the Japanese tradition. A check with major museums and universities in Japan revealed that none of the specimens had been preserved for posterity. During the next several years he roamed the numerous villages in the Ari mine area inquiring from house to house hoping somehow to turn something up. Eventually he did find the miner's grandson, now quite an old man himself, whom he recognized by the dozen or so large, dust-covered sphalerite crystals resting on a shelf in the man's humble shack. He managed to gradually acquire most of them and at ever increasing prices. He retained the best one for his collection and traded others to several interested museums who wanted to preserve these historical specimens. Minerals "with a story" have always intrigued me and I hope this story has been of interest to you too.

The main problem in visiting Japan is the language. I found that while most serious collectors do read and understand a bit of "mineralogical English," the speaking of it is quite a struggle, particularly during a trading session. Mineral shops are difficult to find in Tokyo—I only located one in several trips a few years back, but in Kyoto there were 4 or 5 as I remember. I did find the Japanese rather "immovable objects" both in trading and selling and it is best to accept the more or less moderate Japanese values. Contact with the "Mineralogical Society of Japan" in Tokyo can be of some help in locating shops and collectors, and the concierge at your hotel can be extremely valuable in all aspects of your search.

A Yugoslavian friend recently reported with much sadness that the famous Idria mine on Mt. Avala near Belgrade, in the province of Slovenia, has been closed. The mine had been worked almost continuously since 1470 for commercial cinnabar but it has produced some cinnabar crystals of excellent quality which have more than rivaled the better known crystals from the Spanish deposit at Almaden for brilliance and size. They have always been elusive but occasionally are seen at the European bourses with brilliant trigonal crystals ranging to over 1 cm. Seems like most mercury mines date pretty far back—Almaden has been worked for over 2000 years, still goes on, and there are records of the Spanish having delivered over 4,500 tons (we presume metric) to the Romans in 100 BC! I would sure like to know "the story" on the Chinese cinnabar mines. Can anyone help here?

Incidentally, most Yugoslavians we have met are deeply proud of their country's few collector minerals, are very friendly and anxious to meet (and trade) with "outsiders." Their beautiful Trepča (in the ancient country of Serbia, South Yugoslavia) minerals continue to flow in reasonable quantities into Europe and at steadily increasing prices, but are still eagerly scooped up, particularly by the German and Swiss collectors. I have often wondered why the Trepča minerals are so little appreciated in the American market—perhaps it is because of their vague similarity to their lower cost brothers from Naica, Mexico? They happen to be one of my favorite collector groups and, in particular, the Trepča sphalerite groups with their jet-black, sharply formed shiny crystals ranging to over 5 cm, usually associated with shiny galena, twinned chalcopyrite, pyrite, pyrrhotite, arsenopyrite (among the world's best); also quartz, calcite (look for the s-shaped formations and black ones), barite and occasionally fluorite. Tops in my book, however, are the sphalerite groups topped with deep rich pink, bladed rhodocrosite groups or chain-like formations.

The mine at Mežica (sometimes called Mies), Slovenia, Yugoslavia, has been best known for the 1 to 2-cm, platy, opaque, intergrown, yellow wulfenite crystal groups it has sporadically produced over the past few years. Usually they are rather badly damaged as extraction of an intact matrix specimen is virtually impossible from the nearly full small pockets in which they are found, and have been

of interest principally to the locality collectors. Recently a couple of Yugoslavian amateurs exploring the mountains rising some 1000 feet above the commercial mine hit several pockets of a similarly colored wulfenite which was indeed attractive and different. The 3 to 5 mm opaque wulfenite crystals were more of an orange-yellow color, barrel-like in shape, and were attractively sprinkled on a drusy white calcite matrix. Some specimens also showed deposits of small, secondarily crystallized white to clearish calcite rhombs to further add to their attractiveness.

Incidently, a few superb matrix specimens of deep green, well-terminated gemmy vivianite crystals from Trepča, Yugoslavia, were being offered by one dealer at the bourses this past summer with the monoclinic crystals ranging from 2 to 10 cm in length, but the prices went up to the kilobuck region. Frankly I prefer the much cheaper Bolivian ones which are now showing up in reasonably quantity, but admittedly most of the matrix specimens run to a cm or less in crystal length. Yugoslavia, by the way, is the only eastern European country to put on a mineral bourse and each year in May a small but growing bourse is held in Trzic, northern Slovenia, just over the border from Klagenfurt, Austria, and about 30 miles north of Ljubjana. Tržič should not be confused with Trzec which lies some 75 miles northwest of Ljubjana. The pickings have been somewhat slim from what I have heard, but for traders the going is better as a number of collectors have been coming over from the normally unreachable areas of Hungary, Czechoslovakia, Romania and even Bulgaria. Best bet for Yugoslavian minerals for the collector are the Adriatic coast tourist shops during the summer, but dealers will have a problem—Trepča visits are taboo and the export of minerals from Yugoslavia remains illegal. A friend of mine had a brand new Mercedes Benz confiscated at the border when he was picked up with a trunkful of Trepča material! Contrary to what you may have read, Yugoslavia is a beautiful and friendly country to visit, inexpensive, and with particularly fine coastal and inland fishing, which happens to be another of my several hobbies!

Here is a final update on the fall and early winter European mineral bourses. Note that this list supplements the one in my previous column (MR vol. 9, p.) and check out any marked "usually" as the exact date has not been released as of this moment. Some will have passed by the time you read this, but remember them for next year. Switzerland: Bern (Oct. 15), Zurich (Nov. 11–12), Basel (Dec. 9–10); Germany: Koblenz (Oct. 22), Munich (Oct. 27–29, to the general public Oct. 28–29), Hannover (Nov. 4–5), Berlin (Nov. 18–19), Hamburg (Nov. 24–26), Karlsruhe (near Frankfurt–Dec. 17). Also Paris, France (Dec. 2–3) *usually*, Liege, Belgium (Nov. 18–19) and Amsterdam, Holland (Nov. 26). There are a number of other bourses in France, also Italy—the big one in Torino, for example; but dates are still unavailable. Following December there are no major bourses or shows in Europe until spring time. Hope you can make one!

I am sorry to have to disappoint you about the "blood red anatase" I teased you with in my last column, but the "expedition" which set out for this locality has not reported back yet! Hopefully next time. Until then, think young.

Cheers,

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Glossary Update

Third list of additions and corrections to *Glossary of Mineral Species, 1975*

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Previous lists have been published in *Mineralogical Record* **7**, 91–95 (1976) and **8**, 398–399 (1977). Since then descriptions of 100 new minerals have been published and new data have caused many changes of formulas or symmetry. In addition, the I.M.A. Subcommittee has published its report (Hogarth, *American Mineralogist* **62**, 403–410 (1977)) on the classification and nomenclature of the pyrochlore group, which requires many changes in nomenclature.

Reprints of the earlier updates, in booklet form, are available from the *Mineralogical Record* for 30¢ in stamps.

new mineral names in **bold**.
*mineral name changes

Page

1 Achrematite = a mixt. of Mimetite and Wulfenite, *62*, 170 (1977)
1 Afghanite, change formula to $(Na,Ca,K)_8(Si,Al)_{12}O_{24}(Cl,SO_4,CO_3)_3 \cdot H_2O$
2 **Albrittonite**, $CoCl_2 \cdot 6H_2O$, mon., magenta to reddish-violet, *63*, 410–412 (1978)
2 **Aleksite**, $PbBi_2Te_2S_2$, ps. trig.
3 Allopalladium = Stibiopalladinite, *63*, 796 (1978)
5 Annite, $KFe_3^{+2}(AlSi_3)O_{10}(OH,F)_2$, mon., Mica Group
5 Antarcticite, change hex. to trig.
6 Apophyllite, a Group name including Fluorapophyllite and Hydroxyapophyllite
6 **Archerite**, $(K,NH_4)H_2PO_4$, tet., compare Biphosphammite, *62*, 1057 (1977)
6 **Arcubisite**, Ag_6CuBiS_4, *63*, 424 (1978)
6 Aristarainite, change formula to $Na_2MgB_{12}O_{20} \cdot 8H_2O$
6 Armenite, change formula to $BaCa_2Al_6Si_9O_{30} \cdot 2H_2O$, hex., Osumilite Group
7 **Arsenbrackebuschite**, $Pb_2(Fe,Zn)(AsO_4)_4 \cdot H_2O$, mon., light brown to yellow
7 **Arsenuranospathite**, $HAl(UO_2)_4(AsO_4)_4 \cdot 4OH_2O$, orth., ps. tet., pale yellow, Mineral. Mag. *42*, 117–128 (1978)
9 **Bahianite**, $Al_5Sb_3O_{14}(O,OH)_2$, mon., Mineral. Mag. *42*, 179–182 (1978)
10 Baricite, change formula to $(Mg,Fe)_3(PO_4) \cdot 8H_2O$
10 *Bariomicrolite, $Ba(Ta,Nb)_2(O,OH)_7$, cub. Pyrochlore Group, *48*, 1415 (1963), add *62*, 403–410 (1977), formerly called Rijkeboerite
10 *Bariopyrochlore, $(Ba,Sr)_2(Nb,Ti)_2(O,OH)_7$, cub., Pyrochlore Group, *44*, 1324 (1959), formerly called Pandaite
10 Barrerite, change formula to $(Na,K,Ca)_2Al_2Si_7O_{18} \cdot 7H_2O$
10 **Bartonite**, $K_3Fe_{10}S_{14}$
10 **Bastnaesite-(La)**, $(La,Ce)CO_3F$, hex.
11 Bazirite, change trig. to hex.
11 Benitoite, change trig. to hex.
11 Berborite, change hex. to trig.
12 Beta-fergusonite, see Fergusonite, beta
12 Beta-fergusonite-(Ce), see Fergusonite, beta-(Ce)
12 Betafite, $(Ca,Na,U)_2(Ti,Nb,Ta)_2O_6(OH)$, cub., Pyrochlore Group, *46*, 1519 (1961)
13 **Bilibinskite**, $Au_3Cu_2PbTe_2$, ps. cub.
13 Bilinite, change formula to $Fe^{+2}Fe_2^{+3}(SO_4)_4 \cdot 22H_2O$
13 Birnessite, change to $Na_4Mn_{14}O_{27} \cdot 9H_2O$, orth.
14 *Bismutomicrolite, $(Bi,Ca)(Ta,Nb)_2O_6(OH)$, cub., Pyrochlore Group, *48*, 215 (1963) formerly called Westgrenite
14 Bloedite, add compare Nickelbloedite
15 Bournonite, add forms a series with Seligmannite
15 **Boyleite**, $(Zn,Mg)SO_4 \cdot 4H_2O$, mon.
15 Bracewellite, add *62*, 593 (1977)
15 **Brenkite**, $Ca_2F_2(CO_3)$, orth.
16 *Brindleyite, $(Ni,Mg,Fe^{+2},Al)_3(Si,Al)_2O_5(OH)_4$, mon. and trig., dark yellowish-green, Kaolinite-Serpentine Group, *63*, 484–489 (1978), formerly called Nimesite
16 Britholite, change formula to $(Ce,Ca)_5(SiO_4,PO_4)_3(OH,F)$, hex., Apatite Group
16 Britholite–(Y), change formula to $(Y,Ca)_5(SiO_4,PO_4)_3(OH,F)$, hex., Apatite Group, syn. Abukumalite
17 **Buchwaldite**, $NaCaPO_4$, orth., *62*, 362–364 (1977)
17 Bukovite, add compare Thalcusite
17 **Burangaite**, $(Na,Ca)_2(FE,Mg)_2Al_{10}(PO_4)_8(O,OH)_{12} \cdot 4H_2O$
18 Cafarsite, change formula to $Ca_3(Ti,Fe^{+2},Fe^{+3},Mn^{+2},Mn^{+3})_4(AsO_3)_6 \cdot 2H_2O$
19 **Canavesite**, $Mg_2(CO_3)(HBO_3) \cdot 5H_2O$, mon., Can. Mineral. 16, 69–73 (1978)
21 *Ceriopyrochlore, $(Ce,Ca,Y)_2(Nb,Ta)_2O_6(OH,F)$, cub., Pyrochlore Group., *62*, 403–410 (1977), formerly called Marignacite
21 **Cernyite**, $Cu_2(Cd,Zn)SnS_4$, tet., Can. Mineral. *16*, 139–146 (1978)
21 Cerolite, also Kerolite = change to a mixt. of a Serpentine mineral plus a Talc-like mineral
21 Ceruleite, add *62*, 598–599 (1977)
22 **Chabourneite**, $(Tl,Pb)_5(Sb,As)_{21}S_{34}$, tric.
23 **Changbaiite**, $PbNb_2O_6$, trig.
23 **Chantalite**, $CaAl_2(SiO_4)(OH)_4$, tet.
23 Chenevixite, add compare Luethite
24 **Christite**, $HgTlAsS_3$, mon., crimson to bright orange, *62*, 421–425 (1977)
24 Chudobaite, change formula to $(Mg,Zn)_5H_2(AsO_4)_4 \cdot 10H_2O$, add *62*, 599 (1977)
25 **Claringbullite**, $Cu_4Cl(OH)_7 \cdot 1/2H_2O$, hex., blue, *63*, 793, (1978)
25 Clinoeulite = magnesian Clinoferrosilite
26 **Cl-tyretskite**, $Ca_2B_5ClO_8(OH)_2$, trimorph. with Hilgardite and Parahilgardite, *63*, 598 (1978)
28 Crichtonite, add compare Loveringite
31 Davreuxite, $Mn_2Al_{12}Si_7O_{31}(OH)_9$, mon. (revalidated)
31 Deerite, change formula to $Fe_6^{+2}(Fe,Al)_3Si_6O_{20}(OH)_5$, mon., ps. orth., *50*, 278 (1965), *62*, 1262 (1977)
32 Derbylite, add *62*, 396 (1977)
32 Deweylite = Change to a mixture of Chrysotile or Lizardite plus a Talc-like mineral
33 Dixenite, change formula to $Mn_{11}^{+2}Mn_4^{+3}(AsO_3)_6(SiO_4)_2(OH)_8$, trig., *6*, 93, (1921), add *63*, 150–159 (1978)

