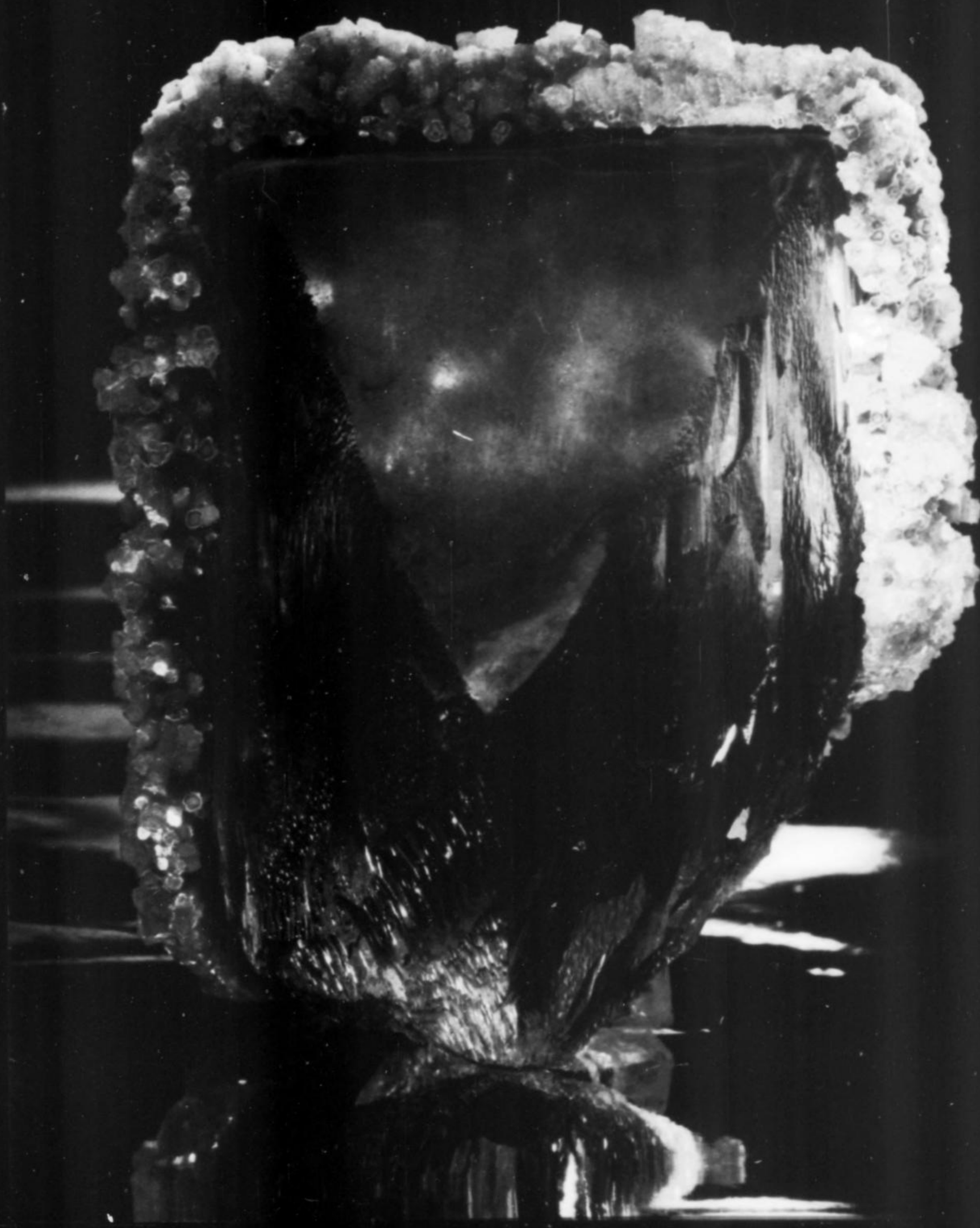
the Mineralogical Record

Volume Sixteen, Number Two
March-April 1985 $5.00



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March-April 1985
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Articles

Departments

COVER: TOPAZ crystal, 7 cm, with crown of lepidolite, from Virgem da Lapa, Minas Gerais, Brazil. (For more on the locality see the article by Cassedanne and Lowell, vol. 13, no. 1, p. 19–28.) William Larson collection; photo © Harold and Erica Van Pelt.

notes from the EDITOR

THE BIG INDEX

When we first started thinking about the possibility of producing a cumulative index to the *Mineralogical Record,* it was going to be a *ten*-year index . . . and we had a while to go before volume 10 would be done. That gives some idea of how long this notion has been brewing. We wanted it to be cast in considerably greater detail than the annual indexes so, to get a feeling for the length and time that would be involved, I prepared a sample index based on a single issue. It became immediately clear that (1) the time required was far beyond what I had available if I was to continue a regular schedule of magazine publishing, and (2) the production cost would be staggering, and certainly beyond the capabilities of our fragile budget. Consequently, with great reluctance, the idea was dropped as infeasible.

And yet, the cumulative index was an idea that refused to stay dead. A number of mineralogists (particularly associate editor Pete Dunn) urged us repeatedly over the years to try to find *some* way to accomplish the impossible. The value to the science of mineralogy and to our readers would be incalculable, they said. The index would open up every detail of the thousands of pages of back issues to quick and easy access. The true reference value of the *Mineralogical Record* would finally be realized in full. Without the index, they said, it would become progressively more difficult to actually use the journal in any practical way, and eventually few people would. After all, there are many fascinating articles within the complete run of other unindexed magazines such as the *Lapidary Journal.* But would you actually want to *page through* the *Lapidary Journal* back issues looking for something you couldn't remember the location of? A complete set, unbound, occupies nearly 3 meters (*over 9 feet*) of shelf space!

Nevertheless, no matter how much we agreed with their viewpoint, the logistics and financial problems remained insurmountable. Then, in February of 1983, Mike Groben was elected President of the Friends of Mineralogy. FM is an independent, nonprofit organization devoted to serving essentially the same fraction of the population which the Mineralogical Record, Inc., serves, and it occurred to Mike that an FM project undertaken on behalf of the Mineralogical Record would be a nice thing. What to do? The cumulative index, of course!

We talked it over at great length, and I provided him with a copy of my feasibility study of several years earlier. I have to admit that I was impressed with the way Mike dug in on the project, even though I'm sure that neither he nor anyone else in FM fully comprehended the enormity of the task they were undertaking. A whole staff of FM volunteers was organized, the 14 volumes were divided up by subject and volume number, schedules for completion of the various parts were laid out, indexing standards and rules for format and consistency were discussed, revised and settled upon, and at length people began the real work of compilation. Many months of labor by a basic staff of 15 mineralogists at last yielded the raw copy—over 20,000 entries. Then the massive task of entering all that information into a computer for alphabetization was begun. Following that, the data had to be edited, revised, corrected, cross-referenced . . . truly a research project all by itself, as those involved will testify.

While overseeing all this activity, and doing a portion of the compilation himself, Mike undertook the equally formidable tasks of (a) learning how to be a publisher, and (b) determining a way to finance the project, total cost of which would equal several times the current FM bank balance. In the end, despite having obtained many donors to help out, FM still required a loan from the Mineralogical Record to make ends meet. The challenge, too big for either organization alone, was finally met jointly.

Mike had to run for the FM presidency for a second year in order to bring the project to completion; but, through an all-out effort, he and his team successfully accomplished the enormous job by the end of that second term. The index was typeset, pasted up, printed, bound, and delivered to the Mineralogical Record in time for distribution at this year's Tucson Show.

I hope that, given this brief background, readers will appreciate the true significance of the cumulative index. It covers the first 14 volumes of the *Mineralogical Record* (1970–1983), subdivided into six separate indexes: Articles and Departments, Authors, Localities (over 4,000 entries), Minerals (over 11,000 entries), Photographs, and Miscellany . . . 246 pages total!

Who should own a copy? First of all, there is no question whatever that people possessing a complete set of the *Mineralogical Record* must obtain an index since, without one, they don't really have a complete set. Anyone wishing to purchase a complete set in the future will expect that set to include the index.

But really, the index is made to be *used,* and not just to fill out a set. People still building their collection of the *Mineralogical Record* will find the index equally useful, as a guide to acquiring specific back issues as well as an aid in fully utilizing that portion of the run which they do own. With this in mind, a pagination key has been thoughtfully included, so that the page numbers of any entry listed in the index can be used to quickly determine exactly which issue the item will be found in.

Browsing through the index will, I'm sure, become a favorite pastime of many people. It is amazing what can be found in the earlier issues that one had completely forgotten or had accidentally missed reading the first time around. I have no doubt that *Mineralogical Record* readers will find the cumulative index a great boon to their enjoyment of the magazine. The Friends of Mineralogy are due a tremendous vote of thanks for the invaluable service they have provided.

Copies of the index are available at $20.00 postpaid (foreign orders add $1.00 per copy) from the Mineralogical Record Book Department, P.O. Box 1656, Carson City, Nevada 89702.

Incidentally, there is something of a problem with the distribution of the index to subscribing libraries. Due to the way library procedures are generally set up, indexes to publications are rarely purchased. This means that, regrettably, the *Mineralogical Record* is liable to remain unindexed in most libraries. Readers wishing to donate one or more indexes to libraries are invited to do so, either directly or through us, and the purchase will be tax deductible.

W.E.W.

HOT TIP FOR LAMP LOVERS

A new miner's lamp calendar has been published for 1985 by Senior Conflow, P.O. Box 265, Clinton, Pennsylvania 15026. The twelve color photos show groups of mine lamps and other mining antiques from the extraordinary private collection of Karsten Porezag, Wetzlar, West Germany. A total of 94 items are pictured, 72 of them lamps. The photos are beautifully done and the antiques, mostly German in origin, are superb.

The calendar is available at no charge, while the supply lasts.

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6. Photographs. Photos must be submitted loose, in numbered envelopes. Do not tape or glue photos, and do not write on the front or back of photos; doing so can ruin them for publication.

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Recent discoveries of Phenakite in Brazil

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Instituto de Geociências
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INTRODUCTION

Phenakite, Be_2SiO_4, occurs in granitic and miarolitic pegmatites primarily, but also in greisens, hydrothermal veins and Alpine-type veins. Localities include Mount Antero, Colorado (Jacobson, 1979); Sverdlovsk in the Urals, Soviet Union; the Morefield mine, Amelia County, Virginia; and the Anjanabonoina pegmatite in Madagascar, among many others. The finest specimens known, however, are from Brazil, where two new occurrences have recently been discovered.

SÃO MIGUEL DE PIRACICABA DEPOSIT

The São Miguel de Piracicaba deposit, in the state of Minas Gerais, was discovered prior to 1910 (Hussak, 1917), and produced what have long been considered to be the finest specimens of phenakite known (Sinkankas, 1966). The locality, now exhausted, lies about 50 km east of Belo Horizonte, and includes two separate pegmatite bodies: the Talho Aberto and the Morro Agudo.

The Talho Aberto pegmatite strikes N60°E and dips 55° to the southeast. The pegmatite body, which is unweathered, is enclosed within mica schist country rock and consists of milky quartz, abundant muscovite, amazonite, phenakite, pale blue beryl, and green and pink fluorite. A large adit 25 meters in length stretches along the pegmatite body to an elevation of about 740 meters. The prospect has been long abandoned, and was so thoroughly worked that it is now impossible to find even small fragments of phenakite in the adit or on the dump, despite the use of a berylometer (Cassedanne, 1969).

The Morro Agudo pegmatite is located about 800 meters from the Talho Aberto body at an elevation of about 920 meters. The pegmatite is weathered, and strikes east-west with a vertical dip. It was mined on a small scale for tantalite, but the tortuous adits caved in during the 1975 rainy season. The mineral assemblage includes milky quartz, kaolinized feldspar, schorl, abundant muscovite, beryl, topaz, and small amounts of phenakite, tantalite, zircon and fergusonite. Ferraz (1929) also observed dark smoky quartz, hematite, pyrite, xenotime, red almandine and rare monazite.

Over the years the São Miguel de Piracicaba pegmatites produced at least 13 metric tons of phenakite. The crystal habit is a round, flattened lens shape in sizes up to 10 cm in diameter, sometimes in very attractive groups up to 30 cm. Crystals are colorless and pale milky or translucent. Unfortunately the pegmatites

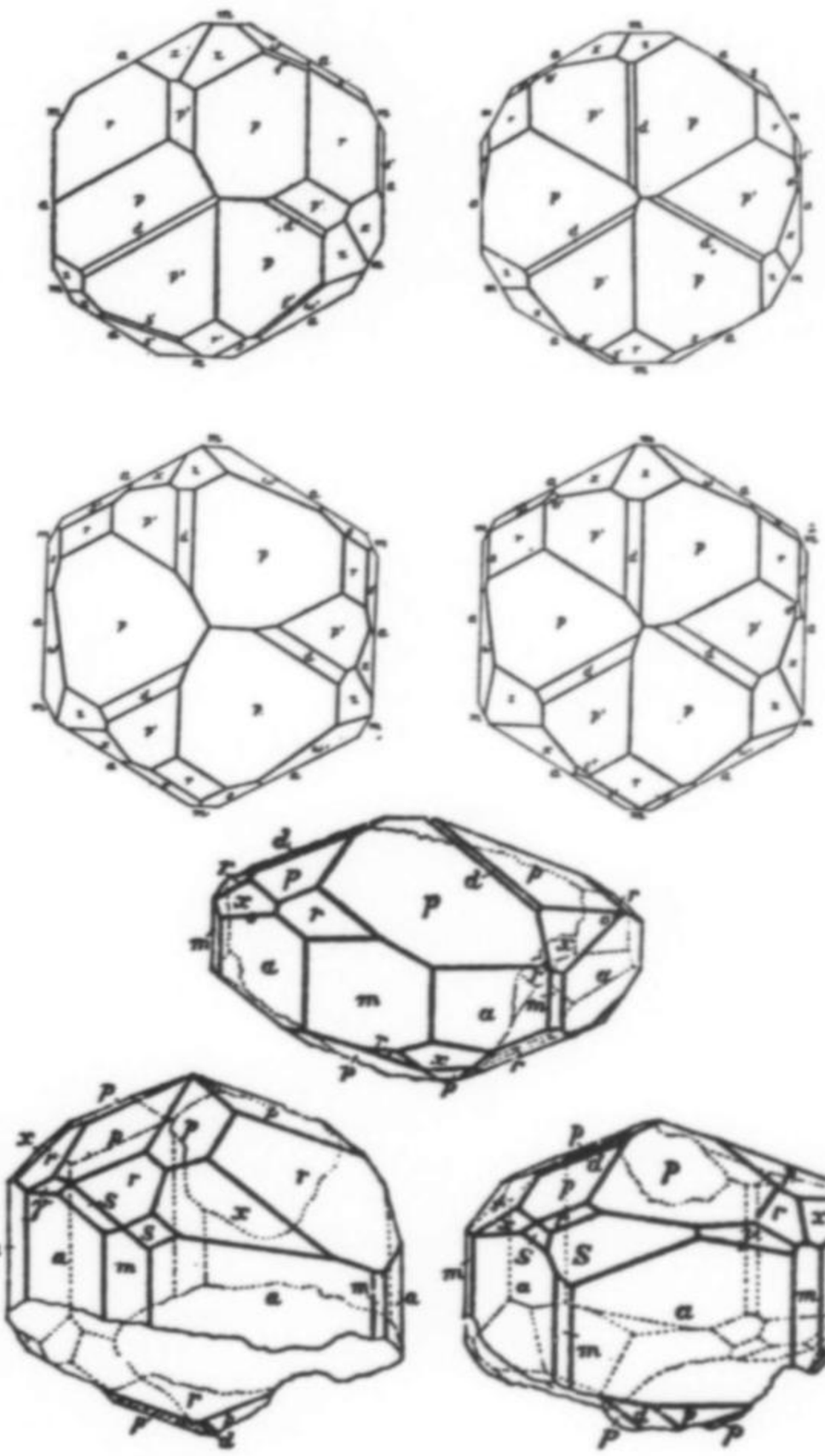

Figure 1. **Crystal drawings of phenakite from São Miguel de Piracicaba (Goldschmidt, 1920)**

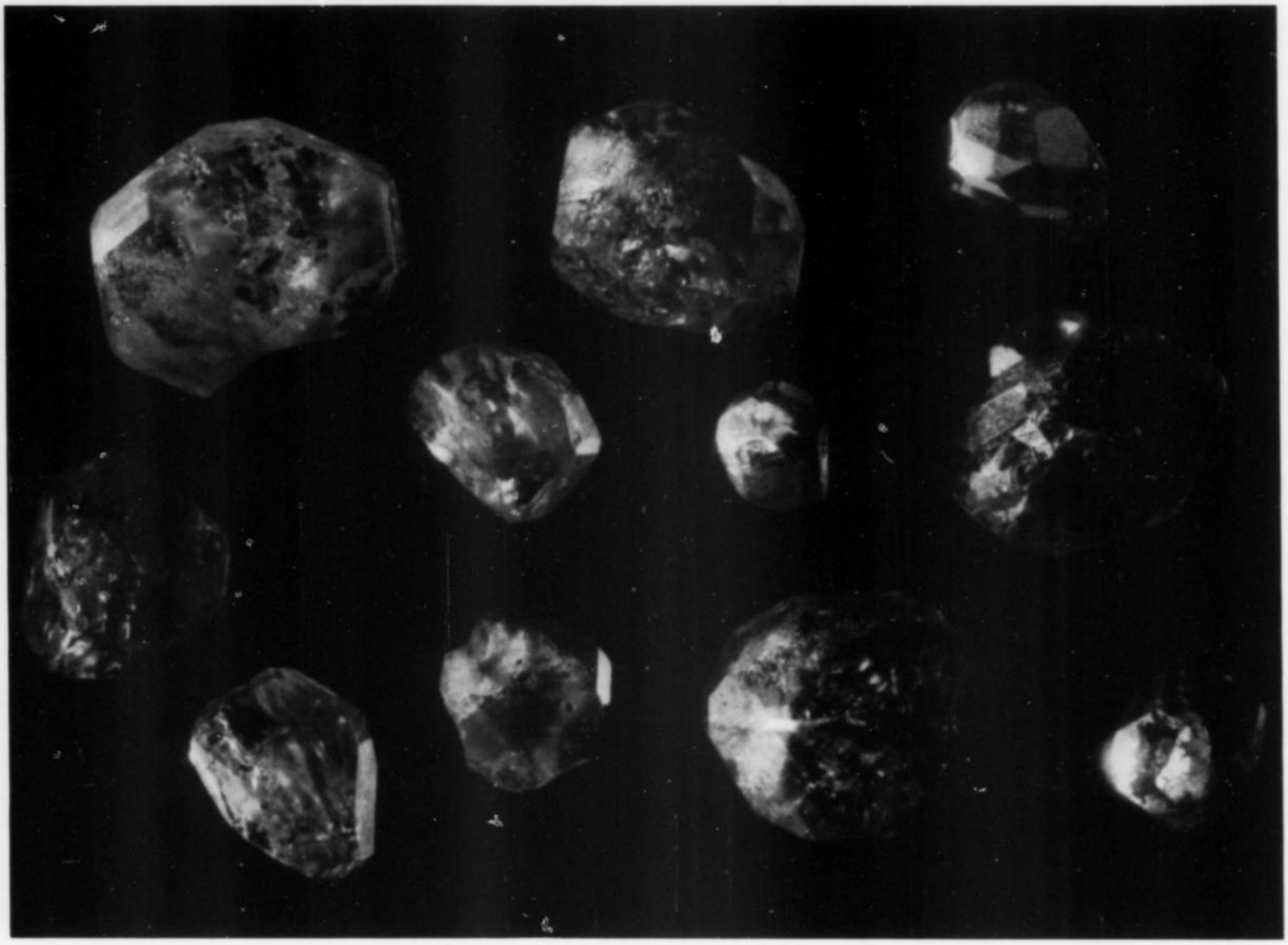

Figure 2. **Translucent, colorless phenakite crystals from the Pica Pau deposit. The largest crystal measures 2.5 cm.**

have been completely worked out, and no new specimens have been recovered in many years. Some small, sharp, discoidal crystals have appeared on the local mineral market in recent years, but the locality for these is unknown and local mineral dealers believe they are probably from the Catugi aquamarine placers.

SOCOTÓ EMERALD DEPOSIT

A short time after the Socotó emerald deposit was discovered in 1982, several large, slightly rounded phenakite crystals were found there. By 1983 thousands of garimpieros were working over the area, but failure of many of the diggings resulted in a partial closing of the mine in 1984.

The Socotó mine lies north-northeast of the Campo Formoso chromite mines and northwest of Salvador, approximately in the northern center of the state of Bahia. Access is easy via the Arara road, 17 km from Campo Formoso to Ituiutiba, then 8 km on a dirt road to the workings at an elevation of 890 meters. The region consists of low hills partially covered by grass and scattered dry forests.

The steeply dipping deposit strikes north-northeast and continues for about 3 km, reaching a maximum width of about 300–400 meters. It is surrounded by a metamorphic series of quartzites, gneiss, talc schists and peridotites of Precambrian age, 1.7 to 2.2 billion years old (Bruni, 1976). These rocks are intersected by fine-grained granite, quartz veins and thin, lenticular pegmatite bodies. The pegmatites, striking in various directions, are always steeply dipping with a core of dark smoky quartz surrounded by coarse white feldspar. Veinlets and large spots of greenish feldspar border the pegmatites in the wall rock. Gem-quality emerald, associated with sparse phenakite, rare molybdenite and very rare alexandrite are only found in the pegmatite rim (in a rock called sludite). Schorl is common in the feldspar.

Primitive mining at the deposit consists of small, irregular open pits on the outcrops and small shafts which branch out into tortuous adits. The main prospect workings are known as Cesta do Povo (in the north) and Mamona (in the south), divided by a nameless dry creek.

Geologically the Socotó deposit is very similar to the famous emerald deposit at Carnaíba less than 50 km to the southwest (Cassedanne and Cassedanne, 1975). At Carnaíba, however, phenakite is not found and scheelite and molybdenite are relatively abundant. At both localities good green beryl with quartz is found, though not of gem quality.

Phenakite from the Socotó mine occurs as milky to translucent crystals up to 10 cm in size, with rough faces and inclusions of sludite. The habit is short prismatic with a hexagonal cross-section, commonly terminated by two rhombohedrons with subrounded edges. The luster is vitreous, and the crystals are very brittle. Measured density is 2.95 ± 0.03. Optical indices (measured in Na light) are: $\omega = 1.654$, $\epsilon = 1.670$, both ± 0.002. The powder diffraction pattern is identical to that listed for phenakite in the JCPDS powder diffraction file. Phenakite specimens are easily obtained from the miners by asking for "white emerald."

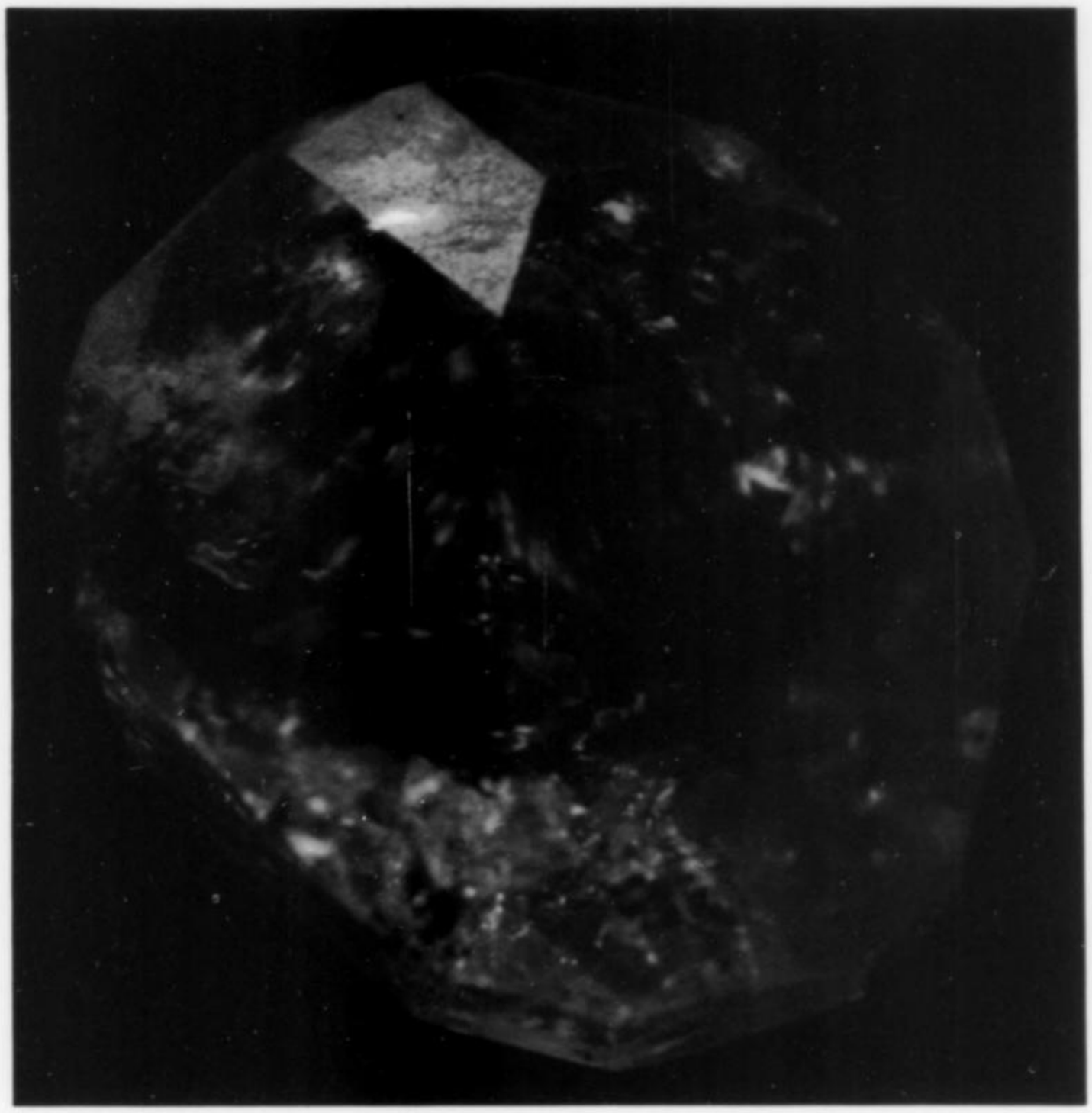

Figure 3. **A translucent phenakite crystal from the Pica Pau deposit. Note the two-phase inclusions. The crystal measures 2.5 cm.**

PICA PAU BERYL DEPOSIT

During 1983 a number of small, beautiful, transparent phenakite crystals were recovered from the Lavra do Pica Pau (Pica Pau prospect . . . Pica Pau means "woodpecker"). This deposit lies south-southeast of Padre Paraiso and north-northeast of Teofilo Otoni in northeastern Minas Gerais. Workings are on the northwestern slope of a granitic outcrop in the southwestern portion of the fazenda (property of) Manual Batista Duarte.

Access is by way of the Rio-Bahia highway as far as Ponte do Marambaia, and from there 12.7 km on a good dirt road along the Marambaia River, past some aquamarine placers. The farm road, 3.3 km long, begins at a place called Manoel Marciano; finally the prospect is reached by a steep footpath which crosses a small stream near the workings. The region is hilly, with inselbergs overlooking narrow valleys and small patches of tropical forest between poor pasture areas.

The Pica Pau prospect is an irregular open pit exceeding 100 square meters in area and 5 to 15 meters deep. The host granite is coarse-grained with potassium feldspar phenocrysts, irregular lenses of fine-grained granite, and abundant schist xenoliths. Workings are located on small, irregular pegmatite lenses running roughly north-south. Where these intersect, fine-grained granite, specimens of quartz, feldspar, large biotite books, aquamarine, phenakite, schorl, magnetite, small garnets and a few dark smoky quartz crystals have been found.

Many phenakite crystals have been recovered from the colluvium in the steep slope of the nearby foothill area of the granite outcrop, and in a small flat area below the prospect.

The phenakite crystals at Pica Pau are always loose, transparent and well formed with many faces. Crystals are commonly 1–2 cm but have been found as large as 6 cm. The habit is almost flat lenticular, very rarely prismatic, and crystal faces tend to be smooth or pitted with small growth features and contact points. Two-phase inclusions and iron oxide-filled fractures are common. Pica Pau phenakite is not especially brittle. Measured density is 2.96 ±0.02; X-ray data and optical indices are identical to those given above for Socotó phenakite.

ACKNOWLEDGMENTS

Many of the Pica Pau phenakite crystals examined for this study were kindly provided by Aldo Mario Barroso Pinheiro, a mining engineer in Teofilo Otoni.

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INTRODUCTION

A few years ago, Carlos Barbosa separated some hard, brown to orange pebbles from tin ore and recognized the material as a new mineral. Shortly thereafter this new species was formally described and named bahianite ($Al_5Sb_3O_{14}(OH)_2$) by Moore *et al.* (1978). In their description the type locality is given only as the Paramirim area in the state of Bahia, Brazil. The environment is described as a deposit of tin ore, but specifics of the occurrence and geological description are not included. Our purpose here is to describe the geological environment, principal bahianite-bearing prospects and occurrences, and the associated minerals.

LOCATION

The Chapada Diamantina is a quartzitic highland plateau running north and south, located west of Salvador in central Bahia. The bahianite occurrences are restricted to the western portion of the *chapada* (= plateau), a region known as the Serra da Mangabeira (Schobbenhaus, 1967), and are located near the small towns of Livramento do Brumado and Paramirim. From Vitória da Conquista one travels 145 km on the Rio-Bahia highway to Brumado, and from there both towns can be reached by good roads at distances of 66.5 and 130 km respectively.

The chapada is situated between the Paramirim Valley lowlands in the West and the Itaberada plain in the East, and is broken by high mountains and deep valleys. Summits, reaching 1836 meters at the Pico das Almas, tower more than a thousand meters over the surrounding grassy to forested plateau. Rain forests occupy the slopes, and population is concentrated in the humid, cultivated valleys.

GEOLOGIC SETTING

Quartzites of the chapada are members of the Chapada Diamantina group, which is part of the Espinhaço supergroup (Precambrian, 1.7 to 1.1 billion years old). They lie in angular unconformity on older Precambrian gneisses and are covered, also in angular unconformity, by the Bambuí group formations. The Chapada Diamantina group, several thousand meters in thickness, consists of extrusive volcanic rocks in the lower members; quartzites, schists, diamond-bearing conglomerates and phyllites in the middle units; and limestone in the upper part. The group is divided into six units (Pedreira, 1976; Bruni and Schobbenhaus, 1976), and is folded into wide anticlines trending north to north-northwest which are intersected by transverse and longitudinal faults.

At the base of the series is Unit 1 or the Rio dos Remédios complex, a long, westward dipping volcanic sequence which outcrops from Itanagé in the South to beyond Ibitiara in the North, all on the western portion of the chapada. It is a metamorphosed felsic volcanic flow a few hundred meters in thickness and consisting of quartz porphyrys, rhyolites, dacites, tuffs, breccias and intermediate rocks and also locally some conglomerates, quartzites, slates and kyanite-andalusite schists containing rutile and allanite (Schobbenhaus, 1972). The volcanic rocks are generally dark gray with porphyroblasts of feldspar and quartz in an anorthite-quartz-magnetite matrix. Accessory minerals include fluorite, garnet, biotite, apatite, zircon, titanite, tourmaline, pyrophyllite, topaz, rutile, ilmenite (leucoxene) and hematite. Epidote, sericite, calcite and kaolinite occur as weathering products and hydrothermal alteration products in the flow. The volcanics are characterized by epizone metamorphism with local development of mylonites, cataclasites and lenses of muscovite-quartz schist. Stringers and corrugated veins of pegmatite and quartz intersect the volcanic rocks, all affected by Brazilian-age dynamometamorphism.

The flow rocks are overlain in angular unconformity by quartzites having lenticular basal conglomerates. See Pedreira (1976) for descriptions of the other units. The three lower units are cut by tholeiitic intrusions of various sizes, including some ultrabasic sills.

The bahianite pebbles, originally a part of the volcanic flows, tend to concentrate in river gravels derived from weathering of the flow rocks. Local residual soils may include bahianite as well.

MORRO DO CHAPEÚ PROSPECT

This occurrence, also known as Paramirim das Crioulas and Rio do Pico das Almas, was the principal producer of bahianite and therefore most likely the actual type locality. Associations here include cassiterite, gem-grade andalusite and small amounts of gold.

Access is by way of Paramirim via Água Quente (15 km), where a dirt road (passable only by four-wheel-drive vehicles in the dry season) leads upstream along the Córrego da Barra, passing Brejo (25 km), Barra and Barra de Cima (31.5 km) before crossing the Serra das Crioulas (36.5 km) and descending to the Riacho Taipará Valley upstream to Paramirim das Crioulas (50 km, at an elevation of 1000 meters). From this poor hamlet to the occurrence it is two hours on horseback and an additional 30 minutes on foot. The occurrence is on the southern slope of the Pico das Almas, about 8 km southeast of Paramirim das Crioulas.

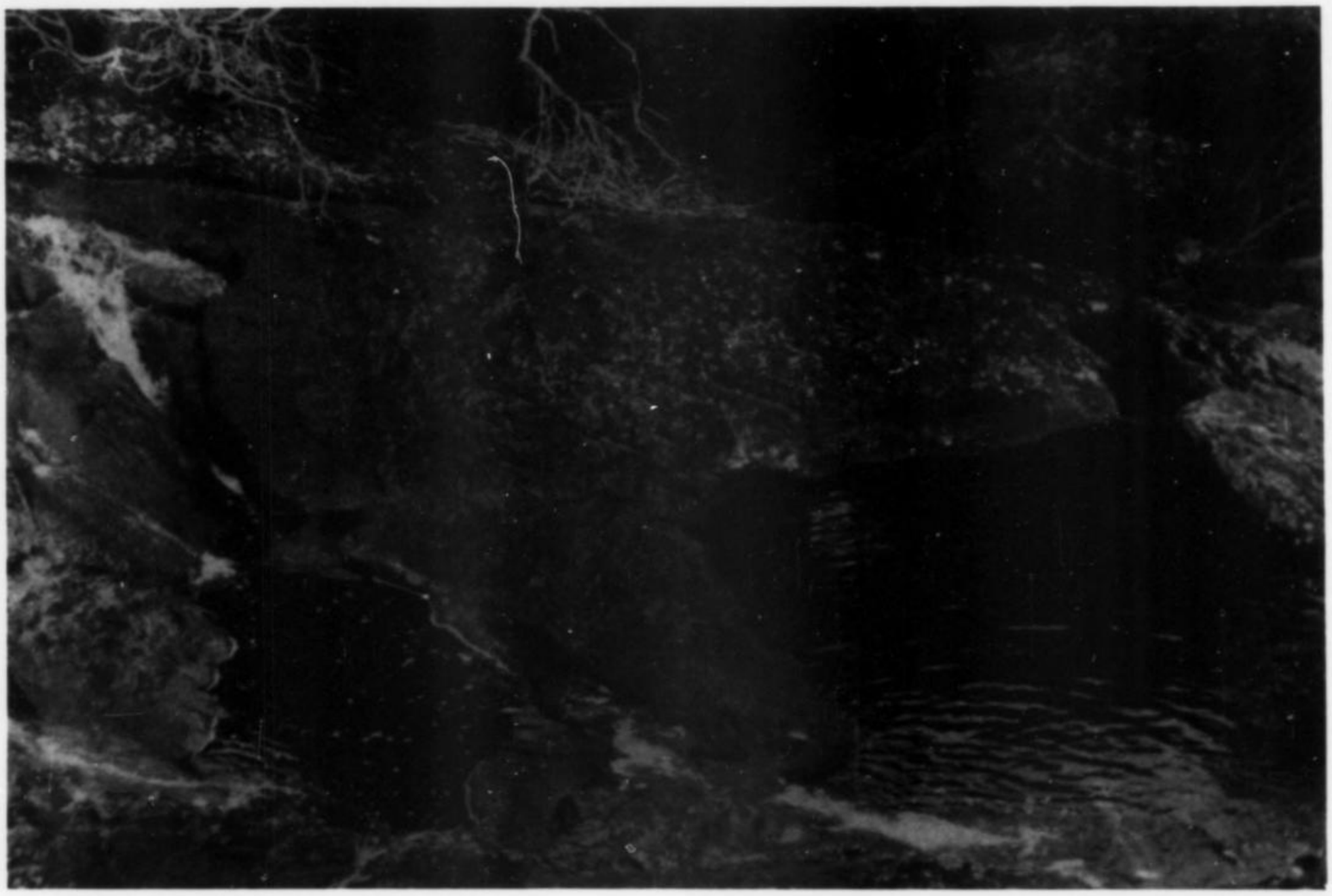

Figure 1. **Pot holes in the Rio do Pico das Almas, near an elevation of 1270 meters.**

The Morro do Chapeú prospect is situated in a northwest-trending creek flowing over volcanic rocks striking north-northwest and dipping steeply to the northeast. The creek falls to the bottom of a wide amphitheater lined by cliffs of gently dipping quartzite and conglomerate lenses. Andalusite, disseminated or in veins, is abundant in the volcanic rocks whereas cassiterite and bahianite are scarce. Hematite beds exceeding 5 cm in thickness are common, as are beds of talc sprays on pyrophyllite. Corrugated or wavy quartz veins intersect the volcanic rocks, and patches of eroded laterite crust occur near the 1280-meter level.

Bahianite (referred to simply as "antimony" by the miners) was discovered a few years ago near the 1260-meter level where the creek runs across giant dismantled blocks of volcanic rock, and where old, hard, ferruginous gravels have been preserved. These, called *cascalho gelado* ("frosty gravel"), were crushed by hand to remove the included gold. Low grade and a predominance of bahianite over cassiterite made the operation uneconomical and the prospect was abandoned. Cassiterite and gem-grade andalusite were prospected for downstream but without success. Upstream bahianite is found concentrated in large pot holes, but ceases beyond the junction with a small creek which enters from the left side near the 1280-meter elevation. In the valley of this small creek, minor concentrations of bahianite occur in small pits developed in the volcanic rocks by weathering.

Extensive weathering of the bahianite-bearing volcanic rocks has resulted in a deposit restricted in surface area to a few thousand square meters. Following an initial enrichment of the residual soil by the dense and insoluble bahianite, the mineral subsequently became concentrated in coarse, heterogeneous laterite crusts (probably Cenozoic in age) and also in traps in the bed of the Rio das Almas. This occurrence, despite its small size, appears very similar to the cassiterite occurrence in the Livramento-Paramirim area (Cassedanne and Cassedanne, 1981).

Bahianite *in situ* will probably be found in an antimony-rich lens

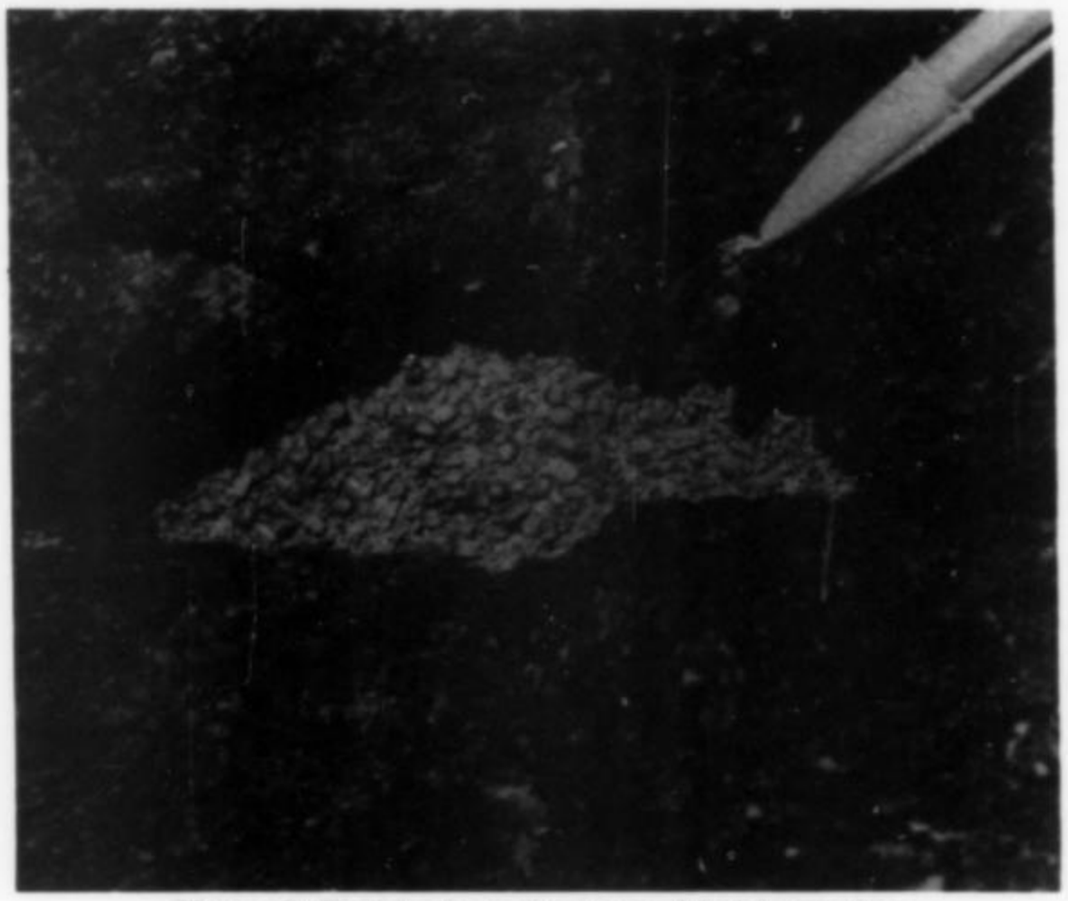

Figure 2. **Residual cassiterite and bahianite in a small erosional pit in volcanic rock. Rio do Pico das Almas, near an elevation of 1280 meters.**

of volcanic rock which has been metamorphosed and enriched in aluminum (evidenced by andalusite and staurolite). Some bahianite grains have inclusions of quartz and others are coated by a staurolite-like alteration product.

Recent alluvial deposits in the area are argillaceous and contain abundant reddish pebbles and fragments of hematite-rich rocks, quartz and andalusite. Table 1 lists minerals identified from Morro do Chapeú. Particularly noteworthy are the exceptional crystals of eskolaite, hexagonal singles to 4 mm in length (Cassedanne and Cassedanne, 1980a), and good pseudomorphs of goethite after twigs which are visible in polished section. See Cassedanne and Cassedanne (1980b) for information on the gem properties of the green andalusite (variety *viridine*).

