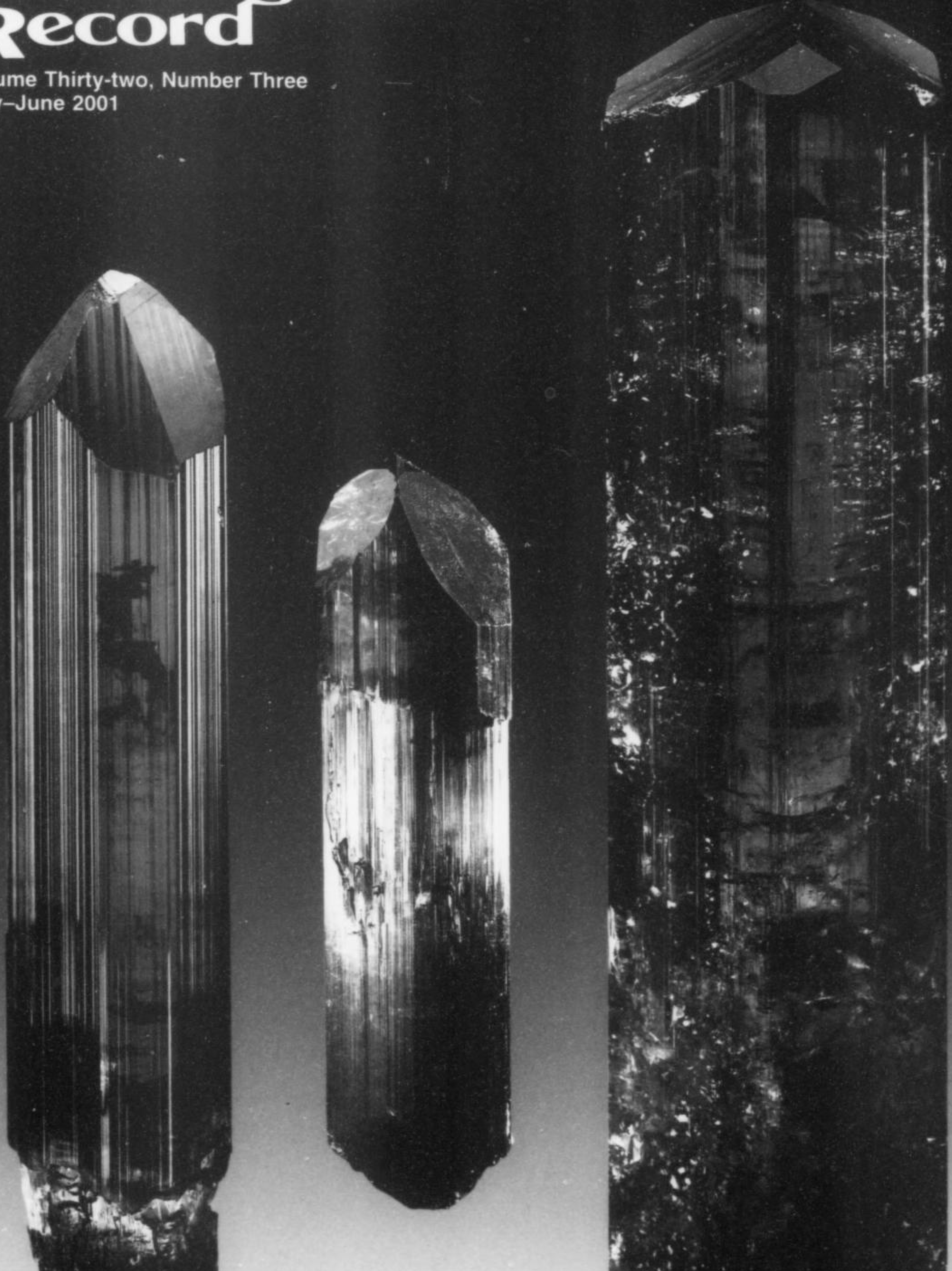
the Mineralogical Record
Volume Thirty-two, Number Three
May–June 2001
$12

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THE MINERALOGICAL RECORD

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COVER: ELBAITE crystals from Barra de Salinas, Minas Gerais, Brazil. Left: Gene Meieran collection, 9.5 cm. Middle: Gene Meieran collection, 6.6 cm. Right: Steven Smale collection, 12.5 cm. Photos by Jeff Scovil.

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The Mineralogical Record (ISSN 0026-4628) is published bi-monthly for $51 per year (U.S.) by Mineralogical Record, Inc., a non-profit organization, 7413 N. Mowry Place, Tucson, AZ 85741. Periodicals postage paid at Tucson, Arizona and additional mailing offices. POSTMASTER: Send address changes to: The Mineralogical Record, P.O. Box 35565, Tucson, AZ 85740.

notes from the EDITOR

WEBSITE LISTINGS

Due to popular demand, the *Mineralogical Record* will be offering an advertising page for websites. (Readers will already have noticed Rob Lavinsky's "Best of the Web" ad, but that one is more or less closed to additional listings.)

A listing will include (1) company name in bold, (2) a notation about what you sell, in 40 characters or less, (3) your website address, (4) your email address, and (5) a small numerical indicator of when your renewal payment will be due (no renewal notices will be sent).

The rate will be $200 for one year (six issues). The listing will not be classified by categories, but will be organized alphabetically by company name.

This is a good deal! Our smallest display ad, the one-inch box, costs $504 per year. If you have a mineral-related website, a listing in the *Mineralogical Record* is the best way to make yourself known to the mineral world. Send your check and text to the editor at 4631 Paseo Tubutama, Tucson, AZ 85750, or fax (520-299-5702) or email (minrec@earthlink.net) your VISA/Mastercard number and text.

Regarding Rob Lavinsky's "Best of the Web" ad page, I should mention that it was at my suggestion that Rob opened that page, and managed the selection of websites to list there. The Mineralogical Record is very grateful to him for doing this. It was designed to showcase a sort of "juried selection" of websites representing only the most active internet businesses who are well-known to each other and vouched for by each other as reputable. They decided to limit it to its current size, even though other websites than those shown might conceivably qualify. Admission of a new listing to that page, when vacancies appear, is now by consensus of the remaining people in the ad and not by fiat of any one person; currently it has no vacancies.

The NEW listing page being offered by MR is, by contrast, a general non-juried listing open to all (although we reserve the right to reject anyone at our discretion, or cancel ads from businesses having too many unresolved complaints on file against them, as would be the case with any ad in the MR). The new, open directory listing will appear on the page facing Rob's ad, thereby keeping all of the website listings together, so that no one feels the need to be listed on both. People are welcome to ask Rob to be placed on his waiting list, and in the meantime have a listing in the general directory on the facing page. We hope this structure will serve equally the established internet dealers, as well as established dealers with new sites, and the new, less well-known dealers people might like to meet.

ANNOUNCEMENTS

Died, Roy Beck, 56, of an aneurism, in Michigan. Roy developed a passion for minerals early in life, and was able to collect at many quarries in Michigan and Ohio (especially the classic celestine/sulfur occurrence at Maybee/Scofield, Michigan, and the famous Auglaize quarry fluorite occurrence in Ohio). He frequented Martin's Minerals in Brighton (at the time well-known locally for having top-quality minerals in stock) and developed a keen eye for the classics. Roy frequently displayed his collection at the Detroit and Cincinnati Shows, where he purchased many small, superb specimens. His collection specialized in aesthetic, damage-free specimens from famous localities, including one of the finest Tsumeb wulfenites in existence, a remarkable Michigan copper-in-calcite, a fine Red Cloud wulfenite, a Muzo (Colombia) emerald, a superb Virgem da Lapa topaz, a large San Pedro Corallitos mimetite, and many others.

Roy earned his B.S. degree from Eastern Michigan University in 1971, and later gained GIA certification in colored stones and diamonds, education which helped him produce some exquisite pieces of jewelry. In his later years he served as a part-time teacher and was very active in local school sports. His greatest passion remained mineral collecting; he was a connoisseur who handled himself with class at every turn.

D. S. Slaughter

The following people have made donations to the Mineralogical Record in memory of Roy Beck:

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WOODEN CABINET WARNING

An examination of the collection of ancient bronze coins in the Naturhistorisches Museum, Vienna, Austria, revealed that they have suffered serious corrosion while in storage in their wooden cabinets since the 1700's. The nearly air-tight design of the 120 individual drawers in the cabinets resulted in the development of individual microclimates within each drawer. Tests conducted by the Institute of Chemistry at the (Vienna) Academy of Fine Arts, and the Institute of Analytical Chemistry at the Vienna University of Technology revealed that a corrosive atmosphere tended to develop inside the drawers, especially during the summer months. Among the remedies suggested were a change to acid-free paper for labeling, removal of gypsum (castings), and the transfer of the entire collection to metal cabinets. The study ("Corrosion processes endanger collections of antique bronze coins—Are they past saving?") appeared in the International Numismatic Commission's *International Numismatic Newsletter.* For further information contact G. Dembski at the museum (email: guenther.dembski@khm.at).

THE COIN MARKET

Not to belabor the numismatic, but it is often instructive to watch what is going on in parallel collecting fields. Daniel Frank Sedwick, a professional numismatist and specialist in early Span-

(continued on p. 257)

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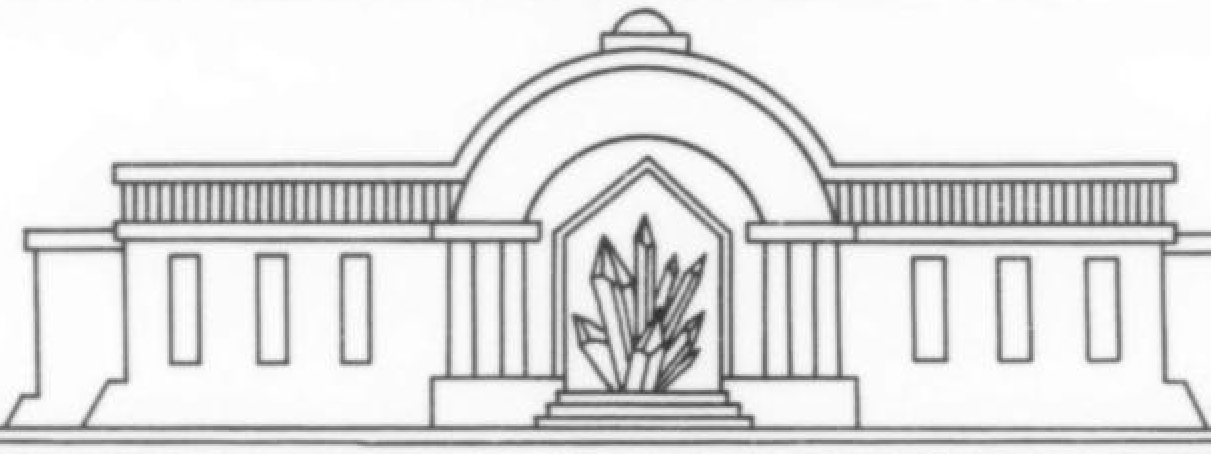

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- Compiling and publishing information on mineral localities, and important mineral collections.
- Encouraging improved educational use of mineral specimens, collections, and localities.
- Support a semi-professional journal of high excellence and interest designed to appeal to mineral amateurs and professionals, through which *FM* activities may be circulated.
- Operating informally in behalf of minerals, mineral collecting, and descriptive mineralogy, with voluntary support by members.

The Mineralogical Record has agreed to an affiliation with the Friends of Mineralogy whereby it will publish its written material and news of its activities. The *Friends of Mineralogy* will support the *Mineralogical Record*, since the aims of both are similarly educational and directed toward better coordination of the interest and efforts of amateurs and professionals.

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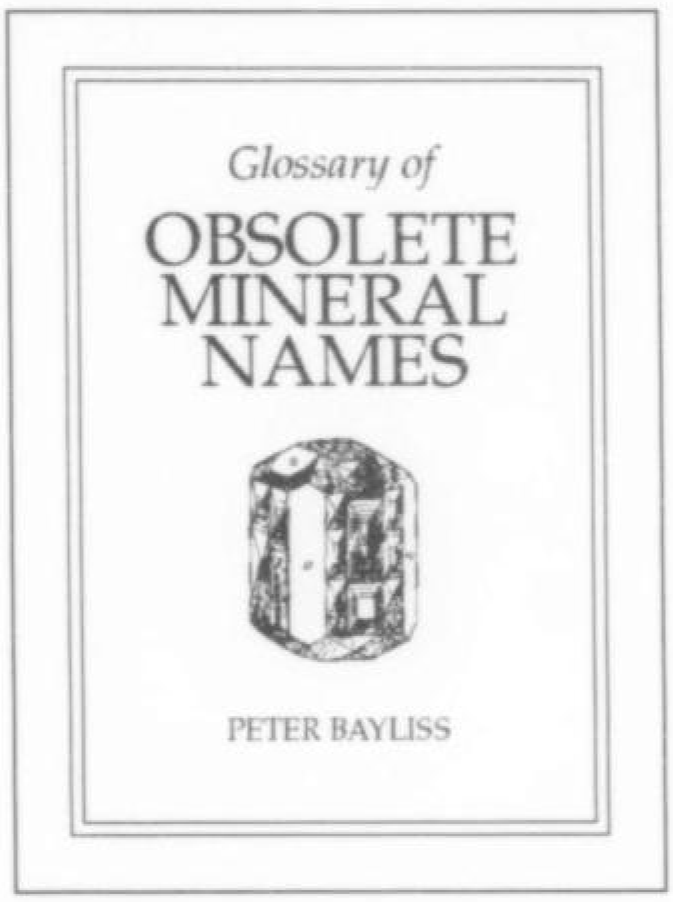
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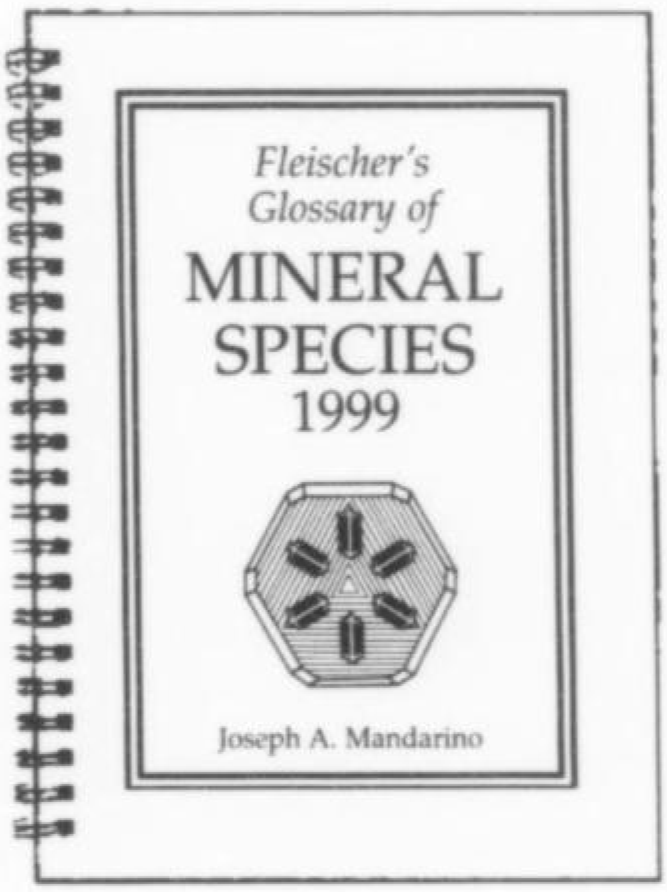
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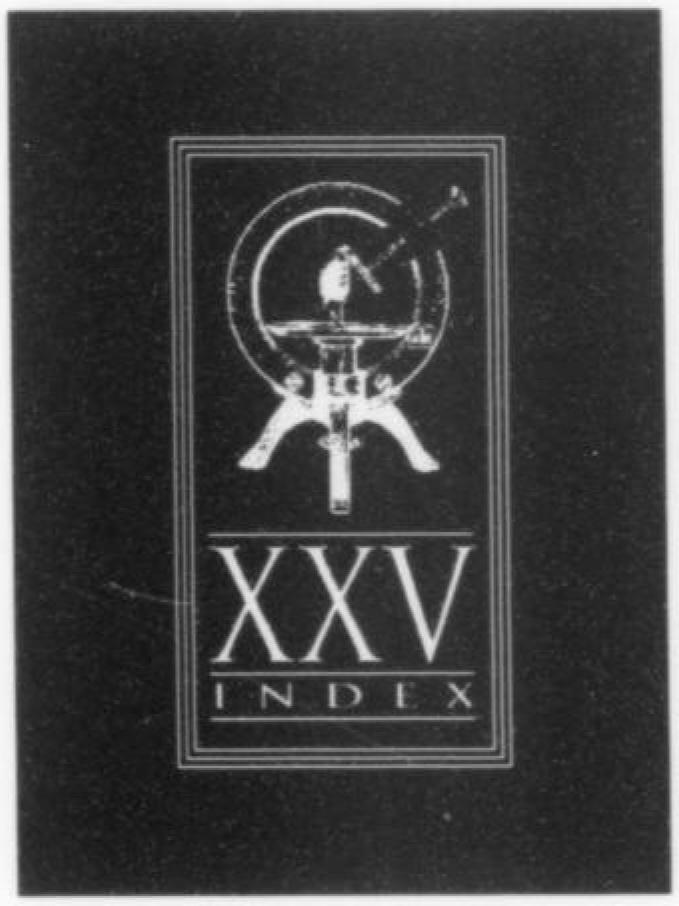
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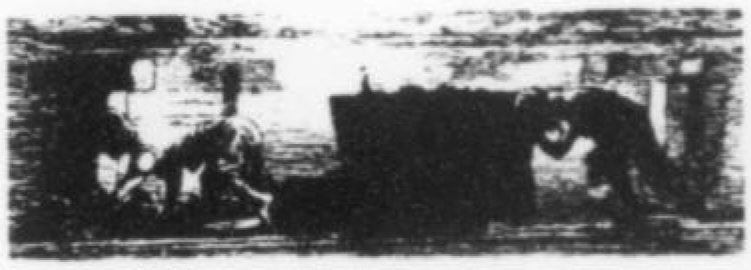

LARGE BARITE CRYSTALS
FROM THE ELANDSRAND GOLD MINE SOUTH AFRICA

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During the second week of July 1997, an unusual cavity was opened underground at the Elandsrand gold mine, South Africa. It yielded superb crystals of barite up to 83 cm long and 76.5 kg (168 pounds) in weight.

The Elandsrand gold mine is located on the northwestern side of the Witwatersrand Basin in the West Wits Line, South Africa. The mine is one of several in the area, where gold is extracted from conglomerates mined at great depths (the neighboring Western Deep Levels mine is currently at a depth of 4,000 meters). A cavity was recently encountered there measuring 1.3 meters wide, 1 meter high and 3 meters long; it was opened during mining operations on the Ventersdorp Contact Reef, at a depth of 2,650 meters below the surface. The underground air temperature at that depth is 31°C and the surface rock temperature is 40–45°C.

Cavities and fissures are encountered from time to time in the Witwatersrand mines but this particular discovery is noteworthy for two reasons: (1) Some of the largest barite crystals ever found were collected from the cavity. And: (2) Associated minerals included large, euhedral crystals of sphalerite, galena and quartz, associated with kerogen (carbon) and small pyrite and pyrrhotite crystals. One of us (BR) discovered the cavity and removed the specimens. Following are the specific details of the discovery.

The cavity was elliptical in shape, dipping 50° down into the footwall. It was found near a dike, approximately 2,700 million years old, that cuts through the conglomerate reef. A large amount of brecciation was present, apparently caused by hydrothermal fluids and/or gases associated with the intrusion. The rocks forming the walls of the cavity were highly altered and fragmented.

At first glance the cavity appeared to be unspectacular, because it was partly covered and infilled with rubble from the preceding blast. Only a few broken quartz crystals were visible in the rubble. It is probable that the entire cavity was originally completely lined with quartz crystals because the walls at the far end of the cavity, 3 meters in, were somewhat protected from the effects of

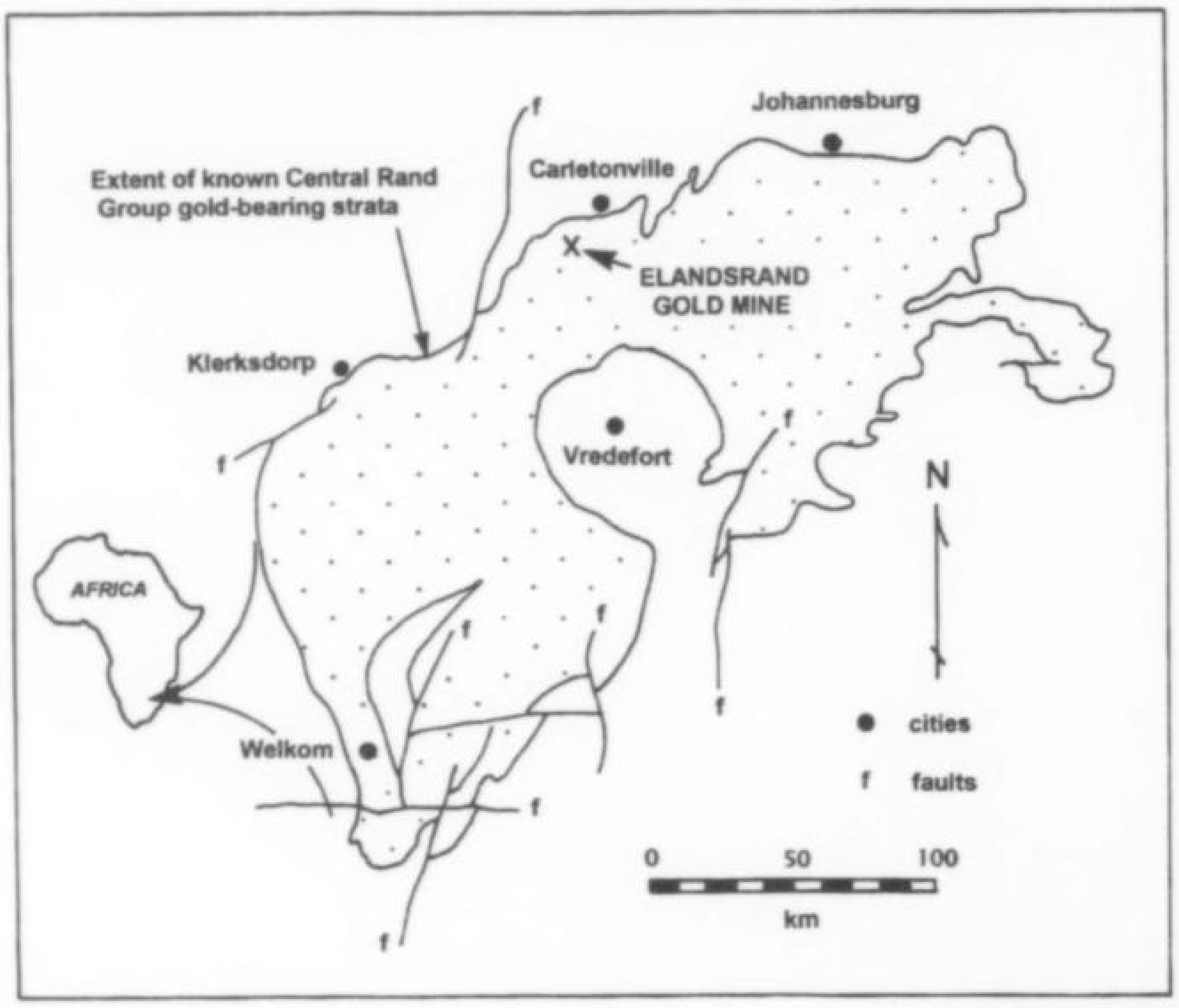
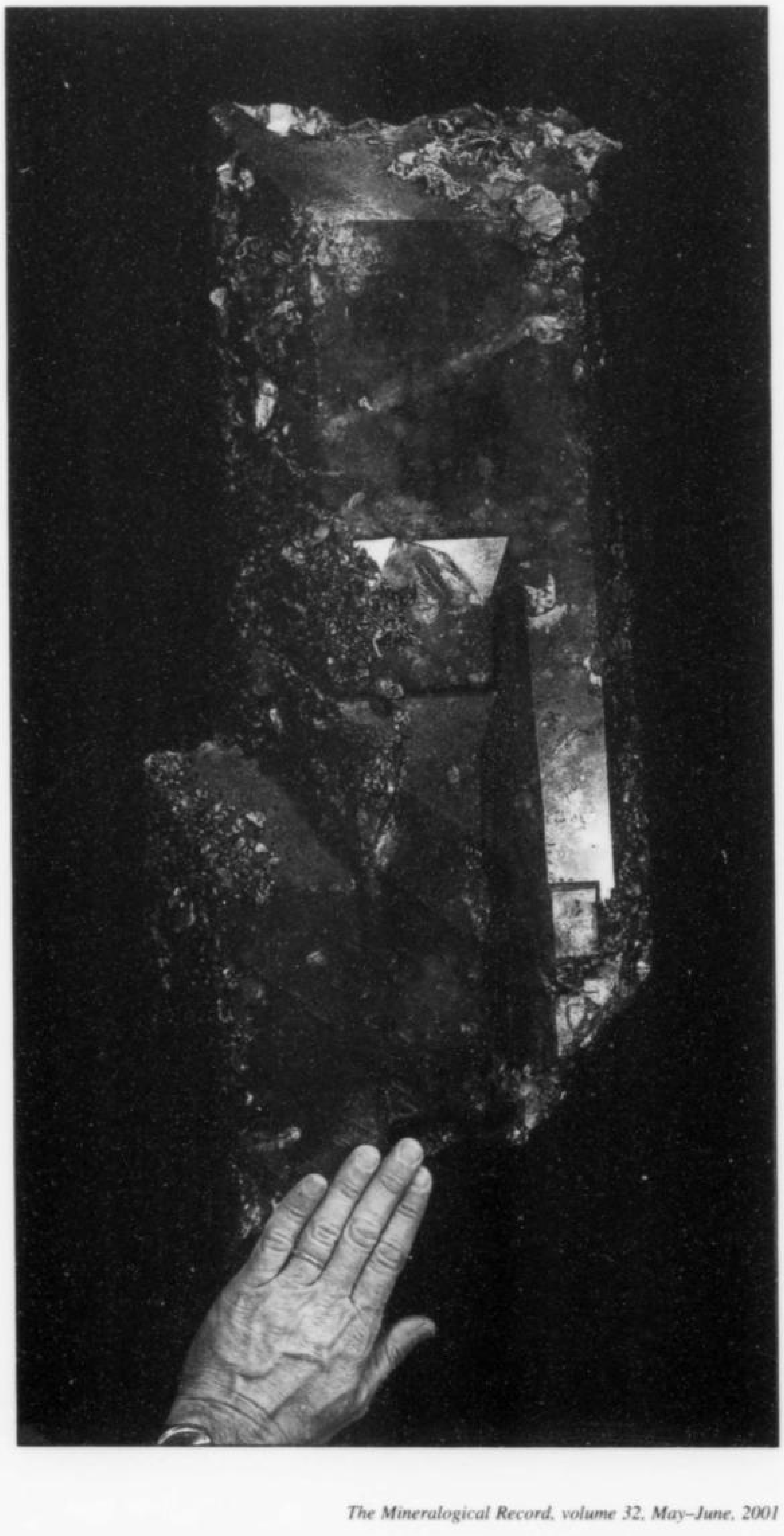


Figure 1. **Locality of the Elandsrand gold mine, situated in the West Wits Line, approximately 100 km west-southwest of Johannesburg, South Africa.**

Figure 2. **The second largest barite recovered at the Elandsrand mine. The specimen is a "floater," doubly terminated. It measures 70 cm in length and 30 cm across the base, and weighs 64 kilograms. Note the attached galena crystals. Pieces of matrix and small quartz crystals are imbedded in the specimen. The crystal is on display at the Elandsrand gold mine offices. Elandsrand Gold Mine specimen; photo by Bruce Cairncross.**



the blast and were covered with undamaged quartz crystals up to 20 cm long. Sifting through the rubble and rock fragments produced several galena, sphalerite and quartz specimens.

During this process, a large crystal surface (the first hint of one of the two large barite crystals) was exposed. The rubble was carefully cleaned away from around the crystal surface, revealing a large, single crystal that was thought to be attached to the cavity walls. The crystal was then lifted out and it was seen to have no points of attachment—it is a "floater," and doubly terminated. Two extraordinarily large crystals were removed. The first measures 70 cm long and 30 cm across the base. (When it was later cleaned, three smaller crystals attached at the base were revealed.) This specimen weighs 64 kilograms. The surfaces are clean and lustrous on one side, while the reverse side has intergrown fine rock material, but still possesses flat crystal planes. A few euhedral galena crystals, some up to 3 cm, are attached.

A second crystal was then removed from the cavity. This one is even larger, 83 cm long and 25.5 x 14.5 cm in cross-section, and weighs 76.5 kilograms! It was attached at one end to the wall of the cavity. Unfortunately, it broke into three pieces. The first break occurred in a crystallographic plane of weakness close to the point of attachment. The second break occurred along a cleavage plane within the crystal that fractured during lifting of the specimen. The individual pieces were, however, removed, repaired and fitted back together.

Carrying two crystals with a combined weight of 140.5 kilograms was no easy task. "Stretchers" were manufactured from wooden stope planks and the crystals were wrapped in bags and jackets and then tied to the stretchers. It was a long and tiresome process, under hot and humid conditions, stumbling over uneven terrain which at some places dropped more than 4 meters. Once the main haulage was reached, a carriage transported the samples to the main shaft, where they were then hoisted to the surface.

Once on the surface, the crystals were washed with water and a soft brush. Most of the sooty black kerogen was removed during the cleaning process, but some of this material still partially coats the crystals. Several of the smaller pieces were removed from the mine office before proper documentation could be done, but enough material remains to undertake a paragenetic study and to perhaps obtain radiometric age dates from the galena, to date the

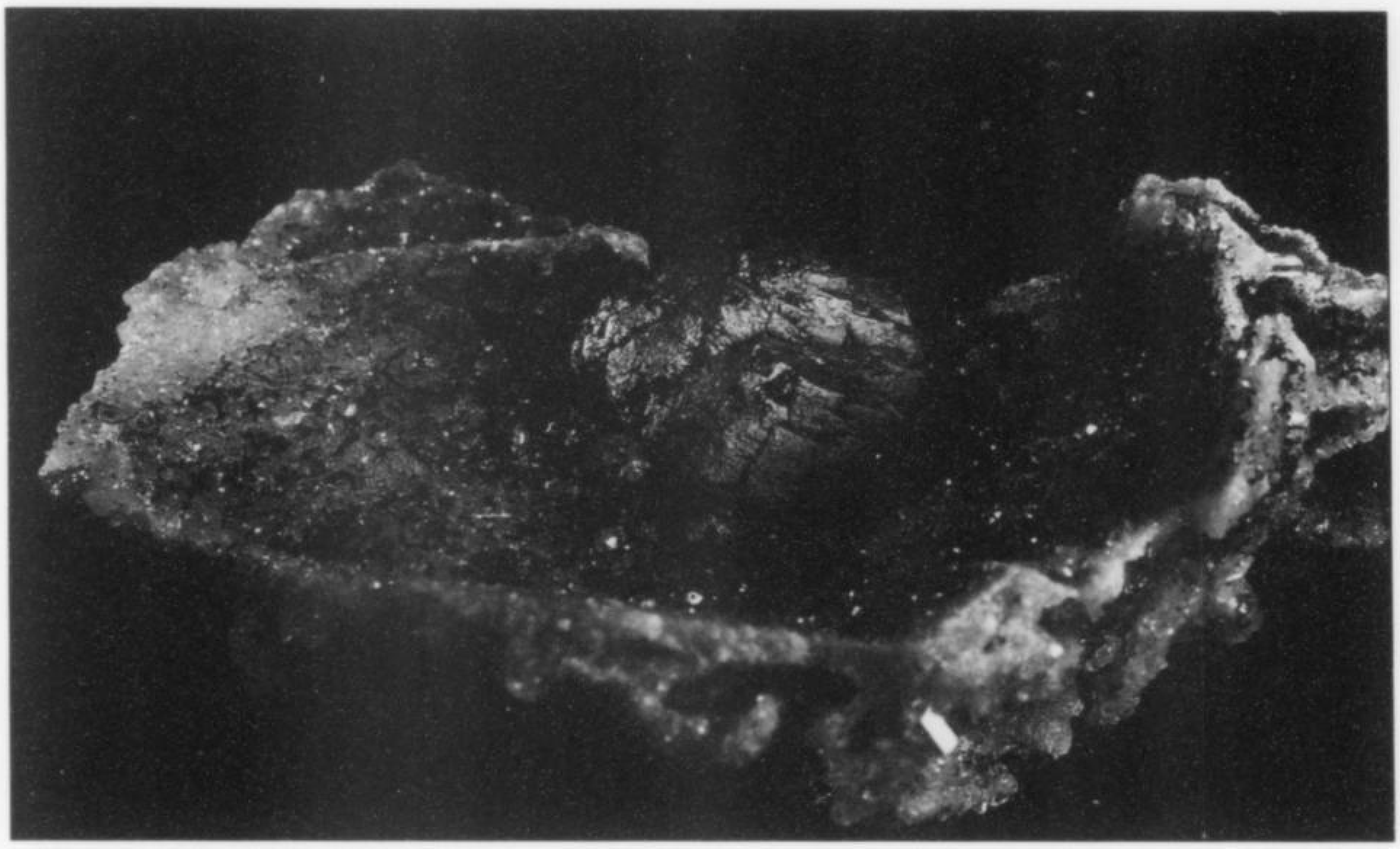
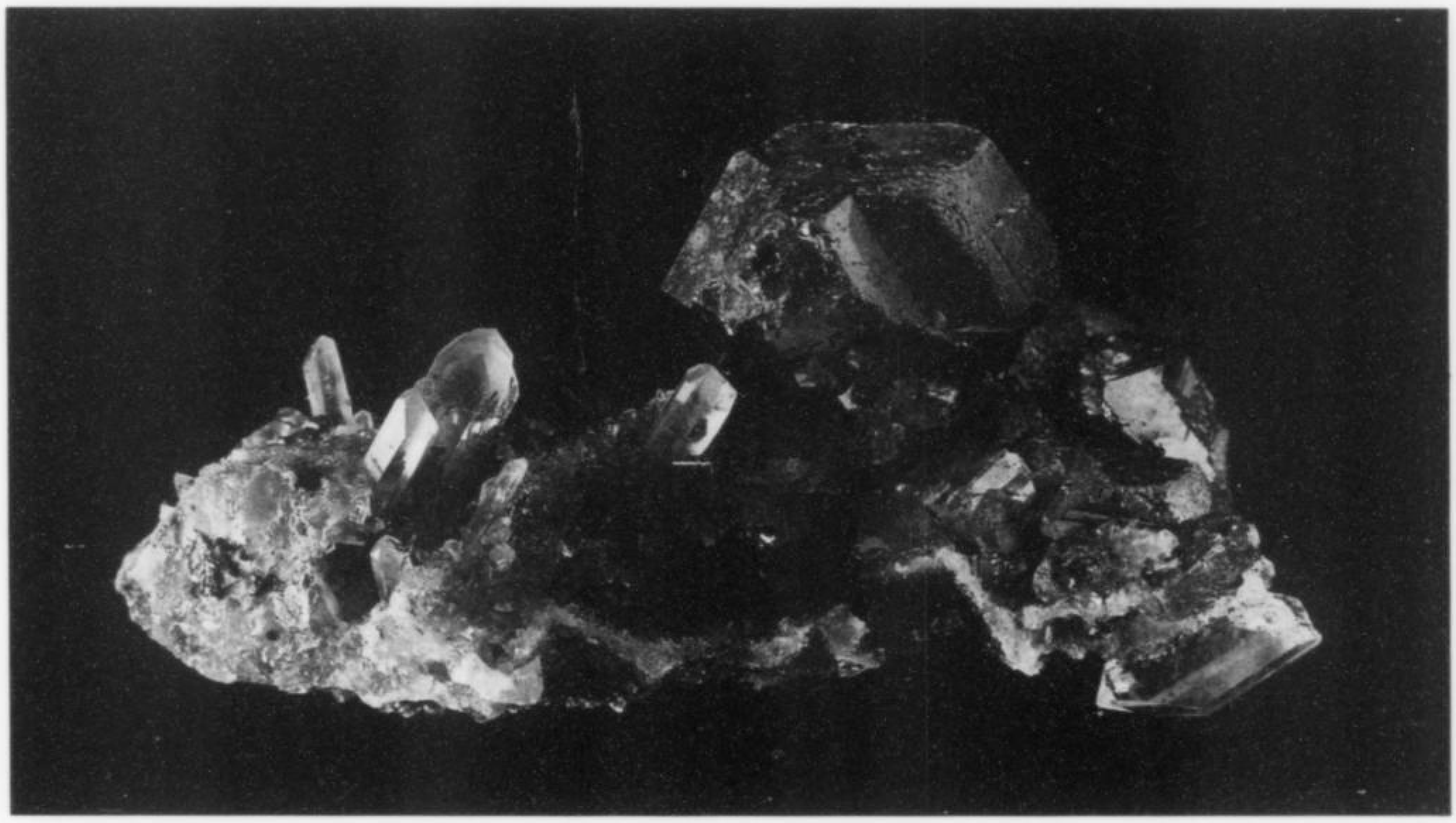


Figure 3. **Sphalerite crystal, 2.8 cm, on a shell composed of small quartz crystals from the Elandsrand mine. The black, amorphous material partially coating the matrix is kerogen. Brenda Rademeyer specimen; photo by Bruce Cairncross.**

Figure 4. **Galena crystal, 2.6 cm, on a matrix of quartz, partially coated with black kerogen, from the Elandsrand mine. Brenda Rademeyer specimen; photo by Bruce Cairncross.**



mineralizing event that formed the sulfates and the sulfides.

Despite the size and weight of the larger crystals, and the difficult task of collecting them and then carrying them to the surface from over 2.5 kilometers underground, the specimens are remarkably free from serious or obvious damage. The smaller of the two giant crystals is very aesthetic. The two barite crystals and a large quartz matrix specimen are now housed at the mine offices.

Apart from the large crystals, about a dozen smaller pieces were also collected. One relatively large, doubly terminated 30-cm crystal that weighs 6 kilograms is in the collection of the Geology Department at Rand Afrikaans University, Johannesburg. The barite is a honey-amber color and the crystals contain inclusions of small (2–4 mm) pyrite that imparts an attractive golden sparkle to the specimens. The barite is intergrown with galena and quartz.

The galena is bright silver and has a high luster. Modified octahedral forms are common. Some complex groups are perched on euhedral barite, forming attractive specimens. Only a few (less than two dozen) galena specimens were found in the cavity, and they must rank among the most aesthetic galena found anywhere in South Africa.

The quartz crystals are relatively transparent, although some display white phantoms close to the terminations.

The sphalerite is somewhat unusual. It is very dark gray to black, in crystals to 3.5 cm. The crystals display distinctive stepped faces.

Although sphalerite has been recorded as a secondary mineral from cavities in the Witwatersrand gold mines, these specimens are probably the best collected.

This single cavity produced aesthetic quartz and kerogen, some of the finest South African galena and sphalerite ever found, and barite crystals which supercede barite from any other South African mine. Indeed they are probably the largest high-quality barite crystals in the world. The contents of the cavity also have geological importance. The galena can perhaps be dated; and fluid inclusion studies of the quartz should yield valuable information regarding the composition of the fluids from which the minerals crystallized. This is of interest, and significance, regarding the debate surrounding the origin of the gold in the Witwatersrand conglomerates. One school of thought supports a hydrothermal origin, and these secondary minerals may be related to the hydrothermal event. Unfortunately, further work on the *in situ* contents of the cavity is no longer possible because it was encountered in a high-production area and was destroyed by the next blast.

KONGSBERG REVISITED

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For more than 300 years the Kongsberg silver district in Norway produced substantial quantities of extraordinary crystallized and wire silver specimens. Abandoned in 1958, the mines have recently attracted renewed interest among enterprising mineral collectors and museum scientists. Some of these specialists have rappelled hundreds of feet down abandoned, ice-sheathed air shafts into the old mine workings, many not visited by man in over 200 years. Recent research in the mines' archives has uncovered fascinating unreported data about old-time Kongsberg mines and miners. This article summarizes many of the latest discoveries.

Figure 1. (top) **Crest of the Kongsberg mines.**

***Figure 2.* King Christian IV (ca. 1620). Photo courtesy of the Norwegian Mining Museum.**

INTRODUCTION

Between 1623 and 1958, continuous mining in the Kongsberg silver district, Norway, produced 1,350,000 kg of pure silver. During their last 30 years of operation, the mines had been sustaining a loss and, after extensive prospecting failed to locate new orebodies, the Norwegian government decided to close the silver mines in 1955. The last silver smelting took place in 1958.

Management of various surviving facilities was gradually turned over to local and national agencies. Woodlands surrounding the mines became a part of the National Forests. The mine water works high in the mountains was redirected to the drinking water system of Kongsberg town. In 1965, the mining company museum was changed to the state-operated Norwegian Mining Museum. It became responsible for managing another 20 buildings around town and at the mines, as well as the entire King's mine, Kongsberg's oldest and largest silver mine, and its underground railroad. The Museum's collections, including its famous silvers, remained intact and on site.

HISTORICAL SOURCES

The greatest single source of information about the Kongsberg district is the Kongsberg Mining Museum and its staff. The Museum's three-story building originally housed the mines' smelter and coin mint. Today it is filled with exhibits of old mining machinery, smelter furnaces, tools, lamps, maps, photographs, minerals and gemstones, and much more. These exhibits present a stunning story of Kongsberg mining history.

Another great information center is the Kongsberg Silver Mines' archives which, in 1962, was reestablished in the National Archives in Oslo. This assemblage includes handwritten documents, some dating to 1623, and about 4,000 maps and other drawings. The subject matter includes mine payrolls; the purchasing of mining tools, equipment and supplies; injury and fatality reports; the sale of mineral specimens; tunneling progress and bullion records. Most items are stored chronologically by their date of origin. The total archive collection occupies nearly 1,000 linear feet of shelves, with documentation of the year 1744 alone exceeding 14,000 papers.

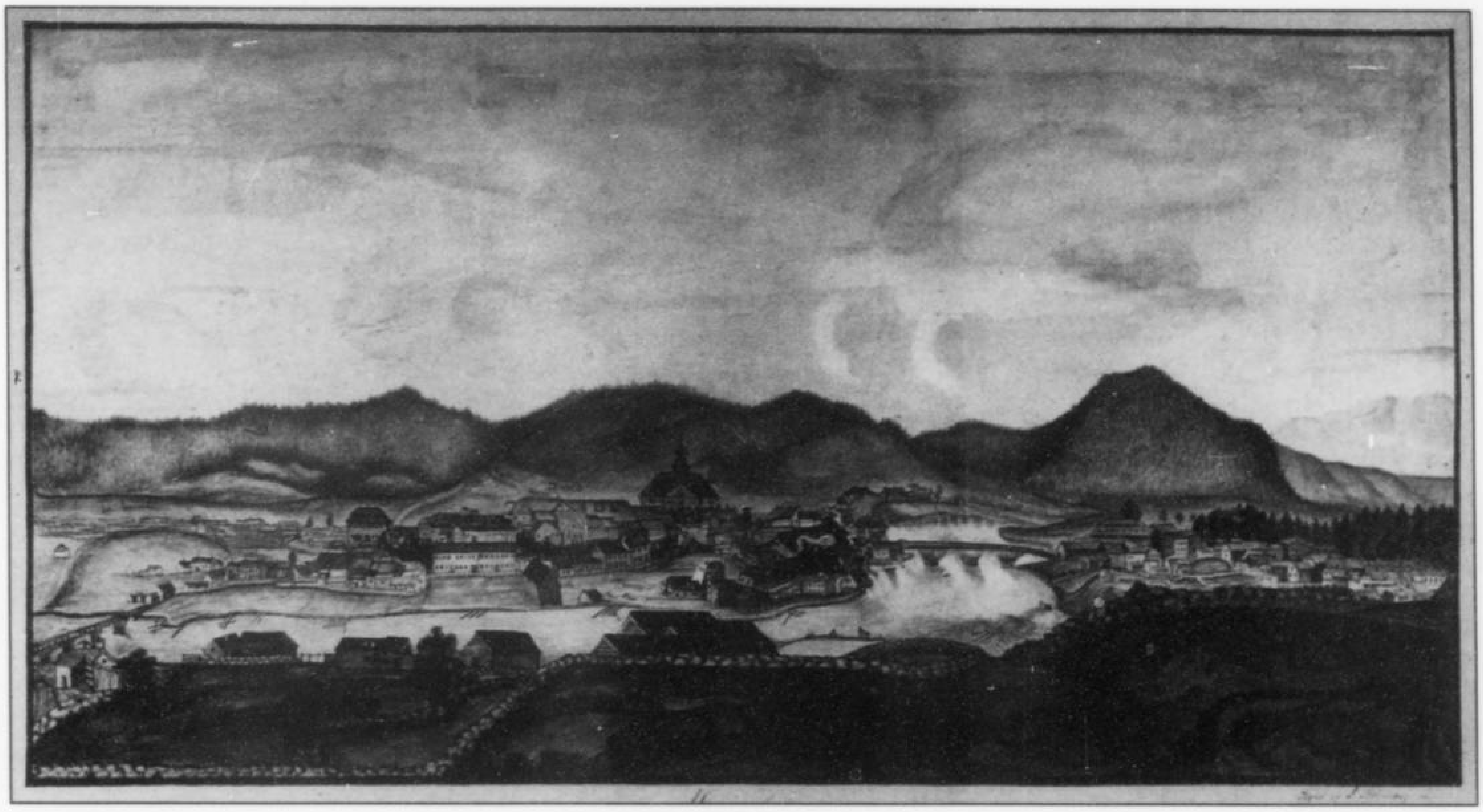


Figure 3. **Painting depicting Kongsberg and surrounding mines by I. Aschehoug ca. 1808. Collection of the National Archives, Oslo, Norway.**

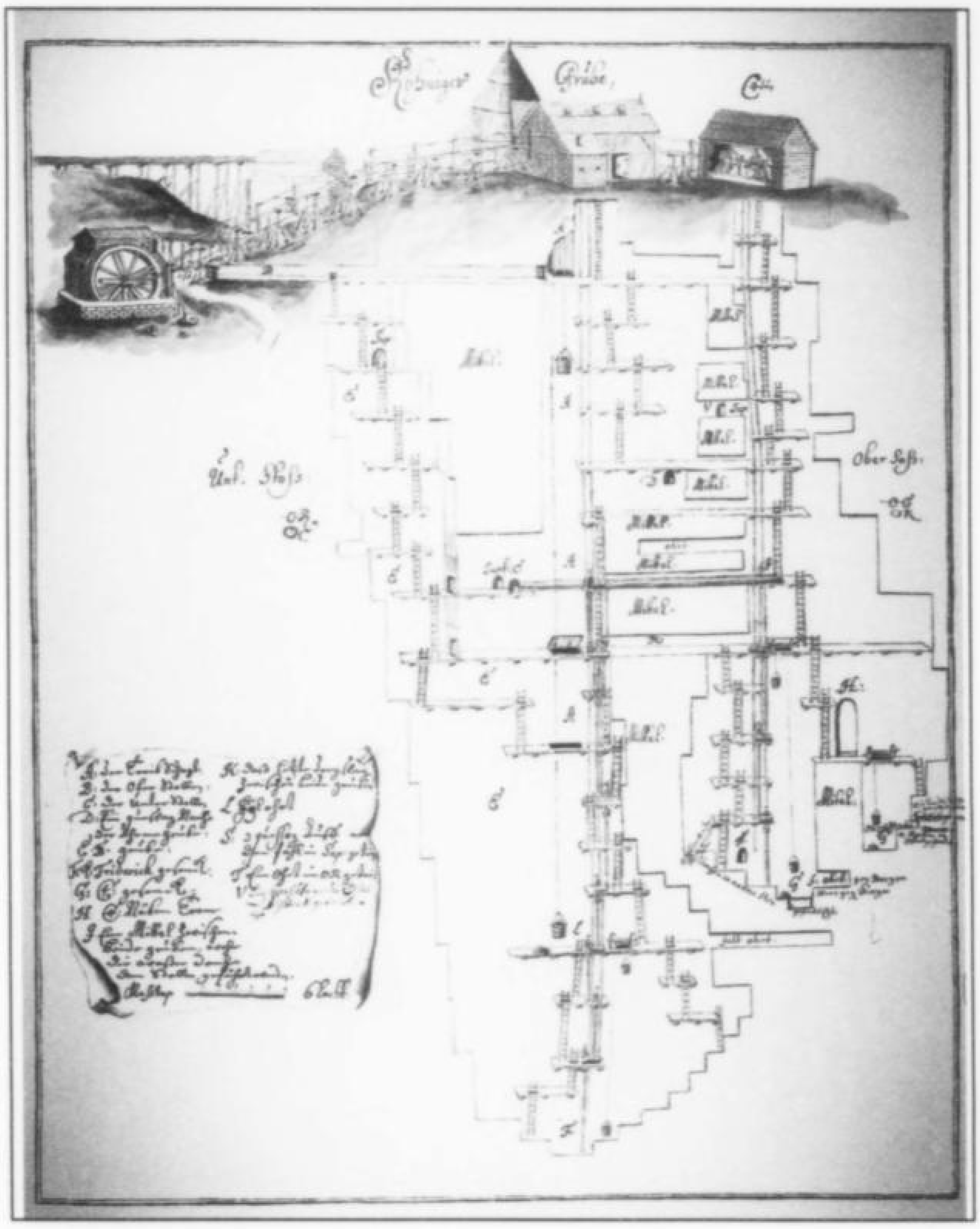


Figure 4. **Map of the King's mine ca. 1715, probably drawn by mining surveyor Gottfried Klem. Collection of the Norwegian Mining Museum, Kongsberg.**

Another important source is the area's group of 300 mines and prospects and hundreds of waste dumps. Also significant are the remains of water-wheel houses, horse whims, aqueducts and dams, ore mills, rock inscriptions, mine roads and mine trains.

Museum staff members and volunteers have personally interviewed nearly 100 old-time miners, as well as many knowledgeable mineral collectors and dealers. Much information, some remembered only by these individuals, has been tape-recorded for future reference.

It seems evident that additional unknown data will be uncovered in the future. Thousands of unread pages in the archives remain for investigation, minerals not previously known from Kongsberg will be discovered, and remaining geological puzzles will be resolved.

RECENT VISITS TO THE OLD MINES

B. I. Berg, current Kongsberg Museum curator, was certain that much could still be learned about underground mining techniques and the habits of early miners. He determined to visit as many

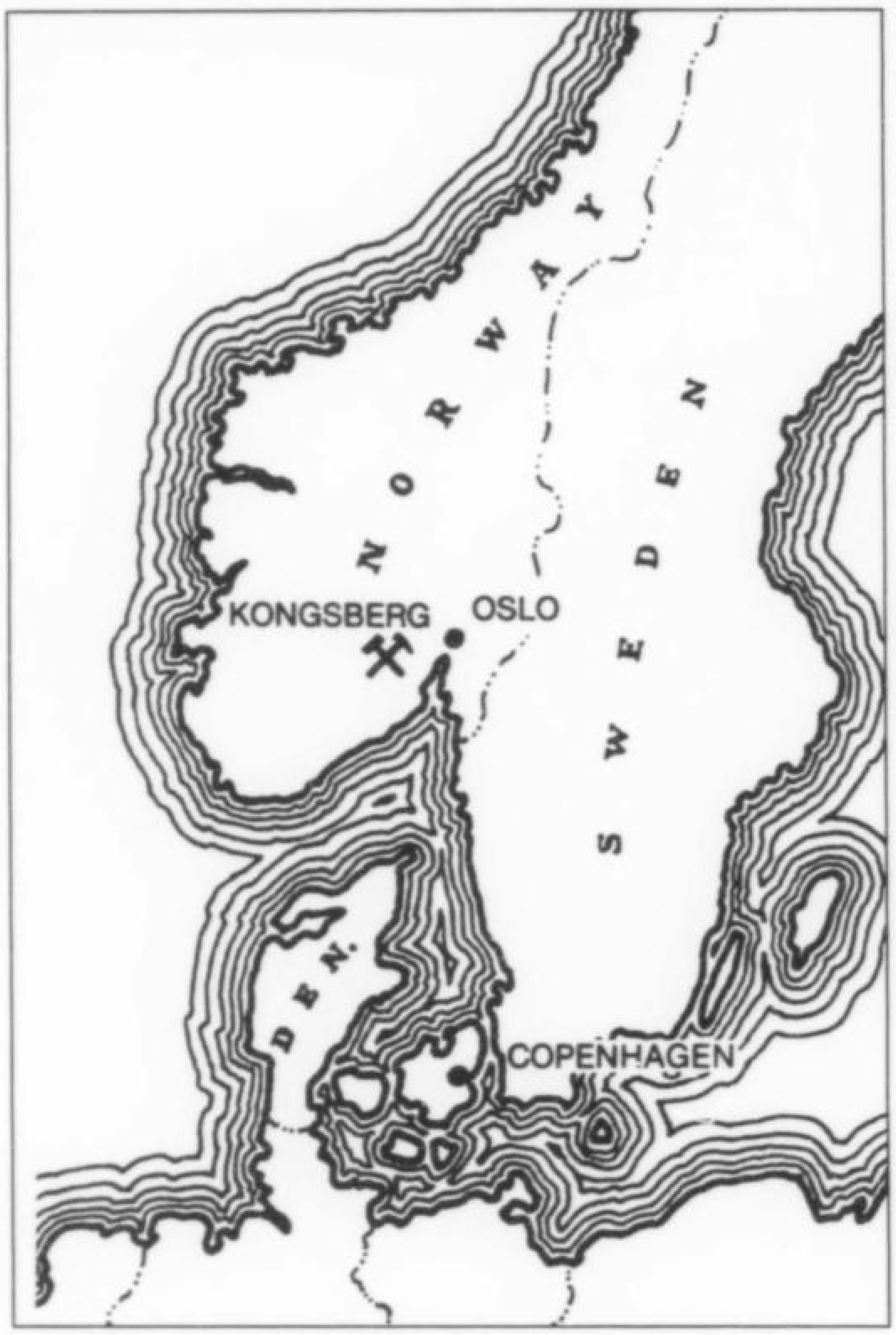


Figure 5. **Location map showing Norway and Kongsberg, courtesy of Ole Johnsen.**

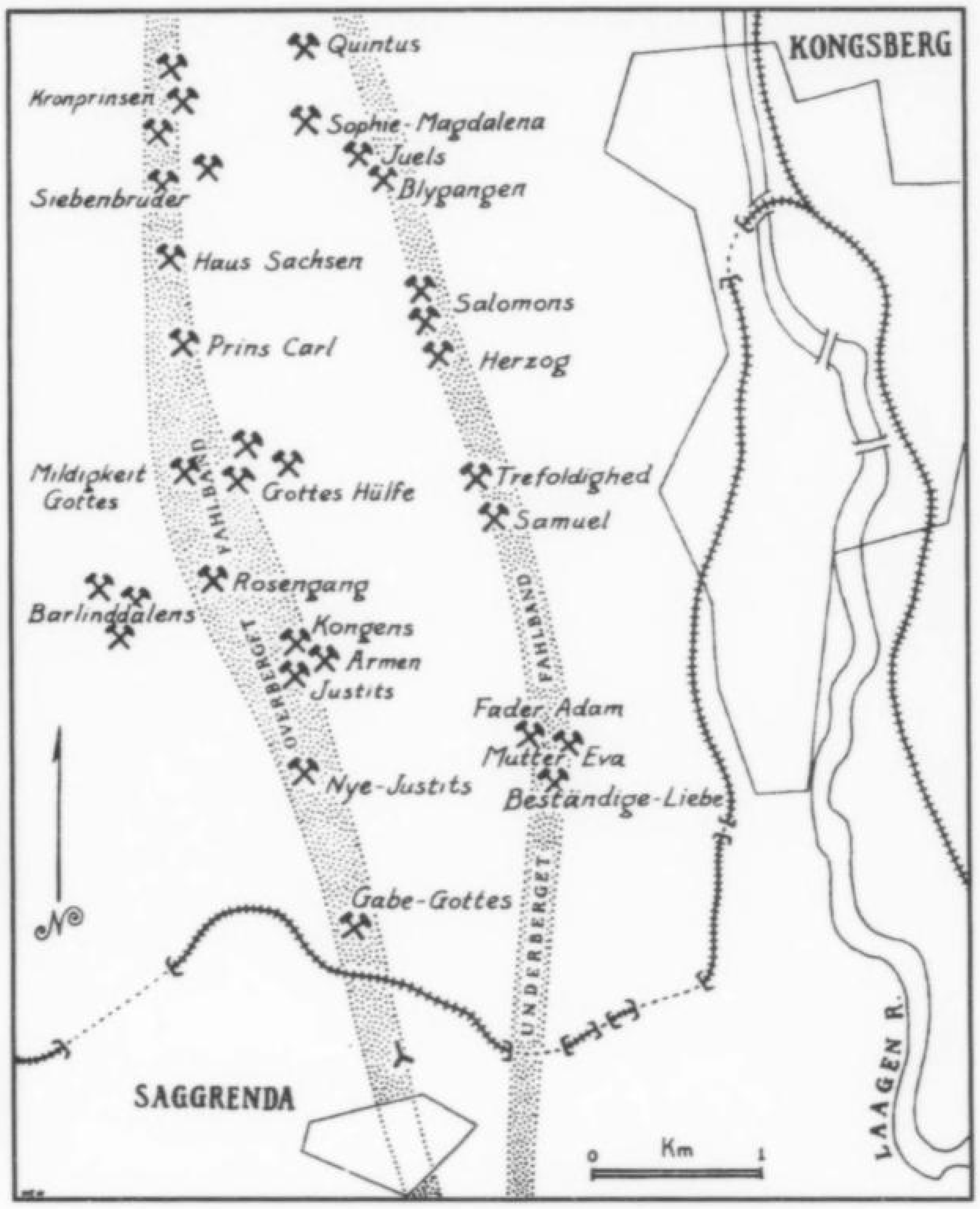


Figure 6. **Map of the Kongsberg mining district showing major mines (after Wilke, 1976, and Holtedahl, 1960).**

long-abandoned shafts, tunnels and galleries as possible, but there were major problems to be resolved. Most entrances were shafts, often with dangerously loose rocks around the openings and in many areas below. Many old timbers and wood floors were rotten, and not a few were covered by stone debris. In addition, a number of shafts were lined year-round with ice.

One factor in Berg's favor, however, was the stability of the underground workings. Even in heavily-faulted zones, Kongsberg's hard, metamorphosed country rock was not prone to caving. Berg believed that if he could gain entrance, he would find old, underground excavations still in good condition.

The Kongsberg archives proved a valuable source for old maps and records of the mine areas Berg wanted to visit. Of greatest interest were vertical profiles and horizontal level plans of the mines. Being an expert mountain climber, he planned to rappel down a series of selected shafts over the course of many visits.

In 1985, Berg and two companions made their first excursion down into some of the old workings. Much time was spent establishing rope lines over enormous slabs of ice, and in avoiding rotting and loose timber. Rappelling downward hundreds of meters, they finally reached the water table, below which all excavations were flooded. (Subsequent visits to other mines showed a variance in the height of water tables from 170 to 360 meters below the surface. The water table in the Sachsen mine was at 460 m.)

Returning upward and walking out into unflooded levels, some encased in ice crystals, was, Berg said, "like stepping back in time." Most areas were undisturbed, just as miners had left them long ago. Even the air smelled of antiquity. Tunnels and galleries were nearly trash-free, but here and there were reminders of the time when hundreds of men labored at extending tunnels and removing ore and waste.

As of now, Berg's teams have traveled underground more than 4,000 vertical meters and 30,000 meters horizontally. Many interesting objects were discovered including wheelbarrows, ore barrels, hand winches, clothing, tobacco pipes and boxes, hand tools, machinery and "lost" silver specimens. A huge wooden waterwheel, 12.6 meters in diameter, was found 170 meters down the main shaft of the King's mine. It was still in relatively good condition more than 150 years after it was built.

At a tunnel face in the Silberspur mine, Berg's group made an amazing find: the remains of a firesetting attempt. There, still stacked as departing miners had left them, were 60 partially charred sticks of coarsely split firewood. Such a discovery is indeed rare anywhere in the world. Later, while researching the archives, Berg found exact reference to this firesetting. In December 1754, Anders Bentsen and Ener Olsen had carried that wood 90 meters into the crosscut, stacked it at the tunnel face and set it afire. The fire caused fissures into an unseen crack zone saturated with water. Gushing water put out the fire, forcing the miners to work in another section of the mine, never to return to the problem area.

Berg made another discovery in the King's mine when he noticed that miners of the 18th century had stopped work just a few meters away from one of the greatest silver orebodies in Kongsberg's history. None of these miners ever knew of the bonanza hidden from them just behind the wall of rock. Archival records accurately described the spot where the miners quit work in the crosscut that day on the 360-meter level. What the miners did know, was that the major calcite vein they had almost reached had expelled a lot of

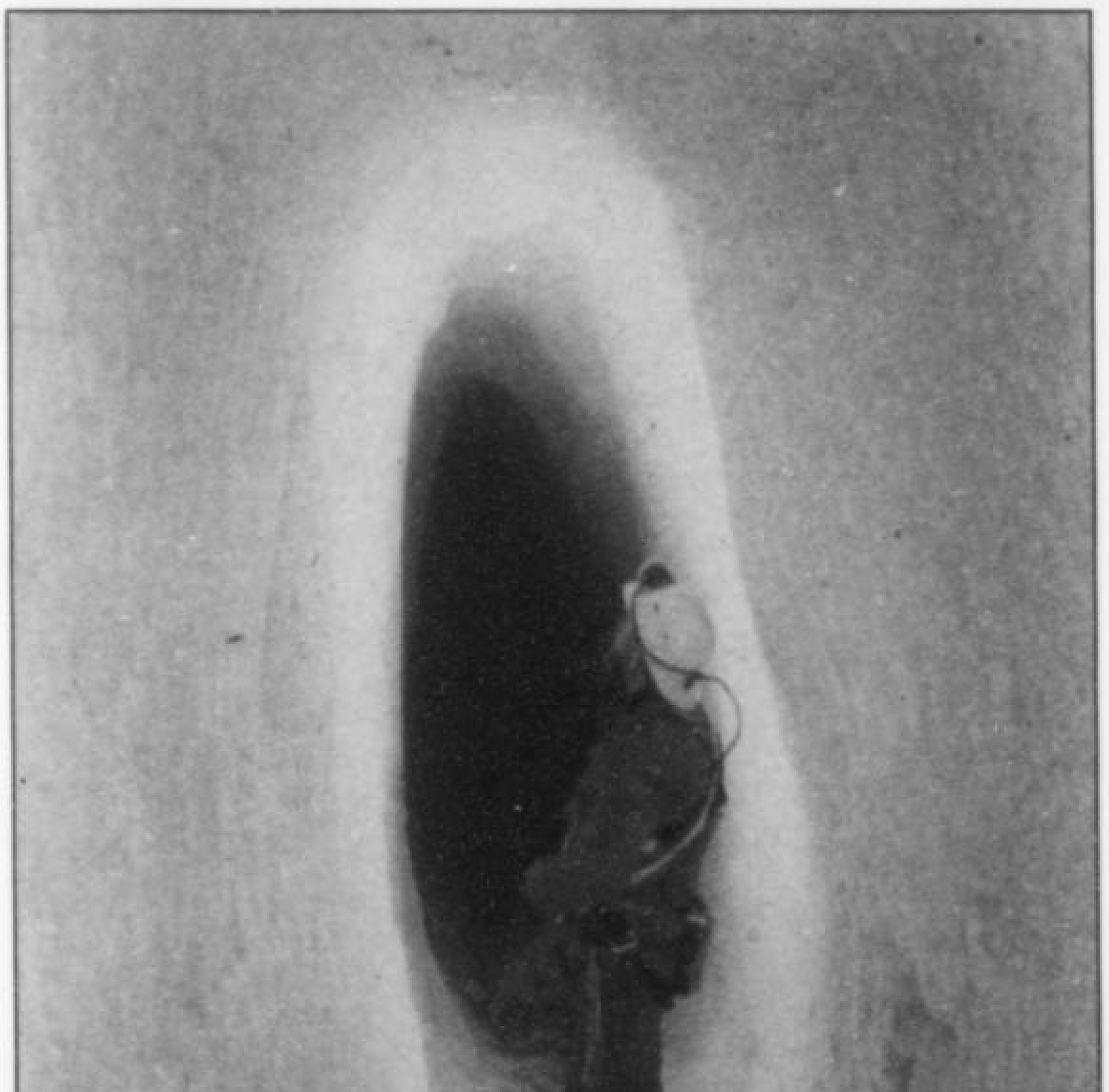


Figure 7. **Museum curator Bjørn Ivar Berg with the remains of a firesetting in the Silberspur mine dating to December of 1754. Photo by Stein Flaata.**

Figure 8. **A crosscut showing the rounded shape typical of mining by the firesetting method, probably dating to around 1700. The walls are covered by small ice crystals. This crosscut is located between the Herzog Ulrich's mine and the St. Johannes mine. Photo by Hans A. Gulli.**

water at a higher level, and they were afraid that when they breached the calcite vein, gushing water could flood their work and endanger the entire mine.

Forty years later, in 1830, miners took a chance and worked the crosscut further to the vein, and in the process discovered enormously rich silver lodes. This find would provide tons of silver annually for the next 50 years, and would yield up to 10% of the annual Norwegian state budget.

MINING KONGSBERG ORE

From the start of silver mining at Kongsberg in the 1620's, the work was led by skilled German miners immigrating from Saxony and the Harz mountains by request of King Christian IV. They brought with them the ability to work hard rock with two techniques, "hammering" and "firesetting," which were most often utilized in tandem.

As the mines extended downward, it was soon recognized that the rocks were harder and tougher than the German miners were used to in their home country. In the 1650's a crisis was reached when management received notice that some workers had made a monthly advance in their tunnels of only 20 cm (Berg 1995). Records indicate the 1660's were a transition period from "hammering supplemented by firesetting" to "firesetting supplemented by hammering."

Hammering

The hammering technique required as its main tools a sharp-pointed chisel with attached handle and a hammer. At Kongsberg, miners usually hammered long, parallel, vertical chisel marks in the mid-section of the tunnel face, in an area going from roof to floor. When this area was hammered out to a certain depth, the side rocks were removed by firesetting until a proper tunnel width was achieved. Besides hammers and chisels, they also used wedges and sledges on fractured rocks.

Firesetting

The first recorded evidence of the firesetting technique being used at Kongsberg was an account of an unhappy miner being burned while setting a fire in the year 1624. Firesetting involved placing and then igniting carefully stacked sticks of wood at the tunnel face. Fire would heat the rock wall, causing cracks to develop and chips to flake away. Miners learned that a continuously burning fire maintained a very hot wall face and was the most efficient technique. Though often referred to in literature, the so-called process of "quenching the hot rocks with cold water" was not used at Kongsberg (and probably very few, if any, other places) because to do so would be inefficient, dirty, and most certainly dangerous (Berg 1995).

Kongsberg silver mines consumed an enormous amount of firewood, which presented a challenge. Company-owned forests adjacent to the mines were unable to produce sufficient wood for firesetting, additional buildings, timbered shafts, miners' torches, and for the making of charcoal for the smelter, the mint and many blacksmiths. Consequently, the royal authorities granted the mining company a "circumference," which was a huge circle within which all farms had to cut and deliver wood and charcoal to the mines. By 1770 nearly 2,000 farms were providing wood at a price per load set by the mining company. This practice was not popular with the farmers, though it often gave them an important supplement to their incomes.

Firesetting caused miners to work in filthy and choking conditions. It consumed oxygen and produced smoke, ashes and carbon monoxide/dioxide, called "stench" by the miners. Mining in areas with inadequate ventilation quite often resulted in fatalities. This is illustrated by an inscription called "the death notice," hewn into a rock wall of the Underberget adit, between the St. Johannes and Heilige Dreifaltigkeit (Holy Trinity) mines. The notice commemorates two miners who, in 1794, were killed in the mine by "stench." Ordinarily, natural ventilation from the surface ceased at any more than 200 meters from the shaft. It is estimated that the long distance of some adits, and the bad air within, hindered their completion for decades.

Years later, in 1844, the company started to build continuous wooden platforms which were hung from the roof of main tunnels. When completely sealed, this upper area became a loft or attic which would carry smoke and hot, polluted air out of the firesetting areas. Fresh air was flushed back into the mine through the lower compartment. The loft concept was a great success, and as ventilation improved throughout the mines, firesetting could be accelerated without fouling breathing air. Eventually, bricks replaced wood in sections of the loft ceilings, thus reducing a major fire hazard. Monthly tunnel advances reached up to 7 meters.