33 Djalmaite, name changed to Uranmicrolite, *62*, 403–410 (1977)
33 **Downeyite**, SeO_2, tet., *62*, 316–320 (1977)
34 Eakerite, change formula to $Ca_2SnAl_2Si_6O_{18}(OH)_2 \cdot 2H_2O$, add *61*, 956–962 (1976)
34 Eardleyite = Takovite, *62*, 449–464 (1977)
34 Earlandite, change ref. to *22*, 71 (1937)
35 Eglestonite, add *62*, 396 (1977)
35 Elbaite, add forms a series with Dravite
35 **Ellisite**, Tl_3AsS_3, *63*, 720 (1978)
35 Ellsworthite = Uranpyrochlore, *62*, 406 (1977)
35 **Emeleusite**, $Na_4Li_2Fe_2^{+3}Si_{12}O_{30}$, orth., ps. hex., Mineral. Mag. *42*, 31–34 (1978)
35 Englishite, change formula to $K_4Na_2Ca_9Al_{18}(PO_4)_6(PO_3OH)_{12}(OH)_{36} \cdot 8H_2O$
36 Erionite, change formula to $(K_2,Ca,Na_2)_2(Al_4Si_{14})O_{36} \cdot 15H_2O$, add *61*, 853–863 (1976)
36 Erlichmanite, add forms a series with Laurite
37 **Eskimoite**, $Ag_2Pb_{10}Bi_{15}S_{36}$, mon.
38 Fairchildite, add dimorph. with Buetschliite
38 Falcondoite, change formula to $(Ni,Mg)_4Si_6O_{15}(OH)_2 \cdot 6H_2O$
38 Ferchevkinite (=ferrian Chevkinite), *63*, 424 (1978)
38 *Fergusonite, beta, $YbNbO_4$, mon., dimorph. with Fergusonite.
38 *Fergusonite,beta–(Ce),$(Ce,La)NbO_4$, mon., *60*, 485 (1975), *62*, 397 (1977)
39 Feroxyhyte, add *62*, 1057 (1977)
39 *Ferrifayalite (=Laihunite), *63*, 424–425 (1978)
40 **Fletcherite**, $Cu(Ni,Co)_2S_4$, cub., steel-gray, Linnaeite Group, *62*, 1057 (1977)
41 **Fluorapophyllite**, $KCa_4Si_8O_{20}(F,OH) \cdot 8H_2O$, tet., forms a series with Hydroxyapophyllite, Apophyllite Group, *63*, 196–202 (1978)
41 **Franzinite**, $(Na,Ca)_7(Si,Al)_{12}O_{24}(SO_4,CO_3,OH,Cl)_3 \cdot H_2O$, hex., Cancrinite Group, *62*, 1259 (1977)
42 **Friedrichite**, $Pb_5Cu_5Bi_7S_{18}$, orth., Can. Mineral. *16*, 127–130 (1978)
42 **Fukalite**, $Ca_4Si_2O_6(CO_3)(OH,F)_2$, orth.
42 **Furongite**, $Al_2(UO_2)(PO_4)_2(OH)_2 \cdot 8H_2O$, tric., bright yellow to lemon-yellow, *63*, 425 (1978)
42 **Gadolinite–(Ce)**,$(Ce,La,Y)_2FeBe_2Si_2O_{10}$, mon., *63*, 188–195 (1978)
42 Galeite, change hex. to trig.
43 Galkhaite, change formula to $(Hg,Cu,Zn)_{12}TlAs_8S_{24}$
43 Ganomalite, change formula to $Pb_6Ca_4Si_6O_{21}(OH)_2$
43 **Gatumbaite**, $CaAl_2(PO_4)_2(OH)_2 \cdot H_2O$, mon., *63*, 793–794 (1978)
43 **Genkinite**, $(Pt,Pd)_4Sb_3$, tet., Can. Mineral. *15*, 389–392 (1977)
44 **Gianellaite**, $Hg_4N_2(SO_4)$, cub., *62*, 1057 (1977)
45 Glaucokerinite, in formula change $(Cu,Zn)_{10}$ to $(Zn,Cu)_{10}$
45 Glockerite = Lepidocrocite, *62*, 599–600 (1977)
45 Goongarrite = Heyrovskyite, *62*, 397 (1977)
46 **Goudeyite**, $Cu_6(Al,Y)(AsO_4)_3(OH)_6 \cdot 3H_2O$, hex., yellow-green, compare agardite.
46 Graemite, add *60*, 486 (1975)
46 Grimaldiite, add *62*, 593 (1977)
47 Guanine, add Mineral. Mag. *39*, 889–890 (1974)
47 Guyanaite, add *62*, 593 (1977)
48 Harkerite, change formula to $Ca_{24}Mg_8Al_2Si_8(O,OH)_{32}(BO_3)_8(CO_3)_8(H_2O,Cl)$, add related to Sakhaite, *62*, 263–272 (1977)
49 Hatchettolite = Uranpyrochlore, *62*, 403–410 (1977)
49 **Hatrurite**, Ca_3SiO_5, *63*, 425 (1978)
50 Hematolite, change formula to $(Mn,Mg,Al)_{15}(AsO_3)(AsO_4)_2(OH)_{23}$, add *63*, 150–159 (1978)
51 Heulandite, change formula to $(Na,Ca)_{2-3}[Al_3(Al,Si)_2Si_{13}]O_{36} \cdot 12H_2O$
51 **Hexahydroborite**, $CaB_2(OH)_8 \cdot 2H_2O$, mon., *62*, 1259 (1977)
51 Heyrovskyite, change formula to $Pb_{10}AgBi_5S_{18}$
51 Hilgardite, change dimorph. to trimorph. with Parahilgardite and Cl-tyretskite
52 Holdenite, change formula to $(Mn,Zn,Mg)_9(AsO_4)_2(SiO_4)(OH)_8$, add *62*, 513–521 (1977)
52 Holtite, change formula to $(Ta,Sb,Li)Al_6[(Si,As)O_4]_3(BO_3)(O,OH)_3$
54 **Hydrodresserite**, $BaAl_2(CO_3)_2(OH)_4 \cdot 3H_2O$, tric., Can. Mineral. *15*, 399–404 (1977)
55 Hydrotalcite, add compare Takovite
55 **Hydroxyapophyllite**, $KCa_4Si_8O_{20}(OH,F) \cdot 8H_2O$, tet., forms a series with Fluorapophyllite, Apophyllite Group, *63*, 196–202 (1978)
56 Ilmajokite, change formula to $(Na,Ce,Ba)_2Ti(Si,C)_3O_9 \cdot nH_2O$
56 Incaite, change formula to $(Pb,Ag)_4FeSn_4Sb_2S_{13}$
58 Isoplatinocopper (=platinian Copper), *63*, 426 (1978)
58 **Janggunite**, $Mn_5^{+4}(Mn^{+2},Fe^{+3})O_8(OH)_6$, orth., dark brown, *63*, 426 (1978)
59 Jennite, change formula to $Ca_9H_2Si_6O_{18}(OH)_8 \cdot 6H_2O$, add *62*, 365–368 (1977)
59 Johachidolite, change formula to $CaAlB_3O_7$, orth., *33*, 98 (1948), add *62*, 327–329 (1977)
59 **Jonesite**, $Ba_4(K,Na)_2Ti_4Al_2Si_{10}O_{36} \cdot 6H_2O$, orth., Mineral. Rec. *8*, 453–456 (1977)
60 Jouravskite, change formula to $Ca_3Mn^{+4}(SO_4)CO_3(OH)_6 \cdot 12H_2O$
60 Jurbanite, add dimorph. with Khademite
60 Kalipyrochlore, $(K,Sr)_{2-x}Nb_2O_6(O,OH) \cdot nH_2O$, cub., Pyrochlore Group, *63*, 528–530 (1978)
61 Kankite, add *62*, 594 (1977)
61 **Kanoite**, $(Mn,Mg)_2Si_2O_6$, mon., Pyroxene Group, *63*, 598 (1978)
61 Katoptrite, change formula to $(Mn,Mg,Fe)_{13}(Al,Fe)_4Sb_2^{+5}Si_2O_{28}$, add *62*, 396 (1977)
61 Keldyshite, change formula to $Na_3Zr_2Si_4O_{13}(OH) \cdot nH_2O$
62 Kellyite, change formula to $(Mn^{+2},Mg,Al)_3(Si,Al)_2O_5(OH)_4$
62 Kerolite, also Cerolite, change to a mixture of a Serpentine mineral plus a Talc-like mineral
62 Keyite, add deep-sky blue, mon., Mineral. Rec. *8*, 87–90 (1977)
62 Khademite, add dimorph. with Jurbanite
62 **Kidwellite**, $NaFe_9^{+3}(PO_4)_6(OH)_{10} \cdot 5H_2O$, mon., green to yellow, Mineral. Mag. *42*, 137–140 (1978)
63 Knipovichite, add *61*, 341 (1976)
63 Kolbeckite, change ref. to read *45*, 257 (1960)
63 Kolovratite, change ref. to read *47*, 1222, (1962)
64 Köttigite, add forms a series with Parasymplesite
64 **Kraisslite**, $(Mn,Mg,Zn)_7(AsO_4)(SiO_4)_2(OH)_3$, hex.
65 Krutovite, correct ref. to read *62*, 173–174 (1977)
65 Ktenasite, change formula to $(Cu,Zn)_5(SO_4)_2(OH)_6 \cdot 6H_2O$, add *62*, 1262, (1977)
65 Kulanite, correct ref. to read *62*, 174 (1977)
65 Kusuite, add *62*, 1058 (1977)
65 Laihunite, change formula to $Fe_2^{+3}Fe_3^{+2}(SiO_4)_3$, orth, black, add *62*, 1058 (1977)
66 Landauite, change formula to $NaMnZn_2(Ti,Fe)_6Ti_{12}O_{38}$, trig., black, add *51*, 1546 (1966), Can. Mineral. *16*, 63–68 (1978)
67 Laurite, add forms a series with Erlichmannite
67 Leiteite, mon., correct ref. to read Mineral Rec. *8*, 95–97 (1977), add *62*, 1259–1260 (1977)
68 Leucite, add *61*, 108–115 (1976)
69 **Liddicoatite**, $Ca(Li,Al)_3(BO_3)_3Si_6O_{18}(O,OH,F)_4$, trig., brown, green, pink, red, Tourmaline Group, *62*, 1121–1124 (1977)
69 Liebigite, change formula to $Ca_2(UO_2)(CO_3)_3 \cdot 10H_2O$
69 Likasite, add *63*, 599 (1978)
69 **Liottite**, $(Ca,Na,K)_8(Si,Al)_{12}O_{24}(SO_4,CO_3,Cl,OH)_4 \cdot H_2O$,

hex., Cancrinite Group, *62*, 321–326 (1977)

69 Lithidionite, correct spelling Litidionite

70 **Loveringite**, (Ca,Ce)(Ti,Fe,Cr,Mg)$_{21}$O$_{38}$, trig., compare Crichtonite, Landauite, Senaite, *63*, 28–36 (1978)

71 **Luetheite**, $Cu_2Al_2(AsO_4)_2(OH)_4 \cdot H_2O$, mon., blue, compare Chenevixite, *62*, 1058 (1977)

71 Macdonaldite, change formula to $BaCa_4Si_{16}O_{36}(OH)_2 \cdot 10H_2O$

71 **Machatschkiite**, $Ca_3(AsO_4)_2 \cdot 9H_2O$, trig., *62*, 1260 (1977)

72 Majakite, add *62*, 1260 (1977)

73 Manganese-shadlunite, change formula to (Mn,Pb,Cd)$(Cu,Fe)_8S_8$

73 **Manganhumite**, $(Mn,Mg)_7(SiO_4)_3(OH)_2$, orth., brownish-orange, Humite Group, Mineral. Mag. *42*, 133–136 (1978)

74 **Maricite**, $NaFe^{+2}(PO_4)$, orth., Can. Mineral. *15*, 396–398 (1977)

74 Marignacite, name changed to Ceriopyrochlore, *62*, 406 (1977)

74 Masutomilite, add *62*, 594 (1977)

75 **Matulaite**, $CaAl_{18}(PO_4)_{12}(OH)_{20} \cdot 28H_2O$, mon.

75 Mcconnellite, add *62*, 593 (1977)

75 Mcgovernite, change formula to $(Mn,Mg,Zn)_{22}(AsO_3)(AsO_4)_3(SiO_4)_3(OH)_{21}$, add *63*, 150–159 (1978)

76 **Merlinoite**, $(K,Ca,Na,Ba)_7(Al_9Si_{23})O_{64} \cdot 23H_2O$, orth., Zeolite Group, *63*, 598 (1978)

79 Michenerite, add forms a series with Testibiopalladinite

79 Minyulite, add *62*, 256–262 (1977)

80 Modderite, (Co,Fe)As, *63*, 600 (1978)

80 Monohydrocalcite, change trig. to hex.

81 Mooreite-delta = Torreyite

82 **Motukoreaite**, $Na_2Mg_{38}Al_4(CO_3)_{13}(SO_4)_3(OH)_{108} \cdot 56H_2O$, hex., *63*, 598–599 (1978)

82 Mroseite, add *61*, 339 (1976)

82 **Nagelschmidtite**, $Ca_3PO_4 \cdot 2\,\alpha\text{-}Ca_2SiO_4$, *63*, 425–426 (1978)

82 Nakauriite, add *62*, 594 (1977)

83 **Nanlingite**, $CaMg_4(AsO_3)_2F_4$, trig., brownish-red, *62*, 1058 (1977)

84 **Nickelbloedite**, $Na_2(Ni,Mg)(SO_4)_2 \cdot 4H_2O$, mon., green, compare Bloedite, *62*, 1059 (1977)

85 Nimesite, name changed to Brindleyite, *63*, 484–489 (1978)

85 *Nitratite. $NaNO_3$. trig., formerly called Soda niter

86 Nyerereite, change hex. to orth. ps. hex., add *63*, 600 (1978)

86 Obruchevite, name changed to Yttropyrochlore, *62*, 407 (1977)

87 Olmsteadite, change formula to $K_2Fe_4^{+2}(Nb,Ta)_2(PO_4)_4O_4 \cdot 4H_2O$

87 **Omeiite**, $(Os,Ru)As_2$, orth.

87 Orcelite, change ref. to read *45*, 753–754 (1960)

88 Osarizawaite, add Alunite Group

88 *Osumilite (K,Mg), change to Osumilite-(Mg)

88 **Otwayite**, $Ni_2(CO_3)(OH)_2 \cdot H_2O$, orth., fib., bright green, *62*, 999–1002 (1977)

88 **Ourayite**, $Ag_{25}Pb_{30}Bi_{41}S_{104}$, orth.

89 Pabstite, change trig. to hex.

89 Palladoarsenide, change ref. to read *60*, 162 (1975)

89 **Palladseite**, $Pd_{17}Se_{15}$, cub., *62*, 1059 (1977)

89 Pandaite, name changed to Bariopyrochlore, *62*, 403–410 (1977)

89 **Para-alumohydrocalcite**, $CaAl_2(Co_3)_2(OH)_4 \cdot 6H_2O$, *63*, 794 (1978)

90 Paramelaconite, change formula to $Cu_2^{+1}Cu_2^{+2}O_3$, add *63*, 180–185 (1978)

90 **Parapectolite** = Pectolite–M2abc, *63*, 427 (1978)

90 **Paraspurrite**, $Ca_5(SiO_4)_2(CO_3)$, mon., dimorph. with Spurrite, *62*, 1003–1005 (1977)

90 Parasymplesite, add forms a series with Köttigite

90 Parawollastonite, $CaSiO_3$, mon., trimorph. with Wollastonite and Cyclowollastonite

90 **Parnauite**, $Cu_9(AsO_4)_2(SO_4)(OH)_{10} \cdot 7H_2O$, orth., green to blue, *63*, 704–708 (1978)

91 Parsettensite, (K,Na,Ca) $(Mn,Al)_7Si_8O_{20}(OH)_8 \cdot 2H_2O$(?), mon., ps. hex., *10*, 107 (1925)

91 **Pectolite–M2abc**, $NaCa_2Si_3O_8(OH)$, mon., dimorph. with Pectolite, *63*, 427 (1978)

91 **Penikisite**, $Ba(Mg,Fe)_2Al_2(PO_4)_2(OH)_3$, tric., blue to green, compare Kulanite, Can. Mineral. *15*, 393–395 (1977)

92 **Perhamite**, $Ca_3Al_7(SiO_4)_3(PO_4)_4(OH)_3 \cdot 16\ 1/2\ H_2O$, hex., Mineral. Mag. *41*, 437–442 (1977), *63*, 794 (1978)

92 Perloffite, change ref. to read mon., Mineral. Rec. *8*, 112–114 (1977), add *62*, 1059 (1977)

91 Petrovicite, add *62*, 594–595 (1977)

92 Pharmacosiderite, change formula to $KFe_4(AsO_4)_3(OH)_4 \cdot 6–7H_2O$

93 Phosphuranylite, change formula to $Ca(UO_2)_3(PO_4)_2(OH)_2 \cdot 6H_2O$

93 **Phurcalite**, $Ca_2(UO_2)_3(PO_4)_2(OH)_4 \cdot 4H_2O$, orth.

94 **Platarsite**, $Pt(As,S)_2$, cub., Can. Mineral. *15*, 385–388 (1977)

94 *Plumbobetafite, $Pb_2(Ti,Nb,Ta)_2O_6(OH,F)$, cub., Pyrochlore Group, *62*, 403–410 (1977)

94 *Plumbomicrolite, $(Pb,Ca)_2(Ta,Nb)_2O_6(OH)$, cub., Pyrochlore Group, *62*, 403–410 (1977)

95 Polymignyte, change to Polymignite

95 Potash alum = Potassium alum

95 Potassium alum, $KAl(SO_4)_2 \cdot 12H_2O$, cub.

95 **Poubaite**, $PbBi_2(Se,Te,S)_4$, trig.

97 Pyrochroite, change hex. to trig.

99 Rasvumite, change formula to KFe_2S_3

99 Renardite, add probably = Dewindtite

99 **Rhabdophane–(La)**, $(La,Ce)PO_4 \cdot H_2O$, hex.