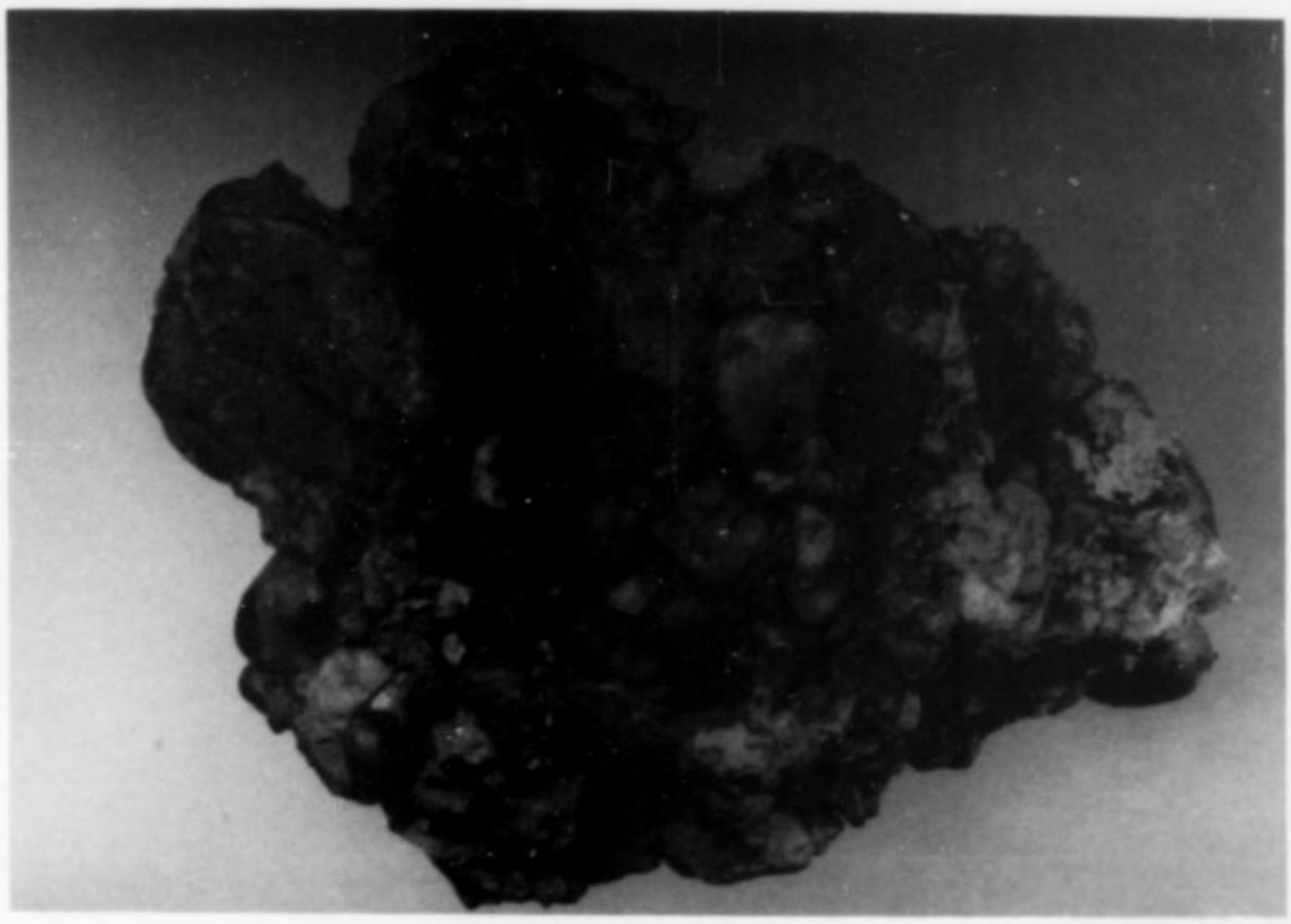

Figure 3. **Old, hard, ferruginous bahianite-bearing gravel. The sample is 11 cm in length. Rio do Pico das Almas, near an elevation of 1260 meters.**

Figure 4. **Bahianite gravel. The largest grain is 6 mm wide. Rio do Pico das Almas.**

A panning test yielded 0.46% heavy material (»2.9); of this residue, 2.3% is bahianite and 0.55% is cassiterite. Gravels from the old horizons are significantly richer.

Aginaldo José Araujo, a placer miner whose house is about 2 km upstream from Paramirim das Crioulas, is an excellent guide to the occurrence and has in the past been a very inexpensive source of bahianite specimen material. He has probably sold many kilograms of bahianite, and his prices are no doubt low because tourists and mineralogists virtually never lose their way so badly as to stumble on this neglected area by accident.

SERRA DO PORCO GORDO PROSPECT

The Serra do Porco Gordo prospect (also known as Furnas, from the former name of a nearby hamlet now known as Arapiranga) is located 19 km north-northeast of Livramento do Brumado at an elevation of 465 meters. Access is by way of the Jussiape road, which climbs up the Serra do Rio de Contas and then descends into the Rio Furnas Valley where a secondary road passes Casa da Telha and Umbuzeiro Grande, finally reaching Arapiranga at a distance of 48 km. A four-wheel drive trail proceeds for another 2 km, followed by a tortuous footpath to Piatã, climbing the western slope of Capãn do Bode mountain to the occurrence. The tiresome climb takes about an hour.

The prospect lies near the Piatã trail between 1150 and 1180 meters elevation, in the flat Riacho Canabravinho valley north-northeast of Arapiranga. Here a creek flows over porphyritic rhyolites. A short distance away, subhorizontal conglomerates and quartzites lie in angular unconformity on volcanic flows. Cassiterite associated with limonite was recovered here from the residual soil, from some large pot holes and from alluvial terraces. The prospect is now almost exhausted after having produced several dozen metric tons of cassiterite and a small amount of bahianite and gem-grade andalusite.

Table 1 lists the composition of local gravels which, when test panned, yielded 0.017% cassiterite and 0.002% bahianite.

PARAMIRIM AREA

Cassiterite has been found in the Paramirim area in creeks which have crossed volcanic rock outcrops, and which drain either inward on the chapada or outward to the Riacho do Bosque area. Mineral-bearing residual soils are remnants of a Cenozoic peneplain or more recent accumulations as colluvium on slopes. Upstream near the small town of Brejo veins of cassiterite "wood tin" to 1 cm in thickness were hand-mined, but bahianite is very rare in this area.

Brejo de Santa Tereza

Brejo de Santa Tereza (also known as Brejinho) is reached from Paramirim by the Brumado road for 9 km, then by a sandy road to the small foothills village of Canabravinha. From there a jeep trail climbs the mountain, passing along the way the Mata do Fumo prospect and Brejinho village, finally reaching the upland. A footpath traverses the final distance, about 15 minutes, to the Lageado Preto and Aguada prospects. At Lageado Preto cassiterite is found in residual soil and stream gravels between outcrops of volcanic rocks striking N20°W and dipping 50°W. At the Aguada prospect residual soil, colluvium, alluvium and subhorizontal "wood tin" veinlets running N65°E and intersecting kaolinized volcanics have been exploited.

The mineral composition of alluvial material from the Brejo area is given in Table 1. Zircon is the principal constituent of the heavy fraction, and bahianite and eskolaite are very rare. A test panning yielded 100 grams of cassiterite, containing 0.4% bahianite and 0.03% gold.

Mata do Fumo

Patches of alluvium and residual soil on volcanic rocks here have yielded some cassiterite.

Figure 5. **The sophisticated balance used in weighing cassiterite/bahianite concentrates for sale at Paramirim das Crioulas. Stones are (very approximately) 4 kg in weight.**

Riacho do Bosque

A bad 10-km trail leads to the Riacho do Bosque prospect about 10 km north-northeast of Paramirim. Pot holes and old gravel horizons here have been searched for cassiterite.

Other prospects

The Fazendas Juriti, Butim, Mimoso, Campos and Carnaubinha have all been prospected for cassiterite (Bruni and Schobbenhaus, 1976) but are currently abandoned.

BAHIANITE

Considering the origin of the name (the state of Bahia), the spelling chosen would probably have been bahiaite, except that this term had already been used by Washington (1914). It was applied to a pyroxenite rock found near Maracas (Bahia) that was described as a "holocrystalline rock characterized by a combination of hypersthene and hornblende." This rock type, first described but not named by Merrill (1894) from a locality at Grass Creek, Montana, was later also observed in Norway (Barth, 1950).

Bahianite occurs as sand, gravel, pebbles and reniform nodules of various sizes, exceptionally reaching 10 cm but more generally 2–4 cm in length, and always free of matrix. A few very rare, rounded crystal aggregates have also been observed. Gravel particles commonly show small crystal faces in cavities. Fracture is uneven; the texture is fine-grained, frequently fibrous and sometimes radiating. Color varies from honey-yellow to brownish gray with tan or chestnut hues.

Mohs hardness is 9, and Vickers microhardness determined on a yellow specimen is 1605 kg/mm^2 with a 100 gram load. Density varies with composition, from 4.78 (Morro do Chapeú) to 5.46 g/cm^3 (Moore *et al.*, 1978). Calculated density is 5.26 g/cm^3.

Crystals have striated, curved faces and a diamond-shaped or rectangular cross-section. Twinning is identical to that of chrysoberyl, luster is adamantine, and cleavage {100} is perfect.

Figure 6. **Bahianite-bearing pot hole in the Riacho Canabravinho.**

Table 1. **Alluvial minerals identified from the bahianite prospects in the Serra do Mangabeira**

Species	Formula	Locality 1	2	3
Amphibole	group			x
Anatase	TiO_2	x		x
Andalusite	Al_2SiO_5	x	x	x
Apatite	group		x	x
Bahianite	$Al_5Sb_3O_{14}(OH)_2$	x	x	x
Barite	$BaSO_4$		x	
Brookite	TiO_2			x
Cassiterite	SnO_2	x	x	x
Chalcopyrite	$CuFeS_2$			x
Chrysoberyl	$BeAl_2O_4$	x		
Corundum	Al_2O_3	x		
Diamond	C	x		
Epidote	$Ca_2(Al,Fe)_3(SiO_4)_3(OH)$			x
Eskolaite	Cr_2O_3	x		x
Feldspars	group	x		x
Galena	PbS			x
Garnet	group	x		x
Goethite	FeO(OH)	x		
Gold	Au	x		x
Hematite	Fe_2O_3	x	x	x
Ilmenite	$FeTiO_3$	x		x
Kyanite	Al_2SiO_5	x	x	x
Lazulite	$MgAl_2(PO_4)_2(OH)_2$	x		x
Limonite	Fe-oxides		x	x
Magnetite	Fe_3O_4	x	x	x
Mn-oxides	Mn-oxides	x		
Monazite	$(Ce,La,Nd,Th)PO_4$	x	x	x
Perovskite	$CaTiO_3$			x
Pyrite	FeS_2			x
Pyrrhotite	$Fe_{1-x}S$			x
Quartz	SiO_2	x	x	
Rutile	TiO_2	x	x	x
Sillimanite	Al_2SiO_5	x	x	
Spinel	$MgAl_2O_4$	x	x	x
Staurolite	$(Fe,Mg,Zn)_2Al_9(Si,Al)_4O_{22}(OH)_2$	x	x	x
Topaz	$Al_2SiO_4(F,OH)_2$	x		
Tourmaline	group	x	x	x
Zircon	$ZrSiO_4$	x	x	x

1 = Morro do Chapeú (Cassedanne and Cassedanne, 1981)
2 = Serra do Porco Gordo
3 = Brejo de Santa Tereza

Moore *et al.* (1978) determined bahianite to be monoclinic, pseudo-orthorhombic, space group C2/n, $a = 9.406(6)$ Å, $b = 11.541(8)$ Å, $c = 4.410(3)$ Å, and $\beta = 90.94(3)°$ with $Z = 2$. The structure is similar to that of simpsonite. Bahianite is biaxial negative with a large 2V. Optical indices are $\alpha = 1.81$, $\beta = 1.87$ and $\gamma = 1.92$ (all ± 0.01), with $r > v$.

In thin section bahianite takes a very good polish and exhibits mosaic texture. Pleochroism is weak. Yellow internal reflections in polarized light tend to mask the anisotropy, but flabelliform (fan-like) texture is well developed. Reflectivity in white light is approximately 5%.

Bahianite composition varies with substitutions from the Moore *et al.* (1978) formula of $Al_5Sb_3O_{14}(OH)_2$ to $Al_5Sb_3(Al,Be,Si)_2O_{16}$.

Qualitative spectroscopic analysis of samples from Morro do Chapeú and Brejinho indicate:

Major elements: Al, Sb
Minor elements: Fe, Ni, Ti, W, Ca, Cr, Bi, Si
Trace elements: Ag, Zn, Cu, V, Sn, Mn, Pb

A recent quantitative analysis by C. Dutra of Belo Horizonte is compared in Table 2 with the data of Moore *et al.* (1978).

Table 2. **Quantitative chemical analyses of bahianite**

	1	2
Sb_2O_5	61.9	57.28
Al_2O_3	30.6	35.37
SiO_2	3.5?	1.03
Fe_2O_3	1.3	1.04
WO_3	0.3	1.20
BeO	0.75	0.75
MnO	tr	n.d.
TiO_2	0.2	n.d.
CaO	n.d.	n.d.
MgO	0.1	m.d.
H_2O	0.85	2.77
	99.50	99.44

1 = Recent analysis by C. Dutra
2 = Analyses of Moore *et al.* (1978) (average of 4)

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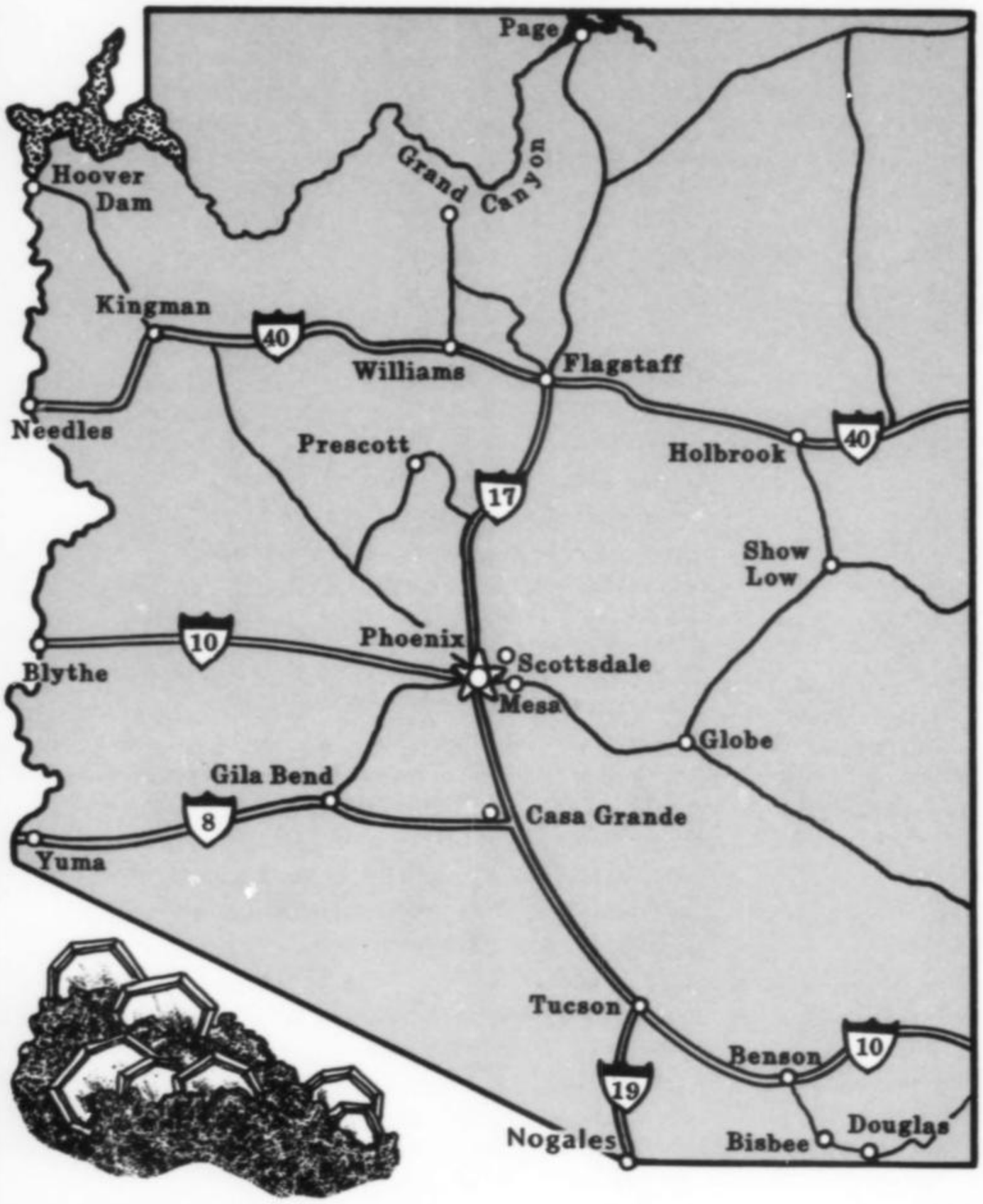

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Mammothite
a new mineral from Tiger, Arizona and Laurium, Greece

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ABSTRACT

Mammothite, $AlCu_4Pb_6Sb(SO_4)_2Cl_4(OH)_{18}$, is a new mineral species from Tiger, Arizona, where it is associated with anglesite and phosgenite, and from Laurium, Attika, Greece, where it is associated with cerussite and phosgenite. Microprobe analysis yielded $Al_2O_3 = 2.3$, $CuO = 14.9$, $PbO = 57.6$, $Sb_2O_3 = 6.1$, $SO_3 = 7.7$, $Cl = 5.7$, H_2O (by difference) = 7.0, less $O = Cl = 1.3$, sum = 100.0 %. Mammothite is monoclinic, space group *C*2, *Cm*, or *C*2/*m*, with lattice parameters $a = 18.89(3)$, $b = 7.22(1)$, $c = 11.31(2)$ Å, $\beta = 112.43(18)°$, $Z = 2$. Mammothite is blue; hardness (Mohs) = 3; cleavage is {010}, luster is vitreous, density (calc.) is 5.25 g/cm^3. Optically, mammothite is biaxial, positive, $2V = 80°$; with indices of refraction $\alpha = 1.868$, $\beta = 1.892$, and $\gamma = 1.928$. Pleochroism is moderate with varying hues of light blue; absorption is $Z < Y \leq X$. The strongest lines in the X-ray powder diffraction pattern are: (*d*, I/Io, *hkl*) 10.4(60)(001), 6.67(90)(110), 6.08(60)(11$\bar{1}$). 4.72(80)(40$\bar{1}$, 31$\bar{1}$), 3.05(90)(221), and 2.896(100)(600,203). Mammothite is named for the Mammoth vein, Tiger, Arizona, and the town of Mammoth, Arizona.

INTRODUCTION

The new mineral described herein has been known for at least 15 years. It was originally noted by one of the authors (RAB) who found it in 1968 during an investigation of the mineralogy of the mines at Tiger, Arizona. Preliminary microprobe investigation by Richard W. Thomssen revealed that it is a lead-copper-antimony chloride-sulfate, and it was reported as an unknown by Bideaux (1980). This species was also known to many European collectors as a light blue unknown from Laurium, Attika, Greece. However, at Laurium, the minerals occur in crystals much too small to permit characterization of the species. During the course of examination of some Cl-bearing phases from Tiger in the Smithsonian collection, another habit of the same mineral was encountered and the common identity of specimens from all these occurrences was established.

We take pleasure in naming this species *mammothite* after the Mammoth vein (one of the two principal ore veins at Tiger) and the town of Mammoth, Arizona, which was named for the mine. The species and the name were approved by the Commission on New Minerals and Mineral Names, I.M.A., prior to publication. Type material is preserved in the Smithsonian Institution under catalog numbers NMNH #141368 and #161200, and in the Mineralogical Museum of the University of Goettingen under catalog #M5632.

X-RAY CRYSTALLOGRAPHY

Crystals from Tiger, Arizona, are sufficiently large and perfect to provide single-crystal X-ray diffraction data. Weissenberg and precession photographs show that mammothite is monoclinic, space group *C*2/*m*, *C*2, or *Cm*. Lattice parameters were refined by least-squares, utilizing powder diffraction data, yielding the values $a = 18.89(3)$, $b = 7.22(1)$, $c = 11.31(2)$ Å, $\beta = 112.43(18)°$, $V = 1426(5)$ Å^3, $Z = 2$. The powder diffraction data are listed in Table 1. They were obtained utilizing a 114.6-mm diameter Gandolfi camera, Cu$K\alpha$ X-radiation, polycrystalline sample, and Si as an internal standard.

PHYSICAL DESCRIPTION

The holotype mammothite from Tiger, Arizona (#161200), is bright blue; it was described as having a cerulean-blue color by Bideaux (1980). The hue is similar to that of linarite or azurite. The crystals are complexly developed and appear similar to triclinic

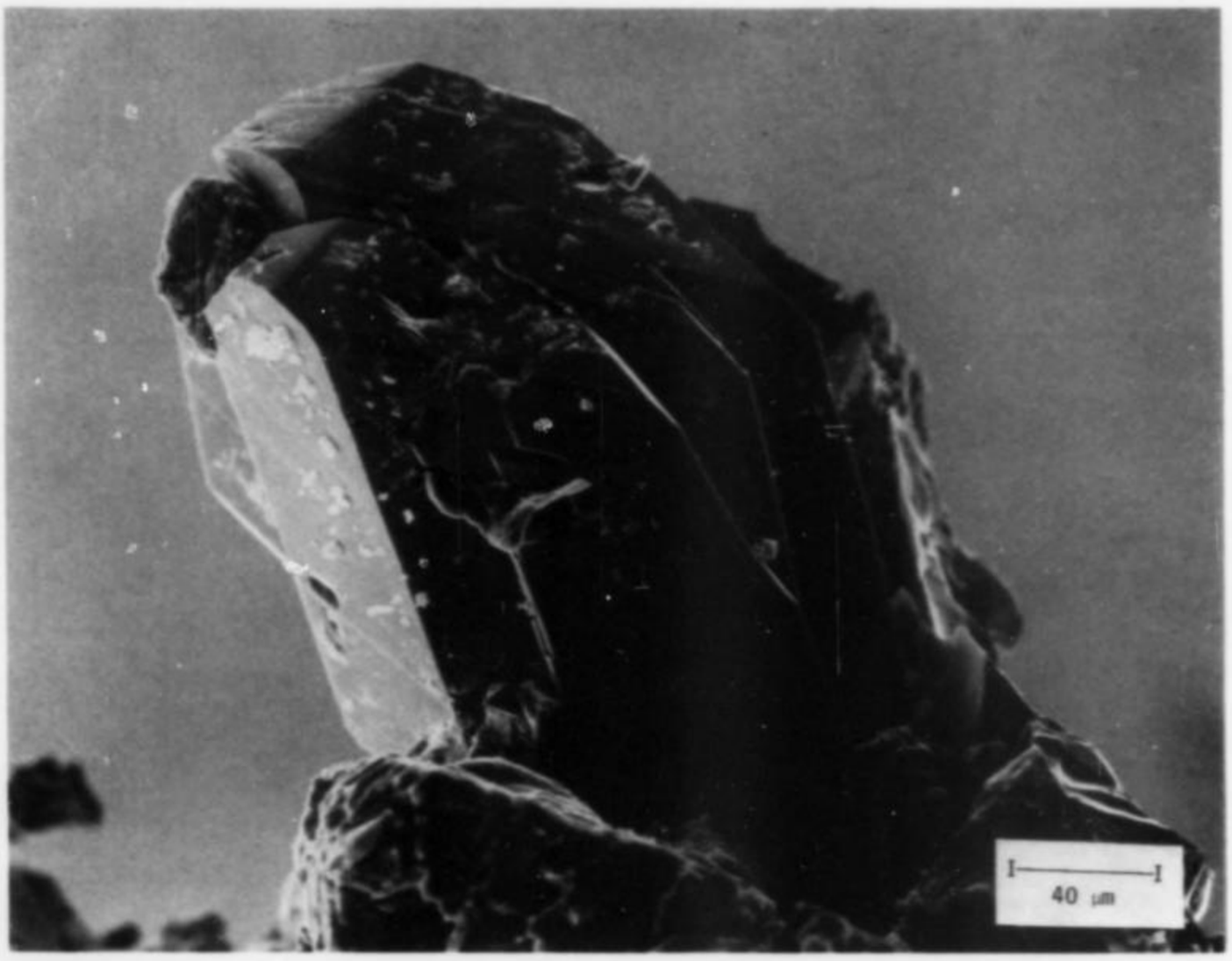

Figure 1. **Mammothite crystals in parallel growth; scale bar is 40 μm. NMNH #161200, Tiger, Arizona.**

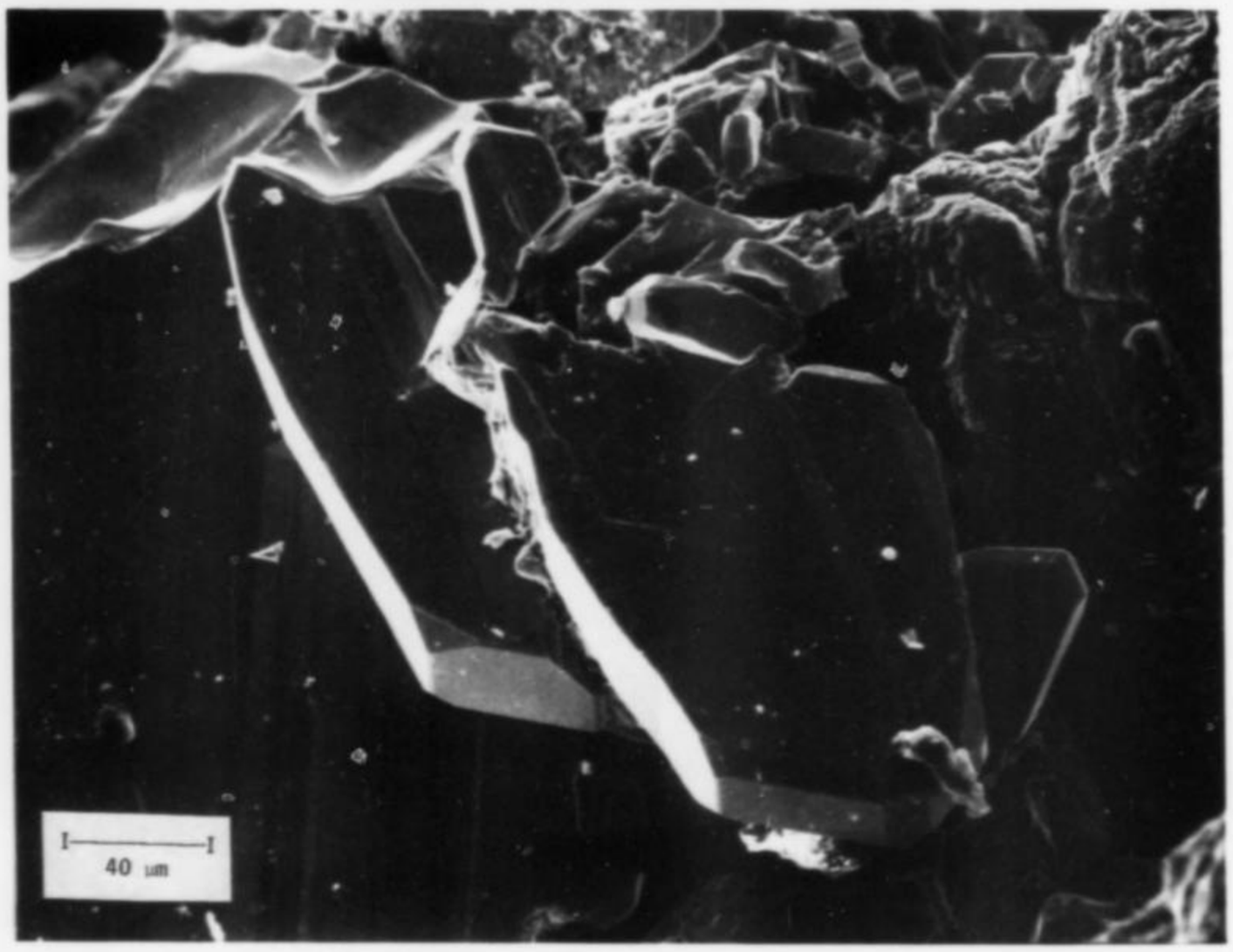

Figure 2. **Severely flattened mammothite crystals. Scale bar is 40 μm. NMNH #161200, Tiger, Arizona.**

chalcanthite crystals in habit, albeit with more complex morphology. Optical goniometer data were obtained for one crystal. The dominant forms are {001}, {110}, and a possible {010}, which is not directly determinable due to low quality reflections on the optical goniometer. Although most crystals are tabular, several are elongate; the axis of elongation is [001]. Crystals which exhibit this morphology are shown in Figure 1, an SEM photomicrograph of three mammothite crystals in parallel growth. Another mammothite crystal from the holotype occurrence is shown in Figure 2. The cotype mammothite (#141368), not depicted here, is markedly different in color and crystal habit; the color is a distinct green-blue with equal intensity of blue and green color components. The habit is strongly prismatic and the crystals have a pseudotetragonal aspect. Crystals are less than 1.0 mm in size.

Mammothite from Laurium, Attika, Greece, is quite different in physical appearance. The material varies in color from pale blue to very pale blue to nearly white. Crystals are extremely small and the morphology is not easily determined by visual examination. There are two habits: one prismatic and bladed; the other extremely prismatic, elongate on [001]. Figure 3 shows a cluster of the prismatic bladed crystals; Figures 4 and 5 show the extremely acicular habit.

Physical properties were determined on the holotype material from Tiger. These include bright blue color; pale blue streak; hardness (Mohs) approximately 3; vitreous luster on both cleavage and fracture surfaces; cleavage distinct on {010}; even fracture; and very brittle. The density could not be precisely measured due to small crystal size and abundant attachments of associated species. It is greater than 4.2 g/cm³, measured using heavy liquid techniques. The calculated value for the idealized end-member is 5.25 g/cm³.

Optically, mammothite is biaxial, positive, with $2V = 80°$ (meas.). Indices of refraction are $\alpha = 1.868$, $\beta = 1.892$, and $\gamma = 1.928$. Pleochroism is moderate with varying shades of pale blue; absorption is $Z < Y \leq Z$. Mammothite is transparent, with no discernible response to ultraviolet radiation. Calculation of

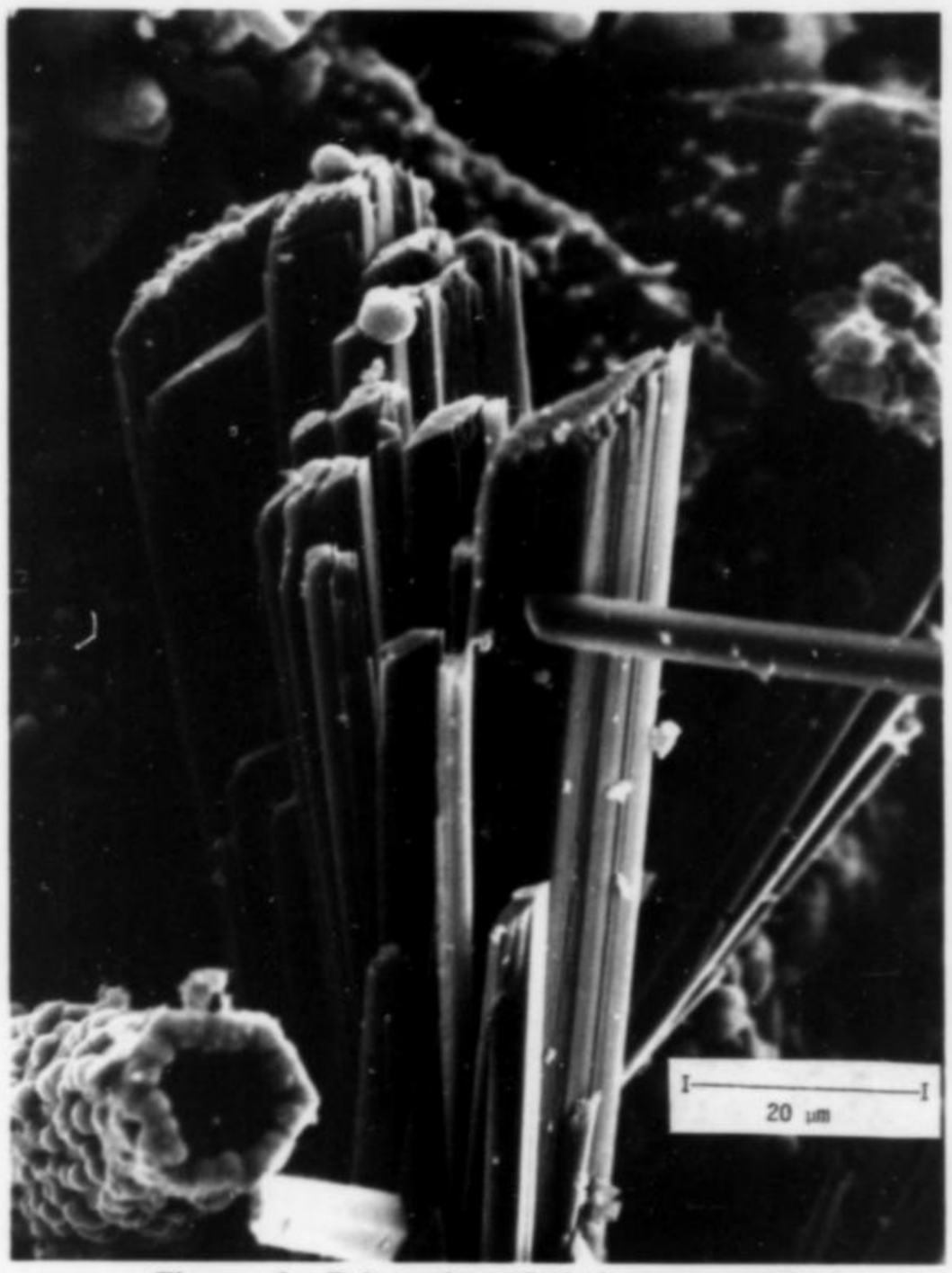

Figure 3. **Prismatic, bladed mammothite crystals in parallel growth. Scale bar is 20 μm. Laurium, Greece.**

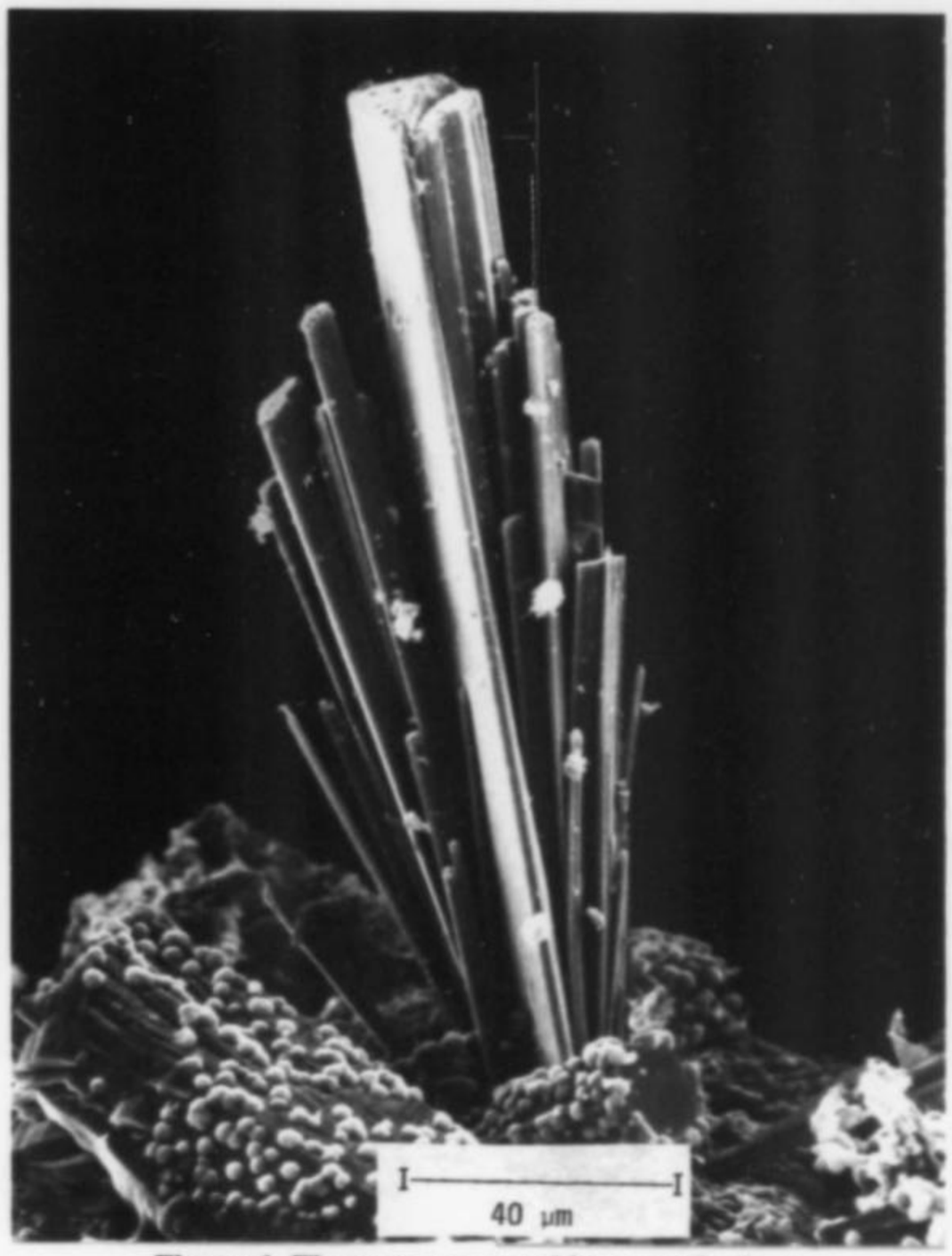

Figure 4. **Elongate mammothite crystals showing prismatic habit. Scale bar is 40 μm. Laurium, Greece.**

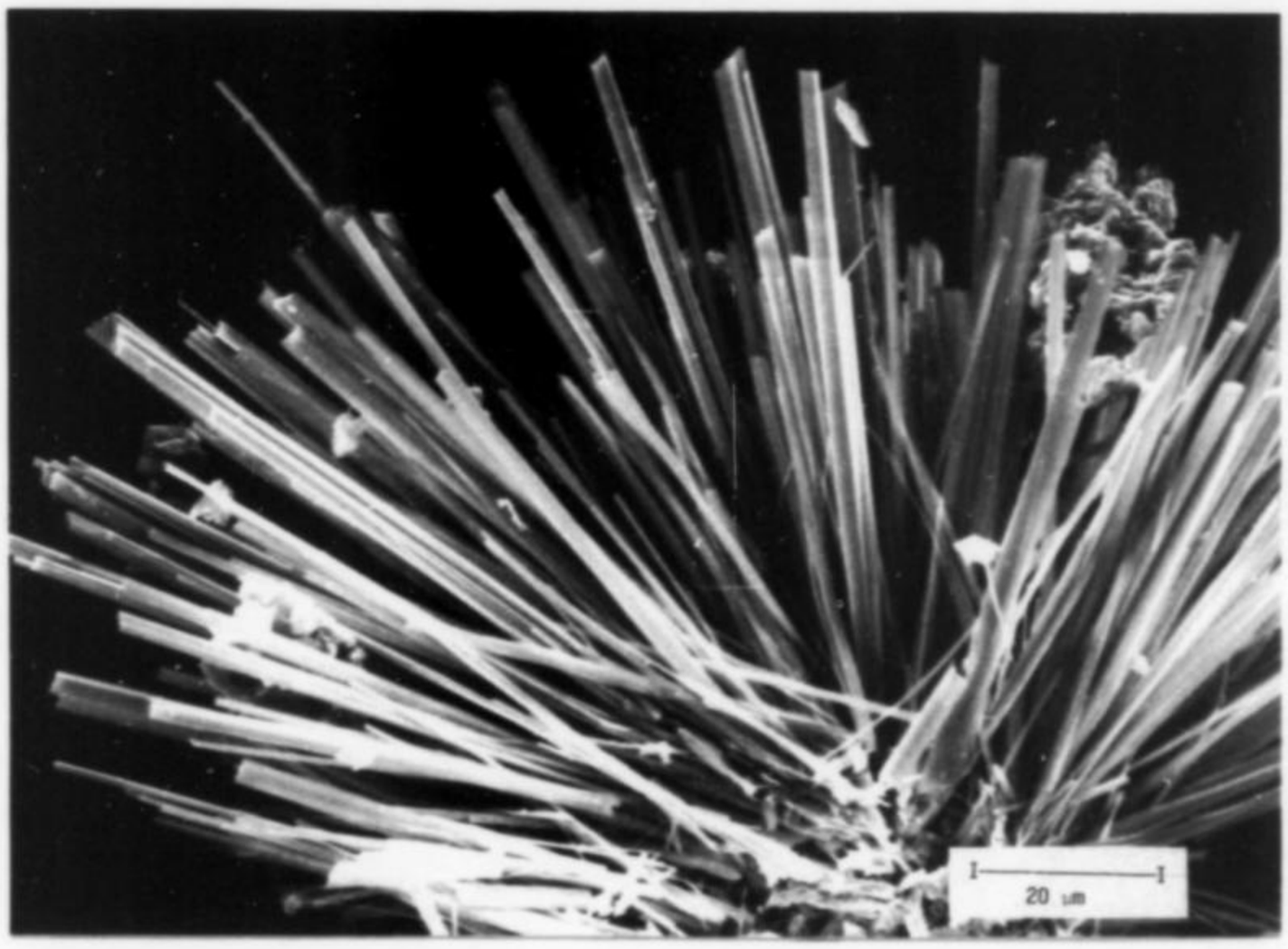

Figure 5. **Spray of radial, acicular mammothite crystals. Scale bar is 20 μm. Laurium, Greece.**

the Gladstone-Dale relationship using the constants of Mandarino (1981) yield a compatibility of $1-(K_P-K_C) = 0.012$ for superior agreement of the chemical and physical data.

CHEMICAL COMPOSITION

Crystals of mammothite from Tiger, Arizona, are of adequate size to permit analysis by microprobe. These crystals were analyzed using an ARL-SEMQ electron microprobe utilizing an operating voltage of 15 kV ard a sample current of 0.025 μA (measured on brass). The analysis was performed with a large (40 μm) beam spot after first ascertaining homogeneity with a small beam spot. A wavelength-dispersive microprobe scan indicated the absence of elements with atomic number greater than 8, except those reported herein. The standards used were synthetic Sb_2O_3 (Sb), cuprite (Cu), PbO (Pb), halite (Cl), barite (S), and hornblende (Al). The data were corrected using a modified version of the *MAGIC-4* program.

Water was calculated by difference. The resultant analyses are given in Table 2. Calculation of unit cell contents was not possible due to the difficulty in obtaining a precise density measurement. The formula for the holotype mammothite, calculated on the basis of $\Sigma(O+Cl)=30$, is: $Al_{1.02}Cu_{4.22}Pb_{5.81}Sb_{0.94}S_{2.14}Cl_{3.62}H_{17.49}O_{26.38}$ for the holotype sample ($Z=2$). We interpret this as $AlCu_4Pb_6Sb(SO_4)_2Cl_4(OH)_{18}$ with the presumption that all hydrogen is present as hydroxyl, inasmuch as there are no associated hydrated minerals; those associated with mammothite do have hydroxyl, however.

Mammothite from Laurium occurs in crystals too small and sparse to permit a highly accurate microprobe analysis. However, qualitative microprobe analysis of this mammothite by Alfred Schneider of Goettingen found the same elements in roughly the same proportions. This identification of Laurium mammothite was confirmed by X-ray diffraction methods.

Mammothite whitens in dilute 1:1 HCl, but because diaboleite and linarite (both found at Tiger) react similarly, this is not a diagnostic test.

Table 2. **Microprobe analyses of mammothite from Tiger, Arizona**

	NMNH #161200 (holotype)	NMNH #141368 (cotype)
Al_2O_3	2.3	2.3
CuO	14.9	15.1
PbO	57.6	56.9
Sb_2O_3	6.1	6.2
SO_3	7.7	7.4
Cl	5.7	5.8
H_2O	7.0*	7.6*
O=Cl	1.3	1.3
Total	100.0%	100.0%

* Water determined by difference.

Table 1. **X-ray powder diffraction data for mammothite.**

I/Io	*d*(obs)	*d*(calc)	*hkl*	*I/Io*	*d*(obs)
60	10.43*	10.46	001	30	2.377
10	8.46*	8.48	$20\bar{1}$	20	2.331
90	6.67*	6.67	110	40	2.274
60	6.08*	6.04	$11\bar{1}$	30	2.244
20	5.72*	5.72	201	5	2.135
20	5.51*	5.51	$20\bar{2}$	10	2.095
30	5.24*	5.23	002	5	2.050
80	4.72	4.72	$40\bar{1}$	5	2.032
		4.70	$31\bar{1}$	2	1.994
10	3.78	3.77	$20\bar{3}$	2	1.966
		3.77	311	10	1.882
30	3.59	3.61	401	30	1.835
		3.57	020	20	1.753
20	3.49*	3.49	003	10	1.707
30	3.37	3.41	021	10	1.679
		3.34	$51\bar{1}$	5	1.623
20	3.29*	3.29	$11\bar{3}$	2	1.603
90	3.05*	3.05	221	10	1.576
100	2.896	2.911	600	5	1.542
		2.884	203	10	1.526
20	2.824	2.827	$60\bar{3}$	5	1.513
		2.817	$20\bar{4}$	30	1.448
20	2.761*	2.761	511	5	1.419
10	2.640*	2.642	222	10	1.383
20	2.518	2.516	$71\bar{2}$	10	1.317
				5	1.301
				2	1.288
				20	1.193

Intensities estimated visually.
* Refers to lines used in the least-squares refinement of lattice parameters.