Adits developed by the firesetting method are easily identified by their characteristic elliptical, egg-shaped profiles. Other evidence is remaining debris on tunnel floors, which contains thin shells of waste rock and bits of charcoal. Small amounts of soot still cling to some walls.

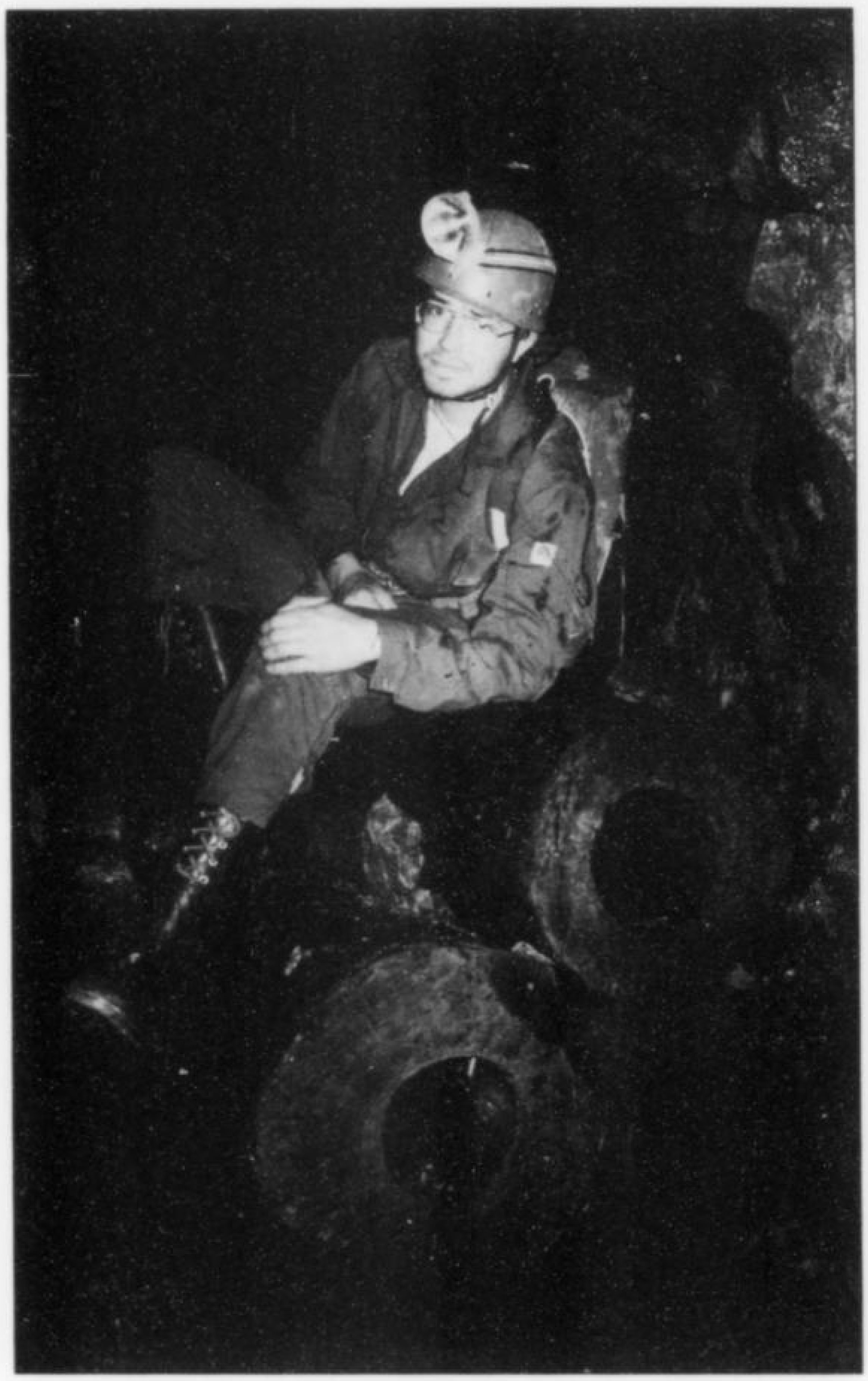


***Figure 9.* An old storage room in the St. Johannes mine for wooden pipe used in 18th-century water pumping systems. Photo by Bjørn Ivar Berg.**

An interesting rock specimen was recently discovered in the Drei Bruder mine at a level which was being mined around 1640. On one side are clearly defined chisel marks, while the other side is smooth and heavily sooted from firesetting—visible evidence of both hammering and firesetting techniques being used in the same area at nearly the same time. This specimen is part of the Kongsberg Mining Museum collection.

Gunpowder Blasting

Blasting rocks with gunpowder was successfully demonstrated in France in 1617, and in Slovakia in 1627. In Kongsberg the technique was first considered in 1643, but was not well established until the early 18th century. Firesetting was still being used in horizontal tunnels, while black powder was employed in vertical works.

Drill holes for blasting were bored by hand up to about a meter in depth, one man hitting the drill while another twisted it. After a gunpowder charge had been pushed to the bottom of the hole, it was plugged with dry clay by means of a ramrod. A small channel was left in the clay from the charge to the front of the hole, and this was filled with gunpowder. Lastly, a cotton string fuse impregnated

Figure 10. **An abandoned blacksmith's workshop in the Gottes Hülfe in der Noth mine, 335-meter level. Photo by Peter Bancroft.**

Figure 11. **Miners in the elevator of the King's mine ca. 1940. Photo: Norwegian Mining Museum, Kongsberg.**

with sulfur was tamped into place. The device worked, but proved to be dangerous and resulted in many injuries.

A gunpowder-producing mill was in operation in Kongsberg from 1734 to 1865.

Man-powered treadmill

While working with archival papers, Berg (1995) made many interesting discoveries. One revealed that for a short period during the 18th century, a number of treadmills, or treadwheels, were introduced for hoisting ore, waste and equipment within the mines. The wheels looked like greatly enlarged versions of exercise wheels in rat cages. Two workers made a giant wooden wheel rotate by walking inside it, while a third worker, seated above the wheel, kicked its lugs on the outer periphery. These treadwheels were more efficient than the hand winches, but were unpopular among the workers and were soon abandoned.

THE LIFE OF THE MINER

Working and Social Conditions

A detailed employment report for the year 1732 listed the ages of the 1,619 employees working for the Kongsberg mines. The list included five boys under age 10, and 272 at ages between 10–14. While boys were not permitted to work underground, some were assigned hard and often dangerous work in the surface ore crushers and sorting houses. At 18, young men could apply for work underground.

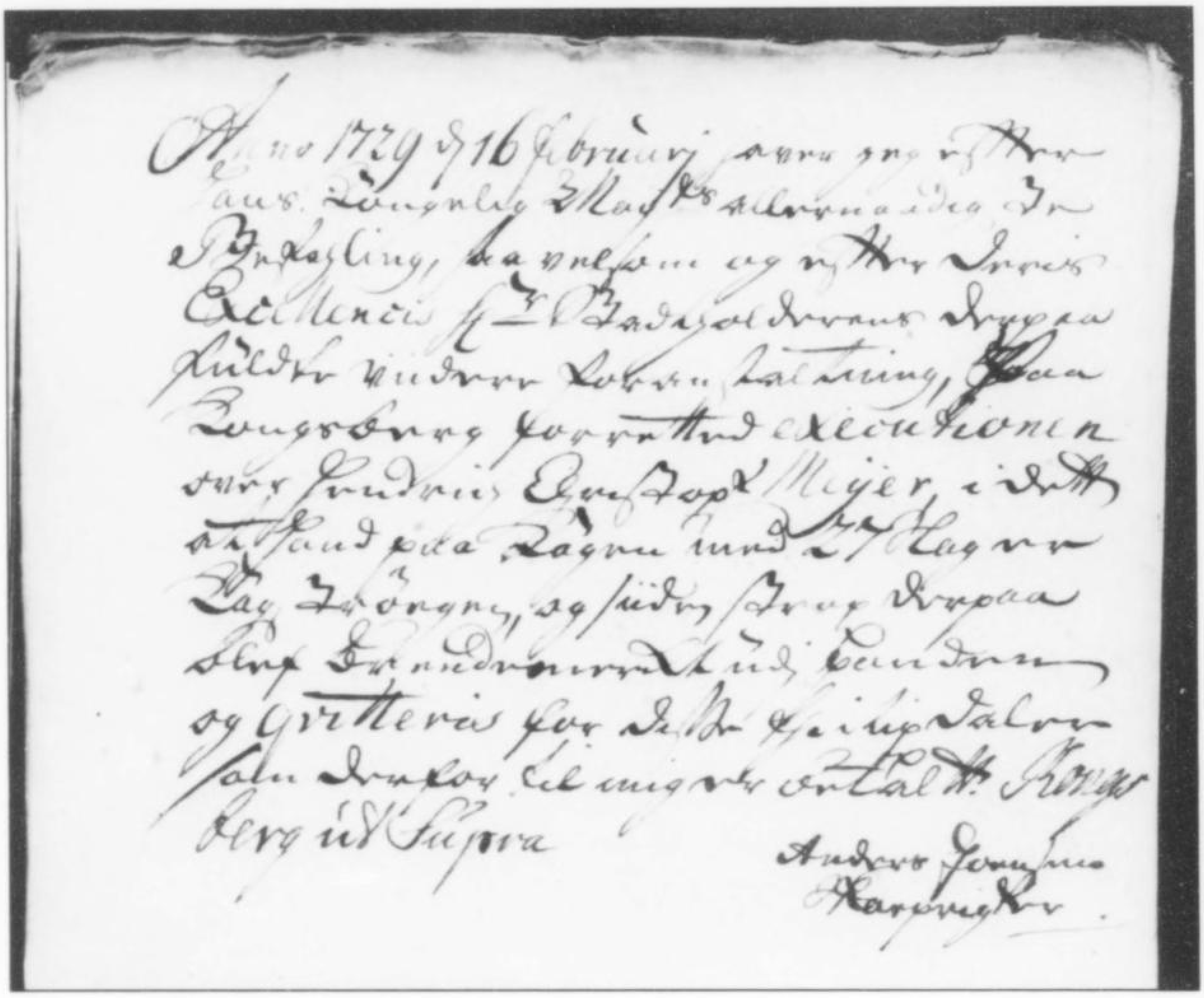


Figure 12. **Executioner's payment receipt dated 1729, regarding the punishment of former mint master Henrik Christoffer Meyer who was convicted of silver theft (courtesy of the Norwegian Mining Museum, Kongsberg). It reads (translated):**

> ***In 1729 on February 16th I have, on the most gracious command of his Royal Majesty, and in accordance with Your Excellency Mr. Governor's further instructions, inflicted punishment on Henrich Cristoph Meyer, insofar as he has been flogged on the rack with 27 lashes and subsequently marked with a brand on his front, and so I sign for the ten rix-dollars which have been paid unto me. Kongsberg, as above, Anders Jonsen, Executioner***

A miner's daily life was far from easy. Ringing church bells signaled the beginning of a new day at 4:00 a.m., when miners began the long walk up the mountain to the mine shaft. There, they had to attend prayers before entering the nearest mines. Late arrivals for the prayers were fined.

Using tallow lamps or pine torches for light, miners climbed down wooden ladders 200–400 meters to their working levels. It was then that the work day began.

At day's end, sweat-soaked miners retraced their steps and trudged down the mountain, frequently in rain or snow. In town they usually attended more prayers and devotional services in the church. Those who were caught sleeping in the pews were hit over the head with a long pole by an overseer. One habitual sleeper was fined 4.5 dalers (almost one month's salary).

Dust from drilling, and ash and stench from firesetting and burning torches created havoc with the miners' lungs. Many were incapacitated with colds, asthma and pneumonia. Some died. Funeral lists of accidental deaths in the mines between 1740 and 1749 show that 20 miners died from falling off ladders, 12 from stench, 10 from falling rocks, 10 in premature blasts, and 18 from other causes. The largest loss of life in a single accident happened in 1856, when five miners died in a fire in the Gottes Hülfe in der Noth mine's main shaft (Berg 1980).

From the beginning of mining in Kongsberg, the company created various social and medical services for its miners. In 1628, field barbers were employed, as was a medical doctor in 1656, and a surgeon in 1701. The miners got free medicine and, in 1695, a pharmacy was opened in town. Other benefits included full salary for up to 14 days for injured miners, then half salary for miners unable to work for a longer period of time; company-paid funeral expenses for fatally injured miners; pensions awarded to those who could no longer work due to accident, illness or old age; and support allotments for widows and fatherless children (Kruse 1979).

The Royal Government ruled that miners would be exempted from military service, and did not have to pay taxes. Small parcels of farm land were available for a modest rental fee, and Saturday was declared a day off so that miners could work their own land.

From the very beginning, employees were trained for different kinds of work or jobs within the company. By 1717, in-house advancement programs were well established. Those chosen to become mine officers started as trainees and then received scholarships to study at advanced mines and schools abroad.

In 1757, the Kongsberg Mining Academy was founded; it functioned until 1814, when the education of mining engineers and geologists was transferred to the newly established University of Oslo. In 1841, the mining company established collections of minerals, ores and professional books, and in 1861 the miners started their own book collection (library). The need to develop

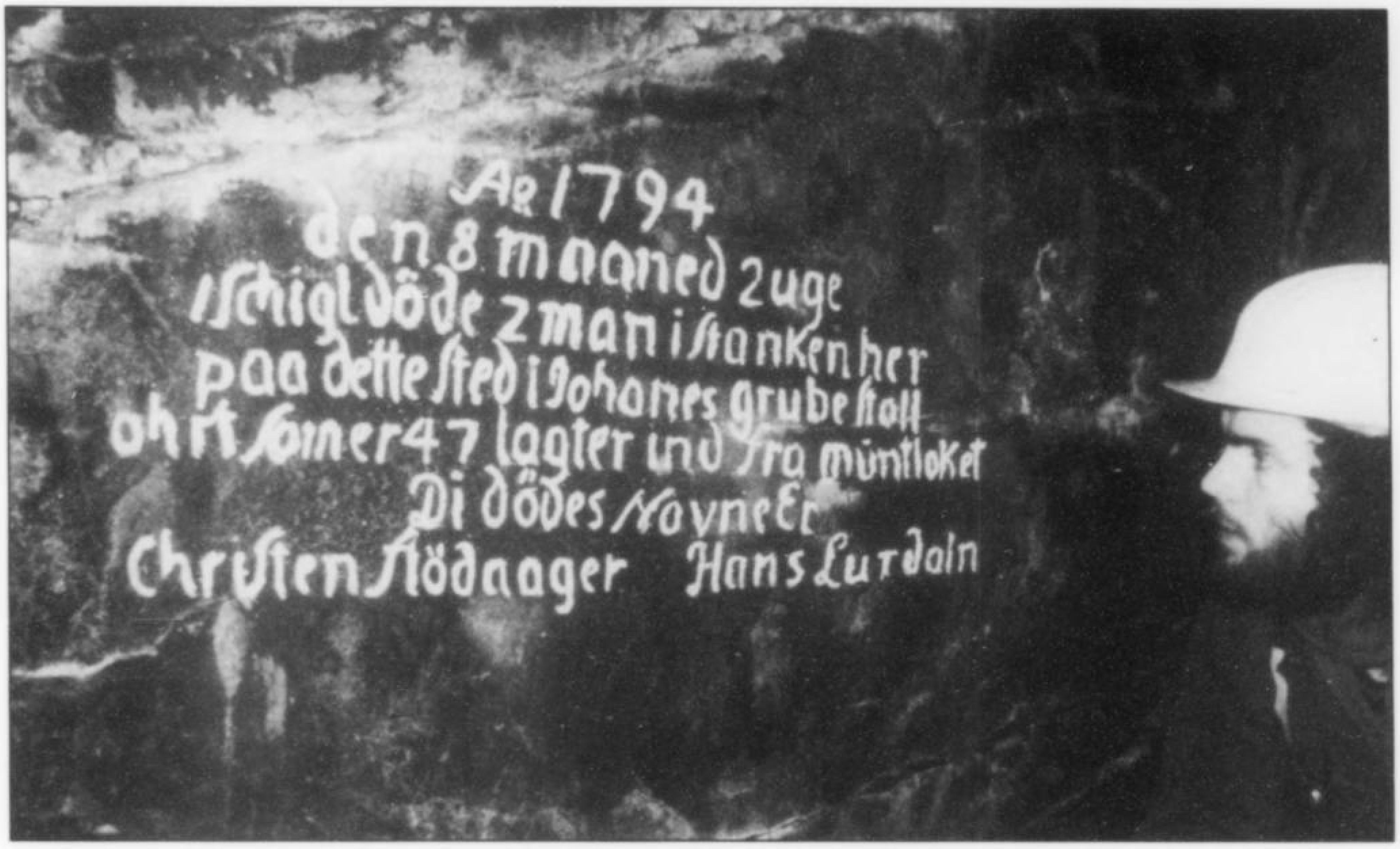


Figure 13. **"Death Announcement" telling of two miners who died on this spot in the Underbergstollen adit from firesetting gasses in 1794. Photo by Bjørn Ivar Berg.**

leadership training at Kongsberg remained, so in 1866 a mining school for the training of overseers (Bergskolen) was started. (When the silver mines were abandoned in 1958 the school was transferred to Trondheim.)

With all of these advantages, Kongsberg silver miners achieved a high social status. Most were skilled workmen with permanent jobs, and they were paid in cash, unlike many farmers and traders of the times, whose income was largely derived from the exchange of goods. Miners were, therefore, attractive in the marriage market. It was said that "it took two farmers to equal one silver miner in wedlock." Most miners were proud of their jobs.

Kongsberg miners apparently liked to use nicknames and to haze each other. This practice probably goes back to the earliest times. During the 18th century, nicknames often appeared in church records. Many miners received nicknames according to their looks, behavior or some activity in which they were involved. Most did not like their nicknames, which were usually used behind their backs.

The preferred method for embarrassing a miner was to make reference to his nickname without actually uttering the word. Thus, a miner nicknamed "the rooster" might be greeted with a "cock-a-doodle-do," or he might find a chicken bone in his lunch pail. A specific example was a newly employed miner named Halvor, who was courting a servant girl at a nearby farm. He frequently visited the girl at night, using a long ladder to enter her room on the top floor. One night when Halvor was upstairs, a couple of miners cut a rung of the ladder nearly in two, and it broke as he climbed down. Falling to the ground with a great deal of noise, Halvor looked up to see the girl at the window shouting, "Did you hurt yourself, Halvor?" That phrase became his nickname.

Another miner was reportedly annoyed by a flock of magpies squabbling outside his window. He grabbed his rifle and fired, but his shot missed the magpies and instead hit his pig. Wounded, the pig ran screaming around the courtyard. The noise drew his neighbor's attention, who promptly nicknamed the miner, "the pig shooter."

The nicknames, which were generally passed from father to son, were only used in and about the mines, for it was considered poor judgment to use them elsewhere. (Sanness 1941).

Many miners, like Thor Nilsen (1921–1996), were storytellers. He told of a tourist who noticed the cows that frequently sought the cold draft at the opening of the main adit. The cows were trying to get away from flying insects, but when the tourist asked why they were there, he was told: "We put 'em there to keep the milk cool." Ragnvald Dusterud (1906–1980) knew of a man who was driving goods to the mine. He treated his horse badly, and one day as he exited the mine office, some miners told him that his horse had just eaten half a case of dynamite. "The man didn't dare beat his horse for fourteen days."

Dusterud also told about his work in the Mildigkeit Gottes mine in 1938. He was drilling in rich ore, which was very difficult and time-consuming because of the soft and solid nature of the native silver and argentite. After blasting, he saw signs of a pocket underfoot. Reaching down in the dirty water, he grasped something that felt like a steel wire in a vug. Further investigation revealed a large amount of pure silver in an ore pocket. Dusterud had discovered a remarkable collection of wire and crystal silvers. Though he had mined silver in Kongsberg for more than 30 years, every new find was exciting, according to Dusterud, and "great fun!" His find was recorded in the local newspaper, and was exhibited at the World Fair in New York in 1939. Some specimens were sold at the fair, and the remainder was shipped back to the Mining Museum. Several of the better pieces are currently on display, including the museum's biggest wire silver, a monster weighing 48 kg (Nordrum and Saelebakke, 1981).

MINERS IN TROUBLE

Most miners led pious and orderly lives, but some got into trouble, occasionally under bizarre circumstances. In 1646, mine superintendent Daniel Barth wrote about a miner named Ivar Anderson who, "last Sunday came drunk to church. He managed to climb up to the church gallery, and leaning over the rail, urinated on the congregation below, hitting the bailiff, Karsten Hansen." Anderson was confined to jail for 14 days, fined two daler (dollars), was banished from Kongsberg and forbidden to ever work in the mines again (Helleberg 1984).

In another incident on February 25, 1690, a group of unpaid miners demanded payment for wages overdue. When neither of the two principal officers accepted the blame, each accusing the other, irate miners confronted them. Afraid for his life, oberbergamtsforvalter Brügmann gave the order that all available coins at the mint were to be given to the miners. The miners put six guards at the mint until all overdue accounts had been settled.

The farmers, who did most of the horse transport for the mining company, also had not been paid for some time. When they heard of the miners' victory, they also confronted Brügmann. They "beat the wig off of him," and tore his clothes while pummeling him, shouting "Get hold of our money or we will drag out your guts." Brügmann got help from three ministers, who tried to protect him, but the farmers would not give up. At last Brügmann was able to flee up a chimney and, dressed like a woman, he escaped from town in a horse wagon (Bull 1948).

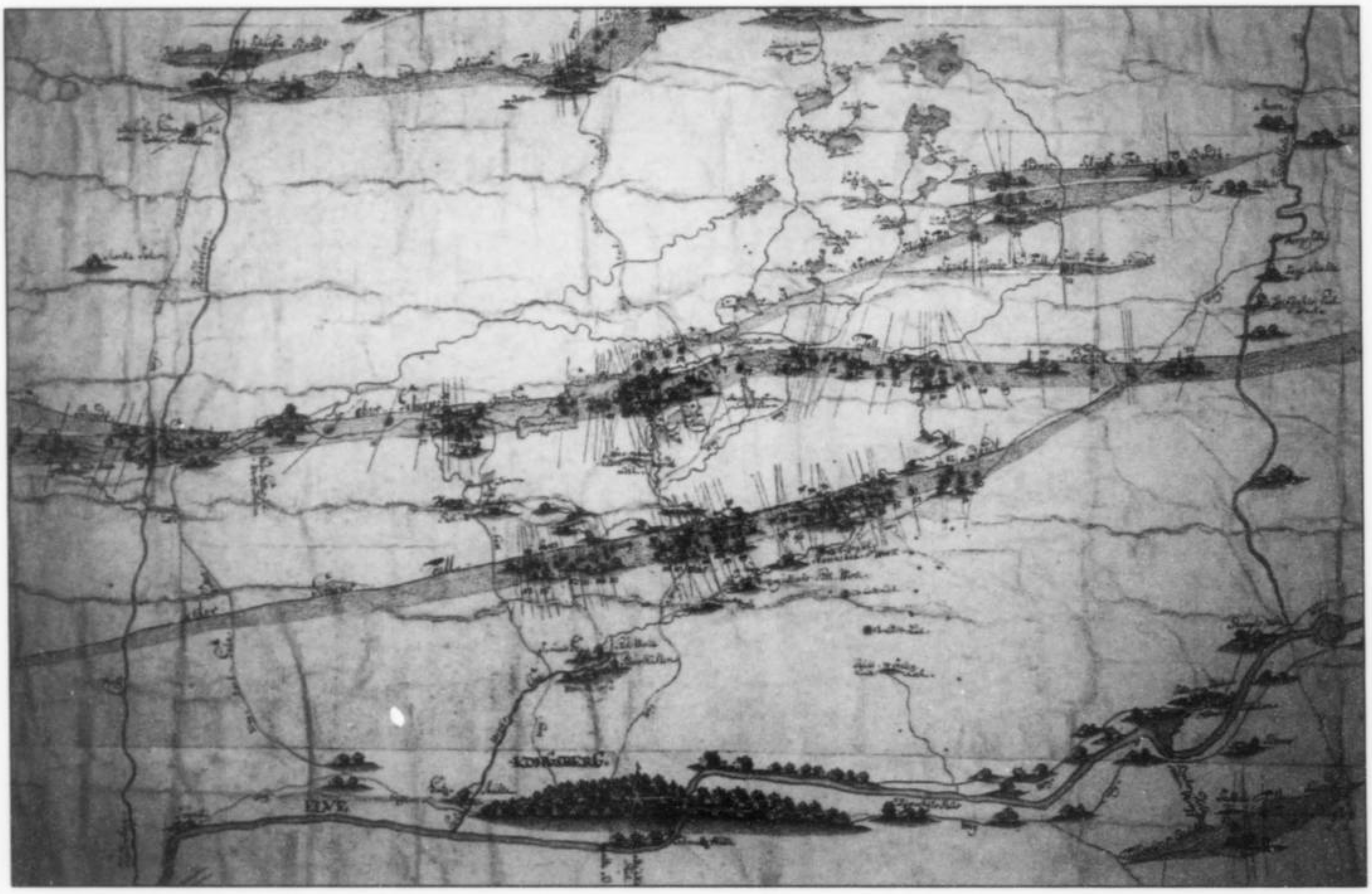


Figure 14. **Portion of a 1776 map showing two fahlbands and several calcite veins, mine buildings, and (lowermost) a profile of the town of Kongsberg. Drawing by J. G. Madelung; photo by P. H. Sælebakke.**

Insubordination by miners was not tolerated. Those who led riots or complained of injustice were often punished by stays in prison, or were banished from town. Thefts of raw silver were an ongoing problem, and the mining company would issue severe sentences, and on occasion, the death penalty by hanging, if the theft was of more than a half pound. However, some major thieves appear to have received clemency from death and were instead sent to prison for life.

The mining town had a police force, and every now and then miners were inspected when leaving work. During the night, a guard watched the mine entrances, but still much silver disappeared.

It was discovered that miners were not the only culprits. Henrick Christoffer Meyer, who succeeded his father as mint master in 1719, was the best-educated master in the mint's history. He had been taught by his father and had studied at mints in several other countries. He lived lavishly and built a fashionable residence in town. His performance at the mint seemed impeccable until 1727, when inspectors noticed that a large amount of copper was missing from the storage room. Further investigation showed that coins struck during Meyer's term (1720–1727) contained insufficient silver. He had substituted equal amounts of copper for silver, which he kept for himself. It was determined that he had stolen about 40,000 riksdaler (dollars) in silver, a large sum of money in those days.

Meyer was sentenced to "loss of honour, life and property," but King Frederik IV showed him mercy by withdrawing the death penalty. Instead he was sentenced to be whipped, branded and assigned prison work for life at Akershus Castle. The first part of the penalty was executed in public at the market place in Kongsberg at 2:00 p.m. on February 16, 1729. He received 27 whip lashes, and a thief mark was burned into his forehead, so that forever he would be shut out from normal society. (The executioner, Anders Johnsen, got 10 riksdaler (dollars) in fee for the job, probably paid in coins with mint master Meyer's initials on one of the sides.) Two months later, 40-year-old Meyer died in the darkness of his small cell (Rønning 1986).

A REVIEW OF KONGSBERG GEOLOGY

Geologically the Kongsberg ore district lies within the Kongsberg Sector of the Precambrian region of South Norway, which is a part of the Baltic Shield. A large number of papers about Kongsberg have been published since 1631. The most significant works in geology have been the doctoral dissertations of Bugge (1917) (general geology) and Neumann (1944) (mineralogy). Johnsen (1986) presented a very good and thorough review of the early literature in the *Mineralogical Record.* However, much new information has been developed in the last two decades. An update of Kongsberg's geology follows.

Host rocks

At Kongsberg, nearly 300 silver mines and prospects occur within an area about 30 km long (in a north-south direction) and 10 km in width. The whole ore district is within a region of strongly metamorphosed and tectonized Precambrian rocks, mostly quartz-plagioclase-biotite gneisses, mica and chlorite schists, granitic gneisses and amphibolites (metagabbros and metadiorites). Several mylonitic zones and regional breccia/fault structures occur in the region. Age determinations on gneisses have indicated deformation and high-grade metamorphism about 1.6 billion years ago and another metamorphic episode 1.2–1.1 billion years ago (the Sveconorwegian orogeny) (Jacobsen and Heier, 1978). Some of the metagabbros/metadiorites intruded during the first metamorphic episode, while others (originally gabbros and dolerite dikes) have been dated at about 1.2 billion years (the Vinoren intrusion). The gneisses and schists had originally been a series of volcanic and sedimentary rocks which may represent a Proterozoic island-arc formation (Jacobsen and Heier, 1978). The most thorough and complete history of rocks and tectonics is given by Starmer (1985).

West of the Kongsberg mining area, granitic intrusions (1.2 and 1.05 billion years) occur, while Cambrian-Silurian sediments and Permian intrusions and volcanics appear to the south.

Fahlbands

Roughly parallel to the north-south strike of the rocks are zones with disseminated sulfides, predominantly pyrite and pyrrhotite. These zones, showing a variable rusty appearance both on the surface and in the mines, are called *fahlbands* after the old German designation. The two largest fahlband zones occur in the central mine area, and are called the Overberget and Underberget. They range in length more than 10 km, and up to 800 meters in width. Most of the larger mines are found in these zones.

In the early days, miners became aware of a general rule when prospecting for new silver deposits: "Without fahlband and calcite vein, no silver." Silver was always found at the intersections between calcite veins and fahlbands, not in every case, but never outside such intersections. This rule enabled miners to discover most silver deposits at Kongsberg by the 17th century.

In a few places the fahlbands were so sulfide-enriched that they could be economically mined for copper and cobalt. Occasionally massive sulfide lenses were found. The origin of the fahlbands has been debated. Kjerulf and Dahll (1861) and Bugge (1917) supported the notion that sulfide deposition was related to the Vinoren mafic intrusion, later to be influenced by regional metamorphism. Some hold to the opinion that the sulfides are volcanic exhalative sea floor products (Gammon, 1966; Starmer, 1977), while others believe that most of the disseminated sulfides have precipitated along fracture zones (Sverdrup *et al.*, 1967). It seems probable that the sulfide mineralizations in the area resulted from a combination of geological processes.

Veins and dikes

In the Precambrian area, dolerite dikes, quartz and calcite veins of Permian age were deposited along fractures and faults caused by the development of the Oslo Rift. The calcite veins are the youngest, while the quartz veins in most cases are younger than the dolerite dikes. The dolerite dikes have yielded K/Ar ages in the range 276–270 million years (Ihlen *et al.*, 1984).

Quartz veins containing galena, chalcopyrite and sphalerite were periodically mined between 1538 and 1908. Some quartz veins and quartz breccias contain large amounts of fluorite, and three deposits in Kongsberg were mined between 1870 and 1945. Other primary minerals reported from quartz veins are pyrite, pyrrhotite, calcite, stilbite, prehnite, "coal blende" (bitumen), silver and gold. Since 1975 many quartz crystals have been found by collectors in old mines and claims and in road cuts. Pockets up to 3 meters have been reported. Not uncommon are quartz samples showing the outline of ghost calcite and fluorite crystals.

According to Frøyland and Segalstad (1992) and Frøyland (1995), quartz in the Fiskum area (an eastern part of the Kongsberg ore district) was precipitated from hydrothermal solutions with a salinity of about 4 weight % NaCl-equivalents and temperatures around 200°C at an assumed pressure of about 300 bars (hydrostatic pressure at a depth of about 3 km). The solutions were in oxygen isotope equilibrium with the host rocks (according to δ^{18}O-isotope analyses). The veins contain fragments of graphite-bearing aluminous schists which must have fallen down the fissures from earlier overlaying Cambrian sediments. Quartz, pyrite, sphalerite, galena and calcite apparently crystallized as a result of decreasing temperatures, chalcopyrite by heating, pyrrhotite by decreasing ΣS and calcite by increasing pH (although at the end decreasing pH caused the dissolution of calcite). Based on oxygen and carbon isotope analyses of quartz and calcite, the authors proposed that the early quartz stage occurred in an open system, which closed when calcite started to crystallize. No significant regional gradient in temperature or salinity was found in the quartz veins across the Fiskum area.

The calcite veins measure from a fraction of a millimeter up to about 50 cm in width. Their extension horizontally and vertically ranges from a few meters up to 300 meters. The veins normally dip steeply. Most veins have an east-west strike and often occur in sets, but some veins have north-south orientation. In the King's mine area, ordinary veins have been interpreted as depositions along tension fissures formed between normal faults (Øyvik 1997). The larger veins occurring along the east-west faults have been named "rotten veins" (Bugge 1917), while larger north-south veins, which also occur along normal faults, were named "strike veins." These larger dislocation fissures may have been important transport channels for hydrothermal solutions and silver. The larger veins themselves are usually almost barren; but enrichments of silver have been found in their vicinity.

The veins usually have regular borders, and some brecciation is common. Sometimes there are small faults, which occasionally cause a short upswelling of the vein. In some places major brecciation has taken place. Cavities are fairly common, ranging from tiny up to over a meter in length. Larger cavities are usually narrow, and run parallel to the vein. Wallrock alteration is seen by the occurrence of chlorite or light mica, and sometimes by clay minerals.

Veins usually appear to be very simple fissure fillings of white calcite. A closer look, however, shows a long and complicated history of formation. Although calcite dominates, more than 60 primary minerals have been reported from the veins. Some veins are zoned, with quartz crystals showing a comb structure. These crystals formed on fissure walls before the precipitation of calcite and silver. Some veins have large amounts of barite, while others are almost exclusively filled by barite. Regionally, native silver, acanthite, pyrite, sphalerite, chalcopyrite, fluorite and "coal blende" are generally present. On a local scale, the relative amount of the minerals may vary considerably. In parts of a vein native silver may not be visible at all, while elsewhere large masses of silver may occur.

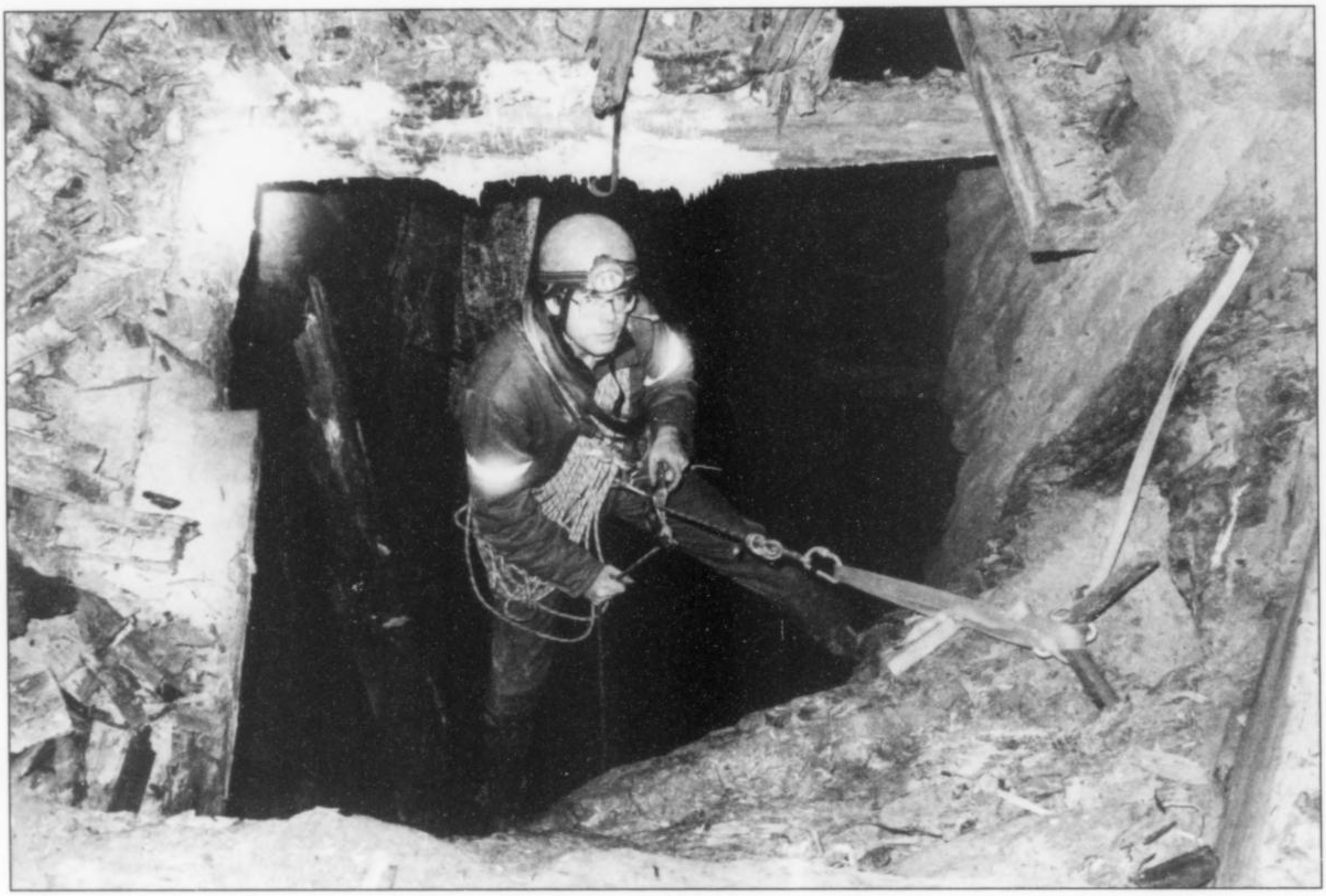


***Figure 15.* Museum curator Bjørn Ivar Berg entering the shaft of the Sachsen mine in 1996. Photo by Stig Flaata.**

Many minerals show several generations. Münster (1883) divided calcite crystallization into four stages according to crystal habits, while Johansen (1985) divided the hydrothermal precipitation into 12 major stages. He found indications of at least 16 calcite generations (calcite appearing within 10 of the stages). Other minerals present as more than one generation include native silver, argentite, pyrite, sphalerite, fluorite, and quartz.

Fluid inclusion data (Segalstad *et al.*, 1986) reveal at least three different heating and cooling cycles and associated changes in salinity. Filling temperatures during crystallization range between 200 and 300°C (pressure corrections applied assuming hydrostatic pressure of 350 bars at 3.5 km stratigraphic depth). Salinities range from 0 to 35 equivalent weight % NaCl. Native silver was generally deposited during the heating part of the cycles, from 250 to 300°C, associated with a decrease in salinity from about 27–22 to about 20–15 equivalent weight % NaCl.

Isotopic $\delta^{34}S$ values in barite correspond to sulfate in contemporary Permian sea water (12 per mil, CDT), while fahlband sulfur (0 per mil) is a likely source for the vein sulfides, showing corresponding equilibrium isotopic values (Segalstad *et al.*, 1986). $\delta^{13}C$ for vein "coal blende" (–30 to –28 per mil, PDB) point to Oslo Region shales (–29 to –22) as possible sources for the reduced carbon. Carbon isotopes in calcite show a large variation (–26 to –1) that excludes Oslo Region limestones (–10 to +3) as possible sources for the reduced carbon. Segalstad *et al.* (1986) concluded that chemical reactions between a saline solution poor in sulfur and rich in carbon, and pyrrhotite in the fahlbands at the temperature of minimum calcite solubility (slightly above 250°C), led to the deposition of native silver with coal blende.

Segalstad (1985, 1996) assumed that the silver and the carbon were derived from original overlying carbonaceous, sulfide-enriched and metal-enriched aluminous shales (black shales) of Cambrian age. He points out that the sub-Cambrian conglomerate may have worked as an aquifer or transport conduit for the hydrothermal fluids. The mineralizing fluid has at one time been in oxygen-isotope equilibrium with its surroundings (Segalstad *et al.*, 1986), and chloride ions have been the major transporting agent for the silver (Segalstad, personal communication, 1996).

In summary, silver deposits were formed by a combination of structural and chemical controls. Calcite veins were deposited along Permian fissures in Precambrian rocks, and native silver was precipitated at the intersections of fahlbands and fissures, when pyrrhotite in the bands reacted with the circulating, silver-bearing hydrothermal solutions at temperatures slightly above 250°C. Closing and reopening of the fissures may have been important for the repeated temperature and salinity cycling and the precipitation of minerals in stages. Water in the solutions was originally meteoric water or magmatic water which had attained equilibrium with its new surroundings. Heat from Oslo Rift magmas at depth may have caused the circulation of solutions (Segalstad, personal communication, 1996). Silver may have been leached from the overlying aluminous shales and transported by chloride ions in the hydrothermal solutions.

RECENT MINERAL COLLECTING

After the Kongsberg silver mines were closed in 1958 the mines and dumps were sporadically visited by collectors until the late 1960s, when Thore G. Pedersen and friends started a systematic

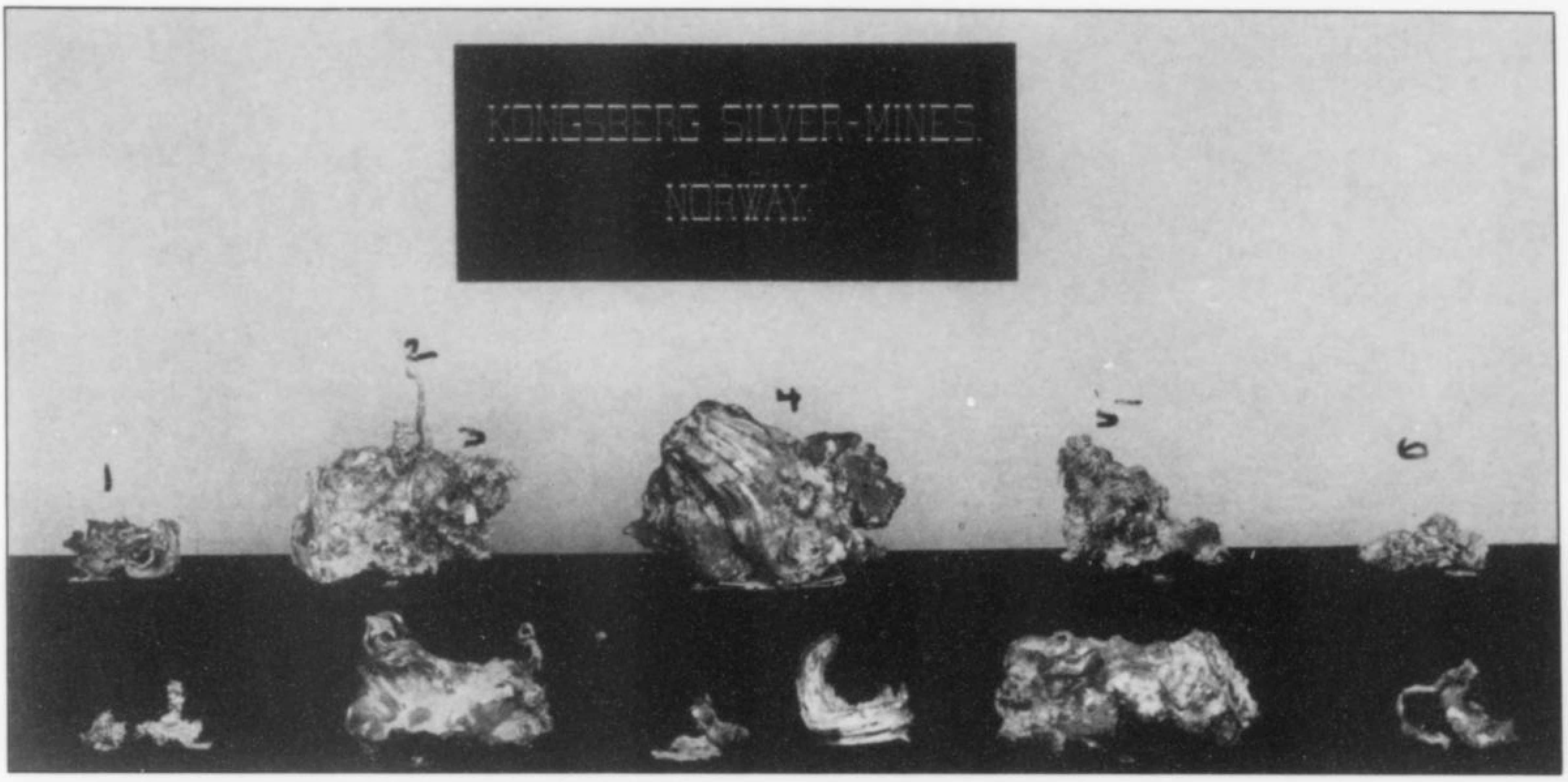


***Figure 16.* Some of the Kongsberg silver specimens discovered by Ragnvald Dusterud in the Mildigkeit Gottes mine in 1938, as displayed at the New York World's Fair of 1939. Photo: Norwegian Mining Museum, Kongsberg.**

search of the dumps on about 300 mines and prospects in the area. Then, in 1972, they began to investigate the main adit levels within the mines. These searches lasted for more than 20 years. They found many silver specimens, most of which are massive, but there are also numerous wire silvers. A few specimens show crystal faces. Since the late 1970's many collectors have hunted for silver treasures at Kongsberg.

An excellent collecting spot was found around the remains of the old sorting house just outside the entrance to the Fredriksstoll adit. In a day's work it was possible for a person to find up to 200 specimens containing silver, of which a half-dozen would show silver wires of good quality.

Dumps outside the Klausstollen adit and the nearby remnants of a crusher proved to be the richest collecting area of all Kongsberg surface tailings. Most specimens found show massive silver, but many came with tiny silver threads and small spearlike crystals, sometimes in fairly well developed herringbone and dendritic patterns. Many 1 to 2-cm wires were found, along with some measuring up to 10 cm. A few specimens with nice, sharp, 5-mm cubes were hammered out of an ore block at the roadside.

Thore Pedersen tells that on one Sunday his group found so many rocks containing silver in the Norske Løve mine that they had to spend every weekend for three months carrying the specimens out of the mine. After the abolition of the state-owned claims in the Kongsberg ore district in 1974, Thore Pedersen immediately staked the first private claim in the area, on the Norske Løve. Since 1979, Kjell Trengen and associates have held the claim on the Norske Løve mine, and have found a great deal of silver and other minerals. For some years Trengen was associated with Egil Olafsen and Arne Helge Slåtta (*World Wide Minerals*). World Wide minerals is now, however, working the Ringnesgangen, a neighboring mine, while Trengen is working the Norske Løve and has also claimed a second neighboring mine, the Juliane Marie. In 1997 both groups received Government approval to work their respective mines for mineral specimens.

In the 1980's more and more people started to use metal detectors, and this initiated a new collecting rush. Collectors found it easier to locate silver specimens, as well as old iron tools, especially chisels, drills and hammers, many dating from the 18th century.

The greatest collecting boom in Kongsberg started at the end of the 1980's, when Stig Flaata borrowed the silver company's annual internal reports from the museum library and located the exact positions of the great silver finds in 1938 and 1947. Eager to explore long-deserted underground workings for any remaining silver, Flaata and a few friends, using alpine ropes, lowered themselves down the abandoned Mildigkeit Gottes shaft. Almost immediately their efforts were rewarded. At the 124-meter level a substantial amount of silver embedded in loose rocks was discovered. Every effort was made to conceal their find, but when some small but choice silver wires hit the market, the secret was out.

By 1990, a mine-climbing boom was in full swing. In the neighboring town of Drammen, cheap cave climbing equipment was offered for sale, and climbing courses were given.

Flaata had claimed the Mildigkeit Gottes mine and locked the entrance, but he lived in a community more than 300 km away, and was only able to work in the mine now and then. In his absence, his locks were broken and people entered the mine. Several groups of highgraders were in operation. Some came from outside the collector milieu, attracted to the mines by adventure and excitement and the possibility of fast money. In the winter of 1991 Flaata broke his leg. The following spring was the busiest highgrading period ever in Kongsberg. Illegal entries were also occurring in the Gottes Hülfe in der Noth mine, claimed by the Soda company (Christer Solberg and Sjur Dagestad), and in the Mining Museum's King's mine. The problems with damaging, littering, and removal of archeological objects were enormous.

One of the richest finds was made by highgraders in the spring of 1991 in the Mildigkeit Gottes. Besides many other silvers, this group found one specimen of nearly pure silver weighing 3.4 kg. It is mostly massive, but includes a few nice wires. Rumors indicate

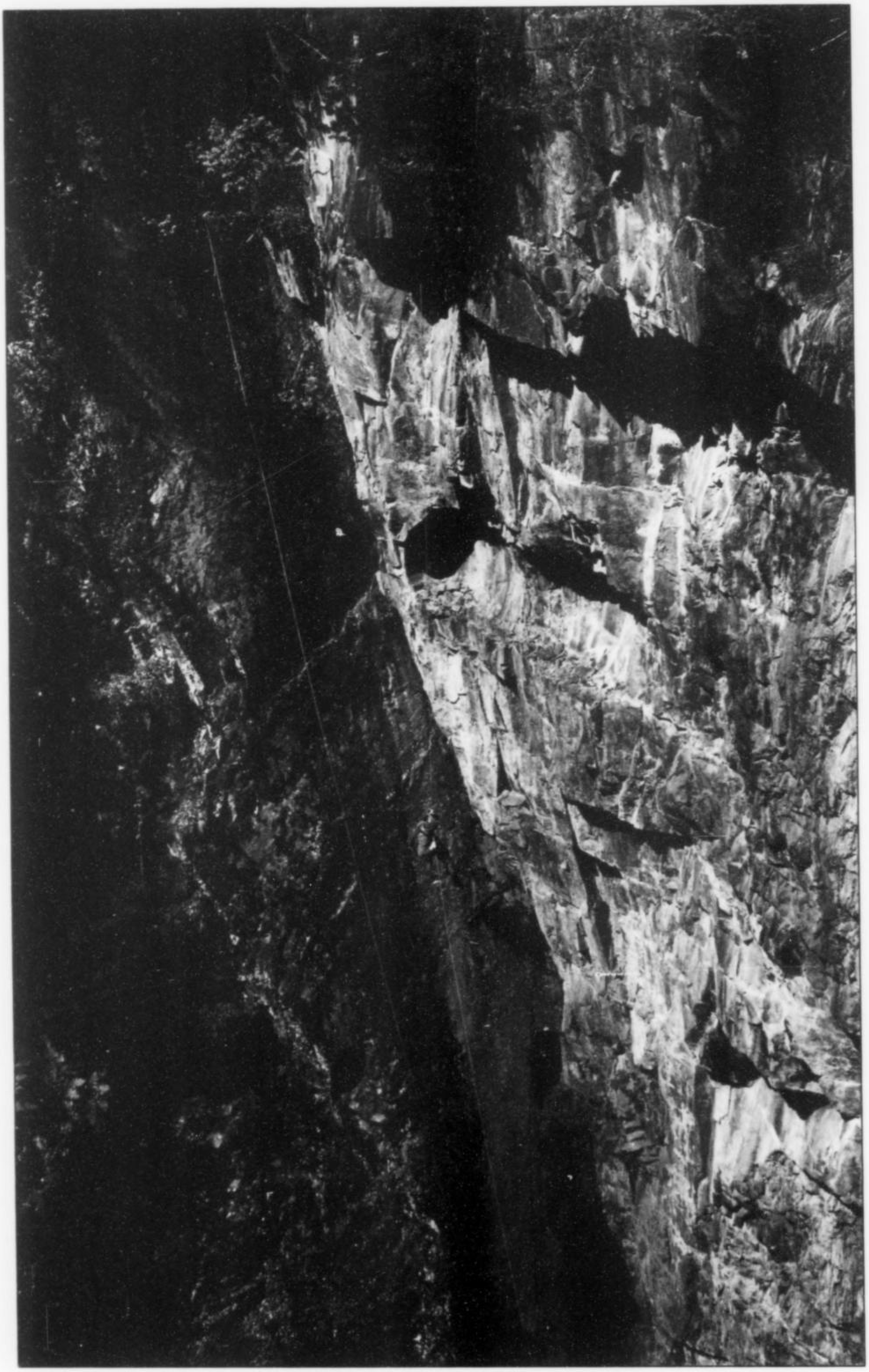


Figure 17. **Museum guide Stein-Arild Nordrum rappelling down the surface opening of the Samuel mine. Photo by Bjørn Ivar Berg.**

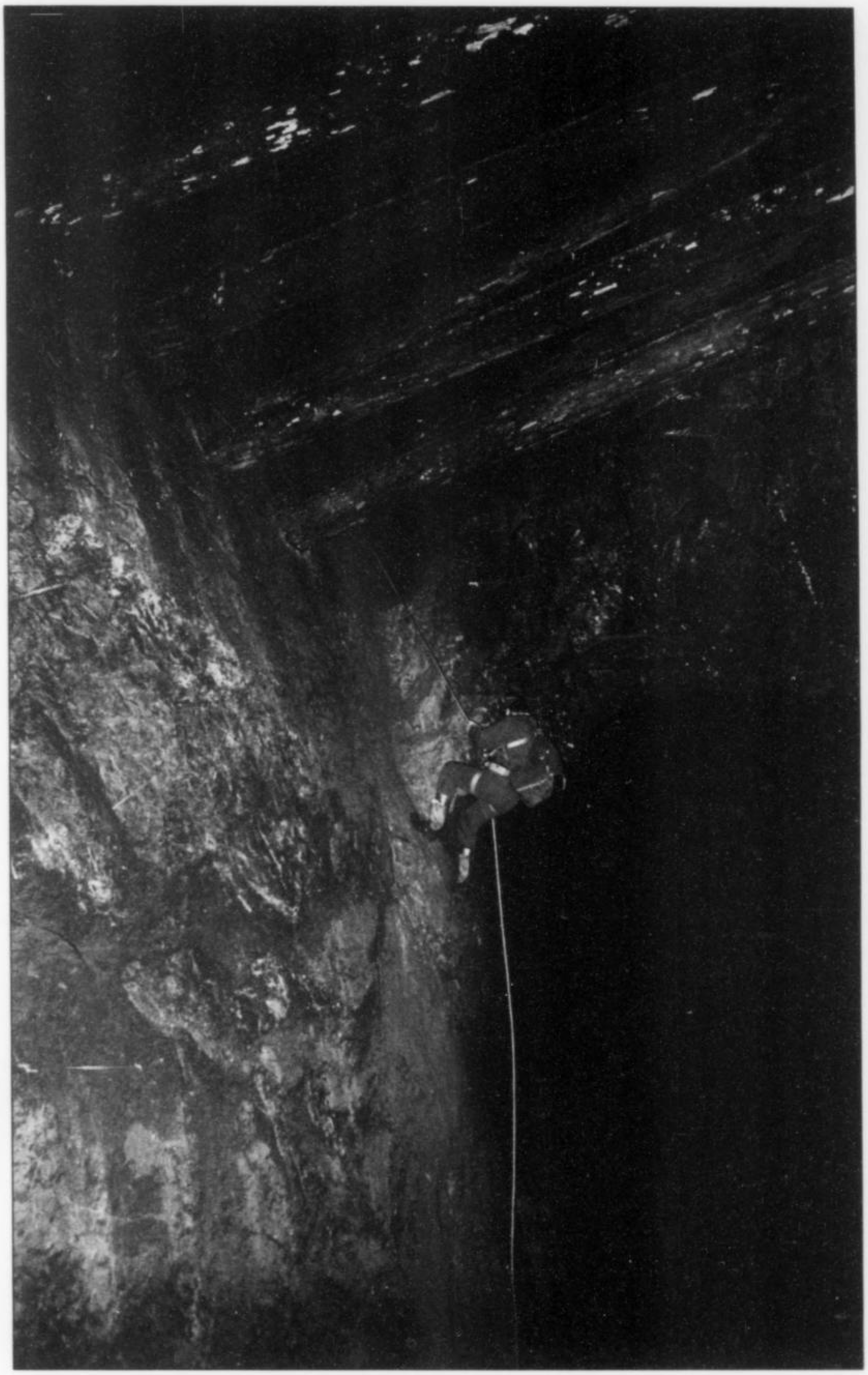


Figure 18. **Museum construction technician Roy Magne Dahlen rappelling down a rope in the King's mine, around the 300-meter level. Photo by Bjørn Ivar Berg.**

the big specimen was later sold to a Norwegian collector for about US $15,000. Museum records suggest this silver mass is the largest of recently discovered specimens.

Collectors have also found other interesting minerals, on waste dumps and in recently discovered pockets underground. One unusual discovery, however, took place in a small gallery used as a storage room on the main level of the Gottes Hülfe mine. Here in the 1970's collectors found several boxes containing crystals of gangue minerals, including calcite, quartz, epidote, axinite, apophyllite and laumontite. Miners had apparently left them there years before. Silver had also been stored in the room, as evidenced by the many silver specimens in the floor gravel.

The central mining area of Kongsberg is the most important historical mining complex in Norway. On June 15, 1992 a national cultural heritage monument, protected by law, was established in this area. From then on, unauthorized work in the mines on tailings of the monument area was strictly prohibited. However, the Norske Løve, Ringnesgangen and many other mines and prospects lie outside the central area, and at present there are no plans for legal protection of these mines. The Government's effort to safeguard Kongsberg's cultural monuments is, so far, the largest ever in Norway. This program aims to secure all remnants of the Kongsberg mines and claims within a 30-square-kilometer area.

RECENTLY COLLECTED MINERALS

Silver Ag

A large number of massive silver specimens and several hundred wires, though mostly small, have been found in Kongsberg mines and dumps since their closure in 1958. In addition to the 3.4-kg silver specimen already mentioned, other specimens of coarse wire silver weighing 2 kg and 1 kg have been found. The longest wire recently discovered is about 24 cm (9.5 inches!) long. Some specimens with small, sharp-edged crystals of regular form have also appeared.

In the Southern Vinoren area, newly mined silver specimens have appeared as masses of tiny threads and small spear-like crystals up to 5 cm long and up to 2 mm thick. Some samples have developed into more or less well-crystallized herringbone structures and irregular dendritic forms. Also ball-shaped silver nodules up to a few millimeters have been found; in some areas they reach a diameter of more than 5 cm. The silvers at Vinoren are mostly found within massive calcite and sometimes barite. When leached out by acid, the silver is recovered relatively undamaged.

In calcite veins, silver is commonly associated with fluorite, "coal blende," pyrite, sphalerite and argentite. Small crystals of argentite, pyrite, chalcopyrite, fluorite and fluorapophyllite have been found on wire silver, and crystals of sphalerite up to 1.5 cm, fluorite up to 5 mm, arsenopyrite up to 3 mm, and galena up to 2 mm have been found on spearshaped silver crystals in the southern Vinoren area.

Other crystallized minerals

Acanthite (argentite) Ag_2S

Most primary silver disulfide at Kongsberg crystallized as argentite (argentite inverts to acanthite below 173°C, but keeps its external morphology). Recently found acanthite commonly occurs as massive or poorly developed crystals, and frequently as a gray-black coating on silver. Some well-developed crystals up to 5 mm have been found in the Norske Løve mine, up to 1 cm in the Ringnesgangen, and up to 1.5 cm in the Mildigkeit Gottes mines. Somewhat rounded crystals up to about 1 cm have been found on silver in the Gottes Hülfe in der Noth mine. Secondary acanthite is frequently found as a coating on the surface of silver-bearing calcite veins in the mine galleries.

Anatase TiO_2

Red and orange anatase microcrystals are reported from Knutehåvet, King's mine, and from Christiansstoll.

Anglesite $PbSO_4$

Anglesite has been found as microcrystals in small vugs in galena-bearing quartz veins in Gamlegrendsåsen.

Ankerite $Ca(Fe^{2+},Mg,Mn)(CO_3)_2$

Brown, rhombohedral ankerite crystals up to 4 mm are found in the King's mine.

Table 1. **Minerals reported from Kongsberg**

Elements

- Amalgam
- Arsenic
- Copper
- Electrum
- Graphite
- Silver
- Sulfur*

Sulfides, Selenides, Arsenides, and Sulfosalts

- Acanthite
- Argentopentlandite*
- Arsenopyrite
- Chalcocite
- Chalcopyrite
- Clausthalite
- Cobaltite
- Covellite*
- Dyscrasite
- Galena
- Jalpaite
- Löllingite*
- Marcasite
- Naumannite
- Nickeline
- Nickel-skutterudite
- Pearceite
- Polybasite
- Proustite
- Pyrargyrite
- Pyrite
- Pyrrhotite
- Rammelsbergite
- Safflorite
- Skutterudite
- Sphalerite
- Stephanite
- Sternbergite
- Tennantite
- Tetrahedrite

Chlorides, Fluorides

- Chlorargyrite
- Fluorite

Oxides, Hydroxides

- Anatase
- Gahnite*
- Goethite*
- Hematite*
- Ilmenite
- Magnetite
- Portlandite*
- Rutile*

Carbonates

- Ankerite*
- Aragonite*
- Calcite
- Cerussite*
- Dolomite*
- Hydrozincite*
- Malachite
- Parisite*
- Rapidcreekite*
- Siderite*
- Synchisite

Silicates

- Actinolite
- Albite
- Almandine
- Antigorite*
- Anthophyllite
- Armenite
- Brewsterite*
- Chamosite
- Chlorite (group)
- Clinozoisite*
- Datolite
- Epidote
- Ferro-axinite
- Fluorapophyllite
- Gadolinite*
- Harmotome
- Hedenbergite
- Heulandite*
- Hornblende*
- Hyalophane
- Illite*
- Kaolinite*
- Laumontite
- Microcline*
- Montmorillonite
- Muscovite*
- Natrolite
- Nontronite*
- Orthochrysotile*
- Orthoclase
- Palygorskite
- Prehnite
- Quartz
- Scolecite*
- Sepiolite
- Stevensite*
- Stilpnomelane
- Tremolite

Arsenates

- Annabergite*
- Erythrite

Sulfates

- Anglesite*
- Barite
- Bronchantite*
- Devilline*
- Gypsum*
- Langite*
- Mirabilite*
- Natrojarosite*
- Posnjakite*

Tungstates

- Scheelite*

Hydrocarbons

- Bitumen

*Minerals added to the list published by Johnsen (1986).

Armenite $BaCa_2Al_6Si_9O_{30}\cdot 2H_2O$

In 1939 Neumann published the first description of the barium mineral armenite, found in one specimen in the collection of the Mineralogical-Geological Museum in Oslo. The specimen was collected in the Armen silver mine in Kongsberg in 1877. It remained the only find of armenite from Kongsberg until May, 1998, when collectors Harald Kristiansen and Per Nærbø found the mineral in solid rock inside a tunnel in the Bratteskjerpet mine. White, pseudohexagonal, prismatic crystals up to 1.6 cm long and 4 mm in width occurred in small pockets together with microcrystals of epidote and axinite, at the border between a barite-dominated and a calcite-dominated vein. Quartz, amphibole, prehnite, galena, sphalerite, pyrite, and chalcopyrite were also present.

Arsenopyrite $FeAsS$

Bright arsenopyrite crystals, usually less than 1 mm in length but occasionally up to 5 mm, have been found in the Ringnesgangen and Norske Løve mines. Radiating, elongated crystals up to 1 cm were recently discovered in the Ringnesgangen mine. In both mines the arsenopyrite is associated with silver. Crystals up to 6 mm have been reported from the Liverud sulfide prospect. Arsenopyrite from the silver deposits was last reported in 1865.

Barite $BaSO_4$

Crystals up to 4 cm (white to light yellow) were found in one pocket in Gottes Hülfe in der Noth mine. Beyond that, barite has only appeared as well developed microcrystals. The amount of massive barite is, however, very large.

Brewsterite-Sr $(Sr,Ba)_2[Al_4Si_{12}O_{32}]\cdot 10H_2O$

A large number of microcrystals of brewsterite were found in a prospect of the Southern Vinoren area in 1994. The first crystals were discovered by Harald Kristiansen. Considering the abundance of barium at Kongsberg, these crystals may well be the new species *brewsterite-Ba*; analyses are pending.

Calcite $CaCO_3$

Crystals of calcite up to 4 cm are common, and crystals up to 10 cm have been found. Crystals are usually dominated by the pinacoid, the hexagonal prism or the rhombohedron.

Cerussite $PbCO_3$

Microcrystals of cerussite have been found in small vugs in galena-bearing quartz veins in the Gamlegrendsåsen mine.

Chalcopyrite $(Cu,Fe)S_2$

Chalcopyrite crystals, often twinned and up to 8 mm in size, have been found in the Norske Løve mine, and rounded crystals (with a bluish tarnish) up to 1.5 cm in the Mildigkeit Gottes mine.

Dolomite $Ca,Mg\ (CO_3)_2$

Rhombohedral crystals of white dolomite up to 4 mm have been found in the King's mine.

Epidote $Ca_2(Fe^{3+},Al)_3(SiO_4)_3(OH)$

Epidote has been found in the Samuel, Gottes Hülfe and Bratteskjerpet mines in crystals up to 1.2 cm, mostly in plates of crystals or as fan shaped crystals.

Ferro-axinite $Ca_2Fe^{2+}Al_2BSi_4O_{15}(OH)$

Ferro-axinite crystals up to 4 mm have been found in the Mildigkeit Gottes, Gottes Hülfe, Samuel, Bratteskjerpet, Dildok, and Knutehåvet mines.

Fluorapophyllite $KCa_4Si_8O_{20}(F,OH)\cdot 8H_2O$

White crystals up to 5 cm and waterclear microcrystals, including some V-twins, have been found in the Samuel mine, and two generations with crystals up to 0.5 cm (colorless and pink) have appeared in the Norske Løve mine. Also, colorless microcrystals occur in Gottes Hülfe in der Noth mine.

Fluorite CaF_2

Fluorite crystals are quite frequently found, mostly as octahedrons and cuboctahedrons. In the Norske Løve mine the crystals usually appear from microsize to 5 mm. In the Gottes Hülfe in der Noth mine fluorite has been found as sharp crystals up to 2 cm and irregularly shaped crystals up to 4.5 cm. Small crystals have also appeared in the Mildigkeit, Samuel and Krags mines. The most common colors are violet and pale green. White, ball-shaped fluorite, in spheroids up to 4 mm, has been found on quartz crystals in the Mildigkeit Gottes mine.

Gypsum $CaSO_4\cdot 2H_2O$

Crystals of gypsum are common, but rarely exceed 1 cm.

Harmotome $(Ba_{0.5},Ca_{0.5},K,Na)_5[Al_5Si_{11}O_{32}]\cdot 12H_2O$

A large number of harmotome crystals from microscopic size up to 1 cm have been found, especially from the northern Vinoren area, and also from the southern Vinoren area, in the Gottes Hülfe in der Noth, Mildigkeit Gottes and Kjennerud mines. Most crystals are colorless or white, but at northern Vinoren they may be yellow, brownish or reddish brown.

Heulandite $(Na,K,Ca,Sr,Ba)_5(Al_9Si_{27})O_{72}\cdot 26H_2O$

Heulandite has been found on the waste dumps outside the Bratteskjerpet, Anne Sophie and Klausstollen mines and in the Fiskeløs prospects in crystals up to 5 mm.

Laumontite $Ca_4[Al_8Si_{16}O_{48}]\cdot 18H_2O$

Laumontite has been found in crystals up to 1 cm at the Mildigkeit Gottes, Gottes Hülfe in der Noth and Kronprins Frederik mines.

Mirabilite $Na_2SO_4\cdot 10H_2O$

White, hairy threads of mirabilite seem to be common within some mines, but when the mineral is taken out of the mine it rapidly transforms to thenardite (A. O. Larsen, personal communication, 1982).

Orthoclase $KAlSi_3O_8$

Colorless adularia crystals up to 4 mm have been found in Gottes Hülfe in der Noth mine.

Parisite-(Ce) $Ca(Ce,La)_2(CO_3)_3F_2$

A specimen labeled parisite from Kongsberg is at the British Museum (Neumann 1985).

Polybasite $(Ag,Cu)_{16}Sb_2S_{11}$

Microcrystals of polybasite have been identified on an old specimen (M. N. Feinglos, personal communication, 1993), and a 1-cm plate of polybasite has been found in the Mildigkeit Gottes mine.

Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$

Pale green prehnite rosettes up to 4 cm in diameter have been found in the Samuel mine, while layers have been found at Kjennerudvann mine and platy, single microcrystals outside the Klausstollen adit. It is also reported from the Bratteskjerpet and Dildok mines.

Pyrargyrite Ag_3SbS_3

Microcrystals of pyrargyrite are reported from the King's mine and the Ringnesgangen mine. Massive pyrargyrite up to a few centimeters has been found in the Mildigkeit Gottes mine.