99 **Rhenium**, Re

100 Rijkeboerite, name changed to Bariomicrolite, *62*, 403–410 (1977)

100 Robinsonite, add *60*, 621–633 (1975)

101 Roscherite, change formula to $Ca(Al,Fe,Mg)_3Be_2(PO_4)_3(OH)_3 \cdot 2H_2O$ (?), mon. and tric., add *63*, 427 (1978)

101 Rozhkovite, add = palladian Auricupride, *62*, 595 (1977)

101 **Rucklidgeite**, $(Bi,Pb)_3Te_4$, trig., *63*, 599 (1978)

101 **Ruizite**, $CaMn^{+3}Si_2O_6(OH) \cdot 2H_2O$, mon., orange to brown, Mineral. Mag. *41*, 429–432 (1977), *63*, 794–795 (1978)

102 Ruthenium, add *61*, 177 (1976)

102 **Rynersonite**, $Ca(Ta,Nb)_2O_6$, orth., cream-white to reddish pink, *63*, 709–714 (1978)

102 Sakhaite, add related to Harkerite

103 Samiresite = change to plumboan Uranpyrochlore (?), *62*, 407 (1978)

103 Samuelsonite, add *62*, 229–245 (1977)

103 **Sarabauite**, $CaSb_{10}O_{10}S_6$, *62*, 1260 (1977), *63*, 715–719 (1978)

104 Saryarkite, change formula to $(Ca,Y,Th)_2Al_4(SiO_4,PO_4)_4(OH)_6 \cdot 9H_2O$

104 Schafarzikite, change formula to $FeSb_2O_4$

104 Schallerite, change formula to $(Mn,Fe)_8(Si,As)_6O_{15}(OH)_{10}$

105 Scheteligite, reference should be *23*, 293 (1938)

105 Schirmerite, should read, composition varies from $Ag_3Pb_3Bi_9S_{18}$ to $Ag_3Pb_6Bi_7S_{18}$

105 **Schoonerite**, $Fe_2^{+2}ZnMnFe^{+3}(PO_4)_3(OH)_2 \cdot 9H_2O$, orth., brown, *62*, 246–255 (1977)

105 Schreyerite, add *62*, 395 (1977)

106 Segelerite, add compare Overite

106 Seinäjokite, add *62*, 1059 (1977)

106 Sekaninaite, *62*, 395 (1977)

106 Selenolite, supposedly SeO_2, discredited, *62*, 316–320 (1977)

106 Seligmannite, add compare Bournonite

106 Senaite, add compare Landauite, Loveringite

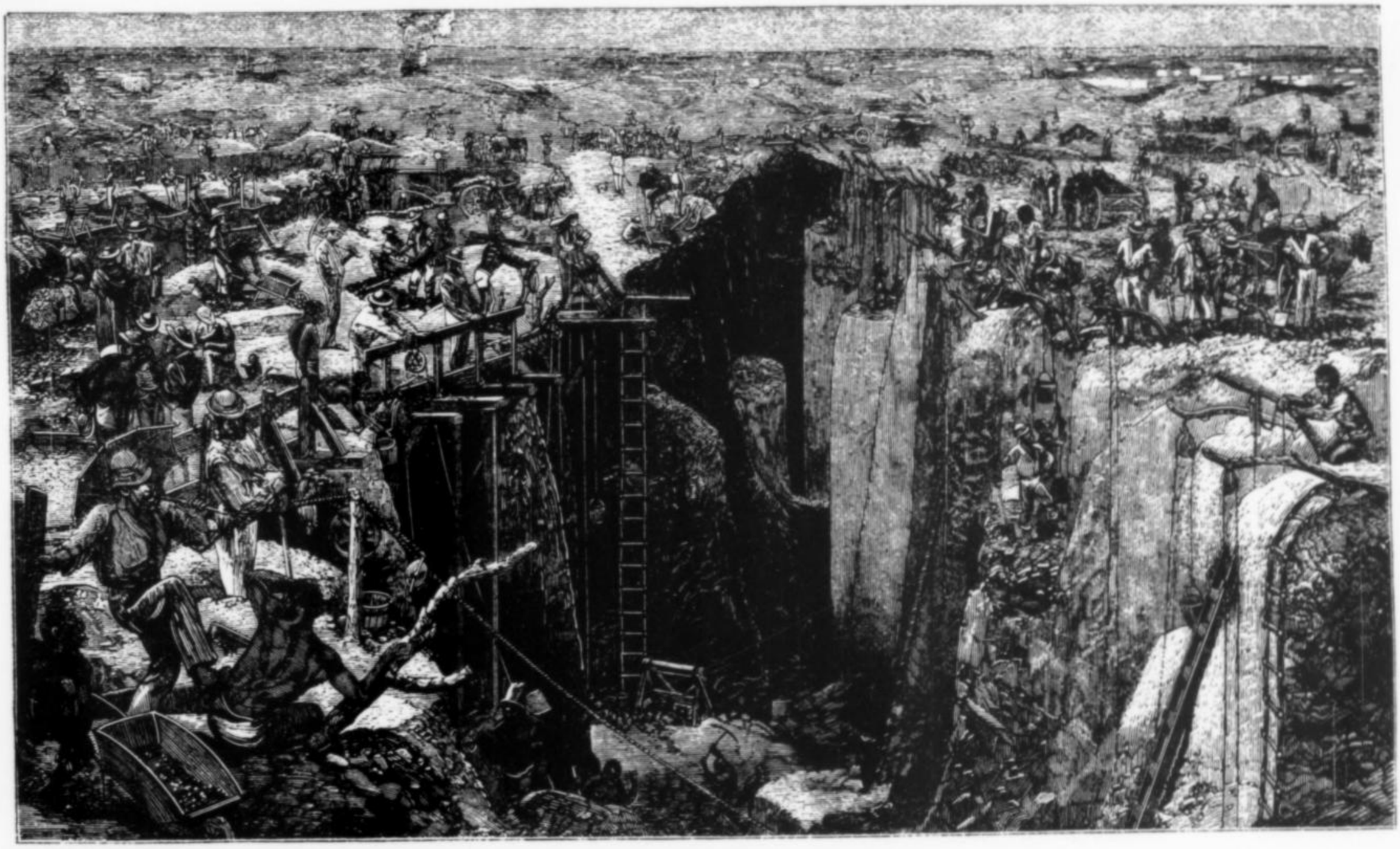
106 Senegalite, add *62*, 595–596 (1977)

108 Sinnerite, add *60*, 998–1012 (1975)
108 **Slavyanskite**, $CaAl_2O_4 \cdot 8–8 \cdot 5H_2O$, tet., *63*, 599 (1978)
108 Slawsonite, add *62*, 31–35 (1977)
109 Smolianinovite, change formula to $(Co,Ni,Mg,Ca)_3(Fe^{+3},Al)_2(AsO_4)_4 \cdot 11H_2O$
109 Soda alum, name changed to Sodium alum
109 Soda niter, name changed to Nitratite
109 Sodium alum, $NaAl(SO_4)_2 \cdot 12H_2O$, cub.
111 Stannoidite, change formula to $Cu_8(Fe,Zn)_3Sn_2S_{12}$
111 *Stannomicrolite, $Sn_2Ta_2O_7$, cub., Pyrochlore Group, formerly called Sukulaite, *53*, 2103 (1968)
111 Staringite, change formula to $(Fe,Mn)_X(Ta,Nb)_{2X}(Sn,Ti)_{6-3X}O_{12}$
111 Stenhuggarite, change formula to $CaFe^{+3}(As^{+3}O_2)(As^{+3}Sb^{+3}O_5)$
112 Stillwaterite, hex., add *62*, 1060 (1977)
112 Stranskiite, change formula to $(Zn,Cu)_3(AsO_4)_2$, add *63*, 213–215 (1978)
112 Stratlingite, add *62*, 395 (1977)
112 **Strontiodresserite**, $(Sr,Ca)Al_2(CO_3)_2(OH)_4 \cdot H_2O$, orth., compare Dresserite,
113 Strunzite, change mon. to tric., Can. Mineral. *15*, 405–407 (1977)
113 Sugilite, change formula to $(K,Na)(Na,Fe^{+3})_2(Li_2Fe^{+3})Si_{12}O_{30}$, add *62*, 596 (1977)
113 Sukulaite, name changed to Stannomicrolite, *62*, 403–410 (1977)
114 Svetlozarite, add *62*, 1060 (1977)
115 Taiyite = Aeschynite–(Y)
115 Takovite, formula changed to $Ni_6Al_2(OH)_{16}(CO_3,OH) \cdot 4H_2O$, add compare Hydrotalcite, *62*, 449–464 (1977)
117 **Texasite**, $Pr_2O_2(SO_4)$, orth., green, *62*, 1006–1008 (1977)
117 Thalcusite, add compare Bukovite, *62*, 396 (1977)
118 **Tlapallite**, $H_6(Ca,Pb)_2(Cu,Zn)_3(SO_4)(TeO_3)_4TeO_6$, mon., green, Mineral. Mag. *42*, 183–186 (1978)
119 **Treasureite**, $Ag_7Pb_6Bi_{15}S_{32}$, mon.
120 Trimerite, change formula to $CaMn_2Be_3(SiO_4)_3$, and tric. to mon.
121 **Tucekite**, $Ni_9Sb_2S_8$, tet., compare Hauchecornite
121 Tuhualite, change formula to $(Na,K)Fe^{+2}Fe^{+3}Si_6O_{15}$, add *62*, 416–420 (1977)
121 **Tuscanite**, $K(Ca,Na)_6(Si,Al)_{10}O_{22}(SO_4,CO_3,OH)_2 \cdot H_2O$, mon., *62*, 1110–1113 (1977)
122 **Tveitite**, $Ca_{1-X}(Y,RE)_XF_{2+X}$, x~0.3, mon., *62*, 1060 (1977) (1977)
122 Tyretskite, change formula to $Ca_2B_5O_8(OH)_2(OH,Cl)$
122 Ullmannite, add tric., ps. cub., *62*, 369–373 (1977)
123 *Uranmicrolite, $(U,Ca)_2(Ta,Nb)_2O_6(OH,F)$, cub., Pyrochlore Group, formerly called Djalmaite, *62*, 403–410 (1977)
123 **Uranospathite**, $HAl(UO_2)_4(PO_4)_4 \cdot 4OH_2O$, tet., yellow, Mineral. Mag. *42*, 117–128 (1978)
123 *Uranpyrochlore, $(U,Ca,Ce)_2(Nb,Ta)_2O_6(OH,F)$, cub., Pyrochlore Group, *62*, 403–410 (1977), formerly called Hatchettolite and Ellsworthite
123 Uricite, add Mineral. Mag. *39*, 889–890 (1974)
123 Urvantsevite, add *62*, 1260–1261 (1977)
125 **Velikite**, $(Cu,Hg)_{5.5}Sn_2S_8$, tet., *62*, 1260 (1977)
125 **Vertumnite**, $Ca_4Al_4Si_4O_6(OH)_{24} \cdot 3H_2O$, mon., *62*, 1061 (1977)
125 **Vikingite**, $Ag_5Pb_8Bi_{13}S_{30}$, mon.
126 **Virgilite**, $Li_XAl_XSi_{3-X}O_6(x=0.5-1)$, hex., *63*, 461–465 (1978)
128 Weibullite, add *62*, 397 (1977)
120 **Weissbergite**, $TlSbS_2$, tric., *63*, 720–724 (1978)
128 **Welshite**, $Ca_2Sb^{+5}Mg_4Fe^{+3}Be_2Si_4O_{20}$, tric., reddish-black, compare Aenigmatite, Mineral. Mag. *42*, 129–132 (1978)
128 Westgrenite, name changed to Bismutomicrolite, *62*, 408 (1977)
129 Wiikite = change to mixt. of Euxenite and Yttropyrochlore, add *62*, 408 (1977)
129 Wittite, add *62*, 397 (1977)
129 Wollastonite, change to trimorph. with Cyclowollastonite and Parawollastonite
129 Wollastonite–2M (=Parawollastonite), $CaSiO_3$, mon., trimorph. with Wollastonite and Cyclowollastonite
130 Woodwardite, add *62*, 599 (1977)
130 **Xiangjiangite**, $(Fe^{+3},Al)(UO_2)_4(PO_4)_2(SO_4)_2(OH) \cdot 22H_2O$, ps. tet., light yellow
130 Xingzhongite, add *61*, 185 (1976)
131 Yeatmanite, add *62*, 396 (1977)
131 **Yftisite**, $(Y,Dy,Er,Yb)_4TiO(SiO_4)_2(F,OH)_6$, orth., *62*, 396 (1977)
131 *Yttrobetafite, $(Y,Ce)_2(Ti,Nb,Ta)_2O_6(OH)$, cub., Pyrochlore Group, *62*, 403–410 (1977)
131 *Yttropyrochlore, $(Y,Na,Ca,U)_{1-2}(Nb,Ta,Ti)_2(O,OH)_7$, cub., *62*, 403–410 (1977), formerly called Obruchevite
131 Yuksporite, add *62*, 1262 (1977)
131 **Zaherite**, $Al_{12}(SO_4)_5(OH)_{26} \cdot 20H_2O$, *62*, 1125–1128 (1977)
131 Zairite, correct ref. to read *62*, 174–175 (1977)
131 **Zektzerite**, $NaLiZrSi_6O_{15}$, orth., Osumilite Group, *62*, 416–420 (1977)
132 Zirkelite, $(Ca,Th,Ce,Zr)(Ti,Nb)_2O_7$, cub., Pyrochlore Group
133 **Zykaite**, $Fe_4^{+3}(AsO_4)_3(SO_4)(OH) \cdot 15H_2O$, orth.
137 Crandallite Group. Formula should be $AB_3(XO_4)_2(OH)_3 \cdot H_2O$ or $AB_3(XO_4)_2(OH)_6$, where A = Ca,Sr,Ba,Pb,Bi,Ce,Th; B = Al, Fe^{+3}, x = P, As
139 Humite Group, add Manganhumite
139 Kaolinite-Serpentine Group, add Brindleyite, delete Nimesite
140 Linnaeite Group, add Fletcherite
141 Mica Group, add Annite
142 Osumilite Group, add Armenite, Emeleusite, Sugilite, Zektzerite
143 PYROCHLORE GROUP.

Formula $A_{1-2}B_2O_6(O,OH,F)$, cub., Fd3m, A = Ca,Na,Ba, Sr,Pb,Ce,Y,U,Th,Sn,Bi,Zr; B = Nb,Ta,Ti, compare Stibiconite Group

Pyrochlore subgroup	Nb > Ta, (Nb+Ta) > 2Ti
Microlite subgroup	Ta > Nb, (Ta+Nb) > 2Ti
Betafite subgroup	2Ti > (Nb+Ta)
Bariomicrolite	Plumbopyrochlore
Bariopyrochlore	Stannomicrolite
Betafite	Uranmicrolite
Bismutomicrolite	Uranpyrochlore
Ceriopyrochlore	Yttrobetafite
Kalipyrochlore	Yttropyrochlore
Microlite	Zirkelite
Plumbobetafite	
Plumbomicrolite	

143 Pyroxene Group, add Kanoite
145 Tourmaline Group, add Liddicoatite
145 Zeolite Group, add Merlinoite



The early diamond diggings in South Africa.

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News from the ROM

by

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On May 11 and 12, 1978, the *Crystal Cave* in the mineralogy gallery was dismantled to make way for the first phase of the ROM's major expansion and renovation program. The history of this exhibit is one of considerable fascination and is worth recording, as it is the only exhibit in the mineralogy gallery to have survived since the late 1930's. It was built by Professor A. L. Parsons, Assistant Director of the Royal Ontario Museum of Mineralogy, a few years after the 1932 wing of the ROM was opened.

Prof. Parsons (1939) records in his description of The Royal Ontario Museum of Mineralogy: "The most recent special exhibit is a reconstruction of a crystal cave. For this an opening was cut through the wall near the northwest corner of the gallery and a special room built. The crystals suspended from the roof and sides and lying on the bottom give a good representation of the way in which these crystals were found. The apparent size of the cave was increased by two mirrors suitably placed. The crystals were obtained by exchange with the New York State Museum and the cave is built on an adaptation of a plan used in such a reconstructed cave in the museum at Albany, New York."

The crystals are calcite from Sterlingbush, Lewis County, New York (a Dana locality), and were acquired in 1934. They are pale mauve-pink in color and vary in size from about 20 cm to over 90 cm. Almost 80 pieces were used to construct the cave, many of them being large crystals with matrix specimens used as "fillers."

The cave was originally illuminated by incandescent light to which long wave ultraviolet was added in 1967. These lights were on a timer which alternated the incandescent with the ultraviolet giving an impressive and mysterious character to the crystals when viewed through the porthole in the main gallery. The cave was about 2.5 m long by 2 m wide and about 2 m high, and has been carefully dismantled so that it can be reassembled in the proposed new gallery of mineralogy and geology. Each specimen was numbered and their positions recorded on the supporting framework using sketches and photographs. The framework itself will be preserved to aid in the reconstruction. Special thanks are due to the ROM preparators, photography department and art department for their meticulous work on this difficult project.

On removing one of the crystals a copy of Toronto's *Globe and Mail* newspaper dated September 8, 1938 was found, thus supporting our guess that it was built between 1937 and 1939.

The job of dismantling the cave was both time consuming and fascinating, and it became immediately apparent that Dr. Parsons had put his whole heart and soul into its construction. The cave has stood for 40 years as a tribute to his brilliant work and has been admired and loved by countless thousands of our visiting public. We all hope that its loss will be only a temporary one and look forward to seeing its rebirth in the coming years.

Reference: PARSONS, A. L. (1939) The Royal Ontario Museum of Mineralogy. *Contributions to Canadian Mineralogy, Univ. of Toronto Studies, Geological Series #42*, 7–22.

Hydroboracite from the Furnace Creek Formation: A Historical Note

by

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Two articles regarding the occurrence of hydroboracite in the Furnace Creek formation of the Death Valley region, California, have appeared in the Mineralogical Record: *Minette and Wilber (1973) and Countryman (1977). Both articles are significant contributions to the mineralogy literature of California. However, both articles include historical references which, though not critical to the mineralogical data presented, require correction. The purpose of this paper is to review additional historical data which may clarify the record.*

First description of hydroboracite

Hydroboracite was described as a new mineral by Hess in 1834: *Annalen der Physik*, Halle, Leipzig, ser.2, **31**, 49. (cited in Palache *et al*. (1951) page 353.)

Early references to occurrence in Death Valley region

The first known published reference to the occurrence of hydroboracite in the Death Valley region was in Esper S. Larsen's classic work, *The microscopic determination of nonopaque minerals* (1921). The hydroboracite used by Larsen in that study is described as from Ryan, California.

The second known reference was Waldemar T. Schaller's article entitled "Hydroboracite from California." This paper was included in the 1928 volume *Festschrift Victor Goldschmidt*, pp. 256–262 (*Festschrift*: "a publication honoring"). The crystal drawing presented by Schaller in that article (Fig. 1) appears also in Palache *et al*. (1951), page 354. It is labeled "Ryan, California."