OCCURRENCE

Mammothite is known from the Mammoth mine, Tiger, Arizona, and from Laurium, Attika, Greece.

Mammothite from Tiger, Arizona, occurs as euhedral crystals imbedded in microgranular white anglesite which has a saccharoidal texture. The associated species are phosgenite, wulfenite, leadhillite and caledonite. The anglesite crystals exhibit various color and crystal habits, and are likely of several generations, as is commonly seen in other Tiger specimens. Of the nearly 100 species known to occur at Tiger, about 25 are considered by Bideaux (1980) to belong to an anomalous oxidized sequence. These anomalous minerals, which occur in close association, are anomalous with respect to the much more commonly occurring Pb, Cu, Fe and Zn normal oxidation minerals which also occur at Tiger and at numerous other deeply oxidized base-metal deposits worldwide. The minerals of this anomalous sequence are characterized by the presence of Pb and Cu, often in the same species, and SO_4 and CO_3 similarly. Chlorine is especially a characteristic element in the anomalous assemblage. Because mammothite from Tiger shows these chemical associations, it is clearly also a member of the anomalous sequence. Aluminum is noted from Tiger in beaverite, $Pb(Cu,Fe,Al)_3(SO_4)_2(OH)_6$. Antimony is a very rare element in the Tiger suite; the only other Sb-bearing mineral is tetrahedrite, $(Cu,Fe)_{12}Sb_4S_{13}$, which is rarely observed as tiny crystals implanted on primary pyrite crystals.

At Laurium, mammothite occurs in very small euhedral crystals and as microscopic druses in the slags. The associated minerals are cerussite, phosgenite and matlockite.

ACKNOWLEDGMENTS

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Sodium-pharmacosiderite
a new analog of pharmacosiderite from Australia and new occurrences of Barium-pharmacosiderite

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ABSTRACT

Sodium-pharmacosiderite, ideally $Na_2(OH)[Fe_4^{+3}(AsO_4)_3(OH)_4]$ $7H_2O$, is a new mineral from Marda, Western Australia, where it is found associated with arsenopyrite, scorodite, quartz and other species. Sodium-pharmacosiderite is cubic (space group $P\bar{4}3m$, with $a = 8.01(2)$ Å), pale green in color, and occurs in cubic crystals. Additional locality and compositional data are provided for barium-pharmacosiderite, now shown to occur at a number of classic mineral localities.

INTRODUCTION

During a survey of the chemical composition of a large number of specimens of minerals in the pharmacosiderite group, we noted one sample which did not have substantial K or Ba, which are the common large cations in this group. Subsequent study indicated that this sample is Na-rich and our investigation has shown it to be the sodium analog of pharmacosiderite. We have named this new mineral *sodium-pharmacosiderite* in allusion to the composition and the relationship to pharmacosiderite. The species and the name were approved by the Commission on New Minerals and Mineral Names, I.M.A., prior to publication. Type material is preserved at the Smithsonian Institution under catalog #146392.

CRYSTALLOGRAPHY

Sodium-pharmacosiderite occurs as pale green, euhedral, cubic crystals with no modifying forms (Fig. 1). The crystals occur as clusters of randomly oriented crystals. Maximum crystal size is 0.5 mm.

Single-crystal Weissenberg and precession photographs are consistent with space groups $P\bar{4}3m$, $Pm3m$, and $P432$. Buerger *et al.* (1967) reviewed the problems associated with the symmetry of pharmacosiderite and confirmed that it has a substructure with space group $P\bar{4}3m$ and $a \approx 8$ Å. Because pharmacosiderite and sodium-pharmacosiderite are isostructural, we infer that sodium-pharmacosiderite must have space group $P\bar{4}3m$. The lattice parameter ($a = 8.012(1)$ Å) was determined through least-squares refinement of powder diffraction data (Table 1), obtained using FeKα radiation and Si as an internal standard.

Buerger *et al.* (1967) noted that their specimen, which has the pharmacosiderite structure, contains very little K, Na or other large cations, and displays superstructure reflections which require that it has a symmetry lower than that of a cubic phase, with both a and c doubled. Mutter *et al.* (1984) studied both natural and ion-exchanged samples, and found that those with alkali ions are generally cubic, some having $a \approx 8$ Å, and some having a superstructure with $a \approx 2x8$ Å. These have space groups $P\bar{4}2m$ and $I\bar{4}2m$, respectively. Barium-dominant samples are generally tetragonal. These fall into one of two groups having $a \approx c \approx 8$ Å, and $a \approx c \approx 2x8$ Å, and space groups $P\bar{4}2m$ and $I\bar{4}2m$, respectively. An ion-exchanged, Na-rich sample, however, displayed powder X-ray diffration relations indicating a symmetry of the orthorhombic system, or lower symmetry. Given these relations, we carefully examined our powder and single-crystal diffraction photographs for the presence of weak superstructure reflections or subtle deviations of symmetry from those required by space group $P\bar{4}3m$. None was observed. However, as lower symmetries are presumably due to ordering, there may be other samples of naturally occurring sodium-pharmacosiderite which are more highly ordered than ours, and which display some other symmetry.

CHEMICAL COMPOSITION

The samples examined for this study were chemically analyzed using an ARL-SEMQ electron microprobe utilizing an operating voltage of 15 kV and a sample current of 0.025 μa. A wavelength-dispersive microprobe scan indicated the absence of any elements with atomic number greater than 9, except those reported here. The standards used were maricite (Fe,Na), synthetic olivenite (As), barite (Ba) and microcline (K). The resultant analysis yields $As_2O_5 = 39.5$, $Fe_2O_3 = 38.2$, $K_2O = 2.9$, $Na_2O = 6.3$, H_2O (by Penfield method) = 19.3, sum = 106.2%. We independently determined that pharmacosiderite can lose substantial H_2O at very low temperatures and presume that our determined weight percent oxides are high due to H_2O loss in sample preparation procedures, and/or under vacuum, and/or under bombardment by the microprobe beam. Accordingly, we have normalized the analysis to sum to 100% with 19.3% H_2O. The normalized analysis yields: $As_2O_5 = 36.7$, $Fe_2O_3 = 35.5$, $K_2O = 2.7$, $Na_2O = 5.8$, $H_2O = 19.3$, sum = 100.0%. The chemical formula, calculated on the basis of Fe = 4 atoms, is (with Z = 1):

$$(Na_{1.68}K_{0.52})_{\Sigma 2.20}Fe_4^{+3}(AsO_4)_{2.87}(OH)_{5.59}\cdot 6.84H_2O.$$

This is idealized as $Na_2(OH)[Fe_4^{+3}(AsO_4)_3(OH)_4]\cdot \approx 7H_2O$,

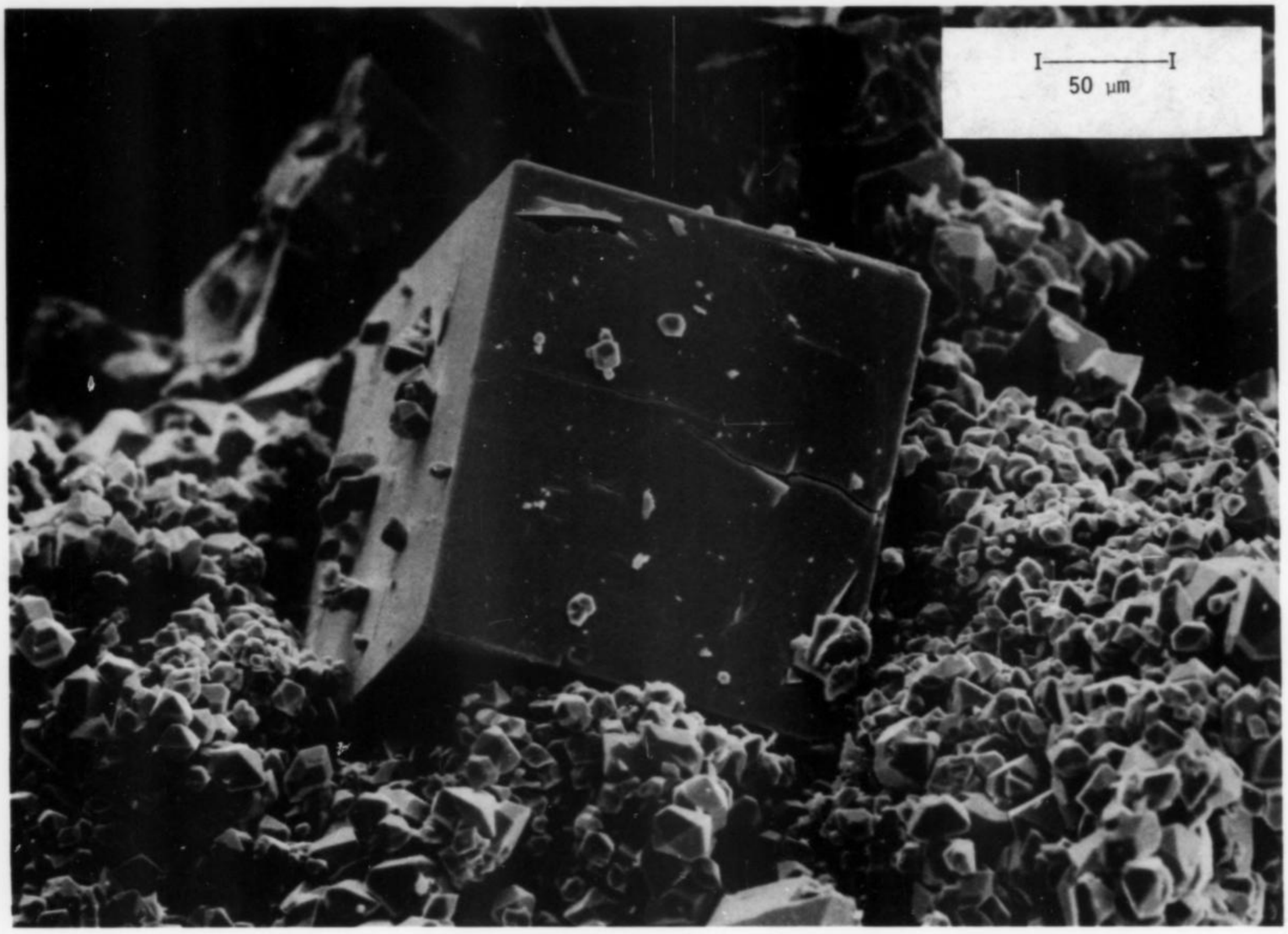

Figure 1. **Scanning electron microscope (SEM) image of a cubic crystal of sodium-pharmacosiderite on a druse of scorodite. Smithsonian Institution #146392. Marda, Western Australia.**

which corresponds to the Na-analog of pharmacosiderite:

$K_2(OH)[Fe_4^{+3}(AsO_4)_3(OH)_4]\cdot \approx 7H_2O$.

The chemical formula for pharmacosiderite has previously been given as $KFe_4^{+3}(AsO_4)_3(OH)_4 \cdot 6\text{-}7H_2O$. Our survey of analyses of the pharmacosiderite group indicates that the large cation site contains either 0.5 Ba or 2K, and that previous analyses of K-bearing species were either low in H_2O values or were of solid solutions with other members wherein Ba substituted in part for K. As our investigation of the new mineral proceeded, we were informed of the independent discovery of these relations by Mutter *et al.* (1984) who confirmed that there are 2 K per 3 As in common pharmacosiderite.

PHYSICAL AND OPTICAL PROPERTIES

Sodium-pharmacosiderite is pale green in color with no obvious color zoning. The hardness (Mohs) is approximately 3. The luster is vitreous on both cleavage and fracture surfaces. The {001} cleavage is very imperfect; the fracture is uneven. The density, determined using heavy liquid techniques, is 2.79 g/cm³ (±0.04), compared with the calculated value of 2.90 g/cm³ for the end-member. The mineral is brittle. Optically, sodium-pharmacosiderite is isotropic and displays no optical anomalies such as are common to some members of the group and which are presumably tetragonal as shown by Mutter *et al.* (1984). The index of refraction is $n = 1.705(4)$. It is pale green to colorless in thin section and is transparent.

OCCURRENCE

Sodium-pharmacosiderite occurs at Marda, Western Australia, Australia. The occurrence of "pharmacosiderite" here was first noted by Simpson (1952) who reported that it was pale green in color and provided a description of the paragenesis that closely resembles what we have found on the one museum specimen available to us.

The type specimen consists of quartz and arsenopyrite. The arsenopyrite is altered, leaving dissolution vugs. Within these vugs are crystals of green sodium-pharmacosiderite, yellow pharmacosiderite (unanalyzed), scorodite, arseniosiderite, and a yellow powdery member of the jarosite group. All of these minerals were identified using X-ray diffraction.

BARIUM-PHARMACOSIDERITE: NEW DATA

Barium pharmacosiderite was originally described from the Clara mine in the Black Forest, Germany, by Walenta (1966). It has subsequently been found in southern Bohemia by Čech *et al.* (1975), and at Schramberg, Germany (Walenta, 1980). In our search (unsuccessful) for additional samples of sodium-pharmacosiderite, we examined a number of samples simply labeled "pharmacosiderite" from various localities. In the course of this survey, we found additional localities for barium-pharmacosiderite, and we have tabulated these in Table 2. Because of the loss of H_2O during microprobe analysis, our analyses are all high in determined weight

Table 1. **X-ray powder diffraction data for sodium-pharmacosiderite.**

d(obs)	*d*(calc)	*hkl*	I/Io
7.99	8.01	100	100
4.61	4.63	111	50
4.00	4.01	200	40
3.58	3.58	120	5
3.27	3.27	211	80
2.831	2.833	220	60
2.668	2.671	221	30
		300	
2.532	2.534	310	50
2.416	2.416	311	60
2.314	2.313	222	10
2.138	2.142	321	2
1.891	1.889	330	20
		411	
1.838	1.838	331	10
1.791	1.792	420	20
1.749	1.749	421	5
1.709	1.708	332	1
1.604	1.603	500	30
		430	
1.544	1.542	511	20
		333	
1.464	1.463	521	10
1.417	1.416	440	20
1.394	1.395	441	10
		522	
1.375	1.374	530	5
		433	
1.335	1.335	442	5
		600	

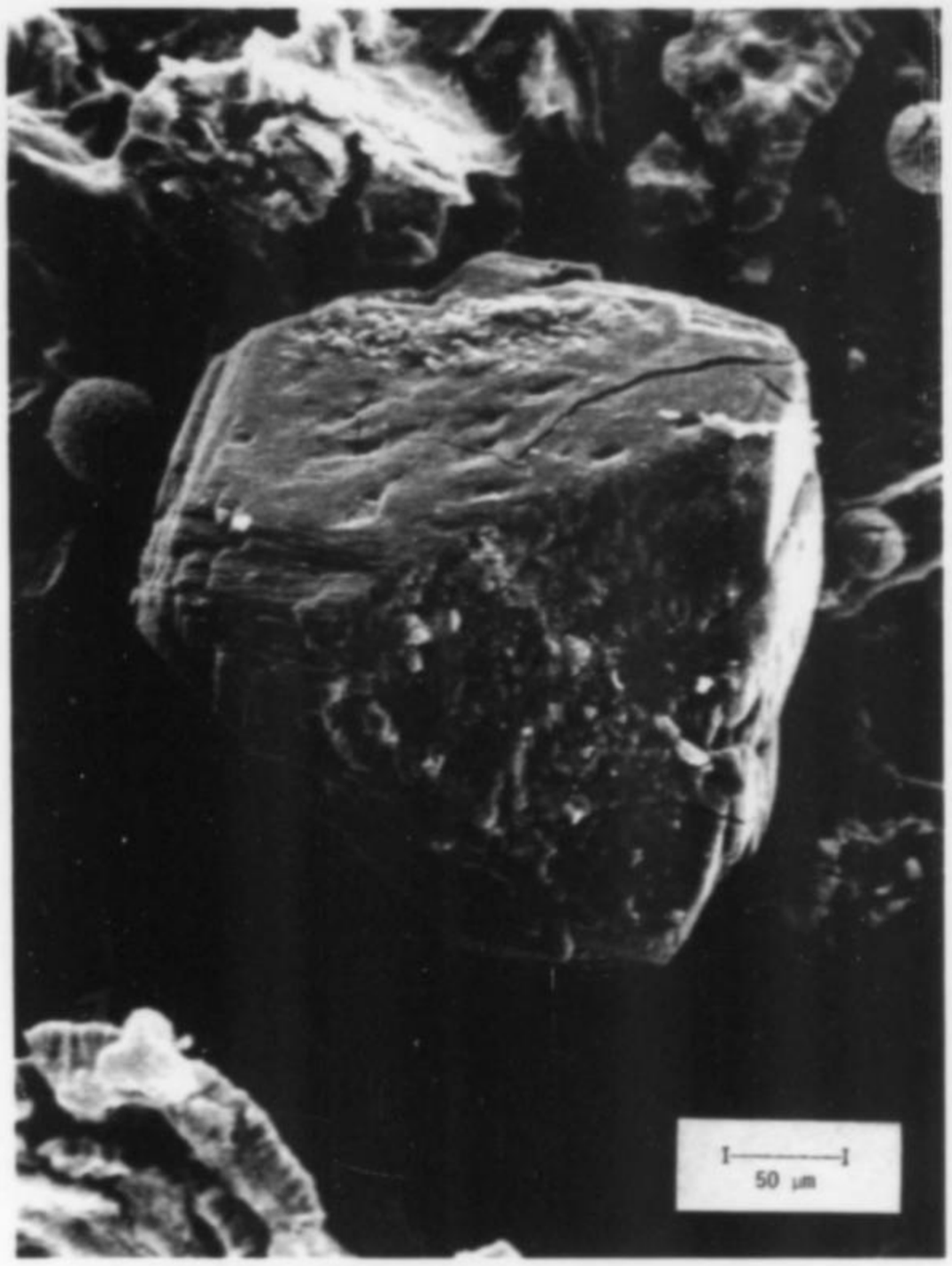

Figure 2. **SEM image of a rough crystal of barium-pharmacosiderite. Sterling Hill, New Jersey. John Kolic collection.**

Table 2. **Chemical data for some barium-pharmacosiderites. Calculated on the basis of As = 3 atoms.**

Sample #	Fe	Al	As	K	Ba	Locality
28458	4.1	0.0	3.0	0.1	0.6	Robinson's Reef, Port Phillip, Victoria, Australia
80473	4.2	0.1	3.0	0.1	0.4	Tintic district, Utah
B14260	4.0	0.2	3.0	0.0	0.4	Liebenschlehen mine, Neustaedtel-Schneeberg, Germany
R8878	4.3	0.1	3.0	0.0	0.5	Tintic district, Utah
B14242	4.5	0.0	3.0	0.0	0.5	Aschaffenberg, Germany
KOLIC	3.8	0.0	3.0	0.0	0.4	Sterling Hill, New Jersey
B14243	4.2	0.1	3.0	0.0	0.5	Aschaffenberg, Germany
R5621	4.2	0.0	3.0	0.0	0.5	Aschaffenberg, Germany
B14347	4.2	0.3	3.0	0.0	0.5	Tintic district, Utah
C4356	4.3	0.0	3.0	0.0	0.7	Cornwall, England

percent oxides. Because the water content of phases in the pharmacosiderite group may vary, and because it was not feasible to perform water determinations on all these samples, we are unable to normalize our data so as to permit its presentation in the conventional manner. Accordingly, in Table 2 we present the numbers of cations for these barium pharmacosiderites, calculated on the basis of 3 arsenic atoms. The data, although limited, clearly demonstrate that barium-pharmacosiderite has ½ Ba atom per 3 arsenic atoms. Thus, its formula, relative to that of pharmacosiderite, $K_2(OH)[Fe_4^{+3}(OH)_4(AsO_4)_3]\cdot \approx 7H_2O$, is very likely to be $Ba_{0.5}[Fe_4^{+3}(OH)_4(AsO_4)_3]\cdot nH_2O$, where n approximates 7. This formula differs from that of Mutter *et al.* (1984), which they gave as $Ba(H_3O)[Fe_4(OH)_2O_2(AsO_4)_3]\cdot nH_2O$. Their formula is based on analytical results which indicate that there is 1 Ba per 3 As. We have no explanation of why the basic analytical data should be different, especially when the data have been obtained by analyses of several samples from different localities in the cases of both investigations. As noted above, we have carefully analyzed our data for sources of error and have found none. However, there may well be additional complexities of formula for the pharmacosiderite group, reflected by these differences in data.

We present SEM photomicrographs of barium-pharmacosiderite crystals from various localities in Figure 2-4. We wish to emphasize that common (K-dominant) pharmacosiderite may also occur at these localities. Inasmuch as all samples from Tintic district, Utah, and from Aschaffenberg, Germany, were consistently Ba-dominant, this may be the common member of the pharmacosiderite group at these localities.

As part of our survey, we analyzed several samples from Sterling Hill, New Jersey. One of these (labeled KOLIC in Table 2) is clearly barium-pharmacosiderite, as shown in Figure 2. Another, consisting of medium yellow, prismatic to cubic crystals

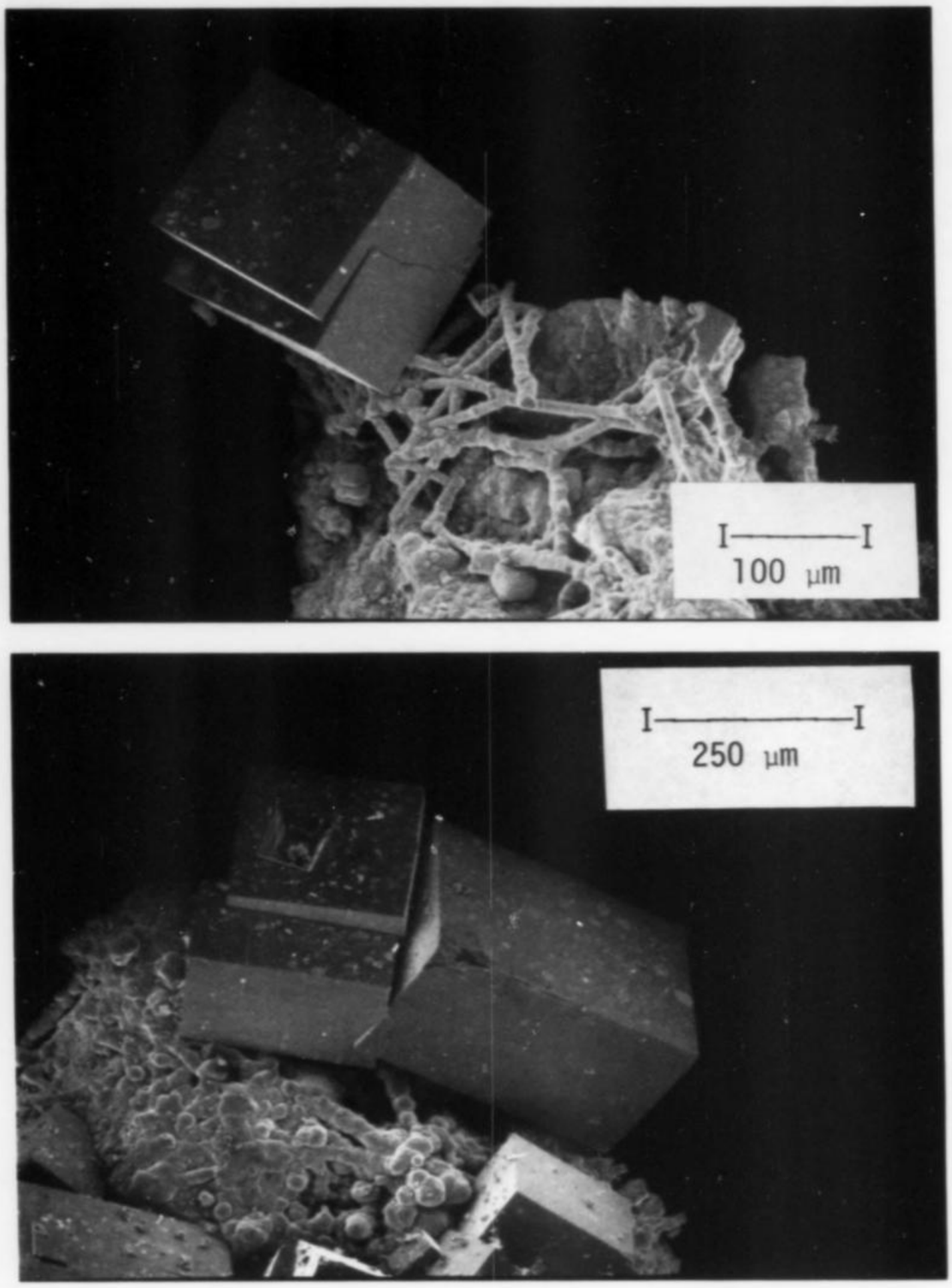

Figure 3. **SEM image of a cubic crystal of barium-pharmacosiderite. Tintic district, Utah. Smithsonian collection R8878.**

Figure 4. **SEM image of a cluster of barium-pharmacosiderite crystals. Tintic district, Utah. Smithsonian collection R8878.**

associated with willemite, koettigite and sphalerite in a vein assemblage, is not clearly any one of the known members of the group. It is strontium-dominant for the most part, but is clearly inhomogeneous, containing variable amounts of Pb, Mn, Zn, Ca and other cations. Although a strontium-dominant member of the pharmacosiderite group is predictable, it should be characterized on the basis of better and more homogeneous material than is presently available. For such samples, where nomenclature designations are ambiguous, the use of the general term, "pharmacosiderite-group mineral" is recommended. Members of the pharmacosiderite group commonly exhibit optical anomalies (presumably related to tetragonal symmetry) and also can be easily ion-exchanged in a manner akin to that of zeolites. Based on studies to date, color is not a useful diagnostic feature for discriminating among species in this series.

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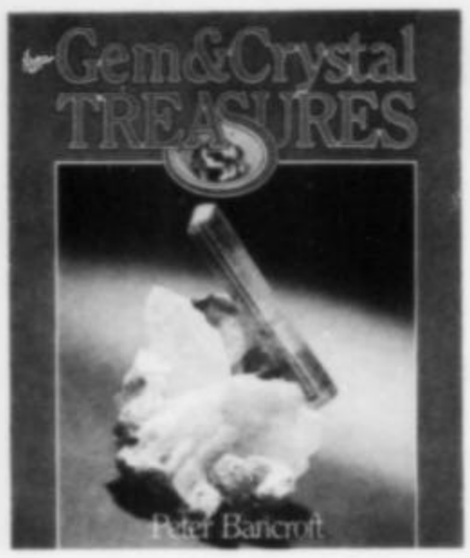

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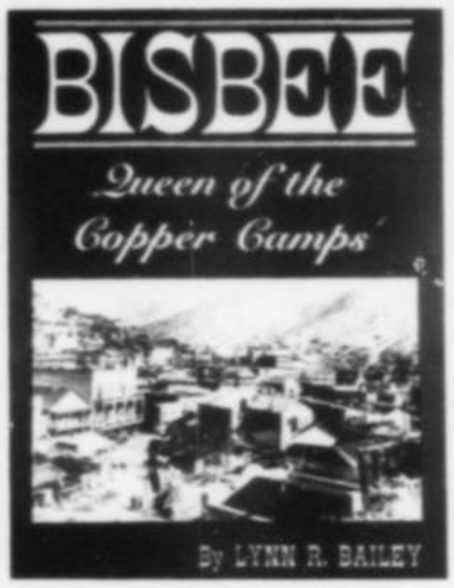

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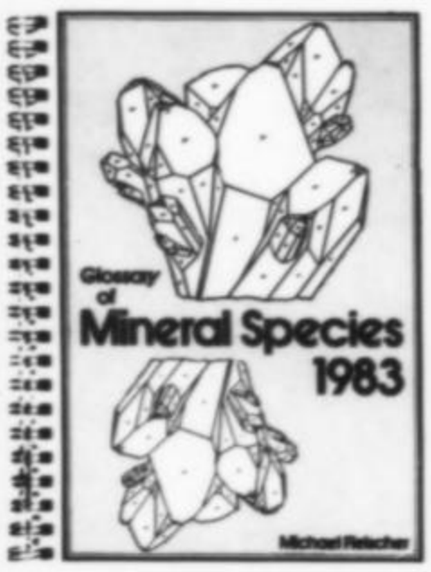

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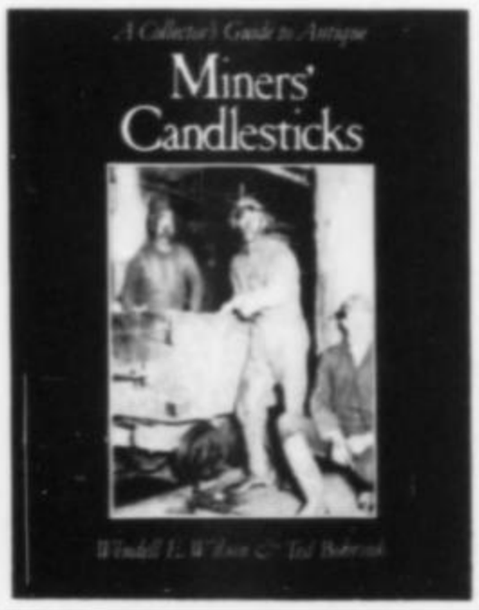

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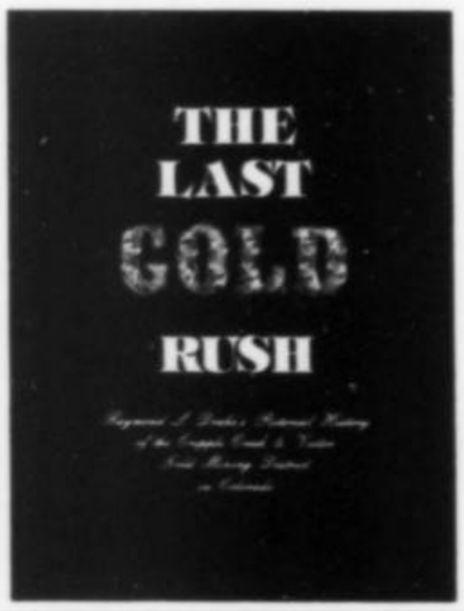

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Miguel Romero and the Romero Mineralogical Museum

William D. Panczner
640 N. La Cholla Boulevard
Tucson, Arizona 85740

Mineral collectors in Mexico are few in number, but even in the U.S. Miguel Romero and his collection would easily rank among the most prominent. Begun modestly in the 1960s, the Romero collection now numbers about 7500 specimens, nearly a thousand of which are display-quality.

Miguel Romero is a warm and friendly person who has become well known to American and international collectors and curators since he began regularly attending (and occasionally displaying at) the Tucson Show in 1972. Private collections of any significance are almost unheard of in Mexico, but Romero is an exception. In his professional life he serves as Director General of the Desarrollo Tecnologico Division of Groupo Romero, a diversified agricultural products corporation. He is also the founder and Director of what has grown to be called the Museo Mineralogico de Romero in Tehuacan, Puebla, Mexico.

Miguel was born in the State of Oaxaca and was the youngest of ten children. His father died when he was only one year old, and his mother took over the running of the family farm. She would start each day at 5:00 a.m. milking the cows while the children worked in the family's corn and sugar fields. All the children completed secondary school and three were given the opportunity to continue on in their education. Miguel was fortunate enough to be one of those three. He received his early university training at the Universidad Nacional Autonoma de Mexico (UNAM) in Mexico City. While working on his Bachelor's Degree in chemistry, he received a fellowship to work as a chemist with the late Eduardo Schmitter in his mineralogical research at the Institute of Geology. For 2½ years, Miguel worked at the Institute from 8:00 a.m. to 2:00 p.m., then rushed through Mexico City to attend classes at the University from 3:00 p.m. until late in the evening. His work schedule often did not permit the attendance of morning classes, but Miguel was allowed to register as long as he did all the classwork on his own and took the weekly exams.

In the middle of his junior year he transferred to the University's Institute of Chemistry where his interest in organic research began. Schmitter said that his heart broke when Miguel left him: "He was one of the most promising students I've ever had, and his love for minerals and their chemical make-up was inspiring." Nevertheless, Schmitter remarked, "Even though I lost a student, I gained a lifelong friend." Miguel became a member of that small group of Schmitter's former students and associates whom he lovingly referred to as "my boys."

After graduation from UNAM, Miguel received a fellowship to Harvard to study organic chemistry. It was there that Miguel learned to speak English; formerly he could read the scientific language, but at Harvard he needed to be able to speak it as well. He eventually received both his MS and PhD degrees in Organic Chemistry at Harvard. Romero subsequently received a post-Doctoral fellowship to the University of London's Imperial College to engage in pure research on organic reactions and mechanisms.

He returned to Mexico City in 1957 to teach Chemistry at UNAM, but the following year his love for chemical research forced him to leave teaching and go to work as Research Coordinator for the G. D. Searle Labs in Mexico City. Romero's extensive background in steroid hormones was a significant factor in the Searle Laboratory's development as one of the world's major steroid research centers.

In 1963 Romero left the Searle organization to work for his family's newly developing poultry company. He began the design and building of four modern feed mills, built a fish meal plant, and formed the Desarrollo Technologico division of Groupo Romero S.A. He began to carefully study what it takes to make an egg. He hired the finest biologists, chemists, chemical engineers,

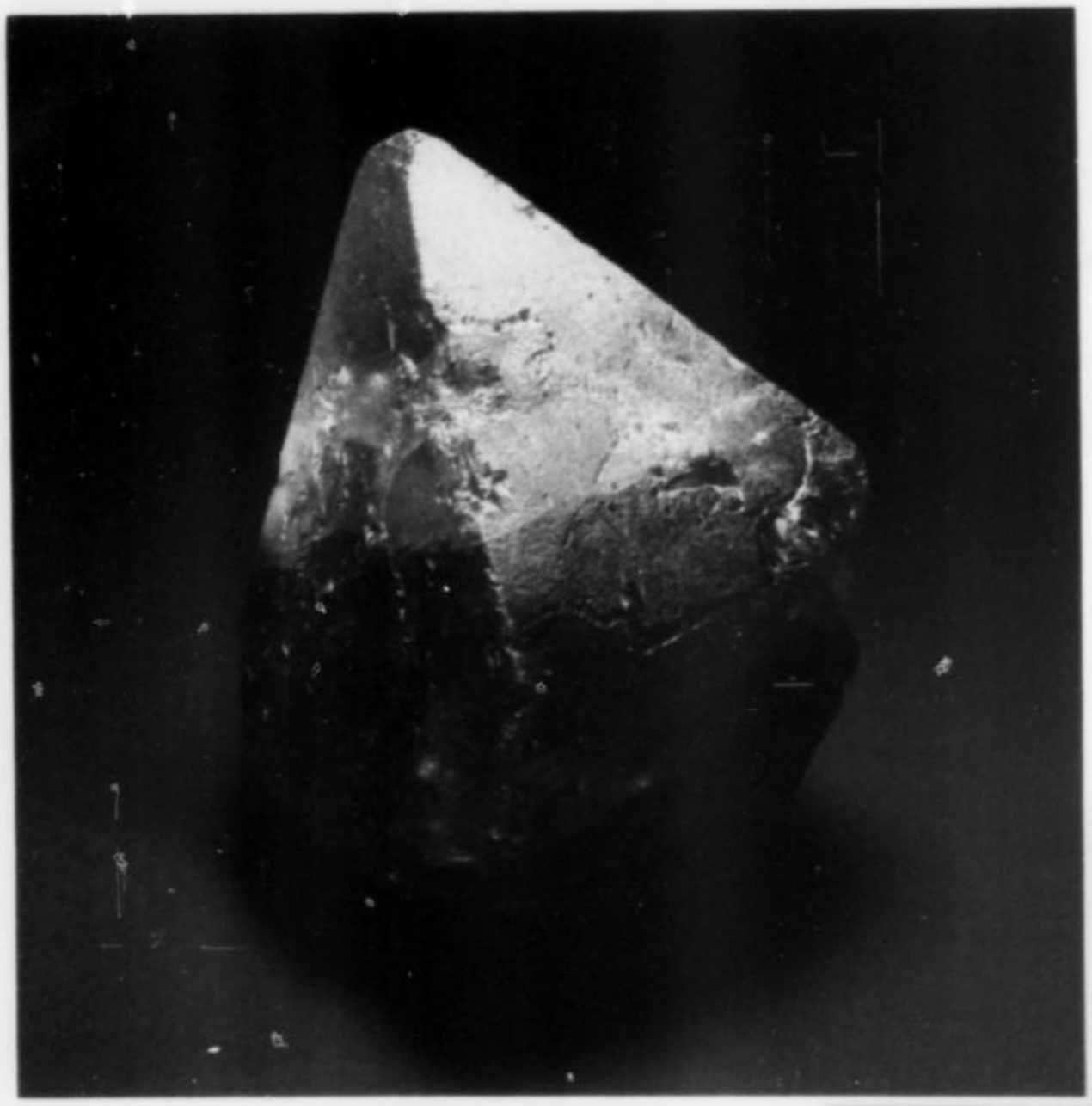
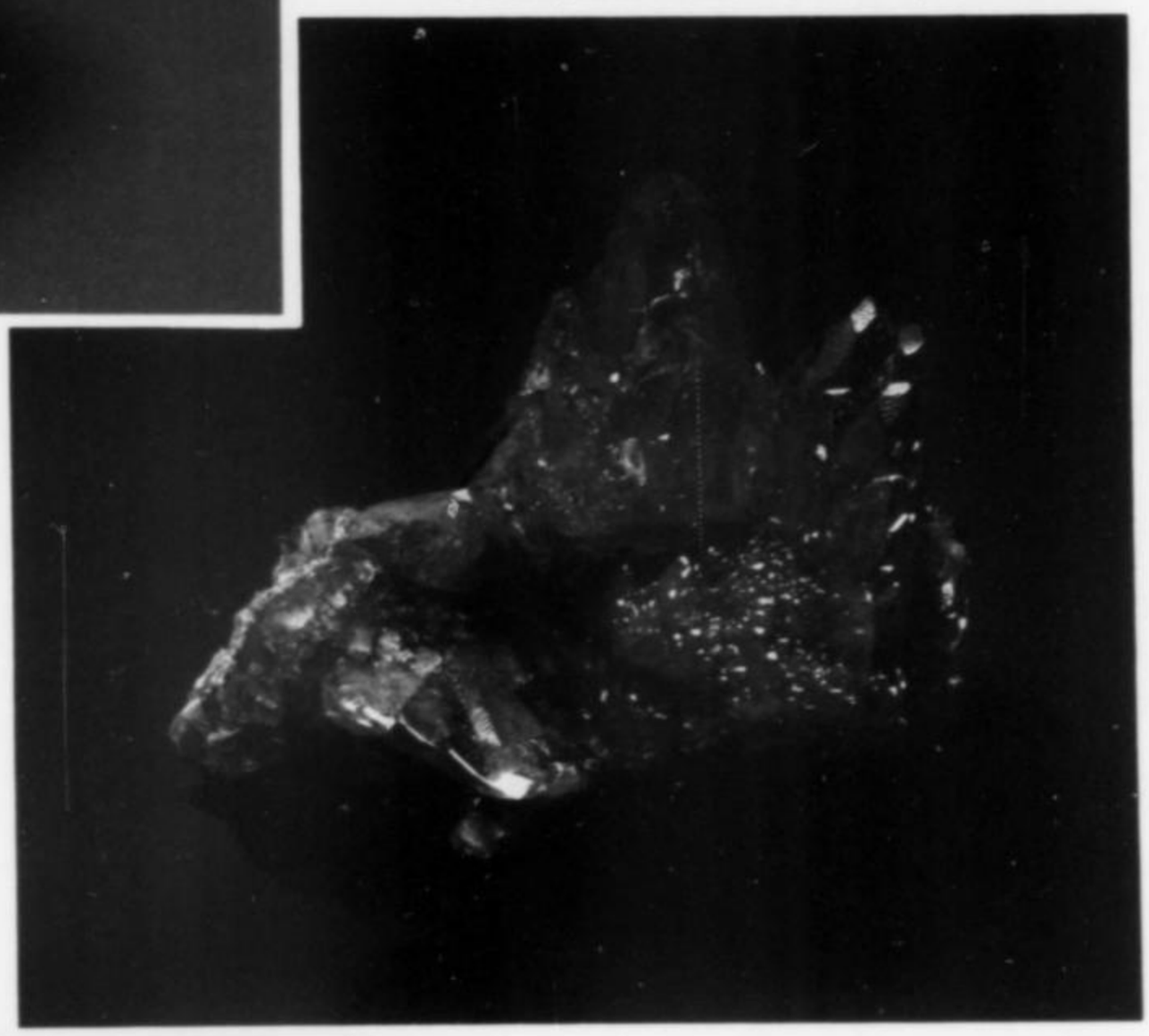


Figure 1. **A large scheelite crystal measuring 9 cm, from Santa Cruz, Sonora.**

Figure 2. **Rhodochrosite specimen with crystals to 8 cm, from Francisco Portillo, Chihuahua.**



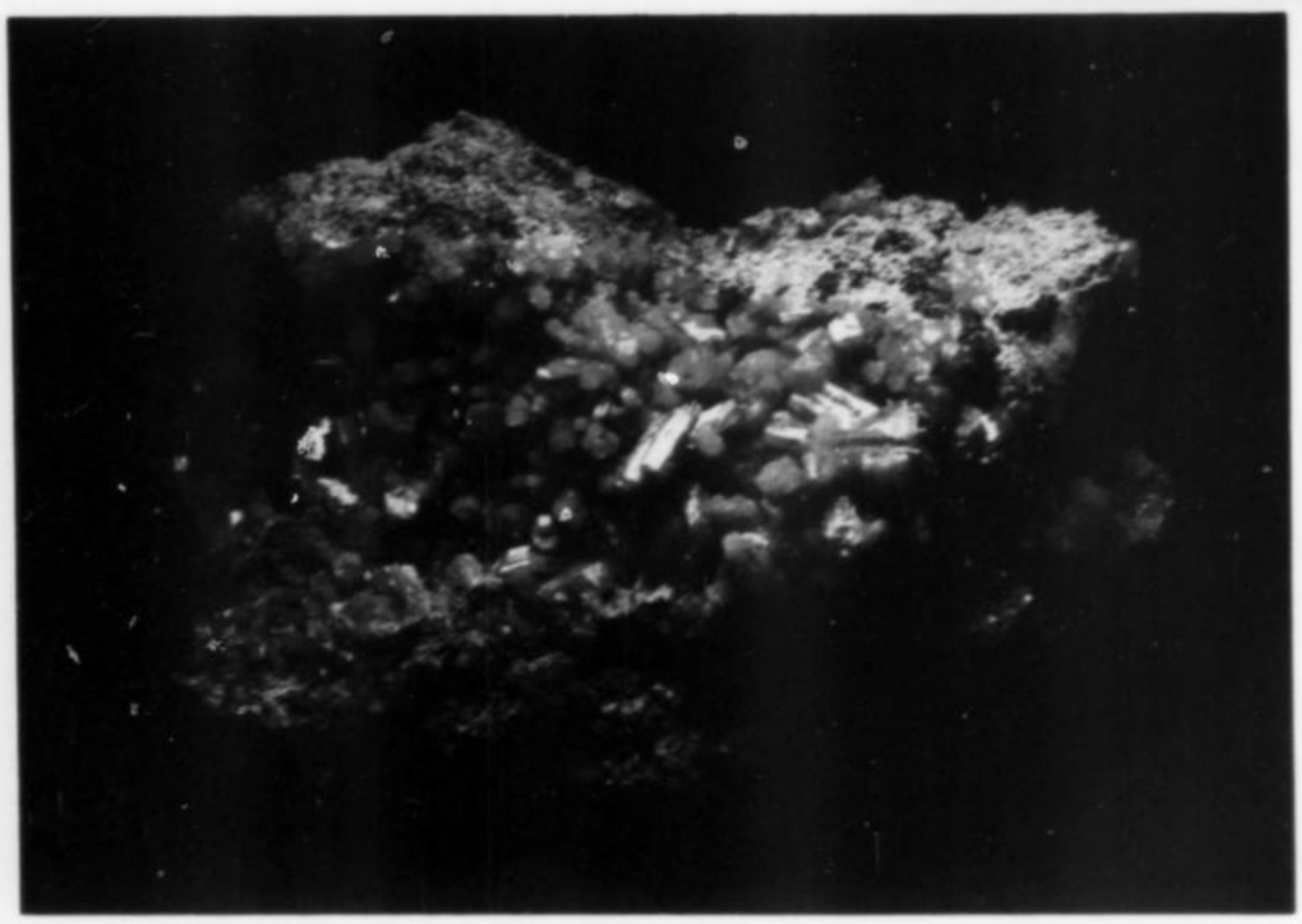


Figure 3. **Pyromorphite crystal group 12 cm across, from Guasarpres, Chihuahua.**