Figure 19. **Armenite crystal, 1 cm, on matrix, found in 1998 in the Bratteskjerpet mine. Collection of Sigmund Aasly; photo by Frode Andersen.**

Figure 20. **Acanthite and calcite crystals, 2.5 cm, from Kongsberg. Collection of the Norwegian Mining Museum, Kongsberg; photo by Rainer Bode.**

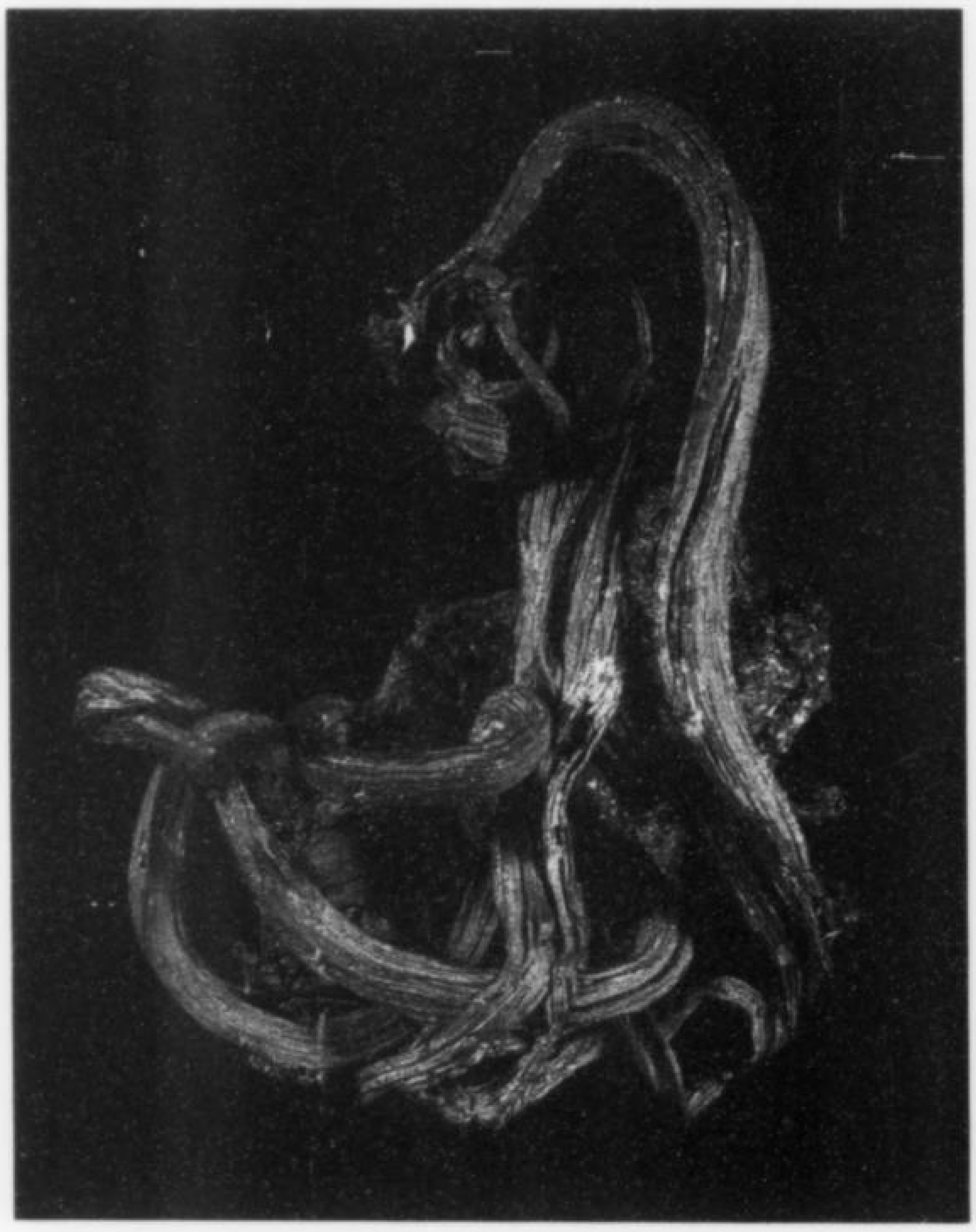


Figure 21. **Acanthite-coated silver, 15 cm, from Kongsberg. Collection of the Norwegian Mining Museum, Kongsberg; photo by Peter Bancroft.**

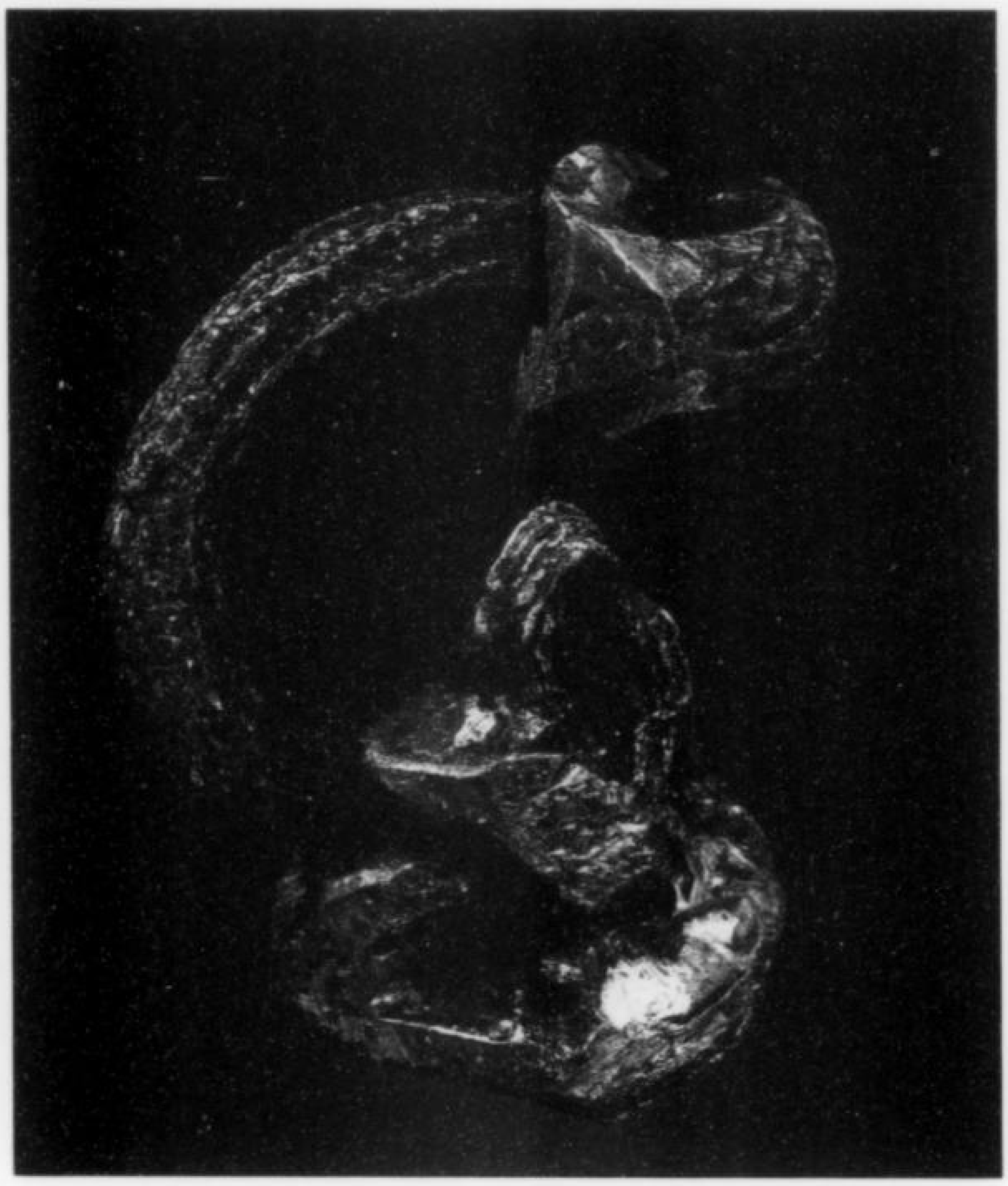


Figure 22. **Wire silver with acanthite, 2.7 cm, from Kongsberg. Collection of Ron Pellar; photo by Jeff Scovil.**

Pyrite FeS_2

Fine pyrite crystals have been found in the Gottes Hülfe in der Noth, the Mildigkeit Gottes and the Samuel mines. The pyritohedron is the common form. In the Gottes Hülfe mine this shape dominates but other forms are also present. Some crystals, with diameters up to 4 cm, show 48 faces.

Quartz SiO_2

Quartz crystals up to 5 cm are common. A few phantoms have been found, visible because of inclusions of "coal blende" in the inner crystal.

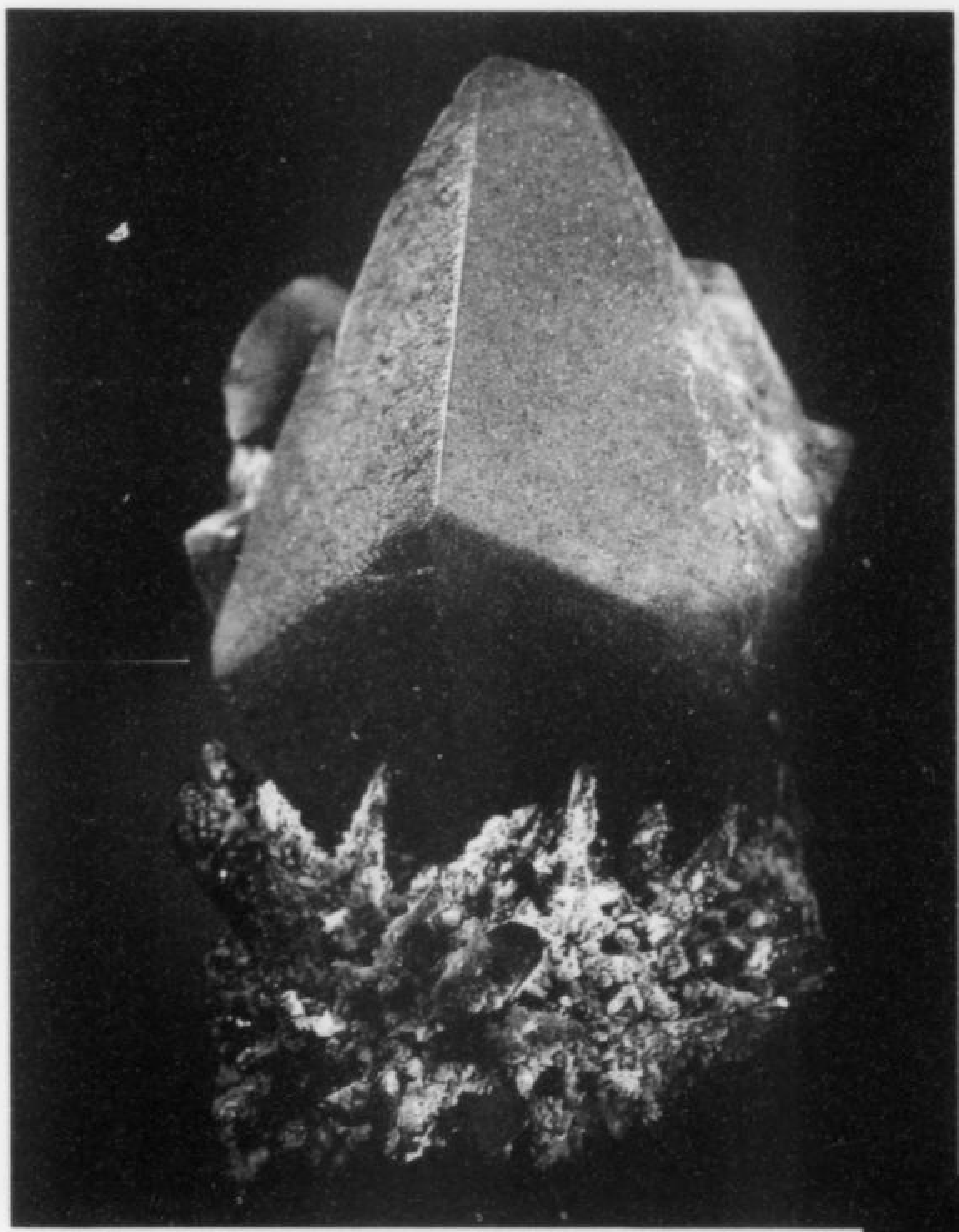


Figure 23. **Calcite scalenohedron, 5 cm, from Kongsberg. Collection of the Natural History Museum, Vienna; photo by Rainer Bode.**

Figure 24. **Fluorite crystal, 2 cm, on silver, from Kongsberg. Collection of the Natural History Museum, Vienna; photo by Rainer Bode.**

Figure 25. **Ferro-axinite crystals to 1 cm, with small fluorapophyllite crystals, from Kongsberg. Collection of the Swedish Museum of Natural History, Stockholm; photo by Peter Lyckberg.**

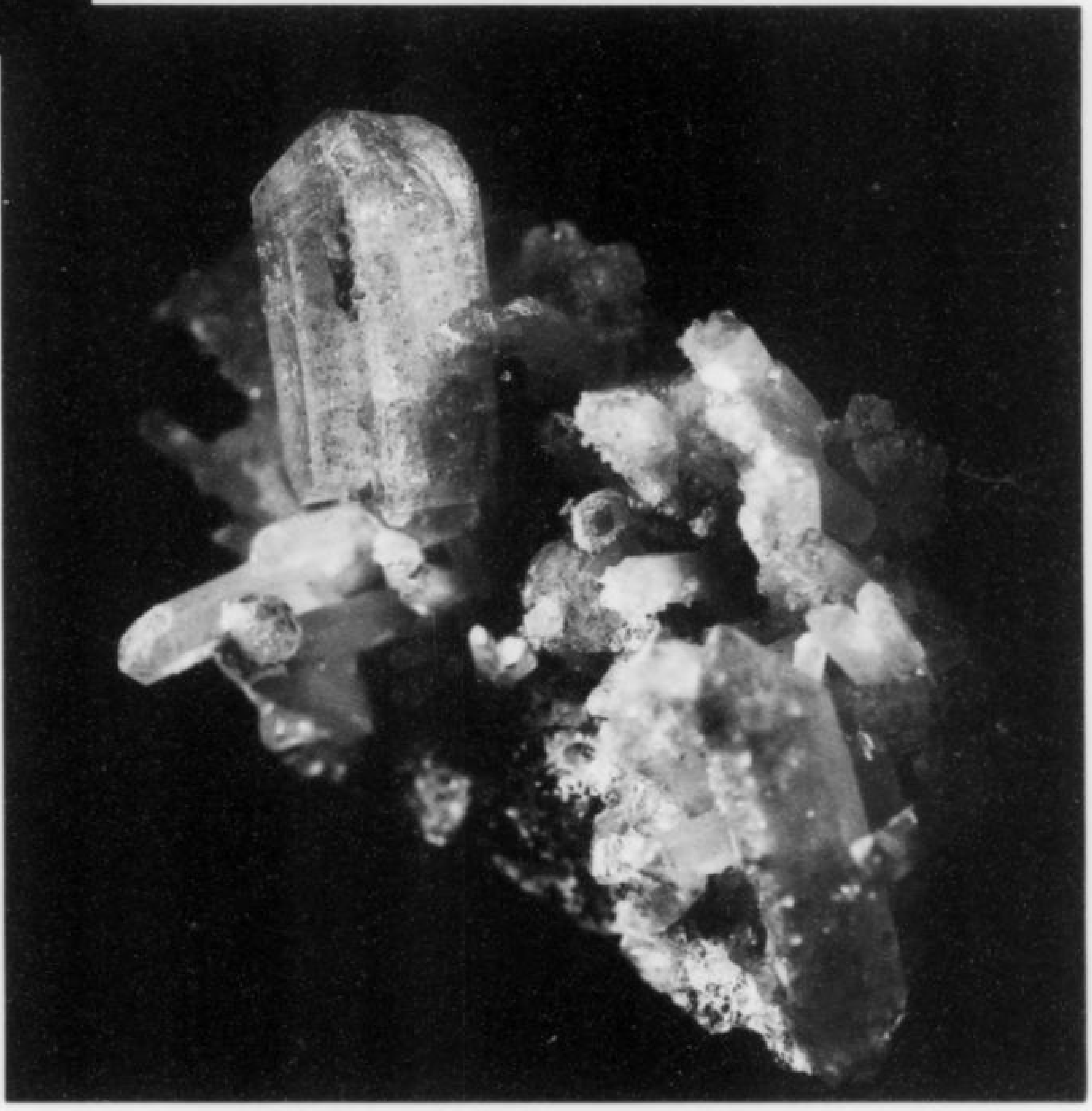


Figure 26. **Twinned harmotome crystal, 8 mm, on quartz, found recently in the northern Vinoren area. Collection of Egil Olafsen; photo by Rainer Bode.**

Rapidcreekite $Ca_2(SO_4)(CO_3)\cdot 4H_2O$

Microcrystals of rapidcreekite have been identified on two specimens (Raade and Sæbø, personal communication, 1990). This may be the first occurrence of the species outside of the type locality, Rapid Creek, Yukon Territory, Canada.

Rutile TiO_2

Microcrystals of rutile have been found in a small, feldspar-rich cavity in the Barlinddalen mine.

Scolecite $Ca[Al_2Si_3O_{10}]\cdot 3H_2O$

Fan-shaped scolecite crystals up to 2 cm have been found on

***Figure 27.* Pyrrhotite crystals, 6 mm, coated by silver from the Gottes Hülfe in der Noth mine. Collection of the Geological Museum, Copenhagen; photo by Rainer Bode.**

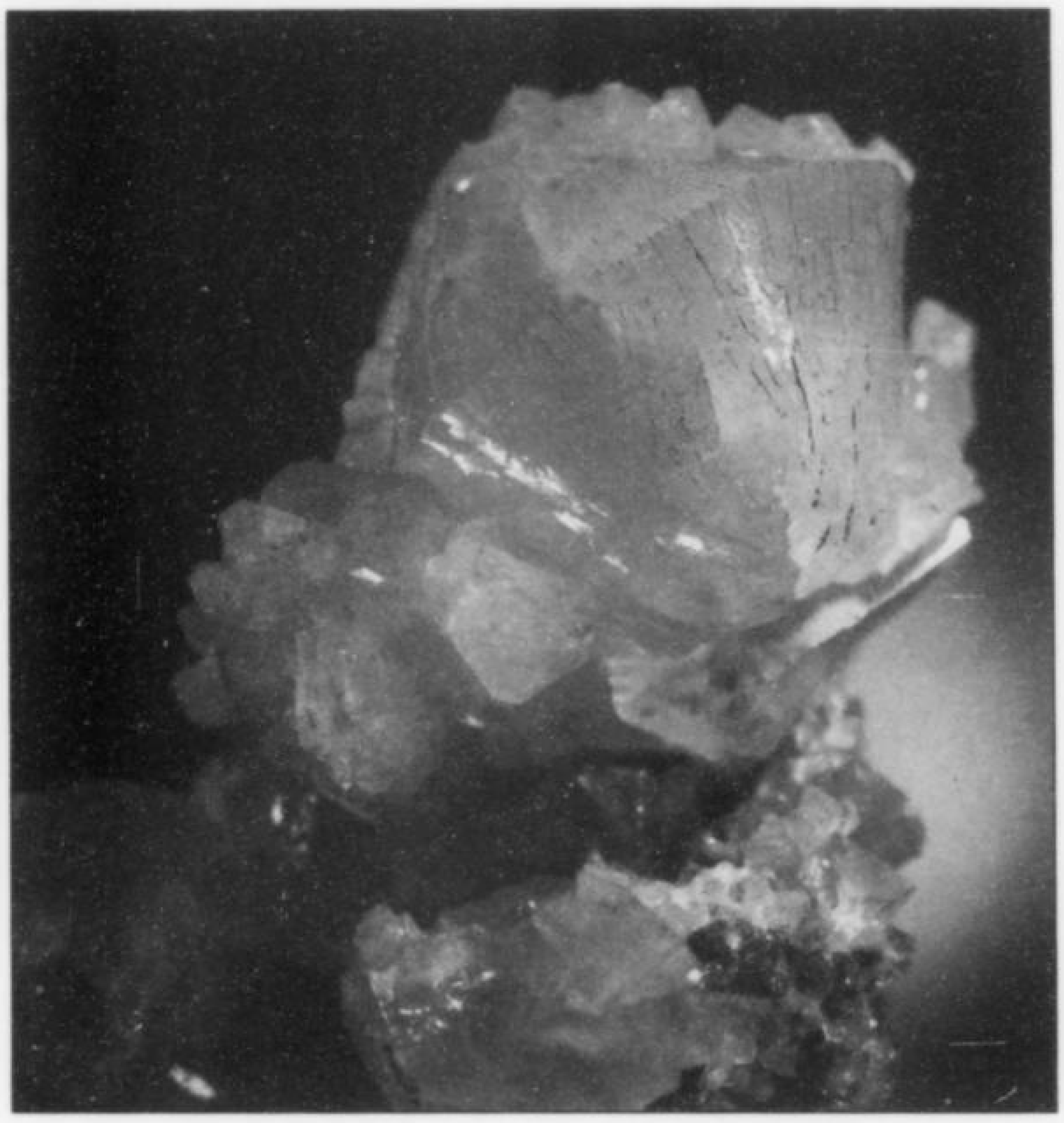


***Figure 28.* Prehnite, 3 cm, with small fluorapophyllite crystals, from Kongsberg. Gift to the Mineralogical-Geological Museum in Oslo from mine inspector Carl Anton Paaske in 1894; photo by Rainer Bode.**

***Figure 29.* Quartz crystals, 2 cm, with inclusions of bitumen ("coal blende") and calcite, found recently in the Gottes Hülfe in der Noth mine. Collection of the Norwegian Mining Museum, Kongsberg; photo by Peter Lyckberg.**

the dumps outside the Fredriksstoll adit. Crystals with good terminations are very rare.

Siderite $FeCO_3$

Reddish brown microcrystals of siderite have been reported from a prospect in the Gamlegrendåsen area.

Sphalerite (Zn,Fe)S

Although a very common mineral at Kongsberg, few good crystals of sphalerite have been reported. Perhaps this is because in most pockets, sphalerite is covered by calcite, and crystals therefore have to be etched out to be seen. A large pocket with sphalerite as tetrahedron crystals up to 1.2 cm was discovered in the Gotte Hülfe mine. Crystals up to 1.5 cm on spear-shaped silver have been found in the Norske Løve mine.

Stilbite-Na $(Na,Ca_{0.5},K)_9[Al_9Si_{27}O_{72}]\cdot 28H_2O$

White stilbite crystals up to 2 cm have been found in a number of quartz vein occurrences on the east side of the valley. Many crystals from the Fiskeløs prospects have microcrystals of heulandite on their principal faces. Neumann (1944) states that all "stilbites" so far reported actually are stellerite, but this has not been confirmed.

Synchysite $Ca(Ce,Nd,Y,La?)(CO_3)_2F$

Synchysite was reported together with anatase from Christiansstoll by Sæbø and Neumann (1961).

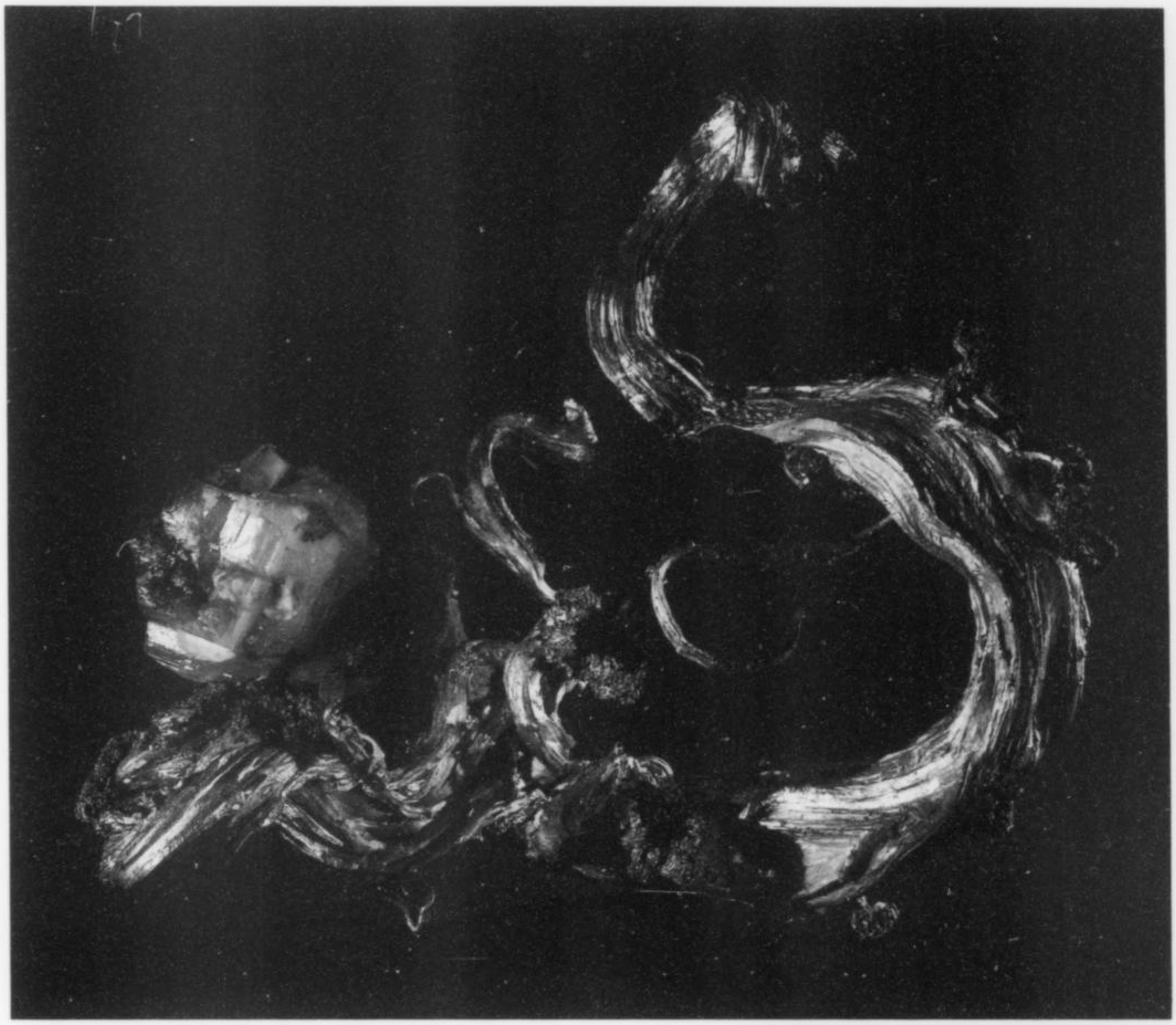
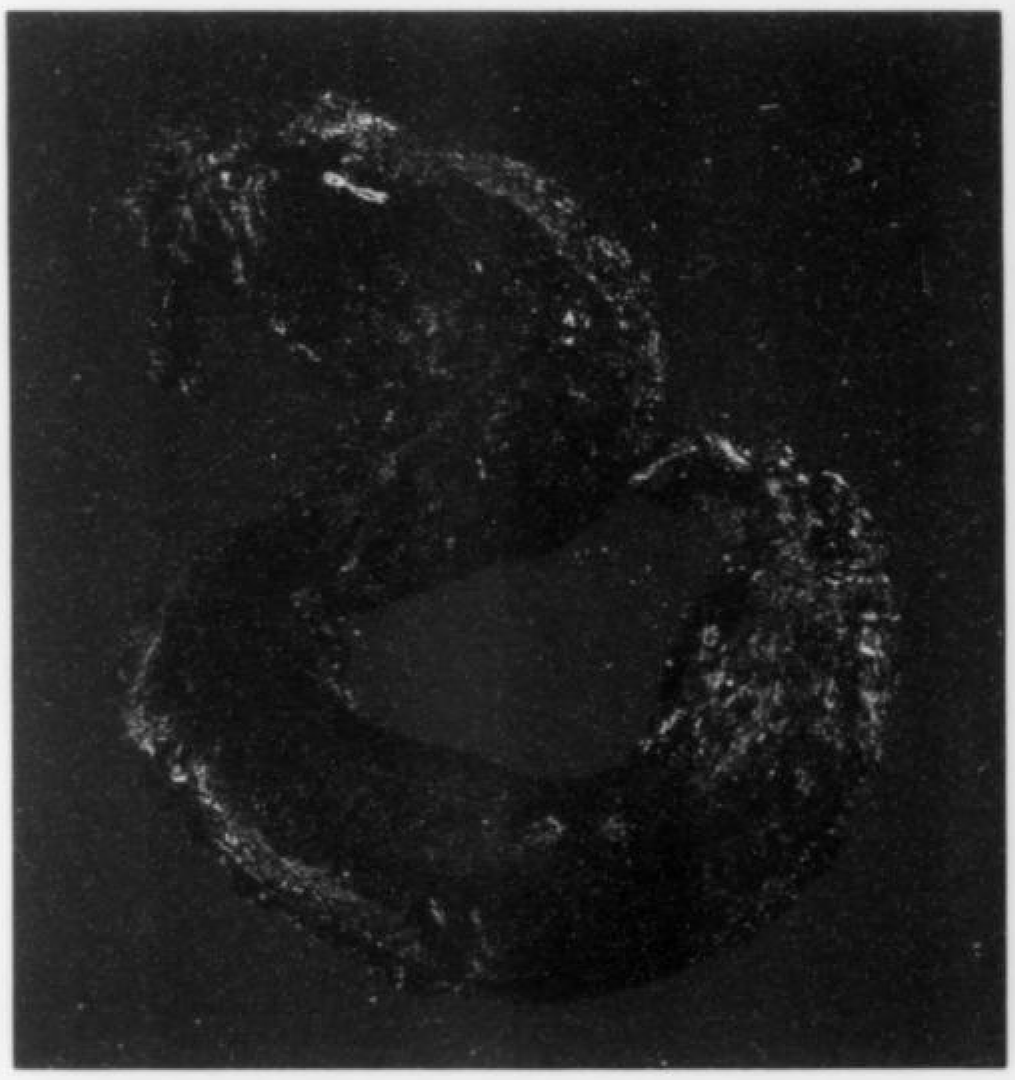


Figure 30. Silver with calcite, 11 cm, from the King's mine. Formerly in the Peter Bancroft collection; photo by Harold and Erica Van Pelt.

Figure 31. Wire silver, 6 cm, covered by acanthite and calcite microcrystals, from the King's mine. Collection of the Norwegian Mining Museum, Kongsberg; photo by Tor Aas-Haug.

Figure 32. Wire silver, 7.5 cm, coated by acanthite, pyrite, chalcopyrite, and sphalerite; found in 1988 at the Mildigkeit Gottes mine by Stig Flaata. F. John Barlow collection; photo by Tor Aas-Haug.



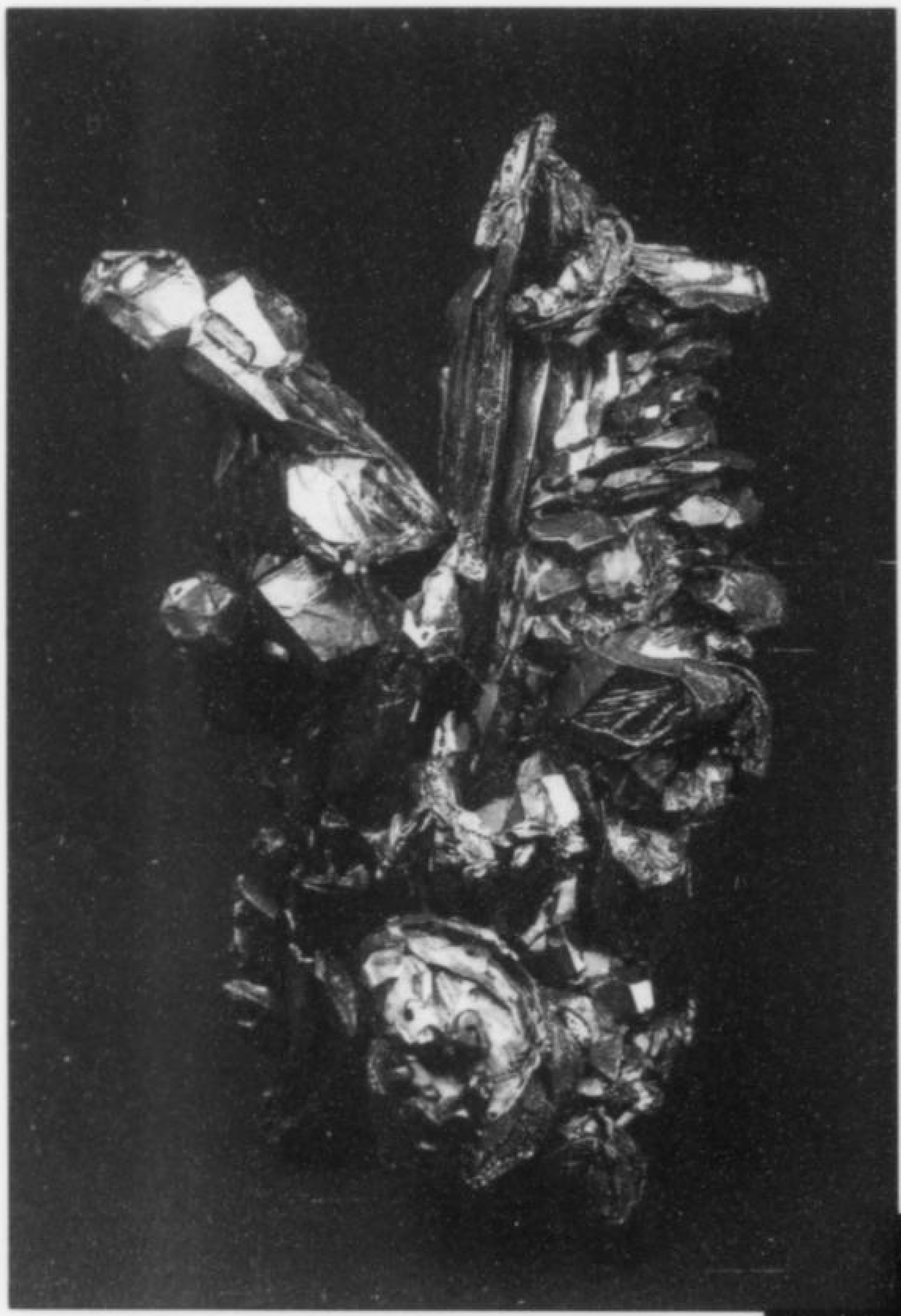


Figure 33. Arborescent silver on calcite, 2 cm, found recently in the Ringnesgangen mine by Egil Olafsen. Collection of Stein-Arild Nordrum; photo by Rainer Bode.

Figure 34. Silver crystals, 4 cm, from Kongsberg. Collection of the Swedish Museum of Natural History, Stockholm; photo by Peter Lyckberg.

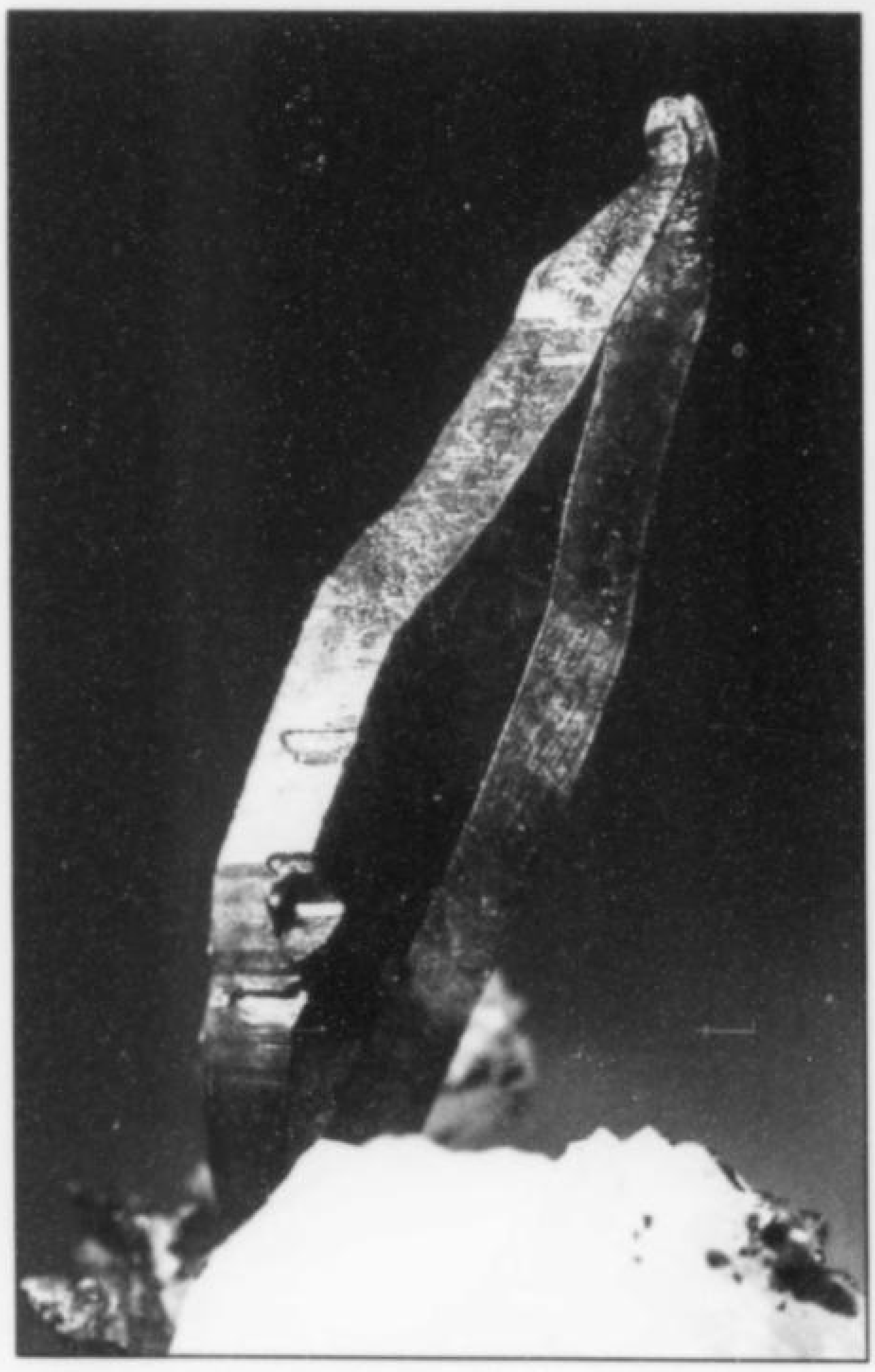


Figure 35. Spear-shaped silver crystal, 2 cm, on calcite, from Kongsberg. Collection of the Norwegian Mining Museum, Kongsberg; photo by Rainer Bode.

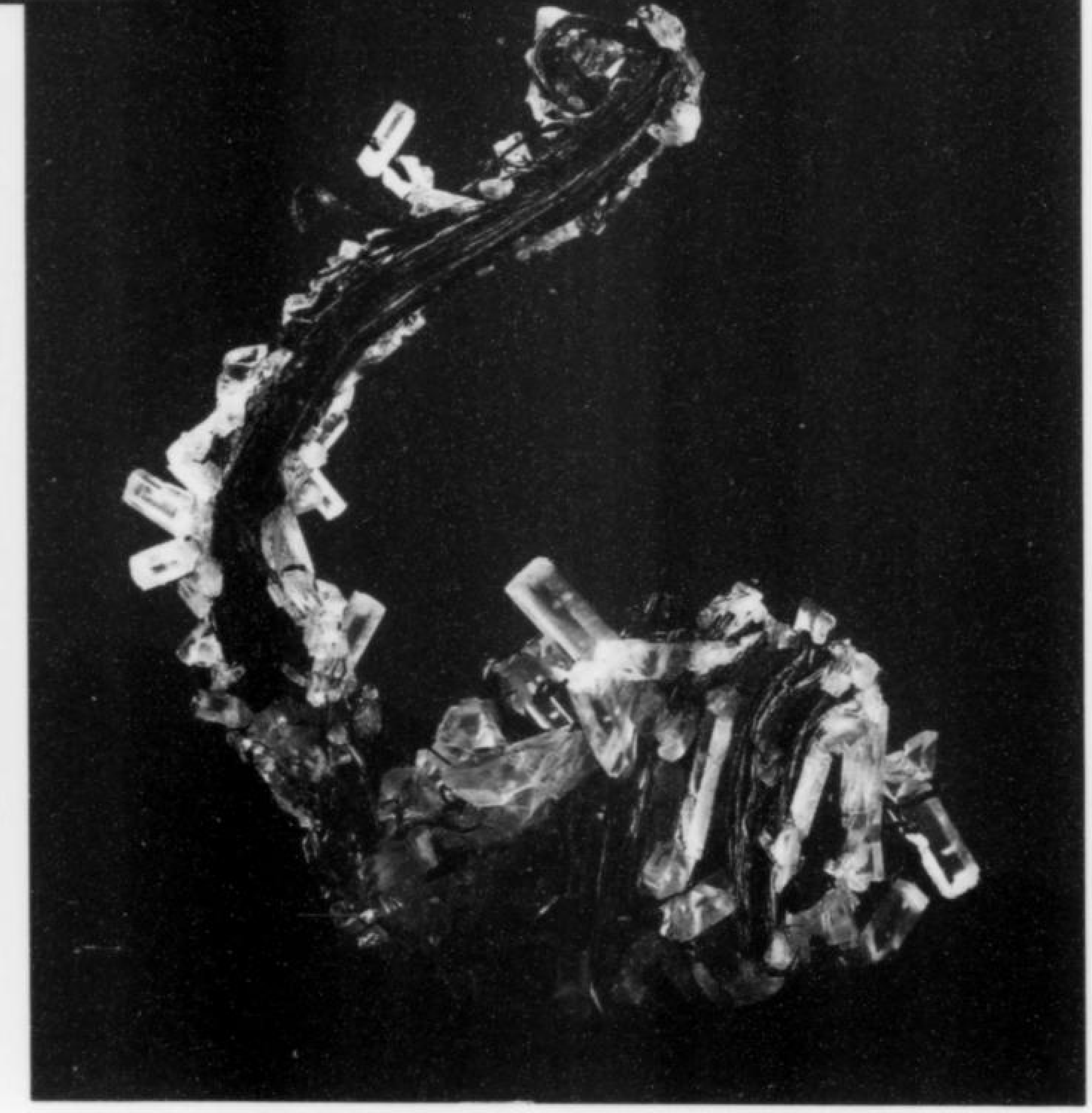


Figure 36. Calcite crystals on wire silver, 6.5 cm, from Kongsberg. Collection of the Norwegian Mining Museum, Kongsberg; photo by Tor Aas-Haug.

Figure 37. A natural wire silver, 4 cm, said to bear a resemblance to the Madonna and Child. Collection of the Kristallmuseum Riedenberg, Bavaria; photo by Konrad Götz.

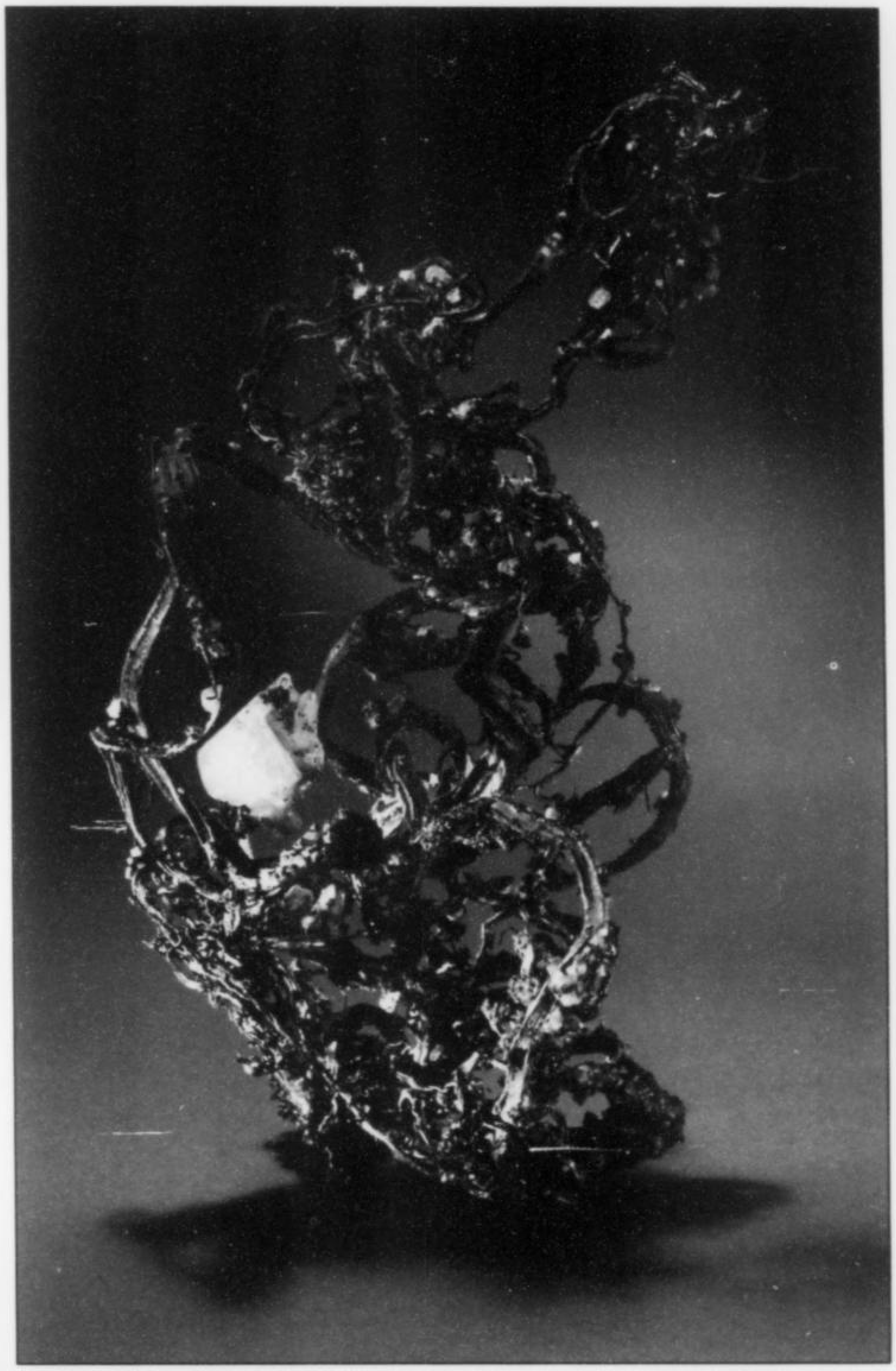
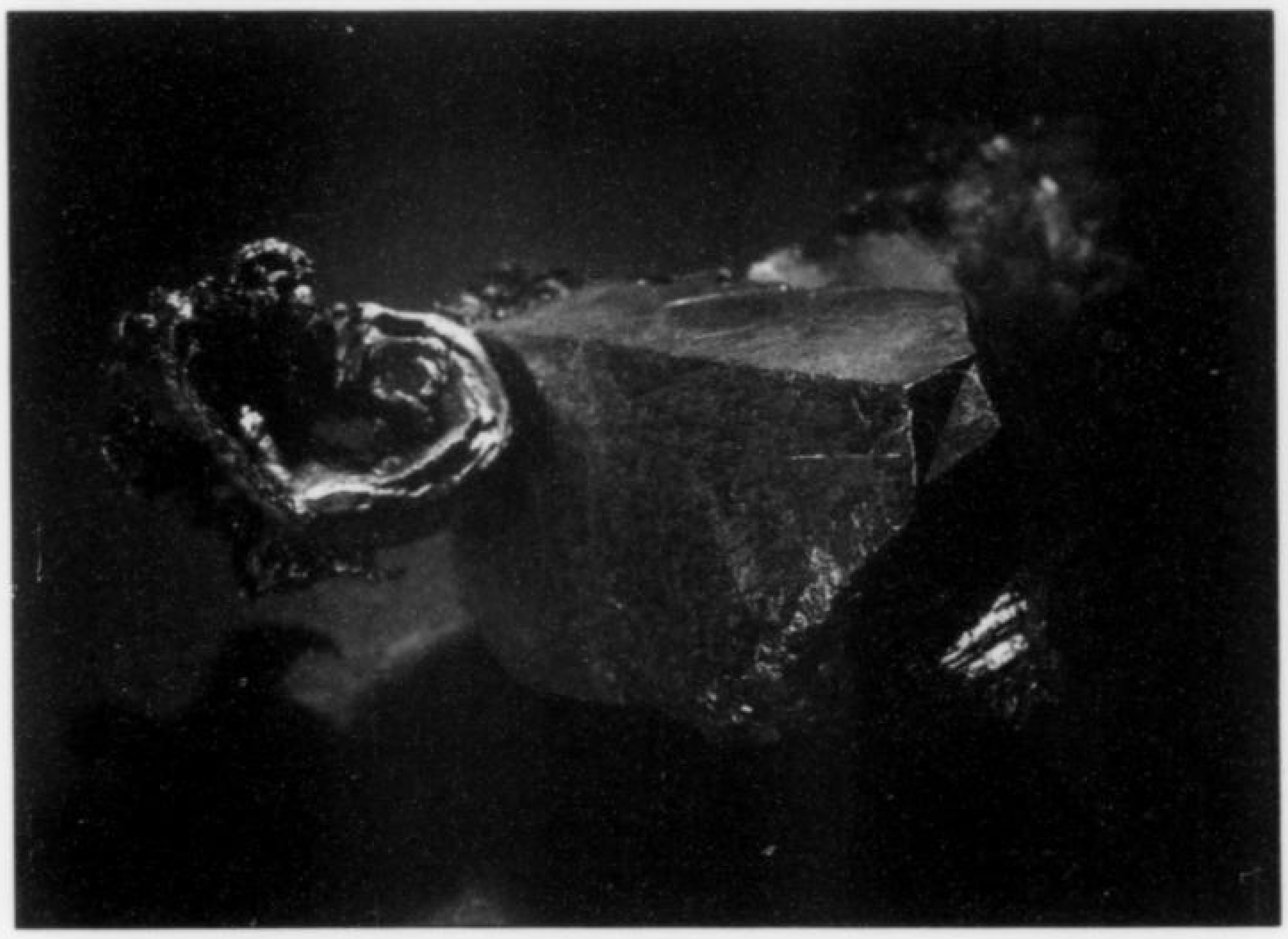


Figure 38. Wire silver with calcite, 12 cm, from Kongsberg. Norm and Roz Pellman collection and photo.

Figure 39. Twinned silver crystal, 3.5 cm, found in 1886 in the Gottes Hülfe in der Noth mine. Collection of the Norwegian Mining Museum, Kongsberg; photo by O. T. Ljøstad.



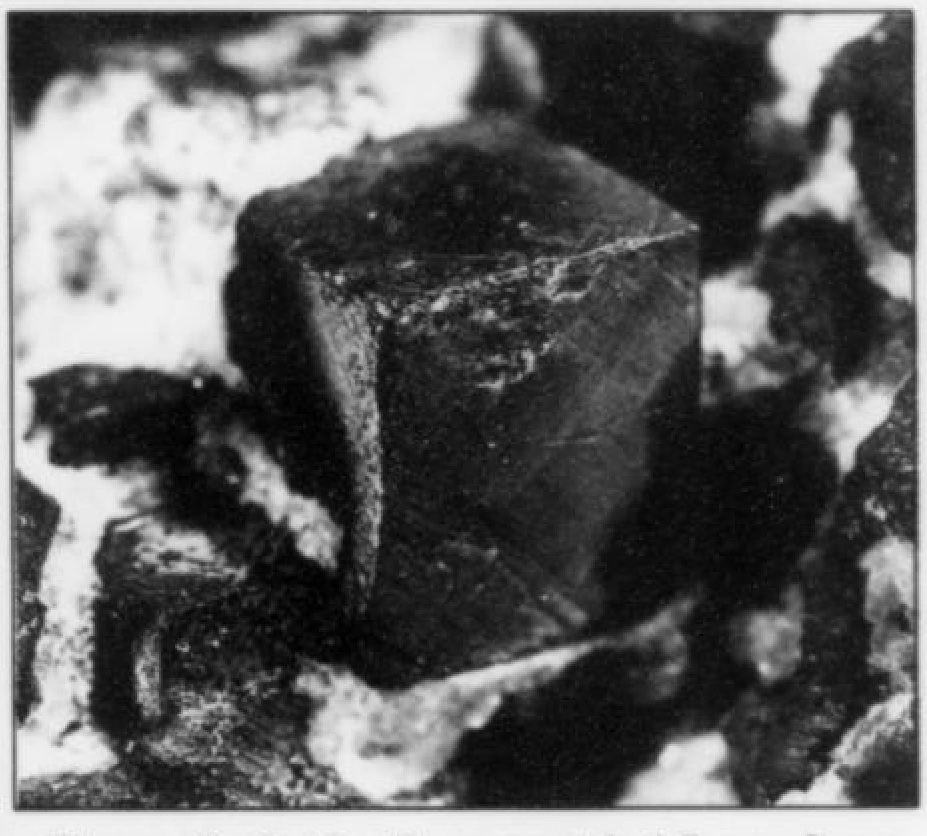


Figure 40. Cubic silver crystal, 1.7 cm, from Kongsberg. Collection of the Mineralogical-Geological Museum, Oslo; photo by Rainer Bode.

Anhedral Minerals

Many recently reported minerals are found in poorly developed crystals, while others are entirely massive. These include: annabergite, aragonite, argentopentlandite (Sirka, 1988), brochantite, chlorite (group), covellite, devilline, erythrite, gadolinite, gahnite, goethite, gold-silver (electrum), illite, kaolinite, langite, malachite, montmorillonite, natrojarosite, naumannite (Frigstad, 1972), palygorskite, posnjakite, scheelite, sepiolite (van der Wel, 1972), stilpnomelane, sulfur, tetrahedrite and tremolite-actinolite.

A search through the recently computerized X-ray film archive (9-cm Debye-Scherrer camera) at the Mineralogical-Geological Museum in Oslo verifies that antigorite, clinozoisite, hematite, hornblende, hydrozincite, löllingite, nontronite, orthochrysotile, portlandite, and stevensite have also been identified from mines and prospects in the Kongsberg area.

CONCLUSIONS

Pyrite crystals larger and better than ever have been found since the mines closed. Larger fluorapophyllite and prehnite crystals have also been found, although the quality cannot match the best of the old finds. Harmotome and barite crystals have been found which equal those found in earlier days, both in size and quality. Good-quality specimens of calcite, quartz, fluorite, sphalerite, stilbite, epidote, argentite and native silver, and nice microcrystals of the rare minerals armenite, brewsterite and rapidcreekite have also recently been found.

Forty-five minerals new to Kongsberg have been identified there since 1958, most in the last ten years. Since the Kongsberg article in the *Mineralogical Record* by Ole Johnsen (1986), 41 species have been added to the Kongsberg list of minerals. These are identified by an asterisk (*) in Table 1. Johnsen did not list amalgam. "Coal blende" (bitumen) is not a mineral, but is an important constituent of the veins. Currently the list of minerals found in Kongsberg totals 108.

Although the Kongsberg silver mines are no longer working, visitors can still be exposed to the life and times of mines and miners of long ago. The Mining Museum, now housed in the old smelter, bustles with visitors and knowledgeable and friendly staff. On display is arguably the world's finest collection of more than 300 silver specimens, as well as a stunning assemblage of rare and fascinating mining antiques. A vintage mine train operated by experienced guides takes tourists deep into the old King's mine.

Nearby timbered mountains are scarred with scores of old mine dumps, water works and canals, and the remaining vestiges of mine buildings. Kongsberg town is a delight, part historic and part contemporary, which straddles the roaring, crystal-clear Numedal River. A few mineral collectors in Kongsberg and vicinity sell and exchange minerals (rarely silvers). Friendly descendents of early mining families are known to offer anecdotes of their own histories. Be advised that visitors wishing to spend more than a day in this beautiful setting need to reserve accommodations well in advance of arrival. Kongsberg has become a popular destination.

ACKNOWLEDGMENTS

The authors would like to thank the many who contributed to this article, especially Bjørn Ivar Berg for providing copious amounts of historical data and photography, Tom Viktor Segalstad and Alf Olav Larsen for valuable comments on the geology, and Alf Olav Larsen for mineral identifications using X-ray diffraction techniques; also the collectors Stig Flaata, Tore Gulbrandsen, Bjørnar Jacobsen, Harald Kristiansen, Egil Olafsen, Thore G. Pedersen, and Kjell Trengen for information and material from mineral finds, Rainer Bode for permission to use a number of his beautiful mineral photographs, and Konrad Götz for permission to use his photo of a wire silver.

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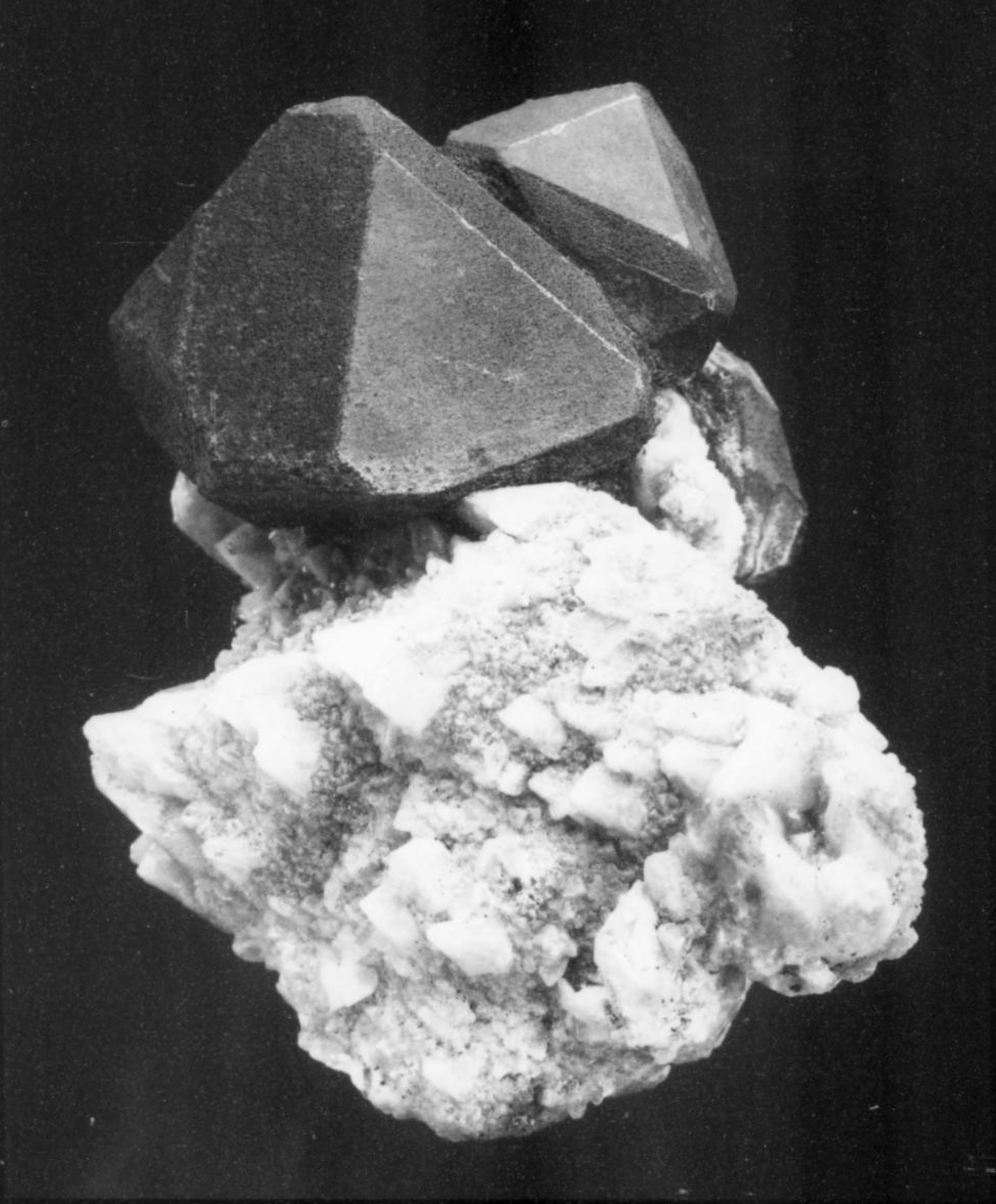
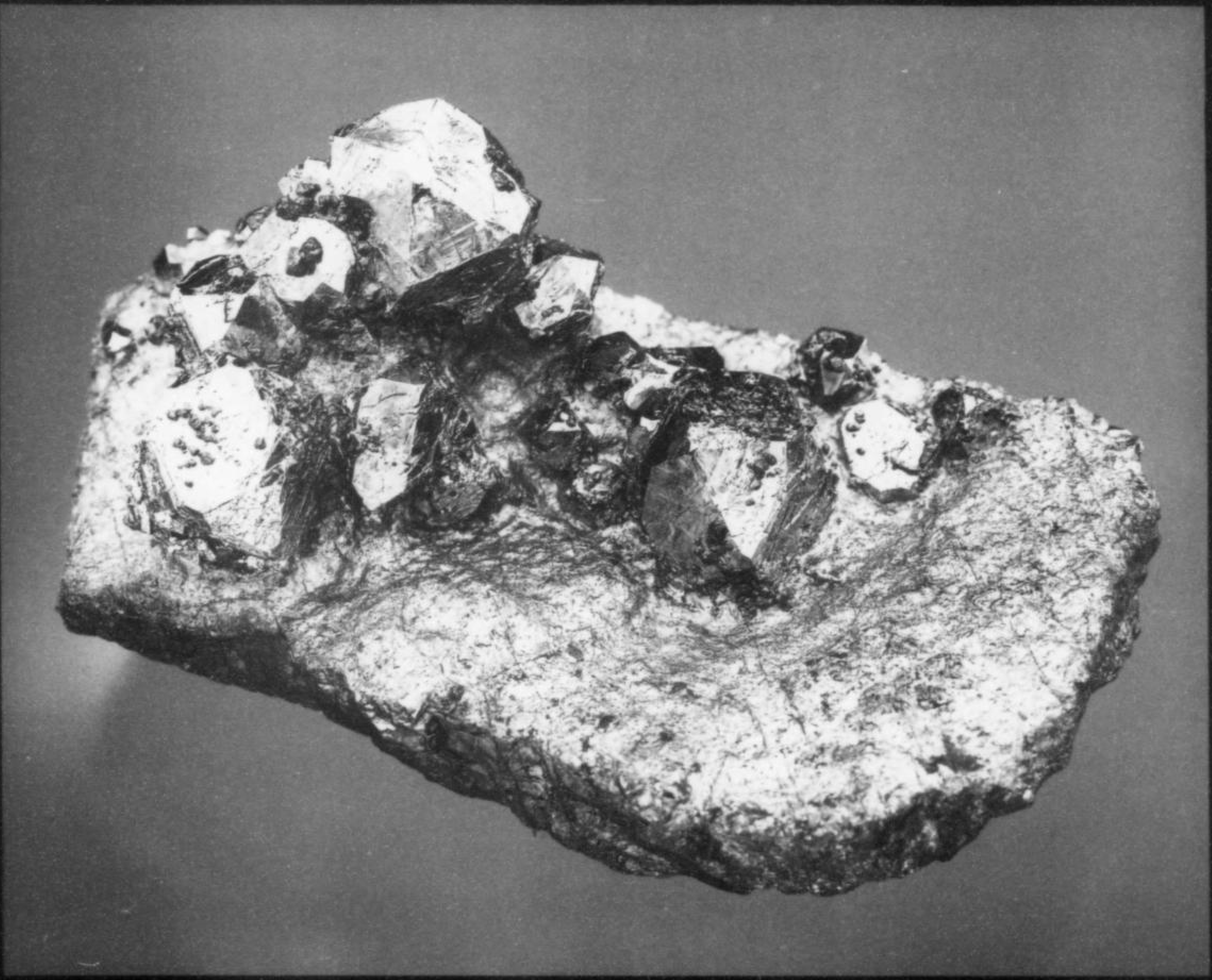


Malachite after Cuprite, 10.3 cm, from Onganja, Namibia

JEFF SCOVIL

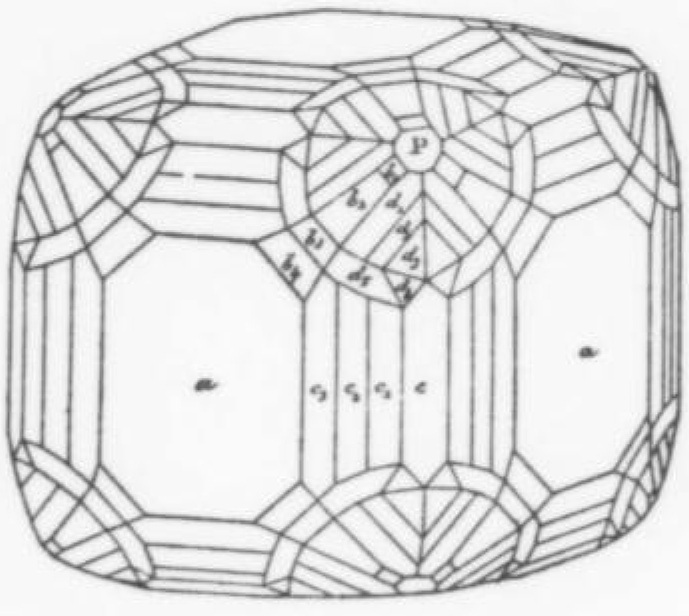


Sperrylite, 9.4 cm, from Talnakh, Norilsk, Russia

JEFF SCOVIL

Legrandite, 8.4 cm, Ojuela mine, Mapimi, Durango, Mexico

Abstracts of New Mineral Descriptions



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Belloite

Monoclinic

Cu(OH)Cl

Locality: An abandoned mine about 3 km west southwest of the village of Sierra Gorda, northeast of Antofagasta, 2nd region, northern Chile.

Occurrence: In a quartz, feldspar, tourmaline rock. Other associated minerals are: nitratine, montmorillonite, paratacamite, atacamite, gunningite, alunite and natrojarosite.

General appearance: Thin encrustations of tiny crystals (about 30 µm, rarely up to 100 µm).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* translucent to transparent. *Color:* yellowish green to olive green. *Streak:* yellowish green. *Luminescence:* nonfluorescent. *Hardness:* soft. *Tenacity:* not given. *Cleavage:* not given. *Fracture:* not given. *Density:* not measured, 3.79 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, $P2_1/a$ (Effenberger, 1984 for synthetic material), *a* 5.552, *b* 6.668, *c* 6.124 Å, β 115.00°, *V* 205.47 Å^3, Z 4, *a:b:c* = 0.8326:1:0.9184. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 5.553 (100) (001), 2.785 (14) $(120, 002, 20\bar{1})$, 2.758 (52) $(11\bar{2}, 12\bar{1})$, 2.516 (18) (200), 2.241 (27) $(12\bar{2})$, 1.851 (21) $(21\bar{3}, 003)$, 1.769 (16) $(31\bar{1}, 122)$, 1.607 (15) $(32\bar{1})$, 1.499 (13) $(11\bar{3}, 320)$. ***Optical data:*** Pleochroic from yellowish green to pale yellowish green. The mean index of refraction calculated from the Gladstone-Dale relationship is 1.84. ***Chemical analytical data:*** Means of five sets of electron microprobe data: CuO 68.84, Cl 26.35, H_2O 7.47, sum 102.66, less O = Cl 5.96, Total 96.70 wt.%. H_2O was analyzed as H by CHN analyzer and recalculated to H_2O. OH was confirmed by IR. Empirical formula: $Cu_{1.05}(OH)_{1.00}Cl_{0.90}O_{0.10}$. ***Relationship to other species:*** The natural analogue of synthetic Cu(OH)Cl.

Name: For Andrés Bello (1780–1865), founder and first rector of the Universidad de Chile, Santiago, Chile. ***Comments:*** IMA No. 1998-054. In the presence of water belloite converts within minutes to botallackite and atacamite. The crystal structure of synthetic Cu(OH)Cl was solved by Effenberger (1984).

SCHLÜTER, J., KLASKA, K.-H., and GEBHARD, G. (2000) Belloite, Cu(OH)Cl, a new mineral from Sierra Gorda, Antofagasta, Chile. *Neues Jahrbuch für Mineralogie, Monatshefte* **2000**, 67–73. EFFENBERGER, H. (1984) Verfeinerung der Kristallstruktur von Kupfer(II)-hydroxichlorid, Cu(OH)Cl. *Monatshefte für Chemie* **115**, 725–730.

Biehlite

Monoclinic

$(Sb,As)_2MoO_6$

Locality: The Tsumeb mine, Tsumeb, Namibia (probably from the third oxidation zone).

Occurrence: Associated minerals are: anglesite and wulfenite.

General appearance: Irregular aggregates and felted masses of fibrous crystals (up to 1 cm long and only some µm in diameter).