The source of the material on which Schaller based his detailed determination of optical properties and crystallographic constants of hydroboracite is described in the first paragraph of the *Festschrift* paper:

> A sample of hydroboracite (U.S. National Museum, Nr. 95432) was collected some years ago by Hoyt S. Gale from a place near Ryan, Inyo County, California. The mineral forms radiating fibrous and columnar masses, the largest group being ten centimeters long and half as thick. Most of the material is without definite terminal crystal faces but occasionally in small cavities, some crystals are very well developed. The fibrous masses rest on and seem to grow out of bladed colemanite. The needles of hydroboracite also penetrate and lie in colemanite and from a genetic point of view seem to have formed at the expense of the colemanite. They therefore are later than and seem to have replaced colemanite. a grayish incrustation of calcite is the only other mineral noticed.

Ryan, California

Ryan, California, is on the east side of the southern end of Furnace Creek wash, at the base of the western slope of the Greenwater range; but it hasn't always been there. Originally the town was at the western edge of the Amargosa Valley section of the Death Valley region. It was at the foot of the eastern slope of the Greenwater range, 12 miles southeast of the present site. It was probably this earlier Ryan from which the material studied by Larsen and Schaller came.

During the 1890's and early 1900's the production of the Pacific Coast Borax Company came mainly from its colemanite mines at Borate in the Calico Mountains of San Bernardino County, California. In 1905, as those mines approached the played-out stage, the company started development of its colemanite deposits in the Death Valley area. The first development was at the Lila C. mine, a deposit on the eastern edge of the borate-bearing Furnace Creek formation, which had been acquired in 1884. Ryan (No. 1) was built at this site as a company town and operations headquarters. When the Tonopah and Tidewater Railroad, building north from Ludlow, was completed to Death Valley Junction, a 7-mile railroad spur was built from Ryan to the railhead. By the time ore shipments started, calcined ore had been stockpiled and 3000 feet of shafts, tunnels, and drifts had blocked out enough ore to last several years. The mine was productive until 1915.

By 1913, as the Lila C. approached the mined-out stage, the company started development of its properties in the Furnace Creek area along the base of the western slope of the Greenwater range—the Ryan area of today. Construction of a railroad spur to that site was completed in December 1914, the Lila C. was closed down, and Ryan was moved to its present site.

It is the writer's supposition that the hydroboracite material collected by Hoyt S. Gale and analyzed by Esper Larsen and Waldemar Schaller came from the Lila C. mine. This thesis is based on the following:

(1) Hoyt Gale's studies of the saline deposits of California as a member of the U.S. Geological Survey staff were completed before Ryan was moved to its present site. His last article in this series, "Salines in the Owens, Searles, and Panamint basins, southeastern California," was published in 1915. Studies basic to the publication were necessarily completed several years earlier.

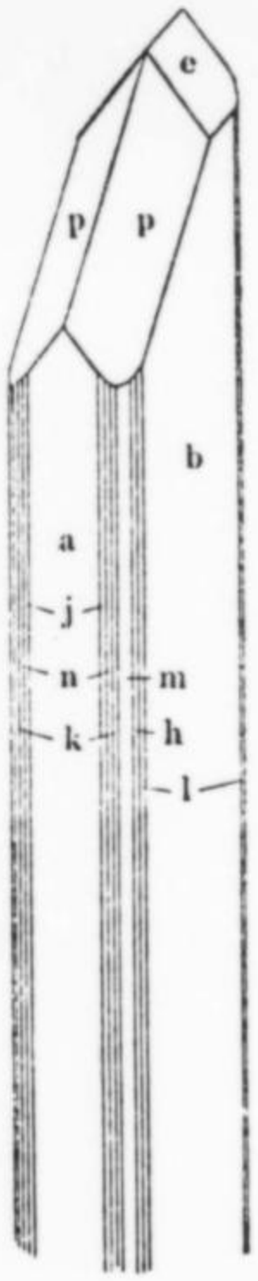

Figure 1 (left). **Crystal drawing of hydroboracite from Ryan, California (from Schaller, 1928).**

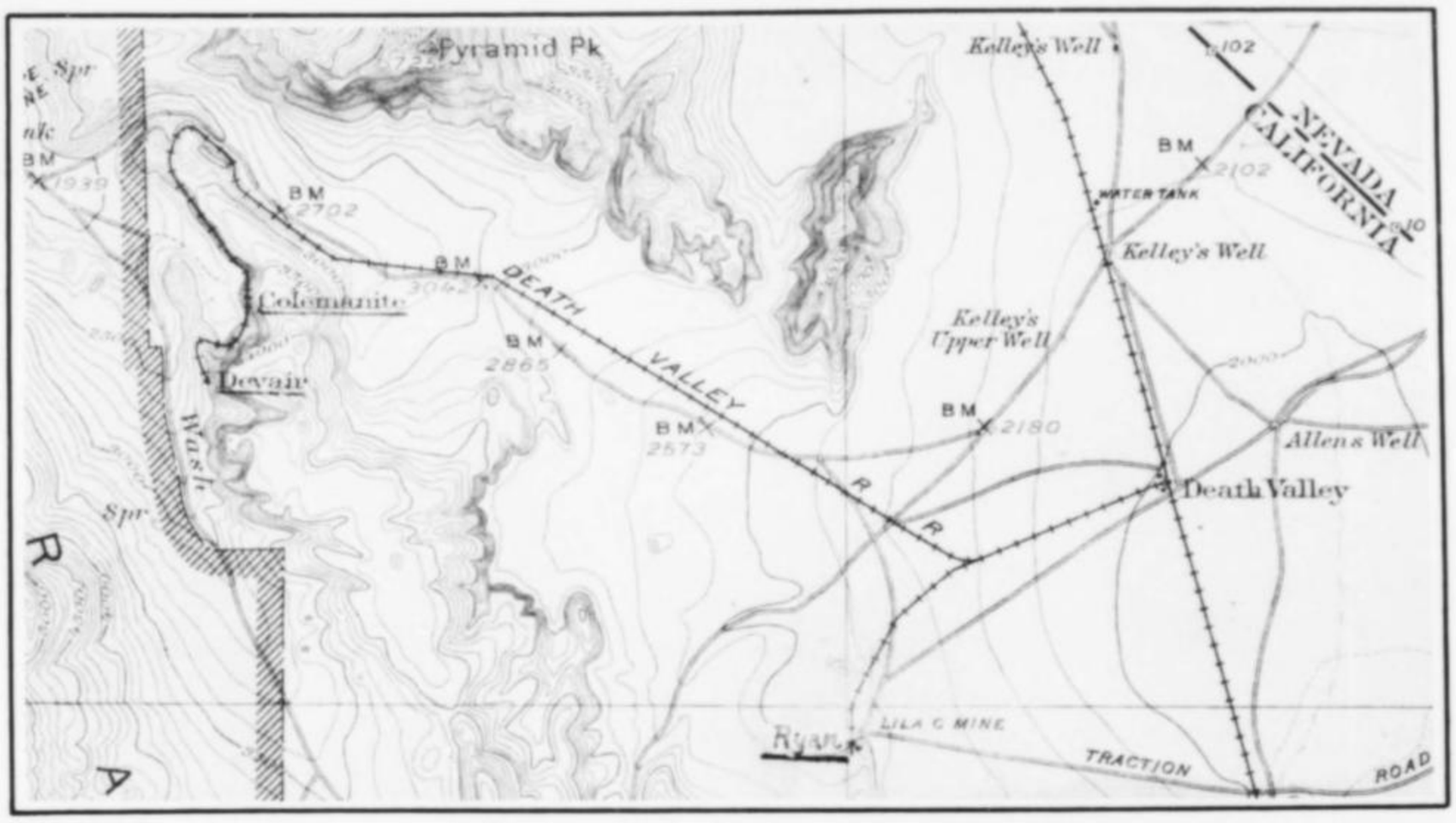

Figure 2 (above). **A section of the Furnace Creek quadrangle (U.S.G.S. map, edition of 1910, reprinted 1947). The culture shown on the map was apparently recorded sometime in 1914 when the route of the railway spur to the new Furnace Creek operations had been surveyed, but before the date in 1915 when the town of Ryan was moved to its present location, shown as "Devair" on this map. The station shown as "Colemanite" was apparently the loading point for ore from an early mine development now referred to as the Played-out mine.**

Figure 3 (below). **The Lila C. mine in 1910, located at the original site of the town of Ryan. (Photo courtesy of U.S. Borax and Chemical Company.)**

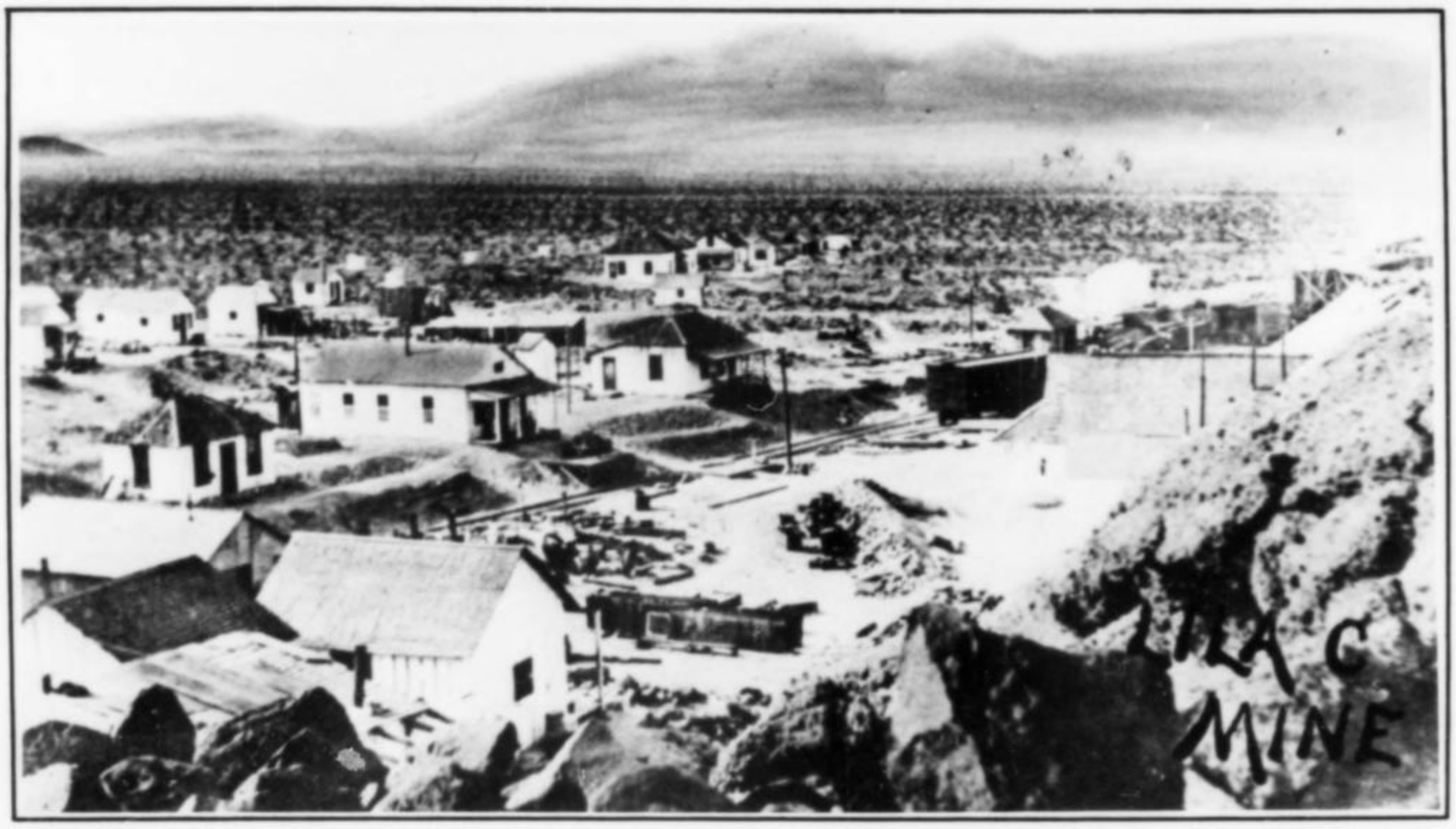

Figure 4 (right). **The original town of Ryan, California, before 1915. (Photo courtesy of U.S. Borax and Chemical Company.)**

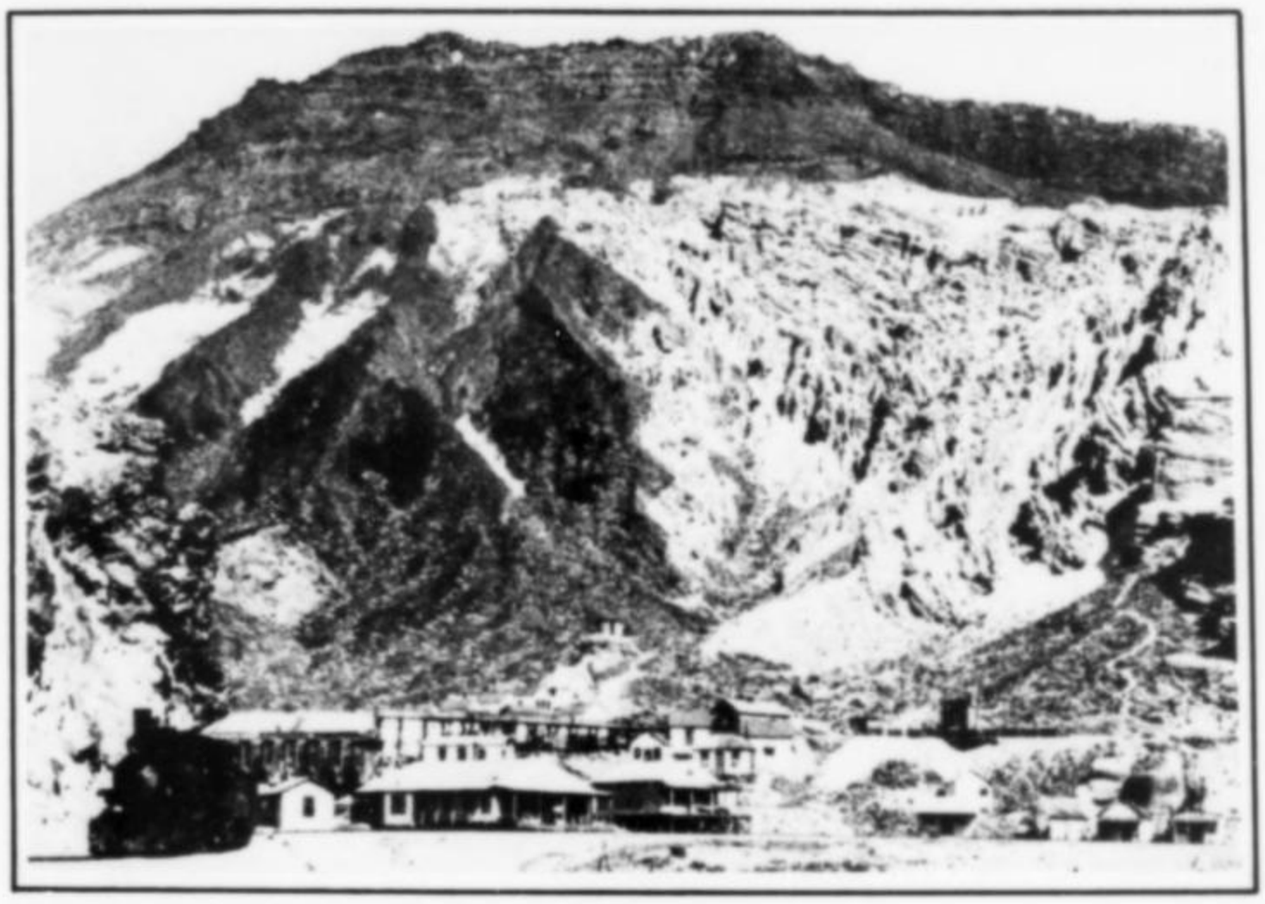

Figure 5. **The town of Ryan, in its second (present day) location, during active mining days. (Photocopy by Charles H. Baines.)**

Figure 6. **The original hydroboracite specimen (Smithsonian #95432) from which Waldemar Schaller obtained the crystals used in his description (1928). The portion of the specimen shown is 3 inches tall. (Photo by Joel E. Arem.)**

(2) Gale's article entitled "The Lila C. borax mine at Ryan California," published in 1912, was his only detailed study of a Death Valley region borate deposit.

(3) Gale probably brought the specimen back to the U.S. Geological Survey offices in Washington. The existence of the specimen was no doubt known to both Lawson and Schaller, who were also members of the U.S.G.S. staff. The specimen provided Larsen with the hydroboracite which might not have been otherwise available from any source for his comprehensive analysis of the nonopaque minerals. Later the material was transferred to the Smithsonian Institution.

Figure 6 shows what the material left from this very significant hydroboracite looks like today, nearly 70 years after it was collected and 50 years after it was studied by Waldemar Schaller. It isn't much of a showpiece now but from Schaller's description it was originally quite a substantial specimen. Perhaps it resembled somewhat the specimens collected from the Terry deposit, which is located only a few miles northwest of the Lila C. site and, like the Lila C., is on the western edge of the Amargosa Valley, and on the eastern edge of the Furnace Creek formation.