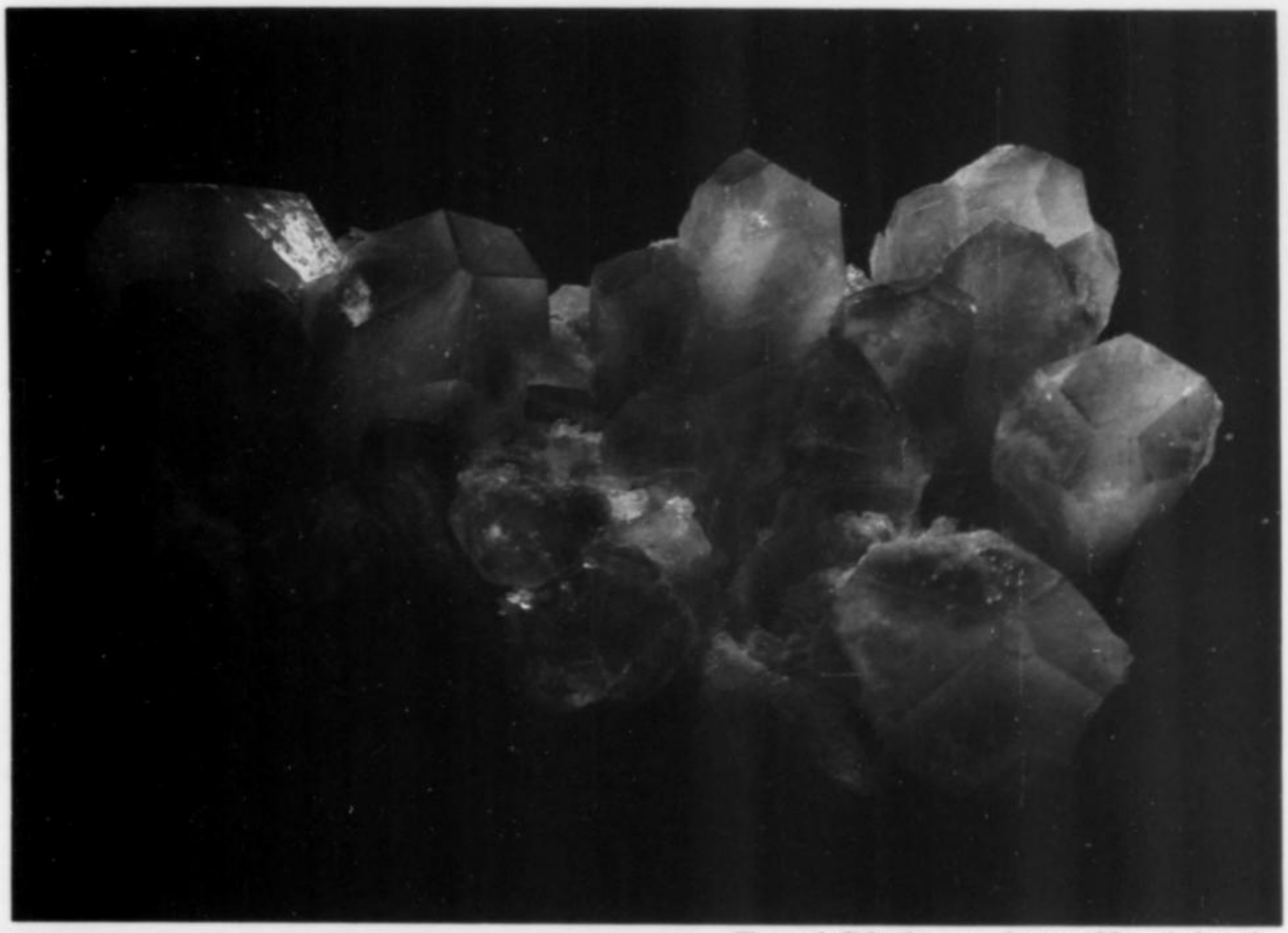


Figure 4. **Celestite crystal group 25 cm in length, from Ramos Arispe, Coahuila.**

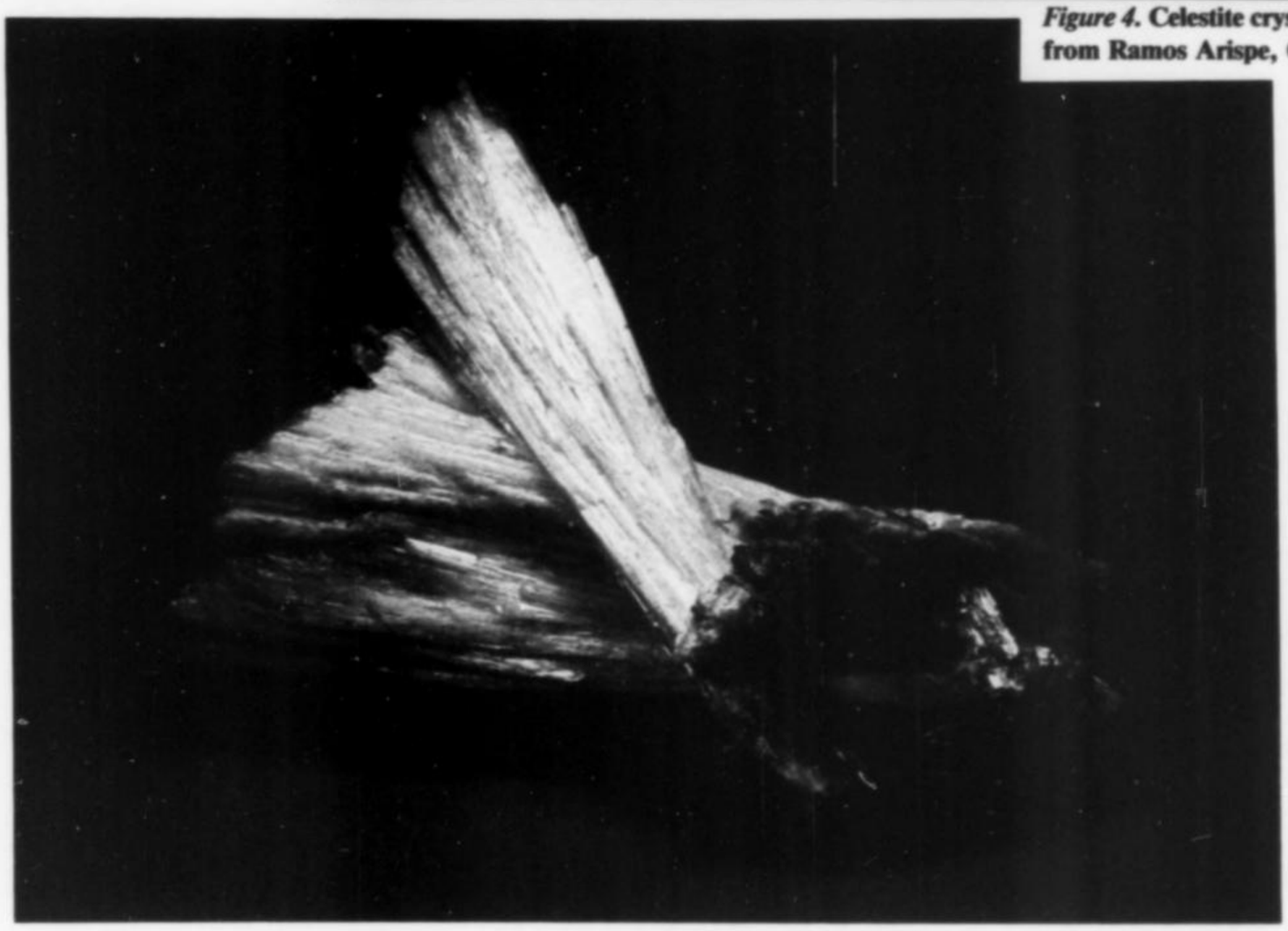


Figure 5. **Legrandite group consisting of sprays up to 23 cm in length, from the Ojuela mine, Mapimi, Durango.**

veterinarians, bacteriologists and technicians available and furnished them with up-to-date laboratory equipment. In the 20 years that Romero has been with Groupo Romero, the company has grown to be regarded as the finest integrated poultry company in the world. His labs are regarded as the best of their type worldwide and are presently doing quality control work for many agricultural companies in Mexico. They do all the quality control testing on the famous spring water of Tehuacan as it is being bottled for shipment throughout Mexico and for exportation to the U.S.

Romero and his lab have full control over computerized feed mills which produce 2,000 tons of specialized poultry feed daily. He personally oversees the design of the diets for the company's chickens, mixing from 30 to 40 different ingredients. The lab also develops veterinary vaccines and antibiotics needed to keep his family business at the top of the poultry business. Because of Mex-

Figure 6. **Miguel Romero and wife Margarite (all photos by W. Panczner).**

ican regulations. Groupo Romero has had to develop a fully diversified industry for complete self-sufficiency.

Groupo Romero maintains a work-force of approximately 6,000 employees and, of this figure, Dr. Romero's lab and auxiliary support staff account for about 500 employees. At the present time, the Romero family chickens produce about *400 million* eggs daily! roughly 80% of all the eggs consumed in Mexico City are produced by Groupo Romero and the Romero family.

The company several years ago expanded into the poultry canning business and is now diversifying into the hog and dairy cattle fields. Romero's labs are now beginning research into genetics engineering.

Miguel is married to the former Margarita Sobral, a noted architect who designed the Romero Museum and many of the outstanding buildings of the Groupo. She is presently working with the Bishop of Puebla in the restoration of several old churches in the Tehuacan area. The Romeros have three children: Miguel, who is finishing his MS in organic chemistry at UNAM , Louisa, who is working on her MS at Cornell in genetics, and Alex, who is working on his BS in chemical engineering at UNAM.

The Romeros are a rarity in Mexico. From their humble beginnings, they have put together one of Latin America's major companies. And yet they have never forgotten their roots, and have given much to the people of Tehuacan as well as the States of Puebla and Oaxaca. They have designed, built and given schools, churches, a prison and recently a home for the elderly.

THE ROMERO MINERALOGICAL MUSEUM

Romero's interest in minerals goes back to the early 1950s when he worked with Eduardo Schmitter at the Geological Institute. Miguel began to collect in the late 1960s when on business trips for Groupo Romero to Brazil. As Miguel says, "It was hard to resist the many store windows with those beautiful tourmaline and beryl specimens for sale." Slowly his desk became covered with many of these fine specimens and soon cases were built to house them. In 1970, he began in earnest to built a collection and, as he reflects on it: "I never thought it would build up to a museum collection. I tried to watch over it, but with my busy schedule with my business I've had to add staff to work full time on it now." Jorge Diaz de Leon is presently the assistant who works with the collection on a daily basis and is the head of the Geology Department of the Museum. Romero occasionally employs geologists and mineralogists from local universities, governmental agencies and Mexican mining corporations. He has given support to several geology students who had an interest in mineralogy while they completed their research for their degree. At the present time he has one student who is completing his studies on the geology and mineralogy of the skarns of western Coahuila and eastern Chihuahua, the region east of Lago Jaco (Lake Jaco). The museum also has five research associates: Abraham Rosenzweig, Fabian Cesbron, Richard Gaines, S. A. Williams and William Panczner.

As of October, 1984, the collection contains 7,500 cataloged specimens divided into three categories: display, systematic and Mexican. The Mexican collection is divided into two subcategories: display and systematic.

Display Collection

The display collection contains 900 specimens; 650 are on display in the main gallery, 100 specimens are in the corporate library upstairs, and 150 specimens are in drawers waiting for mounting and display space. The display collection is 75% Mexican (675 specimens). The glass cases within the main gallery are arranged by State. The wall cases that line three of the four walls in the library are arranged by chemical classification. The specimens that are in metal storage cabinets are arranged by Mexican State or country. Most of the specimens are mounted on clear Plexiglas bases with engraved labels attached to the front of the base. Extreme care has been taken to arrange the specimens to their best display angle for viewing. Because the Puebla area experiences earthquakes, the gallery, labs and cases are designed to withstand seismic shocks.

Systematic Collection

The systematic collection is composed of 2,100 specimens from worldwide locations. They are kept in metal cabinets which line one side of the main gallery. Specimens are kept with their labels in trays within the drawers and are arranged by chemical composition. This is a study collection and is used for reference by the mineralogical lab at the museum.

Figure 7. **Display cases in the main gallery.**

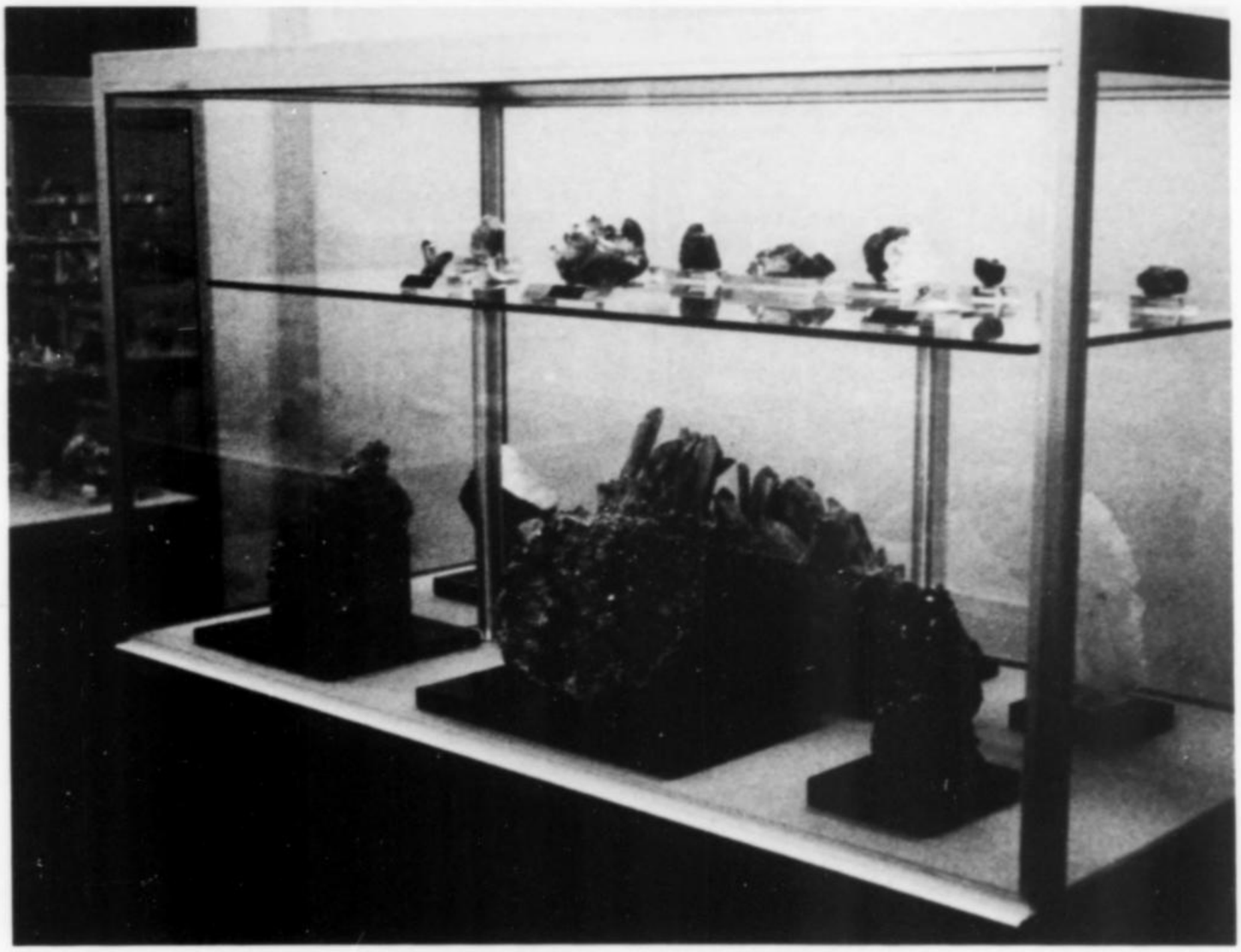


Figure 8. **Display case in the main gallery.**

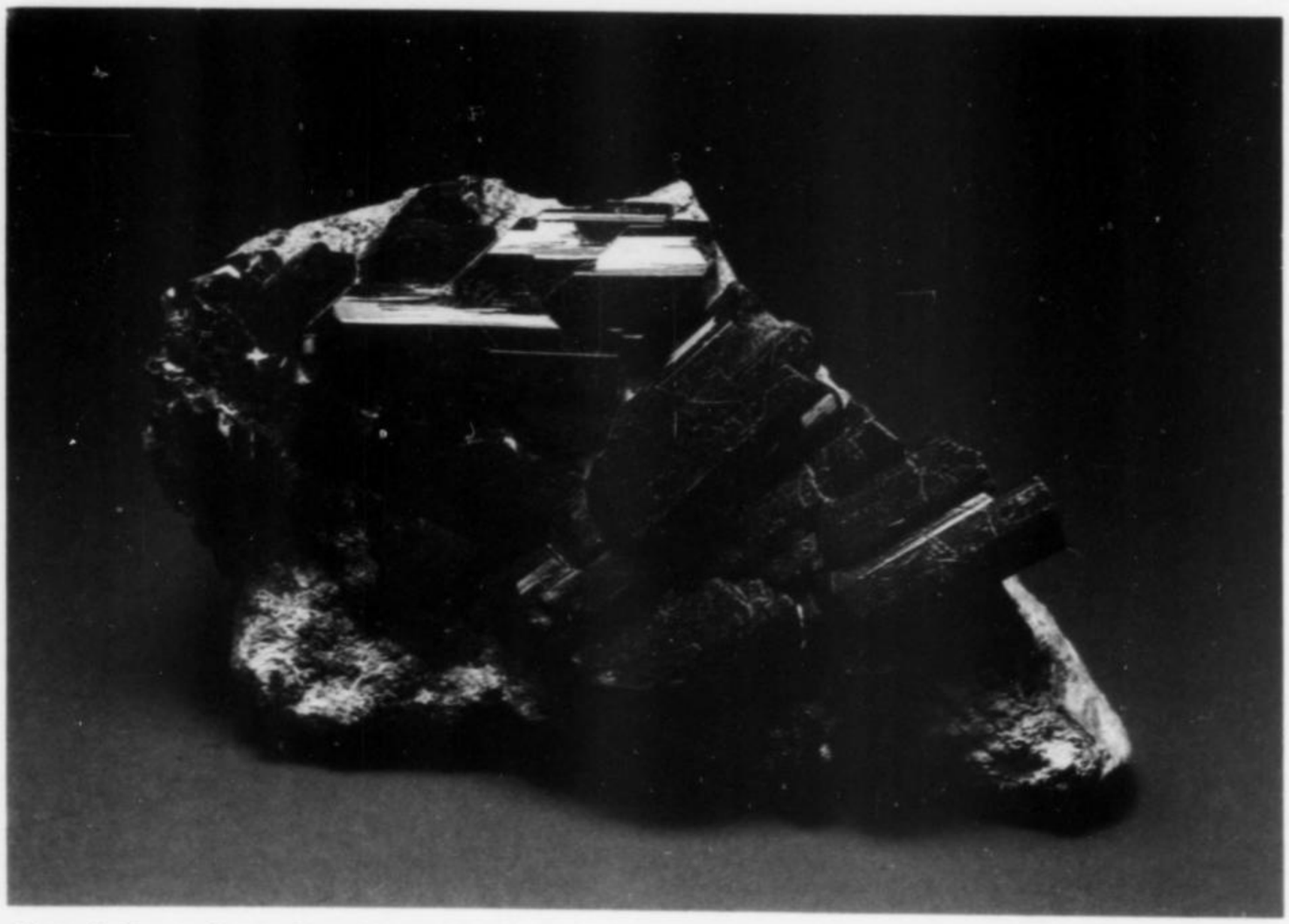


Figure 9. **Buergerite specimen 7 cm across, from Mexquitic, San Luis Potosi.**

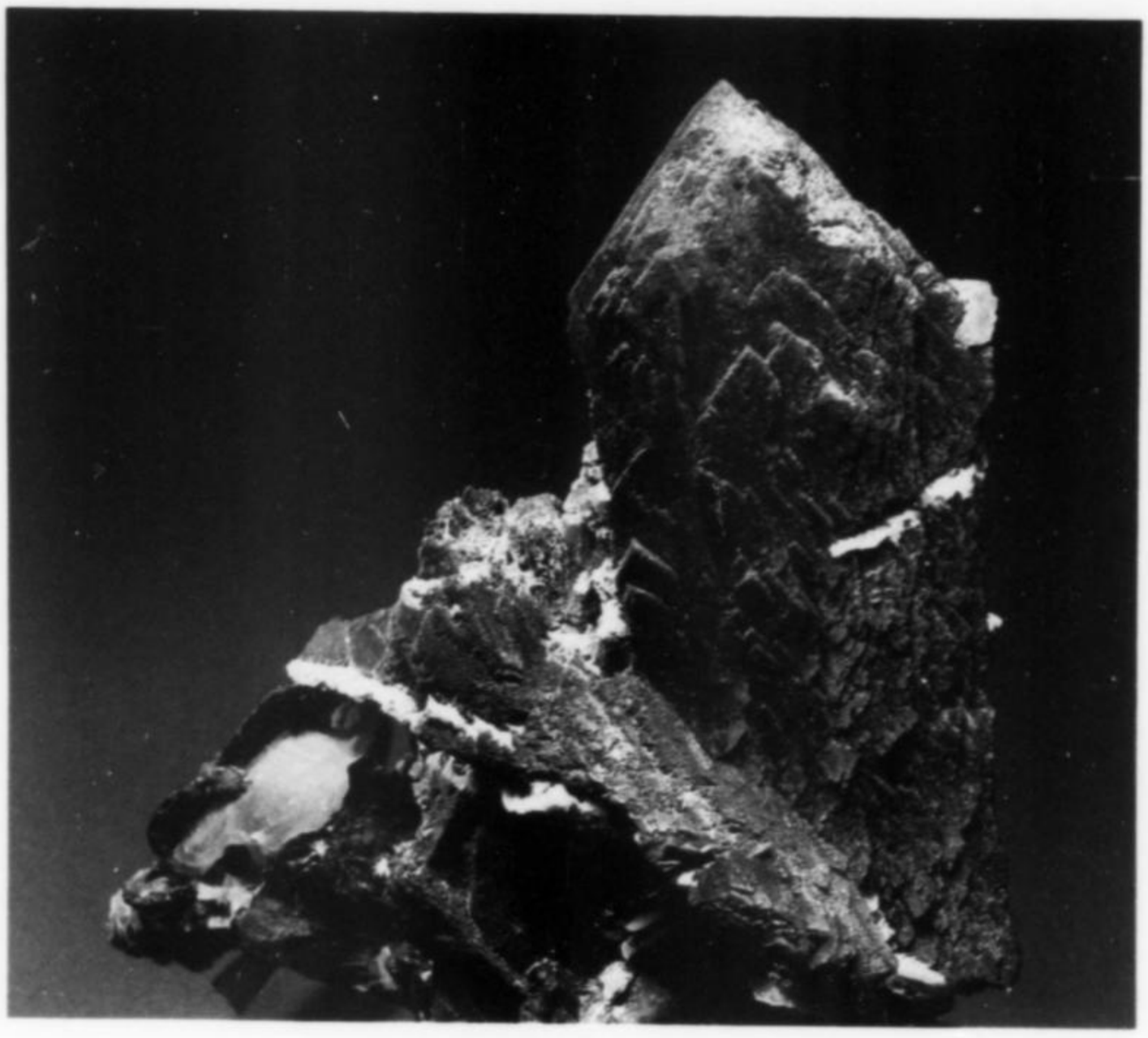


Figure 10. **Malachite pseudomorph after azurite, 8 cm tall, from Concepcion del Oro, Zacatecas.**

Mexican Collection

The Mexican Collection is divided into display (675 specimens) and systematic (3,825 specimens), and totals 4,500 specimens. Specimens not on display are housed in metal cabinets along a long wall in the gallery and are arranged by Mexican states. The Mexican Collection is very complete and is without question the finest collection of its type in Mexico, public or private.

The Mexican Collection also has two newly-developed subcategories: fossils and meteorites. The fossil section of the collection is composed of local fossils from the neighboring municipio (county) of Zepotitlan's famous San Juan de Reyes fossil field.

Romero has recently started a specialized collection of Mexican microminerals for use with the microprobe as optical and chemical standards for analysis. These will be very important, not only for his own lab but for others as well.

Since Romero's Research and Technological Labs have become computerized, all the records for the collection are being prepared for computer entry and storage. This will facilitate the efficient exchange of data with other organizations in Mexico and the rest of the world.

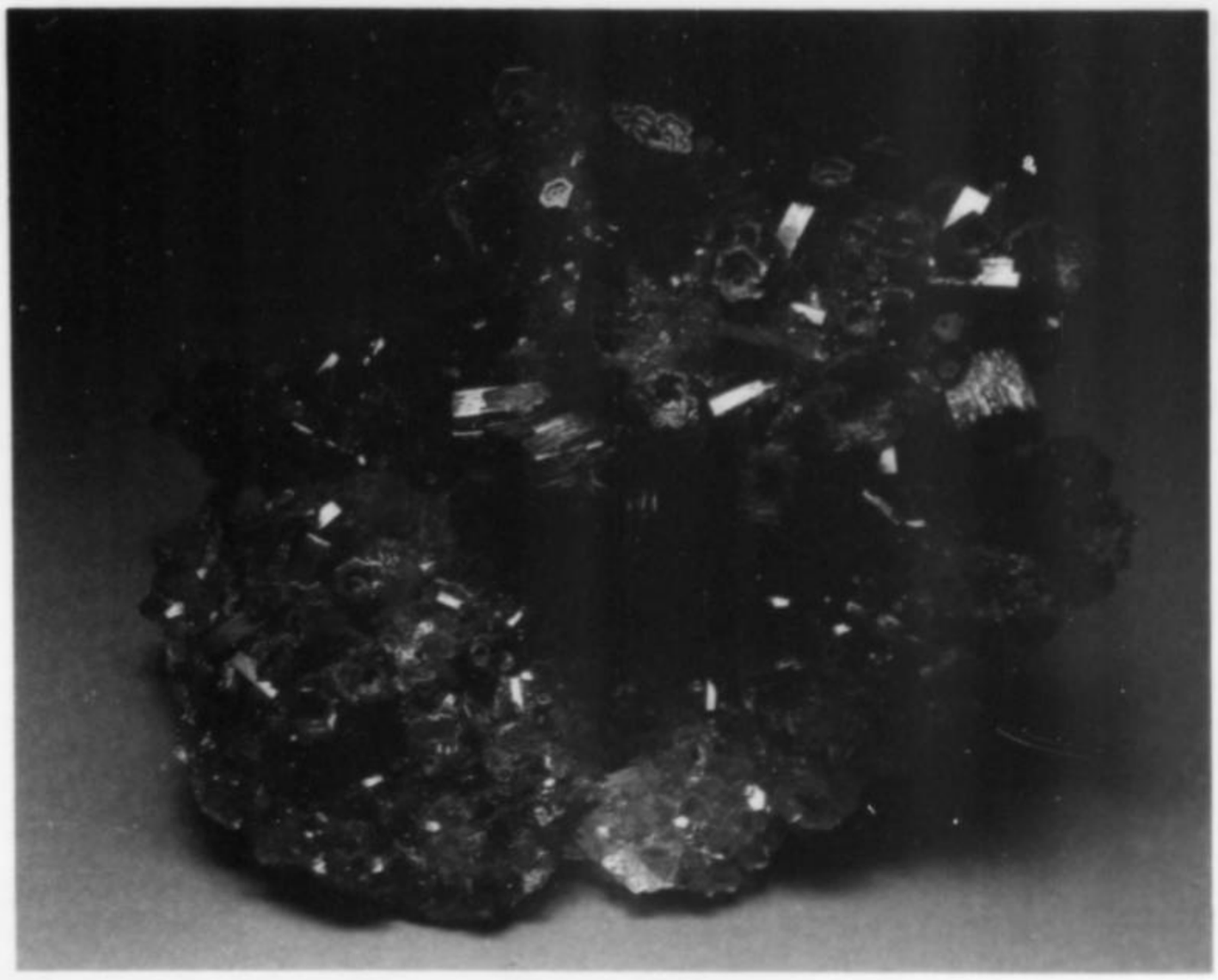
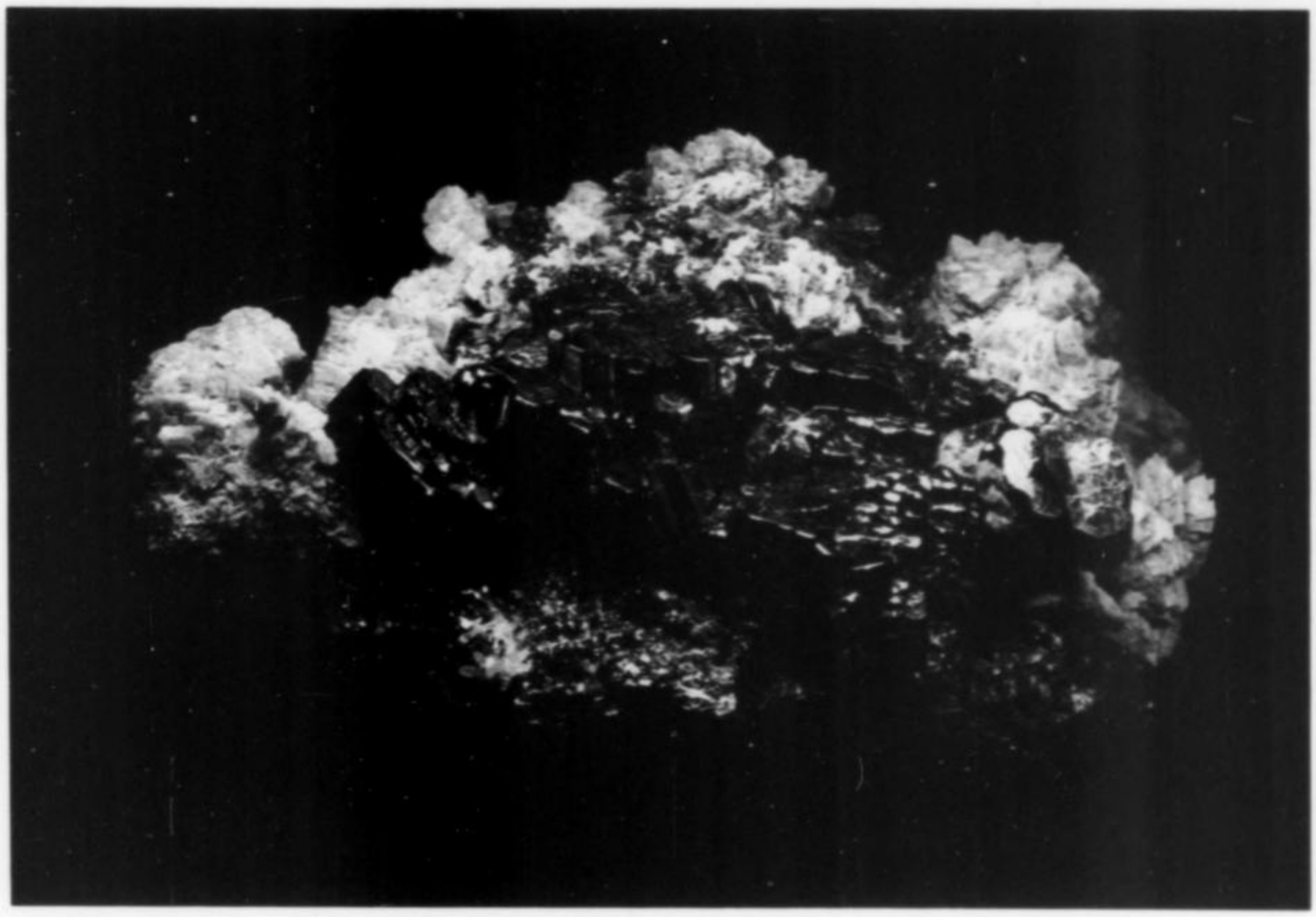


Figure 11. **Vanadinite specimen with crystals to 1.2 cm, from Cuchillo Parado, Chihuahua.**

Figure 12. **Bournonite specimen 9 cm across, with crystals to 2 cm, from Naica, Chihuahua.**



The Museum

The museum does participate in exchanges of data and specimens with other scientific institutions. The Romero Museum presently has working exchange programs with institutions in Russia, France, Denmark and the U.S.

A mineralogical lab is equipped with X-ray fluorescence and diffraction equipment along with most standard optical and wet chemical facilities. At the present time, the lab is preparing for single-crystal X-ray analyses and planning for the addition of an electron microprobe to the lab facilities. A new and more generally accessible building is now being planned for the mineralogical-geological museum and laboratory.

Romero and the state of Puebla's Natural History Museum in Pueblo have taken on a joint project to revamp that museum's geology section and to establish a new mineralogical section. The Romero Museum will provide specimens for the initial displays.

Visitors are always welcome and the Romero Museum is open free to the public from 9:00 a.m. to 1:00 p.m. and 3:00 p.m. to 8:00 p.m. Monday through Friday, and Sunday from 9:00 a.m. to 1:00 p.m. Other hours and days can be arranged by writing or calling for an appointment. Many college and school groups from Mexico visit the museum on a regular basis, and no group is too big or too small. English-speaking personnel are available.

The address and telephone for the museum is:

Museo Mineralogico de Romero
7 Norte #356
Tehuacan, Puebla, Mexico

Telex: 178931-IDIME
Telephone: 011-52-238-20488 (direct dial number from the U.S.), from within Mexico 20-488

Romero is one of the founding members and first president of the Sociedad Mexicana de Mineralogia, A.C., which formed in April 1984. This is the first professional society within Mexico dedicated strictly to mineralogy and is a life-long dream of Miguel's friend and mentor, Eduardo Schmitter.

Miguel Romero has almost single-handedly made a start at bringing back into Mexico some of its fine mineral specimens, its "crown jewels." When one considers the amount of mining that has taken place in Mexico, the number of fine mineral specimens still extant must be enormous. Mexico has retained little of its mineral heritage to show its people. But Dr. Romero and the Romero Museum have taken several giant steps forward in the cause of Mexican mineralogy.

Microminerals of the Western Volcanics

William A. Henderson, Jr.
174 East Hunting Ridge Road
Stamford, Connecticut 06903

A remarkable variety of exquisite and rare microminerals have been found in cavities in extrusive (volcanic) rocks. Premier localities for such species are the volcanics of the Eifel-Laacher See area in Germany and the Roman volcanic province in Italy. While the area is larger and the number of exotic species is much smaller, similar rocks in the western United States offer many species in very attractive specimens.

INTRODUCTION

This article deals only with microminerals found in the more felsic or silica-rich rocks of the Western U.S., not those in mafic rocks such as basalts and gabbros. Zeolites, a mineral group commonly found in many different rock types, will also be left for another time. Since all the specimens described are from my own collection, and since all were obtained by exchange, important localities may well have been overlooked. Furthermore, some localities may be listed separately under what are actually different names for the same place. I beg the reader's indulgence for any such inaccuracies.

The minerals to be described are found in rhyolites, obsidians and andesites, all of which are formed from relatively felsic lava. Compared to the dark colored rocks formed from mafic lavas such as basalts, the felsic rocks are lighter in color and contain less water. The minerals formed are thus quite different.

The best micro crystals, of course, are found free-grown in cavities. Most of these cavities are formed by gases which boil out of the lava when it reaches the surface and the confining pressure is removed. These cavities can be spherical, lenticular or irregular. Among the most interesting types of cavities are lithophysae, which are usually spherical and show concentric rings of crystalline material, thus having much the appearance of a slightly expanded onion (see Fig. 6). Occasionally, cavities are found in volcanic glass, apparently formed by shrinkage of the cooling glass or by devitrification. Such cavities or spherulites are found in abundance at Coso Hot Springs, Inyo County, California (Fig. 7). As will be seen, both types of cavities may contain very nicely crystallized microminerals.

OCCURRENCES

A good place to begin is with a group of four orthorhombic minerals found in western volcanic rocks. The first of these is hypersthene, a magnesium-iron silicate. It forms short to long columnar crystals, transparent and pale to medium brown in color when unaltered. Altered or oxidized hypersthene is opaque, commonly brick-red or dull brown in color, and may be sprinkled with tiny hematite or ilmenite crystals in parallel growth (Fig. 8). The altered crystal shown in Figure 9 is not only coated with tiny hematite crystals as shown in the previous figure but is also decidedly cavernous. All the specimens shown are from Summit Rock, near Diamond Lake, Douglas County, Oregon. Other good localities for hypersthene are listed in the species-locality table.

Pseudobrookite, an iron-titanium oxide, is another orthorhombic mineral. It forms extremely handsome crystals, usually easily distinguished from hypersthene. It occurs most often in one of two paired habits and colors. At many localities, of which the Paramount Claims, Sierra County, New Mexico, seems to be the best, it is found in radiating groups of brilliant, jet-black crystals like those in Figure 10. Other crystals are stubbier, like those in Figure 11. At other localities, of which Lemolo Lake, Douglas County, Oregon, is typical, the crystals have a quite different habit and color. Here they are distinctly flattened or tabular, and striated lengthwise. The color is a reddish brown, and the luster is iridescent to almost resinous, as though the crystals had been varnished (Fig. 2). A third habit, which I have seen from only one locality, is the red-brown, acicular, slightly twisted crystals shown in Figure 12. These are from Dugway Dell, Thomas Range, Juab County, Utah.

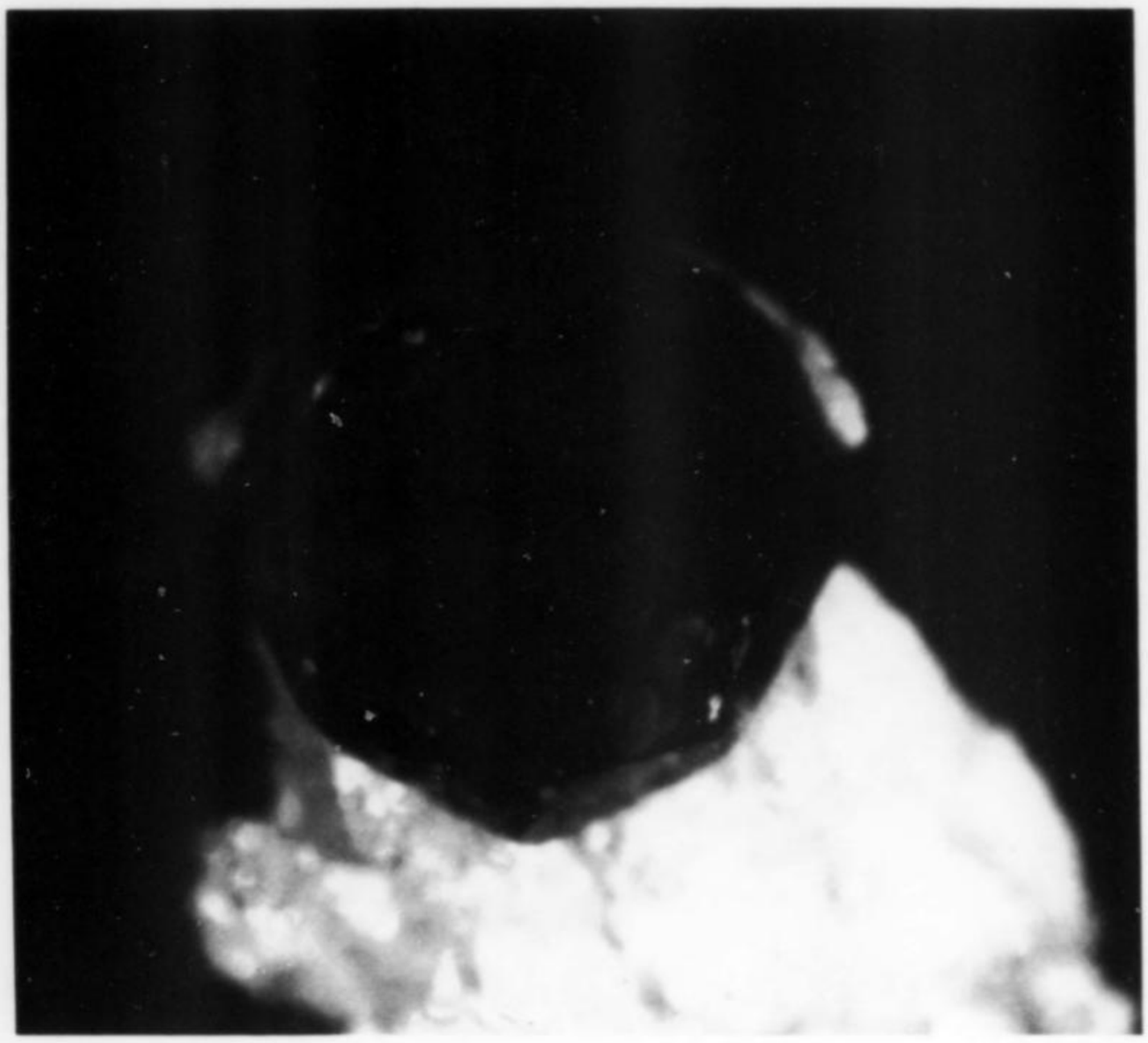


Figure 1. **Claret-colored, transparent spessartine crystal on rhyolite matrix, from Grants Ridge, Valencia County, New Mexico. Bill Hunt specimen and photo.**

Figure 3. **Greenish brown, 3-mm group of extremely thin fayalite crystals in spherulite in volcanic glass, from Coso Hot Springs, California.**

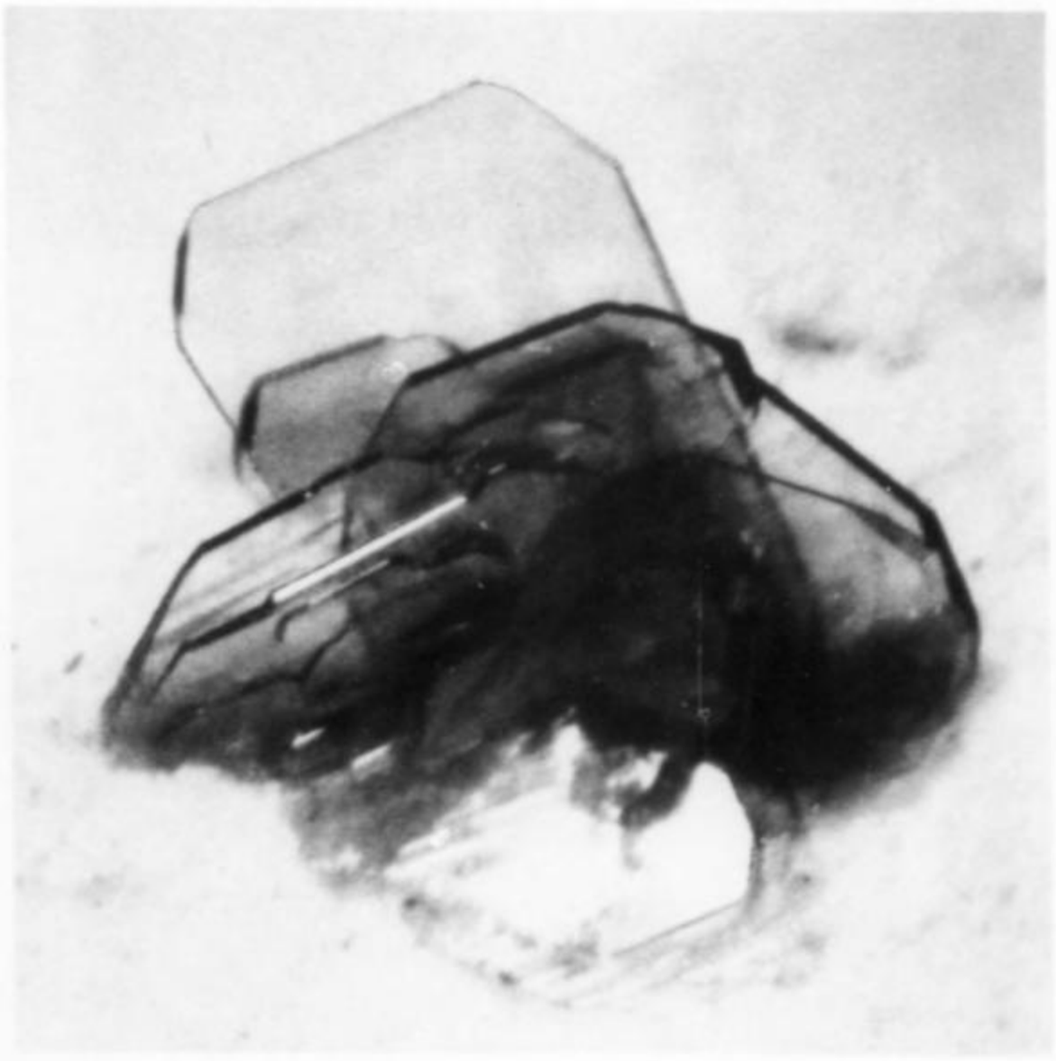


Figure 2. **Yellow-brown to red-brown crystals of pseudobrookite with resinous luster from Lemolo Lake, Douglas County, Oregon. The largest crystal is 0.8 mm long.**

Fayalite is still another orthorhombic mineral found in western volcanic rocks, and is an iron silicate. It forms very thin, unmistakably orthorhombic crystals, striated lengthwise and rectangular in shape. Their color is pale brown, and the crystals are perfectly transparent. It can be confused with hypersthene as to color, but the much flatter crystal form should distinguish the two. Fine crystals in a spherulite in volcanic glass are shown in Figure 3.