Physical, chemical and crystallographic properties: *Luster:* silky (but probably adamantine). *Diaphaneity:* translucent. *Color:* white. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* soft. *Tenacity:* flexible. *Cleavage:* not mentioned. *Fracture:* not mentioned. *Density:* could not be measured, 5.23 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, *C2/c*, *a* 18.076, *b* 5.920, *c* 5.083 Å, β 96.97°, *V* 539.91 Å^3, Z 4, *a:b:c* = 3.0534:1:0.8586. Morphology: no forms were mentioned; fibers are elongated [001]. Twinning: none mentioned. ***X-ray powder diffraction data:*** 5.622 (65) (110), 3.376 (39) $(\bar{3}11)$, 3.104 (61) (311), 2.990 (100) (600), 2.960 (100) (020), 2.104 (42) (620), 1.962 (32) (130). ***Optical data:*** no data could be measured, but the mean index of refraction calculated from the Gladstone-Dale relationship is 2.13. ***Chemical analytical data:*** Means of five sets of electron microprobe data: Sb_2O_3 60.99, As_2O_3 4.95, MoO_3 33.76, Total 99.70 wt.%. Empirical formula: $(Sb_{1.79}As_{0.21})_{\Sigma 2.00}$-$Mo_{1.00}O_{6.00}$. ***Relationship to other species:*** None apparent.

Name: For Dr. Friedrich Karl Biehl (1887–), a mineralogist from Münster, Germany, who first did research on Tsumeb species. ***Comments:*** IMA No. 1999-019a.

SCHLÜTER, J., KLASKA, K.-H., ADIWIDJAJA, G., FRIESE, K., and GEBHARD, G. (2000) Biehlite, $(Sb,As)_2MoO_6$, a new mineral from Tsumeb, Namibia. *Neues Jahrbuch für Mineralogie, Monatshefte* **2000**, 234–240.

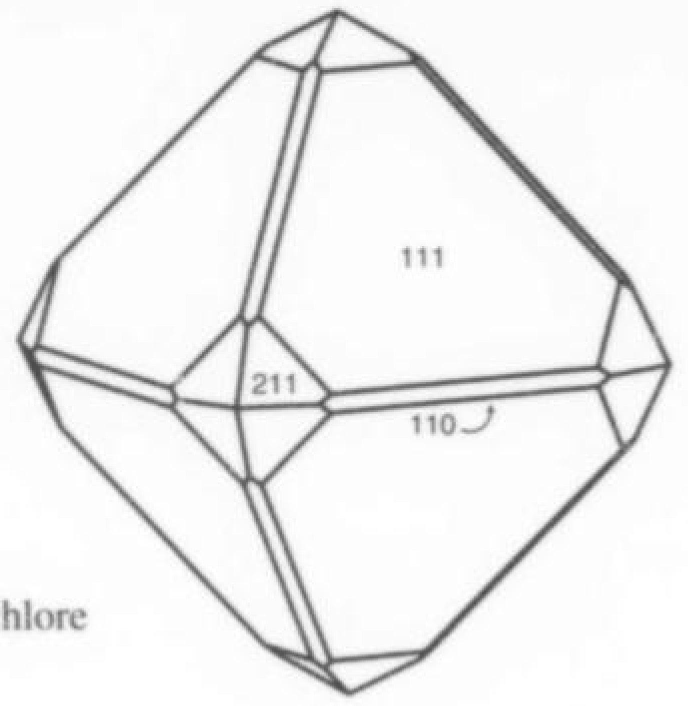
Bismutopyrochlore

Cubic

$(Bi,U,Ca,Pb)_{1+x}(Nb,Ta)_2O_6(OH)\cdot nH_2O$

Locality: The pegmatite vein Mika, the eastern Pamirs, Tadjikistan.

Occurrence: In pegmatite. Associated minerals are: lepidolite, microcline, elbaite, topaz, beryl, quartz, fluorapatite, barite, calcite, pyrochlore, uranpyrochlore, uranmicrolite, bismuth, ustarasite, kaolinite and hisingerite.



Bismutopyrochlore

General appearance: Octahedral crystals (up to 1 cm).

Physical, chemical and crystallographic properties: *Luster:* shiny adamantine. *Diaphaneity:* translucent. *Color:* greenish-brown to black. *Streak:* yellow. *Luminescence:* nonfluorescent. *Hardness:* 5. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* conchoidal. *Density:* 4.97 g/cm^3 (meas.), 6.98 g/cm^3 (calc.). ***Crystallography:*** Cubic, *Fd3m*, *a* 10.41 Å, V 1128 Å^3, Z 8. Morphology: {111}, {110}, {211}. Twinning: none observed. ***X-ray powder diffraction data:*** 5.98 (4) (111), 2.967 (10) (111), 2.614 (7) (224), 1.848 (9) (044), 1.569 (9) (262), 1.500 (4) (444), 1.195 (8B) (662), 1.145 (5) (735). ***Optical data:*** Isotropic, n 2.10. ***Chemical analytical data:*** A set of electron microprobe data: Na_2O 0.33, K_2O 0.48, MgO 0.28, CaO 2.57, MnO 0.16, PbO 5.99, Al_2O_3 0.42, Fe_2O_3 1.74, Sb_2O_3 1.23, La_2O_3 0.18, Ce_2O_3 0.27, Bi_2O_3 14.61, TiO_2 0.32, ThO_2 0.37, UO_2 14.02, Nb_2O_5 34.17, Ta_2O_5 8.55, H_2O 14.60, Total 100.29 wt.%. Empirical formula: $(Bi_{0.37}U_{0.31}Ca_{0.27}Pb_{0.16}Na_{0.06}K_{0.06}Sb_{0.05}Mn_{0.01}Ce_{0.01}La_{0.01}Th_{0.01})_{\Sigma 1.32}(Nb_{1.52}Ta_{0.23}Fe_{0.13}Al_{0.05}Mg_{0.04}Ti_{0.02})_{\Sigma 1.99}O_{6.10}(OH)_{0.90}\cdot 4.33H_2O$. ***Relationship to other species:*** A member of the pyrochlore group.

Name: For the relationship with pyrochlore. ***Comments:*** IMA No. 1998-059. The mineral is metamict and the unit cell parameter and the X-ray powder diffraction data were obtained after heating at 700°C for four hours. The large difference between the measured and calculated densities probably is a function of the heat treatment.

CHUKANOV, N. V., SKRIGITIL, A. M., KUZMINA, O. V. and ZADOV, A. E. (1999) Bismutopyrochlore $(Bi,U,Ca,Pb)_{1+x}(Nb,Ta)_2O_6(OH)\cdot nH_2O$, a new mineral from the pegmatite vein Mika, the Eastern Pamirs. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **128(4)**, 36–41.

Bleasdaleite

Monoclinic

$(Ca,Fe^{3+})_2Cu_5(Bi,Cu)(PO_4)_4(H_2O,OH,Cl)_{13}$

Locality: A granite quarry 10 km SSW of the township of Lake Boga, northern Victoria, Australia (Lat. 35°28′ S, Long. 143°38′ E).

Occurrence: In a pegmatite. Associated minerals are: orthoclase, chalcocite, covellite, pseudomalachite, chalcosiderite/turquoise, ulrichite, libethenite, torbernite and iodargyrite.

General appearance: Thin, scaly crusts and hemispherical clusters (up to about 0.1 mm across) composed of individual crystals (up to about 20 μm and less than 1 μm thick).

Physical, chemical and crystallographic properties: *Luster:* resinous. *Diaphaneity:* transparent in thin sections. *Color:* dark brown. *Streak:* pale brown. *Luminescence:* not given. *Hardness:* estimated to be about 2. *Tenacity:* not given. *Cleavage:* {001} well-developed. *Fracture:* not given. *Density:* could not be determined, 2.77 g/cm^3 (calc.). ***Crystallography:*** Monoclinic (pseudotetragonal), space group unknown, *a* 14.200, *b* 13.832, *c* 14.971 Å, β 102.08°, *V* 2875 Å^3, Z 4, *a*:*b*:*c* = 1.0266:1:1.0823. Morphology: only (001) was observed; platy on {001}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 14.57 (100) (001), 6.95 (40) (200), 6.28 (40) ($\bar{1}$12, 021), 3.469 (30b) (312, 400), 3.104 (30) (402), 2.816 (40) (043), 2.507 (30) (152, 243), 2.452 (30) ($\bar{4}$40). ***Optical data:*** Biaxial (–) pseudouniaxial (–), α 1.718, β 1.748, γ 1.748, 2V could not be measured, 2V(calc.) 0°; dispersion not given; pleochroism medium strong, X = pale yellow-brown, Y = Z = dark yellow-brown, absorption X < Y = Z; X = *c*, Y/Z = *a*/*b* (See Comments). ***Chemical analytical data:*** Means of twenty-four sets of electron microprobe data: CaO 7.59, CuO 34.79, Fe_2O_3 3.04, Al_2O_3 0.13, Bi_2O_3 15.53, P_2O_5 21.70, As_2O_5 0.34, H_2O (16.10), Cl 1.01, sum (100.23), less O = Cl 0.23, Total (100.00) wt.%. H_2O calculated by difference. Empirical formula: $(Ca_{1.63}Fe^{3+}_{0.46}Al_{0.03})_{\Sigma 2.12}Cu_{5.00}(Bi_{0.80}Cu_{0.26})_{\Sigma 1.06}[(PO_4)_{3.67}(AsO_4)_{0.04}]_{\Sigma 3.71}[(OH)_{5.18}Cl_{0.34}]_{\Sigma 5.52}\cdot 7.98H_2O$. ***Relationship to other species:*** There are some similarities with richelsdorfite, $Ca_2Cu_5Sb^{5+}(AsO_4)_4Cl(OH)_6\cdot 6H_2O$.

Name: For the Reverend John Ignatius Bleasdale (1822–1884), an enthusiastic proponent of minerals from Victoria. ***Comments:*** IMA No. 1998-003A. Robin and Gordon Sharp found the mineral and provided samples for the study. The optical orientation is strangely expressed for a monoclinic mineral with β 102.08°; something appears to be wrong.

BIRCH, W. D., PRING, A., and KOLITSCH, U. (1999) Bleasdaleite $(Ca,Fe^{3+})_2Cu_5(Bi,Cu)(PO_4)_4(H_2O,OH,Cl)_{13}$ a new mineral from Lake Boga, Victoria, Australia. *Australian Journal of Mineralogy* **5**, 69–75.

Brandholzite

Trigonal

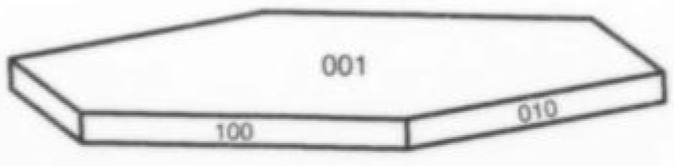
$Mg[Sb(OH)_6]_2\cdot 6H_2O$

Locality: The former Brandholz-Goldkronach mining district in the western part of the Fichtelgebirge, Bavaria, Germany. Specifically, it was found in the Schmidten-Schacht and Jakobi-Schacht (pits) of the master lode.

Occurrence: An alteration product of stibnite in the oxidation zone in a stibnite matrix with "antimony-ochers."

General appearance: Tabular hexagonal crystals up to ~ 1 mm in diameter (most are < 0.5 mm) forming rose-like aggregates.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* colorless. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* VHN (load not specified) 60 kg/mm^2, Mohs 2 to 3. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* conchoidal. *Density:* 2.65 g/cm^3 (meas.), 2.57 g/cm^3 (calc.). ***Crystallography:*** Trigonal, *P*3, *a* 16.119, *c* 9.868 Å, *V* 2220.4 Å^3, Z 6, *c*:*a* = 0.6122. Morphology: the forms are listed as {100} and {001}, but the tabular hexagonal habit requires {010} and {00$\bar{1}$} also. Twinning: on {100}. ***X-ray powder diffraction data:*** No table of data are given, but the strongest lines are listed as 4.636 (100) (300), 3.392 (70) (302),



Brandholzite

4.946 (50) (002), 2.356 (40) (332). ***Optical data:*** Uniaxial (–), ω 1.570, ε 1.569, nonpleochroic. ***Chemical analytical data:*** There was insufficient material for a complete analysis but the synthetic equivalent was analyzed for Sb (by atomic absorption spectroscopy), Mg (by flame emission spectroscopy) and H_2O (by TGA) and gave: MgO 6.7, Sb_2O_5 55.0, H_2O 39.0, Total 100.7 wt.%. Empirical formula: $Mg_{0.94}[Sb(OH)_6]_{1.92}\cdot 6.49H_2O$. ***Relationship to other species:*** It is the Mg-dominant analogue of bottinoite, $Ni[Sb(OH)_6]_2\cdot 6H_2O$.

Name: For the locality. ***Comments:*** IMA No. 1998-017. It is unfortunate that the complete set of X-ray powder diffraction data was not published.

FRIEDRICH, A., WILDNER, M., TILLMANNS, E., and MERZ, P. L. (2000) Crystal chemistry of the new mineral brandholzite, $Mg(H_2O)_6[Sb(OH)_6]_2$, and of the synthetic analogues $M^{2+}(H_2O)_6$-$[Sb(OH)_6]_2$ (M^{2+} = Mg, Co). *American Mineralogist* **85**, 593–599.

Cabalzarite — Monoclinic

$Ca(Mg,Al,Fe)_2(AsO_4)_2(H_2O,OH)_2$

Locality: The abandoned manganese mine near Falotta, Graubünden, Switzerland.

Occurrence: In manganese ore consisting of braunite, rhodonite, spessartine, tinzenite, parsettensite, sursassite and strontian piemontite in radiolarites. Associated minerals are: quartz, sursassite, adularia, kutnohorite, tilasite, grischunite, arseniosiderite, tripuhyite, ranciéite-takanelite and arsenogoyazite.

General appearance: Isolated crystals (up to 1 mm), polycrystalline aggregates (up to 2 mm), fibrous to tabular crystals (up to 3 mm) forming radiating aggregates (up to 5 mm in diameter) and aggregates of parallel needles (up to 2 mm thick).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* light brownish to brownish pink, orange-brown. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* VHN_{50} 429 kg/mm², Mohs ~ 5. *Tenacity:* not given. *Cleavage:* none observed. *Fracture:* irregular. *Density:* 3.89 g/cm³ (meas.), 3.73 g/cm³ (calc.) (for the analytical data given here). ***Crystallography:*** Monoclinic, *C2/m*, *a* 8.925, *b* 6.143, *c* 7.352 Å, β 115.25°, *V* 364.6 Å³, Z 2, *a:b:c* = 1.4529:1:1.1968. Morphology: only {001} was recognized. Twinning: none mentioned. ***X-ray powder diffraction data:*** 4.895 (59) (110), 4.544 (35) $(\bar{1}11)$, 3.373 (54) $(\bar{2}02)$, 3.159 (100) $(\bar{1}12)$, 2.942 (67) (201), 2.684 (55) $(31\bar{1})$, 2.519 (81) $(22\bar{1})$. ***Optical data:*** Because of inhomogeneity, data were difficult to measure; n ∥ to fiber elongation 1.76, n ⊥ to fiber elongation 1.70; mean n calculated from the Gladstone-Dale relationship 1.77; nonpleochroic. ***Chemical analytical data:*** Means of four sets of electron microprobe data: MgO 7.54, CaO 13.64, SrO 0.49, Al_2O_3 9.84, Mn_2O_3 0.55, Fe_2O_3 4.38, SiO_2 0.05, As_2O_5 55.57, H_2O 7.11, Total 99.17 wt.%. Empirical formula: $(Ca_{1.00}Sr_{0.02})_{\Sigma 1.02}(Al_{0.80}Mg_{0.77}Fe_{0.23}Mn_{0.03})_{\Sigma 1.83}(AsO_4)_2$-$[(H_2O)_{1.24}(OH)_{0.76}]_{\Sigma 2.00}$. ***Relationship to other species:*** A member of the tsumcorite group with Mg and Al in the M2 site.

Name: For Walter Cabalzar (1919–), an amateur mineralogist of Chur, Switzerland, who contributed to the mineralogy of the Graubünden canton. ***Comments:*** IMA No. 1997-012. Note that the crystal structure has been solved.

BRUGGER, J., MEISSER, N., SCHENK, K., BERLEPSCH, P., BONIN, M., ARMBRUSTER, T., NYFELER, D., and SCHMIDT, S. (2000) Description and crystal structure of cabalzarite $Ca(Mg,Al,Fe)_2(AsO_4)_2(H_2O,OH)_2$, a new mineral of the tsumcorite group. *American Mineralogist* **85**, 1307–1314.

Carmichaelite — Monoclinic

$(Ti,Cr)O_{1.5}(OH)_{0.5}$

Locality: Garnet Ridge, Navajo volcanic field, Colorado Plateau, Arizona, USA.

Occurrence: In pyrope crystals in an ultramafic diatreme. Associated minerals are: rutile and srilankite. Other minerals in the pyrope host crystals are: ilmenite, crichtonite group minerals, spinel and olivine.

General appearance: Anhedral to subhedral elongated platy crystals (up to 30 µm).

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque; translucent under high magnification. *Color:* black but cinnamon brown in transmitted light. *Streak:* not given. *Hardness:* ~ 6, based on its similar polishing quality to rutile. *Tenacity:* brittle. *Cleavage:* none observed. *Fracture:* not given. *Density:* not measured, 4.13 g/cm³ (calc.). ***Crystallography:*** Monoclinic, $P2_1/c$, *a* 7.706, *b* 4.5583, *c* 20.187 Å, β 92.334°, *V* 708.5 Å³, Z 22, *a:b:c* = 1.6905:1:4.4286. Morphology: no forms were mentioned. Twinning: none observed. ***X-ray powder diffraction data:*** 3.773 (94) (013), 2.842 (100) $(\bar{1}15)$, 2.664 (70) (213), 1.688 (54) $(\bar{3}22)$, 1.679 (44) (226), 1.661 (44) $(\bar{1}28)$, 1.648 (34) (1.1.11). ***Optical data:*** In reflected light: gray to white. R about 18%. ***Chemical analytical data:*** Means of six sets of electron microprobe data: TiO_2 62.16, Cr_2O_3 18.43, Al_2O_3 1.88, FeO 7.61, MgO 2.80, Nb_2O_5 0.37, V_2O_3 0.87, H_2O (5.76), Total (99.88) wt.%. H_2O calculated by stoichiometry and confirmed by IR spectroscopy. Empirical formula: $(Ti_{0.62}Cr_{0.19}Fe_{0.08}Mg_{0.06}Al_{0.03}V_{0.01})_{\Sigma 0.99}O_{1.49}(OH)_{0.51}$. ***Relationship to other species:*** None apparent.

Name: For Prof. Ian S. E. Carmichael (1930–), University of California, Berkeley, for his contributions to petrology. ***Comments:*** IMA No. 1996-062. Details of the crystal structure are given in the paper.

WANG, L., ROUSE, R. C., ESSENE, E. J., PEACOR, D. R., and ZHANG, Y. (2000) Carmichaelite, a new hydroxyl-bearing titanate from Garnet Ridge, Arizona. *American Mineralogist* **85**, 792–800.

Cerchiaraite — Tetragonal

$Ba_4Mn_4Si_6O_{18}(OH)_7Cl$

Locality: The Cerchiara mine, near Faggiona village, val di Vara (La Spezia, northern Apennines, Eastern Liguria, Italy.

Occurrence: Filling microfractures and veins (from 0.1 to some millimeters in width) in Jurassic cherts of the "Diaspra di Monte Alpe" formation. Associated minerals are: quartz, pectolite, orientite and calcite. Other new minerals found at the locality are mozartite, $CaMn(OH)SiO_4$ and caoxite, $CaC_2O_4\cdot 3H_2O$.

General appearance: Scattered individual prismatic to acicular crystals elongated along [001] (up to 2 mm x 0.1 mm) and as a few radiating aggregates (up to about 3 mm in diameter).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* deep green. *Streak:* pale green. *Luminescence:* nonfluorescent. *Hardness:* VHN_{50} 296 kg/mm². *Tenacity:* brittle. *Cleavage:* none. *Fracture:* uneven. *Density:* 3.62 g/cm³ (meas.), 3.69 g/cm³ (calc.). ***Crystallography:*** Tetragonal, *I4/mmm*, *a* 14.223, *c* 6.141 Å, *V* 1242.3 Å³, Z 2, *c:a* = 0.4318. Morphology: tetragonal prisms are present but not identified. Twinning: none mentioned. ***X-ray powder diffraction data:*** 10.15 (M) (110), 5.63 (M) (101), 4.417 (M) (211), 3.319 (S) (321), 3.011 (VS) (411), 2.619 (S) (222), 2.577

(M) (501) plus five other lines with intensities of M. ***Optical data:*** Uniaxial (+), ω 1.745, ε 1.765. ***Chemical analytical data:*** Means of 42 sets of electron microprobe data: BaO 43.29, Al_2O_3 1.02, Fe_2O_3 2.09, Mn_2O_3 19.57, SiO_2 26.18, H_2O (4.81), Cl 3.93, sum 100.89, less O = Cl 0.89, Total (100.00) wt.%. H_2O was calculated by difference. Empirical formula: $Ba_{3.83}(Mn^{3+}_{3.36}Fe^{3+}_{0.35}Al_{0.27})_{\Sigma 3.98}Si_{5.91}O_{17.26}[(OH)_{7.24}Cl_{1.50}]_{\Sigma 8.74}$. ***Relationship to other species:*** It is a cyclosilicate.

Name: For the locality. ***Comments:*** IMA No. 1999-012. Some of the subscripts derived here for the empirical formula differ from those given by the authors.

BASSO, R., LUCCHETTI, G., ZEFIRO, L., and PALENZONA, A. (2000) Cerchiaraite, a new natural Ba-Mn-mixed-anion silicate chloride from the Cerchiara mine, northern Apennines, Italy. *Neues Jahrbuch für Mineralogie, Monatshefte* **2000**, 373–384.

Chromceladonite

Monoclinic

$KCrMg[Si_4O_{10}](OH)_2$

Locality: Srednyaya Padma uranium-vanadium deposit, south Karelia, Russia.

Occurrence: In a metasomatite. Associated minerals are: dolomite, quartz, roscoelite, chromphyllite, calcite, hematite, uraninite, zincochromite, vanadium oxides, etc.

General appearance: Aggregates of thin lamellae (up to 1 cm) and as spherulites and veinlets.

Physical, chemical and crystallographic properties: *Luster:* vitreous to silky. *Diaphaneity:* transparent. *Color:* emerald green to dark green. *Streak:* light green. *Luminescence:* nonfluorescent. *Hardness:* 1½ to 2. *Tenacity:* flexible but not elastic. *Cleavage:* {001} perfect. *Fracture:* platy. *Density:* 2.90 g/cm³ (meas.), 2.97 g/cm³ (calc.). ***Crystallography:*** Monoclinic, *C*2, *a* 5.267, *b* 9.101, *c* 10.162 Å, β 100.67°, *V* 479 Å³, Z 2, *a:b:c* = 0.5787:1:1.1166. Morphology: probably only {001}. Twinning: none observed. ***X-ray powder diffraction data:*** 4.54 (93) (020), 4.36 (40) $(11\bar{1})$, 3.638 (64) $(11\bar{2})$, 3.097 (51) (112), 2.588 (100) $(13\bar{1})$, 2.409 (87) $(13\bar{2})$, 1.518 (56) $(33\bar{1})$. ***Optical data:*** Biaxial (−), α 1.605, β 1.648, γ 1.654, 2V(meas.) 12°, 2V(calc.) 40°; dispersion not observed; pleochroism X = colorless to pale green, Y = Z = green; X ∧ (001) < 5°. ***Chemical analytical data:*** Ten electron microprobe analyses were carried out with Li, Fe^{2+} and Fe^{3+} determined by wet chemical means. Data for the holotype specimen are: Li_2O 0.13, Na_2O 0.14, K_2O 10.42, MgO 7.82, MnO 0.19, FeO 0.73, ZnO 0.22, Al_2O_3 3.25, V_2O_3 1.79, Cr_2O_3 17.01, Fe_2O_3 0.58, SiO_2 53.20, TiO_2 0.16, H_2O 3.38, F 0.57, sum 99.59, less O = F 0.24, Total 99.35 wt.%. Empirical formula: $(K_{0.95}Na_{0.02})_{\Sigma 0.97}(Cr_{0.97}V_{0.10}Al_{0.09}Fe^{3+}_{0.03}Ti_{0.01})_{\Sigma 1.20}(Mg_{0.84}Fe^{2+}_{0.04}Li_{0.04}Zn_{0.01}Mn_{0.01})_{\Sigma 0.94}[(Si_{3.82}Al_{0.18})_{\Sigma 4.00}O_{10.00}][(OH)_{1.62}O_{0.25}F_{0.13}]_{\Sigma 2.00}$. ***Relationship to other species:*** A member of the mica group.

Name: For the relationship to celadonite. ***Comments:*** IMA No. 1999-024.

PEKOV, I. V., CHUKANOV, N. V., RUMIANTSEVA, E. V., KABALOV, Yu. K., SCHNEIDER, Yu. and LEDENEVA, N. V. (2000) Chromceladonite $KCrMg[Si_4O_{10}](OH)_2$—a new mineral of the mica group. *Zapiski Vserossiyskogo Mineralogicheskogo Obshchestva* **129(1)**, 38–44.

Coskrenite-(Ce)

Triclinic

$(Ce,Nd,La)_2(SO_4)_2(C_2O_4)\cdot 8H_2O$

Locality: Alum Cave Bluff, Great Smoky Mountains National Park, Tennessee, U.S.A.

Occurrence: In soil under an overhanging steep cliff. Associated minerals are: epsomite, members of the "hair salt" family (the most abundant of which is apjohnite), gypsum, jarosite, tschermigite, diadochite and four other new species: levinsonite-(Y), zugshunstite-(Ce), the probable ammonium analogue of slavíkite and an iron phosphate. See Comments.

General appearance: Aggregates of tabular, wedge-shaped, euhedral crystals (up to about 0.7 mm wide) embedded within epsomite or "hair salt" or in cavities bounded by these minerals.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* pale pink to cream-colored in incandescent light; the pink material is pale blue under fluorescent lighting. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* could not be determined. *Tenacity:* brittle. *Cleavage:* {001} perfect. *Fracture:* not given. *Density:* could not be determined, 2.90 g/cm³ (calc.) (given as 2.881 g/cm³). *Other properties:* readily soluble in water. ***Crystallography:*** Triclinic, $P\bar{1}$, *a* 6.007, *b* 8.368, *c* 9.189 Å, α 99.90°, β 105.55°, γ 107.71°, *V* 407.4 Å³, Z 1, *a:b:c* = 0.7179:1:1.0981. Morphology: {100}, {010}, {001}, flattened on {100}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 8.52 (70) (001), 6.72 (60) $(01\bar{1})$, 5.48 (100) $(1\bar{1}0)$, 4.26 (50) $(002, 01\bar{2})$, 3.84 (60) (020, 110), 3.35 (40) $(02\bar{2})$, 2.744 (40) $(12\bar{2}, \bar{2}1\bar{2}, 1\bar{3}0, 2\bar{2}0)$. ***Optical data:*** Biaxial (–), α 1.544, β 1.578, γ 1.602, 2V(meas.) 65°, 2V(calc.) 79° (erroneously given as 69°); dispersion r > v, medium; nonpleochroic; Z′ ∧ c = 21° in plane of cleavage. ***Chemical analytical data:*** Means of three sets of electron microprobe data: C_2O_3 10.2, Y_2O_3 0.1, La_2O_3 4.6, Ce_2O_3 25.9, Pr_2O_3 2.1, Nd_2O_3 13.3, Sm_2O_3 1.0, Eu_2O_3 0.8, Gd_2O_3 0.3, SO_3 22.6, H_2O 20.4, F 0.3, sum 101.6, less O = F 0.1, Total 101.5 wt.% (given as 100.0). Empirical formula: $(Ce_{1.11}Nd_{0.56}La_{0.20}Pr_{0.09}Sm_{0.04}Eu_{0.03}Gd_{0.01}Y_{0.01})_{\Sigma 2.05}(SO_4)_{1.98}(C_2O_4)_{1.00}F_{0.11}\cdot 7.95H_2O$. ***Relationship to other species:*** It is the first rare-earth oxalate mineral.

Name: For Dr. T. Dennis Coskren (1942–), geochemist and geologist from Columbia, Maryland, U.S.A., whose efforts to characterize the minerals from Alum Cave Bluff led to the discovery of the new minerals. ***Comments:*** IMA No. 1996-056. Note that the crystal structure has been solved. The authors list destinezite ("diadochite") among the associated minerals; the accepted name for this species is diadochite and "destinezite" is an obsolete synonym for the species. Terms such as "hair salt" also should be avoided.

PEACOR, D. R., ROUSE, R. C., ESSENE, E. J. and LAUF, R. J. (1999) Coskrenite-(Ce), $(Ce,Nd,La)_2(SO_4)_2(C_2O_4)\cdot 8H_2O$, a new rare-earth oxalate mineral from Alum Cave Bluff, Tennessee: characterization and crystal structure. *Canadian Mineralogist* **37**, 1453–1462.

Edgarite

Hexagonal

$FeNb_3S_6$

Locality: Khibina alkaline complex, Kola Peninsula, Russia (Lat. 67°43′ N, Long. 33°47′ W).

Occurrence: In a fenitized xenolith (approximately 0.2 km across) enclosed by nepheline syenite. Associated minerals are: pyrrhotite (Ti- and V-rich), ferroan alabandite, marcasite (Ti- and V-rich), wurtzite-2*H* (Mn- and Fe-rich), corundum, phlogopite, rutile, monazite-(Ce) and a graphite-like mineral.

General appearance: Platy inclusions (up to 0.15 mm) in pyrrhotite and alabandite and as aggregates of platy grains on pyrrhotite.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* dark gray. *Streak:* not given.

Hardness: VHN$_5$ 135 kg/mm^2 and VHN$_{10}$ 205 kg/mm^2, soft. *Tenacity:* not given. *Cleavage:* {001} perfect. *Fracture:* not given. *Density:* not measured, 4.99 g/cm^3 (calc.). ***Crystallography:*** Hexagonal, most probably $P6_322$, *a* 5.771, *c* 12.190 Å, *V* 351.6 Å^3, Z 2, *c:a* = 2.1123. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 6.11 (8) (002), 3.04 (6) (004), 2.606 (8) (112), 2.096 (10) (114), 1.665 (8) (300), 1.524 (6) (008), 1.126 (7) (322), 1.027 (6) (414). ***Optical data:*** In reflected light: gray, strong anisotropism from almost white to dark brown, distinct bireflectance, pleochroic from light gray with a bluish tint to gray. R_1, R_2; $^{im}R_1$, $^{im}R_2$: (28.1, 40.2; 13.0, 24.2 %) 470nm, (27.4, 39.3; 12.3, 22.2 %) 546nm, (27.0, 38.5; 12.2, 21.7 %) 589nm, (27.0, 36.9; 12.4, 20.3 %) 650nm. ***Chemical analytical data:*** Means of four sets of electron microprobe data: Nb 52.87, Fe 10.12, V 0.36, Mn 0.10, Ti 0.04, S 35.86, Total 99.35 wt.%. Empirical formula: $(Fe_{0.96}V_{0.04}Mn_{0.01})_{\Sigma 1.01}Nb_{3.03}S_{5.95}$. ***Relationship to other species:*** It is the natural analogue of synthetic $FeNb_3S_6$.

Name: For Prof. Alan D. Edgar (1935–1998), University of Western Ontario, London, Ontario, Canada, in recognition of his important contributions to the petrology and mineralogy of alkaline rocks. ***Comments:*** IMA No. 1995-017.

BARKOV, A. Y., MARTIN, R. F., MEN'SHIKOV, Y. P., SAVCHENKO, Y. E., THIBAULT, Y., and LAAJOKI, K. V. O. (2000) Edgarite, $FeNb_3S_6$, first natural niobium-rich sulfide from the Khibina alkaline complex, Russian Far North: evidence for chalcophile behavior of Nb in a fenite. *Contributions to Mineralogy and Petrology* **138**, 229–236.

Ferrokinoshitalite Monoclinic

$BaFe^{2+}_3(Si_2Al_2)O_{10}(OH)_2$

Locality: Broken Hill mine near Aggeneys, northern Cape Province, South Africa (Lat. 29°14′ S, Long. 18°48′ E).

Occurrence: In the garnet- and amphibole-rich manganiferous silicate facies of a banded iron-formation. Associated minerals are: quartz, magnetite, spessartine-rich garnet, "apatite," sillimanite, ferroan gahnite, sulfides, Mn-rich grunerite (in places manganogrunerite), manganoan fayalite and Mn-rich pyroxferroite.

General appearance: Tabular, individual crystals (up to 0.2 mm across).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* translucent. *Color:* dark green. *Streak:* green. *Luminescence:* nonfluorescent under short- or long-wave ultraviolet light; noncathodoluminescent. *Hardness:* 3. *Tenacity:* brittle. *Cleavage:* {001} perfect. *Fracture:* none. *Density:* 3.69 g/cm^3 (meas.), 3.47 g/cm^3 (calc.) (given as 3.59 g/cm^3). ***Crystallography:*** Monoclinic, $C2/m$, *a* 5.389, *b* 9.337, *c* 10.054 Å, β 100.53°, *V* 497.37 Å^3, Z 2, *a:b:c* = 0.5772:1:1.0768; these data are for the 1*M* polytype. Morphology: no forms were mentioned but crystals probably are tabular on {001}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.655 (15) $(11\bar{2})$, 2.651 (100) $(13\bar{1}, 200)$, 2.447 (15) $(13\bar{2}, 201)$, 2.176 (40) $(13\bar{3}, 202)$, 1.659 (25) $(13\bar{5}, 31\bar{3}, 204, 311, 006)$, 1.551 (30) $(060, 33\bar{1})$, 1.529 (25) $(20\bar{6})$, 1.520 (15) (135). ***Optical data:*** Complete optical data could not be determined. Biaxial (–), β 1.680, 2V(meas.) ~ 20°, pleochroism strong X = grass green, Y = dark brown green, Z = dark greenish gray-brown, absorption X << Z < Y; orientation not given. ***Chemical analytical data:*** Means of seven sets of electron microprobe data: Na_2O 0.26, K_2O 3.18, MgO 5.84, MnO 1.14, FeO 24.27, SrO 0.07, BaO 14.14, Al_2O_3 15.80, Fe_2O_3 2.35, SiO_2 28.86, TiO_2 2.68, H_2O (2.40), F 2.43, sum (103.42), less O = F 1.02, Total (102.40) wt.%. Water was calculated to give F + OH = 2.00 in the formula. Empirical formula: $(Ba_{0.47}K_{0.34}Na_{0.04})_{\Sigma 0.85}(Fe^{2+}_{1.71}Mg_{0.74}Ti_{0.17}Fe^{3+}_{0.15}Mn_{0.08})_{\Sigma 2.85}(Si_{2.44}Al_{1.57})_{\Sigma 4.01}O_{10.00}[(OH)_{1.35}F_{0.65}]_{\Sigma 2.00}$. ***Relationship to other species:*** A member of the mica group, specifically, the Fe^{2+}-dominant analogue of kinoshitalite and a trioctahedral brittle mica. Only the -1*M* polytype is known.

Name: For the relationship with kinoshitalite. ***Comments:*** IMA No. 1999-026. Prof. A. E. Lalonde, University of Ottawa, assisted in the preparation of this abstract.

GUGGENHEIM, S. and FRIMMEL, H. E. (1999) Ferrokinoshitalite, a new species of brittle mica from the Broken Hill mine, South Africa: structural and mineralogical characterization. *Canadian Mineralogist* **37**, 1445–1452.

Florenskyite Orthorhombic

FeTiP

Locality: The Kaidun meteorite, South Yemen.

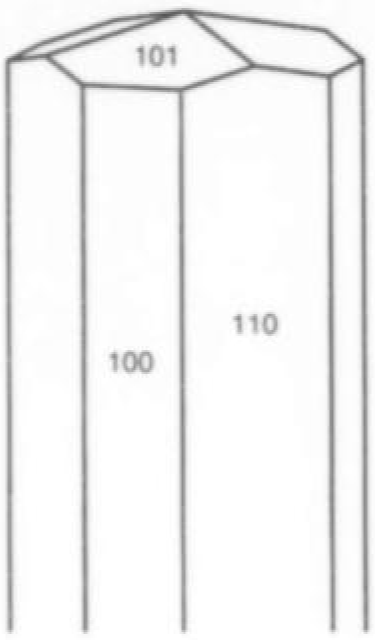
Occurrence: In a chondritic meteorite. Associated minerals are: ferroan serpentine, pentlandite and an uncharacterized Fe-Cr phosphide.

General appearance: Four dispersed grains (up to 14 μm).

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* Megascopic color unknown. *Streak:* not given. *Hardness:* not given. *Tenacity:* not given. *Cleavage:* not given. *Fracture:* not given. *Density:* could not be measured, calculated density not given but was calculated here as 6.08 g/cm^3 (calc.). ***Crystallography:*** Orthorhombic, *Pnma*, *a* 6.007, *b* 3.602, *c* 6.897 Å, *V* 149.23 Å^3, Z 4, *a:b:c* = 1.6677:1:1.9148. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 2.307 (47) (210), 2.301 (100) (112), 2.188 (88) (211), 2.147 (31) (103), 1.938 (45) (013), 1.923 (34) (301), 1.801 (45) (020), 1.115 (38) (230). The pattern was calculated from structural data. ***Optical data:*** In reflected light: creamy white. Other optical properties could not be determined. ***Chemical analytical data:*** Means of three sets of electron microprobe data: Ti 30.08, Cr 0.93, Fe 40.52, Co 0.60, Ni 5.47, V 0.91, Si 0.59, P 21.69, Total 100.79 wt.%. Empirical formula: $(Fe_{0.98}Ni_{0.13}Co_{0.01})_{\Sigma 1.12}(Ti_{0.85}Cr_{0.02}V_{0.02})_{\Sigma 0.89}(P_{0.95}Si_{0.03})_{\Sigma 0.98}$. ***Relationship to other species:*** One of the four known natural phosphides (See Comments).

Name: For Cyrill P. Florensky (1915–1982). Russian geochemist and one of the founders of planetology. ***Comments:*** IMA No. 1999-013. The authors state that there are three other natural phosphides: schreibersite, $(Fe,Ni)_3P$, barringerite, $(Fe,Ni)_2P$, and perryite, $(Ni,Fe)_8(Si,P)_3$. However, strictly speaking, perryite cannot be considered a phosphide because the phosphorus is not dominant. There is another phosphide not mentioned by the authors: nickelphosphide, $(Ni,Fe)_3P$, described in 1999 (See abstract in the *Mineralogical Record* **31**, 369). Florenskyite has the anti-$PbCl_2$ structure and is isostructural with synthetic FeZrP.

IVANOV, A. V., ZOLENSKY, M. E., SAITO, A., OHSUMI, K., YANG, S. V., KONONKOVA, N. N., and MIKOUCHI, T. (2000) Florenskyite, FeTiP, a new phosphide from the Kaidun meteorite. *American Mineralogist* **85**, 1082–1086.



Henrymeyerite

Henrymeyerite

Tetragonal

$BaFeTi_7O_{16}$

Locality: The Kovdor alkaline ultramafic complex, Kola Peninsula, Russia (~ Lat. 67°3′ N, ~ Long. 30°3′ E).

Occurrence: In a late-stage mineral assemblage associated with carbonatitic rocks. Associated minerals are: tetra-ferriphlogopite, calcite, dolomite, fluorapatite, niobian anatase (?), rimkorolgite, catapleiite, collinsite and pyrite.

General appearance: Well-developed acicular crystals (up to 0.2 mm x several tens of µm).

Physical, chemical and crystallographic properties: *Luster:* adamantine. *Diaphaneity:* opaque. *Color:* black. *Streak:* reddish brown. *Hardness:* 5 to 6. *Tenacity:* very brittle. *Cleavage:* not mentioned. *Fracture:* not mentioned. *Density:* 4.0 g/cm^3 (meas.), 4.23 g/cm^3 (calc.). ***Crystallography:*** Tetragonal, *I4/m*, *a* 10.219, *c* 2.963 Å, *V* 309.4 Å^3, Z 1, *c:a* = 0.2900. Morphology: probably {100}, {110} and {101}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.232 (100) (310), 2.486 (34) (211), 2.236 (40) (301), 1.901 (31) (411), 1.703 (22) (600), 1.598 (33) (521), 1.405 (26) (541). ***Optical data:*** In reflected light: grayish brown, weak bireflectance in shades of brown. R_ω, R_ε: (12.0, 13.0 %) 460nm, (11.6, 12.6 %) 540nm, (11.4, 12.7 %) 580nm, (11.3, 13.8 %) 660nm. ***Chemical analytical data:*** Means of eight sets of electron microprobe data: Na_2O 0.40, K_2O 0.05, CaO 0.02, FeO 9.20, BaO 18.25, La_2O_3 0.50, Ce_2O_3 0.56, SiO_2 0.37, TiO_2 67.78, Nb_2O_5 1.00, Total 98.13 wt.%. Empirical formula: $(Ba_{0.96}Na_{0.10}K_{0.01})_{\Sigma 1.07}Fe_{1.03}(Ti_{6.81}Nb_{0.06}Si_{0.05}Ce_{0.03}La_{0.02})_{\Sigma 6.97}O_{16.00}$. ***Relationship to other species:*** A member of the cryptomelane group, specifically the Ba-Fe dominant member.

Name: For Prof. Henry O. A. Meyer (1937–1995) for his contributions to the petrology and mineralogy of mantle-derived xenoliths and kimberlitic rocks and for his services to the mineralogical community.

Comments: IMA No. 1999-016. The crystal drawing presented here was produced from the crystallographic data and the SEM image given in the paper.

MITCHELL, R. H., YAKOVENCHUK, V. N., CHAKHMOURADIAN, A. R., BURNS, P. C., and PAKHOMOVSKY, Y. A. (2000) Henrymeyerite, a new hollandite-type Ba-Fe titanate from the Kovdor complex, Russia. *Canadian Mineralogist* **38**, 617–626.

Hydroxylclinohumite

Monoclinic

$Mg_9(SiO_4)_4(OH,F)_2$

Locality: The ilmenite/magnetite mine of Zelentsovskaya near Magnitka, Zlatoust district, southwestern Urals, Russia.

Occurrence: In magnesium skarn at the contacts between a metagabbro and xenoliths of dolomite marbles. Associated minerals are: calcite, ferroan spinel and clinochlore.

General appearance: Small grains (0.1 to 5 mm) in cavities up to 5 cm in diameter in calciphires.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* yellow-orange. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* VHN_{60} 745 kg/mm^2, Mohs 6½. *Tenacity:* brittle. *Cleavage:* not observed. *Fracture:* uneven. *Density:* 3.13 g/cm^3 (meas.), 3.16 g/cm^3 (calc.). ***Crystallography:*** See Comments. Monoclinic, *$P2_1/c$*, *a* 13.6894, *b* 4.7480, *c* 10.2730 Å, β 100.721°, *V* 656.06 Å^3, Z 2, *a:b:c* = 2.8832:1:2.1636. Morphology: no forms were observed, prismatic [100]. Twinning on {001}. ***X-ray powder diffraction data:*** 5.05 (70) (002, $\bar{1}02$), 3.72 (95) (202), 2.772 (70) ($\bar{1}13$), 2.551 (80) (411), 2.516 (93) ($\bar{3}13$), 2.269 (100) ($\bar{5}12$), 2.259 (95) ($\bar{1}14$), 1.747 (79) (422, $\bar{5}22$, $\bar{1}24$). ***Optical data:*** Biaxial (+), α 1.631, β 1.641, γ 1.664, 2V(meas.) 70°, 2V(calc.) 68°; dispersion weak; pleochroism X = yellow, Y = light yellow, Z = colorless; Y = *b*, X = *c*, Z ∧ *a* = 11° (in obtuse angle β). ***Chemical analytical data:*** Means of two sets of wet chemical analytical data: MgO 57.56, MnO 0.12, FeO 0.70, SiO_2 38.97, TiO_2 0.67, H_2O 2.72, F 0.49, sum 101.23, less O = F 0.21, Total 101.02 wt.%. Empirical formula: $(Mg_{8.81}Fe_{0.06}Ti_{0.05}Mn_{0.01})_{\Sigma 8.93}[Si_{4.00}O_{15.98}][(OH)_{1.86}F_{0.16}]_{\Sigma 2.02}$. ***Relationship to other species:*** A member of the humite group.

Name: For the relationship with clinohumite. ***Comments:*** IMA No. 1998-065. In order to compare monoclinic members of the humite group with orthorhombic members, some mineralogists use a monoclinic unit cell which has its *a* and *b* parameters equivalent to the *a* and *b* parameters of the orthorhombic cell. This nonstandard orientation, adopted by the authors, has the two-fold axis (also referred to as the "unique axis") as *a* instead of *b*. The data given here are for the standard orientation. The data for the nonstandard orientation are: space group *$P2_1/b$*, *a* 4.7480, *b* 10.2730, *c* 13.6894 Å, α 100.721°, *V* 656.06 Å^3, Z 2, *a:b:c* = 0.4622:1:1.3326. The elongation is [001] and twinning is on {010}. Prof. Stefano Merlino (Pisa, Italy) kindly transformed some of the crystallographic data from the nonstandard to the standard orientation.

GEKIMYANTS, V. M., SOKOLOVA, E. V., SPIRIDONOV, E. M., FERRARIS, G., CHUKANOV, N. V., PRENCIPE, M., AVDONIN, V. N. and POLENOV, Yu. A. (1999) Hydroxylclinohumite $Mg_9(SiO_4)_4(OH,F)_2$—a new mineral of the humite group. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **128(5)**, 64–70.

Johntomaite

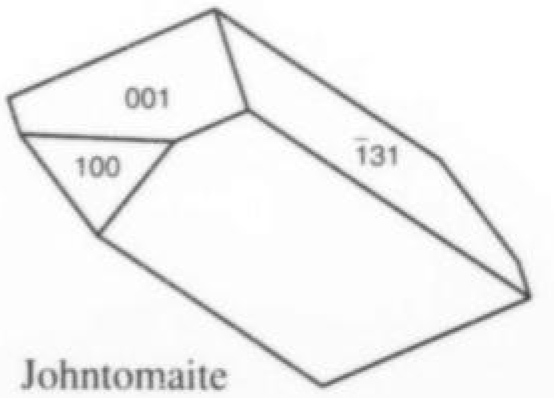
Monoclinic

$BaFe^{2+}_2Fe^{3+}_2(PO_4)_3(OH)_3$

Locality: On the dumps of the Spring Creek copper mine near Wilmington, southern Flinders Ranges, South Australia, Australia (Lat. 32°41′ S, Long. 138°07′ E).

Occurrence: From a heavily brecciated hydrothermal vein. Associated minerals are: quartz, libethenite, pseudomalachite, mitridatite, goethite, cuprite and copper.

General appearance: Clusters of radiating to subparallel prismatic crystals (0.3 to 1 mm long).



Johntomaite

Physical, chemical and crystallographic properties: *Luster:* given as vitreous, greasy to subadamantine, but the optical data indicate adamantine. *Diaphaneity:* opaque. *Color:* greenish black. *Streak:* dark grayish green. *Luminescence:* nonfluorescent. *Hardness:* 4½. *Tenacity:* brittle. *Cleavage:* {100} perfect. *Fracture:* irregular. *Density:* 4.05 g/cm^3 (meas.), 4.08 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, $P2_1/m$, a 9.199, b 12.359, c 5.004 Å, β 100.19°, V 559.9 Å^3, Z 2, a:b:c = 0.7443:1:0.4049. Morphology: {001}, $\{\bar{1}01\}$, {021} and $\{\bar{1}31\}$. Twinning: none observed. ***X-ray powder diffraction data:*** 3.159 (100) (031, $\bar{2}21$), 2.983 (50) (211), 2.749 (50b) (221, $\bar{3}11$), 4.573 (40) (011), 3.091 (40) ($\bar{1}31$). ***Optical data:*** Biaxial (–), α 1.817, β 1.829, γ 1.837, 2V(meas.) 85°, 2V(calc.) 78°; dispersion $r \ll v$, strong; pleochroism strong, X = bluish green, Y = dark brownish green, Z = brownish, absorption Y > X ≥ Z; Z = b. ***Chemical analytical data:*** Means of ten sets of electron microprobe data: Na_2O 0.07, MgO 0.05, CaO 3.28, MnO 2.67, FeO 13.34, CuO 0.07, ZnO 0.06, BaO 21.96, Al_2O_3 0.25, Fe_2O_3 22.62, SiO_2 0.13, P_2O_5 30.45, H_2O 3.73, F 0.36, sum 99.04, less O = F 0.15, Total 98.89 wt.%. Empirical formula: $Ba_{1.00}(Fe_{1.29}$-$Ca_{0.41}Mn_{0.26}Na_{0.02}Mg_{0.01}Cu_{0.01}Zn_{0.01})_{\Sigma 2.01}(Fe^{3+}_{1.97}Al_{0.03})_{\Sigma 2.00}[(P_{2.99}Si_{0.02})$-$O_4]_{3.00}[(OH)_{2.88}F_{0.13}]_{\Sigma 3.01}$. ***Relationship to other species:*** A member of the bjarebyite group, specifically the ferric-dominant analogue of kulanite, $BaFe^{2+}_2Al_2(PO_4)_3(OH)_3$.

Name: For John Toma (1954–) the amateur mineralogist who found the mineral and provided the type specimen. ***Comments:*** IMA No. 1999-009.

KOLITSCH, U., PRING, A., and TIEKINK, E. R. T. (2000) Johntomaite, a new member of the bjarebyite group of barium phosphates: description and structure refinement. *Mineralogy and Petrology* **70**, 1–14.

Juanitaite — Tetragonal

$(Cu,Ca,Fe)_{10}Bi(AsO_4)_4(OH)_{11}\cdot H_2O$

Locality: The Gold Hill mine, Tooele Co., Utah, USA.

Occurrence: On the 30-foot level coating surface and filling thin fractures in limonitic gossan; associated with calcian mixite, conichalcite, chrysocolla, azurite, gold and quartz. On the 150-foot level in as fine-grained coatings on cavity walls in quartz veins; associated with connelite, tyrolite and azurite.

General appearance: Square crystal plates (25 to 150 µm across and 1 µm thick) with rounded corners; also as sheaf-like subparallel aggregates and rosettes.

Physical, chemical and crystallographic properties: *Luster:* resinous to dull. *Diaphaneity:* translucent. *Color:* olive-green to grass-green; reflections from {001} often appear bronzy. *Streak:* pale greenish yellow. *Luminescence:* nonfluorescent. *Hardness:* very soft estimated at about 1. *Tenacity:* flexible but not elastic. *Cleavage:* {001} and {110} perfect, {100} good. *Fracture:* not observed. *Density:* 3.61 g/cm^3 (meas.), 3.56 g/cm^3 (calc.). ***Crystallography:*** Tetragonal, $P4_2/nnm$, a 9.961, c 29.19 Å, V 2896 Å^3, Z 4, c:a = 2.9304. Morphology: {001}, {110} and {310}. Twinning: none observed. ***X-ray powder diffraction data:*** 14.6 (100) (002), 7.04 (50) (110), 6.34 (70) (112), 5.07 (50) (114), 3.146 (60) (310, 303), 2.535 (50) (228). ***Optical data:*** Uniaxial (–), subparallel aggregates show an anomalous biaxial figure with 2V ≃ 20°, ω 1.785, ε 1.705, pleochroism O = olive-brown, E = olive-green. ***Chemical analytical data:*** Means of seven sets of electron microprobe data: CaO 8.64, FeO 2.32, CuO 35.97, Bi_2O_3 14.82, As_2O_5 29.35, H_2O (8.90), Total (100.00) wt.%. Empirical formula: $(Cu_{7.03}Ca_{2.39}Fe_{0.50})_{\Sigma 9.92}$-$Bi_{0.99}(AsO_4)_{3.97}(OH)_{10.90}\cdot 2.22H_2O$. ***Relationship to other species:*** It is chemically similar to mixite, $Cu_6Bi(AsO_4)_3(OH)_6\cdot 3H_2O$.

Name: For Juanita Curtis (1917–) who found the mineral. ***Comments:*** IMA No. 1992-022.

KAMPF, A. R., WISE, W. S., and ROSSMAN, G. R. (2000) Juanitaite—a new mineral from Gold Hill, Utah. *Mineralogical Record* **31**, 301–305.

Kozoite-(Nd) — Orthorhombic

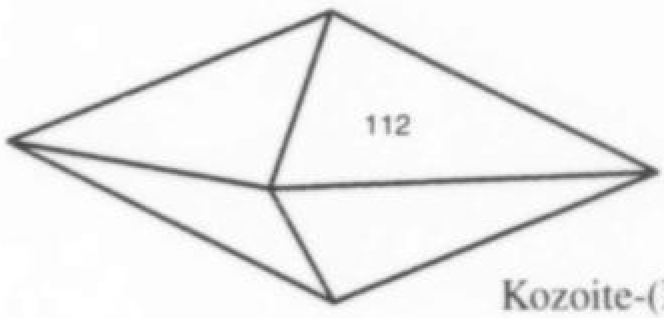
$Nd(CO_3)(OH)$

Locality: Niikoba, Hizen-cho, Higashi Matsuura-gun, Saga Prefecture, Japan.

Occurrence: In cavities and fissures in an alkali olivine basalt. Associated minerals are: lanthanite-(Nd) and/or lanthanite-(La), hyalite-type amorphous silica and kimuraite-(Y).

General appearance: Rhombic bipyramidal crystals (up to 10 µm).

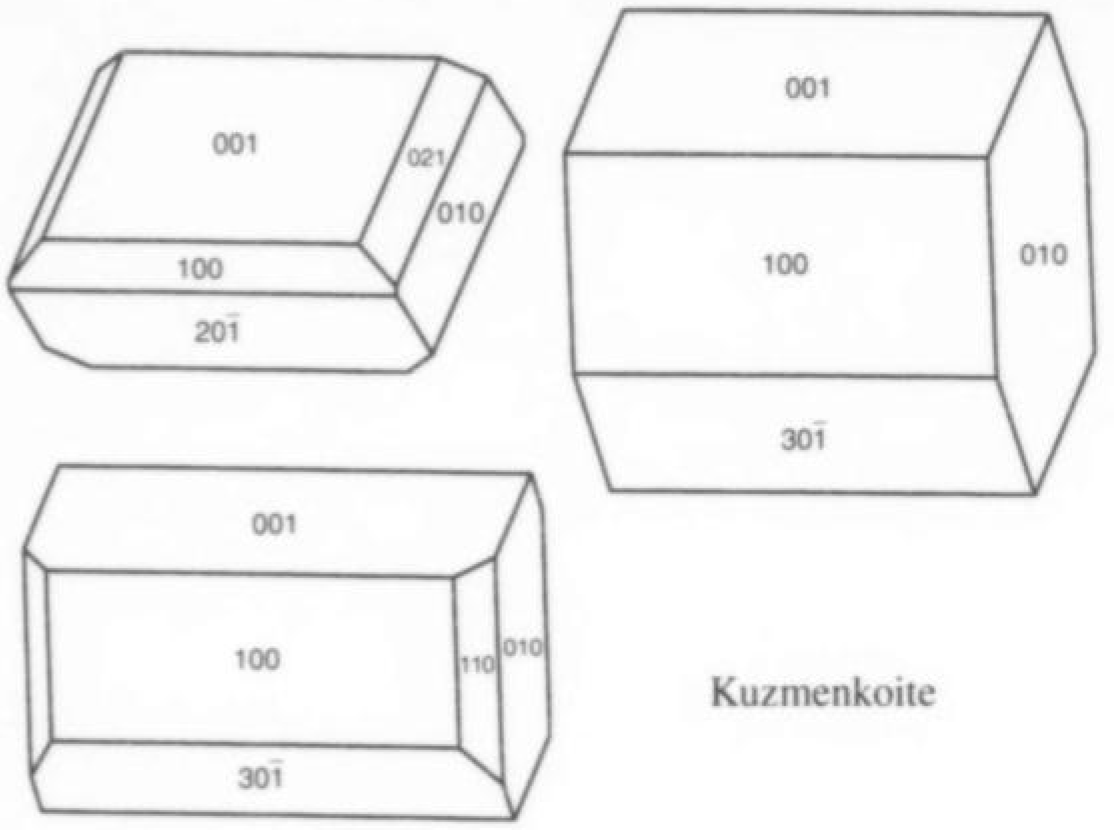
Physical, chemical and crystallographic properties: *Luster:* vitreous to dull. *Diaphaneity:* not given. *Color:* pale pinkish purple to white. *Streak:* not given. *Luminescence:* nonfluorescent. *Hardness:* could not be determined. *Tenacity:* not given. *Cleavage:* could not be determined. *Fracture:* not given. *Density:* could not be measured, 4.40 g/cm^3 (calc.). See Comments. ***Crystallography:*** Orthorhombic, $Pmcn$, a 4.9829, b 8.5188, c 7.2570 Å, V 308.05 Å^3, Z 4, a:b:c = 0.5849:1:0.8519. Morphology: no forms were mentioned, but the form on the crystals shown in the SEM image probably is {112}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 4.29 (100) (110), 3.69 (72) (111), 2.93 (89) (102), 2.640 (59) (031), 2.333 (78) (131), 2.060 (78) (221), 1.994 (75) (212). ***Optical data:*** Biaxial (sign unknown), α 1.698, γ 1.780, high birefringence, 2V not measured, no other properties could be determined. ***Chemical analytical data:*** Means of six sets of electron microprobe data: CaO 0.49, La_2O_3 21.39, Ce_2O_3 0.26, Pr_2O_3 6.25, Nd_2O_3 30.66, Sm_2O_3 5.39, Eu_2O_3 1.84, Gd_2O_3 2.99, Tb_2O_3 0.11, Dy_2O_3 0.24, Y_2O_3 0.70, CO_2 21.10, H_2O 5.44, Total 96.86 wt.%. CO_2 and H_2O by CHN analyzer for C and H. Empirical formula: $(Nd_{0.38}La_{0.28}Pr_{0.08}Sm_{0.07}Gd_{0.03}Eu_{0.02}Ca_{0.02}Y_{0.01})_{\Sigma 0.89}(CO_3)_{1.01}(OH)_{0.63}$-$(H_2O)_{0.32}$. ***Relationship to other species:*** Kozoite-(Nd) is dimorphous with hydroxylbastnäsite-(Nd) and is isostructural with ancylite-(Ce), calcio-ancylite-(Ce), calcio-ancylite-(Nd), ancylite-(La) and gysinite-(Nd).



Kozoite-(Nd)

Name: For Kozo Nagashima (1925–1985), chemist and pioneer in the study of the chemistry of rare earth minerals in Japan, in recognition of his contributions to the mineralogy, chemistry and crystallography of rare earth minerals. ***Comments:*** IMA No. 1998-063. The authors give the calculated density as 4.77 g/cm^3; this is the value based on the ideal composition. The value 4.40 g/cm^3 given above is for the empirical formula. The crystal drawing given here is based on the SEM image.

MIYAWAKI, R., MATSUBARA, S., YOKOYAMA, K., TAKEUCHI, K., TERADA, Y., and NAKAI, I. (2000) Kozoite-(Nd), $Nd(CO_3)(OH)$, a new mineral in an alkali olivine basalt from Hizen-cho, Saga Prefecture, Japan. *American Mineralogist* **85**, 1076–1081.



Kuzmenkoite

Kuzmenkoite

Monoclinic

$K_2(Mn,Fe)(Ti,Nb)_4(Si_4O_{12})_2(OH)_4\cdot 5H_2O$

Locality: Flora Mountain, Lovozero alkaline massif, Kola Peninsula, Russia.

Occurrence: In hydrothermally altered lujavrite. Associated minerals are: labuntsovite, natrolite, calciohilairite, aegirine, eudialyte, lorenzenite, murmanite, potassic feldspar, etc.

General appearance: Prismatic crystals (up to 1.5 mm).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* yellow. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* 5. *Tenacity:* brittle. *Cleavage:* imperfect (direction not given). *Fracture:* rough. *Density:* 2.67 g/cm^3 (meas.), 2.65 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, *C2/m*, *a* 14.369, *b* 13.906, *c* 7.812 Å, β 117.09°, *V* 1389.8 Å^3, Z 2, *a:b:c* = 1.0333:1:0.5618. Morphology: {010}, {100}, {001}, {$\bar{2}01$}, {$\bar{3}01$}, {110}, {021}, elongated on [010]. Twinning: none observed. ***X-ray powder diffraction data:*** 7.00 (9) (001, 020), 6.33 (8) ($20\bar{1}$), 4.86 (7) (021, 111), 3.17 (10) ($42\bar{1}$, $40\bar{2}$), 3.08 (5) (022, $04\bar{1}$), 2.58 (4) ($24\bar{2}$, $20\bar{3}$, 051), 2.47 (4) ($40\bar{3}$, 042), 1.551 (4) ($84\bar{3}$, $17\bar{3}$, $82\bar{4}$). ***Optical data:*** Biaxial (+), α 1.683, β 1.687, γ 1.775, 2V(calc.) 25°; dispersion r > v, medium; pleochroism X = Z = colorless, Y = yellow. ***Chemical analytical data:*** Means of ten sets of electron microprobe data: Na_2O 0.64, K_2O 7.33, MgO 0.31, MnO 4.06, FeO 1.18, BaO 1.17, SiO_2 43.61, TiO_2 25.78, Nb_2O_5 4.82, H_2O 10.93, Total 99.83 wt.% (given as 99.90). H_2O was determined by TGA. Empirical formula: $(K_{1.73}Na_{0.23}Ba_{0.09})_{\Sigma 2.05}$-$(Mn_{0.64}Fe_{0.18}Mg_{0.08})_{\Sigma 0.90}(Ti_{3.58}Nb_{0.40})_{\Sigma 3.98}[Si_{4.03}O_{12.09}]_2(OH)_{4.14}\cdot 4.67H_2O$. ***Relationship to other species:*** Structurally related to labuntsovite.

Name: For M. V. Kuz'menko (1918–1995), a specialist in geochemistry and mineralogy of rare elements and a researcher of the Lovozero massif. ***Comments:*** IMA No. 1998-058. The empirical formula derived here is slightly different from that given in the paper. Details of the crystal structure are given.

CHUKANOV, N. V., PEKOV, I. V., GOLOVINA, N. I. and ZADOV, A. E. (1999) Kuzmenkoite $K_2(Mn,Fe)(Ti,Nb)_4(Si_4O_{12})_2$-$(OH)_4\cdot 5H_2O$, a new mineral. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **128(4)**, 42–50.

Lemmleinite

Monoclinic

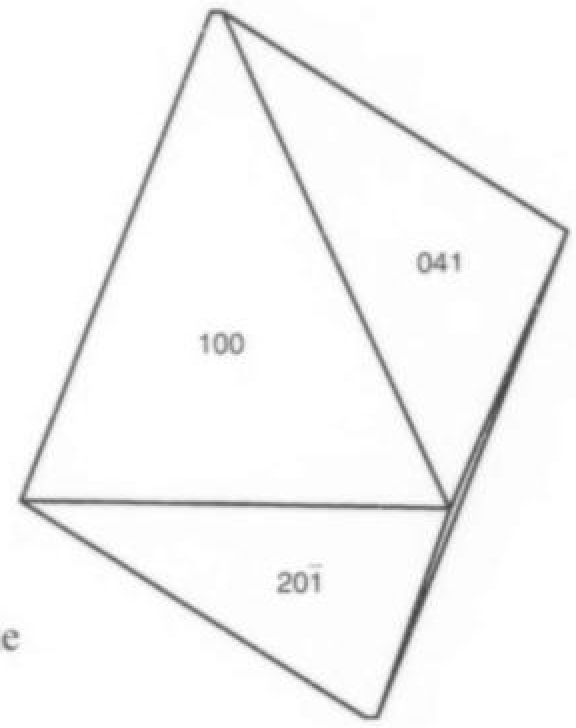
$NaK_2(Ti,Nb)_2Si_4O_{12}(O,OH)_2\cdot 2H_2O$

Locality: Mount Koashva, Khibina alkaline massif, Kola Peninsula, Russia.

Occurrence: In hyperagpaitic pegmatites. Associated minerals are: K-feldspar, natrolite, aegirine, sodium amphibole, pectolite, shcherbakovite, lamprophyllite, catapleiite, sazykinaite-(Y), sitinakite, lomonosovite, rhabdophane-(Ce), sphalerite and galena.

General appearance: Fibrous pseudo-orthorhombic crystals (0.3 to 0.5 mm, rarely up to 1 mm).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent to translucent. *Color:* colorless. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* 5. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* conchoidal. *Density:* 2.80 g/cm^3 (meas.), 2.83 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, *C2/m*, *a* 14.39, *b* 13.90, *c* 7.825 Å, β 117.6°, *V* 1387 Å^3, Z 4, *a:b:c* = 1.0353:1:0.5629. Morphology: {100}, {041}, {$20\bar{1}$}, elongated on [001]. Twinning: on (001) and (041). ***X-ray powder diffraction data:*** 6.94 (61) (020), 6.39 (43b) ($20\bar{1}$, 200), 3.186 (100) ($40\bar{2}$, $42\bar{1}$, 400), 3.100 (96) (041, 022), 2.600 (28) ($24\bar{2}$, $20\bar{3}$), 2.586 (28) (241, 202), 2.489 (24) (401). ***Optical data:*** Biaxial (+), α 1.667, β 1.677, γ 1.802, 2V(meas.) 32°, 2V(calc.) 33°; nonpleochroic; X = *b*, Z = *a*, Y ∧ c = 27° (in obtuse angle β). ***Chemical analytical data:*** Means of four sets of electron microprobe data: Na_2O 5.30, K_2O 14.92, CaO 0.02, MnO 0.06, FeO 0.04, SrO 0.02, Al_2O_3 0.06, SiO_2 39.78, TiO_2 18.42, Nb_2O_5 13.52, Ta_2O_5 0.16, H_2O 7.23, Total 99.53 wt.%. Empirical formula: $Na_{1.02}K_{1.88}(Ti_{1.37}Nb_{0.61}Mn_{0.01})_{\Sigma 1.99}$-$(Si_{3.94}Al_{0.01})_{\Sigma 3.95}O_{12.00}[O_{1.24}(OH)_{0.76}]_{\Sigma 2.00}\cdot 2.00H_2O$. ***Relationship to other species:*** Crystallochemically related to nenadkevichite and labuntsovite.



Lemmleinite

Name: For Georgy G. Lemmlein (1901–1962), prominent Russian mineralogist and crystallographer. ***Comments:*** IMA No. 1997-003.

KHOMYAKOV, A. P., NECHELYUSTOV, G. N., RASTSVETAEVA, R. K., and DOROKHOVA, G. I. (1999) Lemmleinite $NaK_2(Ti,Nb)_2Si_4O_{12}(O,OH)_2\cdot 2H_2O$—a new mineral of the labuntsovite-nenadkevichite family. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **128(5)**, 54–63.

Litvinskite

Monoclinic

$Na_2(\square,Na,Mn)Zr[Si_6O_{12}(OH,O)_6]$

Locality: The Umbozero mine, Alluaiv Mt., Lovozero alkaline massif, Kola peninsula, Russia.

Occurrence: In the aegirine zone of a hyperagpaitic pegmatite. Associated minerals are: microcline, nepheline, sodalite, eudialyte, lomonosovite, ussingite, mangan-neptunite, terskite and gaidonnayite.

General appearance: Equant irregular grains (up to 7 cm) and aggregates (up to 15 cm).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* dark cherry red to reddish brown. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* ~5. *Tenacity:* brittle. *Cleavage:* probably {110} imperfect. *Fracture:* conchoidal. *Density:* 2.61 g/cm^3 (meas.), 2.55 g/cm^3 (calc.) given as 2.63 g/cm^3. ***Crystallography:*** Monoclinic, *Cm*, *a* 10.589, *b* 10.217, *c* 7.355 Å, β 92.91°, *V* 794.6 Å^3, Z 2, *a:b:c* = 1.0364:1:0.7199. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 7.37 (44) (110, 001), 5.29 (100) (11$\bar{1}$, 200), 3.674 (32) (220, 002), 3.329 (74) (11$\bar{2}$, 11$\bar{2}$, 310), 3.238 (100) (130, 221, 112), 2.981 (39) (13$\bar{1}$, 022, 311), 2.642 (32) (22$\bar{2}$, 400), 2.553 (37) (040, 222). ***Optical data:*** Biaxial (–), α 1.546, β 1.574, γ 1.575, 2V(meas.) <10°, 2V(calc.) 21°; dispersion not observed; nonpleochroic; orientation not given. ***Chemical analytical data:*** Electron microprobe data: Na_2O 12.43, K_2O 0.11, CaO 0.13, MnO 1.61, FeO 0.09, Ce_2O_3 0.09, SiO_2 57.67, TiO_2 0.19, ZrO_2 18.85, HfO_2 0.22, Nb_2O_5 0.07, H_2O 8.90, Total 100.36 wt.%. Empirical formula: $(Na_{1.99}K_{0.01})_{\Sigma 2.00}(Na_{0.45}Mn_{0.14}$-$Ca_{0.01}Fe_{0.01})_{\Sigma 0.61}(Zr_{0.93}Ti_{0.01}Hf_{0.01})_{\Sigma 0.95}Si_{5.84}O_{11.99}(OH)_{6.01}$. ***Relationship to other species:*** A member of the lovozerite group.