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The Record Bookshelf

***The Mineralogy of the Diamond* by Yu. L. Orlov. Published by John Wiley and Sons, 605 Third Avenue, New York, New York 10016 (1977). 235 pages, 6¾ x 9½ inches. Hardcover at $28.50.**

Another book on Diamonds! *The Mineralogy of the Diamond* by Orlov is a very interesting volume. For the serious collector, always seeking to expand her/his knowledge of all minerals, this volume is a most readable work and is neither too light nor too deep for easy reading. It fills a gap between the *Physical Properties of Diamond* (1965), edited by Berman (a more technical compendium) and *Diamonds* (1970) by Eric Bruton (an historical and gemological treatise). The work originally appeared in Russian in 1973, but the English edition has much more recent references and, according to the author, chapter 10 on the genesis of diamonds has been largely rewritten.

The quality of the book is good. It is well-bound, on good quality very white paper with good opacity except in the case of some line drawings of graphs. It lies flat and has adequate margins for notes the owner may wish to make.

The volume is divided into 10 chapters devoted to: varieties of diamond crystals and aggregates; the structure of diamond; chemical composition; structural defects; morphology; properties of diamond; occurrence in nature; inclusions; synthesis; and genesis.

For the mineralogist, the chief advantage of this work is a very large (over 700 entries) bibliography on the literature of diamond, and the organization of the work into well-referenced chapters, instead of a selection of papers on narrow subject areas. For the collector, the book provides a very readable introduction to the state of knowledge about diamonds (the kind of book well-suited to a winter snow-storm refuge) which is full of interesting facts and nicely illustrated with both photographs and drawings of diamond crystals. The drawings are particularly well-done; rather than stiff line drawings, the author has depicted diamonds with very realistic drawings showing a large amount of surface detail.

This is a book we can certainly recommend for the interested crystal collector or diamond fancier. The high price might not be well-received by some collectors in view of the monomineralic nature of the subject matter, but it is still a good investment for the diamond fancier or for a mineral club library.

Pete J. Dunn and Paul Seel

***Kristalle wie sie wirklich sind* ["Crystals as they really are"] by Werner Lieber. Published by Christian Weise Verlag, Oberanger 6, D–8000 Munchen 2, West Germany (1977); 132 pages, 8 x 8½ inches, 128 photographs, 54 in color. Cost: 36.00 DM.**

This is not another pretty picture book, although the photos are indeed beautiful. The author describes the origin of many puzzling crystal characteristics related to form, color and structure. The book is well suited to the finer study of minerals, not only by beginners or advanced collectors but also by the professional as a refresher.

There are three basic chapters: (1) crystal form (with 15 sub-chapters), including discussions of crystal groups, single crystals, etching, curved crystals, and other features. (2) Structure (with 10 sub-chapters), covering early theories, grids, X-ray analysis, radioactivity, curiosities, and other features. Exceptionally well-done diagrams illustrate the structure of tubular-habit minerals. (3) Color (with 11 sub-chapters), explaining idiochromatic and allochromatic characteristics, distribution of color, inclusions, and other concepts.

Although the text is in German, the diagrams and photos are self-explanatory.

Paul Seel

***Murphy's Law and Other Reasons Why Things Go Wrong!* by Arthur Bloch (1977). Published by Price/Stern/Sloan Publishers Inc., 410 North La Cienega Boulevard, Los Angeles, California 90048. Softcover, 96 pages, 5 x 7 inches, $2.50.**

Murphy's Law is, of course, well known to almost everyone; it states that "If anything can go wrong, it will." This little book by Arthur Bloch is a compilation of other laws, corollaries, axioms, constants, postulates, statements, commentaries and theorems culled from such sources as *The Journal of Irreproducible Results*, *The Peter Principle* and *Datamation* magazine. Many seem to have direct application to mineralogy and mineral collecting, as they do to all of life's little frustrations in general. Some examples:

Murphy's Constant:
Matter will be damaged in direct proportion to its value.

Sturgeon's Law:
90% of everything is crud.

Johnson's Third Law:
If you miss one issue of a magazine, it will be the issue which contained the article you were most anxious to read.

Harris's Lament:
All the good ones are taken.

Law of Observation:
Nothing looks as good close up as it does from far away. (Or—nothing looks as good from far away as it does close up.)

Finagle's Third Law:
In any collection of data, the figure most obviously correct, beyond all need of checking, is the mistake.
Corollary #1. No one whom you ask for help will see it.
Corollary #2. Everyone with unsought advice will see it immediately.

Finagle's Rule #1: To study a subject best, understand it thoroughly before you start.

Klipstein's First Law:
A patent application (new mineral description) will be preceded by one week, by a similar application made by an independent worker.

Maier's Corollary:
The experiment may be considered a success if no more than 50% of the observed measurements must be discarded to obtain a correspondence with the theory.

Parkinson's Sixth Law:
The progress of science varies inversely with the number of journals published.

Rule of Project Schedules:
The first ninety percent of the task takes ninety percent of the time, and the last ten percent takes the other ninety percent.

I must say that not a few of these have direct application to the production of the *Mineralogical Record*. For instance: "After adding two weeks to the schedule for unexpected delays, add two more for the unexpected unexpected delays."

In additon to being entertaining, this little volume can provide bits of seasoning for lectures and essays, and a better awareness that others suffer frustration as much as we do.

W.E.W.

Quest for New Jersey Minerals by Robert Speiser. Published by Robert Speiser, 13 Beam Place, Haledon, New Jersey 07508. Paper cover, 28 pages, 6 x 10 inches; $2.25 postpaid.

Describes 17 localities, all but one in northern New Jersey, including detailed maps, lists of species to be found, collecting hints for each locality, and the addresses of property owners from whom collecting permission must be obtained. A first-hand report by a field collector intimately familiar with the area.

W.E.W.

Mineralogical Notes

Tilasite from the Sterling Hill Mine, Ogdensburg, New Jersey

by

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with photographs by
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Paterson Museum
Paterson, New Jersey 07501

Abstract

The rare arsenate tilasite has been recognized from a new locality, the Sterling Hill Mine, Ogdensburg, Sussex County, New Jersey, in good, free-standing crystals. X-ray powder diffraction data are in satisfactory agreement with previously published data and microprobe analysis shows only minor chemical substitution. Another more recent occurrence of the species in massive form from Sterling Hill is also described.

Mineralogy

Tilasite, $CaMg(AsO_4)F$, is an arsenate previously reported only from Långban, Sweden; Kajlidengri, Jhabuna State, India; Bisbee, Arizona; and the manganese deposit at Guettera, Algeria (Byramjee & Meindre, 1956). The Sterling Hill mine at Ogdensburg, Sussex County, New Jersey, has recently been recognized as a new locality for crystals

Figure 1. **Tilasite crystal on a background of drusy friedelite crystals. The long diagonal of the crystal measures approximately 1.6 mm. Parker specimen.**

of that mineral even though the specimens were collected many years ago. The tilasite occurs as free-standing monoclinic crystals to 4 mm in length and milky white in color. They fluoresce a soft pinkish orange color under shortwave ultraviolet radiation, a response similar to that of the Långban tilasite. There was no response under longwave ultraviolet radiation, nor was there any observed phosphorescence in either case. The crystals are implanted upon a dark red-brown seam of massive friedelite, $Mn_8Si_6O_{18}(OH,Cl)_4 \cdot 3H_2O$, and light brown friedelite crystals coat some of the tilasite crystals. Additional tilasite crystals are partially or wholly imbedded in white, opaque cleavages of barite. The entire assemblage rests upon calcite fault breccia, the fragments of

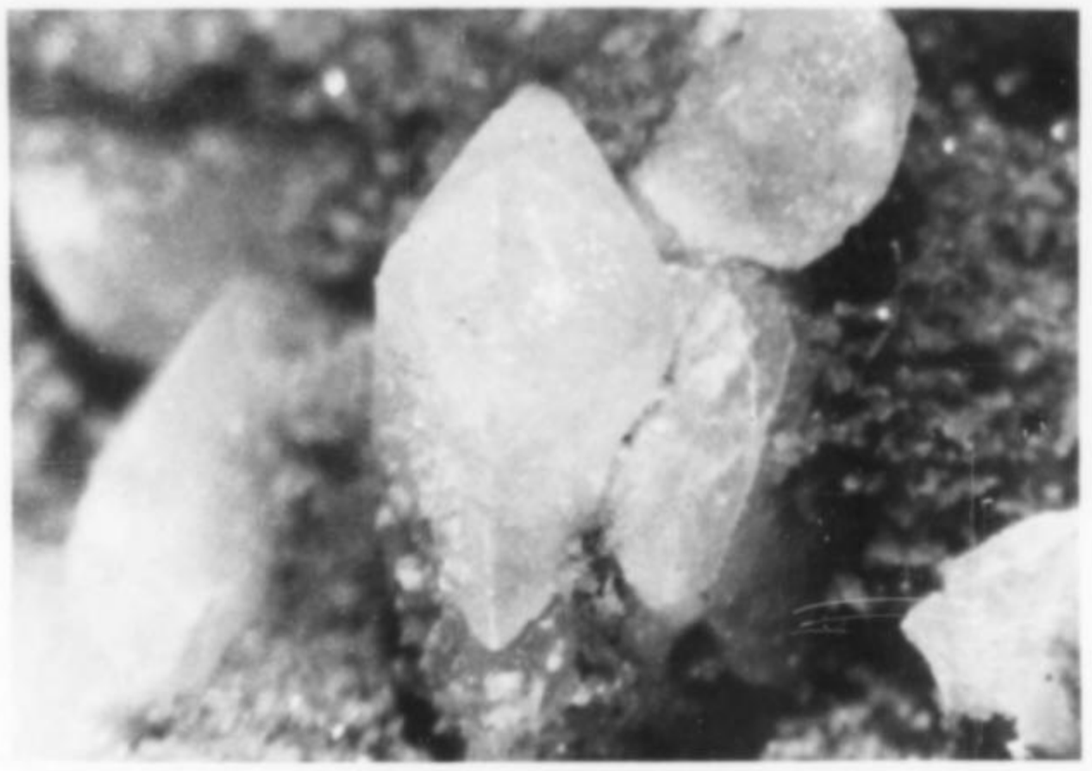

Figure 2. **Sphene-shaped tilasite crystals showing surface rounding and etching, with friedelite crystals in the background (darker). The large crystal is approximately 2 mm high. Parker specimen.**

which fluoresce vivid red under shortwave ultraviolet only, an unusual occurrence of limited extent within the mine. The friedelite vein was the first phase to be emplaced upon the breccia, followed by the tilasite crystals. The friedelite crystals were deposited next and, lastly, the barite. As inferred from evidence elsewhere in the mine, the decomposition of the mineral arsenopyrite, FeAsS, scattered throughout the Franklin marble and/or the loellingite locally associated with dark willemite in the ore body, likely served as the source for the arsenic in the tilasite. Friedelite and barite are common minor constituents throughout the ore body at Sterling Hill.

While the above occurrence of tilasite crystals is unique, the author has recognized the mineral as a non-discrete milky white coating intimately admixed with white willemite on red willemite-franklinite ore matrix from a recent working at Sterling Hill. This tilasite is non-fluorescent and X-ray powder patterns of the massive material and the crystals are identical. Thus, there is an excellent chance additional crystals will be found among the crystallized secondary arsenates which have been emerging from Sterling Hill the past few years.

X-ray powder diffraction

Both the crystals and masses of tilasite were identified by X-ray powder diffraction using a Philips-Norelco diffractemeter. The

Figure 3. **Assemblage paragenesis as explained in the text: crude tilasite crystal with a coating of tiny friedelite crystals imbedded in snow-white barite. The crystal is approximately 2.5 mm across the long diagonal. Parker specimen.**

obtained *d*-spacings were compared to the published data of Williams (1970) and Strunz (1937), and the three were found to be in good to excellent agreement with one exception. Williams notes an observed line at 1.763 (1.765 calculated) which is not noted in Strunz's work. The data obtained for the Ogdensburg crystals show a definite peak at 1.766, indicating an omission in Strunz's tabulation.

All other associated mineral species mentioned herein were confirmed by X-ray powder diffraction methods.

Unit cell constants are documented in several references in the literature and the reader is advised to consult Williams (1970) for an excellent summary of this data.

Chemistry

The tilasite described here was analyzed using an ARL–SEMQ electron microprobe utilizing an operating voltage of 15 kV and a beam current of 0.15 μ A. The standards used were fluorapatite for calcium and fluorine, hornblende for magnesium and iron, synthetic olivenite for arsenic and manganite for manganese. The data were corrected by computer using the MAGIC–4 program of the Geophysical Laboratory. Duplicate analyses using other standards confirmed the composition presented in Table 1.

Sterling Hill tilasite is homogeneous in the two crystals analyzed. The analytical data suggest there is likely some small amount of hydroxyl substituting for fluorine in the tilasite. However, this substitution is minor and the reader is referred to Palache *et al* (1951), who compiled a tabulation of tilasite analyses, none of which had a full complement of fluorine. The elements zinc, iron and manganese were found to be present only as traces in the Sterling Hill material.

Table 1. **Microprobe analyses**[2] of Sterling Hill tilasite.

	#142836[1]	Theory
CaO	26.11%	25.22%
MgO	18.84	18.13
As_2O_5	51.51	51.70
F	6.85	8.85
	103.31	103.60
O–F	2.88	3.60
Total	100.43	100.00

Accuracy of data: ±3% of amount present for Ca.Mg.As. ±5% of amount present for fluorine.

[1]Sample #142836, National Museum of Natural History.

[2]Microprobe data courtesy of Pete J. Dunn, National Museum of Natural History, Washington, D.C.

Acknowledgements

The author wishes to thank Jack R. Alonzo of Exxon Research Corporation for his qualitative (E.D.S.) elemental analysis work. The author is deeply grateful to Pete J. Dunn of the Smithsonian Institution, Washington, D.C., for his quantitative microprobe analyses of the tilasite crystals as well as his constructive assistance in relation to this article.

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Tveitite from the Barringer Hill District, Texas

by

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Fluorite and its rare-earth-containing variety, yttrian fluorite, common constituents of most rare-earth pegmatites, are present in small amounts in the Barringer Hill district, Llano and Burnet Counties, Texas. Many large rare-earth pegmatite districts, like the South Platte region of Colorado, are well-known for their abundance of core-margin rare-earth fluorides (Simmons, 1973), commonly comprising the bulk of the rare-earth minerals. In the Barringer Hill district, however, with the notable exception of Barringer Hill*, rare-earth fluorides are minor constituents of the accessory mineral suite. At Barringer Hill, yttrian fluorite masses up to 50 pounds were reported from the albite core-margin replacement unit (Hidden, 1905; Hess, 1908; Landes, 1932). Many of these displayed crystal faces, some as large as eight inches on a side. The color was mainly deep purple, although colorless, cream-colored and green specimens were also found.

During the course of some previous research by the author, several specimens of rare-earth-rich fluorite from Barringer Hill (University of Kansas Collection) were analyzed using the electron microprobe. The study showed the presence of numerous mineral inclusions, the most common being an extremely rare-earth-enriched fluoride phase. Originally these inclusions were believed to be a second generation yttrian fluorite, however, present research has identified them as the mineral *tveitite*, recently described by Bergstøl, *et al.* (1977) (abstract in *Mineralogical Record*, **9**, 40).

Tveitite is a calcium-yttrium-rare-earth fluoride which is both chemically and structurally akin to yttrian fluorite. It was previously known only from one 10 × 10 × 5 cm specimen from a rare-earth pegmatite at Hoydalen, Telemark, southern Norway. Associated minerals for the Norway specimen include quartz, amazonite (microcline), muscovite, beryl, and monazite. Barringer Hill tveitite is found only as small (0.1 to 1 mm) inclusions in yttrian fluorite. It is associated with gadolinite, allanite, and albite. The color varies from white to cream-yellow. However, this in itself does not megascopically distinguish tveitite from yttrian fluorite. Instead, Barringer Hill tveitite has a strong yellow-orange fluoresence under shortwave ultraviolet radiation, in sharp contrast to the cream to pale yellow fluoresence of most of the yttrian fluorite. The mineral occurs as anhedral inclusions with no observable morphological form (hence no useful photographs can be presented here). A summary of the physical characteristics determined for Barringer Hill tveitite is given in Table 1. These are essentially identical to type Norwegian material.

An electron microprobe analysis of Barringer Hill tveitite shows the mineral to be very similar to type tveitite. The analyses were conducted with 150 nA specimen current and 15 kV excitation voltage (10 kV for fluorine) and used analyzed gadolinite and fluorite as standards. Because the analyses are almost identical with those reported for tveitite from Norway, they are not listed here. As with type tveitite, the Barringer Hill specimens show a selective enrichment in the heavier lanthanides (and yttrium) over the lighter cerium group elements. Ratios of the heavier lanthanides relative to the lighter group are in the order of 4–5:1. Calculation of the empirical formula from the chemical analyses yields a formula unit of $Ca_{1-x}(Y,RE)_xF_{2+x}$ with $x = 0.25-0.30$. The identity of tveitite was confirmed by both X-ray and optical analysis.