These are from Coso Hot Springs, California. A magnesian-manganoan variety of fayalite called hortonolite is found with osumilite at a locality at Three Sisters Peaks, Lane County, Oregon. Although it is not always so at other localities, the hortonolite from the above occurrence is an opaque brick-red in color and is dusted with what appear to be tiny hematite crystals (Fig. 13).

Figure 4. **Deep red, 0.6-mm crystals of cassiterite with jet-black hematite, from near Beaverhead, Sierra County, New Mexico. Bill Hunt specimen and photo.**

hypersthene with which it is found. However, the crystals are much longer, the length-to-width ratio being perhaps 10–15:1 while that of hypersthene is about 2–5:1 (Fig. 16). This distinction holds true for amphiboles in general (i.e. they tend to be long columnar while pyroxenes such as hypersthene tend to be short columnar to equant).

Bixbyite, a cubic iron-manganese oxide, occurs at a number of Western localities in handsome crystals. Crystals are almost always a brilliant black and most commonly show only the cube or slightly modified cube (Fig. 17). Less often, cuboctahedrons are formed, but the finest bixbyites show the trisoctahedron as a major face. Such a crystal from Sierra County, New Mexico, is shown in Figure 18. Frequently bixbyite and topaz occur together, as in the splendid crystals at Topaz Mountain, Utah, described by Lanny Ream in the September-October 1979 issue of the *Mineralogical Record.* Mentioned but not shown by him are the bixbyite necklaces sometimes seen on topaz, such as that shown in Figure 14. These seem to form at incipient cleavage planes (001) on the topaz, and are commonly in epitaxial orientation.

Both hematite and ilmenite are found at numerous localities for extrusive, felsic rocks in the western states. A fine hematite crystal with brilliant luster is shown in Figure 19. The crystal, from Burro Ridge, Sierra County, New Mexico, is typical as to form and also in that the faces are quite pitted. Ilmenite forms almost identical crystals, and the two are commonly found at the same locality. In that case, the two can sometimes be distinguished by the more brilliant luster of the ilmenite. A nice subparallel group of ilmenite

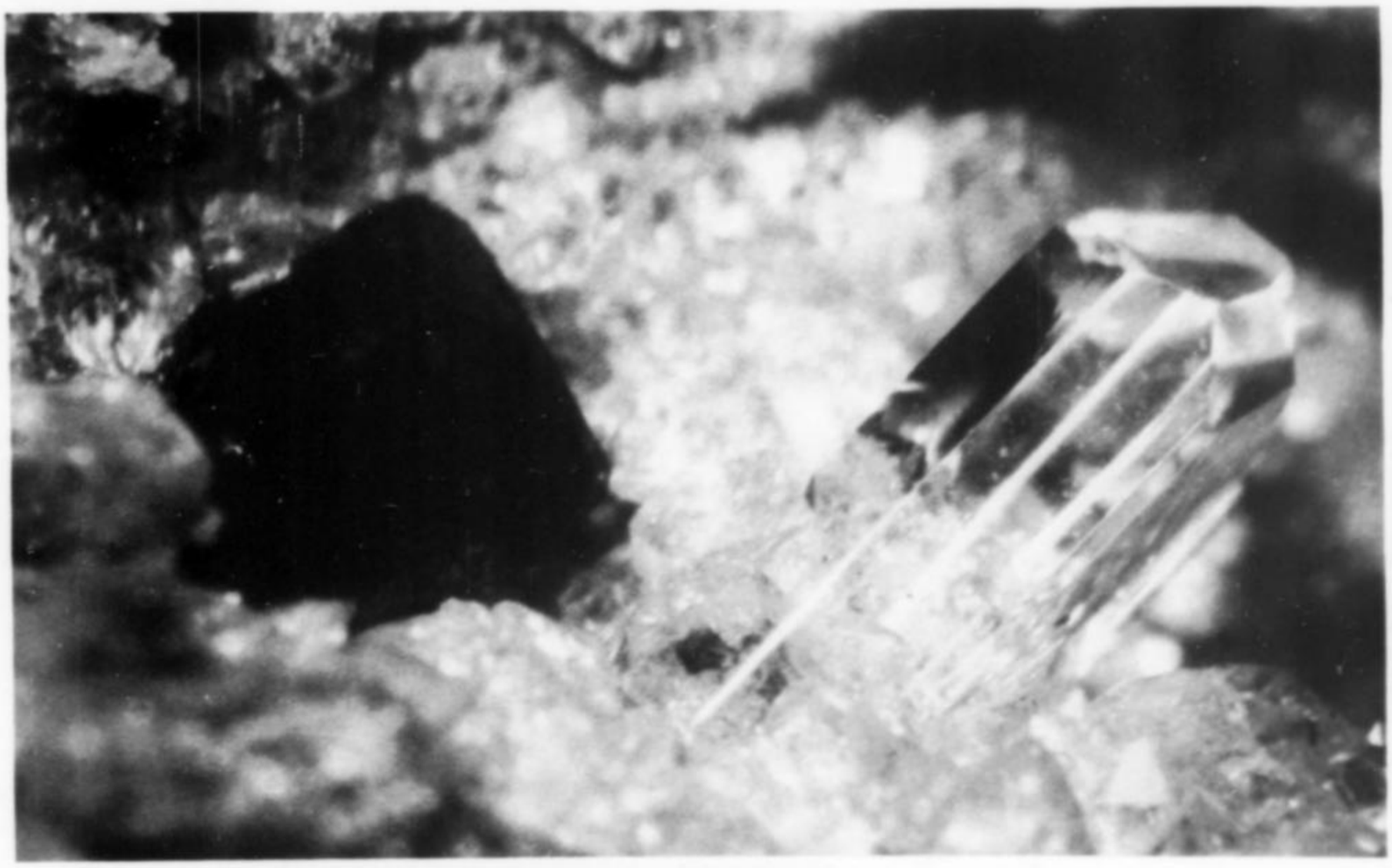


Figure 5. **Wine-red spessartine crystal with colorless, 1.2-mm topaz crystal, from near Grants, New Mexico.**

Besides the hypersthene mentioned above, hornblende and a number of other nice microminerals are found at the Summit Rock locality. They occur in an andesite plug dome (Fig. 15), and were nicely described a number of years ago (Kleck, 1970). There is a small error in Kleck's paper in that what is clearly zircon is called rutile, a mineral not found at this locality. The Summit Rock hornblende, a calcium-iron silicate in the amphibole group, has the same pale brown or almost slightly greenish brown color as the unaltered crystals from Summit Rock is shown in Figure 20, while Figure 21 shows two ilmenite crystals from the same locality with curious, swirling patterns of an unknown overgrowth.

Four polymorphs of silica should be mentioned here: cristobalite, tridymite, high quartz and low quartz. Most specimens of these minerals are either non-photogenic or the very dickens to photograph. For this reason, only one specimen of tridymite is shown. Tabular, transparent crystals from Diamond Lake, Douglas Coun-

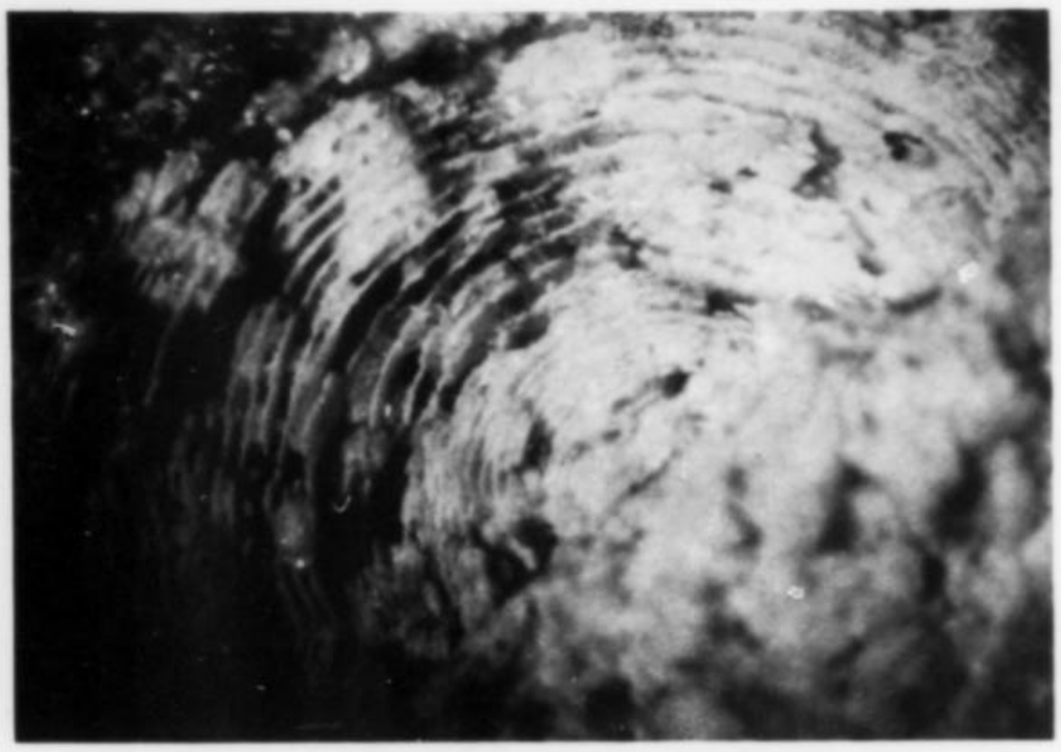


Figure 6. **Lithophysa showing concentric rings of quartz and feldspar crystals; field of view 3 cm across. Specimen is from near Grants, New Mexico.**

Figure 7. **Spherulites to 2 cm in diameter in volcanic glass, from Coso Hot Springs, California. Photo by Wolfgang Mueller.**

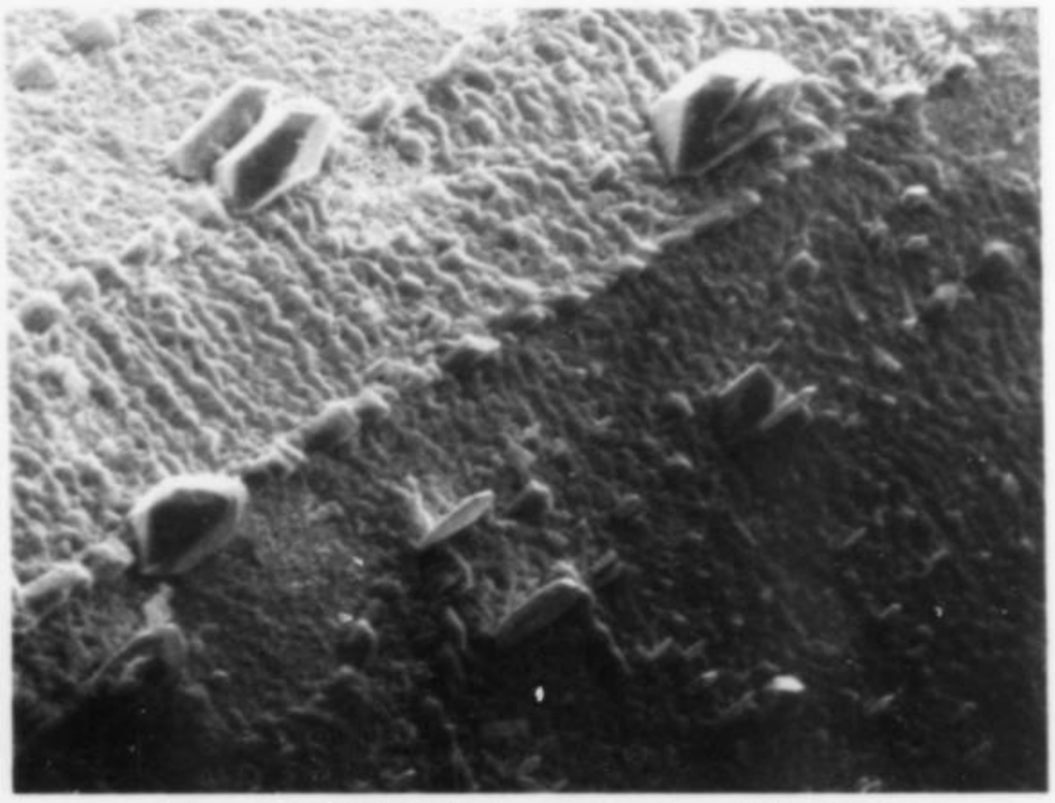


Figure 8. **SEM photograph of metallic black crystals of hematite in parallel array (epitaxial) on brick-red, altered hypersthene from Summit Rock, Oregon. Field of view 0.2 mm Carol Garland photo.**

ty, Oregon are shown in Figure 22. Quartz crystals at this locality are profuse in number, typically with rounded faces, and sometimes showing very well defined growth hillocks and ridges on their faces.

Cassiterite is found in excellent crystals at several of these sites. Deep red, tabular crystals associated with hematite are shown in Figure 4. These are from near Beaverhead, Catron County, New Mexico. At other localities, cassiterite is found as epitaxial overgrowths on hematite. This association is not mentioned in most texts.

Osumilite, one of my favorite minerals, is found in association with hortonolite at Three Sisters Peaks (described above). Readers might be amused to know that this mineral was first sent me in 1968 by my good friend Mike Groben of Coos Bay, Oregon. He and I have been exchanging ever since, and a better trading partner or fellow philosopher would be hard to find. Crystals of the osumilite with interesting markings on the *c*-face are shown in Figure 24, while Figure 25 shows Mike and his friend Al McGuinness packing out 25–50 kilograms each of osumilite matrix from the high hills.

We turn last to photos of two extremely beautiful minerals which are often found in these deposits, not infrequently in close association. These are topaz and spessartine. It is impossible to resist showing yet one more specimen of the topaz from Topaz Mountain, Utah, the pair of crystals shown in Figure 23. At least as striking is the combination of both minerals in the same specimen shown in Figure 5. This specimen and the following one are crystals found in lithophysae from near Grants, Valencia County, New Mexico. For breathtaking beauty, it is hard to beat these spessartine crystals when they have the translucent, claret-red color

Figure 9. **Cavernous, 1.5-mm long crystal of red-brown hypersthene from Summit Rock, Oregon. The outer surface of the crystal is dusted with brilliant black hematite altering to magnetite.**

Figure 10. **Jet-black crystals of pseudobrookite to 2.2 mm in length, from the Paramount claims, Sierra County, New Mexico.**

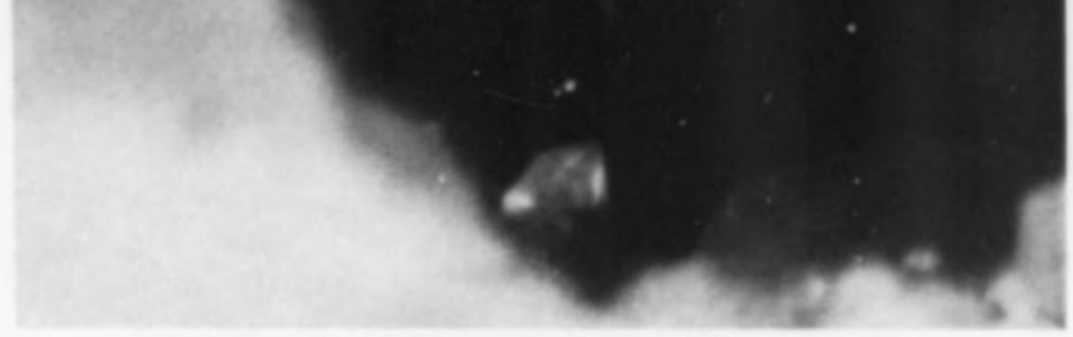


Figure 11. **Stubby, black crystal of pseudobrookite, 1.2 mm long, from Burro Ridge, Sierra County, New Mexico.**

Figure 12. **Red-brown, acicular crystals of pseudobrookite; size of cluster 0.4 mm, from Dugway Dell, Thomas Range, Juab County, Utah.**

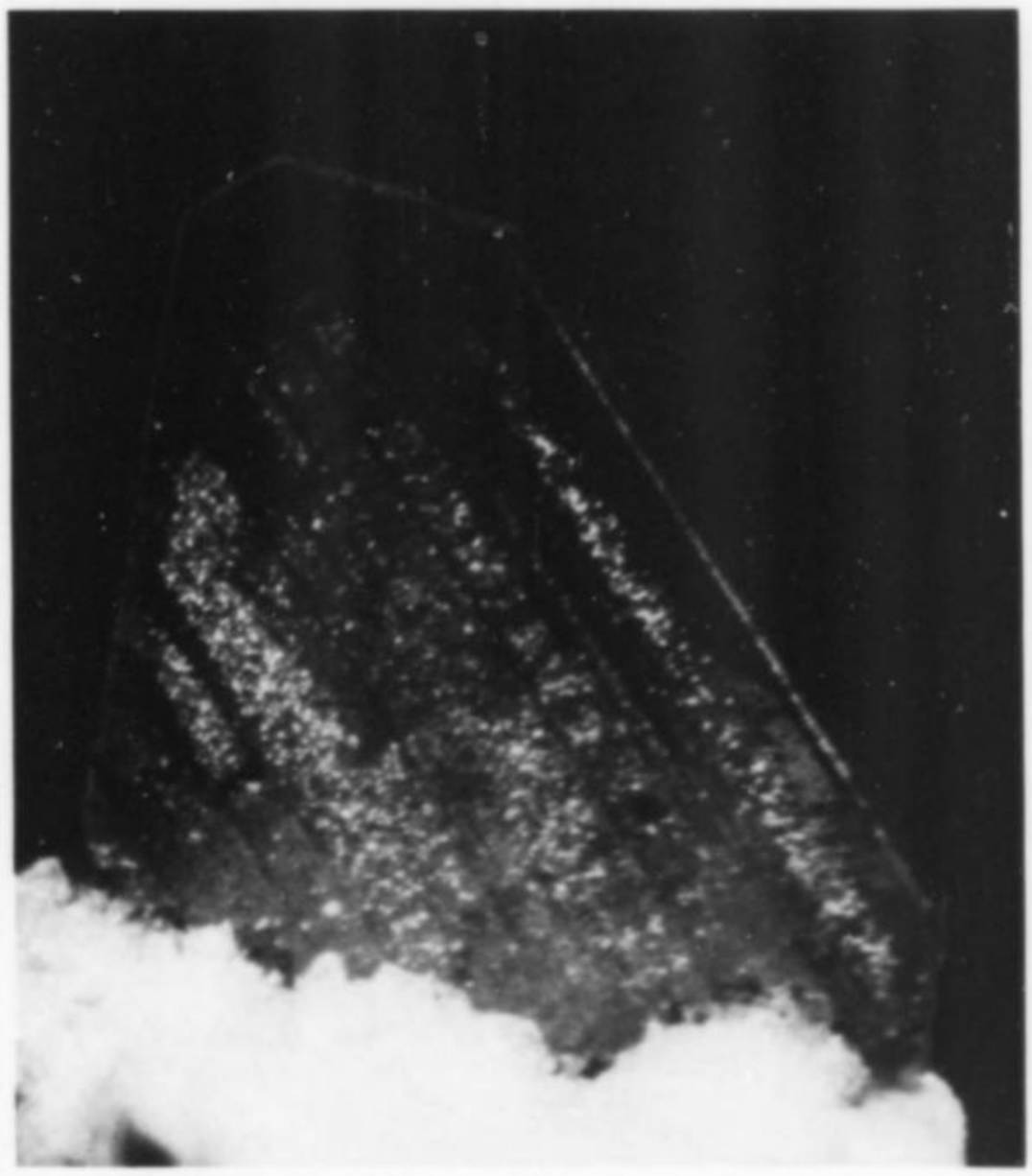


Figure 13. **Brick-red, 2.5-mm crystal of hortonolite dusted with hematite, from the Three Sisters Peaks, Lane County, Oregon.**

of the crystal shown in Figure 1. On its snow-white matrix, it is surely the equal of any gemstone.

The following species/locality table shows the distribution of species within my collection. Of course, being a compilation of those localities and minerals which occur in good micro crystals, it bears little resemblance to the actual distribution of these species. Listed in the table are only those species which I have from more

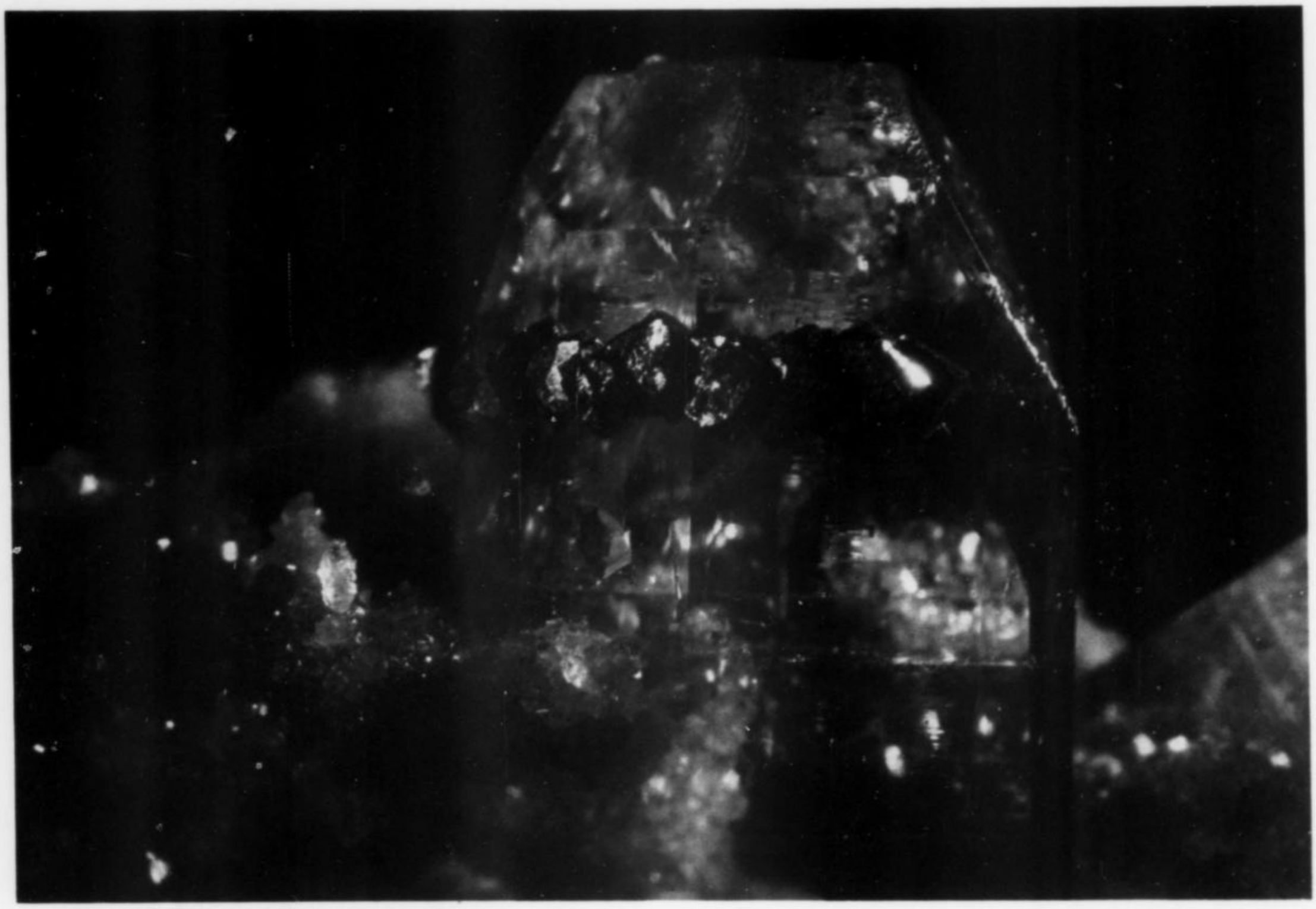


Figure 14. **Black bixbyite crystals growing over incipient cleavage plane of a 2.3-cm long, yellow-brown topaz crystal. Specimen is from Topaz Mountain, Utah. Photo by Wolfgang Mueller.**

Figure 15. **View of collecting area at Summit Rock, Oregon.**

Figure 16. **A 1.8 mm, greenish brown, long columnar crystal of hornblende with short columnar crystals of hypersthene of the same color, from Summit Rock, Oregon.**

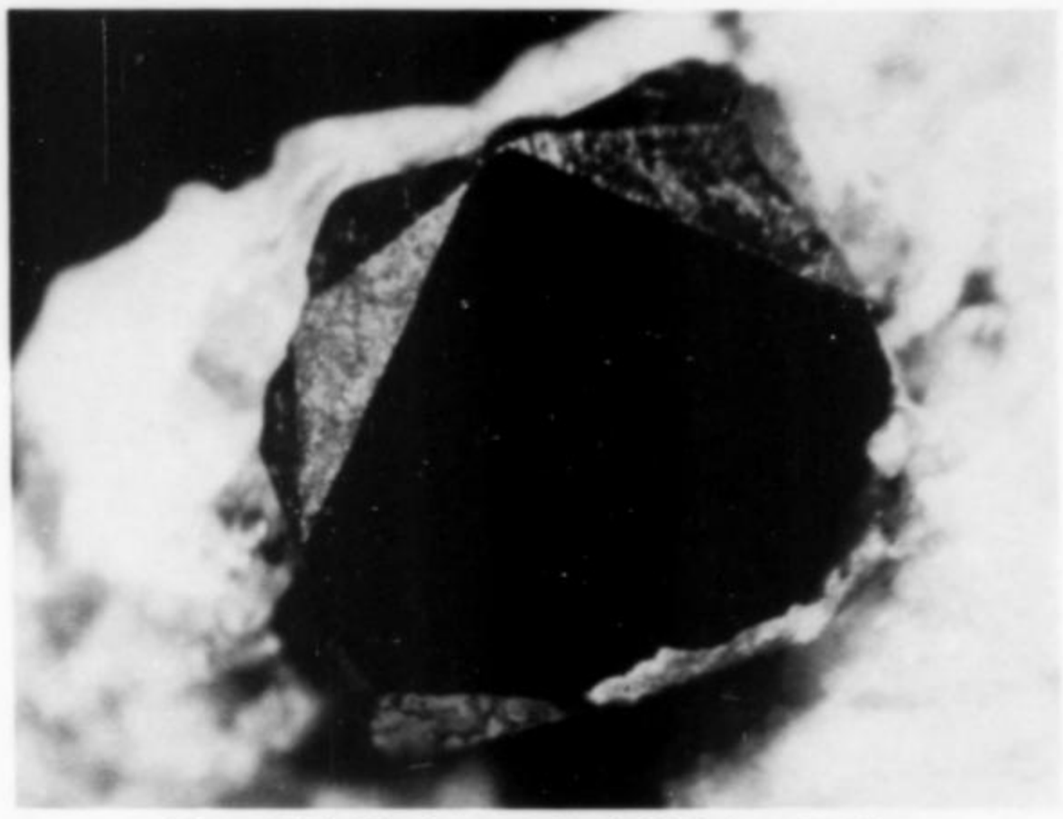
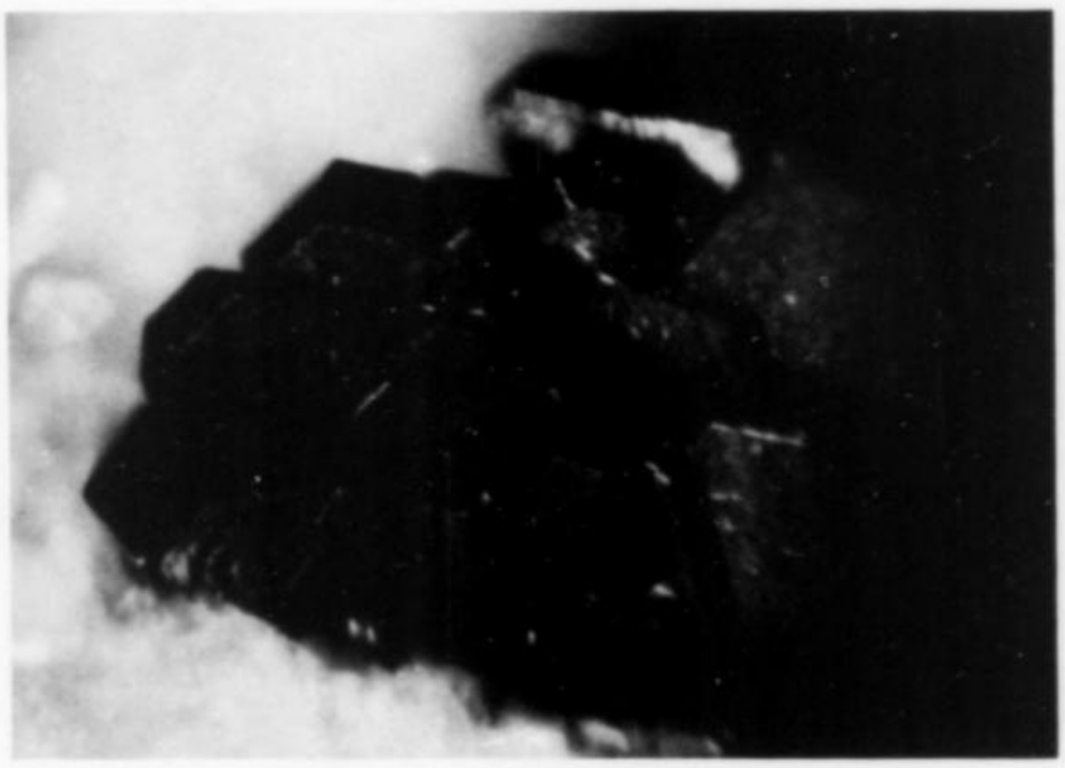


Figure 18. **Black crystal of bixbyite showing cube and major trisoctahedron faces; size of crystal 1.2 mm, from Sierra County, New Mexico.**



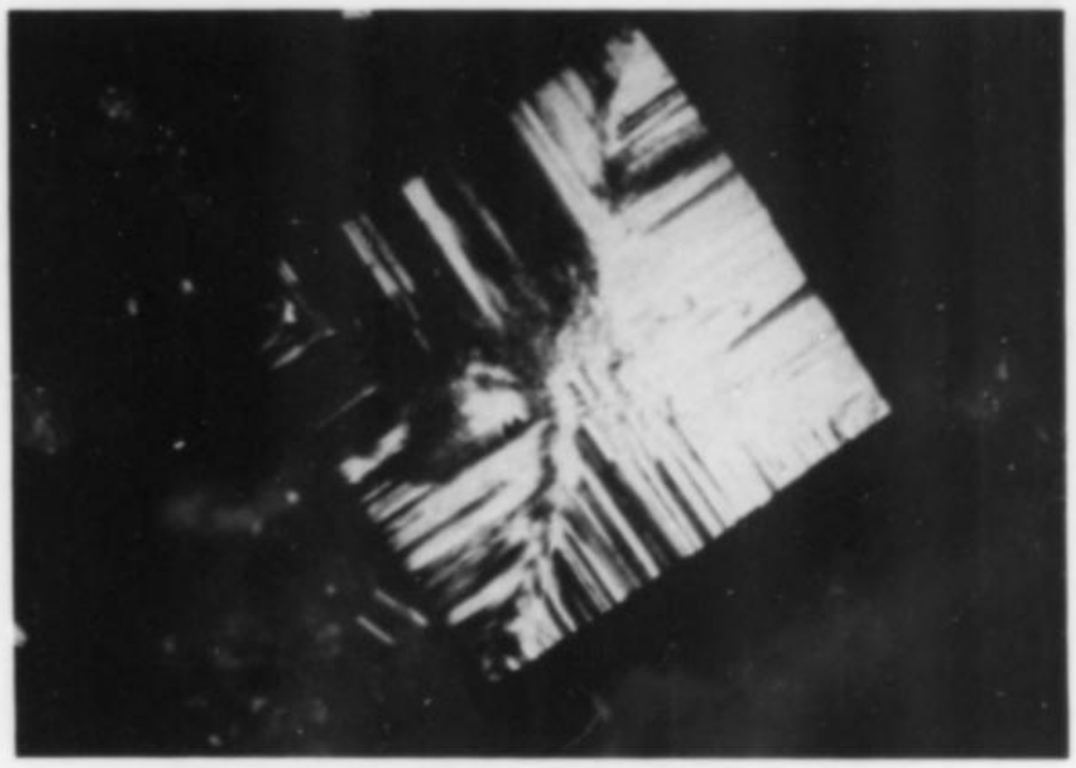


Figure 17. **Jet-black crystal of bixbyite with iridescent tarnish. The crystal is 1.2 mm across, from Sierra County, New Mexico. Omer Dean photo.**

Figure 19. **A 1.7-mm crystal of jet-black hematite showing rhombohedron and basal pinacoid faces. Specimen is from Burro Ridge, New Mexico.**

than one western locality. Single locality species not in the table are: acmite of a bright yellow color, both as crystals and as pseudomorphs after hypersthene from Summit Rock; pale green (!) anatase crystals from the Thomas Range, Utah; the very rare species cuprorivaite in azure-blue crystals from Summit Rock; limpid, euhedral crystals of orthoclase from the Thomas Range; and beautifully transparent, blocky crystals of sanidine from the same locality.

Figure 20. **A 2.2-mm group of sub-parallel plates of black ilmenite crystals from Summit Rock, Oregon.**

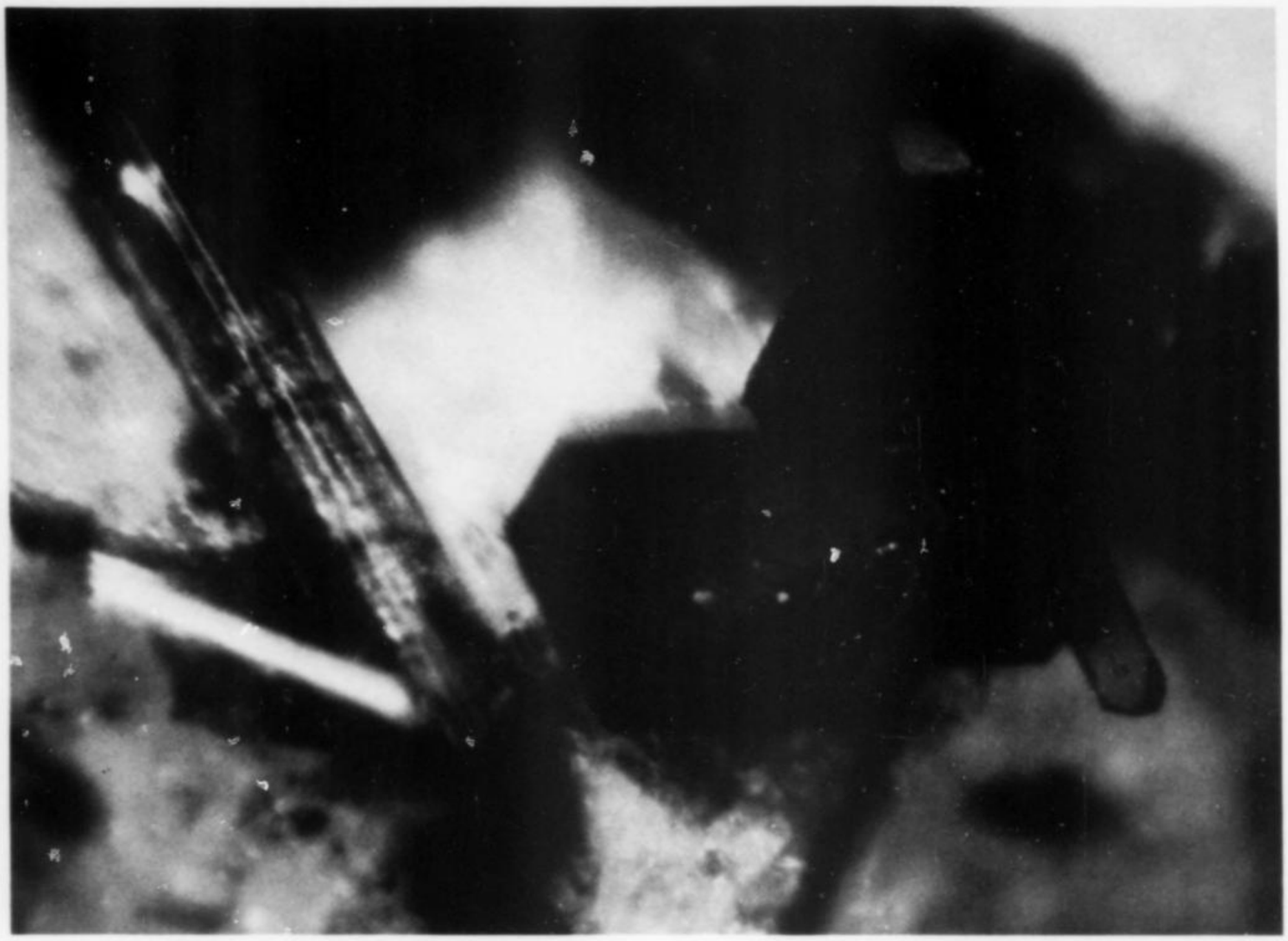


Figure 21. **Two 0.8-mm crystals of gray ilmenite with swirling patterns of an unknown brick-red overgrowth, possibly hematite. From Summit Rock, Oregon.**

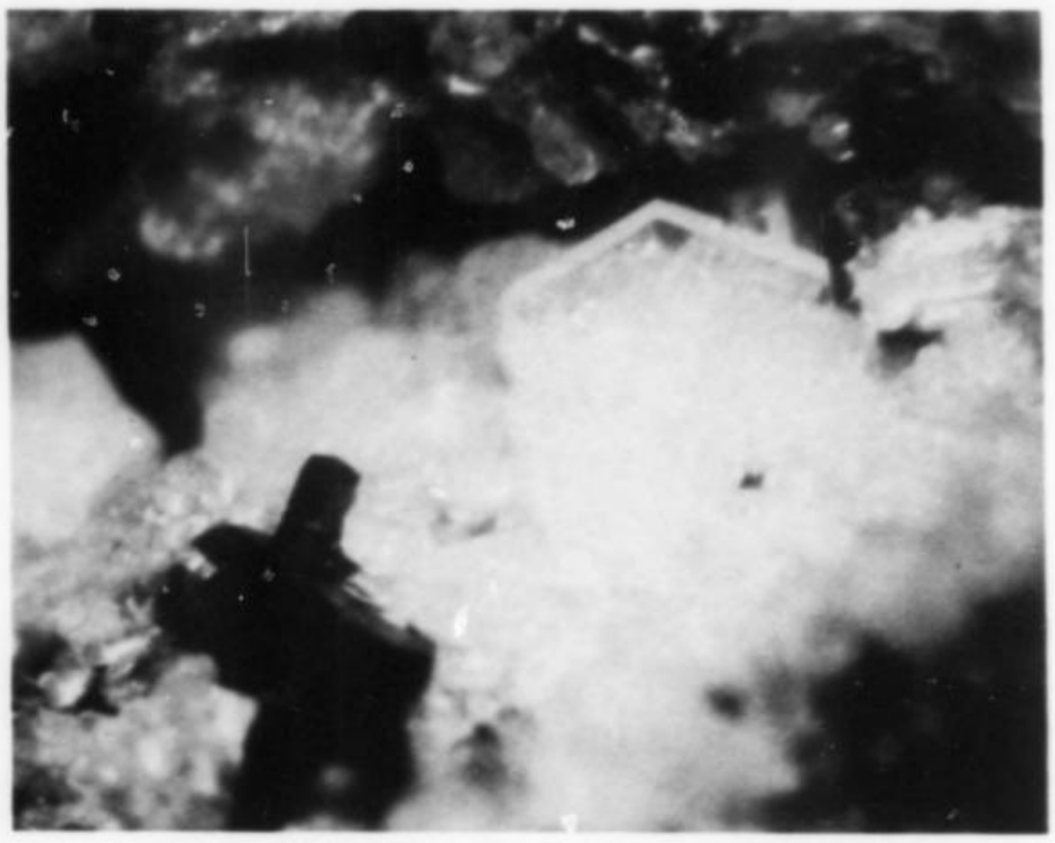


Figure 22. **Colorless, 1-mm crystal of tridymite with yellow-brown hypersthene, from Diamond Lake, Oregon.**

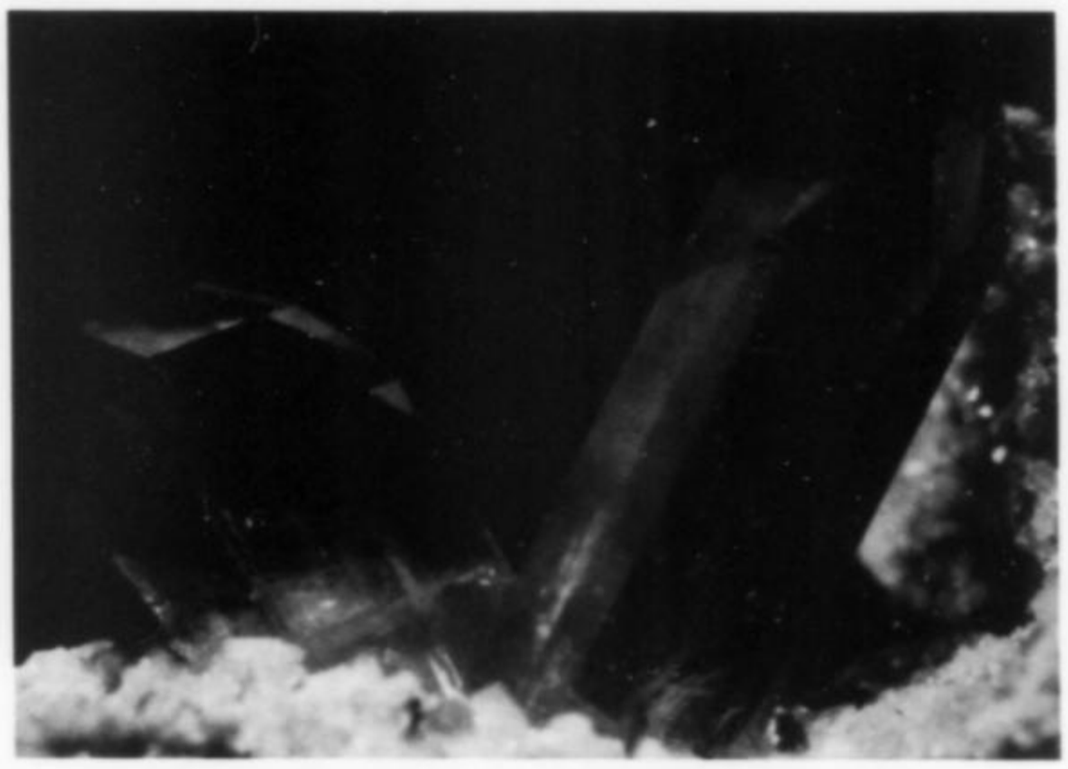


Figure 23. **Sherry-colored, transparent topaz crystals from Topaz Mountain, Utah. Wolfgang Mueller specimen and photo.**

EXCHANGE OPPORTUNITIES

There are, of course, many collectors in the western states who have duplicate specimens of the species described. For those readers who like to exchange, I suggest that they write to any of the following, all of whom are ready to respond.