Name: For Galina P. Litvinskaya (1920–1994), a crystallographer at Moscow State University. ***Comments:*** IMA No. 1999-017.

PEKOV, I. V., EKIMENKOVA, I. A., CHUKANOV, N. V., ZADOV, A. E., YAMNOVA, N. A., and EGOROV-TISMENKO, Yu. K. (2000) Litvinskite $Na_2(\square,Na,Mn)Zr[Si_6O_{12}(OH,O)_6]$—a new mineral of the lovozerite group. *Zapiski Vserossiyskogo Mineralogicheskogo Obshchestva* **129(1)**, 45–53.

Lulzacite

Triclinic

$Sr_2Fe^{2+}(Fe^{2+},Mg)_2Al_4(PO_4)_4(OH)_{10}$

Locality: A quartzite quarry near Saint-Aubin-des-Châteaux, about 8 km west of Châteaubriant, Loire-Atlantique, France.

Occurrence: In veinlets at the contact between quartzite and pyrite-rich limestone. Associated minerals are: goyazite, "apatite," siderite, quartz, calcite, marcasite, pyrrhotite and pyrite.

General appearance: Anhedral aggregates (up to several cm long); rarely as pseudo-pyramidal euhedral crystals (up to 4 mm).

Physical, chemical and crystallographic properties: *Luster:* probably vitreous. *Diaphaneity:* transparent to translucent. *Color:* dark grayish-green to yellowish-green. *Streak:* not given. *Luminescence:* nonfluorescent. *Hardness:* 5½ to 6. *Tenacity:* not given. *Cleavage:* not given. *Fracture:* not given. *Density:* 3.55 g/cm^3 (meas.), 3.56 g/cm^3 (calc.). ***Crystallography:*** Triclinic, *P*$\bar{1}$, *a* 5.457, *b* 9.131, *c* 9.769 Å, α 108.47°, β 91.72°, γ 97.44°, *V* 465.5 Å^3, Z 1, *a:b:c* = 0.5976:1:1.0699. Morphology: No forms were mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 4.47 (41) (02$\bar{1}$), 3.591 (50) (111), 3.218 (100) (1$\bar{2}$2), 3.132 (62) (120), 3.016 (56) (12$\bar{2}$), 2.878 (42) (03$\bar{2}$), 2.8119 (58) (11$\bar{3}$), 2.6526 (44) (1$\bar{3}$2), 2.6635 (43) (013). ***Optical data:*** Biaxial (–), α 1.654, β 1.674, γ 1.684, 2V(meas.) 45° to 65°, 2V(calc.) 70°, dispersion r < v, distinct; pleochroism distinct from brown-yellow to pale blue-violet; orientation not given. ***Chemical analytical data:*** Means of fifteen sets of electron microprobe data: MgO 2.97, SrO 21.79, BaO 1.20, FeO 16.13, MgO 2.97, Al_2O_3 19.16, P_2O_5 28.50, V_2O_5 0.64, H_2O 10.29, Total 100.68 wt.%. Empirical formula: $(Sr_{2.05}Ba_{0.08})_{\Sigma 2.13}$-$Fe^{2+}_{1.00}(Fe^{2+}_{1.18}Mg_{0.71})_{\Sigma 1.89}Al_{3.66}[(PO_4)_{3.91}(VO_4)_{0.07}]_{\Sigma 3.98}(OH)_{11.11}$. The ideal formula requires: MgO 3.31, FeO 16.20, SrO 21.25, Al_2O_3 20.91, P_2O_5 29.09, H_2O 9.24, Total 100.00 wt.%. ***Relationship to other species:*** It is isotypic with jamesite whose revised formula is $Pb_2ZnFe^{3+}_2(Fe^{3+}_{2.8}Zn_{1.2})(AsO_4)_4(OH)_8[(OH)_{1.2}O_{0.8}]$.

Name: For Y. Lulzac (1934–), mining geologist of the BRGM who discovered the mineral. ***Comments:*** IMA No. 1998-039. Note that the crystal structure has been solved and published.

LÉONE, P., PALVADEAU, P. and MOËLO, Y. (2000) Structure cristalline d'un nouvel hydroxyphosphate naturel de strontium, fer et aluminium (lulzacite), $Sr_2Fe(Fe_{0.63}Mg_{0.37})_2Al_4(PO_4)_4(OH)_{10}$.

MOËLO, Y., LASNIER, B., PALVADEAU, P., LÉONE, P., and FONTAN, F. (2000) La lulzacite, $Sr_2Fe^{2+}(Fe^{2+},Mg)_2Al_4(PO_4)_4$-$(OH)_{10}$, un nouveau phosphate de strontium (Saint-Aubin-des-Châteaux, Loire-Atlantique, France). *Comptes Rendu Académie des Sciences de la terres et des planètes* **330**, 317–324.

Magnesiofoitite

Trigonal

$\square(Mg_2Al)Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

Locality: The Kyonosawa area, Mitomi-mura, Higashi-Yamanashi-gun, Yamanashi-ken Prefecture, Honshu, Japan (approximately 100 km west of Tokyo).

Occurrence: In highly altered andesitic to dacitic rocks. Associated minerals are: quartz, dumortierite, kaolinite and rutile.

General appearance: Felted masses of fibrous crystals; individual crystals average ~ 5 µm wide by 50 µm long with the largest about 15 µm wide by 1 mm long.

Physical, chemical and crystallographic properties: *Luster:* presumably vitreous. *Diaphaneity:* not given. *Color:* pale bluish gray. *Streak:* not given. *Luminescence:* not given. *Hardness:* ~ 7. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* not given. *Density:* could not be measured, 3.00 g/cm^3 (calc.). ***Crystallography:*** Trigonal, *R*3*m*, *a* 15.884, *c* 7.178 Å, *V* 1568.0 Å^3, Z 3, *c:a* = 0.4519. Morphology: no forms were mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 6.366 (6) (101), 4.211 (9) (211), 3.969 (10) (220), 3.470 (6) (012), 2.949 (7) (122), 2.567 (10) (051), 2.037 (5) (152). ***Optical data:*** Uniaxial (+) erroneously given as (–), ω 1.624, ε1.650, pleochroism O = gray-blue, E = pale lavender, absorption O > E. ***Chemical analytical data:*** An electron microprobe analysis gave: Na_2O 0.70, MgO 6.15, FeO 0.97, B_2O_3 (11.09), Al_2O_3 40.17, SiO_2 38.27, H_2O (3.82), Total 101.17 wt.%. B_2O_3 and H_2O were calculated to give B = 3 and OH = 4 in the formula. Empirical formula: $(\square_{0.79}Na_{0.21})_{\Sigma 1.00}(Mg_{1.42}Al_{1.35}Fe_{0.13})_{\Sigma 1.90}Al_{6.00}$-$Si_{5.94}O_{18.13}(BO_3)_{2.97}(OH)_{3.96}$. After adjustment to B = 3.00 and OH = 4.00, this becomes: $(\square_{0.79}Na_{0.21})_{\Sigma 1.00}(Mg_{1.44}Al_{1.42}Fe_{0.13})_{\Sigma 1.99}$-$Al_{6.00}Si_{6.00}O_{18.00}(BO_3)_{3.00}(OH)_{4.00}$. ***Relationship to other species:*** A member of the tourmaline group.

Name: For the relationship with foitite. ***Comments:*** IMA No. 1998-037.

HAWTHORNE, F. C., SELWAY, J. B., KATO, A., MATSUBARA, S., SHIMIZU, M., GRICE, J. D., and VAJDAK, J. (1999) Magnesiofoitite, $\square(Mg_2Al)Al_6(Si_6O_{18})(BO_3)_3(OH)_4$, a new alkali-deficient tourmaline. *Canadian Mineralogist* **37**, 1439–1443.

Mozgovaite

Orthorhombic

$PbBi_4(S,Se)_7$

Locality: La Fossa crater of Volcano, one of the Aeolian Islands, north of Sicily, Italy.

Occurrence: A sublimate in a fumarole. Associated minerals are: bismuthinite (dominant), galenobismutite, cannizzarite and lillianite.

General appearance: Acicular crystals (up to 0.2 mm long x 0.02 mm wide).

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* silvery gray. *Streak:* not given but probably gray to black. *Hardness:* VHN_{10} 116 kg/mm^2. *Tenacity:* not given. *Cleavage:* not given. *Fracture:* not given. *Density:* could not be measured, 6.29 g/cm^3 (calc.) (given as 6.26 g/cm^3). ***Crystallography:*** Orthorhombic, *Bbmm*, *a* 13.18, *b* 37.4, *c* 4.05 Å, *V* 1996.4 Å^3, Z 6, *a:b:c* = 0.3524:1:0.1083. Morphology: no forms were mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.80 (10) (280, 121), 3.58 (3) (141), 3.40 (2) (151), 3.30 (3) (400), 3.11 (2) (430), 2.95 (4B) (321), 2.81 (2) (191, 470), 2.34 (4B) (0.16.0). ***Optical data:*** In reflected light: white, rather strong anisotropism, very weak bireflectance, nonpleochroic. R_1, R_2: (40.2, 35.8 %) 460nm, (40.6, 35.3 %) 540nm, (40.6, 35.0 %) 580nm, (40.1, 34.9 %) 660nm. ***Chemical analytical data:*** Means of four sets of electron microprobe data: Cu 0.01, Pb 13.90, Fe 0.02, Cd 0.26, Se 1.63, As 0.05, Bi 64.79, S 16.91, Total 97.57 wt.%. Empirical formula: $(Pb_{0.87}Cd_{0.03})_{\Sigma 0.90}(Bi_{4.01}As_{0.01})_{\Sigma 4.02}(S_{6.82}Se_{0.27})_{\Sigma 7.09}$. ***Relationship to other species:*** It is the natural analogue of synthetic $PbBi_4S_7$.

Name: For Dr. Nadezhda Nikolaevna Mozgova (1931–), mineralogist of IGEM, Academy of Sciences, Moscow, Russia, in recognition of her important contributions to the knowledge of ore mineralogy and, particularly, sulfosalt minerals. ***Comments:*** IMA No. 1998-060.

VURRO, F., GARAVELLI, A., GARBARINO, C., MOËLO, Y., and BORODAEV, Yu. S. (1999) Rare sulfosalts from Vulcano, Aeolian Islands, Italy. II. Mozgovaite, $PbBi_4(S,Se)_7$, a new mineral species. *Canadian Mineralogist* **37**, 1499–1506.

Niobokupletskite Triclinic

$K_2Na(Mn,Zn,Fe)_7(Nb,Zr,Ti)_2Si_8O_{26}(OH)_4(O,F)$

Locality: Poudrette Quarry, Mont Saint-Hilaire, Rouville County, Quebec, Canada.

Occurrence: In nepheline syenite pegmatites. There are three distinct types of material, each with its own suite of associated minerals. Type-I: kupletskite, aegirine, albite, microcline and pyrochlore. Type-II: kupletskite, aegirine, albite, calcio-ancylite-(Ce), catapleiite, microcline, natrolite, pyrochlore and rhodochrosite. Type-III: kupletskite, aegirine, albite, analcime, calcio-ancylite-(Ce), calcite, catapleiite, epididymite, fluorite, genthelvite, microcline, natrolite, pyrochlore, rhodochrosite and wurtzite.

General appearance: Type-I: anhedral to subhedral, platy to tabular epitaxic growths on kupletskite. Type-II: dense, fibrous overgrowth on kupletskite. Type-III: very fine-grained acicular crystals in sheaf-like aggregates (originally described as "witch's broom astrophyllite"). Size varies from zones up to 0.5 mm, grains up to 1 mm in diameter and aggregates 5.0 x 2.0 mm of acicular crystals 1.0 x 0.05 mm.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* light beige to yellow (Type-I), light yellow-brown (Type-II), bronze to silvery brown (Type-III). *Streak:* light brown. *Luminescence:* nonfluorescent. *Hardness:* 3 to 4. *Tenacity:* brittle. *Cleavage:* {001} perfect. *Fracture:* uneven to splintery. *Density:* greater than 3.325 g/cm^3 (meas.), 3.46 g/cm^3 (calc.). ***Crystallography:*** Triclinic, $P\bar{1}$, *a* 5.4303, *b* 11.924, *c* 11.747 Å, α 112.927°, β 94.750°, γ 103.175°, *V* 669.5 Å^3, Z 1, *a:b:c* = 0.4554:1:0.9852. Morphology: no forms were mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 10.707 (100) (001), 4.405 (20) $(\bar{1}\bar{1}1)$, 3.536 (50) (003), 3.294 (20) $(\bar{1}\bar{1}3)$, 2.793 (40) $(\bar{1}\bar{3}1)$, 2.677 (30) $(\bar{2}11)$, 2.587 (40) (130), 2.503 (20) $(\bar{2}12)$. ***Optical data:*** Biaxial (+), α 1.718, β 1.733, γ(calc.) 1.750, 2V(meas.) 87°; pleochroism X ≈ Y = light orange-yellow, Z = red-brown; X and Y in the (001) plane, Z = *c*. ***Chemical analytical data:*** Analytical data for all three types are given. Means of three sets of electron microprobe data for Type-I: Na_2O 2.62, K_2O 5.97, Rb_2O 0.82, Cs_2O 0.12, MgO 0.15, MnO 26.37, FeO 2.64, ZnO 4.08, Al_2O_3 1.14, SiO_2 31.85, TiO_2 1.34, ZrO_2 3.43, Nb_2O_5 12.13, Ta_2O_5 0.63, H_2O 2.48, F 0.14, sum 95.91, less O = F 0.06, Total 95.85 wt.%. Empirical formula: $(K_{1.84}Rb_{0.13}Cs_{0.01})_{\Sigma 1.98}Na_{0.95}(Mn_{5.40}Zn_{0.73}Fe_{0.53}Na_{0.28}Mg_{0.05})_{\Sigma 6.99}(Nb_{1.33}Zr_{0.40}Ta_{0.04})_{\Sigma 2.01}(Si_{7.71}Al_{0.33})_{\Sigma 8.03}O_{26.00}(OH)_{4.00}(O_{0.89}F_{0.11})_{\Sigma 1.00}$. ***Relationship to other species:*** It is a member of the astrophyllite group, specifically the K-Mn-Nb-dominant member.

Name: For the relationship to kupletskite. ***Comments:*** IMA No. 1999-032.

PIILONEN, P. C., LALONDE, A. E., McDONALD, A. M., and GAULT, R. A. (2000) Niobokupletskite, a new astrophyllite-group mineral from Mont Saint-Hilaire, Quebec, Canada: description and crystal structure. *Canadian Mineralogist* **38**, 627–639.

Obertiite Monoclinic

$NaNa_2(Mg_3Fe^{3+}Ti^{4+})Si_8O_{22}O_2$

Locality: The Bellerberg quarry, Laacher See district, Eifel region, Germany.

Occurrence: In cavities with basaltic flows. Associated minerals are: tridymite, fluororichterite, hematite, rutile, aegirine-augite, kinoshitalite and fluorapatite.

General appearance: Elongated blades (up to 10 x 40 x 200 μm) and divergent aggregates.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* presumably transparent to translucent. *Color:* pale pink. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* 5. *Tenacity:* brittle. *Cleavage:* {110} perfect. *Fracture:* conchoidal. *Density:* could not be measured, 3.17 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, *C2/m*, *a* 9.776, *b* 17.919, *c* 5.292 Å, β 104.05°, *V* 899.3 Å^3, Z 2, *a:b:c* = 0.5456:1:0.2953. Morphology: no forms were mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 8.414 (10) (110), 4.467 (5) (040), 3.39 (6) (131), 3.117 (5) (310), 2.705 (7) (331, 151), 2.531 (5) (202). ***Optical data:*** Biaxial (–), α 1.643, β 1.657, γ 1.670, 2V(meas.) 81°, 2V(calc.) 87° (given as 93°); dispersion not visible; pleochroism slight in shades of pink to red-orange, absorption X ~ Y ~ Z; X ∧ *a* = 2° (in obtuse angle β), Y ∧ *c* = 12° (in obtuse angle β), Z = *b*. ***Chemical analytical data:*** Means of ten sets of electron microprobe data: Li_2O 0.05, Na_2O 9.51, K_2O 0.98, MgO 14.13, CaO 0.52, FeO 3.36, ZnO 0.08, Al_2O_3 0.15, Mn_2O_3 3.27, Fe_2O_3 2.61, SiO_2 54.53, TiO_2 7.75, H_2O 0.20, F 0.55, sum 97.69, less O = F 0.23, Total 97.46 wt.%. The Mn^{3+}:Mn^{2+} and Fe^{3+}:Fe^{2+} ratios are not known so calculations were carried out expressing all manganese as Mn^{3+} and also as Mn^{2+}. Fe^{3+} and Fe^{2+} were adjusted for each of these assumed valence states of manganese and the site occupancies are based on the crystal structure refinement. The empirical formula derived in this manner is: $(Na_{0.82}K_{0.18})_{\Sigma 1.00}(Na_{1.84}Ca_{0.08}Fe^{2+}_{0.06})_{\Sigma 1.98}(Mg_{3.09}Ti_{0.86}Mn^{3+}_{0.37}Fe^{2+}_{0.35}Fe^{3+}_{0.30}Al_{0.03})_{\Sigma 5.00}Si_{8.00}O_{22.00}[O_{1.54}F_{0.26}(OH)_{0.20}]_{\Sigma 2.00}$. ***Relationship to other species:*** It is the second anhydrous member of the amphibole group; the first is ungarttiite.

Name: For Dr. Roberta Oberti (1951–), Pavia, Italy, for her contributions to the understanding of the crystal chemistry of the amphibole group. ***Comments:*** IMA No. 1998-046.

HAWTHORNE, F. C., COOPER, M. A., GRICE, J. D., and OTTOLINI, L. (2000) A new anhydrous amphibole from the Eifel region, Germany: Description and crystal structure of obertiite, $NaNa_2(Mg_3Fe^{3+}Ti^{4+})Si_8O_{22}O_2$. *American Mineralogist* **85**, 236–241.

Orlandiite Triclinic

$Pb_3Cl_4(SeO_3)\cdot H_2O$

Locality: The Baccu Locci mine near Villaputzu, Cagliari, at the northern border of the Sarrabus-Gerrei mining region, Sardinia, Italy.

Occurrence: In the oxidation zone of an old lead and arsenic mine. Associated minerals are: a second new selenite, $Pb_4CuCl_3(SeO_3)_3(OH)$, chalcomenite (up to 2 cm long!), atacamite, pseudoboléite, chlorargyrite, olsacherite, mandarinoite, schmiederite, francisite, clausthalite-galena, galena, covellite and arsenopyrite.

General appearance: Elongate tabular crystals (up to 150 μm long).

Physical, chemical and crystallographic properties: *Luster:* given as vitreous to silky, but the optical data indicate adamantine. *Diaphaneity:* translucent. *Color:* colorless to white. *Streak:* not given but presumably white. *Luminescence:* nonfluorescent. *Hardness:* not given. *Tenacity:* brittle. *Cleavage:* {010} perfect. *Fracture:* not given. *Density:* could not be measured, 5.60 g/cm³ (calc.) given as 5.66 g/cm³. ***Crystallography:*** Triclinic, $P\bar{1}$, *a* 8.136, *b* 8.430, *c* 9.233 Å, α 62.58°, β 71.84°, γ 75.13°, *V* 529.29 Å³, Z 2, *a:b:c* = 0.9651:1:1.0953. Morphology: only {010} was mentioned. Twinning: invariably on {010}. ***X-ray powder diffraction data:*** 8.090 (36) (001), 4.000 (100) (002), 3.818 (55) (201), 3.731 (44) (122), 3.258 (75) ($\bar{1}$21), 3.188 (75) ($\bar{2}$01), 2.728 (38) (223), 2.365 (37) ($\bar{1}$23), 2.103 (40) (142). ***Optical data:*** Complete optical data could not be determined because the mineral reacts with liquids of high indices of refraction. Measurement of the Brewster angle gave a value of 1.96 for the mean index of refraction. ***Chemical analytical data:*** Means of eight sets of electron microprobe data: FeO 0.42, CuO 0.39, ZnO 0.35, CdO 0.11, PbO 74.18, SO_2 0.20, SeO_2 12.31, H_2O (2.34), Cl 14.35, sum (104.65), less O = Cl 3.24, Total (101.41) wt.%. Water was calculated from the structure determination and charge balance. Empirical formula: $(Pb_{2.93}Fe_{0.05}Cu_{0.04}Zn_{0.04}Cd_{0.01})_{\Sigma 3.07}[Cl_{3.57}(OH)_{0.55}]_{\Sigma 4.12}[(SeO_3)_{0.98}(SO_3)_{0.03}]_{\Sigma 1.01}\cdot 0.87H_2O$ (See Comments). ***Relationship to other species:*** None apparent.

Name: For Prof. Paolo Orlandi (1946–), University of Pisa, in recognition of his contributions to the study of new minerals and mineral occurrences in Italy. ***Comments:*** IMA No. 1998-038. No true empirical formula is presented in the paper; the one given here was derived by the abstractor. The ideal or theoretical composition given in the paper as PbO 75.50, SeO_2 11.67, Cl 13.73, H_2O 2.20, sum 103.10, less O = Cl 3.10, Total 100.00 wt.% is incorrect and should be: PbO 73.71, SeO_2 12.22, Cl 15.61, H_2O 1.98, sum 103.52, less O = Cl 3.52, Total 100.00 wt.%.

CAMPOSTRINI, I., GRAMACCIOLI, C. M., and DEMARTIN, F. (1999) Orlandiite, $Pb_3Cl_4(SeO_3)\cdot H_2O$, a new mineral species, and an associated lead-copper selenite chloride from the Baccu Locci mine, Sardinia, Italy. *Canadian Mineralogist* **37**, 1493–1498.

Potassic-ferrisadanagaite Monoclinic

$(K,Na)Ca_2(Fe^{2+},Mg)_3(Fe^{3+},Al)_2[Si_5Al_3O_{22}](OH)_2$

Locality: Ilmen Mountain, South Urals, Ilmen Nature Reserve, Miass, Chelyabinsk region, Russia.

Occurrence: In the contact zone of the Ilmen alkaline massif as a rock forming mineral in amphibole syenite. Associated minerals are: alkali feldspar, "plagioclase," "garnet," titanite and "apatite."

General appearance: Fine, short prismatic grains (up to 1 mm) and coarse poikilitic grains (1.5 to 3 mm).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent in small fragments. *Color:* black. *Streak:* greenish-gray. *Luminescence:* not mentioned. *Hardness:* 5½ to 6. *Tenacity:* brittle. *Cleavage:* {110} perfect. *Fracture:* uneven to subconchoidal. *Density:* 3.44 g/cm³ (meas.), 3.40 g/cm³ (calc.). ***Crystallography:*** Monoclinic, *C2/m*, *a* 9.94, *b* 18.08, *c* 5.38 Å, β 105.5°, *V* 932 Å³, Z 2, *a:b:c* = 0.5498:1:0.2976. Morphology: {110}, {010}, prismatic. Twinning: none observed. ***X-ray powder diffraction data:*** 8.44 (90) (110), 3.405 (25) (131), 3.285 (30) (240), 3.145 (100) (310), 2.823 (26) (330), 2.722 (52) (151), 2.606 (27) (061), 2.579 (25) (20$\bar{2}$), 2.356 (24) (42$\bar{1}$). ***Optical data:*** Biaxial (–), α 1.696, β 1.712 (calc. here), γ 1.715, 2V(meas.) 45°, dispersion not determined; pleochroism X = brownish yellow, Y = brownish green, Z = bluish green; Y = *b*, Z ∧ c = 20°. ***Chemical analytical data:*** Wet chemical analysis gave: Na_2O 1.78, K_2O 3.20, MgO 2.31, CaO 10.04, MnO 1.83, FeO 16.13, Al_2O_3 18.25, Fe_2O_3 9.25, SiO_2 33.24, TiO_2 1.58, H_2O 1.30, F 0.80, sum 99.71, less O = F 0.34, Total 99.37 wt.%. Empirical formula: $(K_{0.65}Na_{0.28})_{\Sigma 0.93}(Ca_{1.72}Na_{0.27}Mn_{0.01})_{\Sigma 2.00}(Fe^{2+}_{2.16}Fe^{3+}_{1.11}Al_{0.75}Mg_{0.55}Mn_{0.24}Ti_{0.19})_{\Sigma 5.00}(Si_{5.31}Al_{2.69})_{\Sigma 8.00}O_{22.00}(OH)_{1.39}F_{0.40}O_{0.21}]_{\Sigma 2.00}$. ***Relationship to other species:*** A member of the amphibole group.

Name: Follows the IMA approved nomenclature for the amphibole group. ***Comments:*** IMA No. 1997-035. The subscripts of the empirical formula derived here are somewhat different from those given by the authors.

BAZHENOV, A. G., BAZHENOVA, L. F., KRINOVA, T. V., and KHVOROV, P. V. (1999) Potassicferrisadanagaite $(K,Na)Ca_2(Fe^{2+},Mg)_3(Fe^{3+},Al)_2[Si_5Al_3O_{22}](OH)_2$, a new mineral species of the amphibole group (Ilmen Mountain, the South Urals). *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **128(4)**, 50–55.

Remondite-(La) Monoclinic

$Na_3(La,Ce,Ca)_3(CO_3)_5$

Locality: Koashva Mt., Khibiny alkaline massif, Kola Peninsula, Russia.

Occurrence: In the aegirine core of a small hyperagpaitic pegmatite. Associated minerals are: cancrisilite, microcline, sodalite, villiaumite, natrolite, pectolite, lomonosovite, barytolamprophyllite, catapleiite, natron, thermonatrite, sazykinaite-(Y), "Nb-rinkite," vitusite-(Ce) and fluorcaphite.

General appearance: Rough prismatic segregations (up to 2 x 0.8 x 0.5 mm) made up of tiny (up to 5 μm) irregular grains.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* translucent. *Color:* bright orange yellow. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* ~3. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* conchoidal. *Density:* 3.5 g/cm³ (meas.), 3.56 g/cm³ (calc.). ***Crystallography:*** Monoclinic, $P2_1$ (?), *a* 10.49, *b* 6.417, *c* 10.50 Å, β 119.8°, *V* 613 Å³, Z 2, *a:b:c* = 1.6347:1:1.6363. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 5.28 (5) (101, 011, 20$\bar{1}$, 110), 3.70 (7) (012), 3.036 (9) (211, 31$\bar{1}$), 2.740 (5) (310, 121), 2.623 (10) (20$\bar{4}$, 022, 40$\bar{2}$, 220), 2.143 (8) (014, 410), 2.041 (6) (222), 1.985 (5) (401, 21$\bar{5}$), 1.939 (6) (032, 230). ***Optical data:*** Biaxial (–), α 1.615, β 1.619, γ 1.622, 2V(meas.) 80°, 2V(calc.) 82°; dispersion not observed; nonpleochroic; orientation not given. ***Chemical analytical data:*** Means of eleven sets of electron microprobe data: Na_2O 15.48, K_2O 0.58, CaO 5.13, SrO 2.93, BaO 0.18, La_2O_3 19.75, Ce_2O_3 16.67, Pr_2O_3 0.99, Nd_2O_3 2.27, Sm_2O_3 0.37, CO_2 32.97, ThO_2 1.34, Total 98.66 wt.%. Empirical formula: $Na_{3.00}(La_{0.81}Ce_{0.68}Ca_{0.61}Na_{0.33}Sr_{0.19}Nd_{0.09}K_{0.08}Pr_{0.04}Th_{0.03}Sm_{0.01}$-$Ba_{0.01})_{\Sigma 2.88}(CO_3)_{4.99}$. ***Relationship to other species:*** The La-dominant analogue of remondite-(Ce).

Name: For the relationship with remondite-(Ce). ***Comments:*** IMA No. 1999-006. The subscripts derived here for the empirical formula are somewhat different to those given in the paper.

PEKOV, I. V., CHUKANOV, N. V., KONONKOVA, N. N., ZADOV, A. E., and BELOVITSKAYA, Yu. V. (2000) Remondite-(La), $Na_3(La,Ce,Ca)_3(CO_3)_5$—a new mineral of the burbankite family from Khibiny Massif, Kola Peninsula. *Zapiski Vserossiyskogo Mineralogicheskogo Obshchestva* **129(1)**, 53–60.

Scainite

Monoclinic

$Pb_{14}Sb_{30}S_{54}O_5$

Locality: The Buca della Vena mine, southern Apuan Alps, near Pietrasanta, northern Tuscany, Italy (Lat. 43°59′55″ N, Long. 2°09′31″ E) at an altitude of 479 meters.

Occurrence: In calcite veins which cut an iron and barium ore body. Associated minerals are: zinkenite, boulangerite, robinsonite, tintinaite, sorbyite, a new chloro-sulfosalt, sphalerite, cinnabar, galena, andorite, bournonite, tetrahedrite, chalcostibite, gersdorffite, barite, cerussite and stibiconite.

General appearance: Acicular crystals (up to 2 mm long and 0.2 mm thick).

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* black with a bluish superficial coating due to alteration. *Streak:* not given, but probably black. *Hardness:* VHN_{20} 192 kg/mm^2. *Tenacity:* brittle. *Cleavage:* not mentioned. *Fracture:* irregular. *Density:* could not be determined, 5.70 g/cm^3 (calc.) (given as 5.56 g/cm^3 by the authors). ***Crystallography:*** Monoclinic, *C2/m*, *a* 51.996, *b* 8.148, *c* 24.311 Å, β 104.09°, *V* 9991 Å^3, Z 4, *a:b:c* = 6.3819:1:2.9836. Morphology: no forms were identified; habit acicular on [010]. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.472 (100) ($\overline{14}$.04), 3.441 (18) (10.04), 3.041 (35) ($\bar{4}$08), 2.956 (54) ($\overline{12}$.21, $\overline{12}$.22, 10.2.2), 2.827 (20) ($\bar{6}$26, 026, $\overline{12}$.24), 2.28 (22) ($\bar{8}$29), 2.052 (46) (8.0.10, 14.08, 24.01). ***Optical data:*** In reflected light: grayish white, low anisotropism, low bireflectance, nonpleochroic, rare red internal reflections. R & ^{im}R: (37.3, 19.9 %) 470nm, (35.5, 19.2 %) 546nm, (34.4, 18.3 %) 589nm, (32.8, 16.5 %) 650nm. ***Chemical analytical data:*** Means of ten sets of electron microprobe data: Pb 36.99, Sb 41.80, S 20.39, O 0.65, Total 99.83 wt.%. Empirical formula: $Pb_{15.34}Sb_{29.51}S_{54.66}O_{3.49}$. ***Relationship to other species:*** Among lead sulfosalts, scainite belongs to the zinkenite group of cyclically twinned structures and their derivatives.

Name: For Dr. Giuseppe Scaini (1906–1988), engineer and skilful investigator of systematic and Italian mineralogy. ***Comments:*** IMA No. 1996-014A. Franco Jarnò, an amateur mineralogist from the Gruppo Ricerche Geologiche di Prato, provided the first specimens for this study.

ORLANDI, P., MOËLO, Y., MEERSCHAUT, A., and PALVADEAU, P. (1999) Lead-antimony sulfosalts from Tuscany (Italy). I. Scainite, $Pb_{14}Sb_{30}S_{54}O_5$, the first Pb-Sb oxy-sulfosalt, from Buca della Vena mine. *European Journal of Mineralogy* **11**, 949–954.

Serrabrancaite

Monoclinic

$MnPO_4 \cdot H_2O$

Locality: The Alto Serra Branca pegmatite, approximately 10 km southwest of the village of Pedra Lavrada, Paraiba, Brazil.

Occurrence: In a granitic pegmatite intruded into biotite schist. Minerals in the pegmatite are: quartz, microcline, muscovite, albite, amblygonite, "apatite," beryl, uraninite, elbaite, members of the tantalite group, secondary uranium minerals, triphylite, triplite, purpurite, rockbridgeite, tavorite, barbosalite, huréaulite, eosphorite, phosphosiderite, carlhintzeite, colquirite, pachnolite, ralstonite and fluellite. Serrabrancaite is an alteration product of triplite and is closely associated with vernadite.

General appearance: Equant or short prismatic crystals (up to 0.3 mm).

Physical, chemical and crystallographic properties: *Luster:* adamantine. *Diaphaneity:* translucent in thin fragments. *Color:* dark brown to dark greenish black. *Streak:* olive green. *Luminescence:* not mentioned. *Hardness:* 3½. *Tenacity:* brittle. *Cleavage:* none discernible. *Fracture:* uneven. *Density:* 3.17 g/cm^3 (meas.), 3.19 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, *C2/c*, *a* 6.914, *b* 7.468, *c* 7.364 Å, β 112.29°, *V* 351.8 Å^3, Z 4, *a:b:c* = 0.9258:1:0.9861. Morphology: no forms were mentioned but some are visible in the SEM images. Twinning: none mentioned. ***X-ray powder diffraction data:*** 4.856 (12) (110), 4.633 (15) ($\bar{1}$11), 3.503 (100) (111), 3.271 (10) (021), 2.957 (10) ($\bar{2}$02), 2.516 (19) (022), 2.104 (12) (221). ***Optical data:*** Biaxial (sign not given), α 1.75, β 1.79, γ > 1.79, 2V not measured, pleochroism from dark brown to olive greenish-brown. ***Chemical analytical data:*** Means of four sets of electron microprobe data: Mn_2O_3 46.85, P_2O_5 42.72, H_2O 9.80, Total 99.37 wt.%. H_2O by TGA. Empirical formula: $Mn_{1.01}P_{1.02}O_{4.06} \cdot 0.92H_2O$. ***Relationship to other species:*** Structurally related to synthetic $MnPO_4 \cdot H_2O$ and $MnAsO_4 \cdot H_2O$ and to members of the kieserite group.

Name: For the locality. ***Comments:*** IMA No. 1998-006.

WITZKE, T., WEGNER, R., DOERING, T., PÖLLMANN, H., and SCHUCKMANN, W. (2000) Serrabrancaite, $MnPO_4 \cdot H_2O$, a new mineral from the Alto Serra Branca pegmatite, Pedra Lavrada, Paraiba, Brazil. *American Mineralogist* **85**, 847–849.

Sodic-ferripedrizite

Monoclinic

$Na(LiNa)(Fe^{3+}_2Mg_2Li)Si_8O_{22}(OH)_2$

Locality: In the Arroyo de la Yedra, Eastern Pedriza Massif, Sierra de Guadarrama, Central System, Spain. The locality is about 20 m east of the occurrence of sodic-ferri-clinoferroholmquistite (see abstract in *Mineralogical Record* **30**, 325).

Occurrence: In hydrothermal episyenites. Associated minerals are: albite, pyroxenes, Li-amphiboles and micas.

General appearance: Granular aggregates of subhedral crystals of mean size 0.18 x 0.10 mm.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* semitranslucent. *Color:* green. *Streak:* gray. *Luminescence:* nonfluorescent. *Hardness:* ~ 6. *Tenacity:* brittle. *Cleavage:* {110} perfect; parting {001} poor. *Fracture:* splintery. *Density:* 3.15 g/cm^3 (meas.), 3.15 g/cm^3 (calc.). ***Crystal-***

lography: Monoclinic, *C2/m*, *a* 9.536, *b* 17.789, *c* 5.277 Å, β 102.53°, *V* 873.8 Å^3, Z 2, *a:b:c* = 0.5361:1:0.2966. Morphology: {010} and {001} are observed and {100} is rare and poorly developed; prismatic and elongated on [001]. Twinning: none mentioned. ***X-ray powder diffraction data:*** 8.246 (24) (110), 4.446 (22) (040), 3.397 (28) (131), 3.056 (100) (310), 2.749 (54) (330), 2.699 (60) (151), 1.920 (20) (421), 1.639 (44) (461), 1.396 (23) ($\bar{6}$61). ***Optical data:*** Biaxial (–) (given as +), α 1.694, β 1.698, γ 1.702, 2V(meas.) 83°, 2V(calc.) 89.8° (given as 83°); dispersion r > v, medium; pleochroism strong, X = green blue, Y = blue green, Z = yellow green, absorption X > Y > Z; Y = *b*, X ∧ *c* = 4°, Z ∧ *a* = 8° (both in obtuse angle β). ***Chemical analytical data:*** Means of twenty-four sets of electron microprobe data: Li_2O 3.98, Na_2O 4.78, K_2O 0.15, MgO 8.45, CaO 0.56, MnO 0.58, FeO 2.79, ZnO 0.12, Al_2O_3 1.26, Fe_2O_3 15.81, SiO_2 57.70, TiO_2 1.04, H_2O (1.46), F 1.48, sum (100.16), less O = F 0.62, Total (99.54) wt.%. Li_2O was determined by flame photometry and H_2O was calculated to give OH + F = 2. Empirical formula: $(Na_{0.70}K_{0.03})_{\Sigma 0.73}(Li_{1.34}Na_{0.58}Ca_{0.08})_{\Sigma 2.00}(Mg_{1.75}Fe^{3+}_{1.65}Li_{0.88}Fe^{2+}_{0.32}Al_{0.21}Ti_{0.11}Mn^{2+}_{0.07}Zn_{0.01})_{\Sigma 5.00}Si_{8.00}O_{22.00}[OH_{1.35}F_{0.65}]_{\Sigma 2.00}$. ***Relationship to other species:*** It is a new member of the amphibole group.

Name: For the locality. Because of its chemical composition it requires a new root name, pedrizite; the prefixes "sodic" and "ferri" are required by the amphibole classification. ***Comments:*** IMA No. 1998-061.

OBERTI, R., CABALLERO, J. M., OTTOLINI, L., LÓPEZ-ANDRÉS, S., and HERREROS, V. (2000) Sodic-ferripedrizite, a new monoclinic amphibole bridging the magnesium-iron-manganese-lithium and the sodium-calcium groups. *American Mineralogist* **85**, 576–585.

Springcreekite Trigonal

$BaV^{3+}_3(PO_4)_2(OH,H_2O)_6$

Locality: The dumps of the Spring Creek copper mine near Wilmington, southern Flinders Ranges, South Australia, Australia.

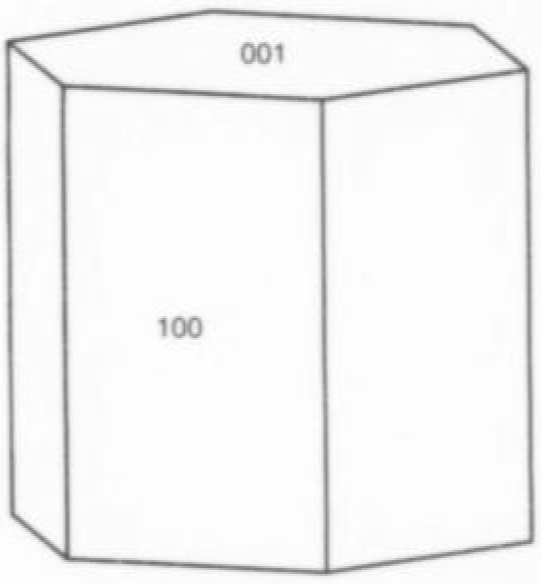
Occurrence: In a cavity in brecciated quartz-goethite rock. Associated minerals in the type specimen are: quartz, fluorapatite, copper, whitlockite, barite, an unidentified Ca-Fe-phosphate (probably mitridatite) and bariosincosite. A cotype specimen contains: cuprite, copper, quartz, mitridatite and fluorapatite.

General appearance: Pseudocubic rhombohedra (between 0.05 and 0.1 mm).

Physical, chemical and crystallographic properties: *Luster:* dull to vitreous. *Diaphaneity:* opaque. *Color:* black. *Streak:* brownish black. *Luminescence:* nonfluorescent. *Hardness:* approximately 4 to 5. *Tenacity:* brittle. *Cleavage:* {102} poor (may be a parting). *Fracture:* irregular. *Density:* 3.48 g/cm^3 (meas.), 3.55 g/cm^3 (calc.). ***Crystallography:*** Trigonal, *R$\bar{3}$m*, *a* 7.258, *c* 17.361 Å, *V* 792.0 Å^3, Z 3, *c:a* = 2.3920. Morphology: only {102} was observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 5.90 (9) (101), 3.627 (4) (110), 3.073 (10) (113), 2.301 (4) (107, 122), 1.971 (5) (033), 1.814 (4) (220). ***Optical data:*** Uniaxial (–), ω 1.858, ε 1.817, pleochroism very strong, O = blackish brown to black, E = pale brownish to brownish, absorption O > E. ***Chemical analytical data:*** Means of four sets of electron microprobe data for the type specimen: Na_2O 0.08, CaO 0.15, CuO 0.17, ZnO 0.14, BaO 23.34, SrO 0.27, Al_2O_3 0.32, Fe_2O_3 15.02, V_2O_3 19.44, SiO_2 0.12, P_2O_5 23.26, H_2O (12.16), F 0.21, sum (94.76), less O = F 0.09, Total (94.67) wt.%. H_2O calculated. Empirical formula: $(Ba_{0.91}Ca_{0.02}Sr_{0.02}Na_{0.02})_{\Sigma 0.97}(V^{3+}_{1.55}Fe^{3+}_{1.12}Al_{0.04}Cu_{0.01}Zn_{0.01})_{\Sigma 2.73}[(PO_4)_{1.86}(SiO_4)_{0.02}][(OH)_{4.36}(H_2O)_{1.84}F_{0.07}]_{\Sigma 6.27}$. ***Relationship to other species:*** A member of the crandallite group.

Name: For the locality. ***Comments:*** IMA No. 1998-048.

KOLITSCH, U., TAYLOR, M. R., FALLON, G. D., and PRING, A. (1999) Springcreekite, $BaV^{3+}_3(PO_4)_2(OH,H_2O)_6$, a new member of the crandallite group, from the Spring Creek mine, South Australia: the first natural V^{3+}-member of the alunite family and its crystal structure. *Neues Jahrbuch für Mineralogie, Monatshefte* **1999**, 529–544.



Stoppaniite

Stoppaniite Hexagonal

$Fe^{3+}_3(Mg,Fe^{2+})Na(Be_6Si_{12}O_{36})\cdot 2H_2O$

Locality: The Vico Volcanic District, north of Rome, at Capranica (Viterbo), Latium, Italy.

Occurrence: In ejectum from an explosive breccia belonging to the "C" pyroclastic flow unit. Associated minerals are: biotite, quartz, sanidine, hematite, danburite, helvite, hellandite, allanite-(Ce) and a not yet completely characterized gadolinite-like mineral.

General appearance: Prismatic euhedral crystals (up to 0.5 mm long).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* light blue. *Streak:* white. *Luminescence:* not mentioned, but probably nonfluorescent. *Hardness:* not given, but probably about 7 or 8 by analogy with beryl and bazzite. *Tenacity:* probably brittle. *Cleavage:* {001} parting. *Fracture:* probably conchoidal. *Density:* 2.79 g/cm^3 (meas.), 2.85 g/cm^3 (calc.). ***Crystallography:*** Hexagonal, *P6/mcc*, *a* 9.397, *c* 9.202 Å, *V* 703.7 Å^3, Z 1, *c:a* = 0.9792. Morphology: no forms were mentioned, but {001} and {100} appear to be present according to the photograph in the paper. Twinning: none mentioned. ***X-ray powder diffraction data:*** 8.12 (65) (010), 4.00 (38) (012), 3.278 (100) (112), 2.903 (64) (121), 2.553 (18) (122), 1.752 (18) (034). Some of the indexing here differs from that given in the paper. ***Optical data:*** Uniaxial (–), ω 1.625, ε 1.619, pleochroism weak from colorless to very light blue. ***Chemical analytical data:*** Means of nineteen sets of electron microprobe data: Na_2O 2.47, K_2O 0.08, Cs_2O 0.19, BeO 14.59, MgO 2.21, MnO 0.41, Al_2O_3 1.80, Sc_2O_3 0.08, Fe_2O_3 18.36, SiO_2 59.13, TiO_2 0.11, SnO_2 0.03, H_2O 2.98, Total 102.44 wt.%. Empirical formula: $(Fe^{3+}_{2.71}Mg_{0.65}Al_{0.42}Mn_{0.07}Ti_{0.02}Sc_{0.01})_{\Sigma 3.88}Be_{6.00}(Si_{11.61}Be_{0.88})_{\Sigma 12.49}(Na_{0.94}K_{0.02}Cs_{0.02})_{\Sigma 0.98}O_{36.05}\cdot 1.95H_2O$. ***Relationship to other species:*** A member of the beryl group.

Name: For Dr. Francesco Saverio Stoppani (1947–), a distinguished amateur mineralogist active in the volcanic regions of Latium. ***Comments:*** IMA No. 1996-008. Note that the crystal structure has been solved.

DELLA VENTURA, G., ROSSI, P., PARODI, G. C., MOTTANA, A., RAUDSEPP, M., and PRENCIPE, M. (2000) Stoppaniite,

$(Fe,Al,Mg)_4(Be_6Si_{12}O_{36})*(H_2O)_2(Na,\square)$ a new mineral of the beryl group from Latium (Italy). *European Journal of Mineralogy* **12**, 121–127. FERRARIS, G., PRENCIPE, M., and ROSSI, P. (1998) Stopanniite, a new member of the beryl group: crystal structure and crystal-chemical implications. *European Journal of Mineralogy* **10**, 491–496.

Strontiomelane

Monoclinic

$SrMn^{4+}_6Mn^{3+}_2O_{16}$

Locality: The Praborna manganese mine, 5 km south of the village of Saint-Marcel, in a lateral valley of Val d'Aosta, Italy.

Occurrence: In manganese-enriched horizons in a quartzitic layer. Associated minerals are: braunite, quartz, the "violan" variety of diopside-aegirine-jadeite, strontiopiemontite, hollandite, cryptomelane, jadeite, antimony-bearing titanite and arsenic-bearing fluorapatite.

General appearance: Thin (100 to 200 µm) elongate inclusions.

Physical, chemical and crystallographic properties: *Luster:* submetallic. *Diaphaneity:* opaque. *Color:* black. *Streak:* sepia. *Hardness:* VHN_{100} 398 kg/mm². *Tenacity:* brittle. *Cleavage:* rarely observed. *Fracture:* not stated. *Density:* could not be measured, 4.66 g/cm³ (calc.). ***Crystallography:*** Monoclinic, $P2_1/n$, *a* 10.00, *b* 5.758, *c* 9.88 Å, β 90.64°, *V* 568.85 Å³, Z 2, *a*:*b*:*c* = 1.7367:1:1.7159. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.15 (100) ($\bar{1}03$), 3.13 (80) (103), 2.409 (80) (122), 2.170 (60) (320), 1.556 (50) ($\bar{2}25$). ***Optical data:*** In reflected light: gray, moderate anisotropism with gray-blue to white tints, bireflectance not mentioned, strong gray-white pleochroism. $R_{max.}$ & $R_{min.}$: (34.2, 26.0 %) 470 nm, (31.7, 24.4 %) 543 nm, (30.6, 23.4 %) 587 nm, (29.7, 22.3 %) 657 nm. ***Chemical analytical data:*** Six sets of electron microprobe data are given; that with the highest amount of strontium gave: Na_2O 0.17, K_2O 0.83, BaO 1.39, SrO 12.77, Fe_2O_3 6.27, Mn_2O_3 16.51, SiO_2 0.45, TiO_2 0.70, MnO_2 58.71, Total 97.80 wt.%. Empirical formula: $(Sr_{1.01}K_{0.14}Ba_{0.07}Na_{0.04})_{\Sigma 1.26}(Mn^{4+}_{5.52}Fe^{3+}_{0.35}Ti_{0.07}Si_{0.06})_{\Sigma 6.00}(Mn^{3+}_{1.71}Fe^{3+}_{0.29})_{\Sigma 2.00}$. ***Relationship to other species:*** It is the strontium-dominant analogue of cryptomelane.

Name: For the relationship to cryptomelane. ***Comments:*** IMA No. 1995-005.

MEISSER, N., PERSEIL, E.-A., BRUGGER, J., and CHIAPPERO, P.-J. (1999) Strontiomelane, $SrMn^{4+}_6Mn^{3+}_2O_{16}$, a new mineral species of the cryptomelane group from St. Marcel–Praborna, Aosta Valley, Italy. *Canadian Mineralogist* **37**, 673–678.

Suredaite

Orthorhombic

$PbSnS_3$

Locality: The Oploca vein system of the Pirquita silver-tin deposit, in the Puna, 135 km west of Abra Pampa, Province of Jujuy, northwestern Argentina.

Occurrence: In a vein. Associated minerals are: franckeite, cylindrite, hocartite, rhodostannite and sphalerite. Minor amounts of Ag-Bi sulfosalts belonging to the andorite group, lillianite as well as pavonite homologous series.

General appearance: It has an overall similarity to teallite. As layers (up to 1 cm thick) composed of tabular prismatic crystals elongated along [010] and as individual euhedral almost needle-like crystals.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* grayish-black. *Streak:* black. *Hardness:* VHN_{50} 19.6 (range 18.2 to 20.6) kg/mm², Mohs 2½ to 3. *Tenacity:* not given. *Cleavage:* {001}, {101} and {100} perfect. *Fracture:* not given. *Density:* 5.54 to 5.88 g/cm³ (meas.), 5.66 g/cm³ (calc.). ***Crystallography:*** Orthorhombic, *Pnma*, *a* 8.8221, *b* 3.7728, *c* 14.0076 Å, *V* 466.23 Å³, Z 4, *a*:*b*:*c* = 2.3383:1:3.7128. Morphology: no forms were mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 5.483 (26.4) (102), 4.128 (100.0) (103), 3.730 (30.0) (202), 3.1085 (27.6) (112), 2.8081 (50.8) (211), 2.7421 (40.9) (204), 1.9335 (53.5) (314), 1.6316 (38.9) (124), 1.3754 (26.5) (309). ***Optical data:*** In reflected light: white, anisotropic metallic blue to mauve to brown, nonbireflectant, nonpleochroic. R_1 & R_2: (34.3, 36.3 %) 460nm, (31.5, 33.1 %) 540nm, (30.3, 31.7 %) 580nm, (29.0, 30.2 %) 640nm. ***Chemical analytical data:*** Four sets of electron microprobe data are given. The means of 61 analyses of one of these sets are: Fe 0.77, As 1.41, Ag 0.80, Sn 30.12, Pb 42.27, S 24.23, Total 99.60 wt.%. Empirical formula: $(Pb_{0.81}As_{0.08}Ag_{0.03}Sn_{0.06})_{\Sigma 0.98}(Sn_{0.95}Fe_{0.05})_{\Sigma 1.00}S_{3.01}$. ***Relationship to other species:*** It is the natural analogue of synthetic $PbSnS_3$.

Name: For Ricardo Jose Sureda Leston (1946–), Professor and Head of the Department of Mineralogy and Economic Geology, University of Salta, Argentina, in recognition of his significant contributions to the mineralogy and metallogeny of NW Argentina. ***Comments:*** IMA No. 1997-043.

PAAR, W. H., MILETICH, R., DAN TOPA, CRIDDLE, A. J., DE BRODTKORB, M. K., AMTHAUER, G., and TIPPELT, G. (2000) Suredaite, $PbSnS_3$, a new mineral species, from the Pirquitas Ag-Sn deposit, NW-Argentina: mineralogy and crystal structure. *American Mineralogist* **85**, 1066–1075.

PREHNITE

FROM LA COMBE DE LA SELLE, SAINT CHRISTOPHE-EN-OISANS, ISÈRE, FRANCE

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Prehnite specimens from La Combe de la Selle are among the finest known for the species. Though never prolific, the locality has produced specimens sporadically for over 200 years. Excellent examples can be found in most European museums and many private collections.

INTRODUCTION

Crystallized prehnite specimens from La Combe de la Selle in Saint Christophe-en-Oisans, Isère, France, are among the finest known for the species. Situated in the French Alps, La Combe de la Selle is a classic alpine cleft deposit located near the famous axinite locality, Bourg d'Oisans.

Compared to the famous prehnite localities in Switzerland, Italy and Austria, La Combe de la Selle has never been as prolific in specimen production (see Albertini, 1991; Burchard and Bode, 1986; Canac, 1980; Exel, 1982; Gramaccioli, 1978; Groth, 1885; Guillemin, 1972; Hochleitner, 1989; Legros and Legros, 1979; Nannoni and Sammartino, 1979; Mattioli, 1979; Parker, 1973; Weibel *et al.*, 1990). Discoveries have been sporadic, and mainly the result of the work of enthusiastic private collectors. Nevertheless, during the last 200 years nearly all mineral museums in Europe have acquired splendid crystallized prehnite specimens from this locality.

The locality given on labels is often brief and fragmentary. "Dauphiné," is sometimes cited, or merely "Alpes," or the locality is confused with "Bourg d'Oisans," or shortened simply to "Oisans." "La Combe de la Selle" is the correct specific locality name.

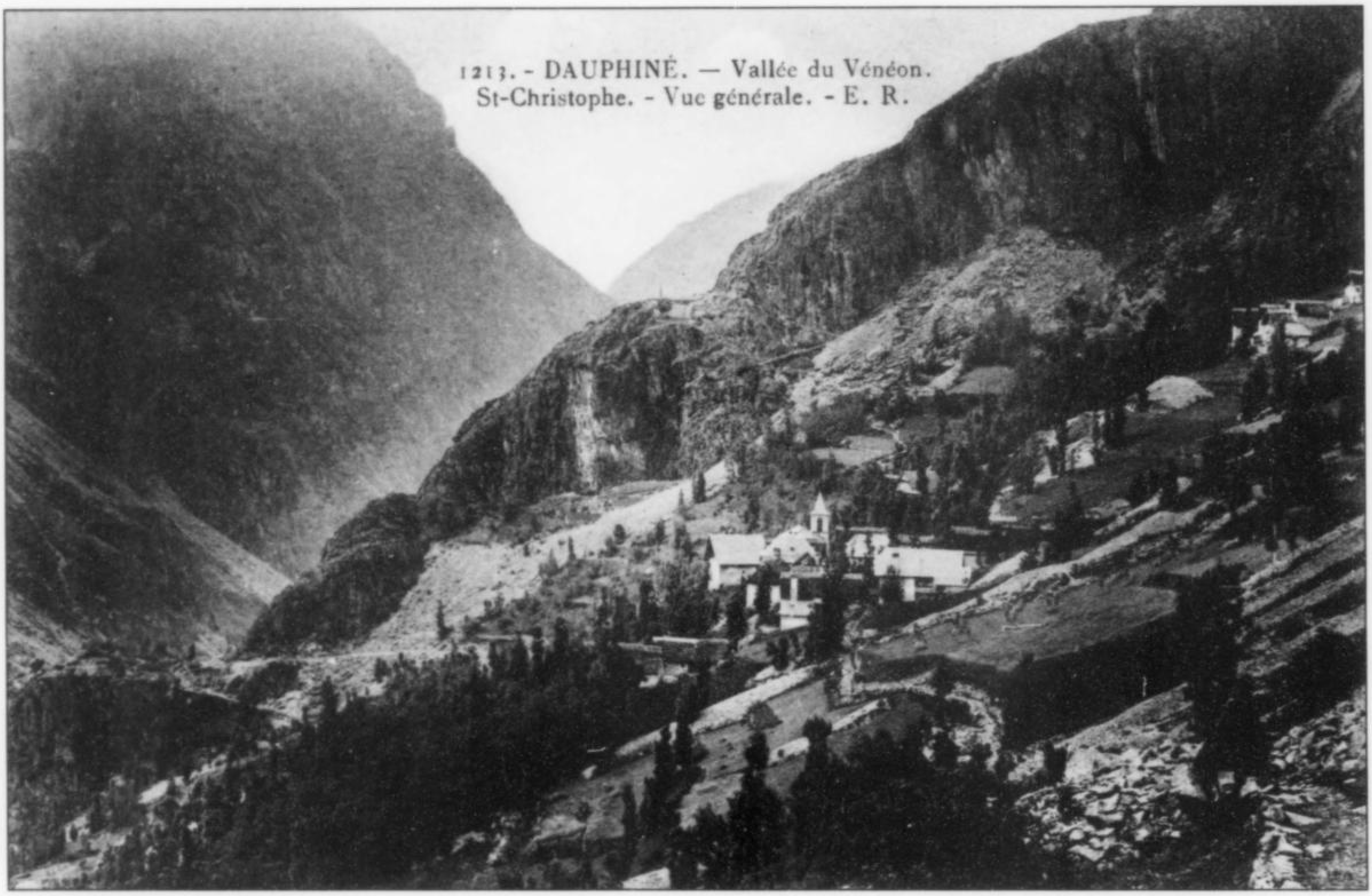


***Figure 1.* General view of Saint-Christophe-en-Oisans ca. 1900. The cliffs rising in the background are the Aiguille Rouge de la Toura; on the left is the Véneon Valley River and the steep slopes of "Les Charbonnières."**

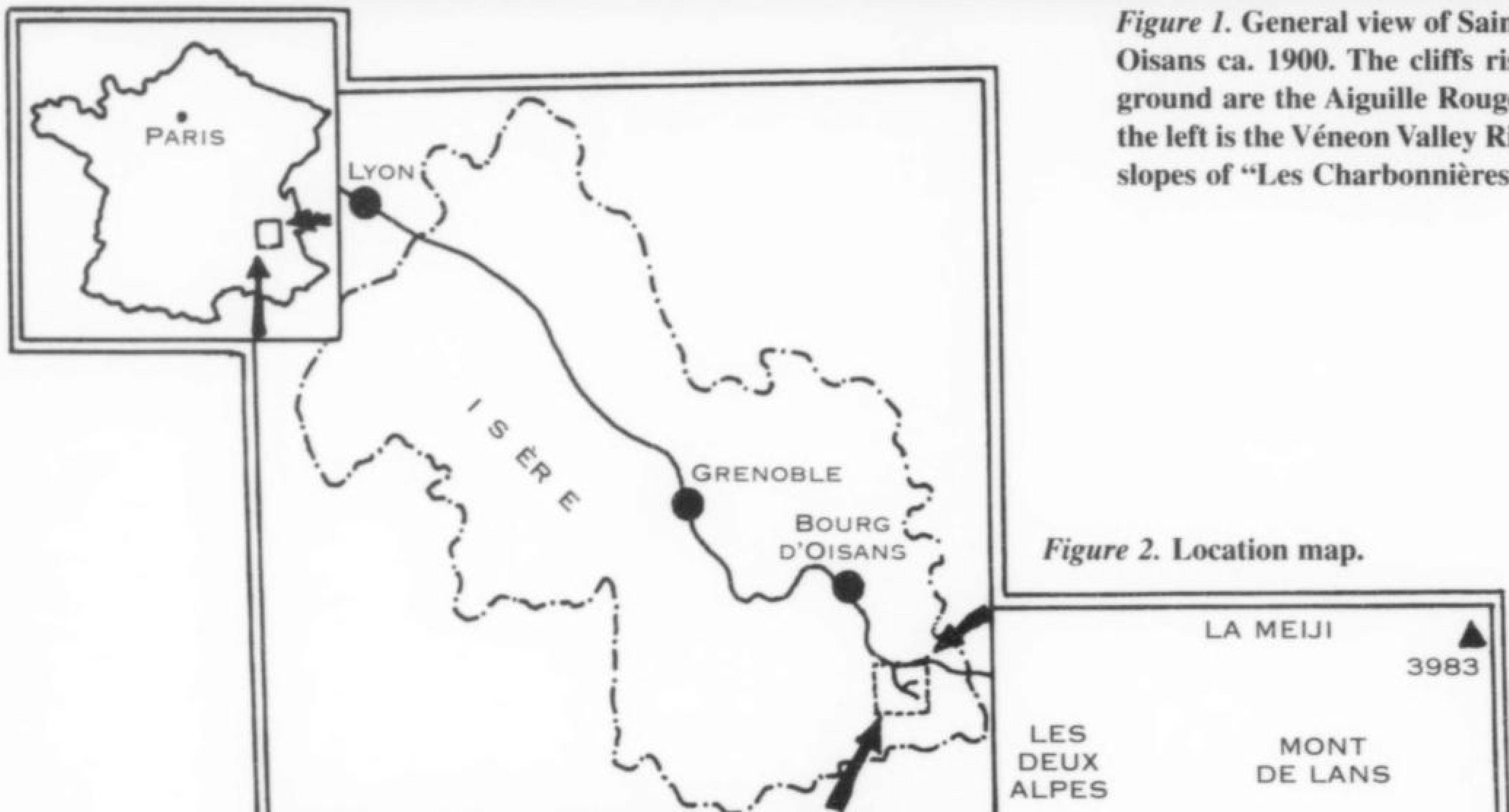


***Figure 2.* Location map.**

Figure 3. **The valley of La Combe de la Selle; at left is the slope of the Aiguille du Plat de la Selle.**

HISTORY

Prehnite was first described by Balthazar Sage in 1777 (he called it "chrysotile"), based on specimens brought back from the Cape of Good Hope by Colonel Hendrick Von Prehn (1733–1785). Romé de l'Isle, in his *Cristallographie* of 1783, indicates that the Count Jacques Louis de Bournon (1751–1825) may have been among the first to find the mineral in France, while field-collecting in the Bourg d'Oisans area. He called it "chrysotile," too, specifying that it was a kind of "schorl" (at the time, every unknown vitreous silicate lacking cleavage was called a "schorl"). He wrote:

> I received from Monsieur de Bournon some samples of streaked prismatic schorl which he found in the mountains of Bourg d'Oisans in Dauphiné. This very hard schorl varies from the chrysotile of the Cape of Good Hope only in its paler color, and by the clayrock which serves as its matrix. The crystals are intergrown in a very confused manner.

In 1782 the famous mining engineer Johann Gottfried Schreiber had also noted the presence of prehnite in Oisans, from a deposit he said was situated on Monts de Lans, the mountain overlooking La Combe de la Selle. Schreiber, who had come to France in 1777, was an experienced Saxon miner. He supervised the operation of the silver mines at Challanches in Allemont, France, and also the famous La Gardette gold mine near Bourg d'Oisans. He had been engaged to operate those concessions by the owner, Louis Stanislas Xavier, Count of Provence and later crowned King Louis XVIII (who in 1814 bought the Count de Bournon's mineral collection). Schreiber thoroughly prospected the mountains in the vicinity of the mining concessions, looking for ore, and in the process found deposits of prehnite.

The earliest illustration of prehnite is probably the excellent handcolored plate in Gautier d'Agoty's *Histoire Naturelle . . . Règne Minéral,* produced around 1789 to 1792 by Swebach Desfontaines as Plate 66. It is labeled *Chorle vert, du Cap de Bonne Esperance* ("Green schorl from the Cape of Good Hope"), from the collection of Jean Gigot d'Orcy (1733–1793).

In 1789 Werner named the species *prehnite* after Von Prehn; it

***Figure 4.* Collecting prehnite in the alpine veins at La Combe de la Selle.**

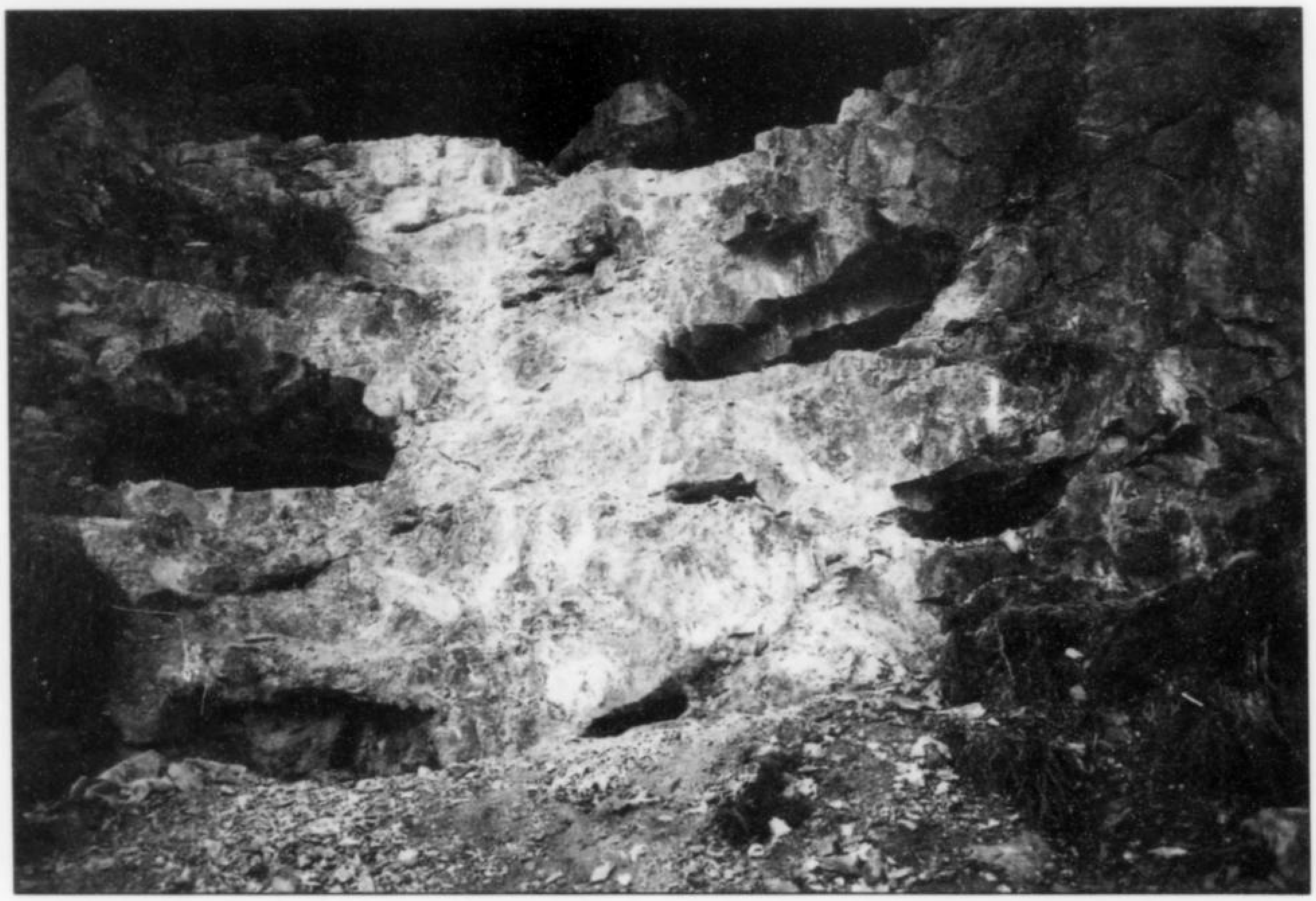


***Figure 5.* Lenticular veins and pockets to 1 meter in amphibolite at La Combe de la Selle.**

was the first mineral ever named after a person, setting a nomenclatural precedent that endures to the present day.

Prehnite specimens began appearing in the Parisian collections. Haüy, writing in the *Journal des Mines* in 1797, noted:

> The prehnite of the Cape of Good Hope could be related to the prehnite of France, a substance found with the so-called "white schorl" from Dauphiné. It is found in white rhomboidal blades . . . in clusters of blades which diverge like the rays of a fan: this is the fan-shaped prehnite and, in piles of divergent curved blades, it is the shell-shaped prehnite.

Haüy, in his *Traité de Minéralogie* (1801) described Schreiber's discovery specifically:

> The French prehnite was found in 1782 by Citizen Schreiber, Inspector of Mines, in the rise of the road leading to Rivoire, a hamlet in the township of Lans. It presents the varietal aspect of a fan-like shape, and so the Citizen has called it "shorl in spray." The matrix is clayrock similar to the rock which, in the same area, serves as support to feldspar crystals (in the past called "white schorl"), to epidote and to axinite.

During the two centuries since the time of Haüy and Schreiber, countless collectors have removed fine prehnite specimens from the locality.

LOCATION

The La Combe de la Selle ("Comb of Rocks") deposits are situated 60 km southeast of Grenoble in the French Alps. The site, in what is called the Vallon de la Selle ("Valley of the Saddle") on some maps, is near Bourg d'Oisans in Saint-Christophe-en-Oisans township, a small village town on the slope of the l'Aiguille du Plat de la Selle Mountain. It has a long history of habitation, being first mentioned in the 11th century as the "parish of Ecclesia de Valle Sancti Christofori" (Cortes, 1926). This is in the modern-day department of Isère, a part of the old province of Dauphiné. The commune of Saint Christophe, one of the three largest communes in France (of which there are 36,664), includes 15 small towns and villages having a total population of 102 people (known as "Christolets"). Seasonal activity in the area is based primarily on tourism, for the alpine hiking, canoeing and rafting, hotels and restaurants. Agriculture is now only a marginal activity; with the first snow permanent population falls to about 30.