The occurrence of tveitite at Barringer Hill is significant for two reasons: it marks the second known occurrence of the mineral, and it establishes the possibility that tveitite may occur in other rare-earth, fluorite-bearing pegmatites. The origin of the mineral is unclear, although field evidence suggests that it is related to yttrian fluorite, possibly as a breakdown or inversion product.

Collectors owning specimens of Barringer Hill yttrian fluorite should re-examine them under ultraviolet light for the presence of tveitite.

Table 1. Physical Properties of Tveitite from Texas.

Crystal System:	monoclinic, $\frac{2}{m}$ (pseudo-cubic)
Hardness:	3½–4
Density:	3.789 (5) meas.
Cleavage:	{111}, good
Fracture:	subconchoidal to uneven
Color:	white to cream-yellow
Luster:	resinous to greasy
Streak:	white
Optics:	biaxial (−), $\alpha = 1.476(2)$, $\beta = 1.479(2)$, $\gamma = 1.481(2)$, $2V = 35°$.

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*Author's Note: The Barringer Hill pegmatite has been covered by Lake Buchanan since 1937. The only mineral samples now available from this once-prolific rare-earth mineral producer are in the collections of several U.S. universities and museums, and in a few private collections.

Notes on Some New Occurrences in Alabama

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Dufrenite crystals from Wolfden Mountain

Dufrenite [$Fe^{2+}Fe_4^{3+}(PO_4)_3(OH)_5 \cdot 2H_2O$] was first reported from Alabama in 1938, the locality listed as Rock Run (Palache, et al, 1954). Recently this location was rediscovered several miles southwest of Rock Run on the east slope of Wolfden Mountain and has yielded some very large and fine specimens of dufrenite.* The dufrenite occurs as fracture coatings and fillings up to several centimeters wide in shaly iron ore. Only the upper 1 m of the ore contains any dufrenite and nowhere was the mineral found more than 2 m below the surface of the ground.

Several specimens were found which contain open pockets with bright, prismatic, dark brown to black crystals of dufrenite projecting

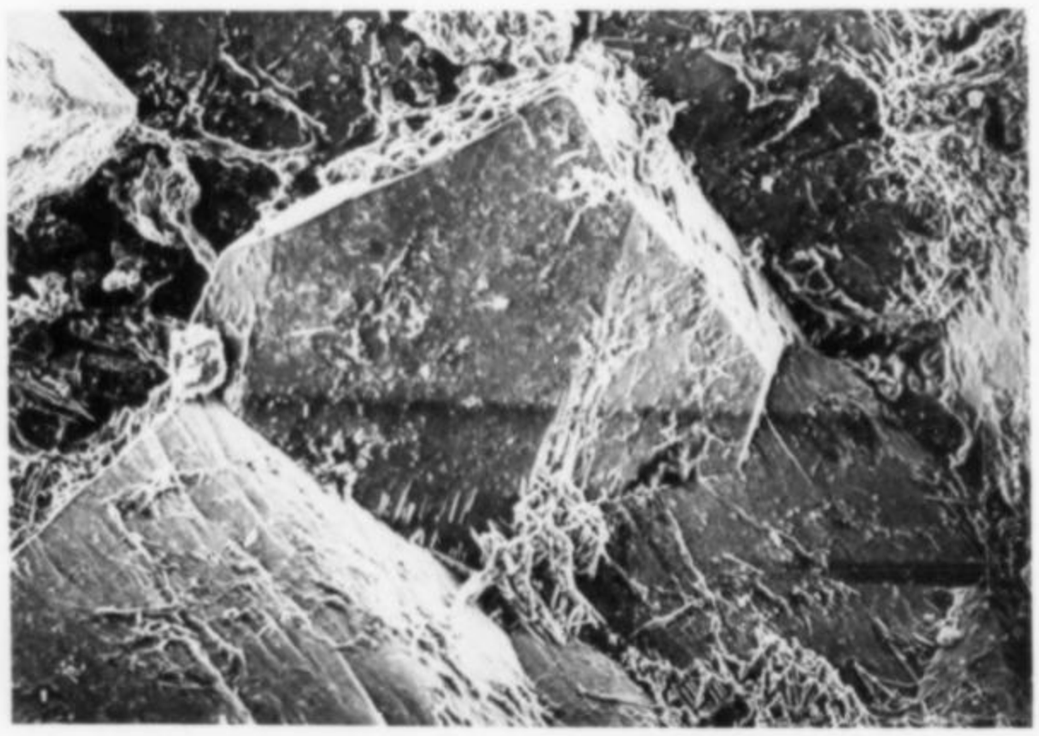

Figure 1. **Steel-gray pyrolusite crystals from Rock Run station, Alabama (SEM photo). The central crystal is 1 cm across.**

from the surfaces of fibrous dufrenite hemispheres. Many of the crystals are 6mm or more in length with a cross section of up to 2 x 2 mm. The crystals are very similar to dufrenite crystals found at the phosphate mineral locality on Indian Mountain, except that they are larger and more lustrous, as a rule.

No iron phosphate minerals other than dufrenite have been found at the locality; however, the iron ore below the level where the dufrenite is abundant contains many small patches of wavellite* [$Al_3(PO_4)_2(OH)_3 \cdot 5H_2O$]. Many of the specimens of dufrenite radiate from distinct plant root channels and the possibility that the phosphate minerals are biogenic in orgin cannot be discounted at this stage.

Pyrolusite from Rock Run Station

A manganese prospect near the old Rock Run station on the southwest slope of Indian Mountain contains abundant, porous, crystalline masses of manganese oxides replacing quartzite. When broken, these pieces or ore display glittering pockets of tiny, steel-gray crystals (Fig. 1) which have been shown to be pyrolusite* [MnO_2]. Associated with the pyrolusite is a small amount of white, radially fibrous wavellite.

*Identified by X-ray diffraction analysis.

Figure 2. **Light green kidwellite tufts on strengite crystals (SEM photo) from Rock Run station, Alabama. The largest strengite crystal is 3 mm.**

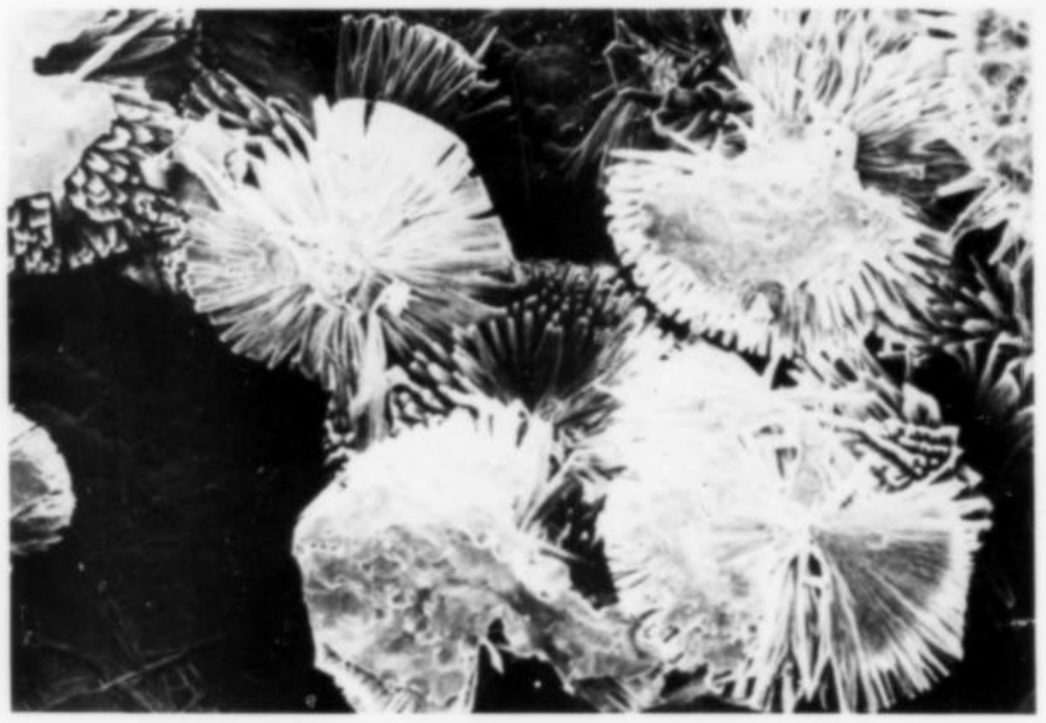

Figure 3. **Cacoxenite sprays on shale from a roadcut near Rock Run station, Alabama (SEM photo). The sprays are about 3 mm in diameter.**

Kidwellite from Rock Run Station

Float boulders of iron ore from the south slope of Indian Mountain, near the old Rock Run station, have yielded specimens of a light green, radially fibrous mineral coating fracture surfaces (Fig. 2). The mineral has proven to be kidwellite* [$NaFe_9^{3+}(PO_4)_6(OH)_{10} \cdot 5H_2O$] (Moore and Ito, 1978). Associated minerals are cacoxenite [$Fe_9^{3+}(PO_4)_4(OH)_{15} \cdot 18H_2O$], beraunite [$Fe^{2+}Fe_5^{3+}(PO_4)_4(OH)_5 \cdot 4H_2O$], and strengite [$Fe^{3+}PO_4 \cdot 2H_2O$]. Wavellite and abundant pyrolusite crystals occur in a nearby manganese prospect. Shale zones throughout the area contain as much as 4.47% phosphorous and often contain fracture surfaces coated with minute fibers of cacoxenite (Fig. 3).

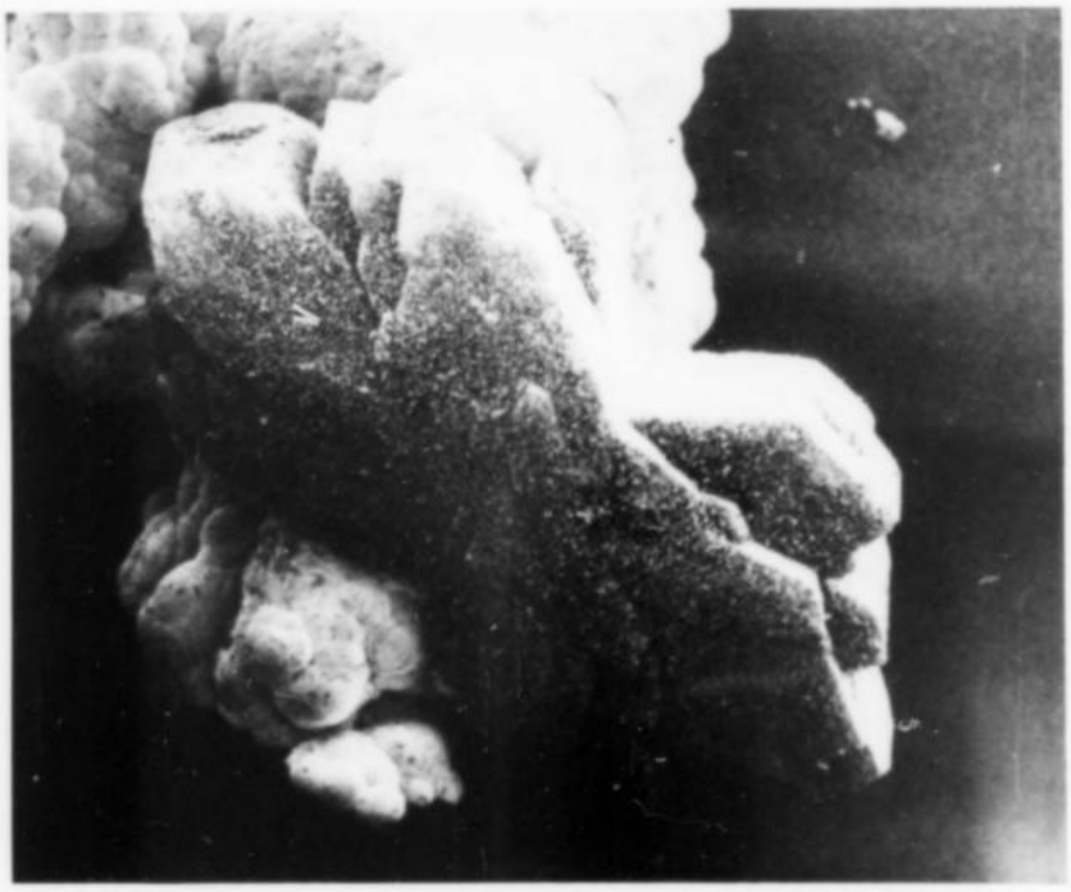

Figure 4. **Dufrenite "bow tie" crystal about 6 mm across (SEM photo) from Indian Mountain, Alabama.**

Figure 5. **Black rockbridgeite crystals to 1.2 mm across (SEM photo) from Indian Mountain, Alabama.**

Figure 6. **A spray of kidwellite crystals 1.3 mm across on strengite from Indian Mountain, Alabama (SEM photo).**

Dufrenite, rockbridgeite and kidwellite from Indian Mountain

In a previous article the senior author reported laubmannite from the Indian Mountain mineral locality (Barwood, 1974). Additional research has indicated that the material identified as laubmannite from Indian Mountain consists instead of an intimate mixture of finely fibrous dufrenite and kidwellite which give an X-ray diffractometer pattern easily confused with laubmannite.

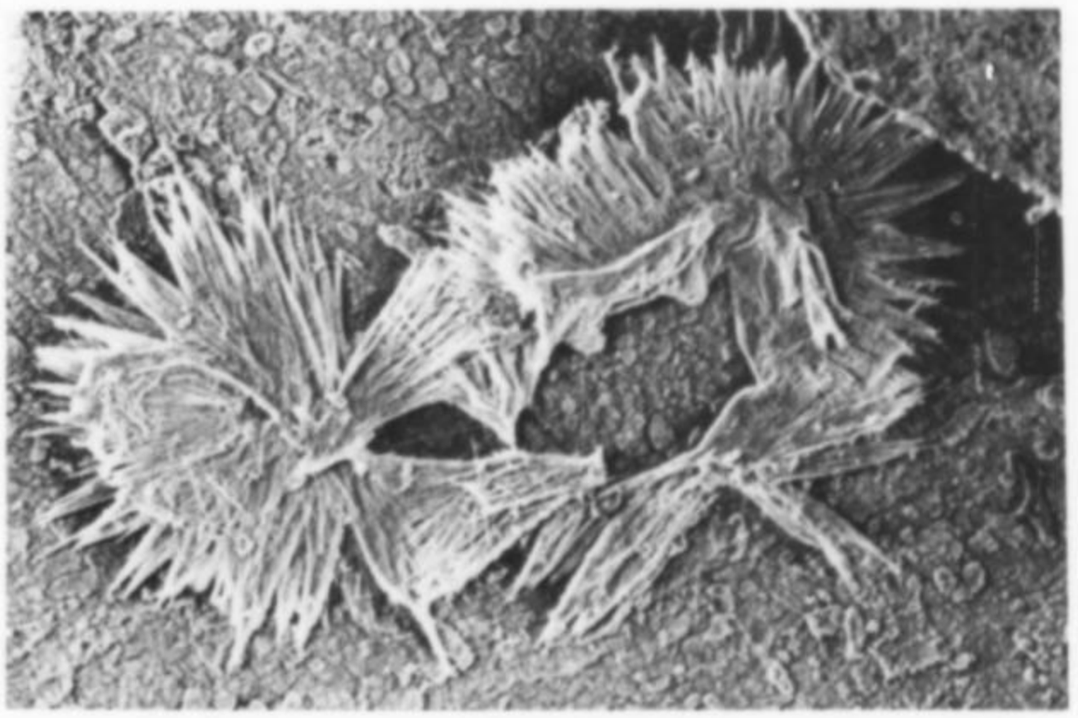

Figure 7. **Sprays of white churchite crystals 0.3 mm in diameter from Indian Mountain, Alabama.**

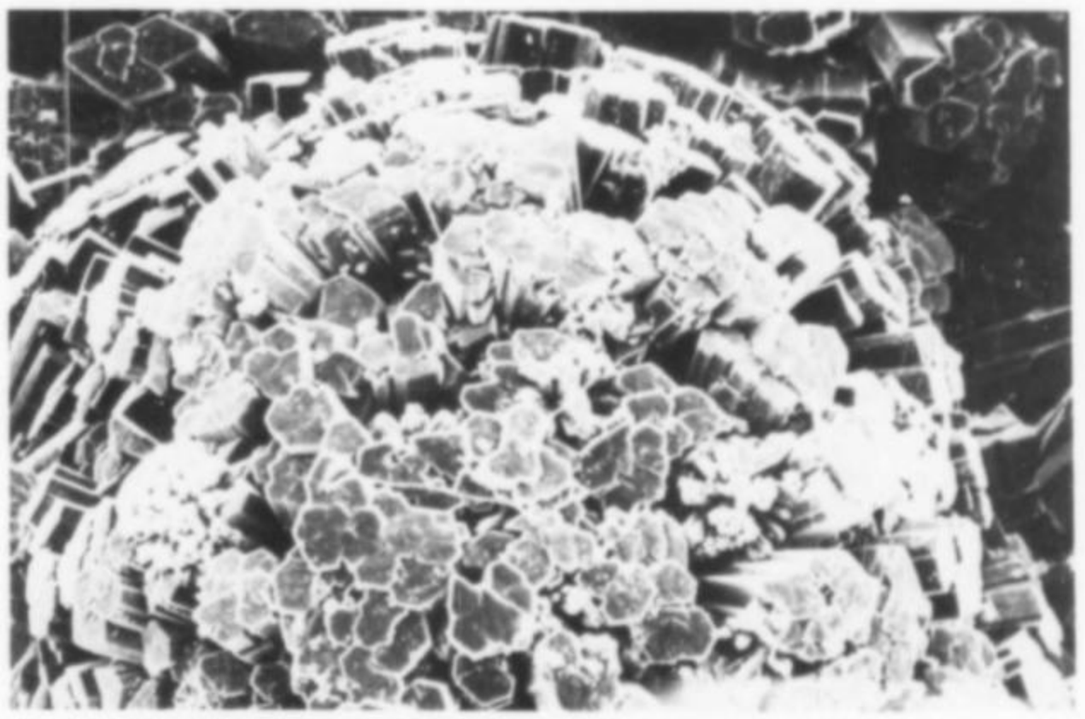

Figure 8. **Wavellite in a spherical aggregate about 0.3 mm across (SEM photo) with minor cacoxenite from near Jacksonville, Alabama.**

X-ray diffraction analysis showed that almost all of the green to yellow-green fibrous hemispheres of "dufrenite" from the Indian Mountain locality were zoned mixtures of dufrenite and kidwellite. Dark brown to black radially fibrous hemispheres found on the dumps are weathered mixtures of rockbridgeite [$(Fe^{2+},Mn)Fe^{4+}{}_3(PO_4)_3(OH)_5$] and goethite [FeO(OH)]. Crystals of both dufrenite and rockbridgeite occur at Indian Mountain (Fig. 4 and 5); however, the rockbridgeite is apparently restricted to a single zone in the mine. Veins of dark black, fibrous rockbridgeite are locally abundant as replacements of the shaly iron ore near the original mine surface, and cavities in this material yield an occasional crystal druse. Both rockbridgeite and dufrenite were found to occur in the same specimens. Tiny crystals of kidwellite were found coating strengite and forming pseudomorphs after beraunite (Fig. 6).