Edith and John Collins
Box 7111
Spreckels, CA 93962

Mike Groben
1590 Olive Barber Road
Coos Bay, OR 97420

William Hunt
10350 Andover Avenue
Sun City, AZ 85351

Jean and Jack Downing
22617 E. Rhine River Road
Sonora, CA 95370

Jean and Don Hall
664 Forbes Avenue
Montebello, CA 90640

Table 1. **Species and locality table of some Western volcanic minerals**

	Apatite	Augite	Beryl, pink or red	Bixbyite	Cassiterite	Cristobalite	Fayalite	Hematite	Hornblende	Hypersthene	Ilmenite	Magnetite	Pseudobrookite	Quartz	Spessartine	Topaz	Tridymite
Arizona																	
near Ajo, Pima County													o	o			
Arnett Creek, Pinal County		o															
Galiuro Mountains, Pinal County						o											
Wickenburg, Maricopa County														o			
California																	
Coso Hot Springs or near Little Lake, Inyo County						o	o										o
Cougar Butte, Modoc County						o	o										
Colorado																	
Nathrop, Chaffee County															o		
Nevada																	
Denio, Humboldt County														o			
Ely, White Pine County															o		
Lane City, White Pine County																	o
New Mexico																	
Beaverhead, Catron County			o	o			o		o								
Burro Ridge, Sierra County							o						o				
Cuchillo, Sierra County													o				
near Grants, Valencia County														o	o	o	
Grants Ridge, Valencia County															o	o	
Paramount Claims, Sierra County		o	o									o	o				
Tin Mine, Squaw Creek, Catron County					o		o										
Valencia County															o		
Oregon																	
Diamond Lake, Douglas County						o		o					o				o
Lemolo Lake, Douglas County	o							o	o				o				o
near Red Cone, Crater Lake									o				o				
Summit Rock, Douglas County	o	o				o		o	o	o	o	o				o	
Three Sisters Peaks, Lane County									o								
Umpqua River, Douglas County													o				
Utah																	
Dugway Dell, Thomas Range													o				
Thomas Range, Juab County			o	o				o					o		o	o	o
Twin Peaks								o									
Topaz Mountain, Juab County			o	o				o				o		o		o	
Wah Wah Mountains, Beaver County			o														

ACKNOWLEDGMENTS

When I began writing this column and accumulating photos to illustrate it, I wrote to a number of collectors requesting information and specimens. They responded most generously, and I would like to acknowledge the help given me by Bill Baldwin, Marvin Deshler, Jean Downing, Vi Frazier, Mike Groben, Bill Hunt, Wolfgang Mueller and Dave Richerson. Many thanks to them all!

REFERENCES

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

Microminerals

Bill Henderson

1984 Tucson Show*

My wife Audrey and I attended the 1984 Tucson Show, together with our good friends Charlie and Marcelle Weber of Guilford, Connecticut, and Omer and Betty Dean of Norwalk, Connecticut. We all stayed at the same motel, and engaged in a veritable orgy of swapping, buying, collecting and eating. Since we began before the show and were busy well after it, we certainly got our fill of the mineral hobby. All six of us are micromineral collectors, so we ferreted out a considerable variety of specimens at the show and in the motel rooms.

Before describing the specimens we acquired, perhaps I should briefly describe the arrangement of the show itself and our collecting techniques. The Tucson Gem and Mineral Show, to use its proper title, is held over a four day period in February, and takes place at the Tucson Community Center. This enormous hall is the place to see major dealers, exhibits of mineral specimens and gems, demonstrations of equipment, and publishers' offerings. In nearby motels are to be found satellite shows run by dealers not willing or able to find accommodation at the show itself. These dealers do business from rooms at the motels. They are usually open several days before the beginning of the main show, but may close before the main show closes.

Most of our collecting was done at the satellite shows. One or more of us would descend upon a selected motel, almost every room of which would be occupied by a dealer. On each floor, we would go from room to room spying out micro material. A few dealers had micro material only, a few had nothing of interest, but many a dealer in hand specimens would have a few goodies in our size class. Then, sometimes by swapping and sometimes with the silver pick, we would negotiate to acquire the choicest specimens. Choice of material in many cases was made using nothing but a hand lens. Occasionally, those swappers and dealers who specialize in micro material had microscopes available, thus making our task considerably easier.

For me, the purest joy was that experienced when I found a kindred soul with a fine stock of micro material and who was eager to obtain what I had for exchange. With luck, I would later walk away with 20 or more fine micros new to my collection, obtained in exchange for equally nice duplicates from my own supplies. The rest of this column shows just a small fraction of the fine micromounts we brought home.

Benny and Elva Fenn of Juarez, Chihuahua, Mexico, were dealers in the main showroom. While most of their material was hand specimens of Mexican minerals, they had a few excellent pieces with micro potential at very reasonable prices. Ten dollars was enough to acquire a 5 x 9 cm piece of matrix liberally covered with pale red to pink, radiating, superbly formed creedite crystals like that in Figure 1. For part of the same ten dollars, a smaller piece of matrix was obtained scattered with rich pink, transparent crystals of rhodochrosite, both specimens from Santa Eulalia, Chihuahua, Mexico. Readers will remember that the Fenns were written up in the July-August 1984 issue of the Record, in Bill Panczner's *Notes from Mexico* column.

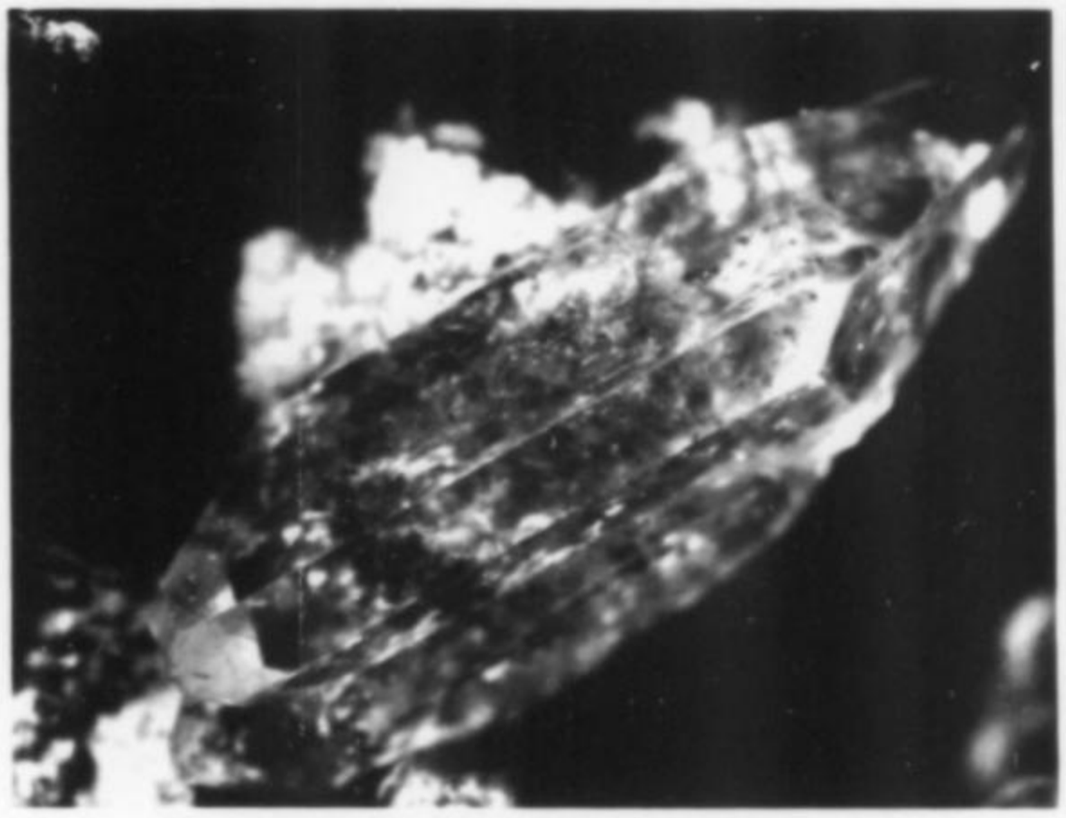


Figure 1. **Pale pink 0.5-mm creedite crystal from Santa Eulalia, Mexico.**

Among the sleepers of the show were superb crystals of powellite, a mineral very seldom seen in good micro crystals. These were obtained from Bernard Brunet, 10 Rue Gracieuss, 75005 Paris, France. It took quite a sharp eye to spot these, as they were first seen in a deeply shadowed corner of a motel room without adequate facilities for viewing micros. The crystals, one of which is shown in Figure 2, are a pale canary-yellow, transparent, very sharp, and associated with what appears to be brochantite. The powellite crystals, like those from almost all other localities, are fluorescent a deep yellow. The locality is Inca de Oro, Antofagasta, Chile.

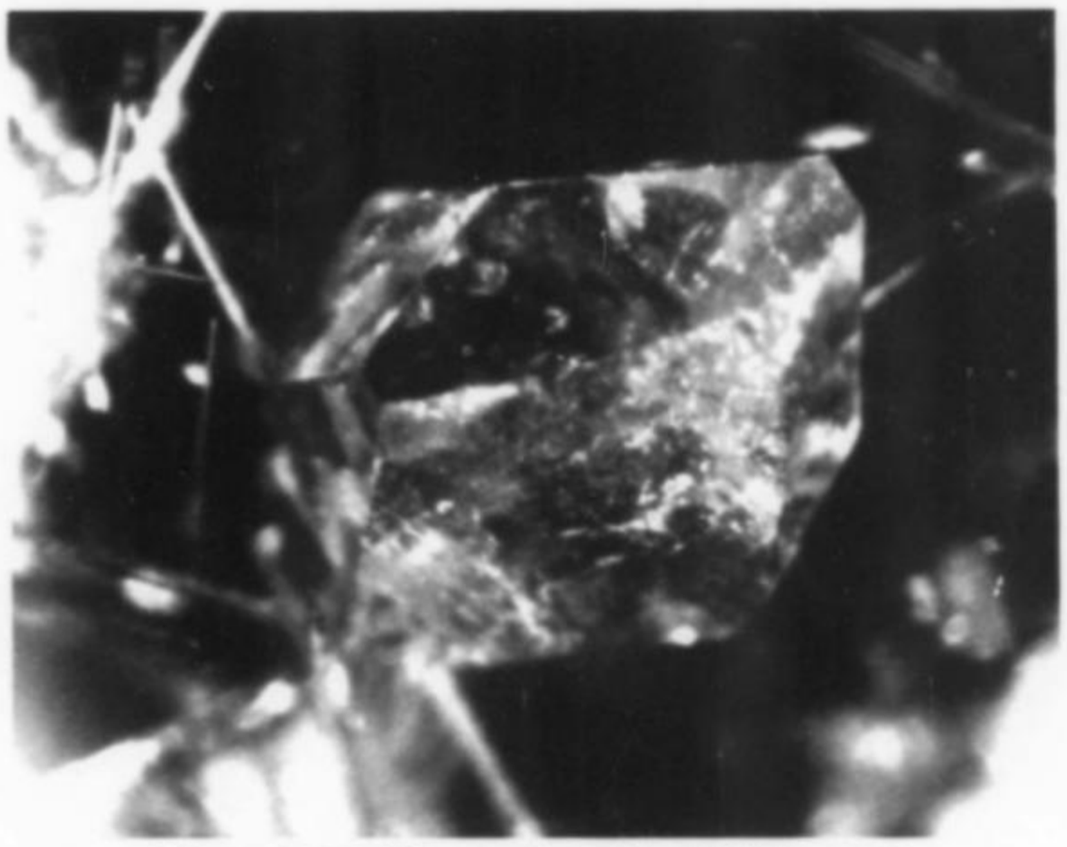


Figure 2. **Doubly terminated powellite crystal perched on brochantite. The crystal is 0.9 mm high; the locality is Inca de Oro, Antofagasta, Chile.**

*The editor regrets the rather late publication of this installment, but the contents are still of interest. Ed.

Luis Menezes, Rua Maria Dick, 65; 04709 São Paolo, S.P., Brazil, had superb groups of forsterite as twinned crystals like those shown in Figure 3. These are from the Jacupiranga mine, São Paulo, Brazil (see his article on this interesting locality in the September-October 1984 issue). Other minerals obtained from him include zirkelite from the same locality and lanthanite-(Nd) from the type locality at Curitiba, Parana, Brazil.

Figure 3. **A very pale yellow, twinned crystal of forsterite from the Jacupiranga mine, São Paulo, Brazil. The twin is 4 mm across.**

Many readers are by now familiar with the new mineral sturmanite, found at the N'Chwaning #2 mine, near Kuruman in South Africa. Larry Introna of *Gem and Mineral Mining Company,* Capetown, had an enormous supply of superb hand specimens in single crystals and groups. Considering the rarity of the mineral and the perfection of the crystals, prices were very reasonable. Inquiry produced only a single piece of matrix with crystals of micro size. Apparently, the South African gods don't stoop to making many micro specimens! The piece passed hands, and all three couples in our party now have superb micro specimens of the mineral (Fig. 4). The crystal is yellow, transparent, and shows well the hexagonal prism, dipyramid and pinacoid.

Figure 4. **Transparent, orange-yellow crystal of sturmanite. The 0.6-mm crystal is from the type and only locality for the mineral, the N'Chwaning #2 mine, near Kuruman in South Africa.**

Sharon Cisneros of *Mineralogical Research Company,* (an advertiser in the *Mineralogical Record*) was at the show. As usual, she had a case containing hundreds of micro specimens in Perky boxes at the back of her display. Many were very nice, such as the deep red, transparent spinel octahedron from Upper Burma shown in Figure 5. A great many other choice micros were available, including an excellent rutherfordine with sklowdowskite from Zaire (not shown). Sharon often has microminerals available in her bimonthly lists.

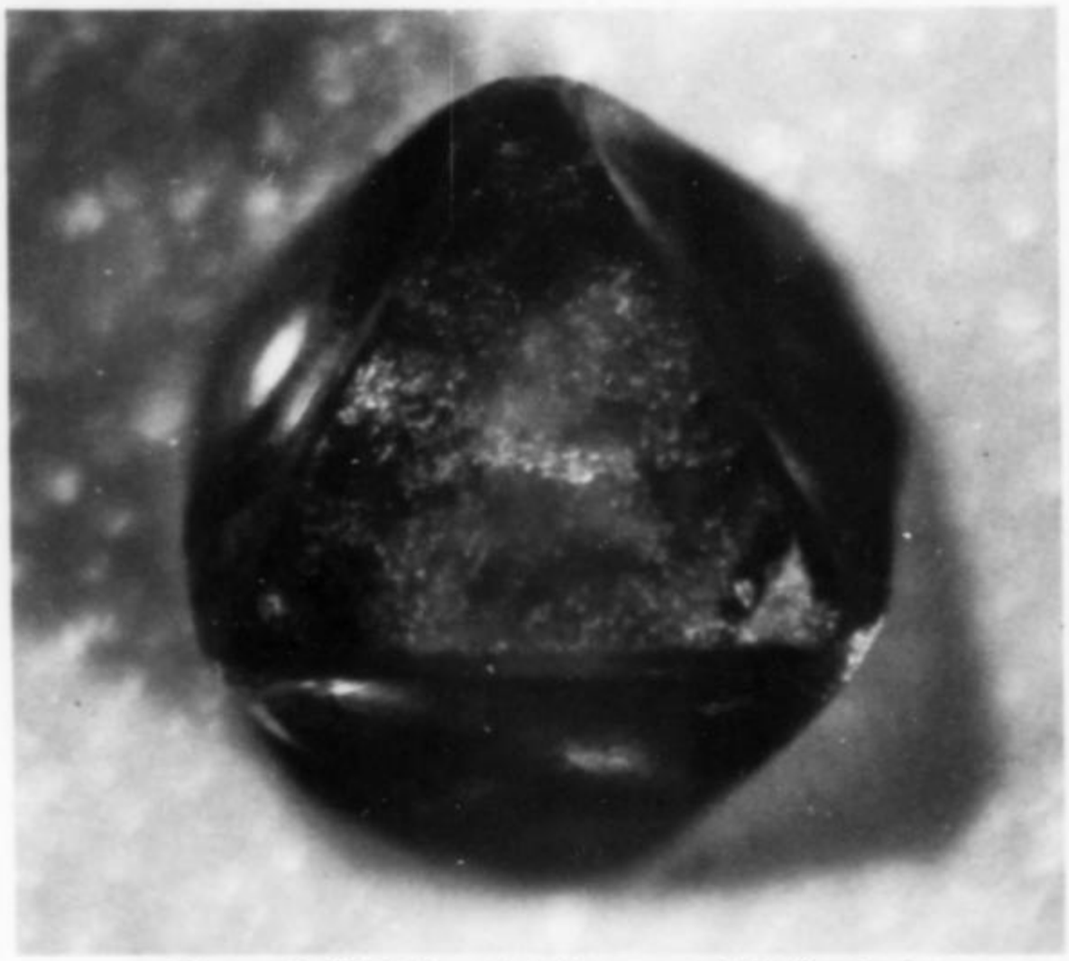


Figure 5. **Pinkish red 1.4-mm crystal of spinel from Upper Burma.**

Bob Jackson, Box 2652, Renton, Washington 98055, is a dealer who had a number of excellent examples of pyrite inclusions in quartz from Goldmeyer Hot Spring, King County, Washington.

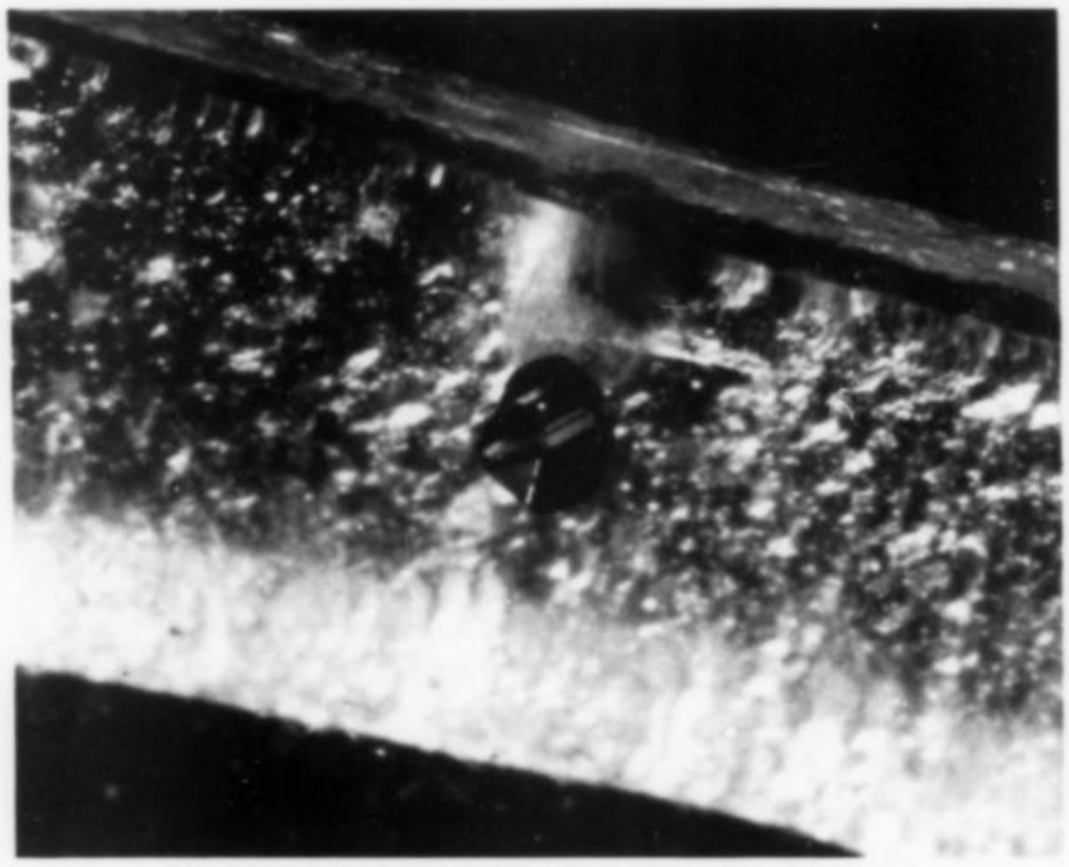


Figure 6. **Pyrite inclusion in quartz crystal. Note hazy area of disrupted growth to left of the pyrite crystal as the quartz continued to grow. Specimen is from Goldmeyer Hot Spring, King County, Washington.**

The one in Figure 6 is interesting in that there is an opaque, cloudy area to the left of the pyrite inclusion. Apparently, in this case and others, the pyrite crystal disrupted subsequent growth of the quartz crystal somehow, thus causing the opaque region in the quartz. Bob also had pyrite outlining phantoms in quartz from the same locality, and superb micro Japan-law twins of quartz.

Les Cubit is a swapper/dealer we found in one of the motel rooms. His address is Star Route 2, Box 60, Socorro, New Mexico 87801. Les had such a fine variety of micro specimens available that the big problem was finding things to swap or sufficient cash for all the specimens we wanted. Four nice ones are shown in Figures 7–9. The first is brilliant black groutite on chalcedony on petrified wood from Apache County (?), Arizona. The color of the brilliantly yellow uranophane from Valentine, Jeff Davis County, Texas is striking, while the levyne from Mount Vernon, Grant County, Oregon, is valued for the nice crystal form and the locality. Other fine species which Les had are millerite sprays *in* calcite, from Coralville, Iowa; excellent, large crystals of jarosite on hematite from Morenci, Greenlee County, Arizona; nice colored vanadinite with descloizite from the C and B mine, Gila County, Arizona; cuprian adamite from Gold Hill, Tooele County, Utah; kornelite from Coso Hot Springs, Inyo County, California; bastnaesite from the Red Cloud mine, Lincoln County, New Mexico; kentrolite from Hillsboro, Sierra County, New Mexico; and a number of Point of Rock species, about which I will say more later.

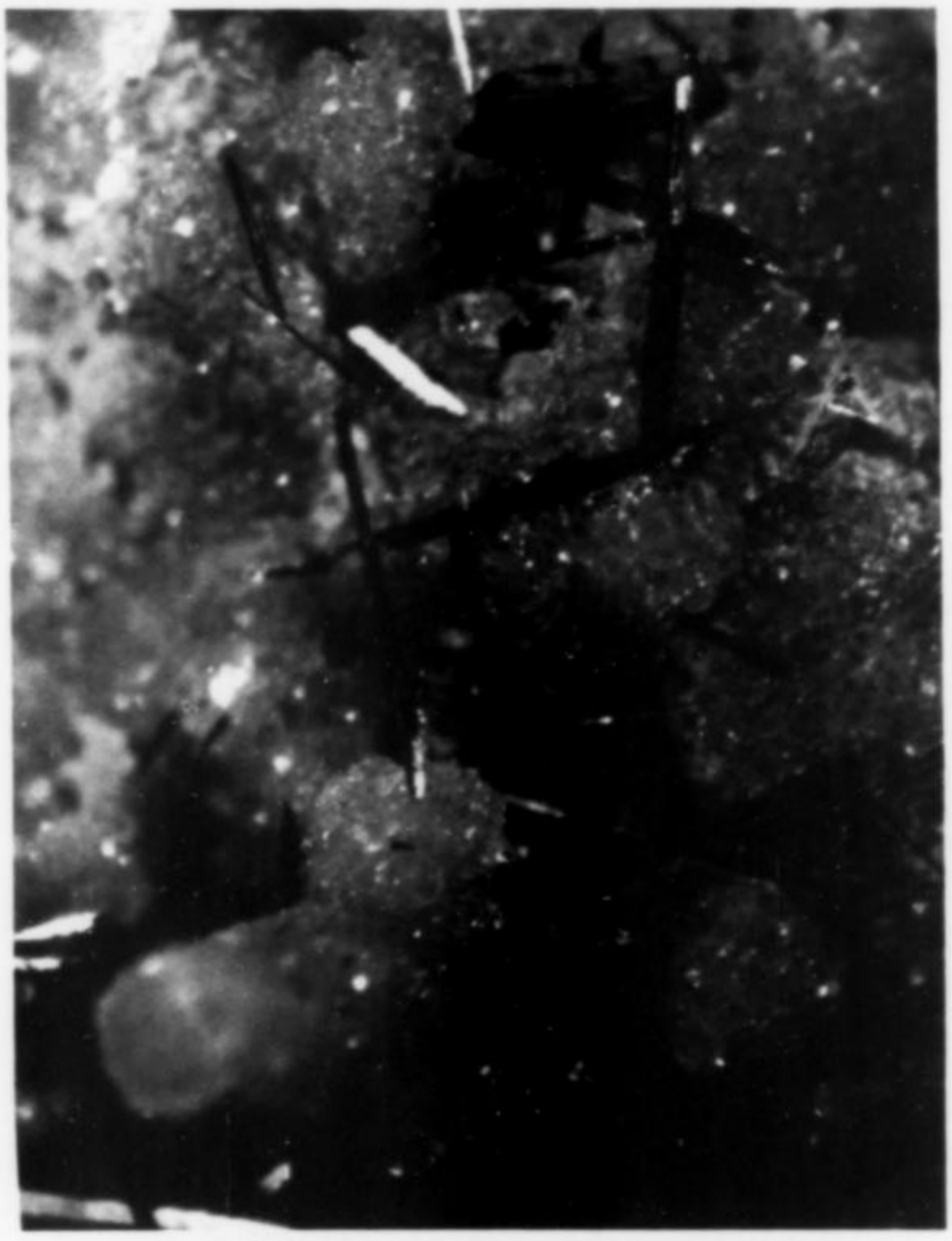


Figure 7. **Up to 2 mm, deep black crystals of groutite on petrified wood, from Apache County (?), Arizona.**

We obtained only one micro specimen from Forest Cureton, a dealer in rare minerals who advertises in the *Mineralogical Record,* but that one is a real winner. It is a 2.5 x 5 cm matrix piece covered with hundreds of tiny, white minrecordite crystals. Studded here and there are larger, deep blue-green crystals of dioptase. The specimen, from Tsumeb of course, is shown in part in Figure 10.

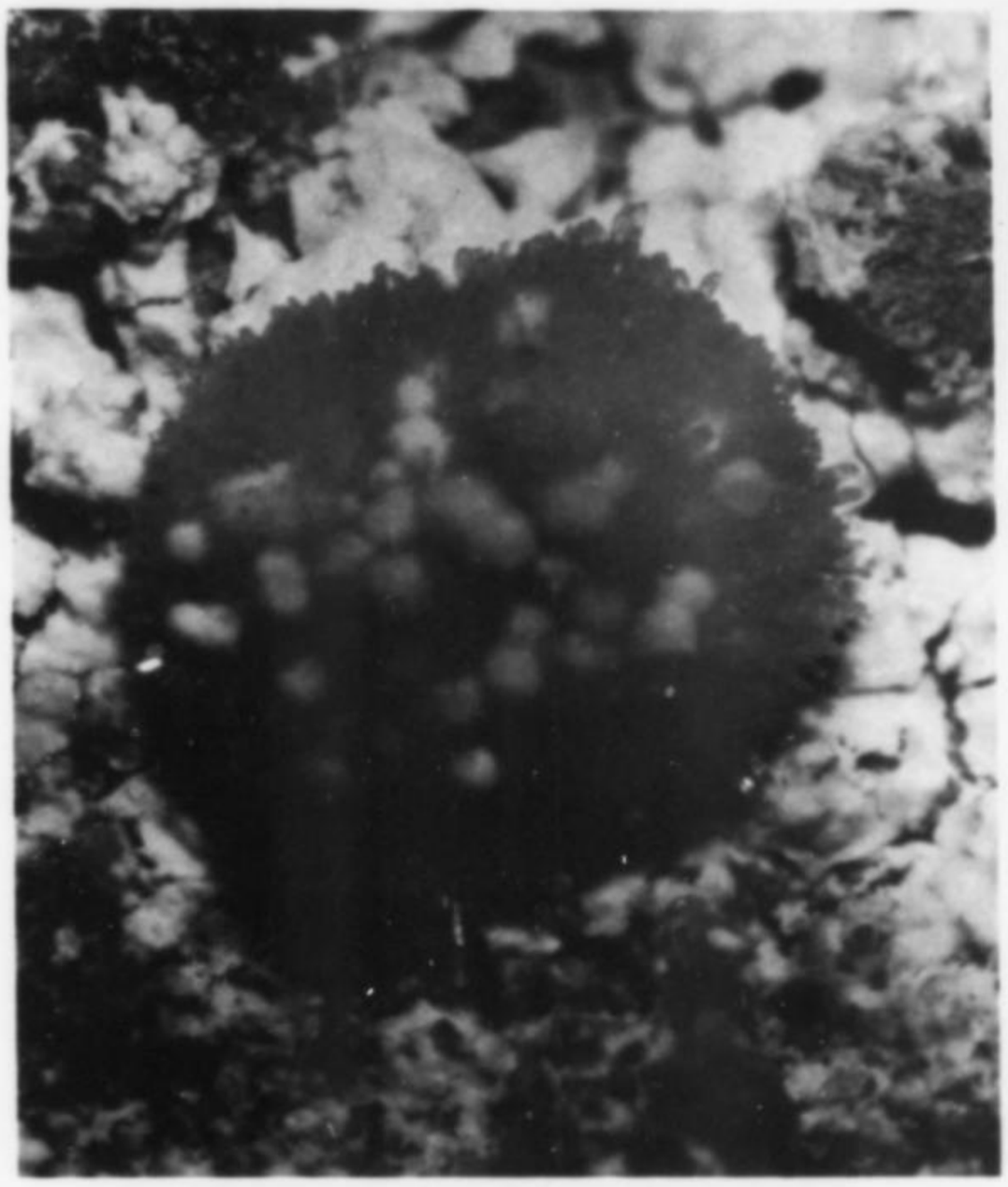


Figure 8. **Lemon-yellow, 2.5-mm radiating group of uranophane crystals surmounted by an unknown white mineral, from Valentine, Jeff Davis County, Texas.**

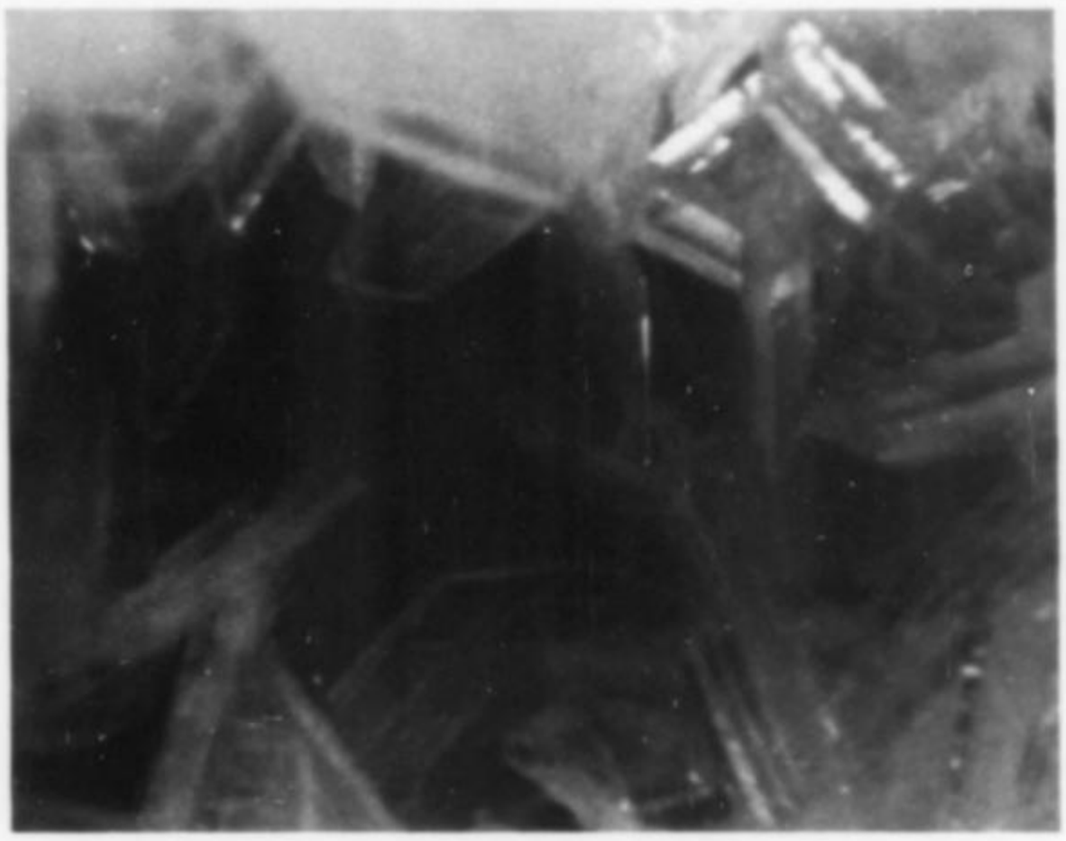


Figure 9. **Druse of transparent to white levyne crystals in vug, the largest crystal 0.5 mm across, from Mount Vernon, Grant County, Oregon.**

Readers will recall the excellent article by Ramon DeMark in the May-June 1984 issue of the *Mineralogical Record* on the minerals of the Point of Rocks quarry, Colfax County, New Mexico. Mark was in one of the motel rooms, and by swapping and purchase, a very fine assortment of the rare species was obtained. Among them are excellent crystals of cancrinite, serandite, eudialyte, lorenzenite, superb Mn-neptunite, nepheline, polylithionite, searlesite, villiaumite and some of the unknowns. The occurrence is of special interest to us since most of the Point of Rocks minerals also occur at our favorite collecting locality, Mont St-Hilaire, Quebec. Despite the fine photos in Ray's article, we could not resist showing the two

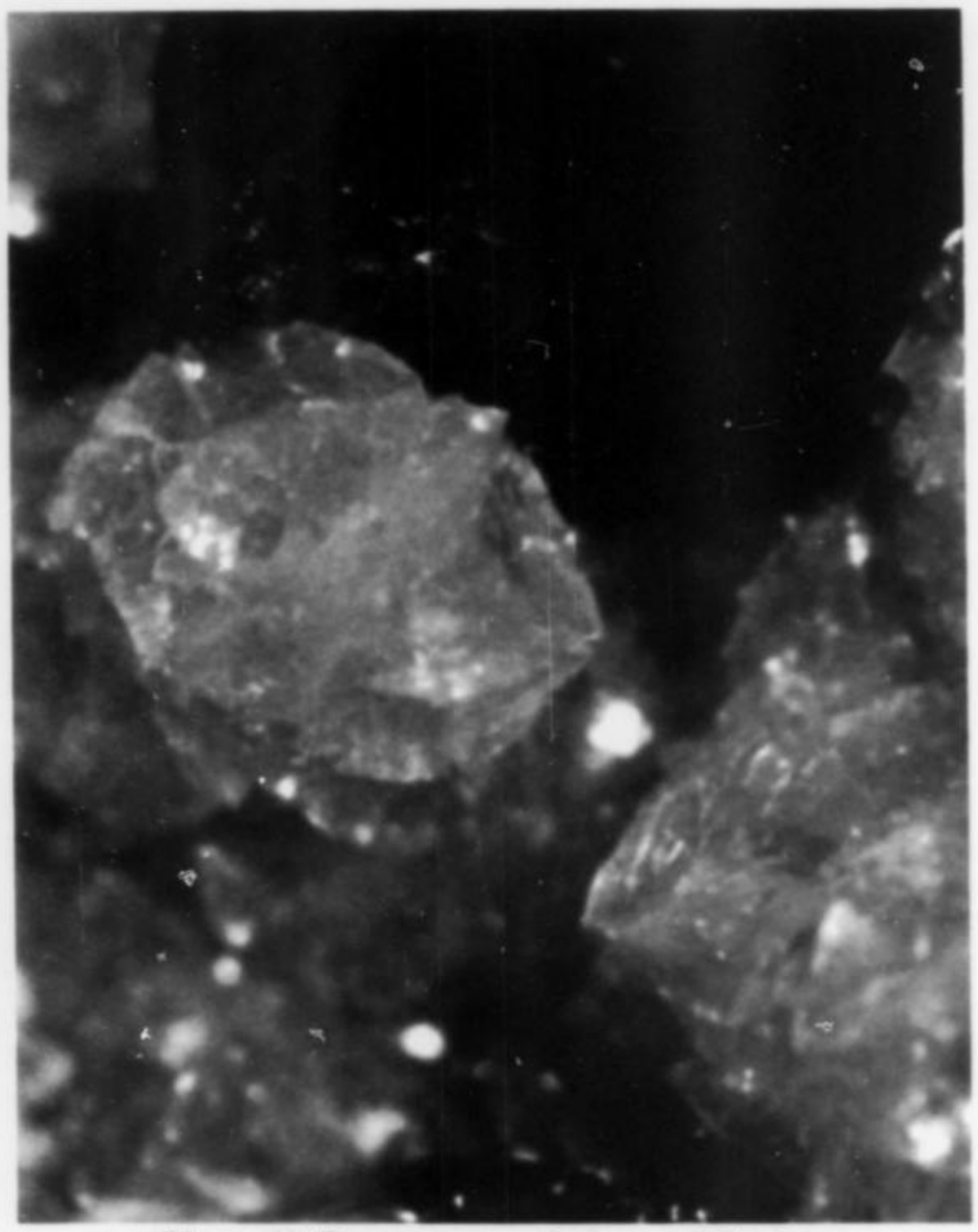


Figure 10. **Transparent, colorless, saddle-shape crystals of minrecordite with diotase from Tsumeb, Namibia.**

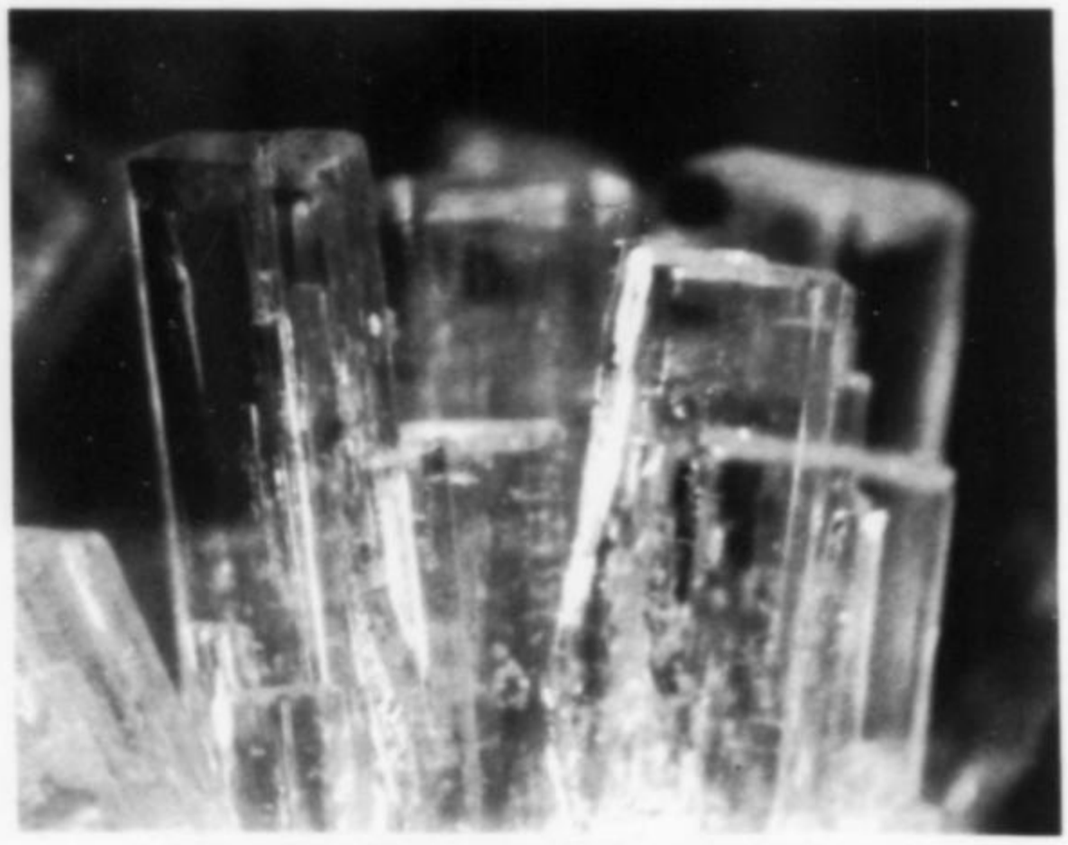


Figure 11. **Colorless searlesite crystals about 1 mm in length, from Point of Rocks, Colfax County, New Mexico.**

Point of Rocks specimens in Figures 11 and 12.