The Vallon de la Selle is a well-glaciated, cliff-line valley over 6 km long cutting the Pelvoux massif (also known as the Oisans massif). A stream called Le Ruisseau (or Le Torrent) du Diable ("The Devil's Stream") runs down the center of the valley. Most of the peaks surrounding the valley exceed 3000 meters, the highest being La Barre des Ecrins at 4102 meters (13,332 feet).

The prehnite occurrence is at an altitude of about 2000 meters, an hour's hike from Saint-Christophe-en-Oisans. Heavy snow renders the collecting area inaccessible during the winter months.

GEOLOGY

The La Combe de la Selle deposit is located in the Dauphiné external autochthonous zone. The zone consists of a metamorphic basement complex (gneiss, amphibolite, etc.) intruded by Hercynian-age granitoid bodies and overlain by Mesozoic sedimentary rocks. Tectonically the area has been faulted into a patchwork of blocks, some of them overthrusting as a result of the Alpine orogeny.

Tectonic movements during the Tertiary period further displaced some of the overlapping blocks as the alpine massifs were thrust upward. Renewed movement along Hercynian-age faults was significant at this time, in places correlating with the formation of alpine clefts (see *Carte Géologique*, 1984). The level of associated alpine metamorphism was low, not exceeding greenschist facies, characterized by zoisite-actinolite-chlorite assemblages in the mafic rocks. Some zeolites formed late during the cooling phase.

The prehnite deposit is enclosed in a north-south strip of amphibolitic rocks (amphibolite and amphibolite gneiss). This strip, about 500 meters wide and bounded by near-vertical faults, extends for more than 5 km. It is embedded in a migmatitic unit called the Lavey Gneiss.

The amphibolites consist of brown to green hornblende, andesitic plagioclase which has been completely sericitized, some quartz, biotite and Mg-rich almandine.

Some of the amphibolite contains ribbons of lighter colored granitic composition. The late Tertiary alpine veins containing prehnite cut across perpendicular to the schistosity of the rock; most are filled with asbestose minerals and have a roughly lenticular shape, varying in thickness from 1 mm to 20 cm, and measuring many meters across.

At the head of the valley is located the classic locality of Le Plan du Lac, where alpine minerals such as anatase, brookite, ilmenite, rutile and titanite occur in aplite. The site is also within the borders of the Saint-Christophe-en-Oisans township.

MINERALS

Actinolite $Ca_2(Mg, Fe^{2+})_5Si_8O_{22}(OH)_2$
and **Ferro-actinolite** $Ca_2Fe^{2+}_5Si_8O_{22}(OH)_2$

Ferro-actinolite and actinolite are the main so-called asbestose minerals, also referred to as "byssolites," which fill most of the veins in the area. (Their identities have been confirmed by electron microprobe analysis.) They occur as thin, acicular fibers up to 10 cm long, varying from pale green to gray-green in color. Ferro-actinolite is the principal vein-filling mineral. Actinolite has only been found as fibrous inclusions in epidote; there may have been an exchange reaction between the epidote host and ferro-actinolite inclusions during the cooling phase which converted included ferro-actinolite to actinolite.

Albite $NaAlSi_3O_8$

Lustrous, white to transparent albite crystals to 6 mm are rather common in the area. The crystals are usually twinned, as at other alpine deposits.

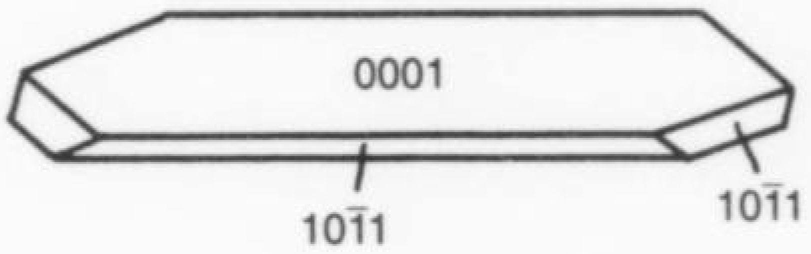


Figure 6. **Calcite crystal drawing illustrating the "paper spar" habit from La Combe de la Selle; forms include primarily {0001} and {10$\bar{1}$1}.**

Calcite $CaCO_3$

Calcite is quite abundant at La Combe de la Selle. It is an important vein-filling mineral, especially where the veins are wide. Crystals are generally lustrous and transparent, measuring up to 20 cm. Common forms include {10$\bar{1}$1} and {0001}, with flattening on {0001}; where closely intergrown they are called "paper spar," a typical alpine habit for calcite. Crystal clusters can reach 40 cm. Some crystals contain fibrous ferro-actinolite inclusions; others may be completely covered by prehnite crystals. Although the calcite from this area has not been as popular with collectors as the prehnite, when fresh and undamaged it is among the best calcite found in the French Alps.

Clinochlore $(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$

Clinochlore, a member of the chlorite family, is a common component of the vein filling in alpine clefts. It occurs both as encrustations and as powdery green inclusions and masses of vermicular material in other minerals.

Epidote $Ca_2(Fe^{3+},Al)_3(SiO_4)_3(OH)$

Epidote (visual identification) is quite common in the alpine veins as thin crystals to 4 cm in length. It is typically lustrous, of a deep olive-green color, and very often contains included acicular actinolite. Crystals may be curved, or grouped in parallel growths, or may be found penetrating prehnite crystals. Electron microprobe analyses of one specimen have yielded the following formula, showing it to be clinozoisite:

$$Ca_{2.01-2.02}(Al_{2.52-2.56},Fe^{3+}_{0.39-0.47})_{2.94-2.99}Si_{2.99-3.03}O_{12}(OH)$$

Galena PbS

Galena nodules to 1 cm are sometimes found included in amphibolite wall-rock. Indications of lead mineralization have

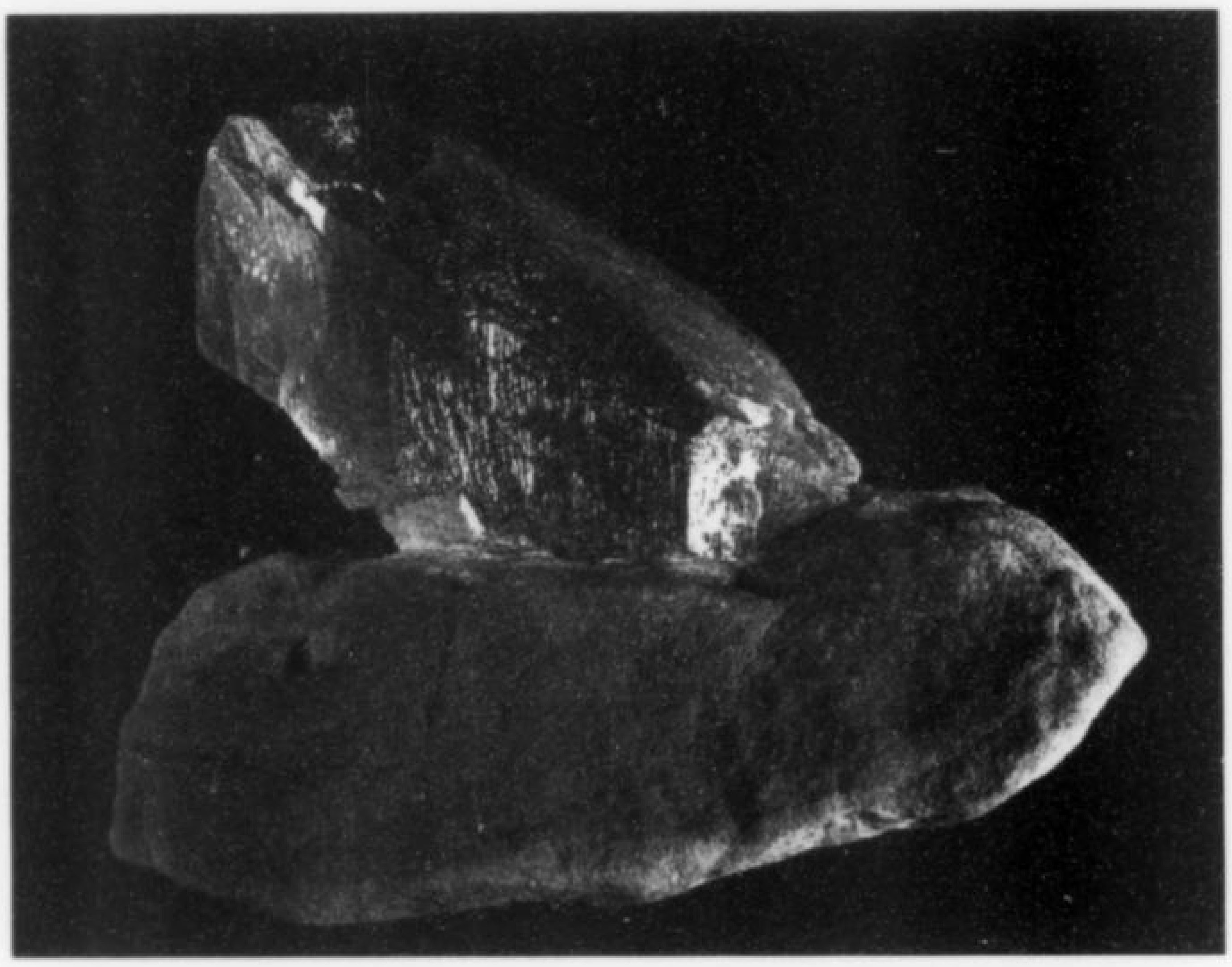


Figure 7. **Manganaxinite crystal, 12 cm, colored green by chlorite inclusions, from La Combe de la Selle. Alexandre Delerm collection; Jean-Michel Lecleach photo.**

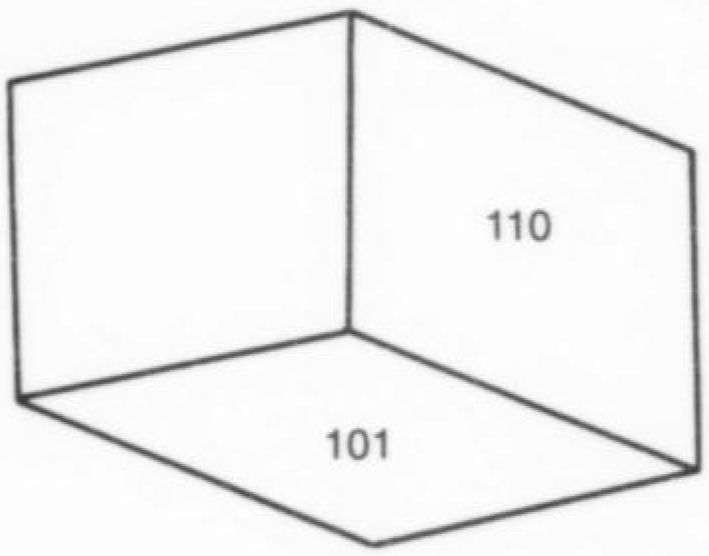


Figure 8. (above) **Orthoclase crystal showing the "adularia" or Maderanertal" habit (forms {101}, {110}), from La Combe de la Selle.** ***(right)*** **Curved orthoclase (var. adularia) in ferroactinolite asbestos, showing the forms {101} and {110}, from La Combe de la Selle.**

been noted at two locations in the vicinity of La Combe de la Selle (see *Carte Géologique*, 1984).

Manganaxinite $Ca_2Mn^{2+}Al_2BSi_4O_{15}(OH)$

Crystals of burgundy-red to brown, gemmy to translucent manganaxinite to around 1 cm are relatively scarce in the alpine veins of the area. Rare larger crystals have been found up to 8 cm in size, exhibiting the forms {112}, {001} and {110}. Manganaxinite and prehnite together make the most attractive combination for collectors. La Combe de la Selle manganaxinite is unusual among alpine axinites for its high Mn/Fe ratio; most alpine axinites are ferro-axinite. Electron microprobe analyses of La Combe de la Selle manganaxinite yielded the formula:

$$Ca_{2.01}(Mn^{2+}_{0.67},Fe^{2+}_{0.35},Mg_{0.09})_{1.11}Al_{1.96}B_{0.91}Si_{4.04}O_{15}(OH)$$

Orthoclase $KAlSi_3O_8$

Transparent, colorless to greenish white crystals of orthoclase (known as the variety *adularia*) are common in the clefts of the area. Crystal size can reach 3 cm. The pale color is caused by inclusions of fibrous ferro-actinolite. The orthoclase shows a classic habit, with rhombic section and the forms {110} and {101} dominant. This habit has been called the "adularia" or "Maderanertal" habit by Swiss authors. The rhomb faces are commonly striated by the alternation of the {100} and {101} forms. Some of the most heavily included crystals are curved.

Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$

Prehnite occurs at La Combe de la Selle in isolated and intergrown crystals to 5 cm on amphibolitic matrix. The crystals usually show the classic "helmet" or "bivalve" habit resulting from a fan-shaped intergrowth of semi-parallel crystal domains. The joined {110} faces form a rounded surface, with {100} edges. Early writers also described a habit consisting of {001}, {110}, {010} and {100}, the so-called "coupholite habit." Fan-like and bow-tie habits are also known. The color varies from white to pale yellow, pale green (most common) and dark green; crystals are translucent to partially transparent and almost always lustrous. The darker crystals are usually rich in actinolite inclusions. When freshly collected the prehnite crystals are usually embedded in "byssolite" which must be brushed away. Even actinolite-free prehnite is usually pale green, the color resulting from a small iron content. Inclusions of epidote have also been seen.

Electron microprobe analyses indicate a somewhat higher iron content in prehnite which is associated with actinolite (Fe_2O_3 = 1.2 to 2.1%), in contrast to unincluded prehnite (Fe_2O_3 = 0.2 to 0.3%). White prehnite yielded the formula:

$$Ca_{2.00-2.03}(Al_{0.96-0.97},Fe^{3+}_{0.01-0.02})_{0.98}(Si_{3.01-3.03}Al_{0.99-1.00})_4O_{10}(OH)_2$$

—whereas green prehnite with actinolite inclusions yielded the formula:

$$Ca_{2.00-2.13}(Al_{0.88-0.90},Fe^{3+}_{0.08-0.11})_{0.97}(Si_{2.93-3.03}Al_{0.97-1.07})_4O_{10}(OH)_2$$

Pyrite FeS_2

Pyrite is common in the alpine veins, usually as isolated, slightly altered cubic crystals to 1 cm in the amphibolitic wall-rock.

Pyrrhotite $Fe_{1-x}S$

Pyrrhotite is the rarest sulfide at La Combe de la Selle, in short hexagonal-prismatic crystals up to 1 cm. The crystals are usually rather rusty and weathered-looking, and are easily mistaken for ferruginous micas.

Quartz SiO_2

Rare prisms of typical transparent quartz to 5 cm have been found (Dauphiné-habit crystals, however, have not been seen at La Combe de la Selle).

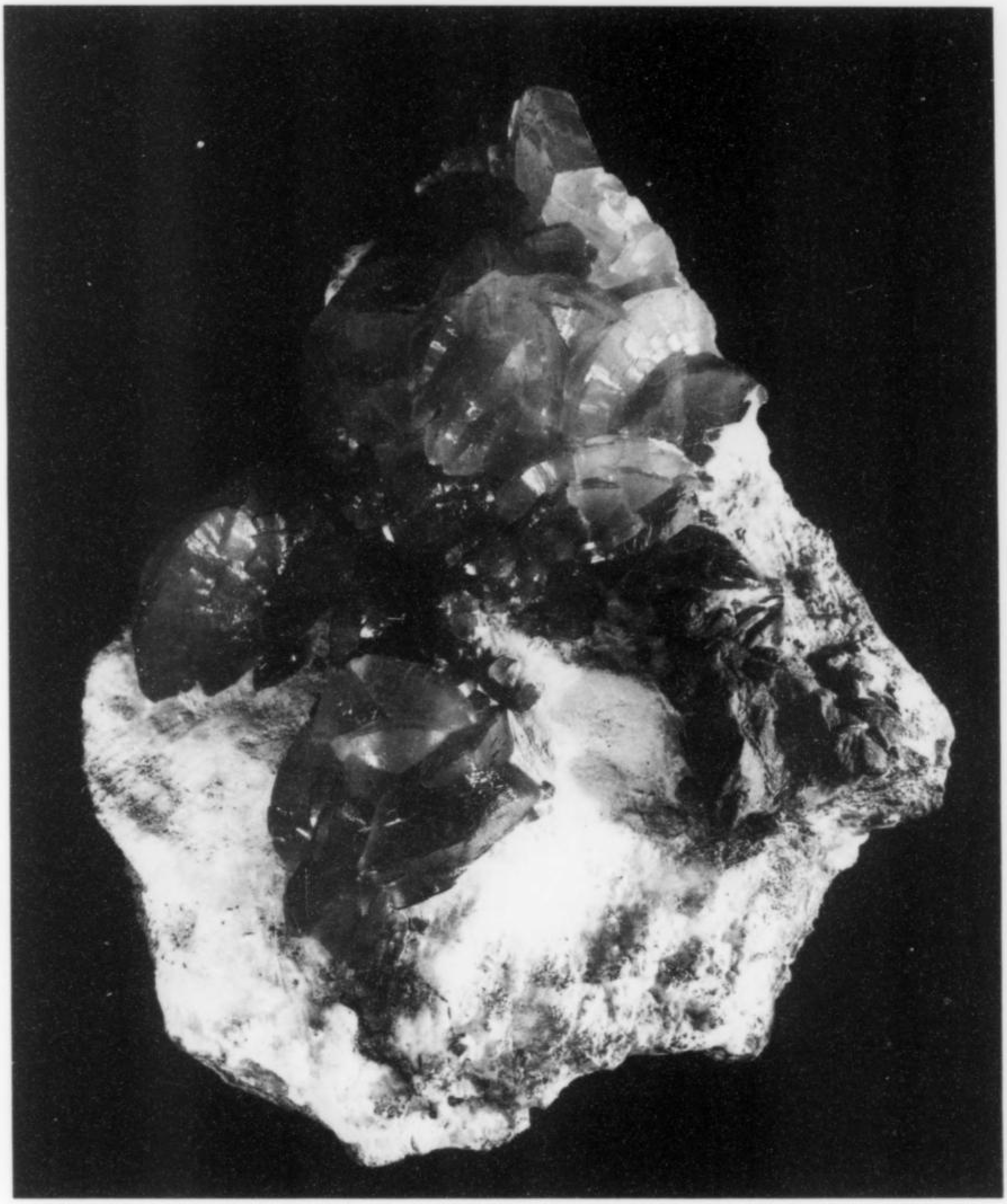


Figure 9. **Prehnite crystals on matrix, 10 cm, from La Combe de la Selle. Sorbonne collection; Nelly Bariand photo.**

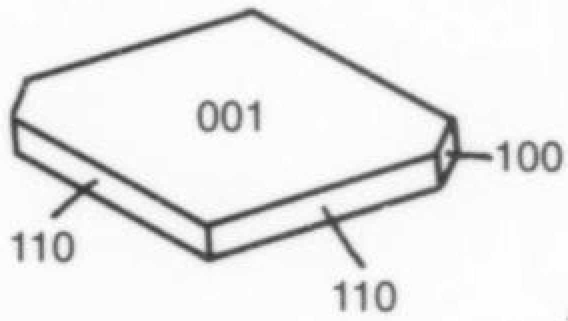
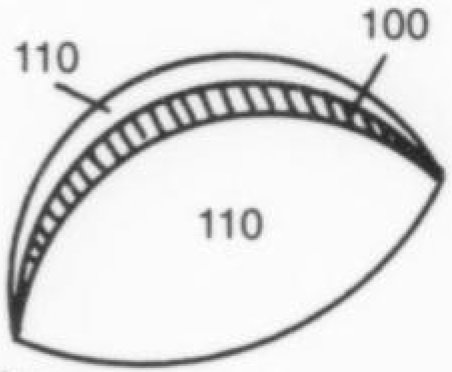


Figure 10. (above) **Prehnite crystal drawing, showing the forms {001}, {110} and {001}, from La Combe de la Selle.**



(right) **Prehnite crystal drawing showing the helmet-like crystal habit (forms {100} and {110}) from La Combe de la Selle.**

DISCUSSION

Assemblages and parageneses similar to those at La Combe de la Selle have been found at other deposits around Bourg d'Oisans. Above La Rivoire in Mont-de-Lans, splendid blue-green crystals of prehnite were found around the turn of the last century (Lacroix, 1897). Small quantities of prehnite crystals have been found at all of the important axinite localities in the area, especially at Le Rocher d'Armentier (Lacroix, 1897) and near Bourg d'Oisans at La Balme d'Auris and La Rampe des Commères. At another occurrence in Isère county, the Belledonne massif (Allevard area), which is geologically similar to the La Combe de la Selle area, identical mineral assemblages have been found.

The quartz-albite-chlorite-galena assemblage has been found to have a formation temperature of 180°C (Ypma, 1963). Ypma (1963) also describes byssolite-calcite clefts as being the result of retrograde metamorphism of the amphibolites.

The alteration of plagioclase is thought to have liberated calcium to form calcite, whereas the actinolite and epidote originated in the breakdown of primary hornblende in the amphibolite.

On-site studies at La Combe de la Selle, combined with a study of many specimens, suggests the crystallization sequence shown in Figure 17.

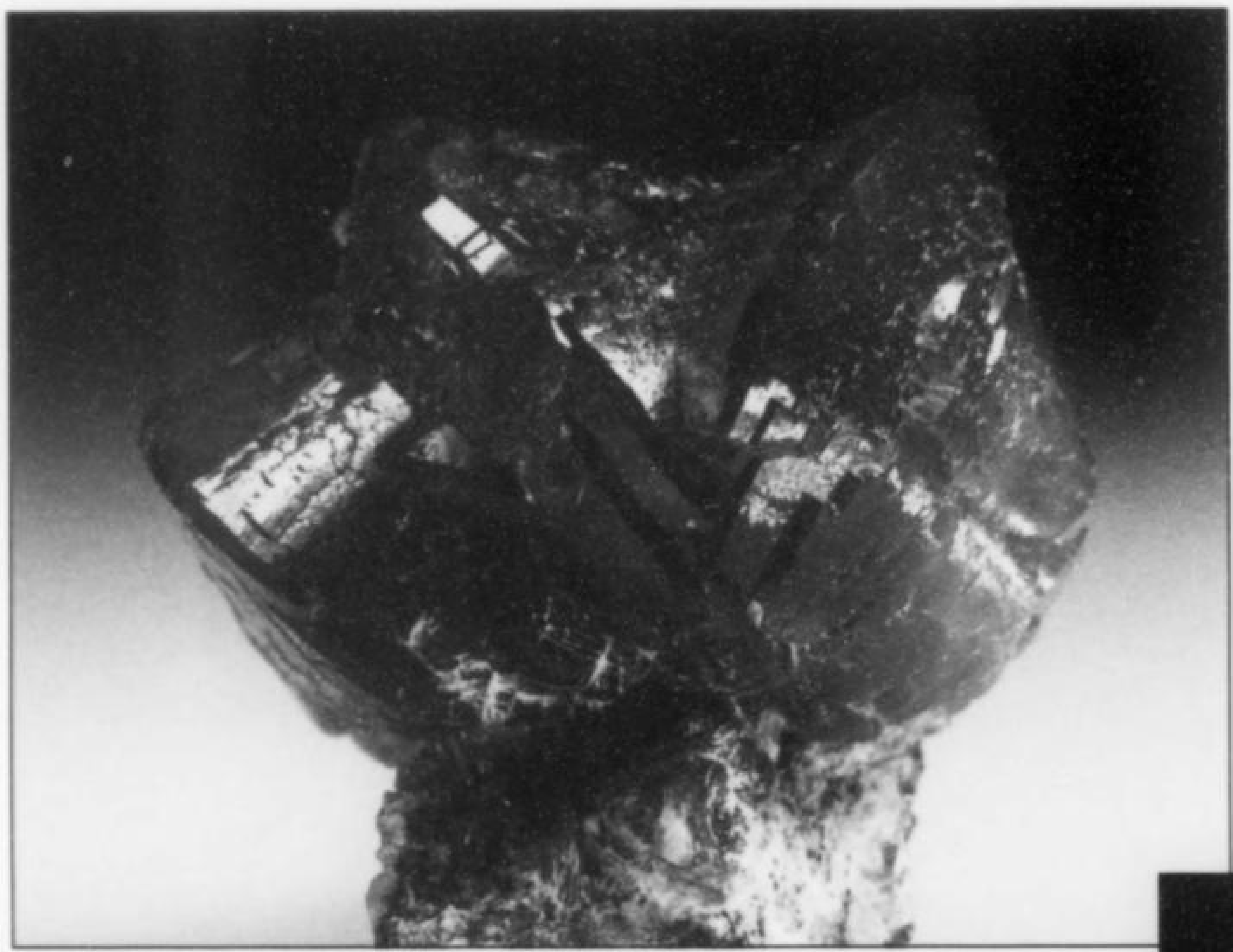


Figure 11. **Prehnite crystals, 2.5 cm, showing the helmet-like habit from La Combe de la Selle. Laurent Gautron collection; Wendell Wilson photo.**

Figure 12. **Rounded prehnite crystals to 2 cm with actinolite and orthoclase (adularia) from La Combe de la Selle. Laurent Gautron collection; Wendell Wilson photo.**

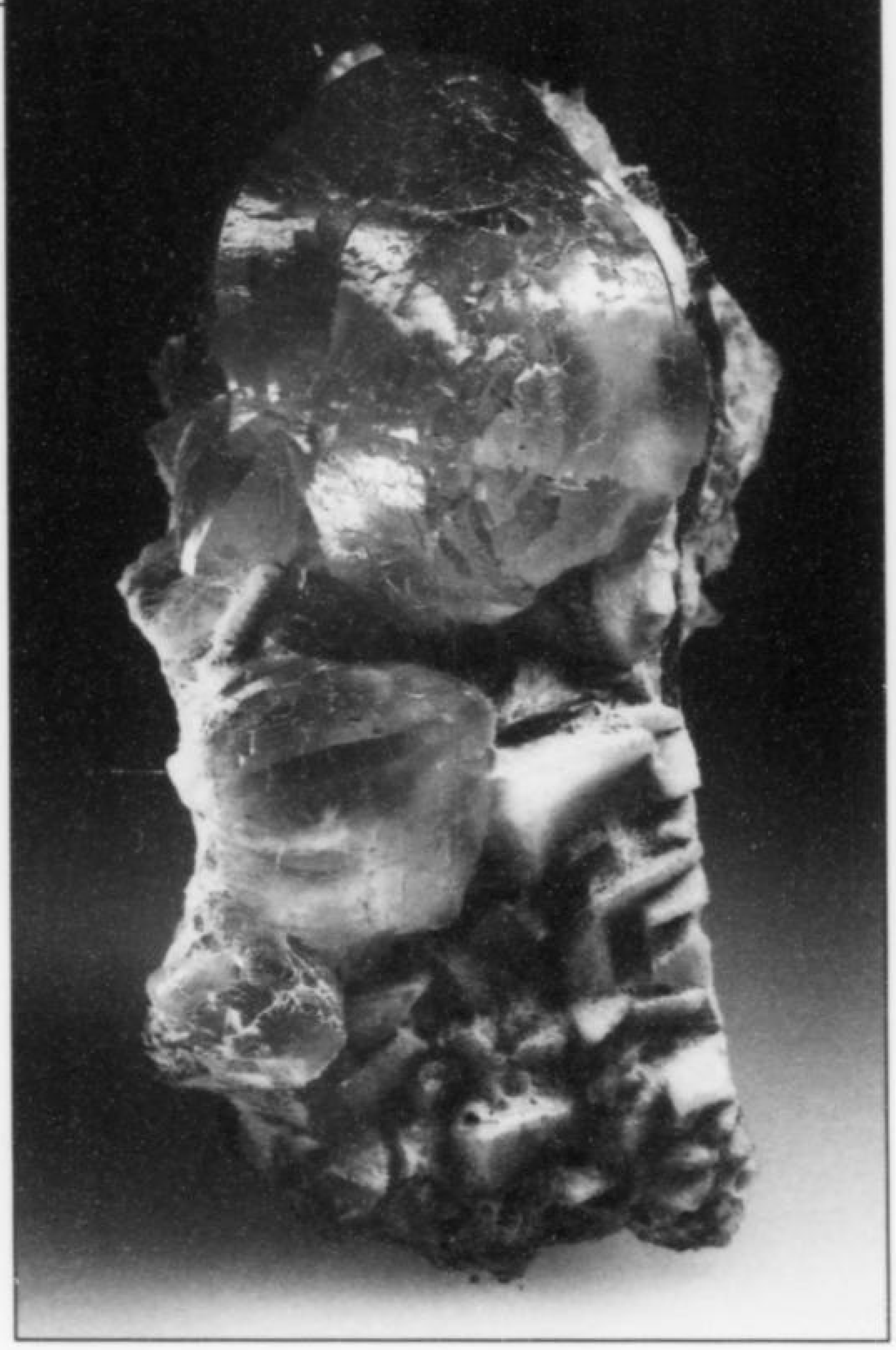


Figure 13. **Prehnite crystals to 1.8 cm from La Combe de la Selle. Laurent Gautron collection; Wendell Wilson photo.**

Figure 14. **Fan-shaped prehnite crystals to 1.8 cm from La Combe de la Selle. Laurent Gautron collection; Wendell Wilson photo.**

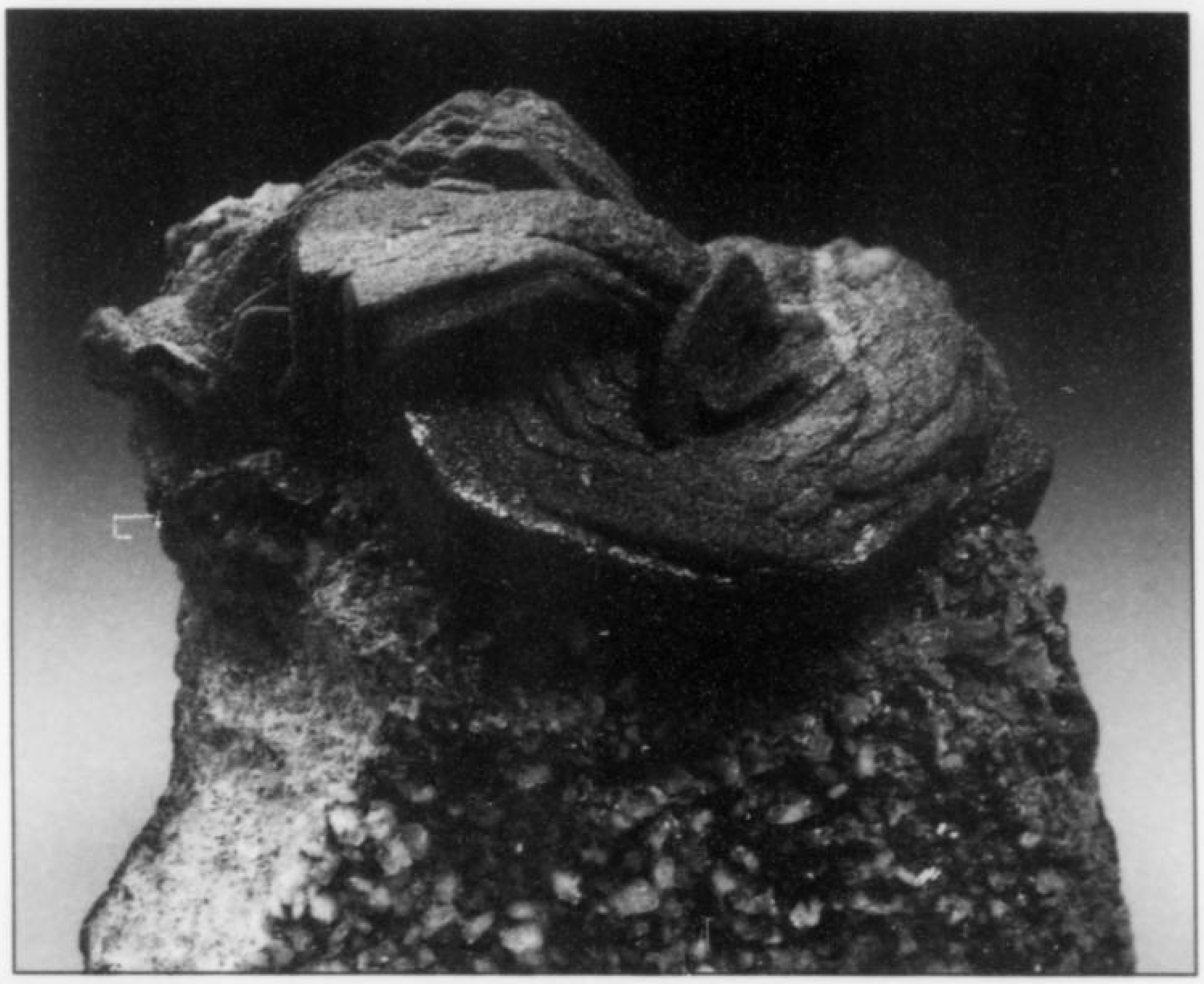


Figure 15. **Unusual prehnite "rose" (2.8 cm), slightly chloritized, with albite, from La Combe de la Selle. Laurent Gautron collection; Wendell Wilson photo.**

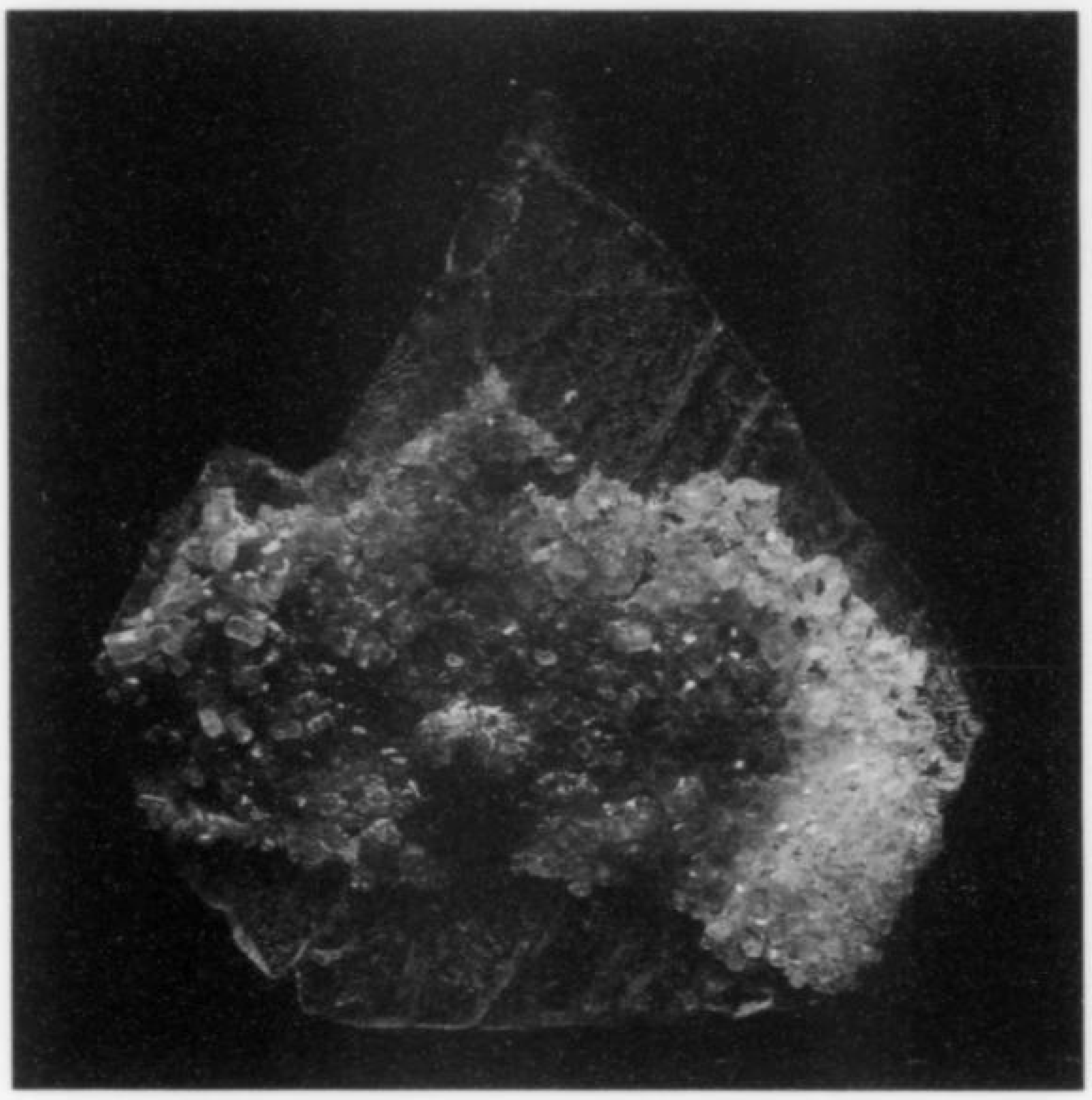


Figure 16. **Prehnite crystal crust on calcite, 11 cm, from La Combe de la Selle. Laurent Gautron collection; Stefan Ansermet photo.**

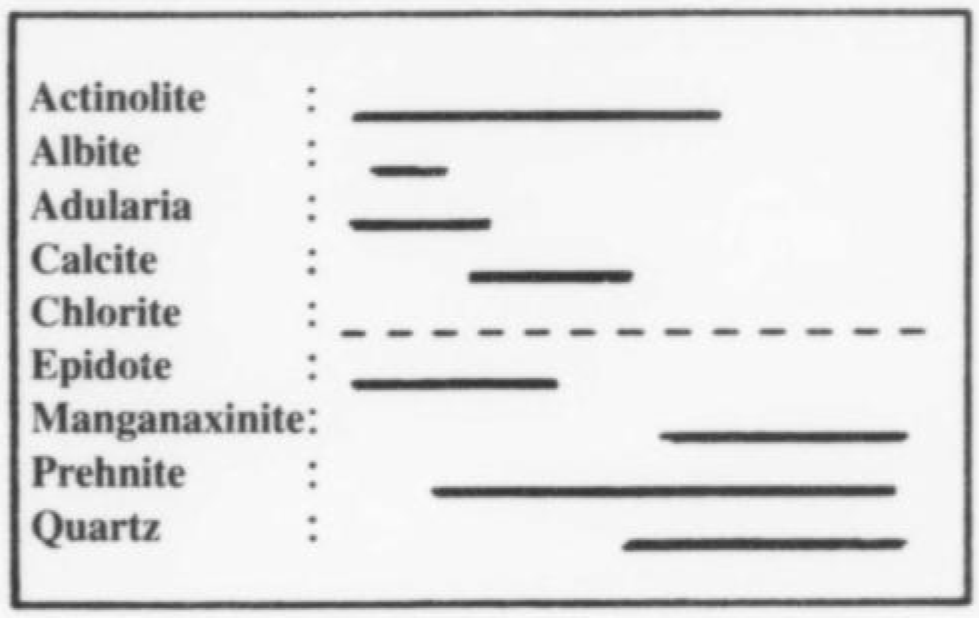


Figure 17. **Paragenetic sequence of crystallization in the alpine clefts at La Combe de la Selle.**

ACKNOWLEDGMENTS

We would like to thank the numerous museums in Europe and the U.S. which kindly assisted in our research on their specimens, especially those institutions which provided mineralogical and historical information on the La Combe de la Selle deposit. Thanks also to A. Salzmann for translating our original (French) manuscript, and to J. C. Boulliard, Brad Van Scriver, G. C. Parodi, Pierre Bariand and Steven Morehead for reviewing the manuscript and offering helpful suggestions. Analyzed specimens have been deposited in the collection of the Geological Museum of Lausanne, Switzerland.

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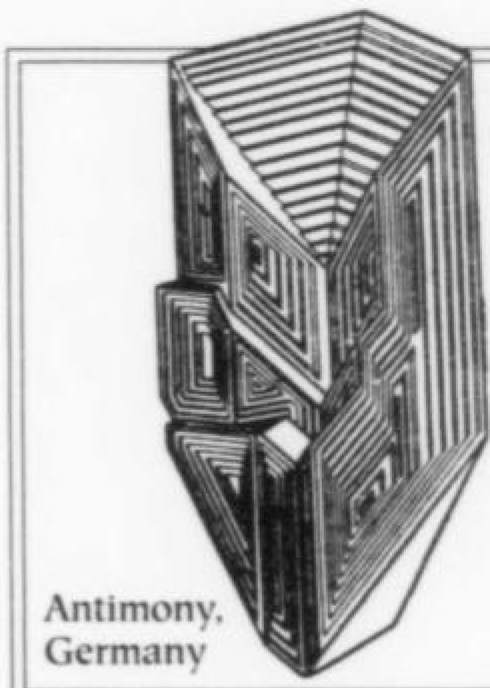

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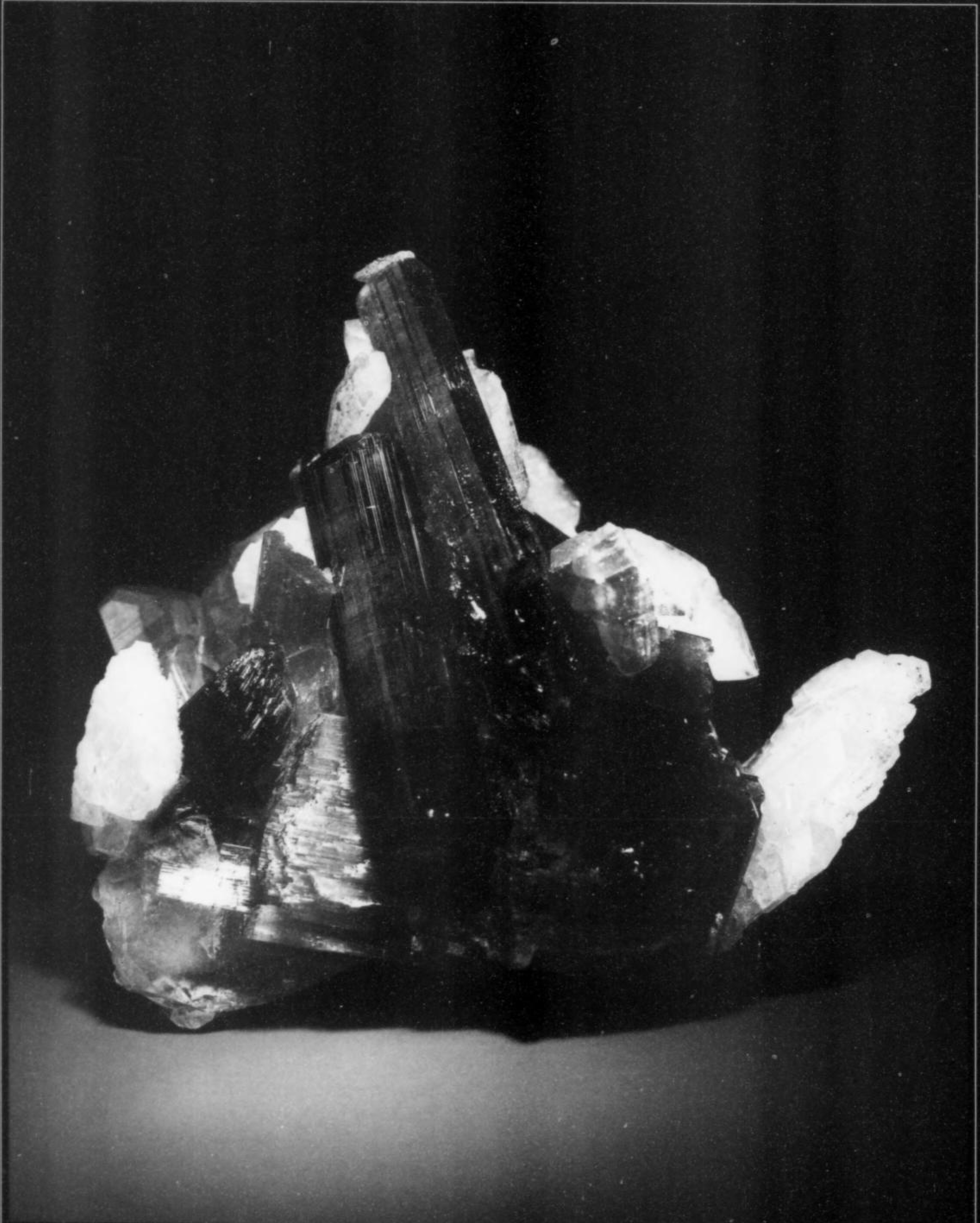
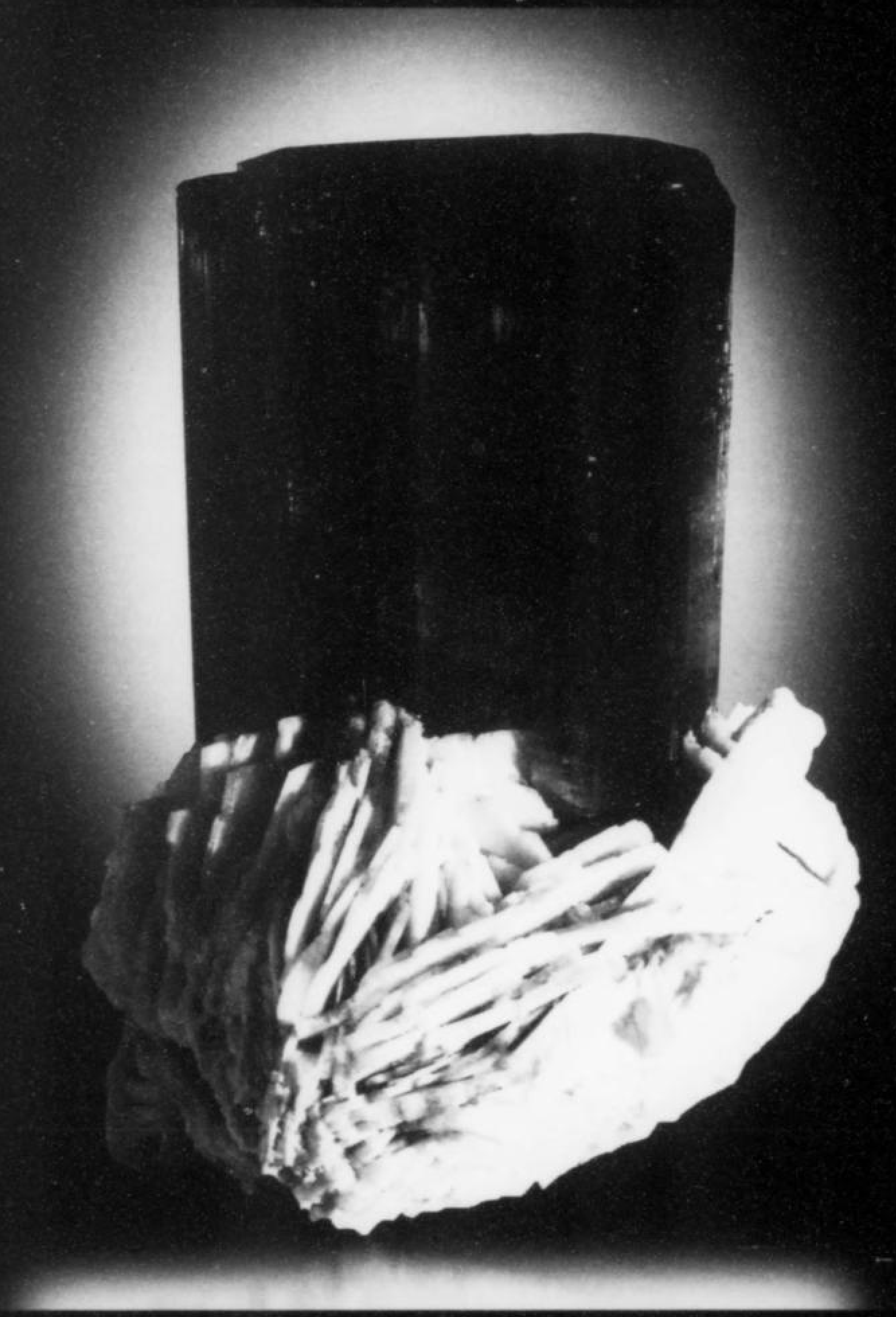


Elbaite with quartz, 3 inches, from the Jonas mine, Itatiaia, Brazil. Purchased from Alvaro Lucio, July 1978.

Clara and Steve Smale

COLLECTORS

PHOTO BY STEVE SMALE



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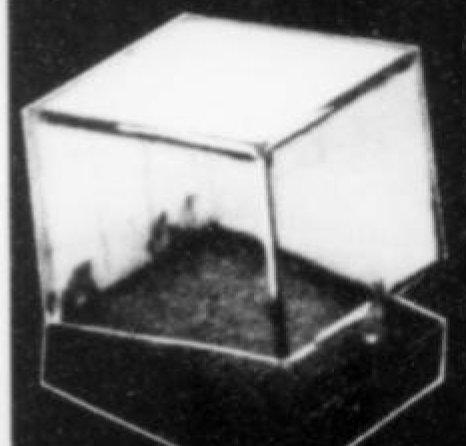

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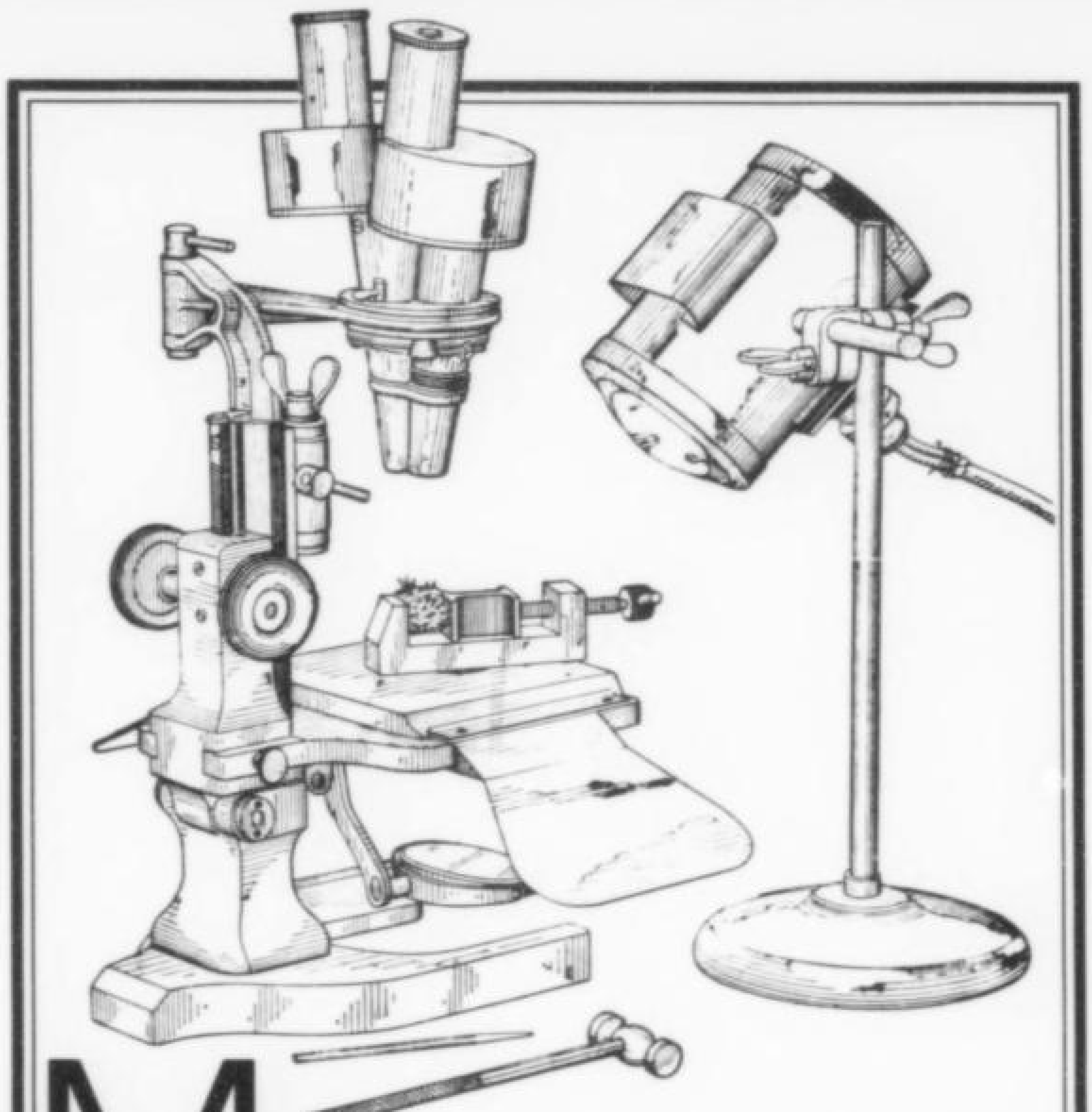


Microminerals

by Quintin Wight

[Editor's Note: We are pleased to announce that, after a hiatus of more than two years, the Micromounting column is back! Microminerals are a challenging specialty involving an appreciation of mineral aesthetics, a firm scientific understanding on which to base identifications, field collecting skill and perseverance, a delicacy of craftsmanship in the mounting process, and a sense of community that is rare or lacking in most other specialties. Our new columnist, Quintin Wight, is an authority on all aspects, as demonstrated in his definitive book on the subject, The Complete Book of Micromounting *(1993).]*

The Cooperative Urge

Micromounting, like the stock market, has its ups and downs. In North America, while there has been an increase in the number of events in recent years, there has also been a concomitant decrease in the number of people attending each event. I think it fair to say that peak attendance at such notable venues as the annual symposia of the Baltimore Mineral Society (BMS) or the Canadian Micro Mineral Association (CMMA), was reached in the mid to late 60's and early 70's, and has generally declined since.

On the other hand, the growth in interest in Europe has been phenomenal. The membership of l'Association Française de Microminéralogie (AFM) at last count was 369, while that of the British Micromount Society (BrMS), a group which limits itself to the study of British minerals, was 204. The world's largest symposium currently takes place in Cremona, Italy. In 2000, it attracted 116 attendees from nine countries. Why is there such a discrepancy between the continents?

I can think of several reasons. One is that there is a significant time lag in hobby activities between Europe and North America, brought about by World War II. It has taken the Europeans many extra years to achieve the level of economic sufficiency required to support what can be both a more technically difficult and more expensive (at least initially) aspect of mineral collecting. By "more technically difficult," I mean, for example, that for the cabinet collector a large rose quartz crystal is fairly obviously a large rose quartz crystal; for the micromounter, a tiny rose quartz crystal may be stillwellite. The micromounter often needs access to sophisticated tools or professional help to guarantee identification of specimens, and access to expensive devices just to see them in the first place. A burgeoning European economy has now broken away from the effects of the war, and the Europeans are experiencing the rush of enthusiasm for micromounting which swept North America in the 1960's.

Again, many North American universities and businesses have swept aside mineralogy as mere chemical taxonomy—the equivalent of stamp collecting in science—and no longer teach or support the subject. That's an error that will come back to haunt society years in the future, but in the meantime, we are forced to live with the results. Those results, of course, are that fewer young people are exposed to mineralogy during their school years, so they zoom by on the techno-highway, with no idea of what they are missing. They all known about silicon, germanium and gallium, but have no idea where they come from. In almost any micromounting symposium in North America the preponderance of silver hair and balding pates bodes ill for the future. We have very few young people.

In Europe, the proportion of younger members is higher, as is the enthusiasm for group projects—a factor which appears to have died out in North America. In 1957, the BMS republished *The Preparation of Micro Mounts,* an article by Dr. L. C. Wills, originally published in *Rocks & Minerals* in 1931; in 1963, the West Essex Mineral Club produced *Micromounting for Everyone,* a 16-page manual on micromounting techniques; and in 1973, the Worcester Mineral Club published *Geology and Mineralogy of Mount St. Hilaire,* (sic) *Quebec.* Not much in the way of group effort has appeared since. Club newsletters usually contain small, local articles and reprints from other newsletters, but not a great deal else.

On the other hand, the BrMS not only maintains a large reference collection available to members for comparison purposes, but is deeply involved in monitoring and commenting on legal rights and permissions for mineral collecting in Britain. Furthermore, the Society maintains a publication base, currently of thirteen papers, available for purchase. Since the BrMS is a micromount society, all of the papers are of interest to micromounters, but three in particular, written by Peter Braithwaite, should be part of every micromounter's library. They are #8, *A Guide to Micromounting: Part 1, Collecting*; #9, *A Guide to Micromounting: Part 2, Micromounting*; and #10, *A Guide to Micromounting: Part 3, Cataloguing.* The three sell together (to non-members) for £7.75 plus postage. While there are obviously some items oriented toward British materials, the papers are universal enough to be of use to any micromounter. The other ten papers, among them: #6, *Stereomicroscopes* and #7, *Photography of Minerals through the Microscope,* are also worth looking into. This is group operation and support at its best. More information on the publications can be obtained from John Pearce (e-mail: Johnpearce@lineone.net).

Similarly, in France, the AFM produces an array of very professional papers on mineral deposits, some of which have already been reviewed in the *Mineralogical Record.* The Association, however, is also building a micromount collection for the School of Mines in Paris. The members are aiming for a collection of 2,000 specimens. Where in North America is there a group working to similar ends? I know of none. Have we lost the cooperative urge along with our youth and enthusiasm? It makes one think.

Photomicrography and Dust

A few months ago, the staff at the Canadian Museum of Nature asked me to take some photomicrographs for a project. "No problem," said I. After all, I had taken thousands of photomicrographs. Then the specimens arrived—small vials containing tiny, loose, crystals of boron minerals washed out of drill cores taken from Sussex, New Brunswick. Clearly, this was a case for using the glass slide substrate technique I had illustrated in my book.

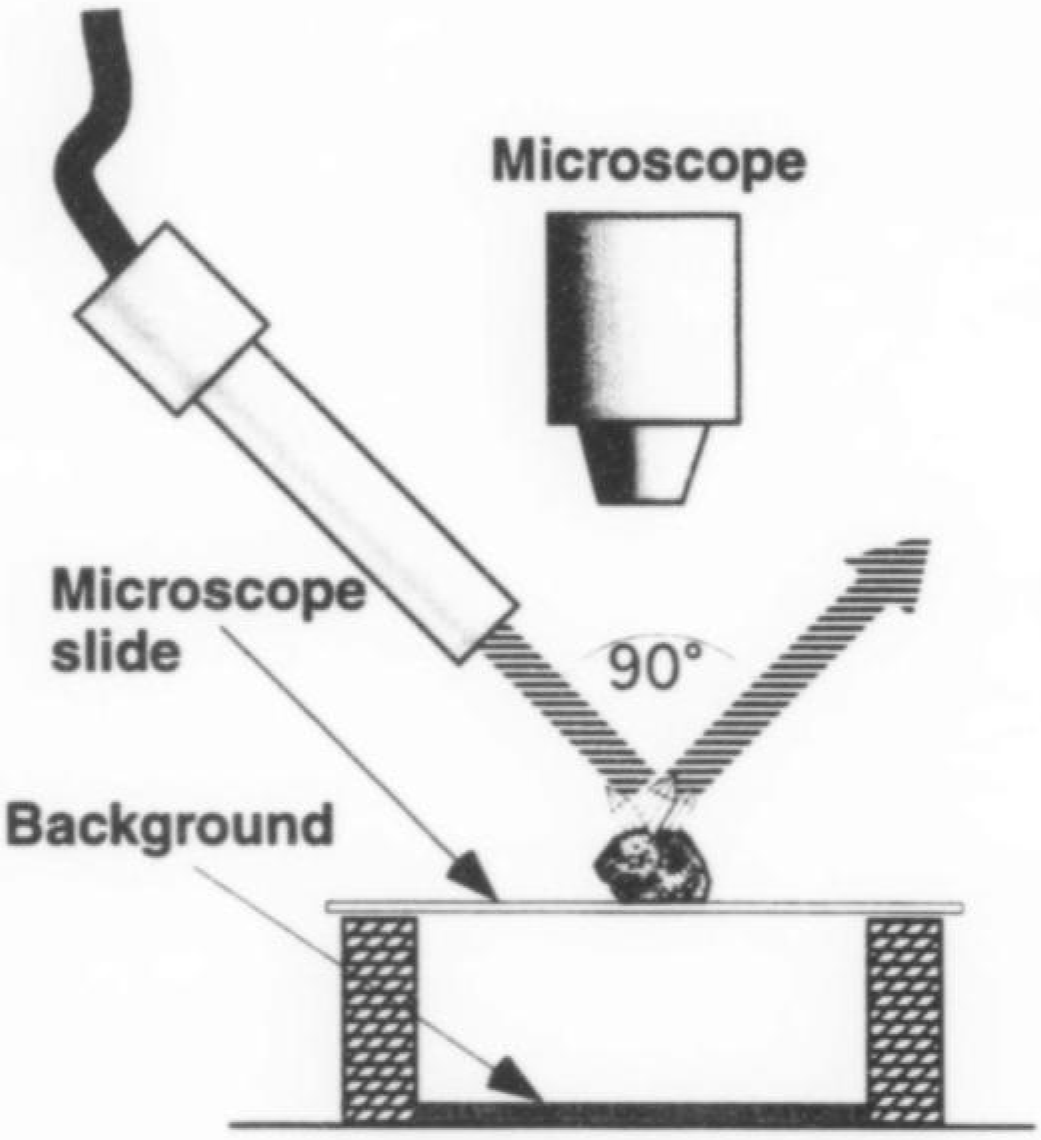


Figure 1. **Standard set-up for photographing small, unmounted specimens. Works well for specimens that are deeper than the depth of field, thereby throwing the glass slide substrate (and any dust particles thereon) out of focus.**

It didn't work!

Oh, the photomicrographs are fine. The crystals are shown in nice focus and placement. But so is every speck of dust on the slide! I wiped the slide off, and took them again. More dust. I cleaned the slide with Windex. More dust. I used lens cleaner; I used eye-glass cleaner; I used anti-static spray (it left little droplets that the microscope could see); I used compressed air; I used fine brushes. More dust. Every stroke across the surface of the glass—even with air—produced a static charge that attracted dust. Compressed air created the least static, but is also came dangerously close to blowing the tiny crystals off to oblivion.

In short, the glass slide substrate technique works well when the depth of the specimen is greater than the depth of field of the camera/microscope combination. The slide makes an excellent support for a loose specimen when the surface of the slide itself is far enough below the point of focus to blur out the dust.

One of the Museum staff suggested substituting a ground glass slide instead of a clear one. That made the dust a little less noticeable, but it also showed the shadow of the crystal. That's almost as bad.

Finally, I changed the technique slightly. It still didn't get rid of all the dust, but it produced an acceptable photomicrograph. Instead of two blocks to support the slide over a uniform background, I got a translucent plastic film canister, poured some ground granite into the bottom, and stuck a slide over the open top with a little Blu-Tack. Once I had the crystal on the slide, I used a loupe to spot as much visible dust as I was able, picked it up with a moistened brush, then took the shot. Because of its height, the film canister allows the pulverized granite (pet shops sell it for fish tanks) to be a reasonable distance from the microscope lens. At that distance, the white quartz and feldspar and the black biotite coalesce to become a granular gray/yellow background. (The yellow is a tinge from the plastic container, since the light now comes through the walls.) The gray is good for the light meter on the camera, and the granulation helps to disguise the dust on the slide. Success!

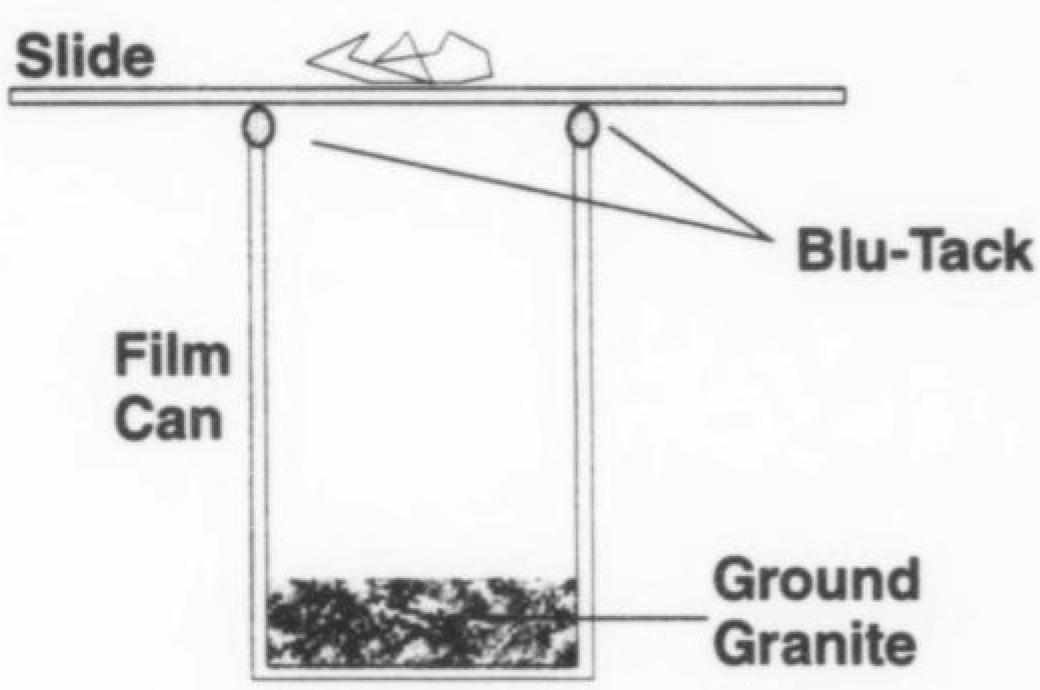


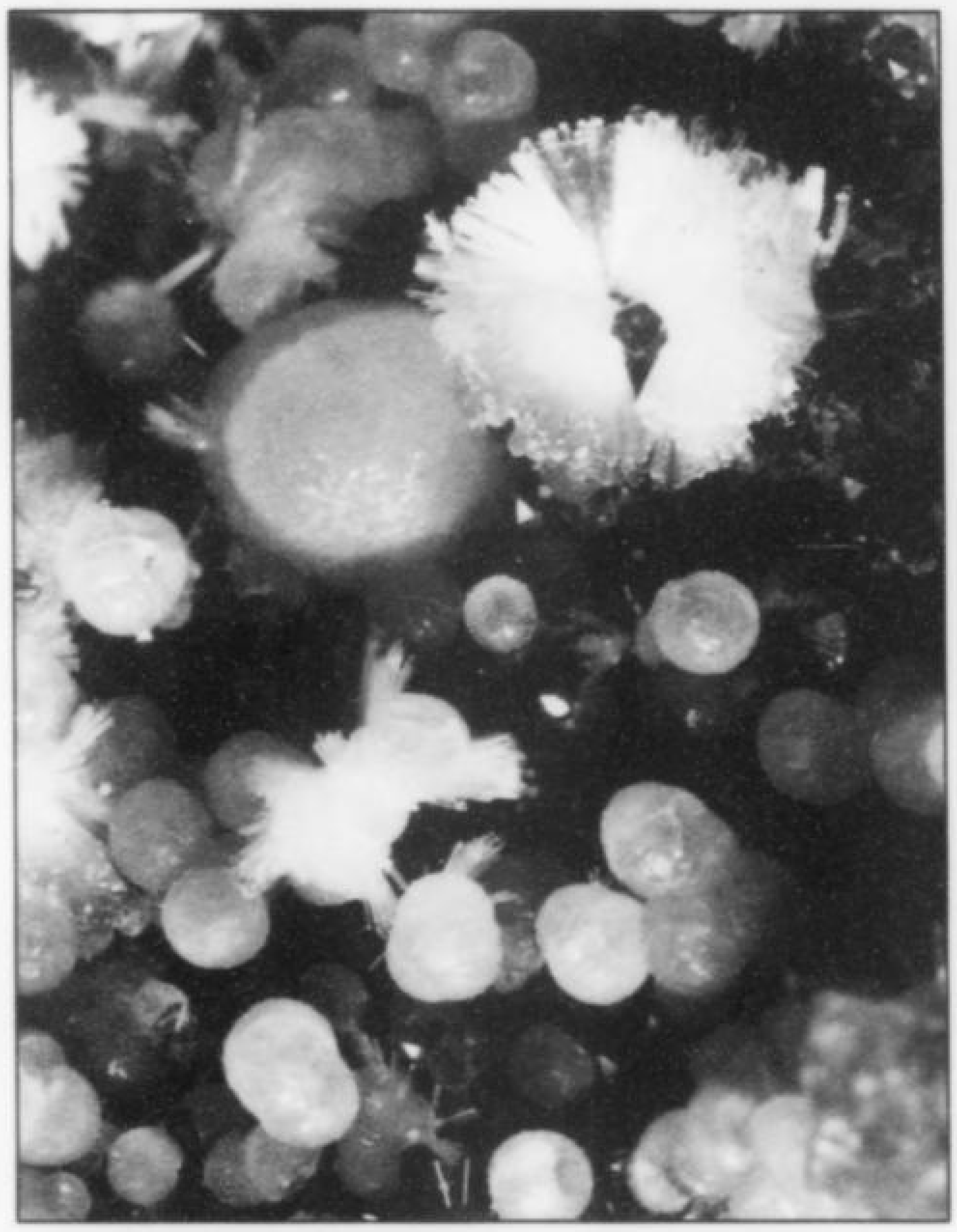
Figure 2. **Revised set-up for photographing specimens which are small relative to the depth of field. The mottled, out-of-focus ground granite helps to camouflage dust particles on the slide.**

Of course, there is always one other solution: take the shot complete with dust, scan it to disk, take the dust out with Photoshop or some other photo-manipulation program, then reconstitute the slide. A little electronic deceit can work wonders these days.