Churchite from Indian Mountain

In 1970 and 1971 a number of specimens of a white, finely fibrous mineral occuring as minute (0.3 mm) tufts implanted on altered rockbridgeite and dufrenite were collected at the phosphate mineral locality

Figure 9. **Acicular crystals of dark green rockbridgeite up to 0.1 mm in length (SEM photo) from near Jacksonville, Alabama.**

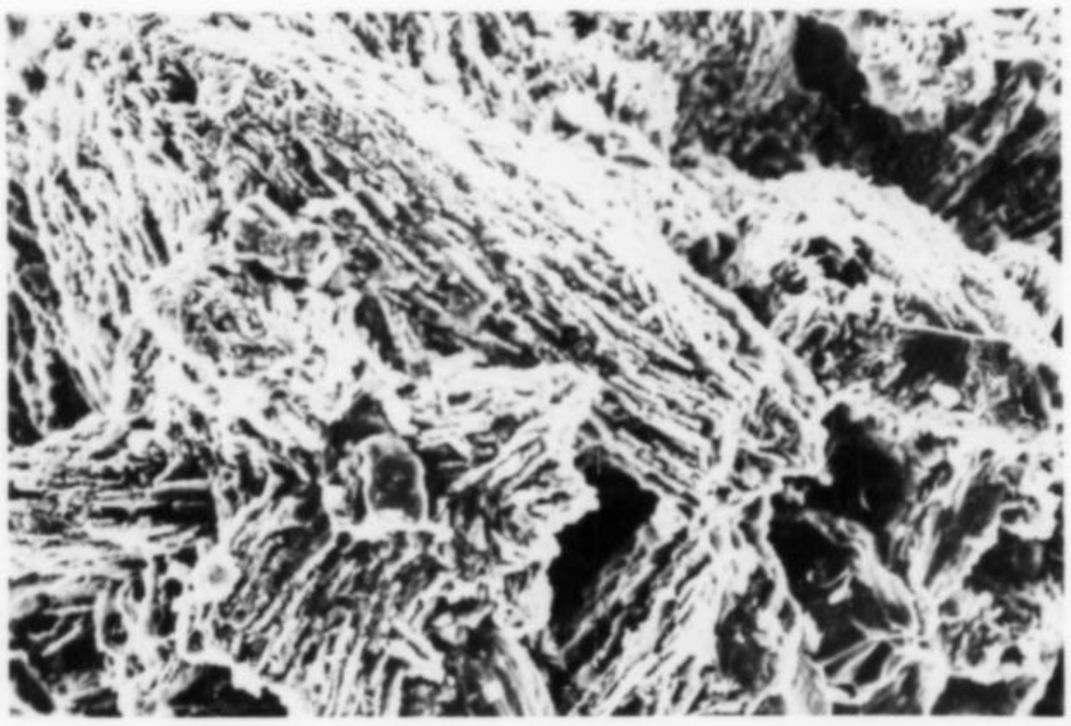

Figure 10. **Blue-green turquoise (54X), possibly pseudomorphous after wavellite, from Erin, Alabama (SEM photo).**

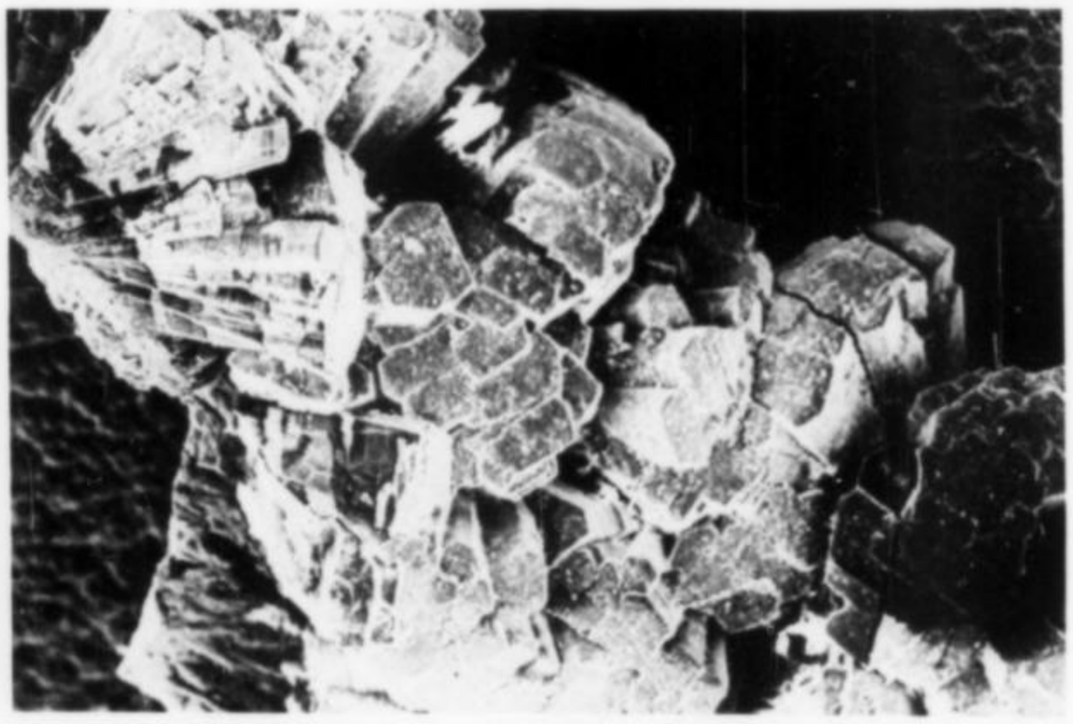

Figure 11. **White wavellite crystal cryst 0.5 mm thick (SEM photo) found with quartz and turquoise from Erin, Alabama.**

on Indian Mountain, Cherokee County, Alabama (Fig. 7). Recently several of the larger tufts were detached and analyzed by X-ray powder diffraction. The pattern of the mineral was found to be identical with the pattern of churchite (weinschenkite) [$YPO_4 \cdot 2H_2O$] from Vesuvius, Virginia (Milton, *et al.*, 1944). Only a few specimens were recovered and the mineral is easily overlooked in the field.

Wavellite and rockbridgeite from Jacksonville

An unusual occurrence of phosphate minerals was in the upper two meters of the contact between the Ft. Payne chert and Floyd shale exposed in a road cut approximately 3 miles northwest of Jacksonville,

Figure 12. **Blue crust of turquoise (100X) from the Wood Copper mine near Micaville, Alabama (SEM photo).**

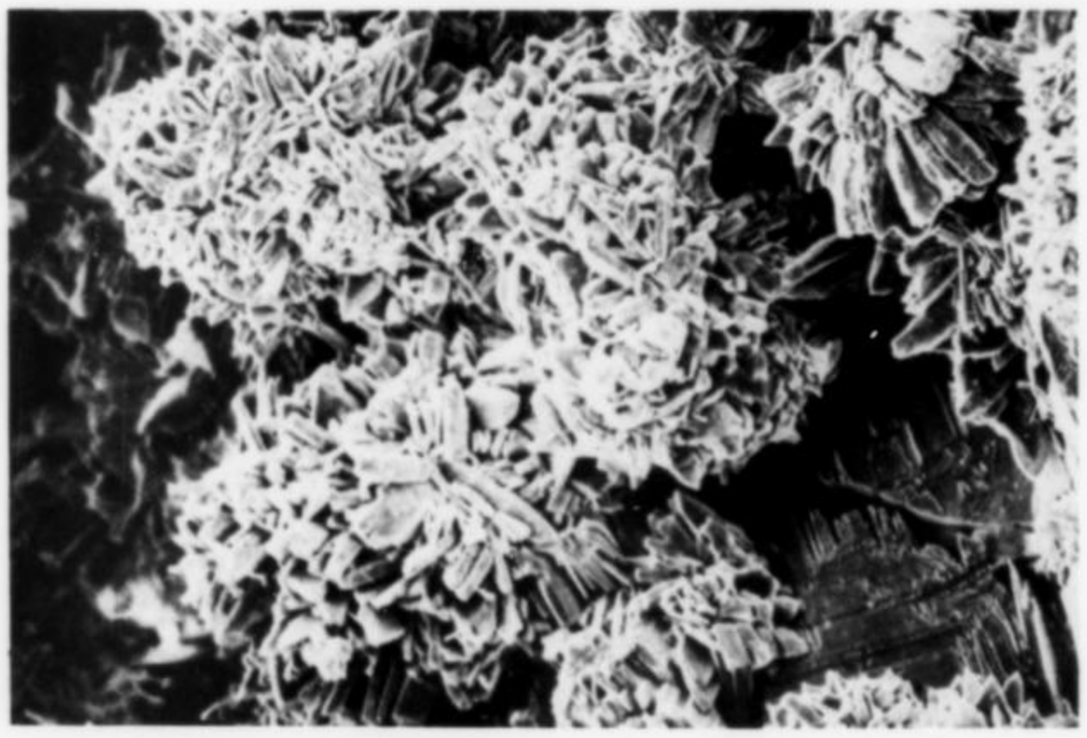

Figure 13. **Blue-green antlerite crystals to 0.02 mm on slag glass from the old furnace area at the Wood Copper mine, near Micaville, Alabama (SEM photo).**

Calhoun County, Alabama. Wavellite* (Fig. 8), cacoxenite*, strengite*, beraunite*, and rockbridgeite* (Fig. 9) occur as fracture fillings in ferruginous chert and occasionally as coatings on the inside of crinoid stem casts.

Wavellite is the most common mineral found at this locality and occurs in veins and masses up to several kilograms lining cavities in limonitic chert and as replacements of shale near the chert-shale contact. Cacoxenite is found as tiny crystals on fracture surfaces in the chert and, abundantly, as fibrous masses in manganese oxides. Beraunite coats fractures in the manganoferruginous chert, but also forms large pockets of crystals. Some small pinkish strengite crystals were found coating the beraunite. Rockbridgeite forms velvety, dark green coatings of tiny crystals lining pockets in porous limonite.

Similar phosphate mineralization was found at the top of the Ft. Payne chert near Pell City, Alabama, and has been found on the western highland rim of Tennessee. The similarity of the occurrences suggests a common origin from an as yet unrecognized phosphatic zone at the top of the Ft. Payne chert. The great amount of chemical brecciation at these localities with no evidence of tectonic activity indicates that similar breccias at other phosphate mineral localities may not represent fault zones.

Wavellite, turquoise and barite from Erin and Micaville

Turquoise [$CuAl_6(PO_4)_4(OH)_8 \cdot 5H_2O$] has long been reported from Alabama as veinlets in black slate near the old Erin railroad station in Clay County (Prouty, 1923). Quartz veins in the railroad cuts near Erin contain blue-green crusts of a radially fibrous mineral commonly capped by milky white, prismatic crystals. Water-clear crystals with pyramidal terminations occur in some of the more ferruginous veins. The blue-green crusts are turquoise* (Fig. 10), the milky white crystals are wavellite* (Fig. 11), and the water-clear crystals are barite*. Light sky-blue fibrous crusts collected from very similar-appearing black slate some 30 miles northeast of Erin at the old Wood Copper mine, near Micaville, Cleburne County, are also turquoise (Fig. 12).

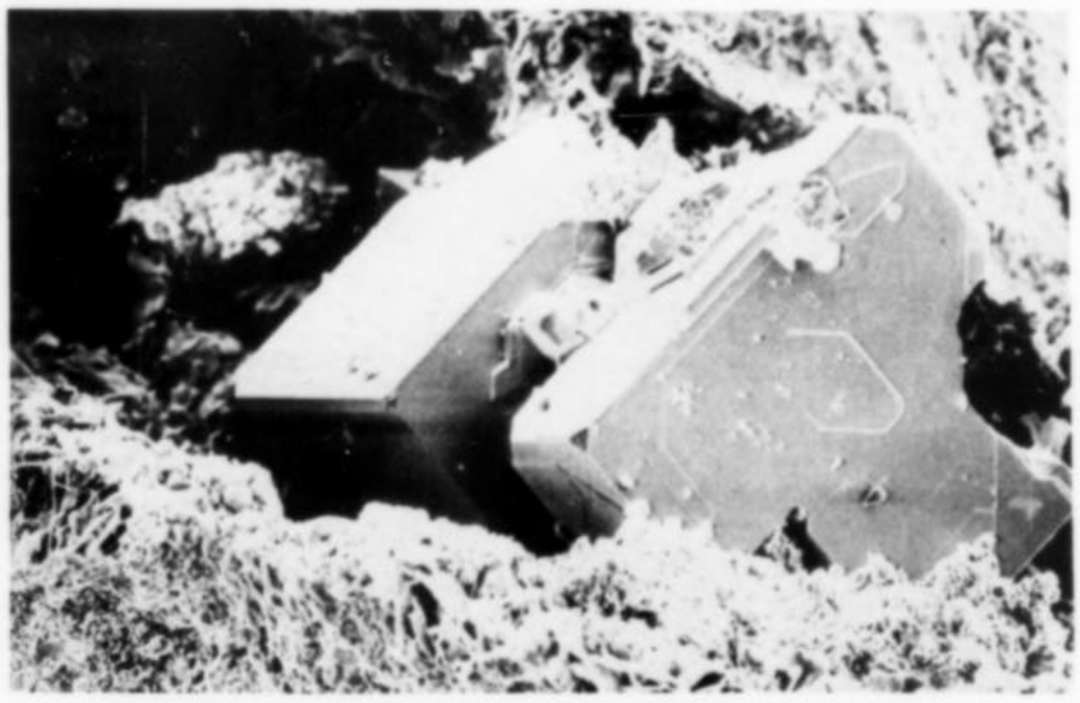

Figure 14. **Cubic, bright red cuprite crystals 0.3 mm on longest edge, on slag glass from the old furnace area at the Wood Copper mine, near Micaville, Alabama (SEM photo).**

Staurolite from Elmore County

A locally well known collecting area for garnets in chlorite schist matrix is at an abandoned garnet prospect on Lake Martin at the border of Elmore and Tallapoosa Counties south of Alexander City, Alabama. Vitreous, dark brown crystals of staurolite* [$(Fe,Mg,Zn)_2AlgSi_4O_{23}(OH)$] have been found in association with the garnets eroded out at the lake's edge. The crystals are up to 2 cm long, generally somewhat equant, and rarely terminated. This is the first proven occurrence of staurolite crystals from Alabama.

Antlerite and cuprite from the Wood Copper mine

The Wood Copper mine near Micaville, Cleburne County, Alabama, has long been abandoned and, with the closing of the old shafts by the county road crews, seldom yields mineral specimens other than a few pieces of malachite-stained gossan and some massive sulfide ore. Recently, however, the old smelter site near the mine yielded some nice micro-crystals of oxidized copper minerals. These furnaces were from an unsuccessful attempt to smelt ore at the mine site and now are overgrown mounds of slag, fused brick, and partially burned sulfide ore. Oxidation of this material has caused bright red cuprite* [Cu_2O] and blue-green antlerite* [$Cu_3(SO_4)(OH)_4$] to form in cracks and gas bubbles in the slag (Fig. 13 and 14). Some copper (sheets and globules of smelted copper which ran down into the bricks and caught in the slag before the furnaces were abandoned) has also been found.