One evening we had a micro micromount meeting of our own in our motel room. Harold and Vi Frazier, Box 27, Point Arena, California 95468, and Jack and Jean Downing, 22617 East Rhine River Road, Sonora, California 95370, dropped by. Of course, with four Californians and a group from Connecticut, we had plenty to look at and exchange. Vi had some of the intriguing "bridges" covered with paulingite crystals, one of which is shown in Figure 13. Of course, these things must have a core or support composed of an acicular mineral, and I'll have more to say about the "cores" in

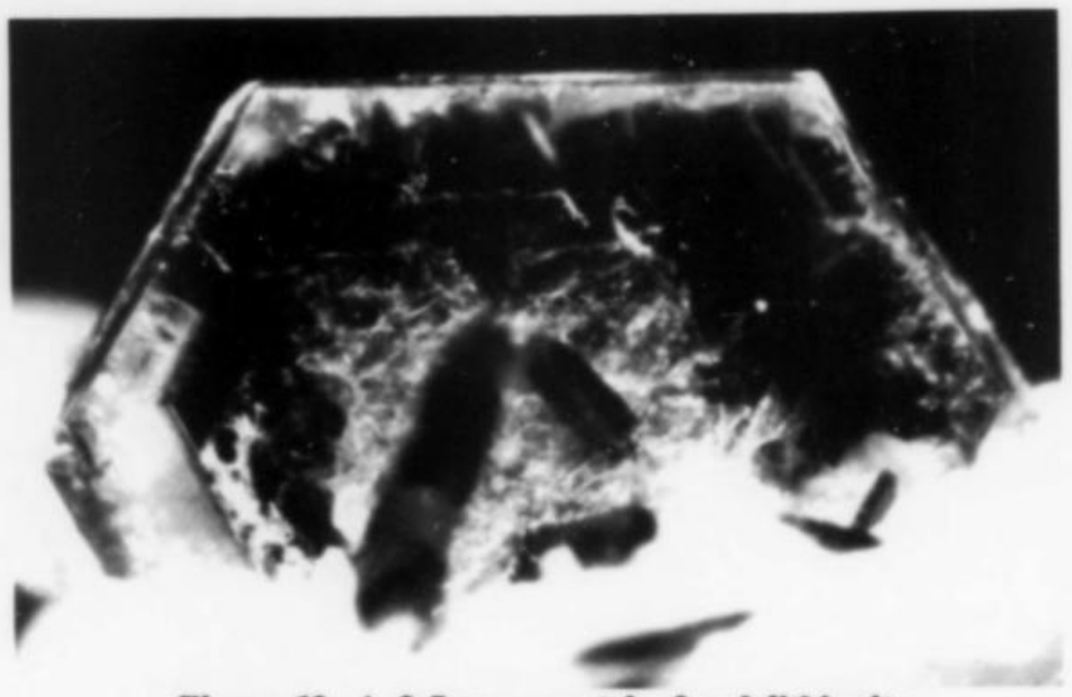


Figure 12. **A 2.5-mm crystal of polylithionite, transparent with a brown center, from Point of Rocks, Colfax County, New Mexico.**

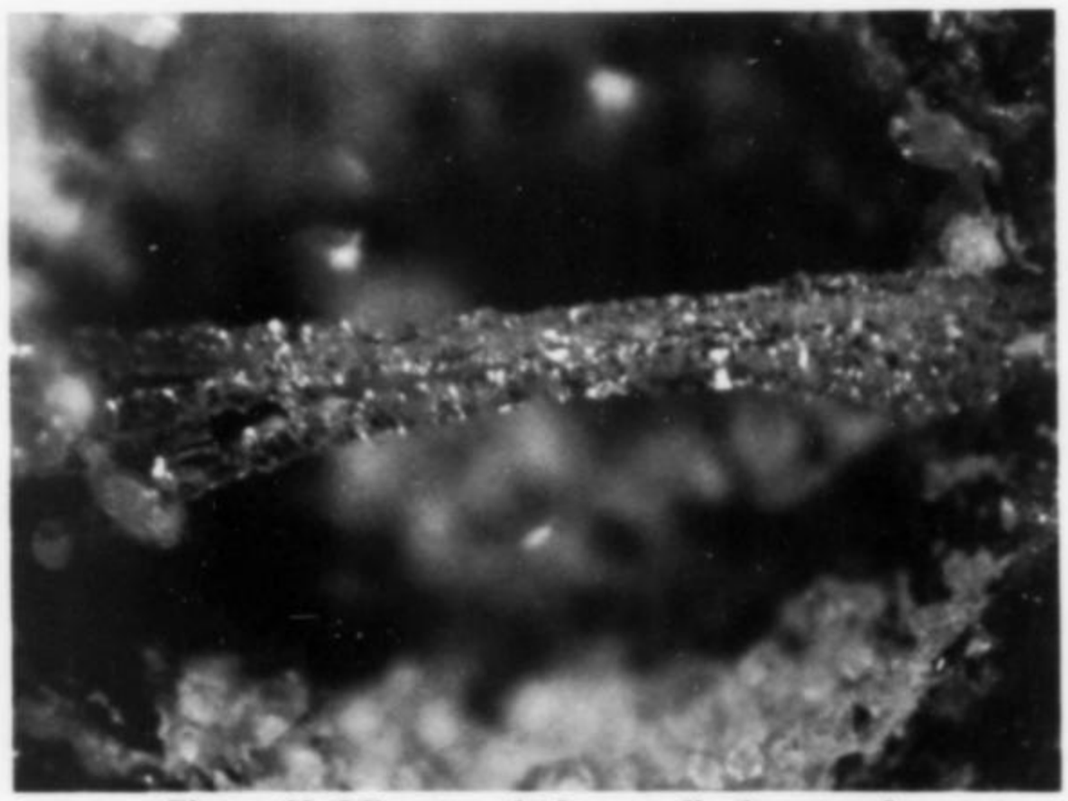


Figure 13. **Minute, colorless paulingite crystals encrusting an unknown acicular mineral; field of view 3 mm; from Three Mile School, Ritter, Grant County, Oregon.**

a future column. Another of Vi's specimens (Fig. 14) is bright yellow boltwoodite on deep purple fluorite, a very nice combination from the New Method mine, Amboy, California. She also had some of the fine micros currently coming out of the Blue Bell claims near Baker, San Bernardino County, California (see the November-December 1977 issue).

Jean Downing has collected excellent micros of a number of species such as hypersthene, pseudobrookite, tridymite and acmite from Lemolo Lake and Summit Rock, Douglas County, Oregon. One remarkable specimen she found but which now resides out East is the tridymite star from Lemolo Lake shown in Figure 15. I can't recall seeing such crystals before. Dana mentions tridymite in fan-shape groups, but I don't know whether Dana is referring to such a regular growth form as this. The components of the star appear to be at 60° angles from the center, in keeping with tridymite's pseudohexagonal tendencies.

Meredith York had some fantastically beautiful phosphate species from a locality he would give no more precisely than as Mena, Polk County, Arkansas. The species available were bright pink strengite balls, extremely clean cacoxenite in tiny crystals, pea-green kidwellite in botryoidal groups, black botryoidal and stalactitic rockbridgeite and very well formed brick-red beraunite laths. Frequently, a single 4 x 4 cm piece of matrix would have three or four of the above species. One specimen of the pink strengite perched on botryoidal kidwellite and stalactitic rockbridgeite is

Figure 14. **Bright yellow boltwoodite needles on a 2-mm, deep purple cube of fluorite, from the New Method mine near Amboy, San Bernadino County, California.**

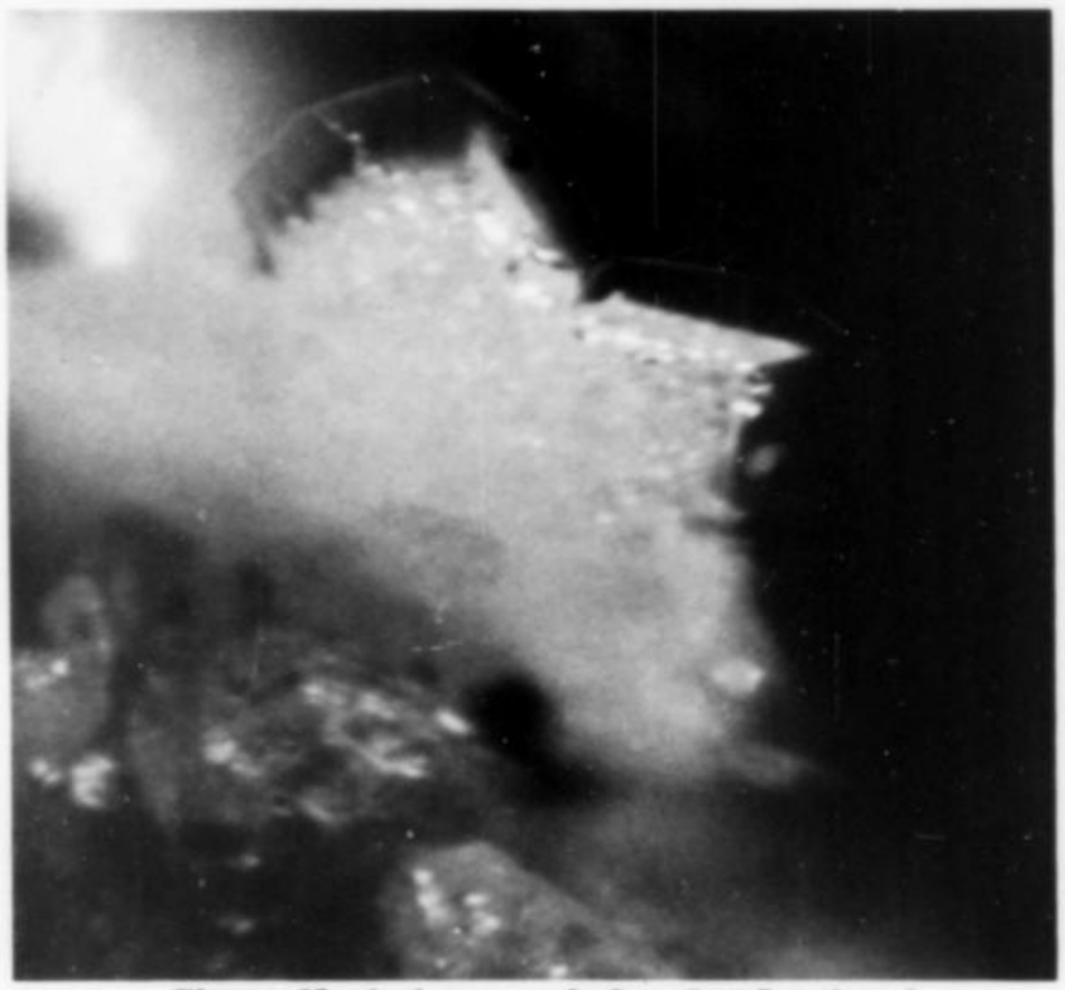


Figure 15. **A 1-mm, colorless "star" twin of tridymite from Lemolo Lake, Douglas County, Oregon.**

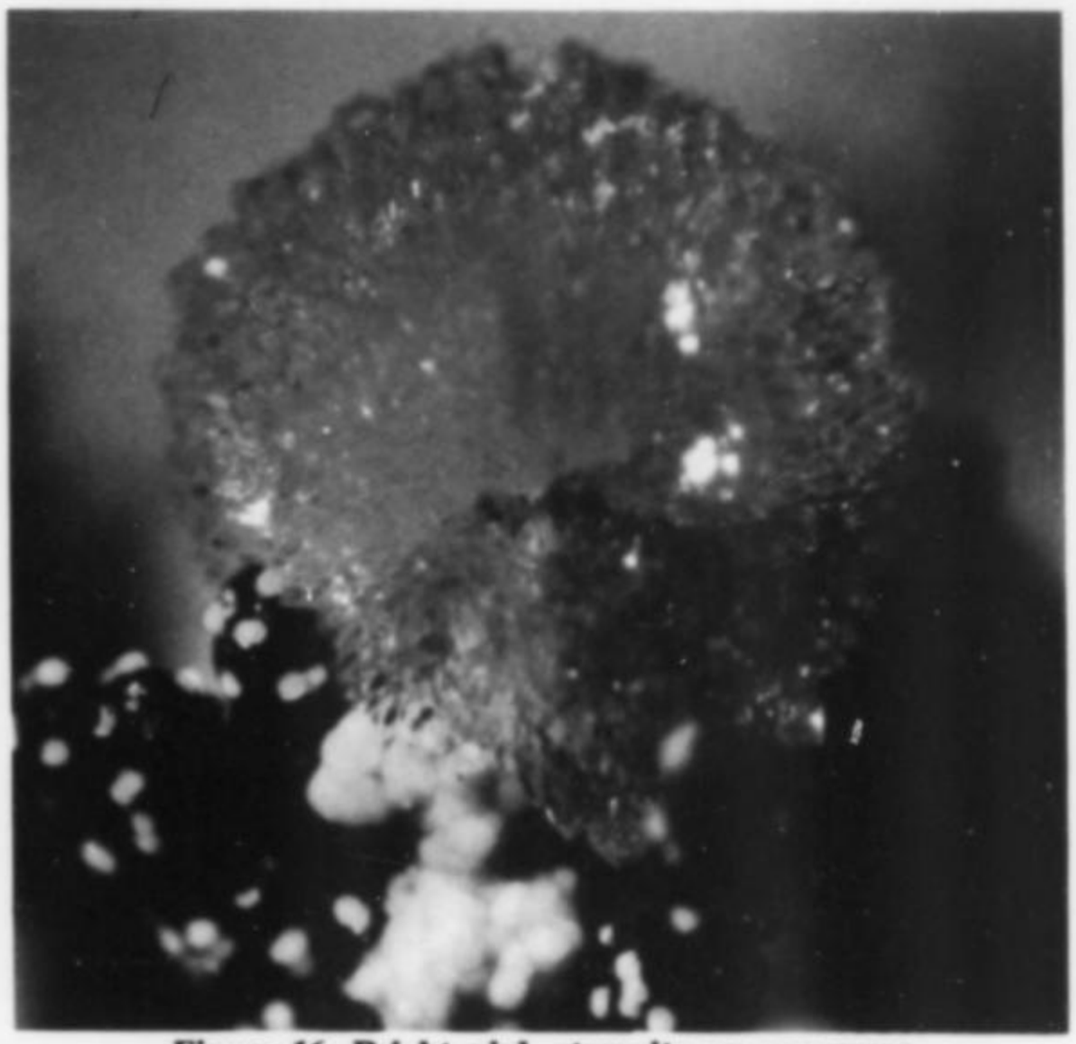


Figure 16. **Bright pink strengite on pea-green kidwellite and black, stalactitic rockbridgeite, from Mena, Polk County, Arkansas**

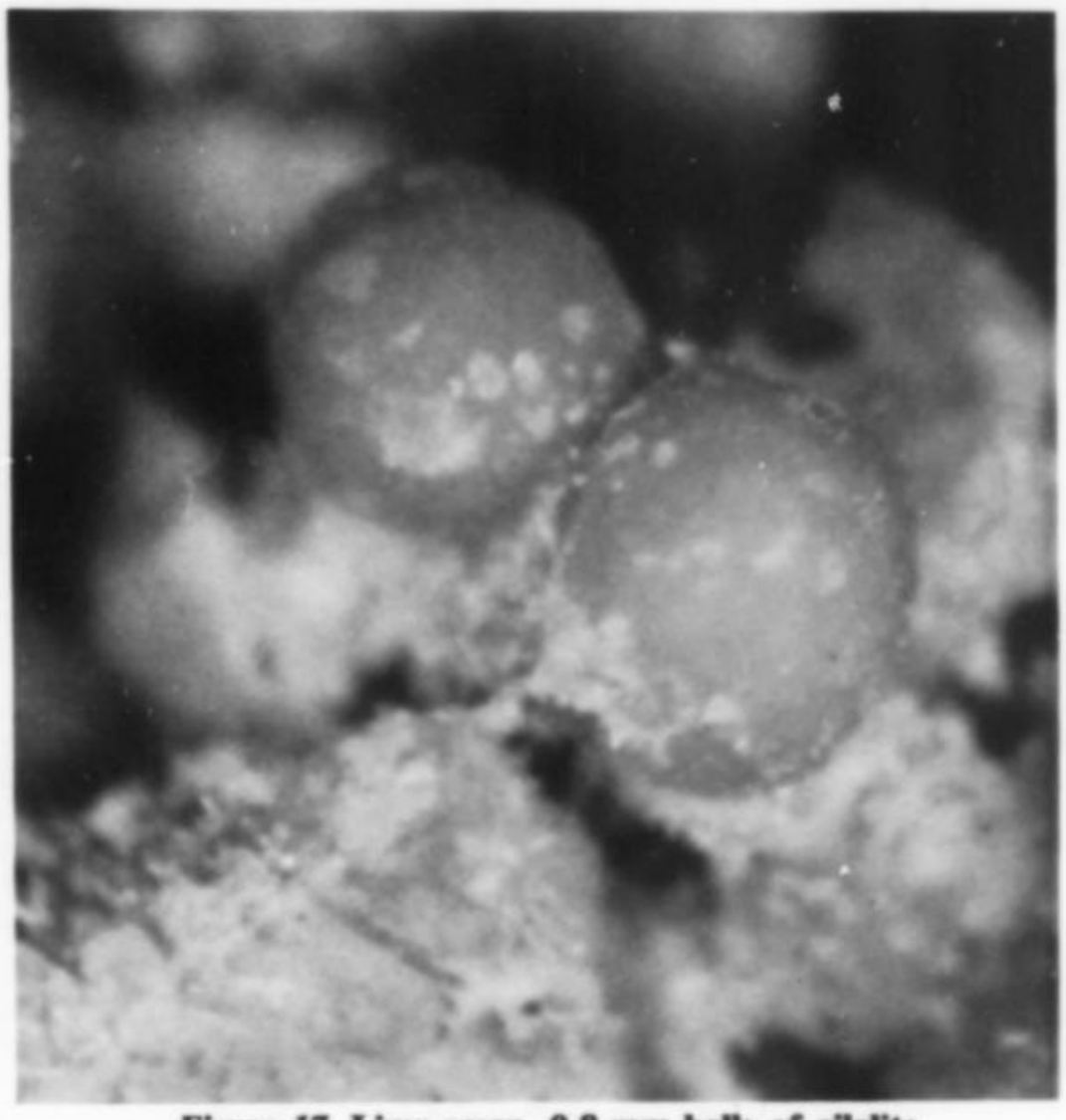


Figure 17. **Lime-green, 0.8-mm balls of gilalite crystals from the Christmas mine, Gila County, Arizona.**

shown in Figure 16. Meredith had other micro material from Arkansas, such as excellent basaluminite from the Rayburn barite mine at Magnet Cove and bright orange labuntsovite from the Diamond Joe mine, Little Rock, Pulaski County. Unfortunately for readers, Meredith does not swap or sell by mail. Their only chance is to catch him at the show!

So late in the show that they were packing up to go home, we discovered at the Desert Inn Motel the Virgin Mining Company, P.O. Box 23186, Albuquerque, New Mexico 87192. A bit of quick work while they were closing their last boxes produced fine, bright green botryoids of gilalite from the Christmas mine, Gila County, Arizona. Shown in Figure 17, the gilalite is associated with orange ruizite. A mere $9.00 was enough to purchase a 6 x 9 cm piece of matrix shot full with sufficient gilalite to make several dozen fine micromounts. Virgin Mining had other fine species such as deep purple crystals of stringhamite, azure-blue kinoite, and white, fibrous xonotlite from the Christmas mine, and attractive adamite from Cap Garonne, France, all at modest prices.

Bertrandite has always been a favorite mineral of the Deans, Webers and Hendersons, the reason being that there are such a large number of localities in our home state where it is found in fine crystals. One of us found a really remarkable specimen of the

mineral among Geary Murdoch's material at the Desert Inn Motel. It is a small, unaltered, pale blue beryl crystal, the termination of which is coated with still smaller bertrandite crystals (Fig. 18). The specimen, from near Centerville, Boise County, Idaho, is of interest since bertrandite is usually found with altered beryl from which the beryllium was derived to form the bertrandite. In this case, the beryl is perfectly fresh.

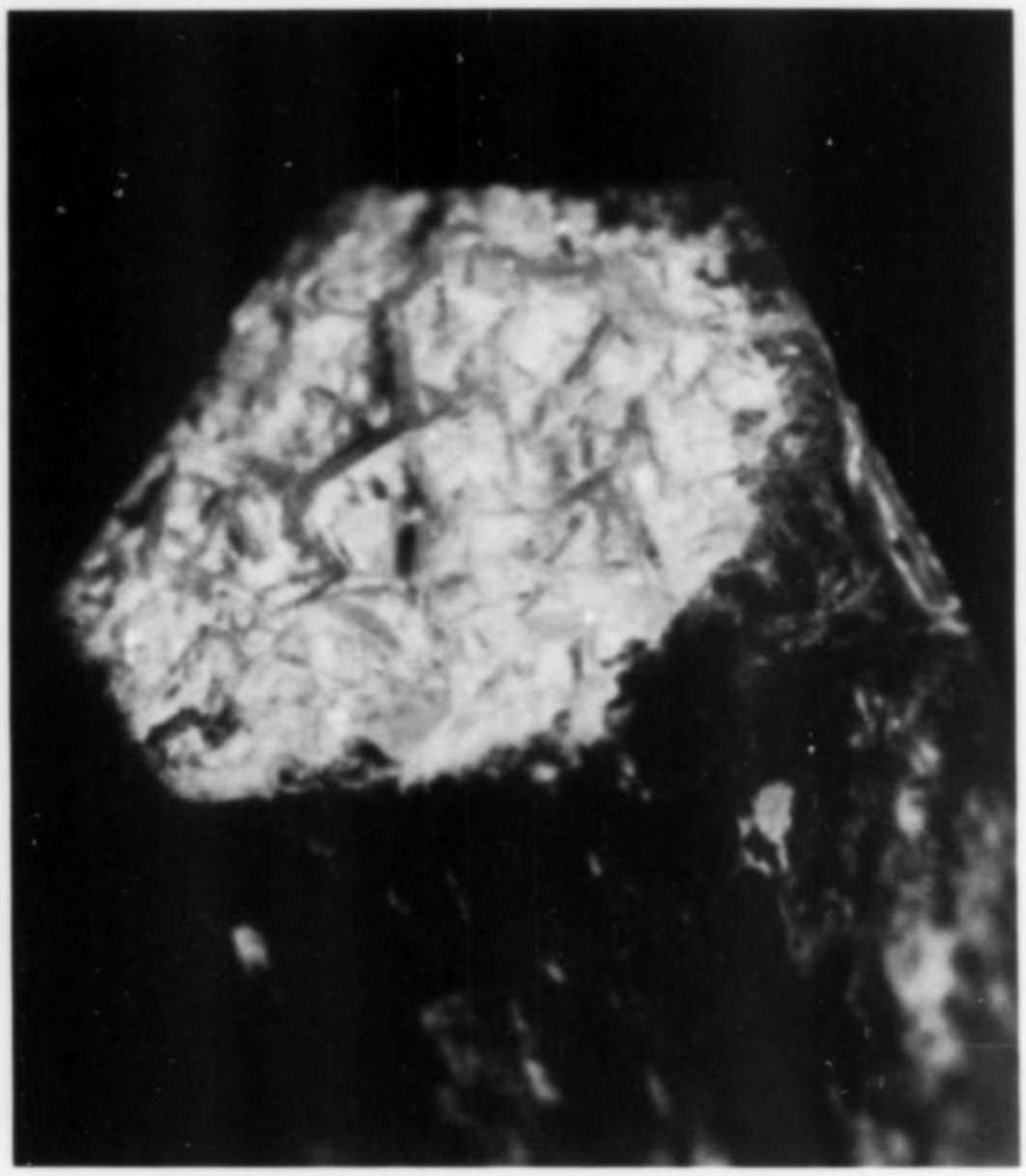


Figure 18. **White bertrandite on the terminal face of an unaltered, pale blue, 8-mm aquamarine crystal, from near Centerville, Boise County, Idaho.**

Brad Van Scriver was another dealer with excellent micro material. In Figure 19 are shown colorless, transparent barite crystals with excellent form from the Machow mine, Tarnobrzeg, Poland.

At the main show, there was a room devoted to micromounting. Collectors would drift in from time to time, and there was plenty of time for viewing specimens, discussing unknowns and swapping. A number of collectors brought in scopes and lights and were generous enough to share them with others.

A mainstay, if not the sparkplug, of this ever-changing group was Bruce Maier. Bruce supplied a great number of really fine giveaways, and also had superb material for exchange. Two of his specimens are shown in Figures 20 and 21. The first is blue-green planerite balls from Mauldin Mountain, Mount Ida, Montgomery County, Arkansas. Planerite is listed in Fleischer's *Glossary* as intermediate between coeruleolactite (check that spelling!) and turquoise, and may soon be accepted as a valid species. The second specimen is extremely sharp, gray-black crystals of tetrahedrite from the Armada mine, Santa Cruz County, Arizona. I've always had a soft spot for "type locality" specimens, and Bruce had two fine ones. They were kinoite crystals of the same color and form as those from the better known localities but on a drill core section from the Helvetia-Rosemont area, Pima County, Arizona; and pale blue whelanite botryoids from the Bawana mine near Milford, Beaver County, Utah. From Bruce were obtained two hemimorphites, both with interesting characteristics. The first is a doubly terminated, very obviously hemimorphic crystal group from the

Figure 19. **Colorless, transparent crystals of barite from the Machow mine, Tarnobrzeg, Poland.**

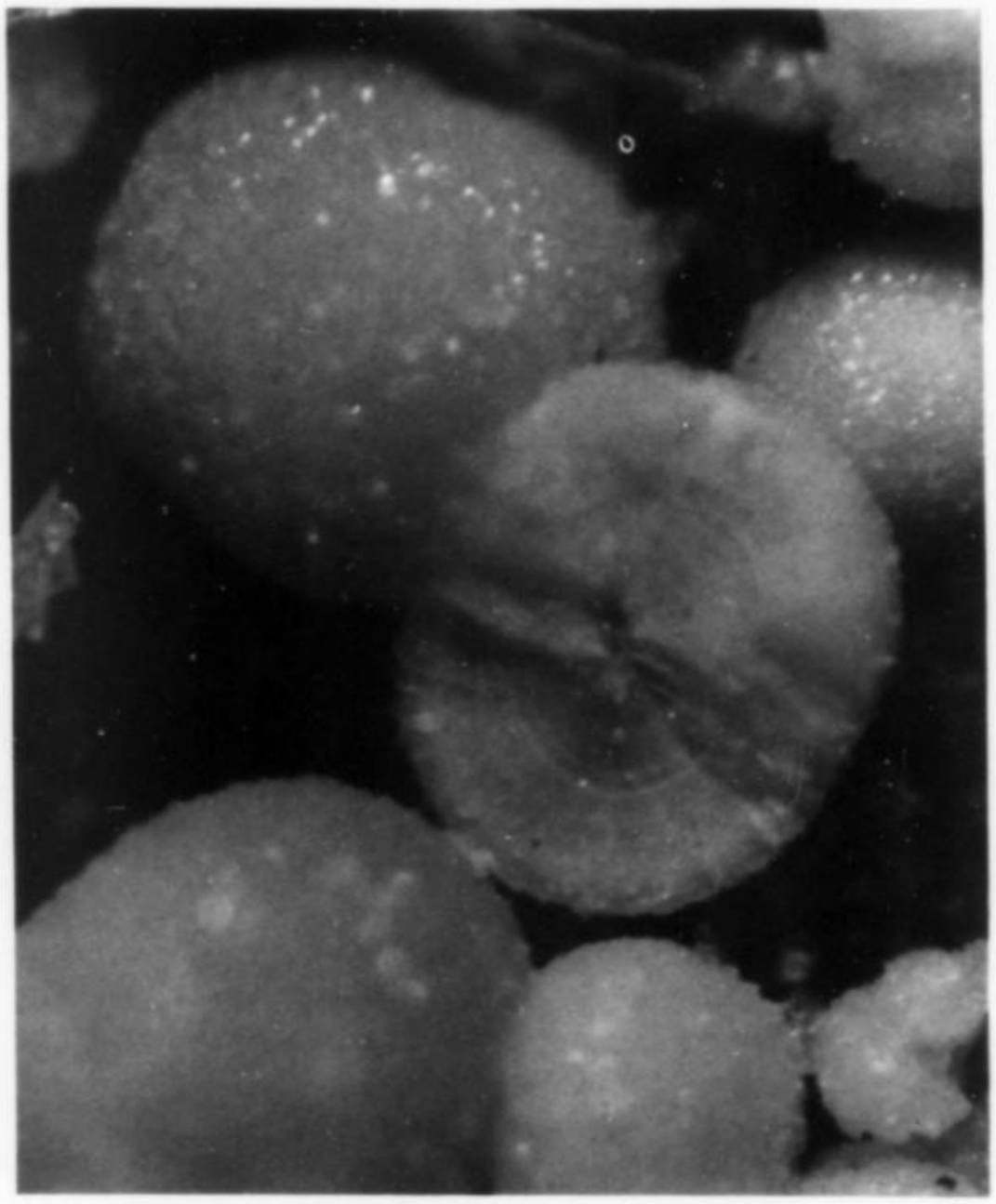


Figure 20. **Lime-green, 0.8-mm botryoids of planerite from Mauldin Mountain, Mount Ida, Montgomery County, Arkansas.**

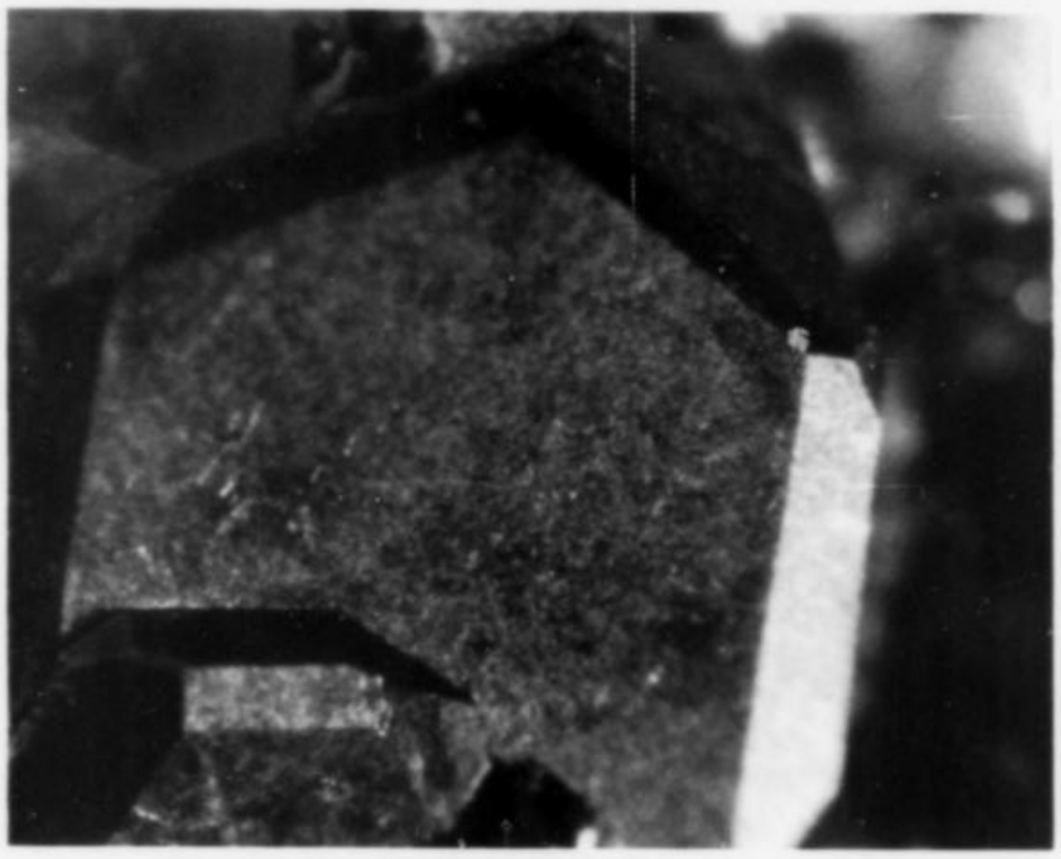


Figure 21. **A gray-black, 2.5-mm crystal of tetrahedrite from the Armada mine, Santa Rita Mountains, Santa Cruz County, Arizona.**

San Antonio mine, Santa Eulalia, Mexico; the second consists of very deeply etched, transparent single crystals partially covered with willemite from the Gila Monster mine, Pima County, Arizona. Other fine specimens obtained from Bruce are magnetite with goethite from Santa Eulalia, Chihuahua, Mexico; svanbergite from the Dover mine near Hawthorne, Mineral County, Nevada; cuprian fraipontite from the Silver Bill mine, Gleeson, Cochise County, Arizona; and stetefeldtite from the Snyder Hill mine, Pima County, Arizona. While Bruce does not care to swap by mail, he is a dealer. The name and address of his establishment is *Hemihedral Productions,* P.O. Box 5506, Tucson, Arizona 85703.

All the photos in this column were taken by Omer Dean. He uses a Nikon SMZ-10 microscope with a third tube for his Nikon camera. Getting the right exposure is a breeze since the light level is determined by a built-in metering system, and the exposure time is completely automated. By using auxiliary lenses with the zoom optical system, Omer is able to cover the range of magnifications from 3.5 to 80x. For these photos, Omer used a fiber optic light source and Kodak Plus X pan film.

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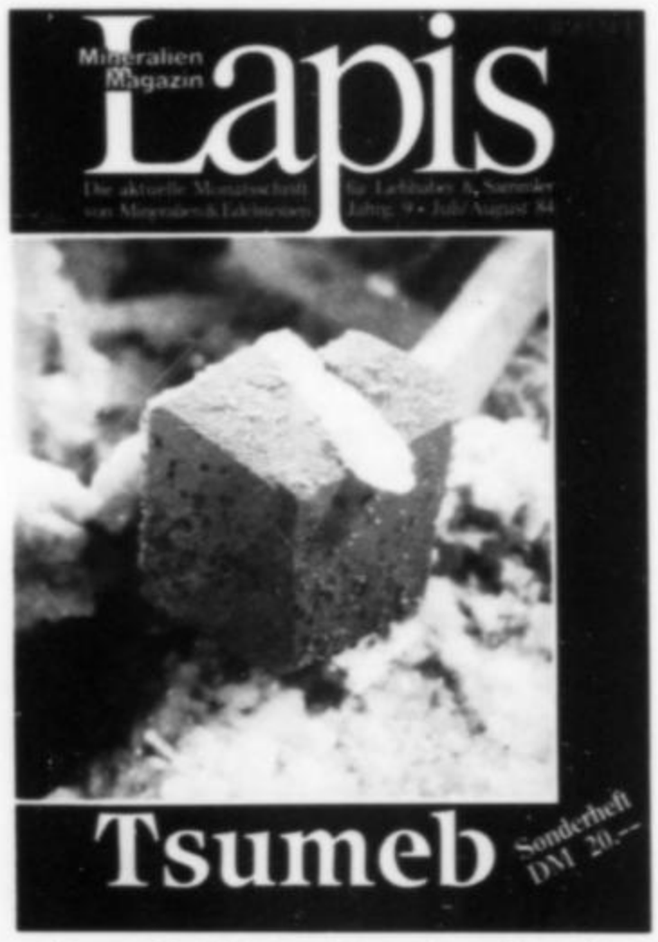

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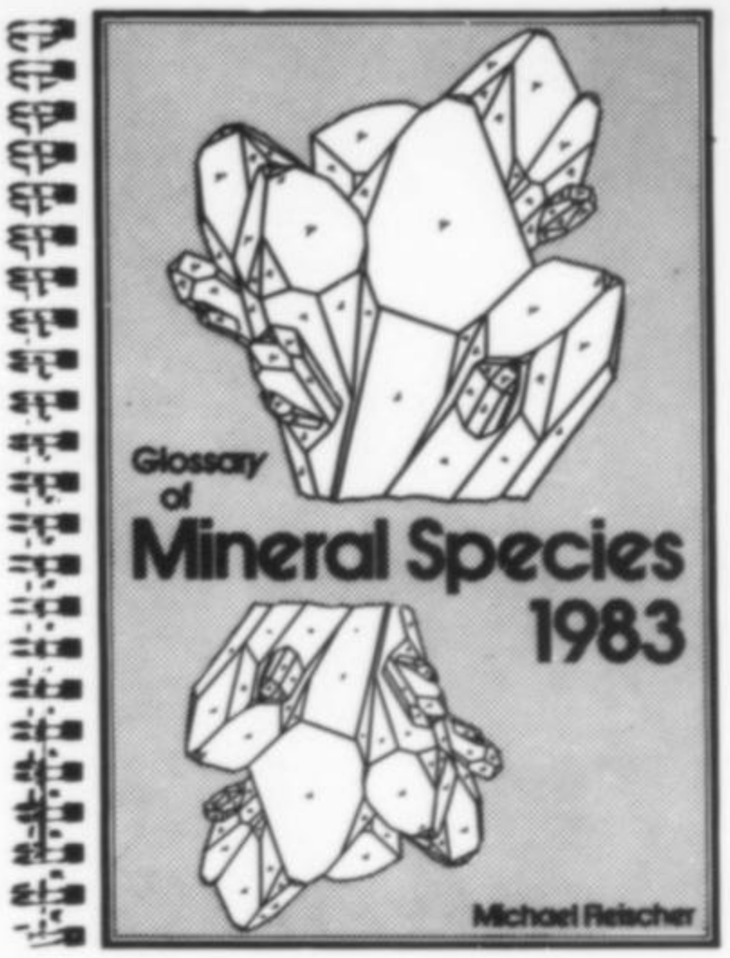
Additions & Corrections to the Glossary of Mineral Species 1983

II. Sept. 15, 1983, to Dec. 1, 1984.

by **Michael Fleischer**
Department of Mineral Sciences
Smithsonian Institution
Washington, D.C. 20560



The rate of publication of new data on minerals has continued to be very high during the past fourteen months; the appended list has more than 300 entries, including descriptions of 90 new minerals. I have also added three new mineral groups: Brackebuschite, Ettringite, Ludwigite and Overite groups.

The attempt to keep up with the science has been possible only because of the help and advice generously given by many friends. I wish I could list them all, but space does not permit that. Especially comprehensive and thoughtful suggestions have come from Peter Bayliss, University of Calgary; Jim Ferraiolo, Smithsonian Institution; Ernest H. Nickel, C.S.I.R.O., Wembley, Western Australia; Andrew L. Palmer, Mayfield, New York; George W. Shokal, San Carlos, California; Deane K. Smith, Pennsylvania State University; and John S. White, Smithsonian Institution. I am grateful to them and to all the many others whose comments and queries have improved this publication.

Page

2 **Aeschynite-(Nd)**, add **69**, 565 (1984)
3 **Albrechtschraufite**, $Ca_4Mg(UO_2)_2(CO_3)_6F_2 \cdot 17H_2O$, tric.
5 Amosite, commercial name for an amphibole, mostly **Grunerite**
8 **Argutite**, add **69**, 406 (1984)
8 **Arhbarite**, add **68**, 1038 (1983)
9 **Arsenbrackebuschite**, add "*Brackebuschite* group"
10 **Arsentsumebite**, $Pb_2Cu(AsO_4)(SO_4)(OH)$, mon., *Brackebuschite* group, **51**, 258–259 (1966)
10 **Arthurite**, add "compare **Earlshannonite, Ojuelaite**"
10 **Arzakite**, $Hg_3S_2(Br,Cl)_2$, mon. or tric., forms a series with **Lavrentievite**
10 **Asbolan**, formula $(Co,Ni)_{1-y}Mn^{+4}O_{2-x}(OH)_{2-2y+2x} \cdot nH_2O$
10 **Aschamalmite**, $Pb_6Bi_2S_9$; mon., **69**, 810 (1984)
10 **Asselbornite**, $(Pb,Ba)(UO_2)_6(BiO)_4(AsO_4)_2(OH)_{12} \cdot 3H_2O$, cub., brown to yellow, **69**, 565 (1984)
11 **Aubertite**, add "compare **Svazhinite**"
12 Badenite, discredited
13 **Barentsite**, $Na_7AlH_2(CO_3)_4F_4$, tric., **69** 565 (1984)
14 **Bassanite**, change "hex." to "mon., ps. hex."
15 **Bentorite**, add "*Ettringite group*"
16 **Bergslagite**, $CaBe(AsO_4)(OH)$, mon., compare **Herderite, Hydroxylherderite**
16 Bessmertnovite = **Bezsmertnovite**
17 **Betpakdalite**, change formula to $(H,K)_6Ca_4Fe^{+3}_6As^{+5}_4Mo^{+6}_{16}O_{74} \cdot 24\text{-}40H_2O$
17 **Bezsmertnovite**, $Au_4Cu(Te,Pb)$, orth., **66**, 878 (1981)
17 **Bijvoetite**, add **68**, 1248 (1983)
17 **Billietite**, add "compare **Becquerelite, Compreignacite**"
19 **Bonshtedtite**, add **68**, 1038 (1983)
20 **Bostwickite**, $CaMn^{+3}_6Si_3O_{16} \cdot 7H_2O$, dark red, **69**, 810 (1984)
23 **Bulachite**, $Al_2(AsO_4)(OH)_3 \cdot 3H_2O$, orth.
24 **Calciobetafite**, change formula to $Ca_2(Nb,Ti)_2(O,OH)_7$
25 **Cappelenite**, $Ba(Y,Ce)_6Si_3B_6O_{24}F_2$, trig., **69**, 190–195 (1984)
26 **Carboirite**, add **69**, 406 (1984)
27 **Cebaite**, $Ba_3Ce_2(CO_3)_5F_2$, mon., yellow to wax-yellow
30 **Charlesite**, $Ca_6(Al,Si)_2(SO_4)_2B(OH)_4(OH,O)_{12} \cdot 26H_2O$, hex., *Ettringite* group, **68**, 1033–1037 (1983)
30 **Charoite**, new formula $(K,Na)_5(Ca,Ba,Sn)_8(Si_6O_{15})_2(Si_6O_{16})(OH,F) \cdot nH_2O$
30 **Chessexite**, add **69**, 406 (1984)
32 **Chromdravite**, add **69**, 210 (1984)
32 **Chursinite**, $Hg^{+1}Hg^{+2}(AsO_4)$, mon.
33 **Claraite**, change hex. to "tric. (?), ps. hex."
34 **Clinokurchatovite**, $Ca(Mg,Fe^{+2},Mn)B_2O_5$, mon., dimorph. with **Kurchatovite**, **69**, 810 (1984)
35 **Colusite**, change formula to $Cu_{26}V_2(As,Sn,Sb)_6S_{32}$, add "compare **Germanite, Nekrasovite**"
36 **Compreignacite**, add "compare **Becquerelite, Billietite**"
36 **Corderoite**, add "dimorph. with **Lavrentievite**"
38 **Cualstibite**, $Cu_6Al_3Sb^{+5}_3O_{18} \cdot 16H_2O$, trig., bluish-green
39 **Curienite**, formula $Pb(UO_2)_2V_2O_8 \cdot 5H_2O$
39 **Cyanophillite**, change formula to $Cu_5Al_2Sb^{+3}_3O_{12}(OH) \cdot 12H_2O$
40 **Dadsonite**, formula $Pb_{10+x}Sb_{14-x}S_{31-x}Cl_x$ (?), tric.
40 **Danbaite**, $CuZn_2$, cub., **69**, 566 (1984)
40 **Daqingshanite**, $(Sr,Ca,Ba)_3(Ce,La)(PO_4)(CO_3)_{3-x}(OH,F)_x$, hex., yellow, **69**, 811 (1984)
40 **Datolite**, add "compare **Hingganite, Hingganite-(Yb)**"
41 **Davreuxite**, $MnAl_6Si_4O_{17}(OH)_2$, mon., **63**, 795 (1978), **69**, 777–787 (1984)
41 **Delvauxite**, formula $CaFe^{+3}_4(PO_4,SO_4)_2(OH)_8 \cdot 4\text{-}6H_2O$ (?), amor.

42 **Derriksite,** formula $Cu_4(UO_2)(SeO_3)_2(OH)_6$

43 **Donpeacorite,** $(Mn,Mg)MgSi_2O_6$, orth., yellow-orange, *Pyroxene* group, **69,** 472–480 (1984)

46 **Earlshannonite,** $(Mn,Fe^{+2})Fe_2^{+3}(PO_4)_2(OH)_2 \cdot 4H_2O$, mon., reddish-brown, compare **Arthurite, Ojuelaite, Whitmoreite,** *Can. Mineral.* **22,** 471–474 (1984)

46 **Eclarite,** $Pb_9(Cu,Fe)Bi_{12}S_{28}$, orth.

46 **Edingtonite,** change "orth." to "orth. and tet."

46 **Eggletonite,** $(Na,K,Ca)_2(Mn,Fe)_8(Si,Al)_{12}O_{29}(OH)_7 \cdot 11H_2O$, mon., brown, compare **Ganophyllite,** *Mineralog. Mag.* **48,** 93–96 (1984)

46 Eifelite, add **69,** 566 (1984), formula $KNa_3Mg_4Si_{12}O_{30}$

47 **Englishite,** change formula to $K_3Na_2Ca_{10}Al_{15}(PO_4)_{21}(OH)_7 \cdot 26H_2O$, *Can. Mineral.* **22,** 467–470 (1984)

48 Epigenite is discredited

49 **Ettringite,** delete "compare **Bentorite,**" and add "*Ettringite* group"

49 **Eztlite,** change formula to $Pb_3Fe_6^{+3}(Te^{+4}O_3)_3(Te^{+6}O_6)(OH)_{10} \cdot 8H_2O$

50 Falkmanite, Pb_5Sb_4S11, mon., = **Boulangerite** (?), **69,** 411 (1984)

51 **Fergusonite-beta-(Nd),** add **69,** 406–407 (1984)

53 **Ferronickelplatinum,** Pt_2FeNi, tet., forms a series with **Tulameenite**

54 **Ferrostrunzite,** $Fe^{+2}Fe_2^{+3}(PO_4)_2(OH)_2 \cdot 6H_2O$, tric., brown, compare **Strunzite, 69,** 811 (1984)

54 **Ferrotychite,** formula should be $Na_6Fe_2^{+2}(SO_4)(CO_3)_4$

54 **Ferrowyllieite,** add "compare **Qingheiite**"

55 **Finnemanite** was misspelled

55 **Fluocerite-(La),** add **69,** 566 (1984)

56 **Franconite,** $Na_2Nb_4O_{11} \cdot 9H_2O$, mon., *Can. Mineral.* **22,** 239–243 (1984)

56 **Francevillite,** formula should be $(Ba,Pb)(UO_2)_2V_2O_8 \cdot 5H_2O$

57 **Fransoleite,** $H_2Ca_3Be_2(PO_4)_4 \cdot 4H_2O$, mon.