Generosity

One of the great things about micromount symposia is that people give so much away. The tables are usually filled to capacity with chunks of rock bearing some very fine crystals—all free for the taking. Of the North American symposia, the one held by the Northern California Mineralogical Association (NCMA) has unquestionably the greatest giveaway tables in the business. At the 2000 symposium, held in Pollock Pines, California, there were more than 100 flats of specimens out for the taking, most donated by Dick Thomssen of Carson City, Nevada, and Joe Marty of Salt Lake City, Utah, but many also by other attendees. Not only was the quantity magnificent, the quality of the material was outstanding. There were brilliant blue balls of carbonate apatite from Humboldt County, Nevada, gorgeous realgar clusters from the Getchell mine, wavellite from the Willard mine, ferrimolybdite from Idaho, erionite from Tunnel Beach, Oregon, and so on. The symposium began on Friday, but on Sunday morning there were still 30 unopened flats available to refresh the material on the tables.

My point is to emphasize the difference between the general run of mineral club meetings and just about any micromount meeting. The NCMA may have the biggest and best of the giveaway



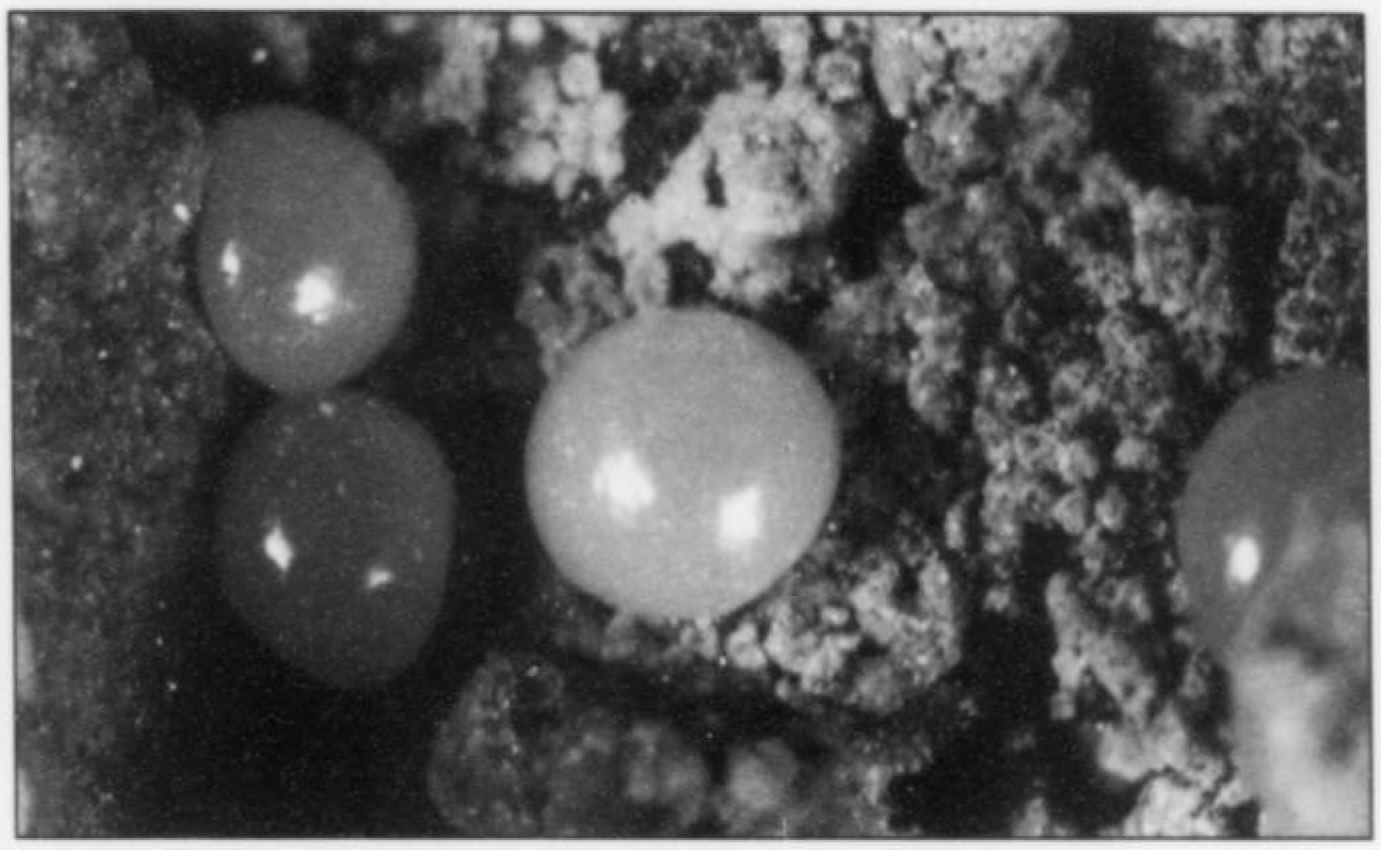


Figure 3. **Carbonate apatite spherules to 1.5 mm, from a prospect south of Golconda Summit, Edna Mountains, Humboldt County, Nevada. The specimen was obtained from a giveaway table at the Northern California Mineralogical Association Symposium in Pollock Pines.**

Figure 4. **Wavellite and variscite spherules to 2 mm, from the Willard mine, Pershing County, Nevada.**

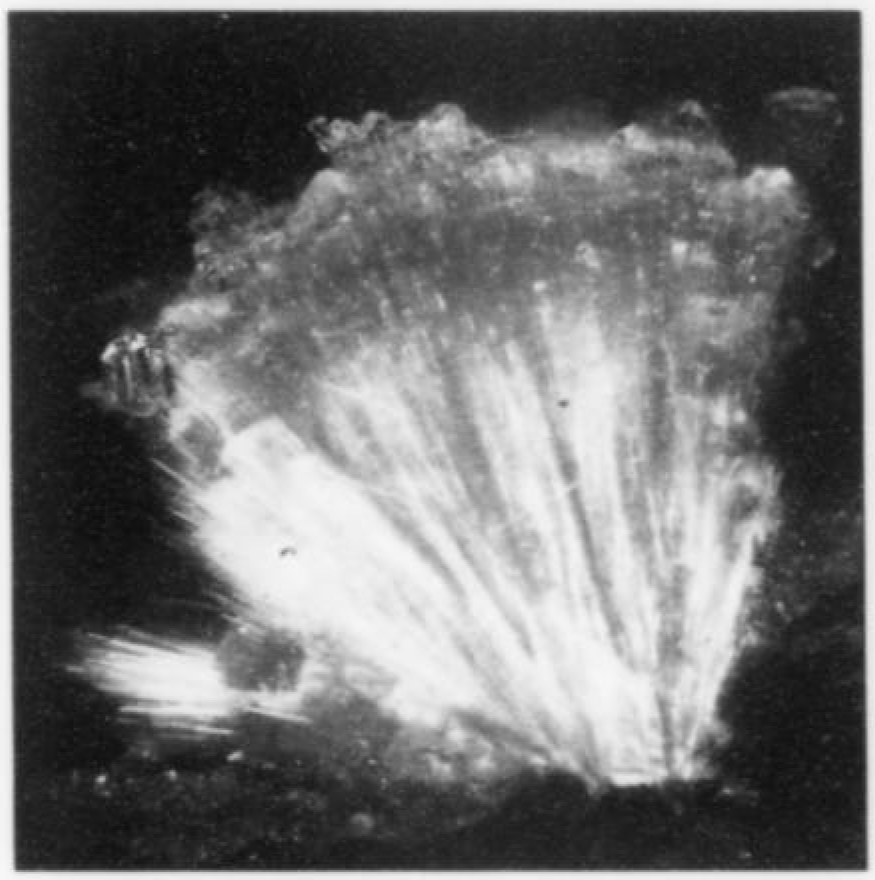


Figure 5. **Erionite spray, 1 mm, from Tunnel Beach, Tillamook County, Oregon.**

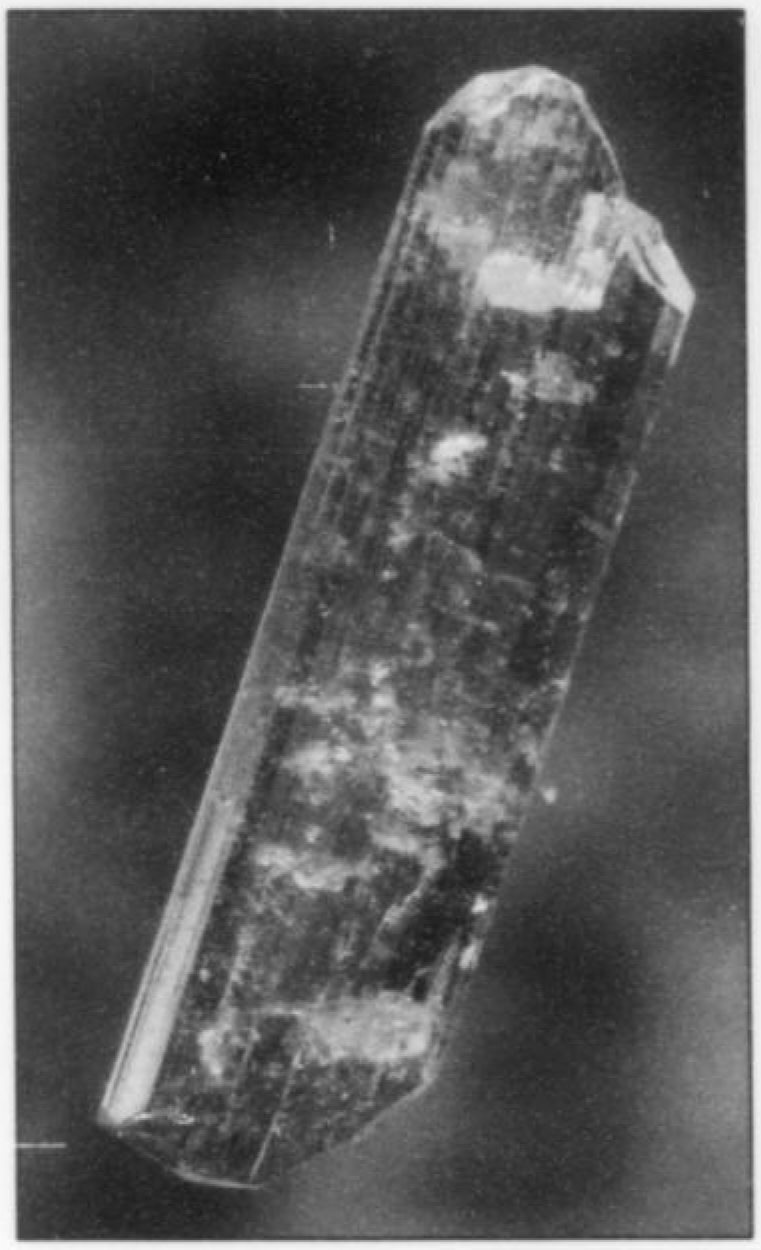
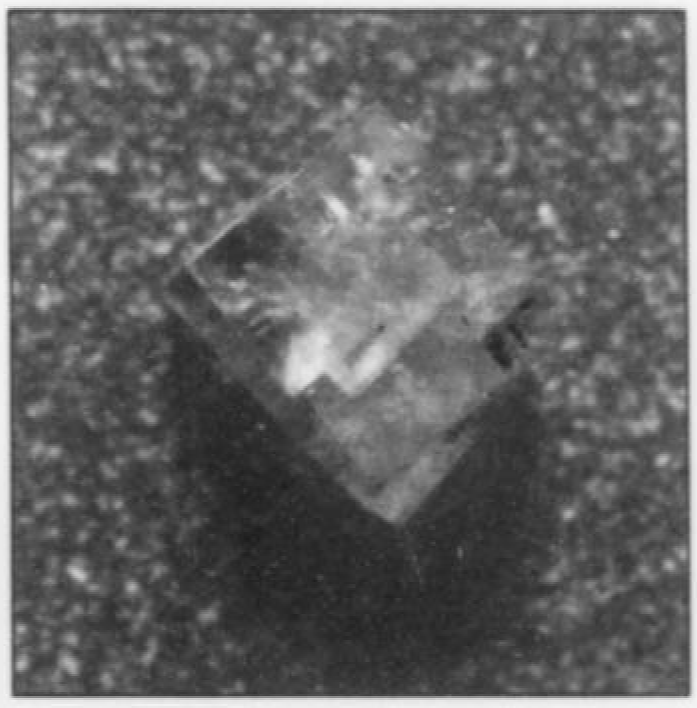


Figure 6. **Hydroboracite crystal, 6 mm, from Sussex, New Brunswick, Canada. Note the mottled background tones created by the crushed granite.**



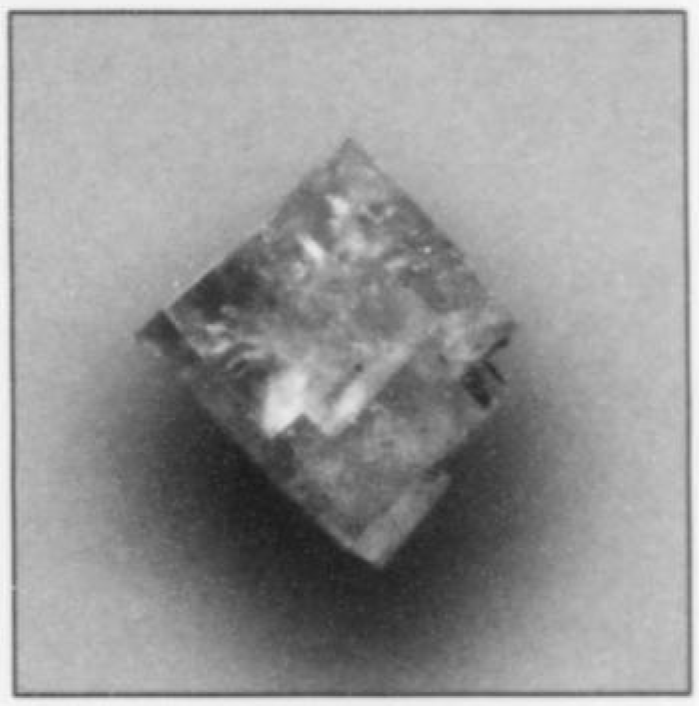


Figure 7. (top) **Trembathite crystal, 2 mm, photographed on an etched glass slide which, at this magnification, resembles styrofoam. Bottom: with computer-generated background.**

arrangements, but every micromount group has a "freebie" table, big or small. Even the first micromount meeting ever held at the *Rochester Mineralogical Symposium* had one—to the evident puzzlement of the "regular" collectors in attendance, who kept stopping by to check it out.

There is a great deal more involved here than a simple "Well, they're just little bits—hardly worth anything." Small some pieces may be, but each one of them represents hard collecting work on the part of the donor, and those that are already mounted represent even more work and cost. Besides, many specimens are of species that are not found in cabinet collections because those species do not occur in large crystals. The giveaway tables stand for work, knowledge, scientific value and, above all, generosity. To my mind, they are the true distinguishing features that separate micromounting from the rest of the mineral community.

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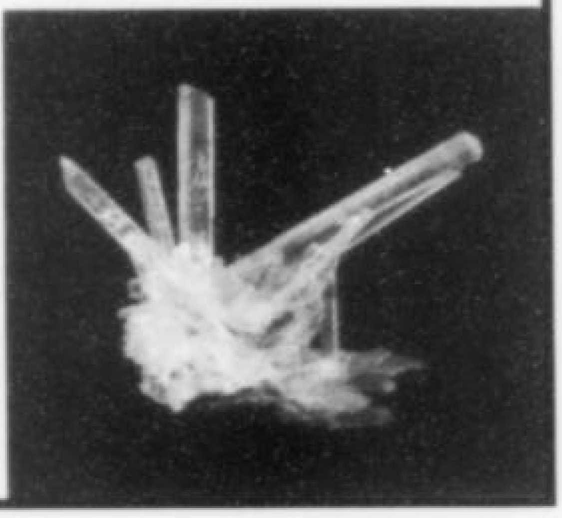

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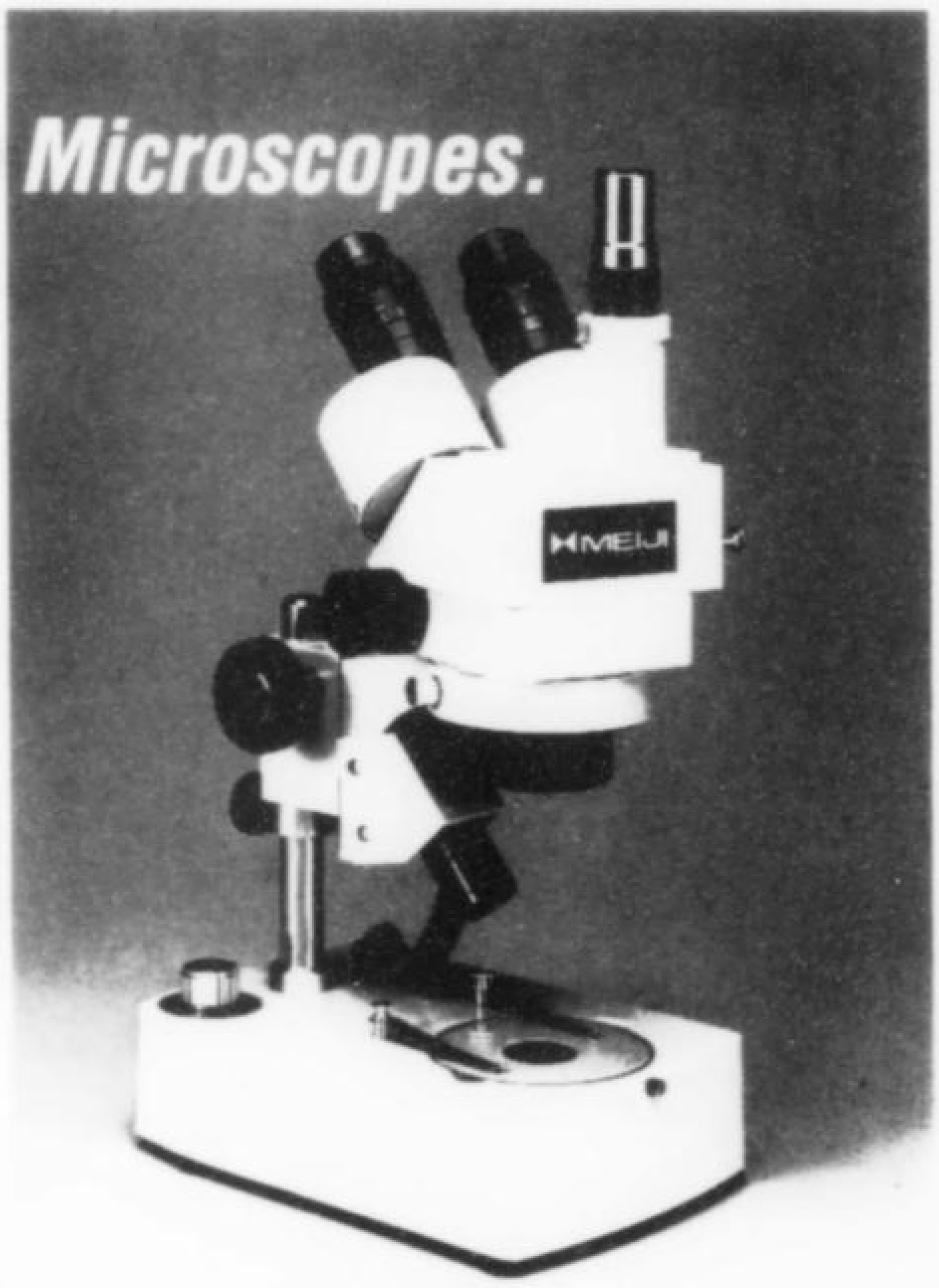

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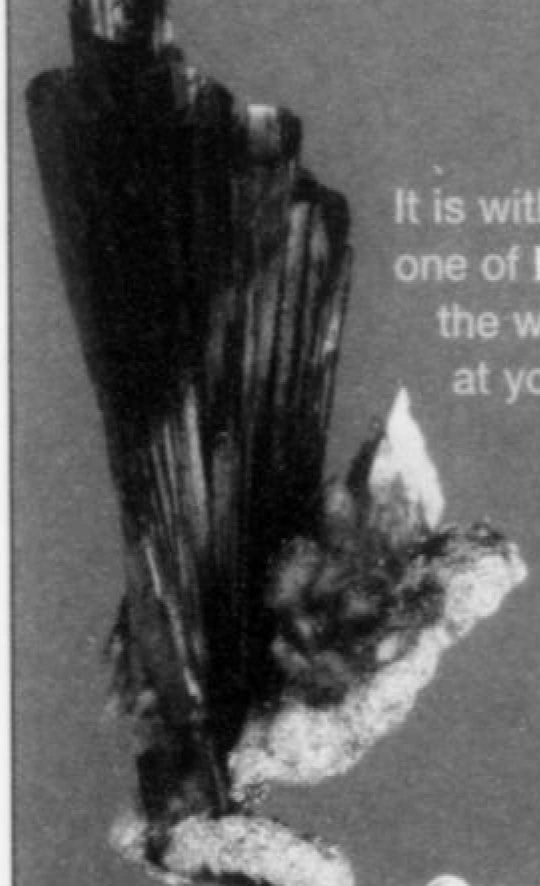

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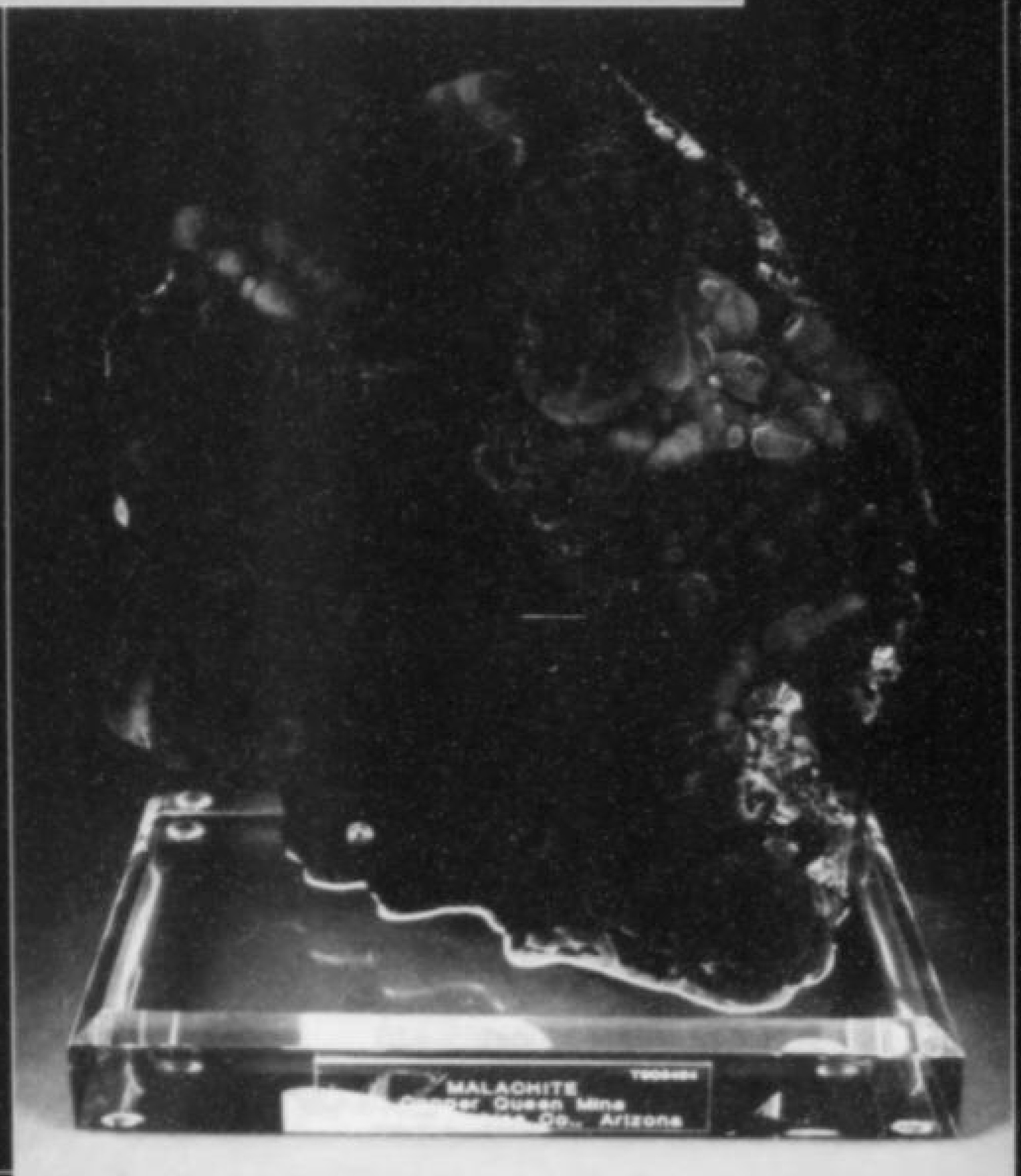
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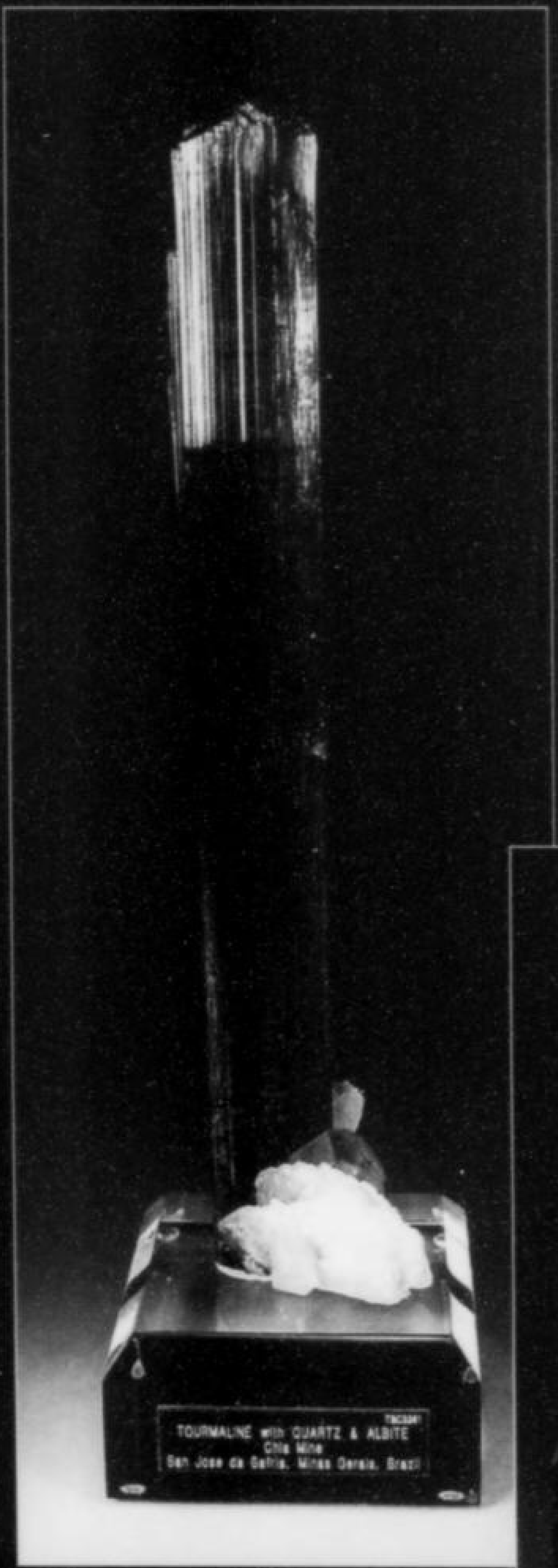
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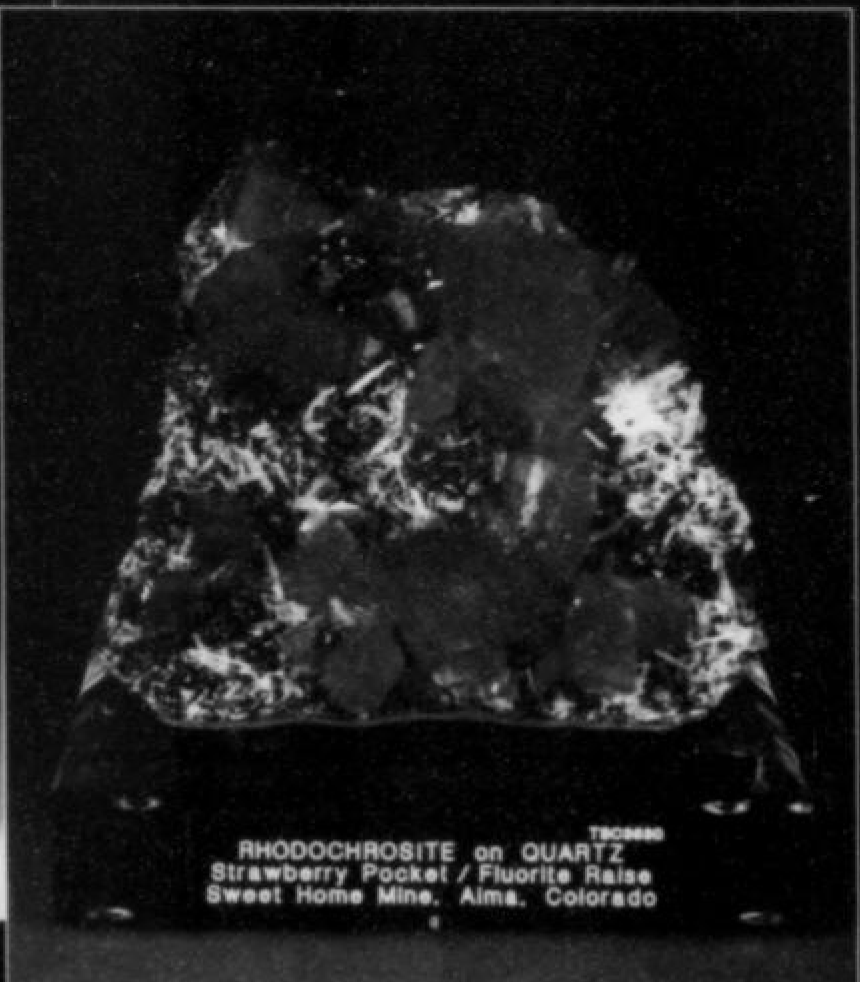
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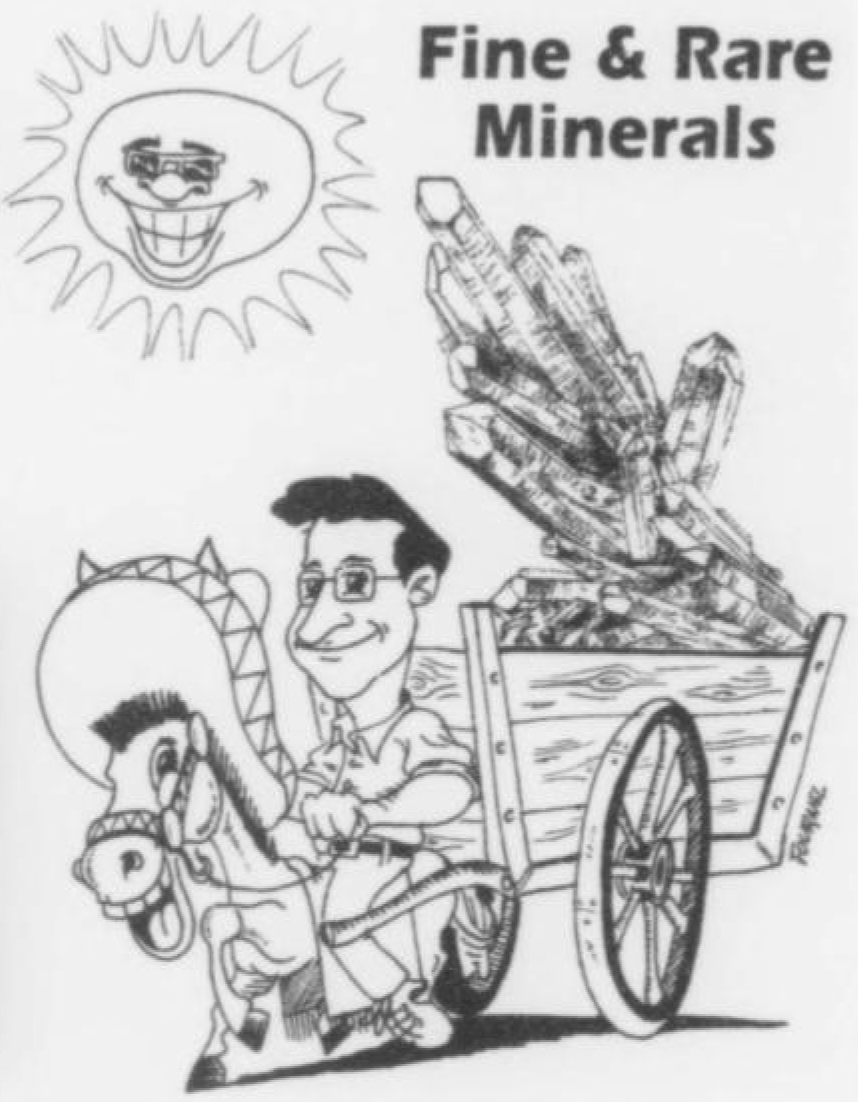
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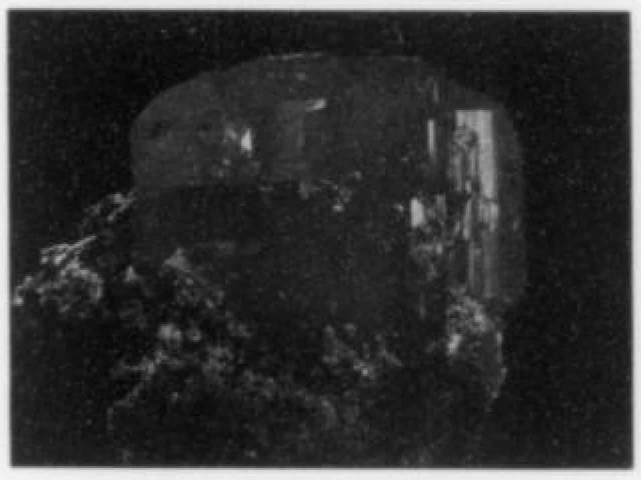

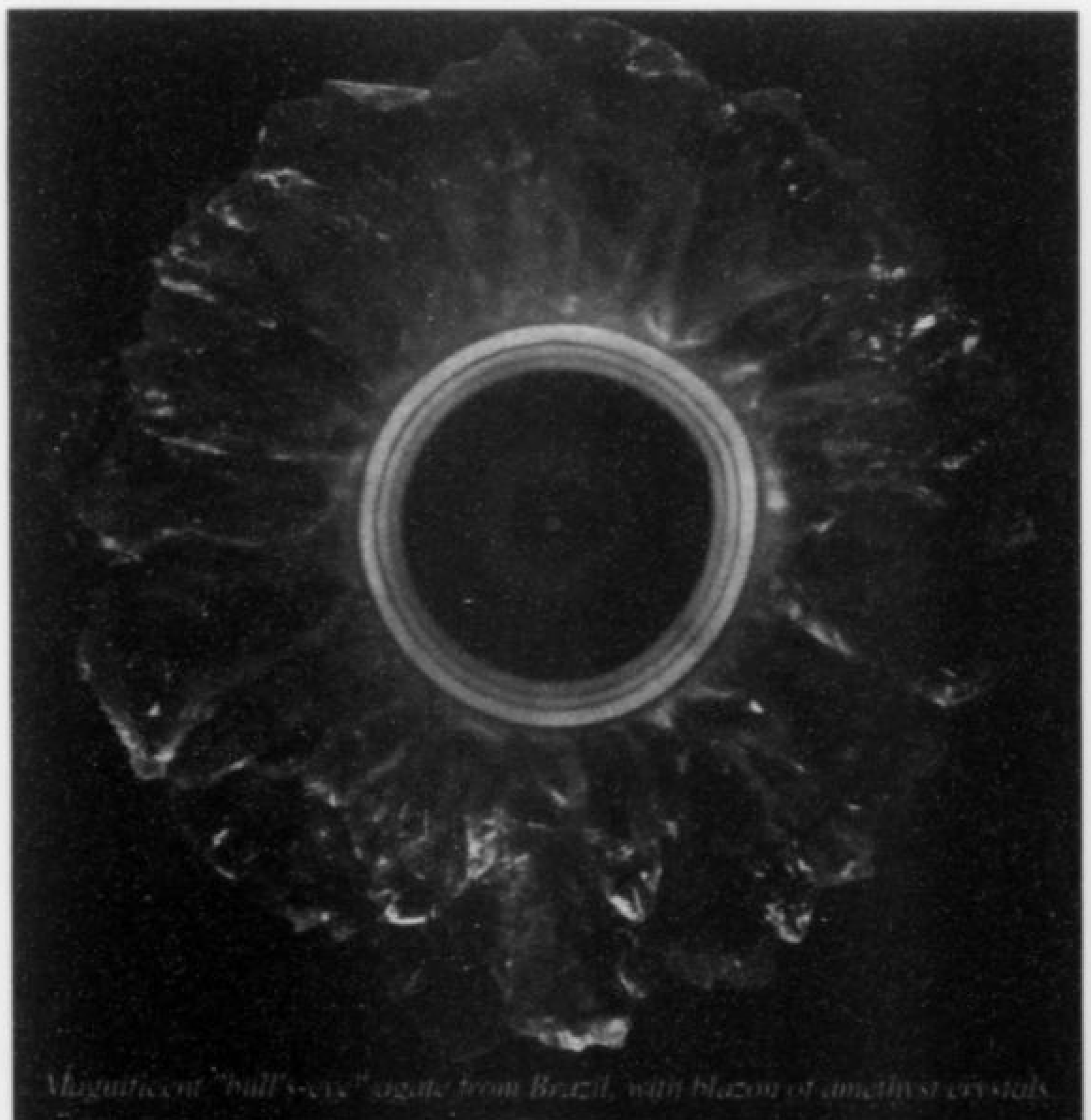

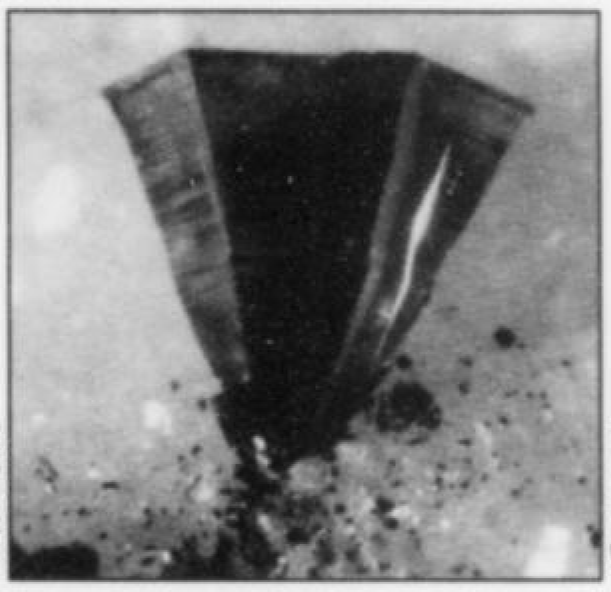
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What's New in Minerals

Tucson Show 2001

by Tom Moore

[February 1–11]

We had nice weather all week in Tucson; you would not have had to be a mineral person to wish you were here. Except for a cooling trend as the Main Show began, the temperature flirted with 80°F, and there were clear skies, mild silky air, mockingbirds singing in the trees . . . all right, I've said all this before about Tucson in February, and it can sound like simple gloating to those who have been dealing with sleetstorms. But we can't help it, we Tucson Show pilgrims, and so all you Klondike People will have to put up with it. Imagine the back-home weather being escaped by the many *Russians* who came this year with their Fabergé treasures, their books and magazines, and their tonnages of specimens to sell.

This year, the usual quota of nifty surprises appeared, rising sometimes to dazzlements and mind-blowings (see, for example, under Australian chalcocite), and Marty Zinn's hotel show picked up from a slow start to a heady traffic of seekers, room hoppers and peekers. And at the Main Show many important items challenged the budgets of those who (like me) had already blown too much of their money back in the Executive Inn and InnSuites. Such is the diversity of the market, and such is the general vitality of the hobby, that alert collectors, even if financially challenged, can always find good minerals to their tastes, good deals, and good fun in the marketplace. You don't *have* to resent the wealthy collector who paid some six-figure price for some giant gem crystals. Among the patient, educated and open-minded, nobody (as our new President might put it) "gets left behind."

This survey will follow its usual worldwide course, commencing in Arizona and ending at several points near the convergences of the Asian and Australian plates. A few photos of specimens which Jeff Scovil saw but I didn't will also be included in the layout.

Two years ago I noted the pretty and promising green octahedral **fluorite** being dug by Dick Morris and Mark Hay from some old gold mines, chiefly the Hardy mine, in the Oatman district of Mohave County, Arizona. This year, as several dozen fine specimens in Dick's and Mark's hotel room proved, the promise is fulfilling itself, and really good Arizona fluorite is no longer a fantasy. These new specimens from the Homestake mine, dug during most of last year, come in all sizes, from winsome thumbnails to the 10 x 12-cm matrix plates with 4-cm crystals shown in their display case at the Main Show. The octahedrons are simple and sharp, the color is a watery pale lime-green to a somewhat deeper green, and the octahedrons perch well on their matrix of drusy quartz. In most of the specimens, including all of the large ones, the crystal faces are frosty-looking composites of innumerable little cube corners approximating the octahedron faces. These handsome products of quartz veins in altered volcanic rocks make truly lovely specimens. Call Dick and Mark at 602-840-5552 or 602-831-9176 if interested.

Les Presmyk of *De Natura* showed me a second new Arizona discovery: **quartz pseudomorphs** after anhydrite, about 70 specimens dug last Thanksgiving by Al and Mary Rose (of Fallbrook, CA) from an outcrop near New River, 40 miles north of Phoenix. The specimens are of thumbnail, miniature and small-cabinet sizes, priced by Les at up to about $125. The matrix is a reddish rhyolite with veins of bluish chalcedony; the pseudomorphous quartz crystals are sharp rectangular blades, opaque and slightly rough, of a pleasant pale pink to salmon-orange color, forming jumbled nests in pockets.

At the Pasadena Show, Jeff Scovil observed some new **trona** specimens dug by John Seibel at Owens Lake, Inyo County, California. In his InnSuites room, John Seibel had a few flats of big cabinet specimens: creamy pale brown, translucent crystals solidly intergrown and standing vertically, with individuals reaching 5 cm, and no damage evident anywhere. Some areas of the plates are tinted a reddish violet by bacteria which thrive in evaporite environments. At the Main Show Victor Yount had a lot of these specimens too; but whether or not these were the same ones, bought from John, I don't know (all of these specimens, though fairly attractive, look pretty much the same).

The spectacular yellow **barite** from the Barrick Meikle mine, Elko County, Nevada, may by now seem like old news, but let's run by it one more time, since Casey Jones of *Geoprime Minerals* (11332 Hawthorne Ave., Hesperia, CA 92345) hit another big pocket last December. It was 20 x 30 feet, and he calls it the "Goldstrike Pocket"; the big barite clusters it yielded look much like the earlier ones except that some crystal faces have dark gray selective overgrowths of uncertain nature. There are almost 700 specimens of the new material, with miniature and small-cabinet sizes predominating, although a few groups are 25 cm across. A similar story is that of Harvey Gordon, whose Main Show stand offered many, many new **barites** from the Dee mine (see earlier show reports), but these are generally much more lustrous than the old ones, and now rival the Meikle barites for dramatic aesthetics.

At the Main Show I met Bill Warren of *Front Range Minerals* (P.O. Box 632, Golden, CO 80401), who proudly showed me a recently acquired hoard of ten large specimens of an old Colorado item: **almandine** garnet in matrix from the Sedalia copper mine, Chaffee County. This mine closed in 1923, although the dumps were collectible into the 1950's, Bill says. The opaque red, rough-faced simple dodecahedrons of almandine are 7 to 10 cm across individually, and they rest in a gray-green chlorite schist, which sometimes smears over onto the crystal faces; dull black **magnetite** octahedrons to 3 mm pepper the faces also. These doorstop-sized specimens cannot be called pretty, but they are old Colorado Classics.

Now to two new western U.S. occurrences *not* represented by specimens at this show, but which may well turn up at future shows (I know about them from email and some specimen trading by

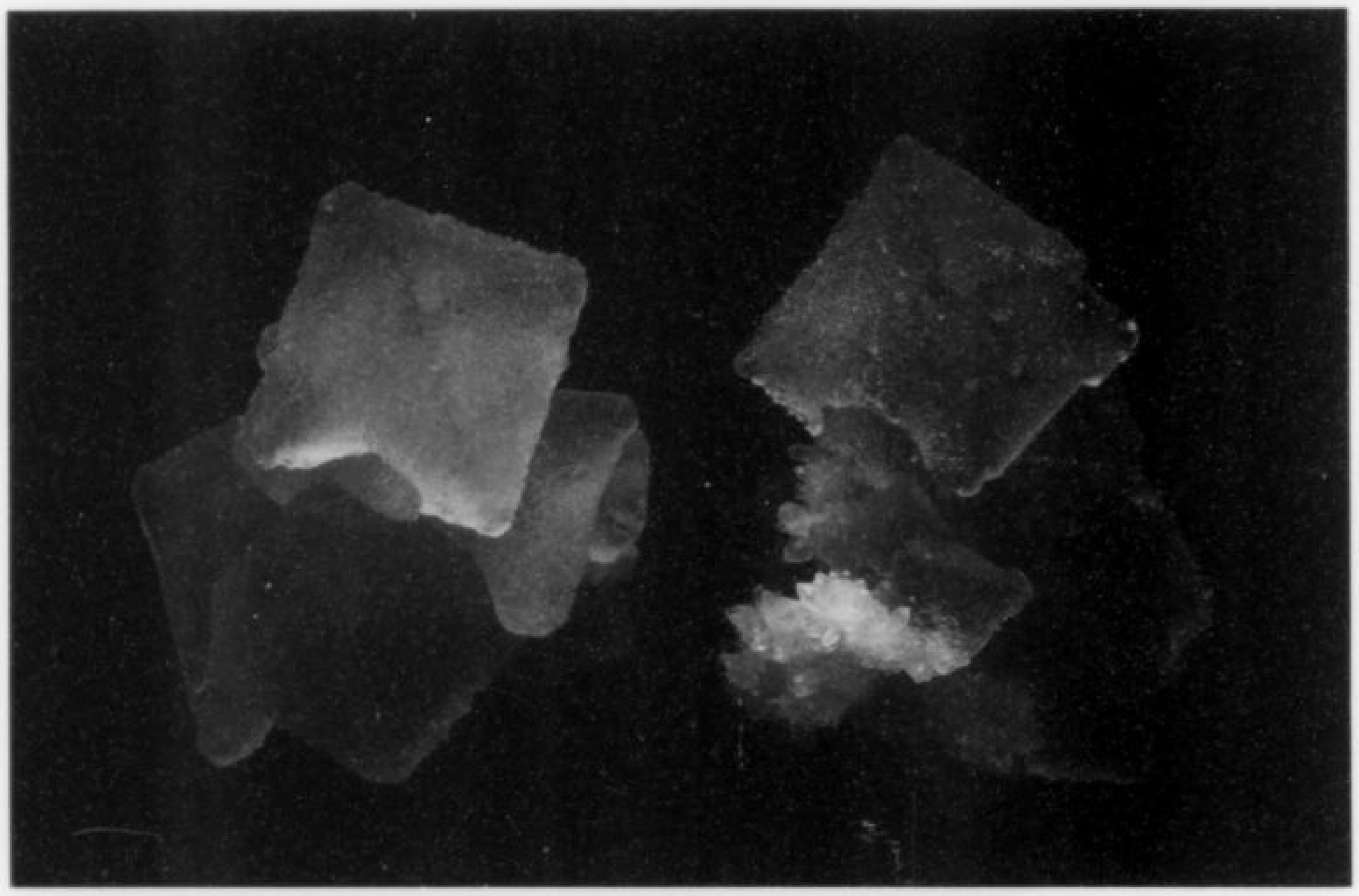


Figure 1. **Fluorite crystal clusters, 2.5 cm and 2.9 cm, from the Homestake mine, Oatman district, Mohave County, Arizona. Tom Moore collection; Jeff Scovil photo.**

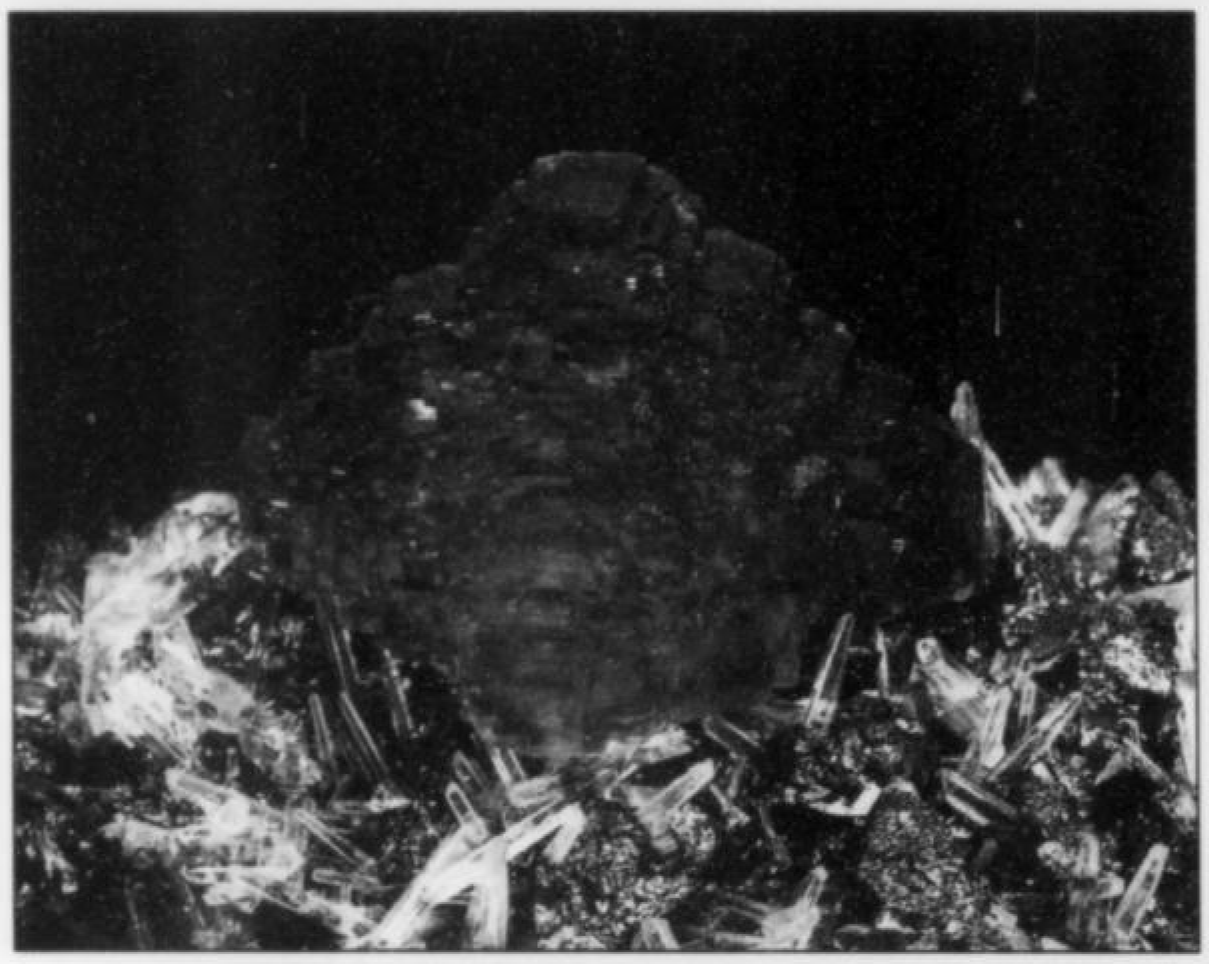


Figure 2. **Fluorite crystal, 3.9 cm, on matrix from the Sweet Home mine near Alma, Colorado.** ***Collector's Edge*** **specimen; Jeff Scovil photo.**

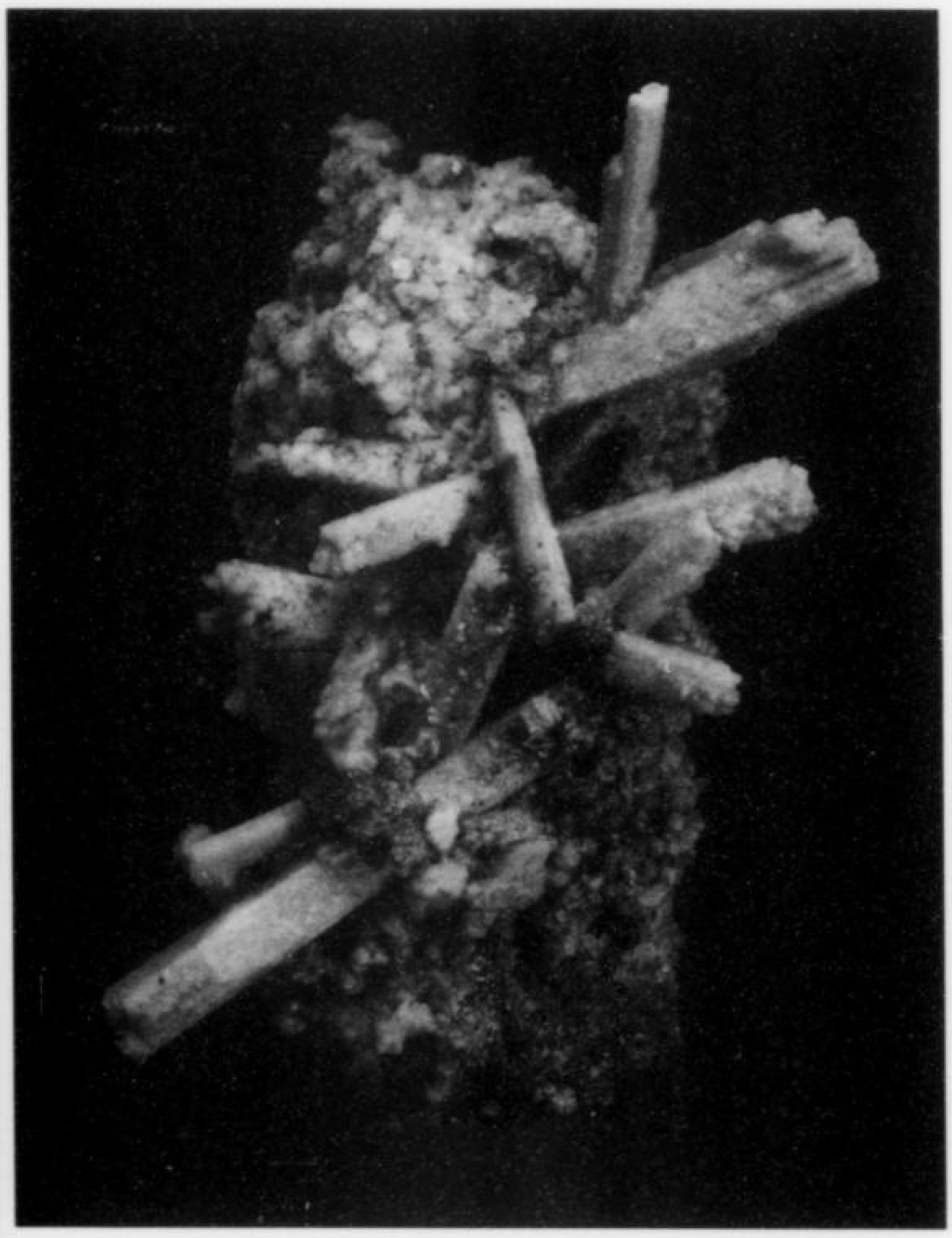


Figure 3. **Quartz pseudomorphs after anhydrite, on matrix, 7 cm, from near New River, Maricopa County, Arizona.** ***De Natura*** **specimen; Jeff Scovil photo.**

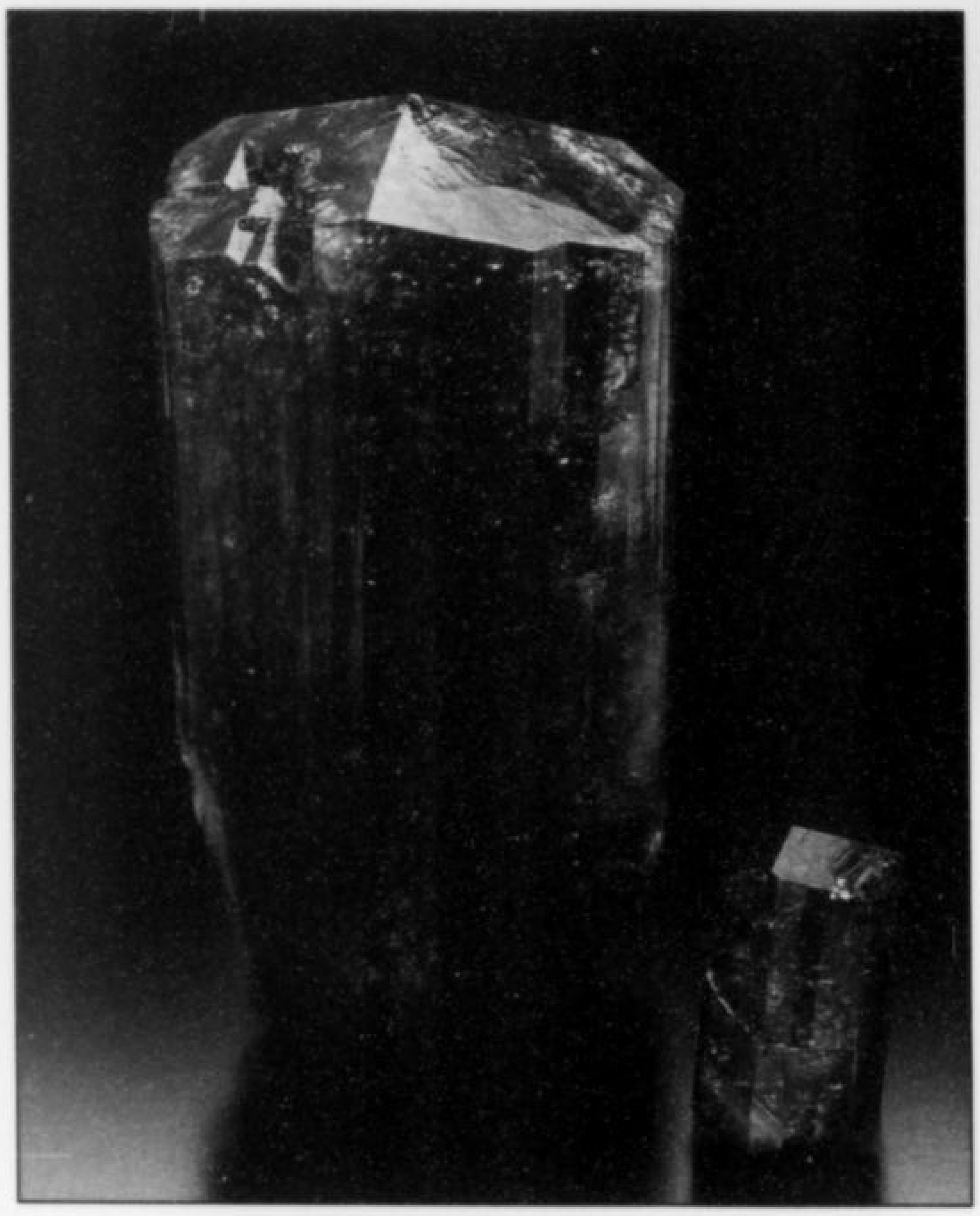


Figure 4. **Elbaite crystals to 3.3 cm, from the Stargazer claim, O'Grady Lake, Northwest Territories, Canada. Guy Dyck and Brad Wilson specimen; Jeff Scovil photo.**

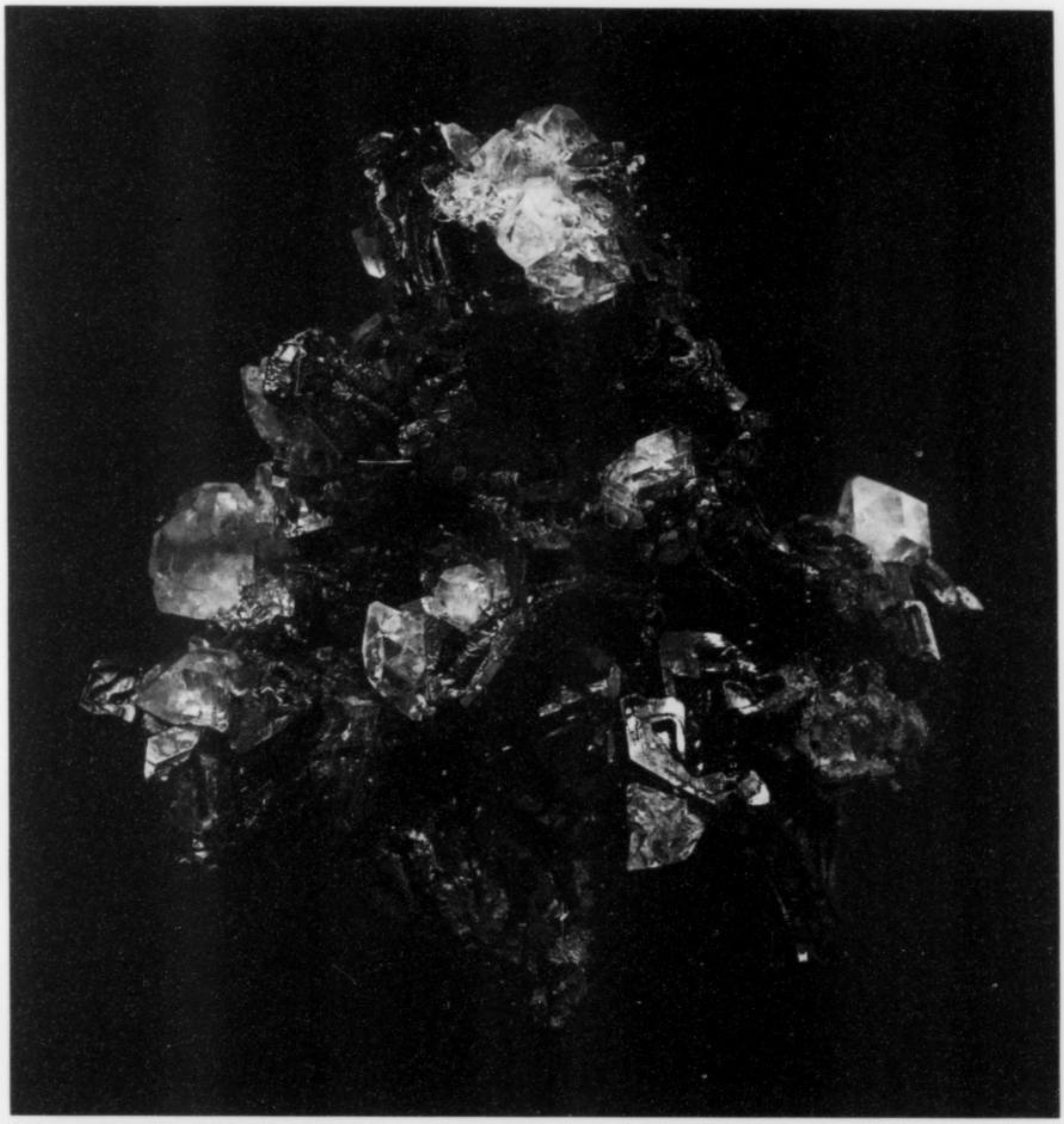
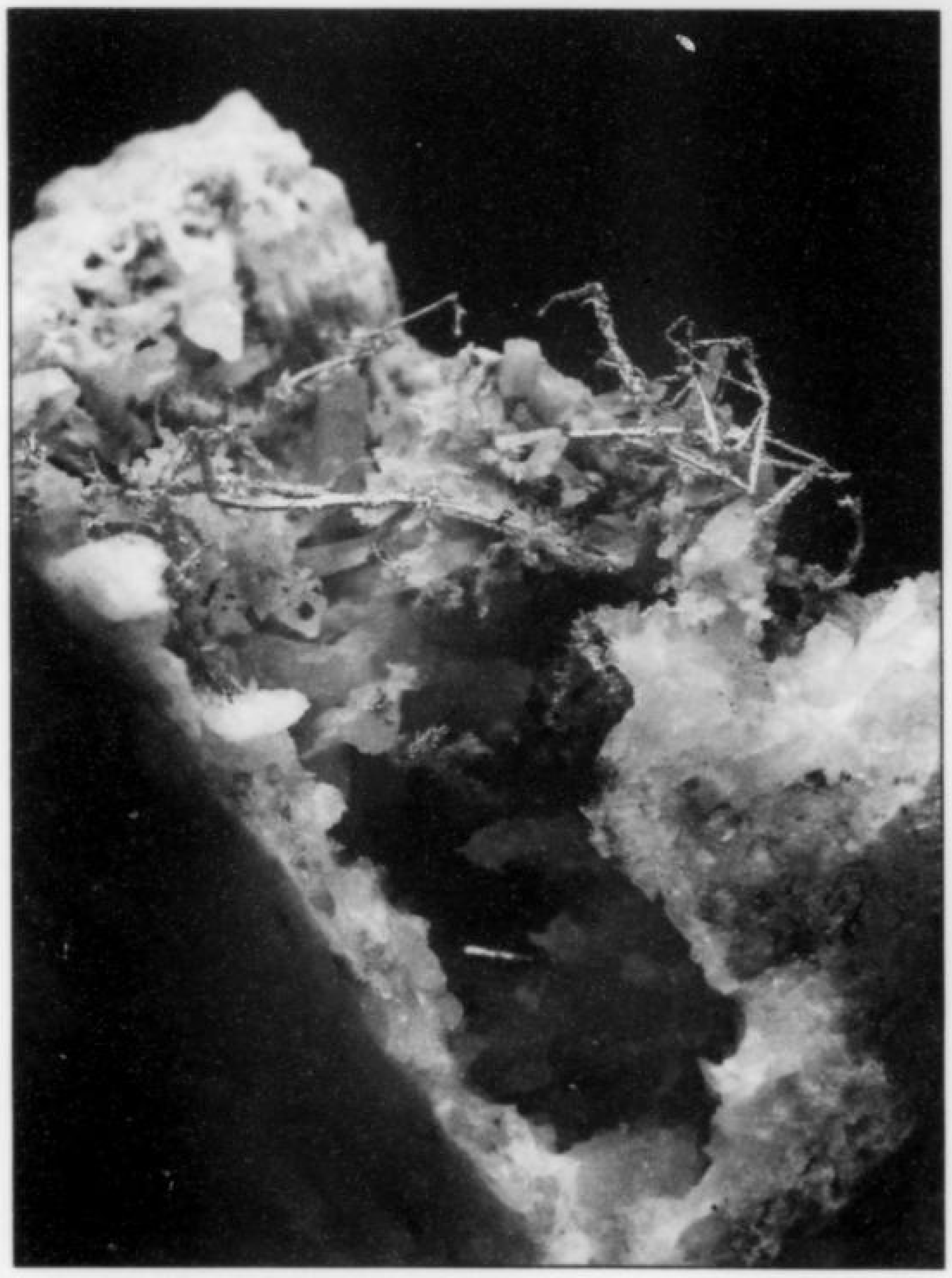


Figure 5. **Acanthite and fluorapophyllite, 3.5 cm, from Falla de Cubo, Torres mine, Guanajuato, Mexico. Dave Bunk specimen; Jeff Scovil photo.**

Figure 6. **Gold wires to 1.5 cm in a quartz-lined pocket, from Pampa San José, Carolita, Huancay, Peru.** ***Miner's Lunch Box*** **specimen; Jeff Scovil photo.**



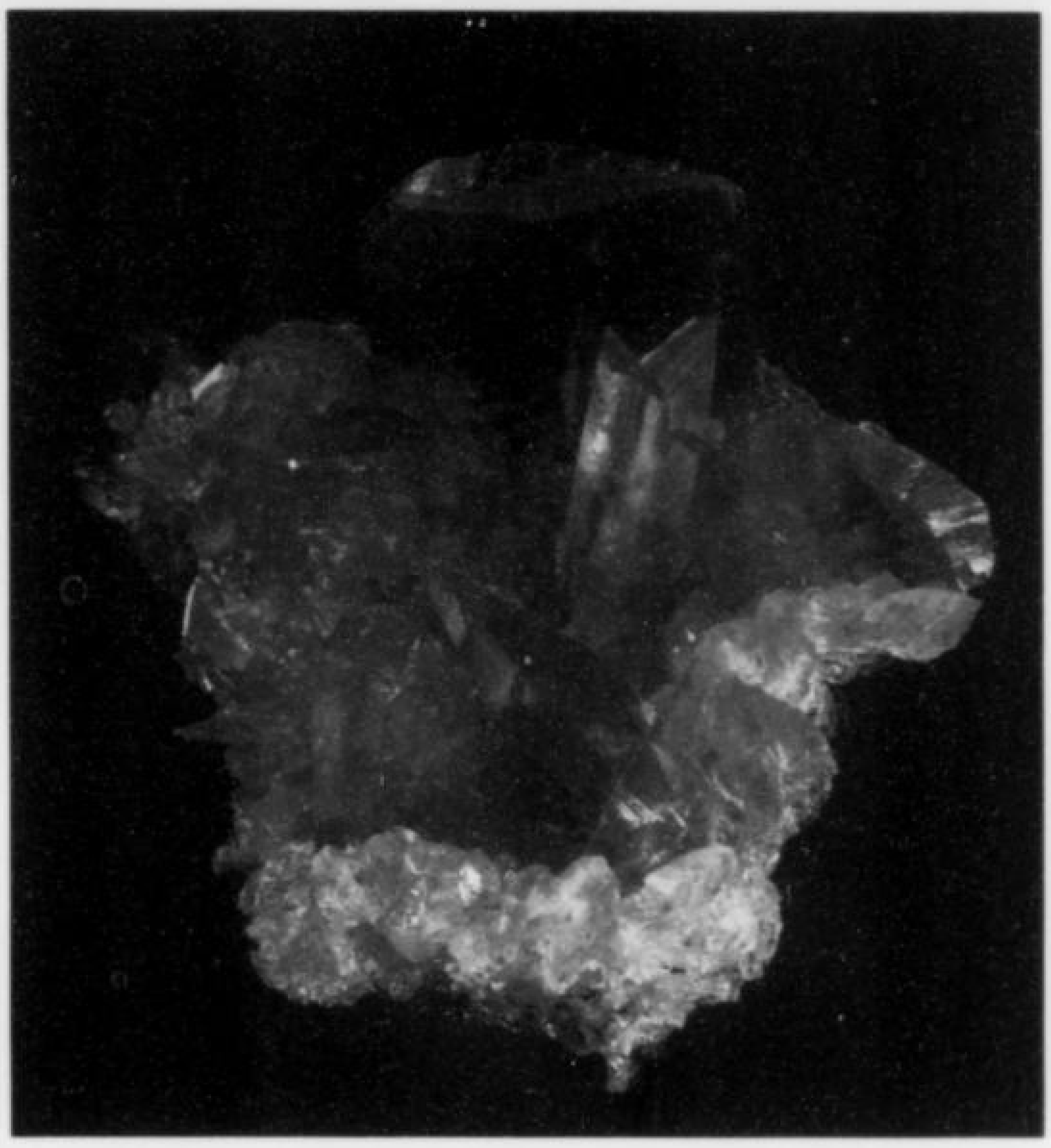


Figure 7. **Gypsum, 8 cm, from Las Salinas, Ica, Peru. Jurgen Tron collection; Jeff Scovil photo.**

post). The first is **chamosite**, a high-Fe member of the chlorite group. It is dull black and unattractive but very rare in good "books" of micaceous crystals such as have recently been dug by Glenn Laidlaw, of Riverton, Wyoming, from the dumps of the now inactive Atlantic City iron mine, South Pass, Fremont County, Wyoming. The chamosite books are sharp, and reach 1.5 cm; they sit on a hard igneous rock matrix or occur enclosed in calcite pods, this according to Glenn, who's the only person ever to have secured permission to collect at the mine. He has sent a very few specimens into the marketplace, he says, though none were to be seen in Tucson; Glenn can be emailed at laidlaw@trib.com.