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Zircons of Summit Rock, Oregon

by **J. C. Huneke** and **George R. Rossman**
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California Institute of Technology
Pasadena, California 91125

Crystals of a variety of minerals, including feldspars, pyroxenes, ilmenite, apatites and tridymite project into cavities in a basaltic andesite body at Summit Rock, Oregon. One widely distributed minor mineral occurs as individuals and clusters of pale pink crystals ranging up to 0.3 mm in length, and is notable for the diverse habits in which it is found. These crystals had previously been identified as rutile on the basis of morphology (Kleck, 1970) and are labeled as such in many micromount collections. However, our studies show that the mineral is actually zircon. This identification was obtained by energy dispersive X-ray analysis, which showed that zirconium and silicon were the only cations present as major constituents. Titanium in particular was absent. The infrared absorption pattern of a typical crystal confirmed that it is a nonmetamict zircon.

A number of zircons have been examined under the scanning electron microscope. Their morphology is frequently very different from the doubly terminated tetragonal prism common for zircons in most igneous rocks. The most striking crystals are hollow prisms. Shown in Figures 1, 2 and 3, such crystals are composed of an "exoskeleton" of thin prism walls surrounding a central cavity. The internal structures are not prismatic. One of the cavernous crystals also displays prominent fluting of the prism, which is a feature observed on many of the crystals. A variety of other minerals including sanidine, ilmenite, hypersthene and apatite are also found with cavernous morphologies in cavities in the andesite at this locality.

Figure 1. **A skeletal zircon crystal with incomplete pyramid faces exposing an internal cavity. All photos were taken with the scanning electron microscope; the scale bar in all figures is 0.1 mm.**

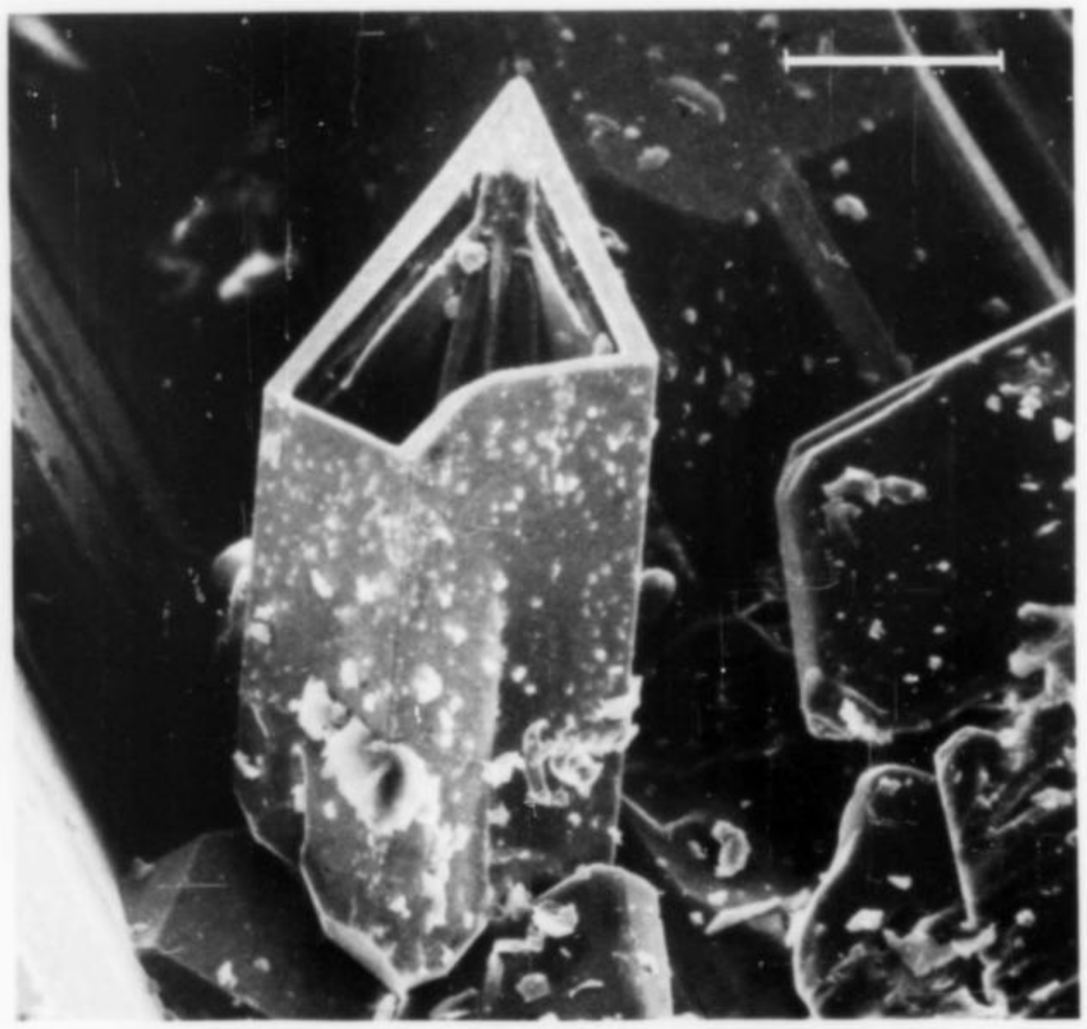

Figure 2. **A thin-walled, cavernous zircon crystal.**

Some zircon specimens show only partial development of the skeletal crystal. Figure 4 shows a group of two zircon crystals. One is incomplete with prominent development of only two prism faces, and the other is a hollow, stubby crystal. A second view of this cluster is shown in Figure 5. A small, diamond-shaped opening remains at the center of a prism face of the smaller crystal.

A cluster of at least five zircon crystals is shown in Figure 6. A variety of different morphologies occurs in this one cluster alone, including both hollow and complete stubby crystals and a long tetragonal prism terminated by only two prominent pyramid faces.

The morphology of the crystal shown in Figure 8 is also fairly typical. It is a plate formed by preferential development of one prism face. The slender, doubly terminated crystals shown in Figure 7 exhibit yet another morphology of zircon encountered in the andesite cavities. These crystals are more symmetrical and elongated than the cavernous types.

The zircons observed were among the last phases to form in the cavities during the formation of the igneous body. They are perched on the interiors of the cavities and, with the exception of possible alteration products, they have no other crystals growing upon them. The cavernous morphology and unequal development of faces of a given form suggest rapid growth from a vapor phase, as proposed by Kleck (1970).

ACKNOWLEDGMENT

A portion of this study was funded by the National Science Foundation Grant EAR 77-23147.

REFERENCE

KLECK, W. D. (1970) Cavity minerals at Summit Rock, Oregon. *American Mineralogist*, **55,** 1396-1404.

*Contribution No. 3087

Figure 3. A cavernous zircon crystal with incomplete development of both the pyramid and prism faces. Note the ribbed appearance of the internal cavity.

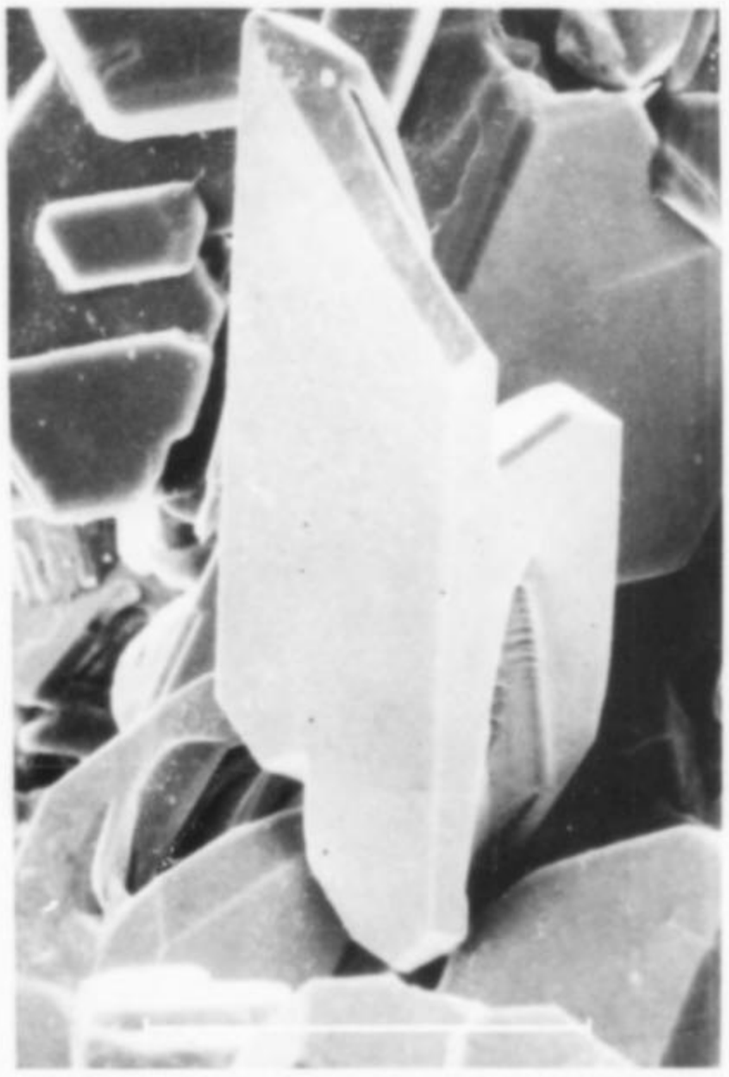

Figure 4. A zircon crystal, with incomplete development of the prism faces, resting upon a hollow zircon crystal.

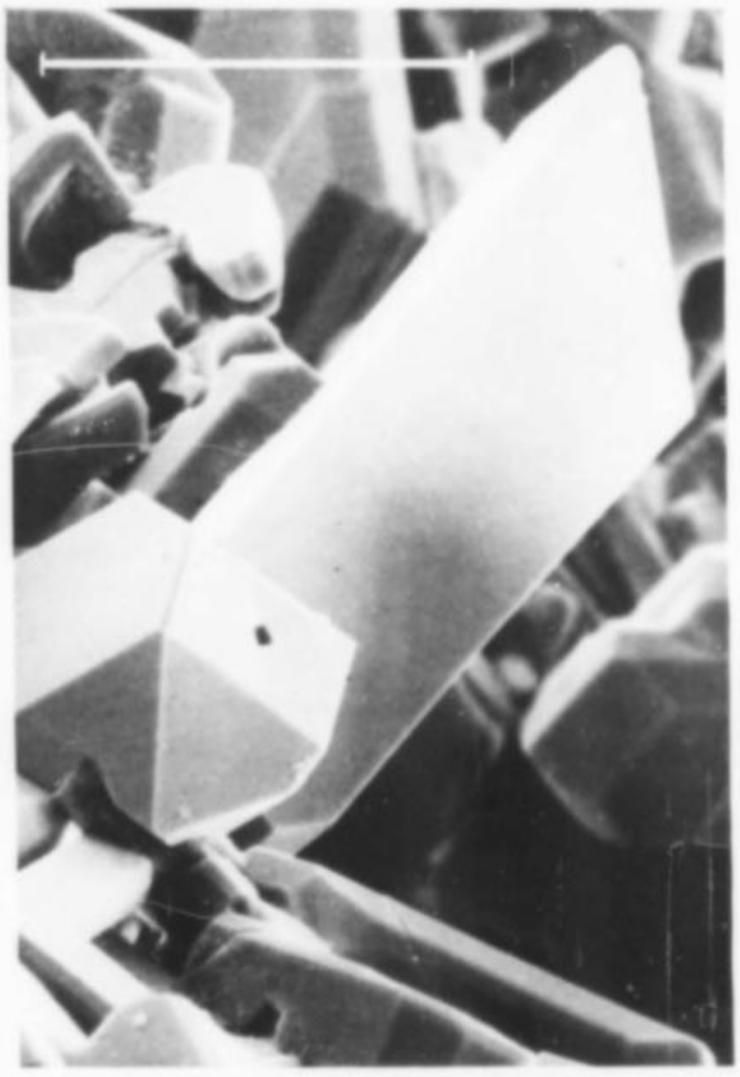

Figure 5. A second view of the zircon crystals in Figure 4. Note the diamond-shaped opening remaining on one face of the hollow zircon crystal.

Figure 6. A cluster of zircon crystals displaying a variety of morphologies. Note the small pseudo-hexagonal tridymite plates at the base of the cluster.

Figure 7. Two acicular zircon crystals, one of which displays unequal development of the pyramid faces. A third crystal (somewhat out of focus) projects into the foreground.

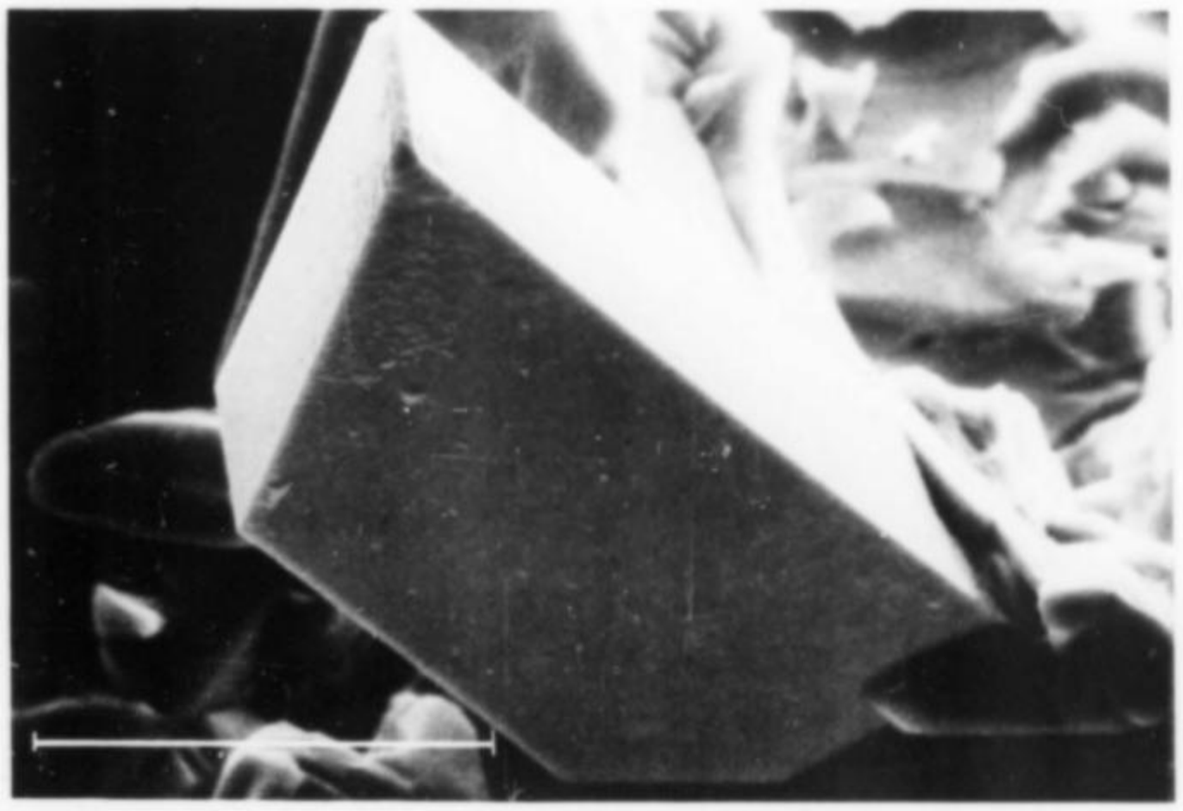

Figure 8. A zircon crystal displaying unequal development of both the prism and pyramid faces.

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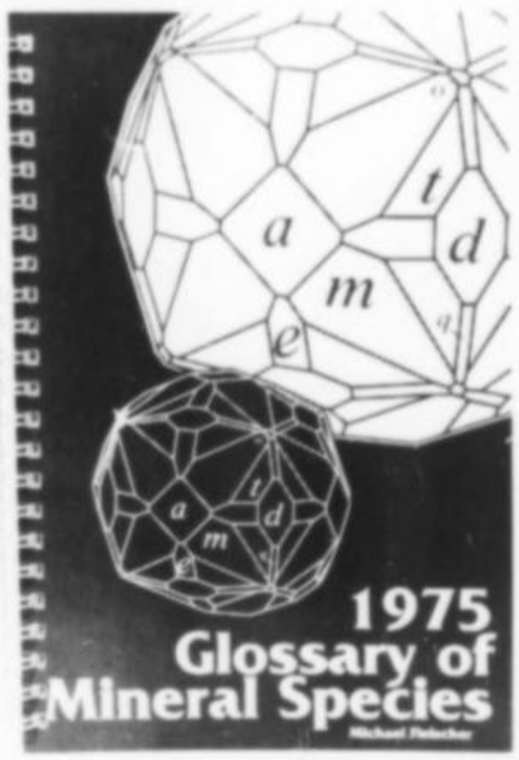

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Mineral World

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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