57 **Fredrikssonite,** $Mg_2(Mn^{+3},Fe^{+3})BO_5$, orth., black, *Ludwigite* group

57 **Fritzscheite,** formula should be $Mn(UO_2)_2V_2O_8 \cdot 10H_2O$ (?)

58 **Gainesite,** $Na_2(Zr,Zr_{?})_2(Be,Li)(PO_4)_4$, tet., **68,** 1022–1028 (1983)

58 **Gamagarite,** $Ba_2(Fe^{+2},Mn)(VO_4)_2(OH,H_2O)$, mon., *Brackebuschite* group, **28,** 329–335 (1943), **69,** 803–806 (1984)

58 **Ganophyllite,** change formula to $(K,Na)_2(Mn,Al,Mg)_8(Si,Al)_{12}O_{29}(OH)_7 \cdot 8\text{-}9H_2O$, add "compare **Eggletonite**"

59 **Garyansellite,** $(Mg,Fe^{+3})_3(PO_4)_2(OH,O) \cdot 1.5H_2O$, orth., brown, forms a series with **Kryzhanovskite, 69,** 207–209 (1984)

60 **Germanite,** formula $Cu_{26}Fe_4Ge_4S_{32}$, add "compare **Colusite, Nekrasovite**"

62 **Gobbinsite,** change to "orth., ps. tet."

62 **Goedkenite,** add "*Brackebuschite* group"

62 **Gortdrumite,** add **69,** 407 (1984)

64 Gruenlingite should precede **Grunerite**

64 **Gugiaite,** $Ca_2BeSi_2O_7$, tet., dimorph of **Jeffreyite,** *Melilite* group

67 **Hashemite,** $Ba(Cr,S)O_4$, orth., dark brown, *Barite* group, **68,** 1223–1225 (1983)

68 **Hedyphane,** change formula to $Pb_3Ca_2(AsO_4)_3Cl$

68 **Hemusite,** add "compare **Kiddcreekite**"

69 **Herderite,** add "compare **Bergslagite**"

70 **Hingganite-(Yb),** add **69,** 811 (1984)

71 **Hongshiite,** PtCu, trig., **69,** 411–412 (1984)

71 **Hotsonite,** $Al_{11}(PO_4)_2(SO_4)_3(OH)_{21} \cdot 16H_2O$, tric., **69,** 979–983 (1984)

73 **Hydroastrophyllite,** formula should have Si_8

73 Hydrobiotite, delete "Mica group"

75 **Hydroxyl-herderite,** add "compare **Bergslagite**"

76 **Ilimoriite,** add **69,** 196–199 (1984)

78 **Izoklakeite,** $Pb_{26}(Cu,Fe)_2(Sb,Bi)_{20}S_{57}$, orth., compare **Kobellite**

79 **Janhaugite,** $Na_3Mn_3Ti_2Si_4O_{15}(OH,F,O)_3$, mon., reddish-brown, **68,** 1216–1219 (1983)

79 **Jarlite,** formula should be $Na_4Sr_4Al_6MgF_{32}(OH,H_2O)$

79 **Jarosewichite,** formula should be $Mn_3^{+2}Mn^{+3}(AsO_4)(OH)_6$

79 **Jasmundite,** add **69,** 566–567 (1984)

79 **Jaskolkiite,** $Pb_{2+x}Cu_x(Sb,Bi)_{2-x}S_6$, $x = 0.2$, orth.

80 **Jeffreyite,** $(Ca,Na)_2(Be,Al)Si_2(O,OH)_7$, orth., ps. tet., related to the *Melilite* group, dimorph. with **Gugiaite,** *Can. Mineral.* **22,** 443–446 (1984)

80 **Jeppeite,** $(K,Ba)_2(Ti,Fe^{+3})_6O_{13}$, mon., black

80 **Jerrygibbsite,** $Mn_9(SiO_4)_4(OH)_2$, orth., violet pink, dimorph. with **Sonolite,** *Humite* group, **69,** 546–552 (1984)

80 **Jinshajiangite,** $(Ba,Ca)_4(Na,K)_5(Fe^{+2},Mn)_{15}(Ti,Fe^{+3},Nb,Zr)_8Si_{15}O_{64}(F,OH)_6$, mon., blackish-red to golden-red, **69,** 546–552 (1984)

82 **Kaatialite,** $Fe^{+3}As_3^{+5}O_9 \cdot 6\text{-}8H_2O$, mon., gray to yellow, **69,** 383–387 (1984)

82 **Kamiokite,** add **68,** 1038–1039 (1983)

83 **Kamitugaite,** $PbAl(UO_2)_5[(P,As)O_4)_2(OH)_9 \cdot 9.5H_2O$, tric., yellow

83 **Katayamalite,** $KCa_7Li_3Ti_2(Si_6O_{18})_2(OH,F)_2$, tric., **69,** 811–812 (1984)

84 **Keivyite,** $Yb_2Si_2O_7$, mon., compare **Thortveitite**

84 **Kelyanite,** add **68,** 1248–1249 (1983)

85 **Khanneshite,** add **68,** 1249 (1983)

85 **Kiddcreekite,** Cu_6SnWS_8, cub., compare **Hemusite**

86 **Kitaibelite,** $Ag_{10}PbBi_{30}S_{51}$

86 **Kittatinnyite,** $Ca_4Mn_4^{+3}Mn_2^{+2}Si_4O_{16}(OH)_8 \cdot 18H_2O$, hex., bright yellow, compare **Walkilldellite, 68,** 1029–1032 (1983)

86 **Kobellite,** formula $Pb_{22}Cu_4(Bi,Sb)_{30}S_{69}$, change mon. to orth., add "compare **Izoklakeite**"

87 **Kosmochlor,** $NaCr^{+3}Si_2O_6$, mon., emerald-green, *Pyroxene* group, **50,** 2096 (1965), **53,** 511 (1968)

87 **Kostylevite,** $K_4Zr_2Si_6O_{18} \cdot 2H_2O$, mon., dimorph. with **Umbite, 69,** 812 (1984)

88 **Kryzhanovskite,** add "forms a series with **Garyansellite**"

88 Kularite = **Monazite, 69,** 210 (1984)

89 **Kulkeite,** change formula to $Na_{0.35}Mg_8Al(AlSi_7)O_{20}(OH)_{10}$

89 **Kurchatovite,** delete "and mon.," add "dimorph. with **Clinokurchatovite**"

89 Kurgantaite = strontian **Tyretskite, 69,** 214 (1984)

89 **Kvanefjeldite,** $Na_4(Ca,Mn)Si_6O_{14}(OH)_2$, orth., pink, *Can. Mineral.* **22,** 455–467 (1984)

90 **Laihunite,** change orth. to mon.

91 **Lannonite,** add **69,** 407 (1984)

91 **Lavrentievite,** $Hg_3S_2(Cl,Br)_2$, mon. or tric., forms a series with **Arzakite,** dimorph. with **Corderoite**

92 **Leadhillite,** change "dimorph. with **Susannite**" to "trimorph. with **Macphersonite** and **Susannite**"

92 **Lennilenapeite,** $K_{6\text{-}7}(Mg,Mn,Fe^{+2},Fe^{+3},Zn)_{48}(Si,Al)_{72}(O,OH)_{216} \cdot 16H_2O$, tric., compare **Stilpnomelane,** *Can. Mineral.* **22,** 259–263 (1984)

92 **Lepersonnite,** add **68,** 1248 (1983)

93 **Letovicite,** change mon. to tric.

93 **Leucophosphite,** add "compare **Tinsleyite**"

94 **Lindströmite** should precede Lingaitukuang

94 **Lithosite,** add **69,** 210 (1984)

95 **Lotharmeyerite,** change formula to $CaZnMn^{+3}(As^{+5}O_3OH)_2(OH)_3$

95 **Loudounite,** add **68,** 1039 (1983)

96 **Lun'okite,** add **69,** 210–211 (1984)
97 **Macaulayite,** $(Fe^{+3},Al)_{24}Si_4O_{43}(OH)_2$, mon., blood-red, *Mineralog. Mag.* **43,** 127–129 (1984)
97 **MacFallite,** add "compare **Surassite**"
97 **Macphersonite,** $Pb_4(SO_4)(CO_3)_2(OH)_2$, orth., trimorph. with **Leadhillite** and **Susannite,** *Mineralog. Mag.* **43,** 277–282 (1984)
99 **Magnesio-sadanagaite,** $(K,Na)Ca_2(Mg,Fe^{+2},Al,Fe^{+3},Ti)_5(Si,Al)_8O_{22}(OH)$, mon., dark brown to black, forms a series with **Sadanagaite,** *Amphibole* group, **69,** 465–471 (1984)
99 **Magnesium-chlorophoenicite,** add "compare **Jarosewichite**"
100 **Magnussonite,** formula $Mn_5^{+2}As_3^{+3}O_9(OH,Cl)$, cub., add **69,** 800–802 (1984)
100 **Majakite** (Mayakite), PdNiAs, hex., **62,** 1260 (1977)
100 **Makatite,** $NaSi_2O_4(OH)\cdot 2H_2O$, mon., **55,** 358–366 (1970); **68,** 852 (1983)
100 **Mandarinoite,** change formula to $Fe_2^{+3}Se_3O_9\cdot 6H_2O$
101 **Manganotantalite,** add "dimorph. with **Manganotapiolite**"
101 **Manganotapiolite,** $(Mn^{+2},Fe^{+2})(Ta,Nb)_2O_6$, tet., dimorph. with **Manganotantalite,** compare **Staringite, Tapiolite**
102 **Mantiennite,** $KMg_2Al_2Ti(PO_4)_4(OH)_3\cdot 15H_2O$, orth., compare **Paulkerrite,** *Mineralog. Record* **15,** 303–306 (1984)
102 **Margaritasite,** formula should be $(Cs,K,H_3O)_2(UO_2)_2V_2O_8\cdot H_2O$
103 Mayakite = **Majakite**
106 **Metakoettigite,** add **68,** 1039 (1983)
107 **Metatyuyamunite,** formula should be $Ca(UO_2)_2V_2O_8\cdot 3H_2O$
107 **Metavanuralite,** formula should be $Al(UO_2)_2V_2O_8(OH)\cdot 8H_2O$
109 Moganite, SiO_2, mon.
109 **Molybdofornacite,** add **69,** 567 (1984)
110 **Monazite - (Nd),** add "*Monazite* group"
111 **Morozeviczite** is misspelled
112 **Mundrabilite,** add **69,** 407 (1984)
112 **Munirite,** $NaV^{+5}O_3\cdot 2H_2O$, orth., **69,** 812 (1984)
112 **Musgravite,** add **69,** 215 (1984)
113 **Nagashimalite,** add "compare **Titantaramellite**"
113 Nanekevite = **Bario-orthojoaquinite**
114 **Natrobistantite,** add **69,** 407–408 (1984)
114 **Natrodufrenite,** add **68,** 1039 (1984)
115 **Nefedovite,** $Na_5Ca_4(PO_4)_4F$, tric., **69,** 812–813 (1984)
115 **Nekrasovite,** $Cu_{26}V_2(Sn,As,Sb)_6S_{32}$, cub., compare **Colusite, Germanite**
115 **Nelenite,** $(Mn,Fe^{+2})_{16}Si_{12}As_3^{+3}O_{36}(OH)_{17}$, mon., brown, dimorph. with **Schallerite,** *Mineralog. Mag.* **43,** 271–275 (1984)
115 **Nevskite,** Bi(Se,S), trig.
115 **Niahite,** add **69,** 408 (1984)
117 **Nordenskiöldine,** add "isostructural with **Tusionite** and with the carbonates of the *Dolomite* group"
119 **Ojuelaite,** add "compare **Arthurite, Earlshannonite**"
120 **Onoratoite,** change tric. to mon.
122 **Oursinite,** add **69,** 567 (1984)
122 **Owyheeite,** formula $Pb_{10-2x}Ag_{3+x}Sb_{11+x}S_{28}$ (x ranges from minus 0.13 to plus 0.20)
125 **Paraumbite,** $K_3Zr_2HSi_6O_{18}\cdot nH_2O$, orth., **69,** 813–814 (1984)
125 **Partheite,** formula should be $Ca_2Al_4Si_4O_{15}(OH)_2\cdot 4H_2O$
126 **Paulkerrite,** $K(Mg,Mn)_2(Fe^{+3},Al)_2Ti(PO_4)_4(OH)_3\cdot 10H_2O$, orth., brown, compare **Mantiennite,** *Mineralog. Record* **15,** 303–306 (1984)
127 **Penzhinite,** $(Ag,Cu)_4Au(S,Se)_4$, hex.
128 **Phosphofibrite,** $KCuFe_{15}^{+3}(PO_4)_{12}(OH)_{12}\cdot 12H_2O$, orth., yellow to yellow-green
129 **Pilsenite,** add **69,** 215 (1984)
129 **Piypite,** $K_2Cu_2(SO_4)_2O$, tet., emerald-green to dark green
131 Plumosite = **Boulangerite** (?), **69,** 411 (1984)
132 **Potosiite,** add **68,** 1249–1250 (1983)
133 **Pumpellyite-(Mn),** add **68,** 1250 (1983)
133 change p-veatchite to **p-Veatchite**
135 **Qingheiite,** $Na_2NaMn_2Mg_2(Al,Fe^{+3})_2(PO_4)_6$, mon., jade green, compare **Ferrowyllieite, Rosemaryite, Wyllieite, 69,** 567–568 (1984)
135 **Ramdohrite,** $Ag_3Pb_6Sb_{11}S_{24}$, mon., **69,** 412 (1984)
135 **Rankachite,** $CaFe^{+2}V_4^{+5}W_8^{+6}O_{36}\cdot 6H_2O$, orth., dark brown to brownish-yellow
136 **Rayite,** add **69,** 211 (1984)
136 **Reinhardbraunsite,** add **68,** 1039–1040 (1983)
137 **Rhabdophane,** add "compare **Tristramite**"
138 **Richelsdorfite,** add **69,** 211 (1984)
139 Roepperite = ferroan **Tephroite** or manganoan zincian **Fayalite**
139 **Roscherite,** change formula to $Ca(Mn,Fe^{+2})_2Be_3(PO_4)_3(OH)_3$
140 **Rosemaryite,** add "compare **Qingheiite**"
142 **Sabugalite,** change tet. to mon., ps. tet.
142 **Sadanagaite,** $(K,Na)Ca_2(Fe^{+2},Mg,Al,Fe^{+3},Ti)_5(Si,Al)_8O_{22}(OH)_2$, mon., dark brown to black, forms a series with **Magnesio-sadanagaite,** *Amphibole* group, **69,** 465–467 (1984)
143 **Santaclaraite,** add **69,** 200–206 (1984)
144 **Sarcolite,** formula $(Ca,Na)_9Al_4Si_6O_{26}F$, tet.
145 **Schallerite,** add "dimorph. with **Nelenite**"
146 **Schulenbergite,** $(Cu,Zn)_7(SO_4,CO_3)_2(OH)_{10}\cdot 3H_2O$, trig., light greenish-blue
146 **Schumacherite,** $Bi_3[(V,As,P)O_4]_2O(OH)$, tric., yellow
147 **Scotlandite,** $PbSO_3$ (a sulfite), mon., *Mineralog. Mag.* **43,** 283–288 (1984)
148 **Sengierite,** formula should be $Cu_2(UO_2)_2V_2O_8\cdot 6H_2O$
148 **Shahovite** (Shakhovite), $Hg_4^{+1}Sb^{+5}O_3(OH)_3$ (?), mon., green, **66,** 1101 (1981)
148 **Sharpite,** change formula to $Ca(UO_2)_6(CO_3)_5(OH)_4\cdot 6H_2O$, orth.
150 **Simonite,** add **69,** 211 (1984)
150 **Sinkankasite,** $H_2MnAl(PO_4)_2(OH)\cdot 6H_2O$, tric., **69,** 380–382 (1984)
150 **Sklodowskite,** formula should be $(H_3O)_2Mg(UO_2)_2(SiO_4)_2\cdot 2H_2O$
151 **Sobolevite,** $Na_2CaMnTi_3Si_4O_{18}\cdot 4Na_3PO_4$, mon., brown, **69,** 813 (1984)
152 **Sonolite,** add "dimorph. with **Jerrygibbsite**"
153 **Srilankite,** add **69,** 212 (1984)
155 **Stilpnomelane,** add "compare **Lennilenapeite**"
156 **Straczekite,** $(Ca,K,Ba,Na)(V^{+4},V^{+5})_8O_{20}\cdot 3H_2O$, mon., greenish-black, *Mineral. Mag.* **43,** 289–93 (1984)
156 **Strelkinite,** formula $Na_2(UO_2)_2V_2O_8\cdot 6H_2O$
156 **Strunzite,** add "compare **Ferrostrunzite**"
157 **Sturmanite,** $Ca_6(Fe^{+3},Al,Mn^{+2})_2(SO_4)_2[B(OH)_4](OH)_{12}\cdot 25H_2O$, hex., yellow, *Ettringite* group, *Can. Mineral.* **21,** 705–709 (1983)
157 **Sulphotsumoite,** add **68,** 1250 (1983)
158 **Sursassite,** $Mn_2Al_3(SiO_4)(Si_2O_7)(OH)_3$, mon., compare **MacFallite**
158 **Susannite,** change "dimorph. with **Leadhillite**" to "trimorph. with **Leadhillite** and **Macphersonite**"
158 **Svyazhinite,** $(Mg,Mn)(Al,Fe^{+3})(SO_4)_2F\cdot 14H_2O$, tric., compare **Aubertite**
158 **Swamboite,** add **68,** 1250 (1983)
158 **Sweetite,** $Zn(OH)_2$, tet., *Mineralog. Mag.* **43,** 267–269 (1984)
158 **Swinefordite,** add $\cdot 4H_2O$ to the formula

159 Sztrokayite, Bi_3TeS_2
160 **Taaffeite,** add **69,** 215 (1984)
160 **Taaffeite - 9R,** add **69,** 215 (1984)
161 **Tapiolite,** add "compare **Manganotapiolite"**
161 Taprobanite, add **69,** 215 (1984)
161 **Taramellite,** $Ba_4(Fe^{+3},Ti,Fe^{+2},Mg)_4(B_2Si_8O_{27})O_2Cl_x$, Fe» Ti, orth., forms a series with **Titantaramellite,** compare **Nagashimalite, 69,** 358–373 (1984)
161 **Tausonite,** $SrTiO_3$, cub., *Perovskite* group
161 **Terskite,** add **69,** 212 (1984)
163 **Tetra-auricupride,** add **68,** 1250–1251 (1983)
163 **Tetrawickmanite, Wickmanite** is misspelled
164 **Thortveitite,** add "compare **Keivyite"**
165 **Tinsleyite,** $KAl_2(PO_4)_2(OH)\cdot 2H_2O$, mon., dark magenta-red, compare **Leucophosphite, 69,** 374–376 (1984)
165 **Tintinaite,** change formula to $Pb_{22}Cu_4(Sb,Bi)_{15}S_{69}$
165 **Titantaramellite,** $Ba_4(Ti,Fe^{+3},Fe^{+2},Mg)_4(B_2Si_8O_{27})O_2Cl_x$, orth., Ti» Fe, forms a series with **Taramellite,** compare **Nagashimalite, 69,** 358–373 (1984)
166 **Tolbachite,** $CuCl_2$, mon., brown to gold-brown, **69,** 408 (1984)
166 **Tongbaite,** Cr_3C_2 (chromium carbide), orth.
167 **Triangulite,** add **69,** 212 (1984)
167 **Trimerite,** formula should be $CaMn_2Be_3(SiO_4)_3$
167 **Tristramite,** $(Ca,U^{+4},Fe^{+3})(PO_4,SO_4)\cdot 2H_2O$, hex., pale- to greenish-yellow, compare **Rhabdophane, 69,** 813 (1984)
168 **Tsumebite,** add "*Brackebuschite* group"
168 **Tulameenite,** add "forms a series with **Ferronickelplatinum"**
169 **Tusionite,** $MnSn^{+4}(BO_3)_2$, trig., yellow to yellow-brown, compare **Nordenskiöldine** and the carbonates of the *Dolomite* group
169 **Tyuyamunite,** formula should be $Ca(UO_2)_2V_2O_8\cdot 5\text{-}8H_2O$
170 **Umbite,** $K_2ZrSi_3O_9\cdot H_2O$, orth., dimorph. with **Kostylevite, 69,** 813–814 (1984)
170 **Upalite,** change formula to $Al(UO_2)_3(PO_4)_2O(OH)\cdot 7H_2O$, change orth. to mon.
170 **Urancalcarite,** $Ca(UO_2)_3(CO_3)(OH)_6\cdot 3H_2O$, orth., yellow
171 **Uranophane,** formula should be $(H_3O)_2Ca(UO_2)_2(SiO_4)_2\cdot 3H_2O$
171 **Uranophane-beta,** formula should be $(H_3O)_2Ca(UO_2)_2(SiO_4)_2\cdot 3H_2O$
171 **Uranosilite,** add **69,** 408–409 (1984)
171 Ureyite = **Kosmochlor** (decision of I.M.A. Commission, 1984)
171 **Ushkovite,** formula $MgFe_2^{+3}(PO_4)_2(OH)_2\cdot 8H_2O$, add **69,** 212–213 (1984)
173 **Vanuralite,** formula should be $(H_3O,Ba,Ca,K)_2(UO_2)_2V_2O_8\cdot 4H_2O$
173 **Varulite,** change reference to **26,** 681 (1941)
173 **Vashegyite,** formula is $Al_{11}(PO_4)_9(OH)_6\cdot 38H_2O$, or $Al_6(PO_4)_5(OH)_3\cdot 23H_2O$, *Can. Mineral.* **21,** 489–498 (1983)
174 **Versiliaite,** formula $Fe_4^{+2}Fe_8^{+3}Sb_{12}^{+3}S_2$, **66,** 1073–1074 (1981)
176 **Vyacheslavite,** $U^{+3}(PO_4)(OH)\cdot 2.5H_2O$, orth., green
176 **Vyuntspakhkite,** $Y_4Al_2AlSi_5O_{18}(OH)_5$, mon.
177 **Walentaite,** $H(Ca,Mn,Fe^{+2})Fe_3^{+3}[(AsO_4,PO_4)]_4\cdot 7H_2O$, orth., bright yellow
177 **Wallkilldellite,** $Ca_4Mn_6^{+2}As_4^{+5}O_{16}(OH)_8\cdot 18H_2O$, hex., dark red, compare **Kittatinnyite, 68,** 1029–1032 (1983)
178 Wehrlite = **Pilsenite,** add **69,** 215 (1984)
179 **Whitmoreite,** add "compare **Earlshannonite"**
179 **Wickmanite, Tetrawickmanite** is misspelled
179 **Wilcoxite,** add **69,** 408 (1984)
179 **Willhendersonite,** $KCaAl_3Si_3O_{12}\cdot 5H_2O$, tric., *Zeolite* group, **69,** 186–189 (1984)
180 **Wonesite,** add "Mica group"
181 **Wyllieite,** add "compare **Quingheiite"**
182 **Xingzhongite,** change formula to $(Pb,Cu,Fe)(Ir,Pt,Rh)_2S_4$, **69,** 412 (1984)
182 **Xitieshanite,** $Fe^{+}(SO_4)(OH)\cdot 7H_2O$, mon., bright green
184 **Zaherite,** add "tric."
184 **Zakharovite,** add **68,** 1040 (1983)
185 **Zirkelite,** add "dimorph. with **Calciobetafite"**
186 **Zvyagintsevite** was misspelled
188 **Amphibole** group – add Magnesio-sadanagaite and Sadanagaite

189 Barite Group
Orthorhombic sulfates and chromate of general formula ASO_4 and $A(Cr,S)O_4$. A = Ba, Pb, Sr

Anglesite	Celestite
Barite	Hashemite

189 Add: Brackebuschite group
Monoclinic arsenates, phosphates, and vanadates of general formula $A_2B(XO_4)_2(OH,H_2O)$, A = Ba, Pb, Sr; B = Al, Cu, Fe^{+3}, Mn; X = As, P, S, V.

Arsenbrackebushite	Gamagarite
Arsentsumebite	Goedkinite
Brackebuschite	Tsumebite

192 Dolomite group
Add "isostructural with the borates **Nordenskoldine** and **Tusionite"**

192 Add: Ettringite group
Hexagonal sulfates of general formula $Ca_6A_2B\cdot 26H_2O$, where A = Al, Cr^{+3}, Fe^{+3}, Mn^{+2}, Si; B = $(SO_4)_3$ or $(SO_4)_2B(OH)_4$;

Bentorite	Ettringite
Charlesite	Sturmanite

194 Humite group: add Jerrygibbsite

195 Add: Ludwigite group
Orthorhombic borates of general formula $X_2Y(BO_5)$, X = Fe^{+2}, Mg, Mn^{+2}, Ni; Y = Fe^{+3}, Mn^{+3}, Ti, Mg

Azoproite	Ludwigite
Bonaccordite	Vonsenite
Fredrikssonite	

Orthopinakiolite, Pinakiolite, Hulsite, and Takeuchiite are related minerals
195 Melilite group: Add Gugiaite. Jeffreyite is a related mineral
196 Mica group: Add Wonesite, delete Hydrobiotite
196 Mixite group: Add Ce to the A elements
196 Monazite group: Add Monazite-(Nd)
197 Olivine group: The general formula should be $A_2^{+2}SiO_4$

197 Add: Overite group
Orthorhombic phosphates of general formula $ABC(PO_4)_2(OH)\cdot 2\text{-}4H_2O$, A = Ca, Mn, Zn; B = Mn, Fe^{+2}, Mn^{+2}; C = Al, Fe^{+3}

Lun'okite	Segelerite
Overite	Wilhelmvierlingite

197 Perovskite group: add Tausonite
197 Pyrochlore group: add Fe and Sn to the B elements
198 Pyroxene group: add Donpeacorite and Kosmochlor, delete Ureyite
201 Zeolite group: add Willhendersonite

Letters

MUNICH SHOW

Thanks so much for the article about Munich (May-June 1984); Don and I are ready to pack now. The composite picture was great.

Jean McKenna
Cranston, Rhode Island

I read your article about the Munich Show and the city of Munich. It is my hometown, and I've never read a story about it as nice as yours; thank you.

Karl Brandl
Newburgh, New York

What a great article in the May-June issue! Thank you very much – we are proud that you chose to give your readers so much information about our show and how to visit it.

Johannes Keilmann
Chairman, Munich Show

We were pleased, delighted, thrilled and amused by your beautiful report on the Munich Show. You are a good observer! Your description of München and its history, and your sketches and drawings are excellent.

Werner Lieber
Heidelberg, West Germany

THE BEST LEAD?

In the January-February 1984 issue of the *Mineralogical Record* you asked in your "What's New in Minerals" column if anyone knew of a better crystallized lead specimen than the one obtained by the Cureton Mineral Company. The Royal Scottish Museum, in 1980, purchased a fine specimen of native lead (shown here) from Långban, Sweden. The group consists of three large, crudely cubic crystals of native lead joined to a curved sheet or plate of native lead. The largest crystal is 3.6 x 4.8 cm. The group as a whole measures 8.4 x 12.8 cm.

Brian Jackson
Mineralogical Curator
Royal Scottish Museum, Edinburgh

STERLING MINE CLOSED TO COLLECTORS

We regret to announce that the Sterling mine near Antwerp, New York, is now closed to mineral collectors. Just as the issue with our article on the locality (vol. 15, no. 4) was being printed, an incident occurred at the property which caused a major financial loss to the property owner. A collector neglected to close a gate and, as a result, a number of cows escaped, two of which were killed on the highway. The collector in question has thus far failed to offer to reimburse the property owner for the loss suffered. As a result the property owner is understandably unwilling to permit further access to the locality.

We would urge readers of this journal not to antagonize the property owner by attempting to visit the site. All of us must take even greater care to influence and educate fellow collectors about the importance of preserving the privilege of access to important localities.

George W. Robinson
National Museums of Canada
Steven C. Chamberlain
Syracuse University

ITALIAN EXCHANGERS

Erberto Tealdi, editor of the Italian mineral magazine *Rivista Mineralogica Italiana,* asked his readers to write in if they were interested in exchanging specimens with readers of the *Mineralogical Record.* People on the following list responded, all of whom can correspond in English. When you write to them be sure to mention that you obtained their address through *Rivista* and the *Record.*

Mineralogical Record readers who would like to take the opportunity to have their own names and trading specialties listed for Italian readers in *Rivista* are invited to write to me and I will compose a similar list to send to Erberto. If you wish to be listed but do not speak Italian, simply note "English only." Ed.

Cristiano Rossi, Piazza Medaglie d'Oro 3, 20100 Milano, Italy. Species collector; miniatures. Have minerals from Lombardy, Piedmont, Val d'Aosta, Sicily. Want U.S. minerals generally.

Renzo Porini, Via C. Colombo 16, 28044 Intra-Verbania, Italy. Species collector; miniatures; thumbnails; micromounts. Have Italian Alpine minerals and European species, list on request. Want rare species.

Antonio Zordan, Via Pascoli 22, 36010 Cogollo del Cengio (VI), Italy. Species collector; micromounts. Have Italian species. Want rare North American species.

Sergio Comper, Via Michelazzi 14, 50141 Florence, Italy. Species collector; thumbnails; micromounts. Have Italian species. Want rare species.

Paolo Stara, P.O. Box 25, 09032 Assemini, Cagliari, Sardinia, Italy. Collect showy, well-crystallized specimens 7 x 10 cm. Have Sardinian minerals. Want any material of equal size and quality. List on request.

Giorgio de Lorenzi, Via Piave 71/A, 20090 Vimodrone (MI), Italy. Species collector; display specimens; micromounts; thumbnails. Have classic and rare Italian minerals. Want North American minerals in general, but especially Franklin, Palermo, Mont St.-Hilaire.

Enrico Cattani, Via Gagliano 2/D, 20097 San Donato (MI), Italy. Micromounts. Have Italian species, list available. Want North American minerals.

Mauro Savia, Corso Milano 170, 28025 Gravellona Toce (NO), Italy. Species collector; micromounts; 5 x 10-cm display specimens. Have rare and/or display-quality specimens mainly from Baveno and Ossola. Want any rare and/or classic specimens.

Marco Campos Venuti, Via Castiglione 13, 30124 Bologna, Italy. Collect all sizes. Have Italian specimens, mainly Elba, Tuscany, Emilia. Want quartz, pegmatite minerals, anatase, pyrite, gypsum.

ERRATA

Jacupiranga mine (vol. 15, no. 5, p. 261)

Pronunciation of the locality should be "*Zhah*'-coo-per-ahng'-gah" rather than "Hah'-coo-per-ahng'-gah" as given.

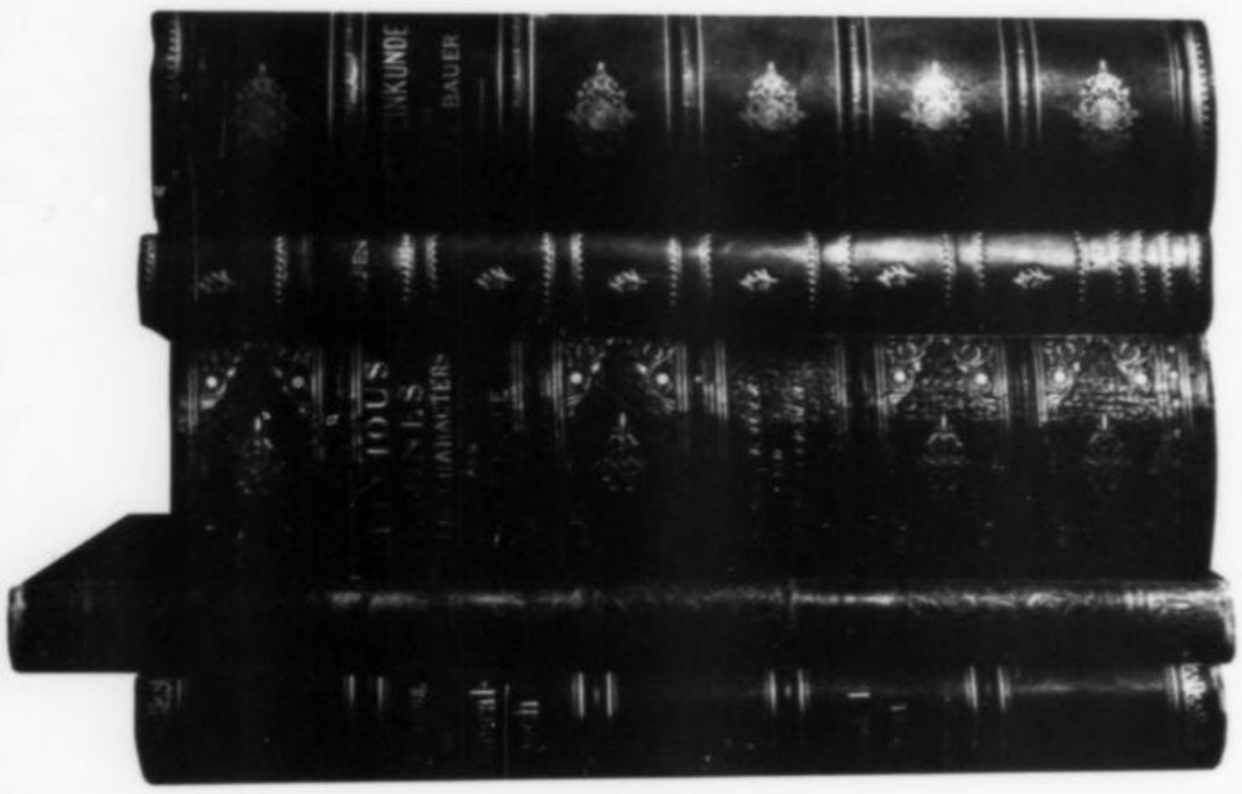
Point of Rocks (vol. 15, no. 3, p. 149)

In the *Introduction* and *Access* sections, the distances given as 14.8 km, 14.8 km, 4.4 km, 1.2 km, .6 km and 0.9 km should instead be 38.4 km (24 miles), 38.4 km (24 miles), 11.5 km (7.2 miles), 3.2 km (2 miles), 1.6 km (1 mile), and 2.4 km (1.5 miles) respectively.

Fluorapatite from the King Lithia mine (vol. 15, no. 6, p. 361)

The locality is erroneously stated in the title and text as being in Custer County. The correct designation is Pennington County.

The editor takes responsibility for all of these errors, with apologies to authors and readers.



Book Reviews

***Gem Cutting, A Lapidary's Manual* by John Sinkankas. Third edition, published (1984) by Van Nostrand Reinhold, 135 West 50th Street, New York, New York 10020. Hardcover, 21.5 x 27.5 cm (8½ x 11 inches), 365 pages, $46.95.**

John Sinkankas is perhaps the most skilled of current authors when it comes to assembling and organizing large amounts of practical information into book form. All of his past publications are meaty and well done, particularly the recent *Emerald and Other Beryls* (Chilton, 1981). Furthermore, he is a recognized master in the field of lapidary, and seems to have an encyclopedic knowledge of things relating to gems and minerals.

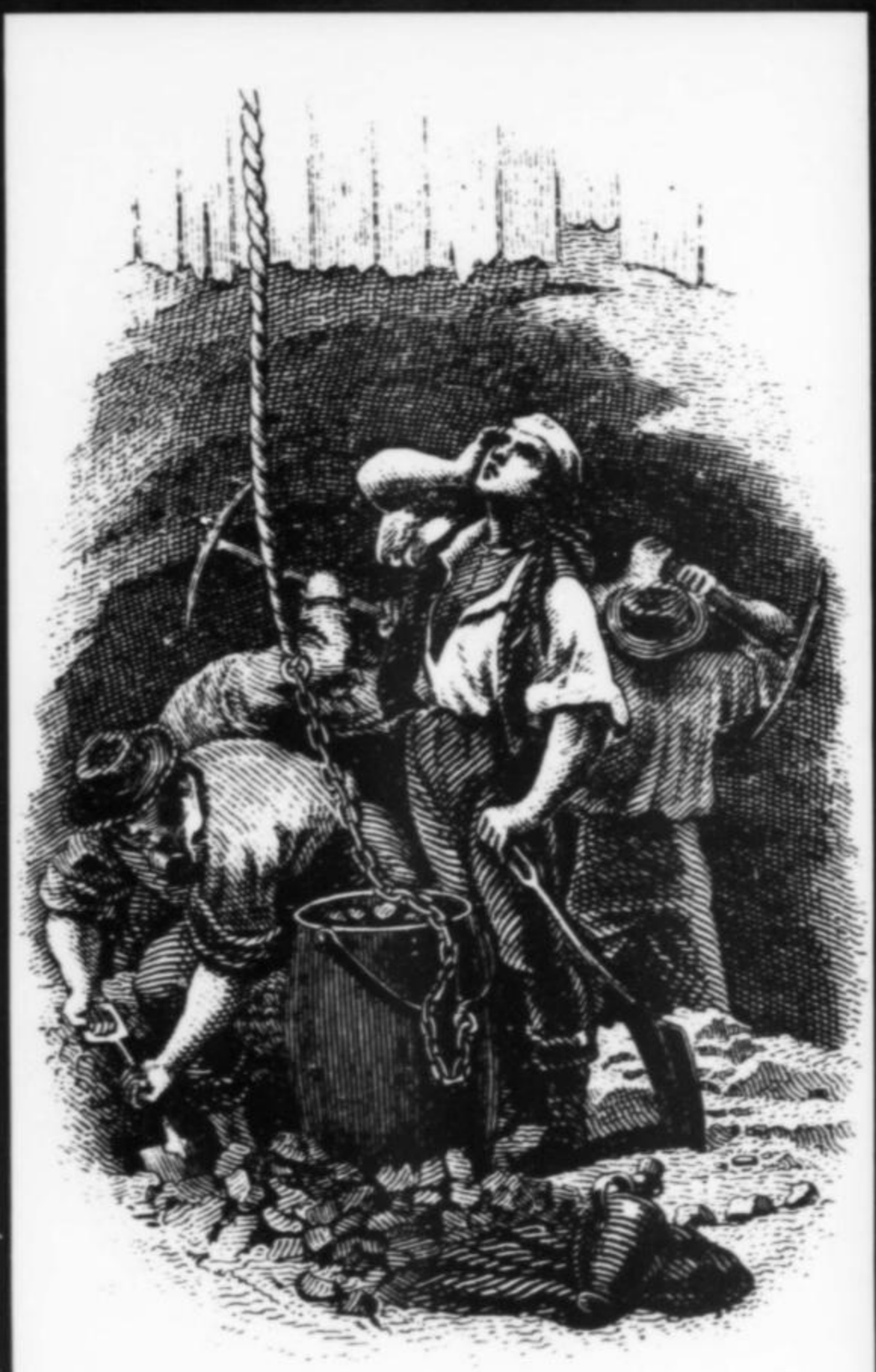
Gem Cutting, surprisingly, contains much information which the mineral collector will find useful and interesting. A significant proportion of the book is devoted to sawing, grinding, sanding, drilling and so forth—techniques easily adapted to specimen trimming and shaping. Furthermore, the interests of many collectors do lap over (so to speak) into gemstones, for instance in determining the gem potential of crystal specimens and in the faceting of unusual species to create collector stones.

Gem Cutting is a basic reference for anyone with even a passing interest in lapidary methods, from faceting stones to cutting cabochons, spheres, beads, carvings and mosaics. Seventy-five pages are devoted to the localities and lapidary-oriented physical properties of over 250 mineral species including boleite, cinnabar, creedite, crocoite, kämmererite, legrandite, proustite and scorodite. The 5½ pages on quartz and its varieties are elegantly concise.

The shelves of mineral collectors are not liable to contain much on lapidary technique; but if only one book could be chosen, this would be it. **W.E.W.**

California Mi

Northern



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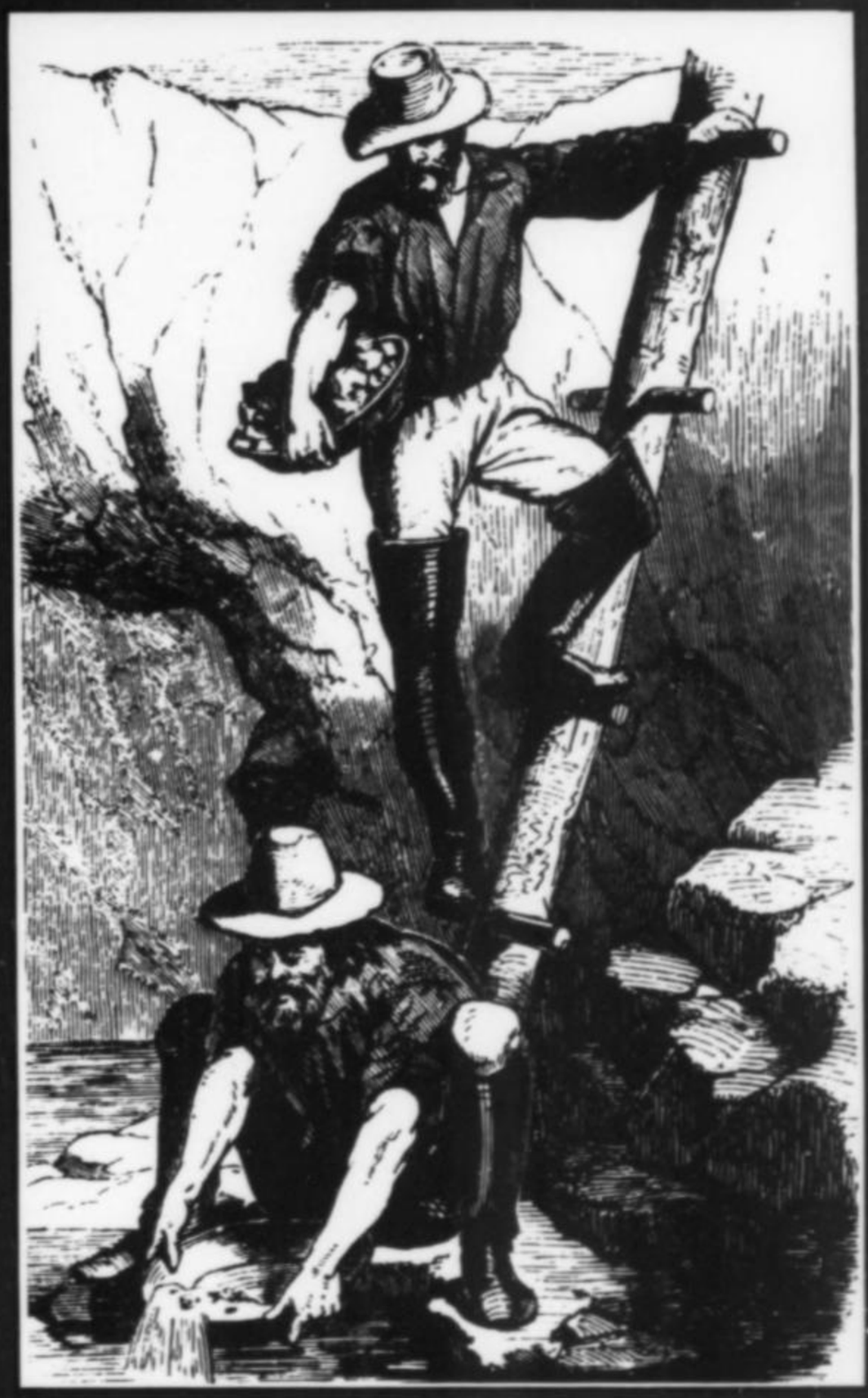

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