Chances seem better that showgoers will soon get to look at Lanny Ream's beautiful new Idaho **heulandites**. This heulandite really is excellent, with lustrous orange-pink crystal sheaves to more than 2 cm rising from matrix of white **mordenite**, the sheaves curled up like coral, glistening like pearls, sometimes lightly interlocking. Lanny says that the geodes from which the specimens come reach diameters of 35 cm, and that they also contain what may be the best mordenite ever found in the world. The locality is somewhere along Warm Springs Creek near Challis, in central Idaho: an exposure of altered andesite on a hillside, where Lanny plans a mining operation for this coming spring. Actually, a little low-end material *was* to be seen in Tucson, but my beautiful new thumbnail obtained by trade before the show made me disdain what was here.

From John Medici (5280 Stover Rd., Ostrander, OH 43061) comes news of a very significant new find of **celestine** at the Stoneco limestone quarry, Portage, Ohio. Here, new blasting last June opened some pockets at the base of a 117-foot wall, and John and his son Jay took out some 1,600 single, loose blades of celestine, ranging from 3 to 25 cm long. The blades are vividly lustrous, milky white through most of their length but showing a palest blue gemminess near their flat-topped ends; 30 or 40 are doubly terminated. John had a caseful at the Main Show, while Rocko Rosenblatt, at the Executive Inn, had some miniature-size specimens.

One hundred or so distinctive and very winning **siderite**, **biotite**, and siderite/biotite specimens were collected back in the 1960's at the Crabtree quarry, Wake County, North Carolina. These were being offered for sale at this year's Main Show by Terry Ledford (the Graves Mountain rutile man!) of *Mountain Gems and Minerals* (P.O. Box 239, Little Switzerland, NC 28749). There are clean, flashing specimens in all sizes, the siderite appearing as very pale brown to medium brown, lustrous, simple or compound rhombohedrons to 4 cm, the biotite chiming in as extremely sharp, extremely black hexagonal books to 2 cm. Between and scattered upon the large crystals of these species are small needles of **rutile**, little gray rhombs of calcite, monazite and apatite microcrystals, and (oddly) tiny hairs of metallic black **jamesonite**. A fine miniature with either siderite or biotite, or both, can be had for around $100.

The ever-resourceful Tysons of *Tyson's Minerals* have just bought up a stock of **gold** specimens from David Joyce, who got them from the mining company that used to operate the now-closed Sigma mine, Louvicourt Township, Quebec. In other words, this is a "new" locality for gold, even though the specimens were found there anywhere from 2 to 60 years ago. They are quite presentable "mossy" gold specimens, with gray-white mottled matrix of quartz/sulfides/tellurides from which rich masses of gold of deep yellow color jut up in outlandish forms. At the Main Show, the Tysons offered about 20 specimens, from a couple of thumbnails up to one 6 cm high, all showing more gold than matrix.

Mont Ste.-Hilaire, Quebec, is ever-prolific, thanks in part to the constant hard work of Gilles Haineault of *Collection Haineault* (224, 2ieme Ruisseau, St-Mathieu de Beloeil, Quebec, Canada J3G 2C9). Last April Gilles (pronounced "Zheel") made a major strike of **carletonite** in amazing abundance. Some marble boulders liberated by a quarry blast produced many flats of specimens including maybe 40 superior examples and hundreds of others. The deep blue to mottled blue-white carletonite is a species known earlier on the market only as diminutive (and expensive) loose crystals and very occasional tiny groups. Here, the high-end specimens are a few thumbnails *and* groups to 5 x 5 cm, with transparent pale blue cubes to 1.5 cm: still expensive, but less so than they would have been just last year. In the remainder of Gilles' pieces, the carletonite is mostly massive, with a few incomplete crystals forming in the tight vugs, these mashed-looking cubes sometimes reaching 2 cm on edge; a pale yellow massive calcite is sometimes woven into the massive carletonite.

Gilles also had little surprises in the way of rare species, funny pseudomorphs and oddball associations from Mont Ste.-Hilaire, all of them essentially thumbnail-size. For instance, there are 1.5-cm floater groups of translucent white **eudidymite** with epitaxial **epididymite**, sparkly pseudomorphs of granular, dark reddish brown **rhodochrosite** after eudehral, 1-cm **eudialyite** crystals, and small thumbnails of triangular, regularly offset crystals of **genthelvite**—little chalky brownish gray starbursts with black **aegirine** needles. Will Mont Ste.-Hilaire ever end?

The most exciting Mexican minerals were offered this year (once again) by Dave Bunk in his Main Show booth. Dave's usual shelf full of small specimens of Mexican silver minerals contained some beauties. Among them were some miniature-size specimens of a new **acanthite** from the Torres mine, Guanajuato, in extremely bright groups of skeletal black metallic crystals to 3 cm, thickly dotted with little colorless and transparent **apophyllite** crystals, for a terrific aesthetic effect. Also here were several insanely lustrous, reddish black specimens of **pyrargyrite** from the Proana mine, Fresnillo, Zacatecas, in crystals to 3 cm high and clusters to 6 cm across, with partial drusy calcite coatings. Five miniatures and a couple of proud thumbnails were endowed with the same blazing luster and princely color.

Dave was also selling miscellaneous, top-quality, large specimens from the collection of Marion Stuart; and he is the man to see if you're interested in that small collection of silver minerals amassed by the late Jack Schissler of Bisbee—see my last Denver Show report. And Dave had what were probably the show's best individual specimens of the new Australian **chalcocite**, Afghanistan **bastnäsite-Ce**, and Chinese **inesite** (all coming up later).

Located in the "annex" area off the Main Show floor, i.e. a little away from most of the serious mineral dealers and customer hangouts, was the booth of Brian Kosnar, where I spent a long time admiring the products of Brian's recent trip to Bolivia. First, there were about a dozen thumbnails of a newly mined **ludlamite** from the Huanuni mine, Oruro Department: exquisite little sprays, to 1.5 cm, of transparent smoky green, lustrous compound crystals, sticking up at all angles from a drusy pyrite matrix. From the Colavi mine, Cornelio Saavedra Province, Potosí Department, there are a few 3 to 5-cm metallic gray matrix specimens with small vugs containing sharp, wedge-shaped, glassy transparent crystals of **valentinite** to 1 cm. Next, consider Brian's excellent specimens of the familiar sulfosalt species from the San José mine, Oruro Department: unusually lustrous black **franckeite** in intergrown shaggy spherical aggregates to 7 cm; four fine thumbnails of **andorite** in thin, metallic gray dull-lustered loose aggregates; and perhaps 50 specimens of **stannite** crystals in those tight little spheres we have seen before, but these overlaid heavily by unusually brilliant **zinkenite** needles. Then there was another *new* thing: bright black **ferberite** in clusters of 2- or 3-cm, sharp, tabular crystals, the clusters from toenail-size to 8 cm, from the Tasna mine, Nor Chichas Province, Potosí Department. And there was **augelite** in 1.5-cm translucent greenish white crystals with **pyrite** and brown lenticular **siderite** on matrix (all sizes these). Finally, among the familiar **vivianite** specimens from the Morococala and Siglo XX mines (XX meaning 20, pronounced "Bain-tay" in Spanish) lurked a handful of new vivianites from the Huanuni mine, with totally gorgeous sea-green color and total gemminess in 5-cm crystals over a brown **siderite** matrix. Rarely has there been such an impressive Bolivian-minerals smorgasbord at a single show stand—and, oh yes, the prices were mostly much lower than you would expect. Brian's new dealership, more or less inherited from his father, Rich Kosnar, is called *Mineral Classics* (3113 Highway 46, Golden, CO 80403).

The Brazilian survey kicks off with some truly major, huge and majestic specimens of **elbaite** from a big pocket recently struck at the Pederneira mine, Minas Gerais. Blasting reduced the pocket to a pile of loose prisms and fractured matrix chunks, so these specimens had to be reconstructed by the experts of Bryan Lees' *Collector's Edge* lab (who of course have done such expert jobs before, as on Sweet Home rhodochrosite, Tree Root Pocket amazonite, etc.). There are 15 Pederneira elbaite specimens in all, from 10-cm to what might be called mega-cabinet pieces whereon five or six 10-cm prisms rise at all angles from a 15-cm matrix of albite (cleavelandite) and bright lilac lepidolite. The crystals are medium-lustrous, lightly striated, gemmy in some areas and translucent elsewhere, and are terminated by low-angle pyramids and small basal pinacoids. Their colors are pink to deep red to smoky green, and the zonation can be complex, although red prevails, every time, at the top. Even for those who are somewhat jaded by looking at many specimens and styles of Brazilian elbaite, these pieces, especially the largest ones, are imagination-broadeners. Postscript: Bryan Lees' mining crews are scheduled to start serious work very soon at the North Geronimo mine, Arizona, and medium-soon at the Red Cloud mine, Arizona, and a little later at the Benitoite Gem mine, California—so we might soon see some fine classic vanadinites, wulfenites and benitoites at *Collector's Edge*.

Carlos Barbosa (Rua Cel. Roberto Soares Ferreira, 586, Gov. Valadares, Minas Gerais, Brazil) had about 75 specimens, found last October, of **ernstite-coated eosphorite** from the Almerino mine, Linopolis, Minas Gerais; they are by far the best yet of this familiar material. The eosphorite inside the crystal blades is gemmy yellow-brown, but the brown ernstite coating renders the crystals opaque, although still pretty, with a lustrous mahogany sheen to them. There are a few clusters, but most specimens are loose, broken-off blades or tight parallel groups of blades; the crystals are very sharp and wedge-terminated. In size the blades range from about 3.5 cm to about 8 cm long, and Carlos has seen one as long as his forearm.

Alvaro Lucio (Av. Celso Porfirio Machado, 751, Belo Horizonte, Brazil) had about 50 specimens of a brand-new **elbaite**, from a small pocket hit last October at the Arqueana mine in Minas Gerais—the same place that has recently turned out those pretty lepidolite crystal sprays on dark green elbaite. The new elbaites aren't dark green, though; they are a lovely pale apple-green with hints of pink, and are quite gemmy and lustrous. The toenail and miniature-size prisms are thick, simply terminated by the pinacoid, and lightly striated, with little clusters and belts of very pale pink lepidolite adhering to their sides. Also, Alvaro Lucio's room in the Executive Inn harbored about 40 small thumbnails of **gold** newly found at Alta Floresta in the state of Mato Grosso, in far northern Brazil. These are alluvial (moderately waterworn) distorted octahedrons and little clusters of same, quite lustrous, with a medium yellow-gold color.

Even though Alvaro also had some of the new **brazilianite**, a new paragraph is in order, since the best pieces were offered at the Main Show by Frank and Wendy Melanson of *Hawthorneden*. This occurrence was mentioned in an earlier report: it's the Telirio mine (some labels say "Marcel Telirio" mine, since that's the name of its owner), Divina das Laranjeiras, Minas Gerais. Brazilianite crystals from here are bladed and are associated mainly with white albite, distinguishing them from the blocky, more equant crystals with muscovite from the much older "Corrego Frio" locality. The color is a pale yellow to deep yellow and yellow-green. The high luster, sharpness of crystal form, and general gemminess make these almost as pleasing as the Corrego Frio patriarchs. The Melansons had 50 or 60 mostly miniature-sized specimens, while Alvaro Lucio and a few others had mostly thumbnails; nobody's prices were what I'd call high for such fine material. On one of Alvaro's thumbnails, a little brazilianite prism rises from a wavy, pearly gray-white cyclic twin of **beryllonite**, a new association for sure. There are also solo beryllonite thumbnails, and one showing beryllonite with gray-white apatite.

Faster than email we transport ourselves now to northern Sweden, where, last summer, some very nice **hedenbergite** specimens were collected in the famous underground iron mine at Malmberget. Andreas Lyckberg (Peter's brother) of *Nordic Mineral* (Raket G.11, 41320 Gothenburg, Sweden) let me pore over about 30 variously sized specimens with sharp, blocky, rich blackish green crystals, the smaller ones very lustrous, in open seams on massive hedenbergite. Thumbnails and larger groups to 4 cm are typical; one loose single is 3 x 4 x 8 cm. These specimens resemble the old ones from Nordmark, Sweden, but are not to be confused with them, as the little Nordmark mines are hundreds of kilometers to the south, near Långban in Värmland, and have long been defunct.

Following up on the English **scorodite** story begun last year, it seems that the story is already over, as all digging now has ceased at the Hemerdon Ball mine, Sparkwell, Devon—this according to Ian Bruce of *Crystal Classics* (The Old Linhay, Woodcockshayes Farm, Halberton Road, Willand, Devon, England EX15 2QF). Too bad; the scorodite crystals, though never larger than 5 mm or so, are quite sharp, are richly colored (and dichroic), and sit smartly in their seams in mineralized quartz veins. In his Executive Inn room this year, Ian was selling off maybe 75 miniature and small cabinet-sized pieces out of a total production of 2,000 pieces from work between January and August of last year. Unfortunately, none of those here approach being "killers," but rather consist of quartz matrix lightly sprinkled with pretty-but-small scorodites. Associated species in microcrystals include **pharmacosiderite**, **aluminotungstite**, **russellite**, **cassiterite**, and two apparent unknowns.

Much prettier are the new orange **barite** crystals collected a year ago from a small quarry at Chatel Guyon, Puy de Dôme, France. About 300 pieces were dug in all, and a couple of flats of them, miniature to small cabinet-sized, were on hand in the Executive Inn room of *Minerama* (49, Rue de la Republique, 42 800 Rive de Gier, France). The barite crystals are sharp, perfect orthorhombic tablets reaching 3 cm, either in loose clusters or on a speckled brown/white matrix; the crystals are translucent to transparent, medium-lustrous, and a pleasing brownish orange.

Vladimir Pusec of *Zur Kristall-Höhle* (Schipfe 31, 8001 Zürich, Switzerland) told of a lucky and happy *Strahler* who, one day last September, broke into a pocket of pink **fluorite** crystals on the Frunthorn, Valsertal, Canton Grisons, Switzerland; the pocket yielded some 200 nice specimens, of which Vladimir had about 25 in Tucson. All are thumbnails, with fluorite octahedrons to 2 cm, either as loose singles and little clusters or on small bits of glittering drusy adularia over granite. I've saved the best part for last: the

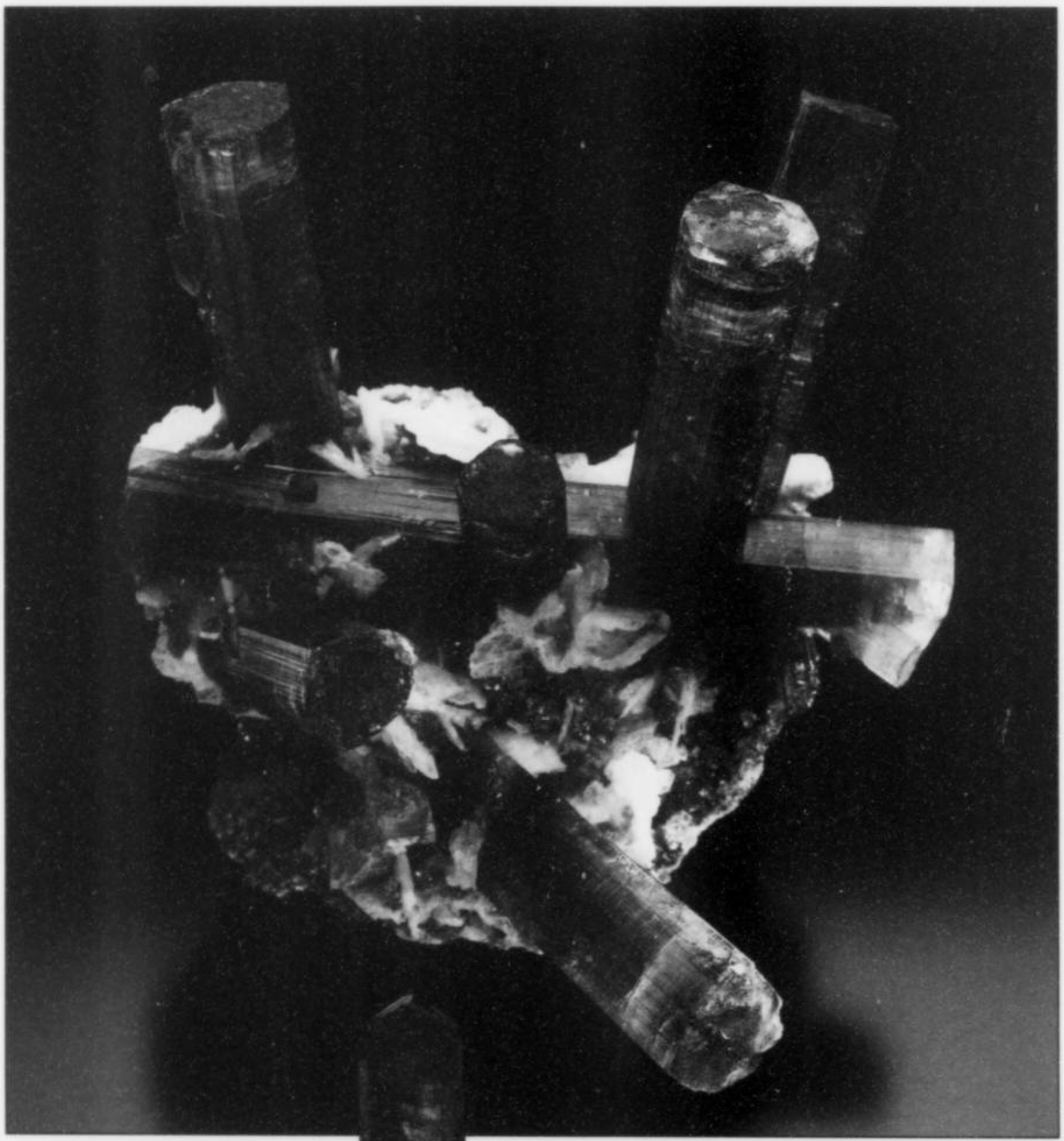
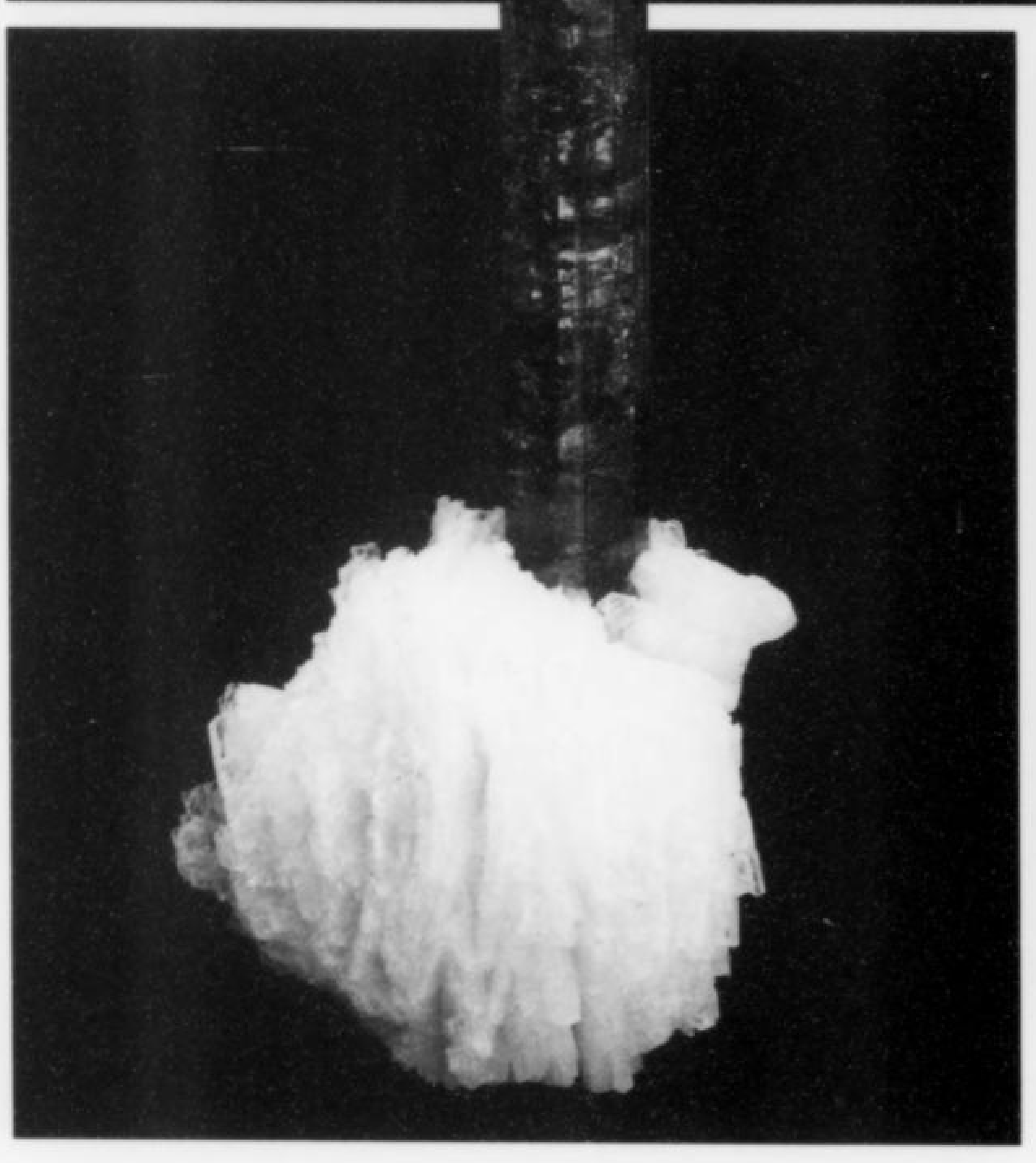


Figure 8. **Elbaite crystals with albite and lepidolite, 9.3 cm, from the Pederneira mine, Minas Gerais, Brazil.** ***Collector's Edge*** **specimen now in the collection of Ed David; Jeff Scovil photo.**

Figure 9. (below) **Elbaite and quartz, 7 cm, from the Pederneira mine, Minas Gerais, Brazil.** ***Collector's Edge*** **specimen; Jeff Scovil photo.**



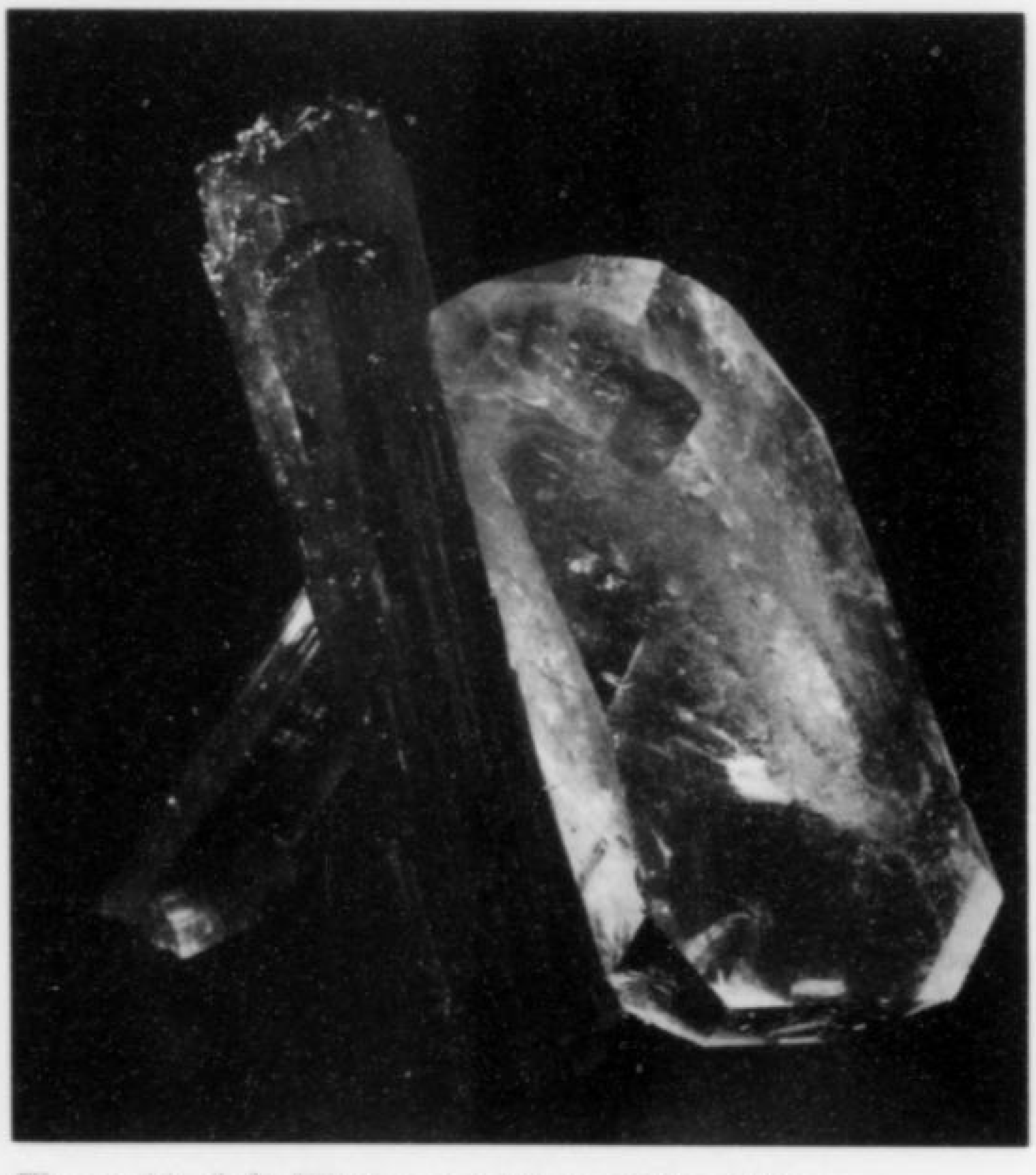


Figure 10. (left) **Elbaite crystal on albite, 11.2 cm, from the Pederneira mine, Minas Gerais, Brazil.** ***Collector's Edge*** **specimen; Jeff Scovil photo.**

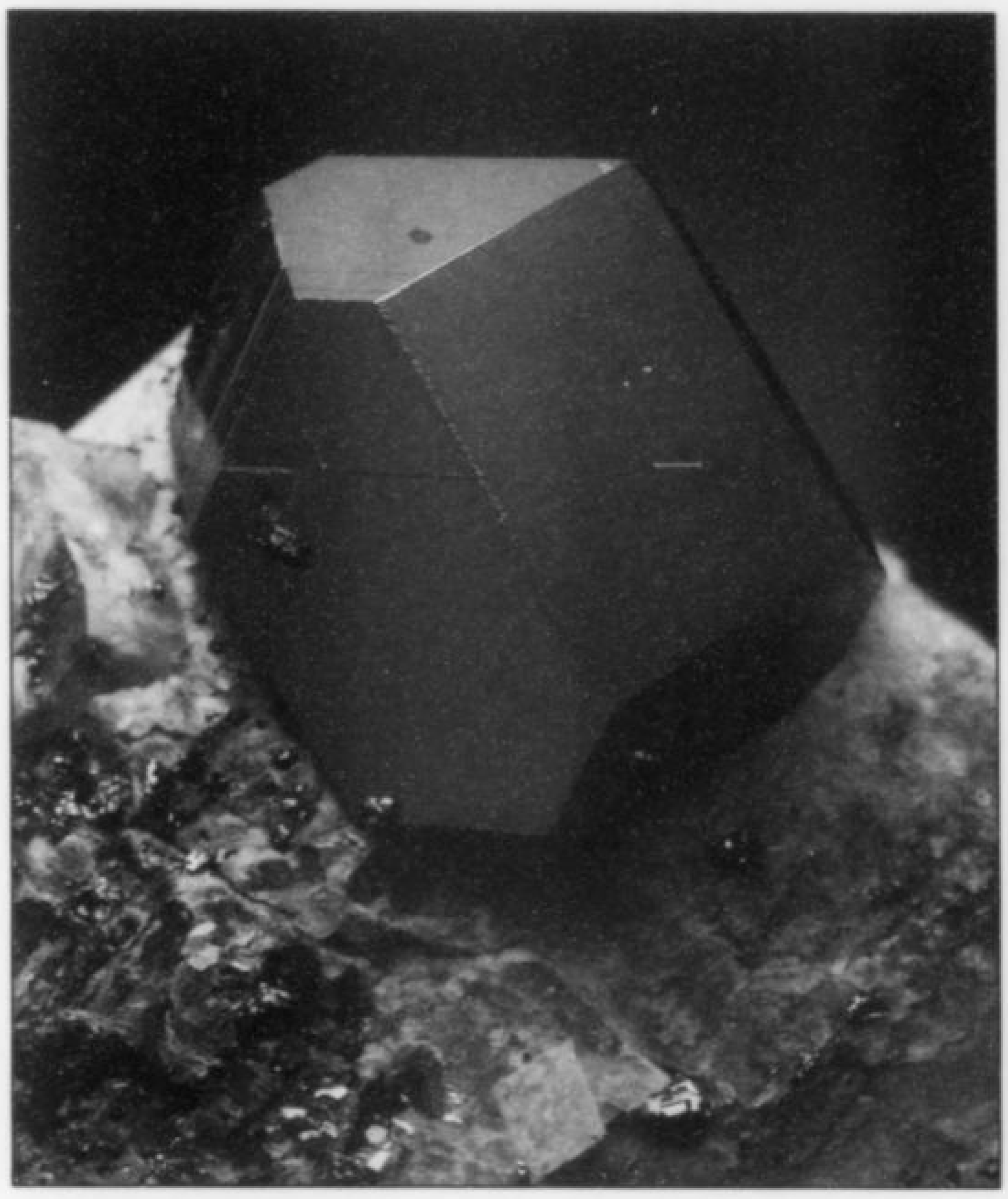


Figure 11. Carrollite crystal, 1.8 cm, on calcite, from the Kamfundwa mine, Kambove, Congo. Paul Stahl collection; Jeff Scovil photo.

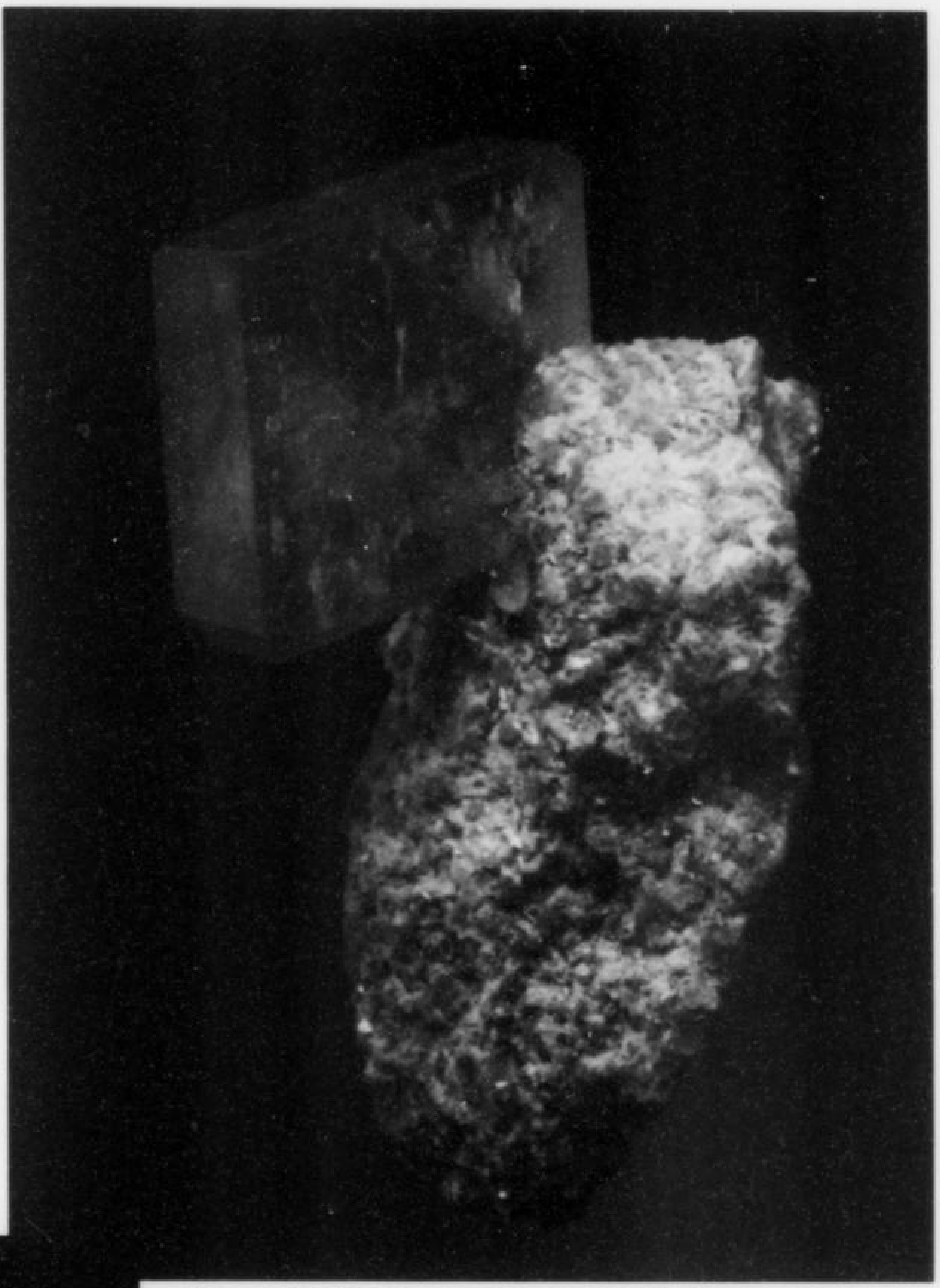


Figure 12. Barite crystal on matrix, 3 cm, from Chatel Guyon, Puy de Dôme, France. Tom Moore collection; Jeff Scovil photo.

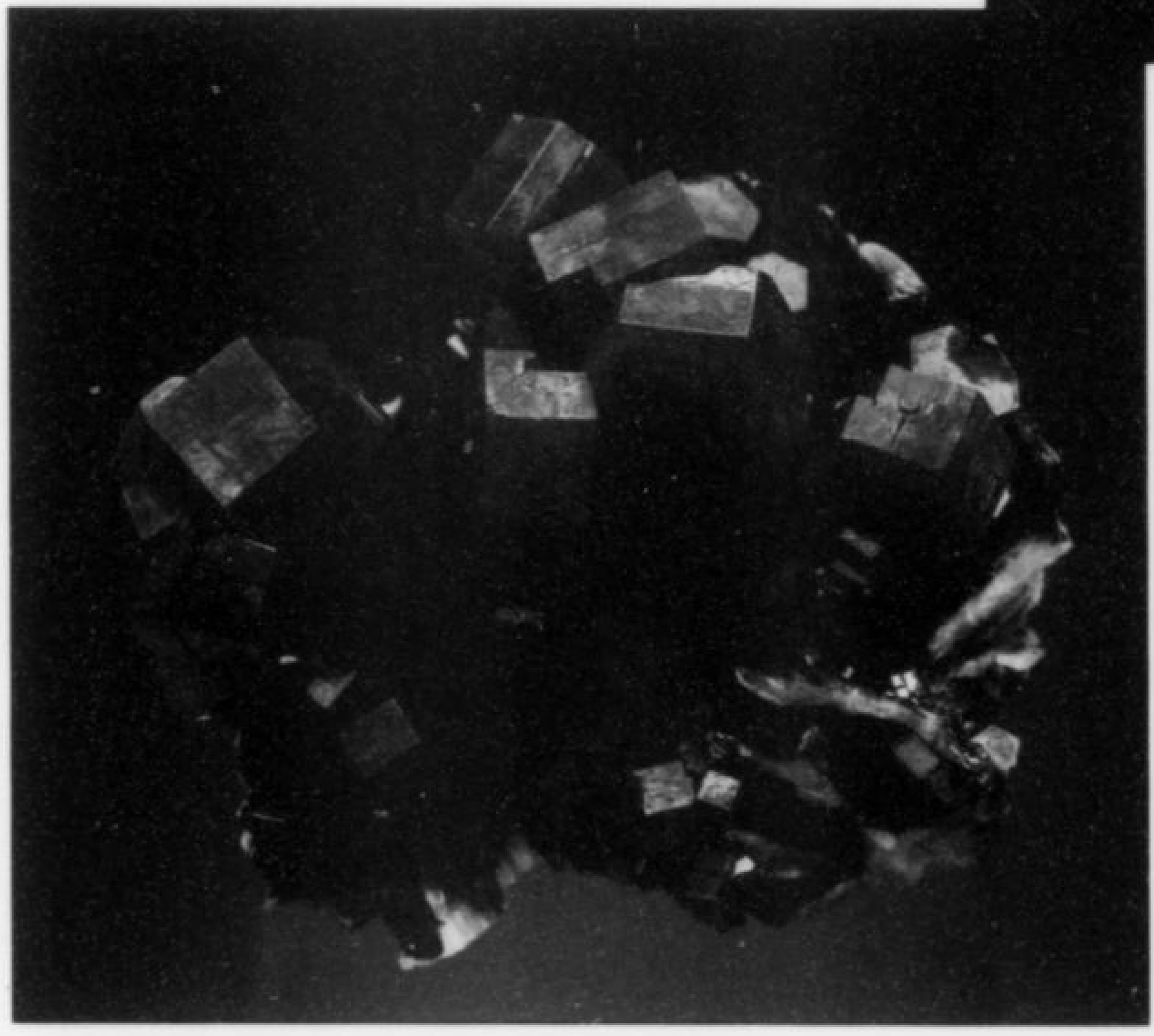


Figure 13. Vanadinite crystals on black, manganese-oxide-coated barite, 4.6 cm, part of a large, new discovery at the famous ACF mine, Mibladen, Morocco. Jurgen Tron collection; Jeff Scovil photo.

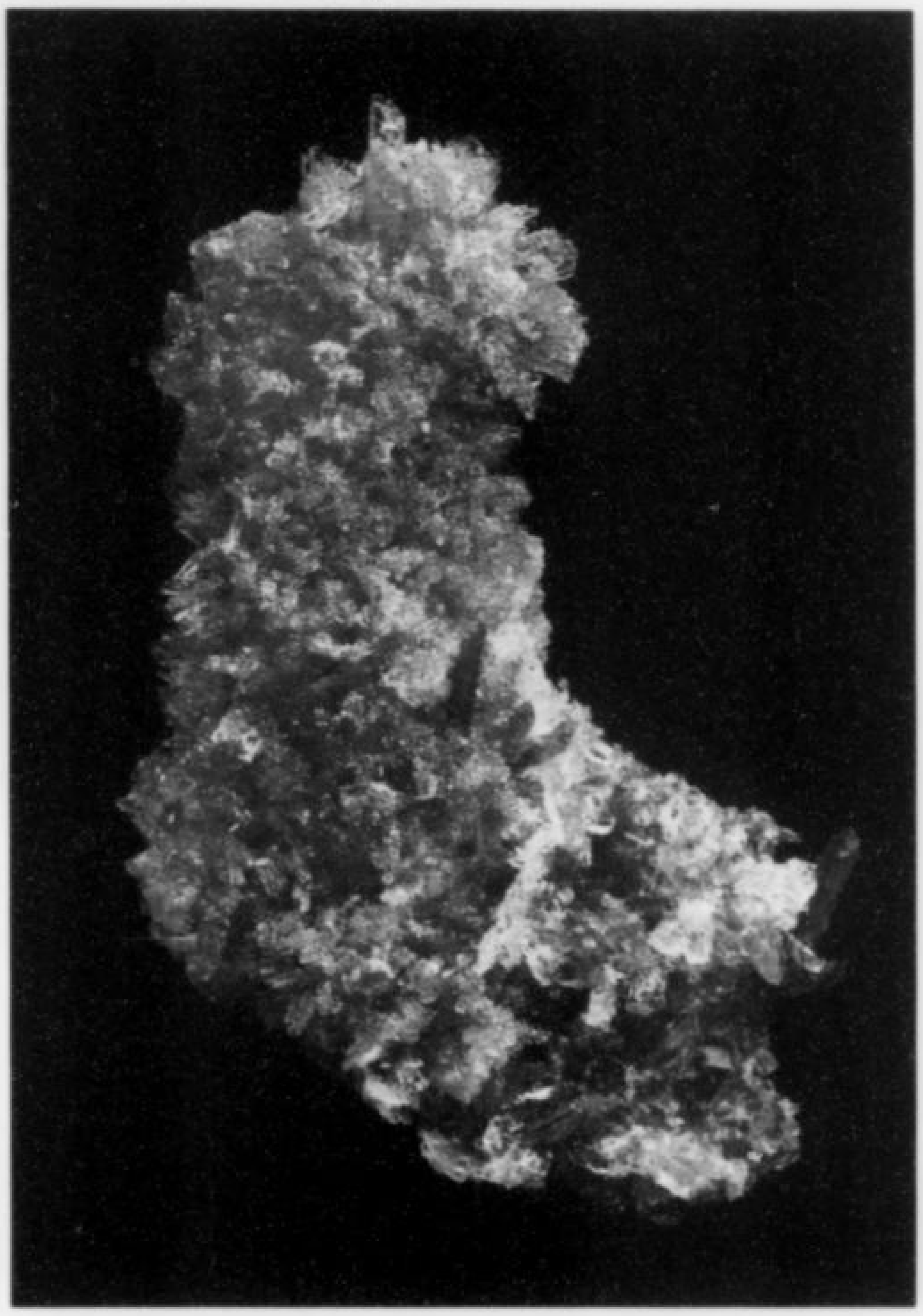


Figure 14. Orange prehnite with inesite, 5.6 cm, N'Chwaning mine, Kalahari Manganese Field, South Africa. John Schneider collection; Jeff Scovil photo.

color is a rich, *deep* rose-pink, much deeper than in the usual run of Swiss Alpine fluorite. Specimen prices ranged from $125 to $350.

The other new Swiss thumbnail mineral is something much rarer and less familiar: the largest crystals of **armenite** yet found in the world, reportedly collected in the late 1970's on the Wasenalp, near the Simplon Pass, Canton Valais. At the Main Show, only eleven little loose crystals were available, divided between two dealerships—Rob Lavinsky's *Arkenstone* (P.O. Box 12801, La Jolla, CA 92039) and Bill Larson's *Pala International* (912 S. Live Oak Park Rd., Fallbrook, CA 92028). The armenite crystals are stout hexagonal prisms with pyramidal terminations, of a translucent milky white color and medium luster; sizes range from 1.5 to 2.5 cm, although Bill Larson says that the biggest one found (hence the world's record for armenite) is about 3.5 cm. Prices on these exotic (read: not pretty) items ranged between $200 and $750. And this paragraph seems a good place to add that Rob Lavinsky had free "Virtual Show" T-shirts available at the Main Show, with Einstein's face on the back.

The Moroccan **erythrite** situation seems not to have evolved since Denver: available erythrite specimens clearly are leftovers from then (but still just as beautiful as they were then), handled by François Lietard, Horst Burkard, and occasional others. A trickle of new **roselite** specimens has appeared from the Aghbar drift, near Bou Azzer—apply to François Lietard, who had some thumbnails and toenails with coatings of lustrous, gemmy, magenta-colored millimetric roselite crystals on pink dolomite. Also, Ernesto Ossola offered some 25 specimens of Bou Azzer **wendwilsonite**, all verified as such, Ernesto said, at the French Museum of Natural History. These include a few dramatic specimens to 15 cm across, with magenta wendwilsonite crystals to about 3 mm thickly lining vugs everywhere, with drusy quartz, in a gray dolomite, with **zincroselite** and **ihrtemite**. Several other dealers also had wendwilsonite, which seems now to have become a more available rare species (remember to ask for analytical verification, as wendwilsonite and roselite cannot be distinguished by sight alone).

At his Main Show booth Bill Larson of *Pala International* was carrying a few specimens of a new find of the kunzite variety of **spodumene**, from the mysterious pegmatite province located between the towns of Jos and Ibadan in Nigeria. There are about 100 loose crystals, in all sizes; the largest is 10 cm long. This looks like "typical" kunzite from Brazil or California, with a nice, deep pink/purple dichroic color, good luster and gemminess, and heavy surficial etching. Prices seem about in line with those for contemporary Brazilian material.

One of this show's biggest buzzes—justifiably so—concerned the new, superlarge and superdramatic **carrollite** crystals from the Shinkolobwe area of Congo. At their best they excel even the best carrollites that came some years ago from Kamoto Fond, in the same region. The new crystals are sharp and equant, showing many isometric forms. They can reach 5 cm, and even the biggest ones remain razor-edged, mirror-faced, and possessed of such brilliant tin-white metallic luster as to suggest Russian sperrylite crystals. The pipeline out of Congo began with who else but Gilbert Gauthier, who filled me in on the specimens' provenance: they were found three months ago at the Kamfundwa open pit mine, near the town of Kambove. Just before the mine went inactive, the manager decided to make a big blast on a lower level, where primary chalcopyrite ore is mixed with white cleavable calcite; and it is in small pockets in this calcite that the carrollite crystals grew. Accordingly, the best specimens are hunks of calcite with carrollite crystals visible in open areas: plenty of challenge for specimen-trimming experts. Also some large, loose, incomplete carrollite crystals were around the show, and Chris Wright had one fascinating 5 x 6 cm calcite matrix with a brilliant 3-cm carrollite pseudomorph after a chalcopyrite crystal. Among the dealers who had these specimens in Tucson were Chris, Gilbert, Rob Lavinsky, Jordi Fabre, and Christian and Brice Gobin.

Readers of the recent Alto Ligonha, Mozambique, issue will have read about the interesting microlites, stibiomicrolites, plumbomicrolites and uranmicrolites found there, so you won't be surprised to hear that another microlite-like species discovered last summer in the Naipa mine in Alto Ligonha may turn out to be something equally interesting; and it occurs in nice-looking specimens too. Frozen in a massive grayish purple lepidolite (with some crude lepidolite crystals) are simple, deep green octahedrons to 3 cm, slightly rough but still impressive, resembling the old green octahedral gahnites of North Carolina and Georgia. However, these crystals are transparent on thin edges, and glow a lush green when backlit. Preliminary work by Prof. Carlos Leal Gomez of the University of Portugal has shown that they are unusually high in bismuth and sodium, and, especially if the sodium is high enough, may qualify as a new species; work is in progress at the University of Portugal. Cal Graeber had the two best specimens I saw in Tucson—miniature matrix pieces with well-exposed 2-cm "microlite" crystals—while Sebastian and Pepe Rodriguez of *Geofil* (Alto da Bela Vista, 2-A, 2750 Cascais, Portugal) had about ten more, from thumbnails to a 12-cm matrix featuring about a dozen embedded crystals. [*Note added in proof*: Mark Feinglos has identified the crystals as **fluornatromicrolite**.]

Paul Botha (P.O. Box 12027, Vorna Valley, 1686 Republic of South Africa) brought some interesting new material out of the Wessels and N'Chwaning mines, in the Black Rock manganese mining district of South Africa. Last year at the Wessels mine, **bixbyite** in bright black (though rough-faced) cubes to 1 cm were found, in groups with clear, colorless calcite rhombs, some of which make very nice thumbnails. Also found at the Wessels at the same time was **braunite** in small (never more than 5 mm) but sharp, brilliant black bipyramidal crystals, with calcite. From the N'Chwaning mine, about 30 modest toenails and miniatures were found composed of densely packed aggregates of tiny prismatic crystals of a *pinkish orange* **prehnite**, associated with **inesite** needles, sparkling little **apophyllite** pseudocubes, and calcite. All of these specimens can be called "promising," although none are yet high-end.

The last stop in Africa is Madagascar, and one of those surreal place names: Anohlamena, Tamatave Province. Here, a discovery was made last May which for some time to come might be teaching us new things about the whims of **Japan-law quartz twins**. The Executive Inn room shared by the dealerships of *Minerama* and *Tropic Stone* (BP 7688 Antananarivo 101, Madagascar) was filled with literally thousands of twins, and Frederic Gautier kept pulling out new styles of them to amaze everyone. Their re-entrant angles vary widely; some twins are simple and unlustrous, some are simple and highly lustrous, some are actually triplets, some are partially amethystine, some are sceptered, some sparkle with drusy quartz coatings, some have blue chalcedony partial coatings, some show black interior dustings of hematite inclusions, etc. etc. And they come in a wide range of sizes, from small thumbnails to one 10-cm specimen. Frederic said that the source is a quarry complex in breccia, spread over a 20-km distance, and that still *more* twins should be appearing in the future.

Ivo Szegeny of *KARP* (P.O. Box 54, 272 80 Kladno, Czech Republic) has earlier been the main information source regarding the odd-looking **hematite** crystals from Hormuz Island, Iran, that I've written about once or twice. At Tucson this time he arrived with more species from Hormuz Island, and an odd mix of species it is, too—apparently all the products of residues from massive salt deposits, found in caverns on the island. They include more of the rough-surfaced, loose, hexagonal hematite barrels; clusters of frosty **halite** cubes to 3 cm individually, on matrix; lustrous loose prisms of translucent blue-white to colorless **danburite** to 5 cm; reddish brown, twinned **dolomite** rhombohedrons to 3 cm in floater clusters; and very sharp 2-cm floater octahedrons of **fluorite**, gemmy grayish green to translucent brownish purple to opaque gray. Ivo had a small caseful of these peculiar specimens in his Executive Inn room, and prices on all were quite low.

An even nicer development out of Iran is the great horde of **cerussite** specimens dug at the end of December by a team led by Matthias Rhineländer of *Mikon Mineralien* (Rosenstr. 7, 37136 Seeburg/Bernshausen, Germany). The Nakhlak mine is an active lead mine in the Anarak district of Iran, with galena veins in limestone/sandstone/conglomerate, and it was in Vein #5, on the 200-meter level of the mine, that the Germans dug about 200 cerussite specimens of all sizes, with gray-brown sandy matrix densely covered by rosettes and "snowflakes" of very pale brown to milky white to colorless and transparent cerussite. There are also sparse little medium-orange **wulfenite** crystals to 5 mm, and a few large specimens show the forms of cerussite pseudomorphs after descloizite. Matthias had some boulders and plates to 30 cm across piled high with interlocked rosettes of cerussite, and there are many small cabinet and miniature-sized specimens of loose cerussite clusters, but I liked (of course) the thumbnails best, especially the pristine white reticulated snowflakes which could easily pass for cerussite from the Mammoth mine, Arizona. There was little or no damage on most of these extremely delicate pieces. Both Matthias and George Stevens of *George Stevens Minerals* (P.O. Box 44313, Tucson, AZ 85733) were selling the thumbnails for no more than $25.

It seems that the copper mines of Dzhezkazgan, Kazakhstan, nearly always get mentioned in these reports; but this time the hot Dzhezkazgan item is not, for a change, anything metallic, but rather is **cuprite**, in sharp floater thumbnail-size crystals. The newest batch was found last July, but they have occurred intermittently for some years, according to Star van Scriver, in small, isolated pods amidst other copper minerals. The Van Scrivers' dealership (*Heliodor*) had ten thumbnails, sharp and cute, all around 2 cm, of blackish red, flat-lustered cuprite: no transparency, but a variety of habits, from simple octahedrons to combinations of forms to octahedrons very deeply hoppered, à la Chessy, France (without the malachite). Prices were $150–$350.

If you will now turn, please, to page 26 of the recent issue on Dalnegorsk, Russia (Vol. 32, No. 1), you will see a terrific specimen of "bipyramidal" **quartz** (six equal-size rhombohedron faces coming to points on each end, no prism faces), colored a milky pale green by fine inclusions of hedenbergite (?), from the Second Sovietskiy mine; indeed, the text says that last year a large pocket of such crystals was found there. Large it must have been, as there were hundreds of these nifty quartz specimens around Tucson. Imagine the one in the picture as being of any size up to a foot long, and you would have seen it in Tucson. Some are simple groups like the pictured one, some are delicate little beds of very lightly intergrown crystals without matrix, some are monster crystals surrounded by small ones; some of the crystals perch daintily atop parallel groups of lustrous black ilvaite crystals, and some are not smooth-faced after all, but are compound growths, with little notches around the equators. The luster and the intensity of the green coloration vary as well. But *all* of these styles make outstanding, very unusual-looking quartz specimens; the best were at *Heliodor*, but many of the Russian dealers and many Western dealers had them too.

There was more of the new Badakhshan, Afghanistan, **phlogopite** around, most notably in the Executive Inn room of *Gillani Enterprises* (P.O. Box 53, GPO Peshawar 25000, Pakistan), who had some 50 miniature and cabinet-sized pieces of white marble with thick, gemmy, dark brown phlogopite crystals to 5 cm long. This dealership also had Badakhshan **lazurite**, **sodalite**, and a brand-new purple to pink material being called "hackmanite" (referring to the pink variety of **sodalite**), all these in rounded, subhedral isometric crystals to 2 cm in marble, with the phlogopite. At the Main Show, Dudley Blauwet of *Mountain Minerals International* had even better lazurite and sodalite specimens, and some information about certain complexities in their composition(s). Both species are members of the sodalite group, and it appears that at Badakhshan they may grade into each other, even within the same crystal; further, some of them have been found to be high in magnesium, not an essential component of either species. Some of these crystals are splotchy-looking, and may be intergrowths of the two phases, or partial pseudomorphs. Dudley himself uses fluorescence as a determinative guide: lazurite is never fluorescent, while sodalite fluoresces pink, the more so in the purplish "hackmanite" variety. Furthermore, the similar species **cancrinite**, practically unknown heretofore in crystals, is present in one unique specimen as a fairly sharp, 2.5-cm, opaque, gray-green crystal, with surrounding smaller ones, in marble.

With Dudley, and also with Andreas Weerth, were more thumbnail and toenail-size loose crystals of **bastnäsite-Ce** from Shinwaro, Kunar Province, Afghanistan—distinctly better in average quality than previously seen. They are medium brown, and range in aspect from opaque and slightly rough-surfaced to glassy-faced and gemmy. The sharpest crystals are distorted hexagonal tablets averaging 2.5 cm across (although the champion one, at Dave Bunk's, is 4.5 cm), and quite gemmy in the small prism faces. These are fine specimens, representing what's easily the best yet of this rare carbonate of the rare-earth metals; it's not surprising that Dudley's thumbnails run $200 to $400. Dudley also had ten giant loose crystals of **chevkinite-Ce** from above Arondu, Haramosh Range, Baltistan, Pakistan: these are loose, incomplete, black, lustrous wedge-shaped crystals to 3 x 3.5 cm, chevkinite being a species formerly known only in microcrystals.

In the Executive Inn room of *Capalion Enterprise* (P.O. Box 906, Williamsville, NY 14231), honcho Chris Ano had an unusual-looking spread of **forsterite**, **titanite**, **pargasite** and **ferroan spinel** specimens, all of which he collected from a remote outcrop near Kolonne, Uva Province, Sri Lanka. Like the last few items above, these are not beautiful minerals, but are rare in large, sharp crystals. A few of them, particularly the spinels (which *can* be attractive), have trickled out before, but Chris's showcase seemed to hold the authoritative selection, with about 20 miniature and cabinet-sized specimens. The forsterite occurs as fairly sharp, tabular crystals to 6 cm, brownish yellow-green and opaque to translucent, resembling dull epidote. The titanites are yellowish brown, mostly as flat singles to 4 cm; the pargasite comes as black, lustrous, sharp crystals (though with too many gunky areas on surfaces) to 3.5 cm. The spinel is jet-black and highly lustrous, in very sharp octahedrons to 2 cm, either singly embedded in calcite matrix, like the other species, or in brilliant loose groups. How sophisticated and educated one feels after going over a suite of minerals like that!

From Momeik, northeast of Mogok, in the renowned "Mogok gem district" of Mandalay Division, Myanmar (Burma), Dudley Blauwet had ten thumbnail and toenail specimens of *botryoidal* pink **elbaite**. It has the pink-tourmaline color and luster, all right, but these are nearly perfect little spheres, their surfaces glistening with rounded transparent pink hemispheres all tightly jammed together. A couple of the toenail specimens are mushroom-shaped, with columnar crystals growing in parallel in three fans, for an

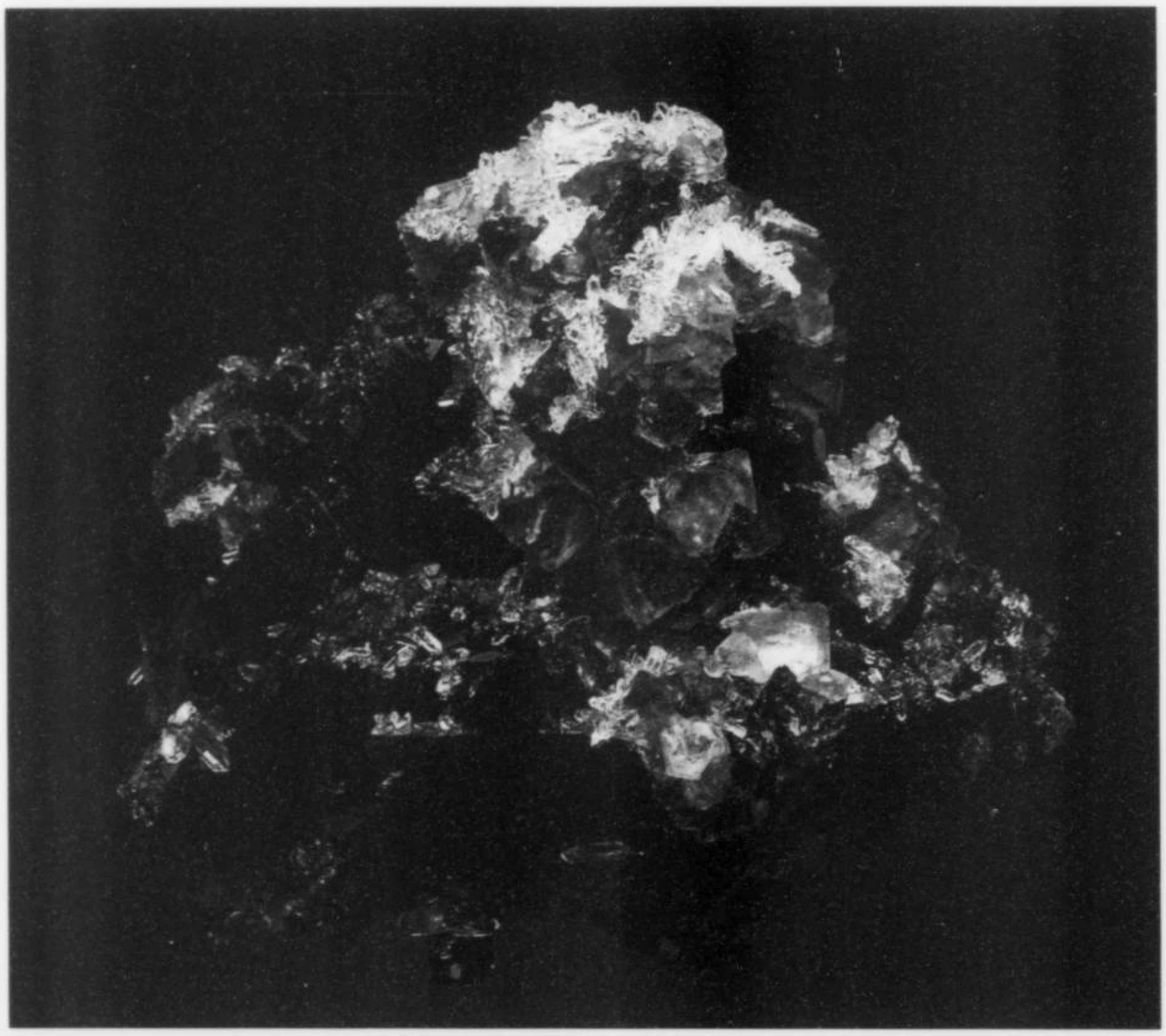


Figure 15. **Octahedral fluorite with manganaxinite, 5.2 cm, from the First Sovietskiy mine, Dal'negorsk district, Primorskiy Kray, Russia.** ***Northstar Minerals*** **specimen; Jeff Scovil photo.**

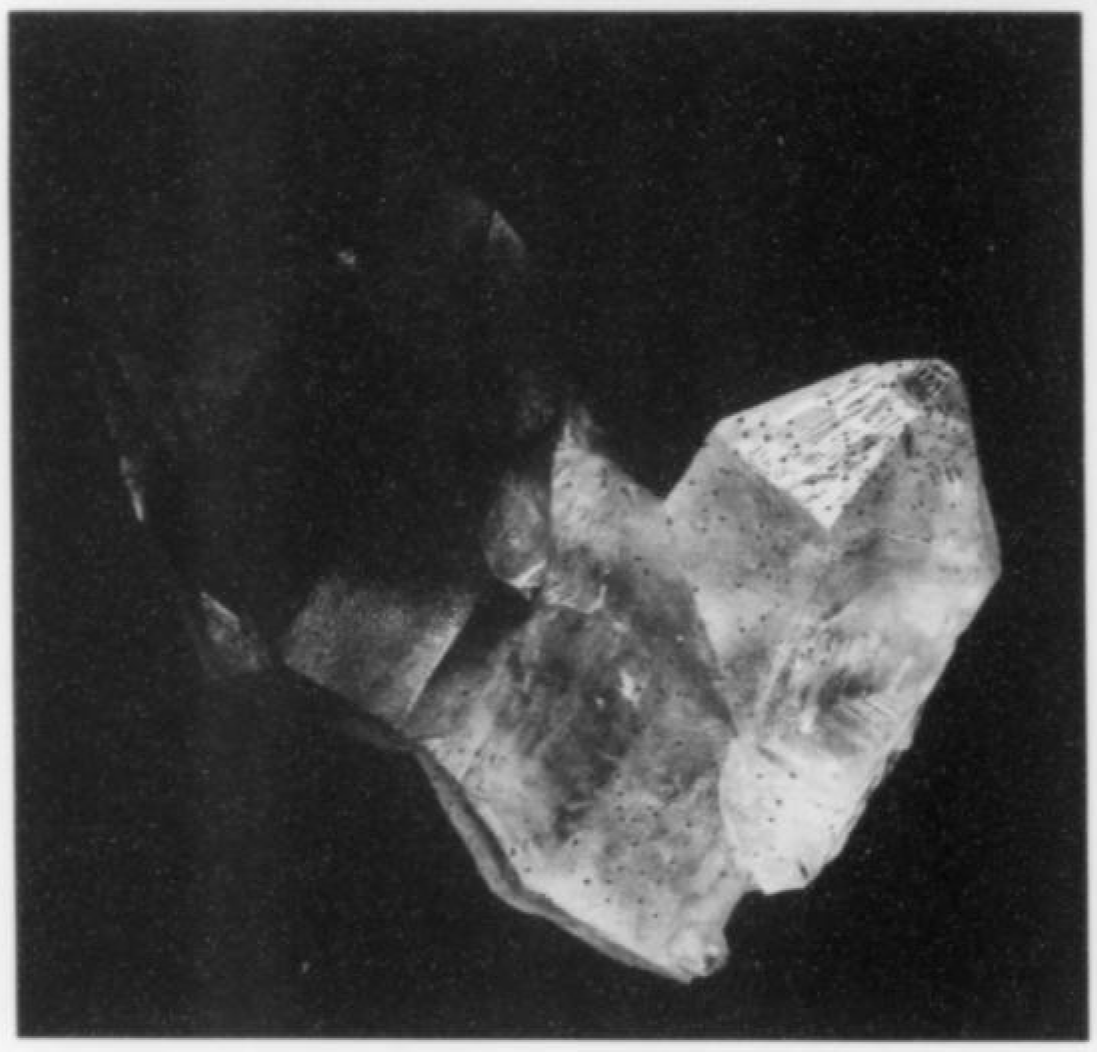


Figure 16. **Amethyst scepter on colorless quartz, 3.2 cm, from Anohlamena, Tamatave, Madagascar.** ***Tropic Stone*** **specimen; Jeff Scovil photo.**

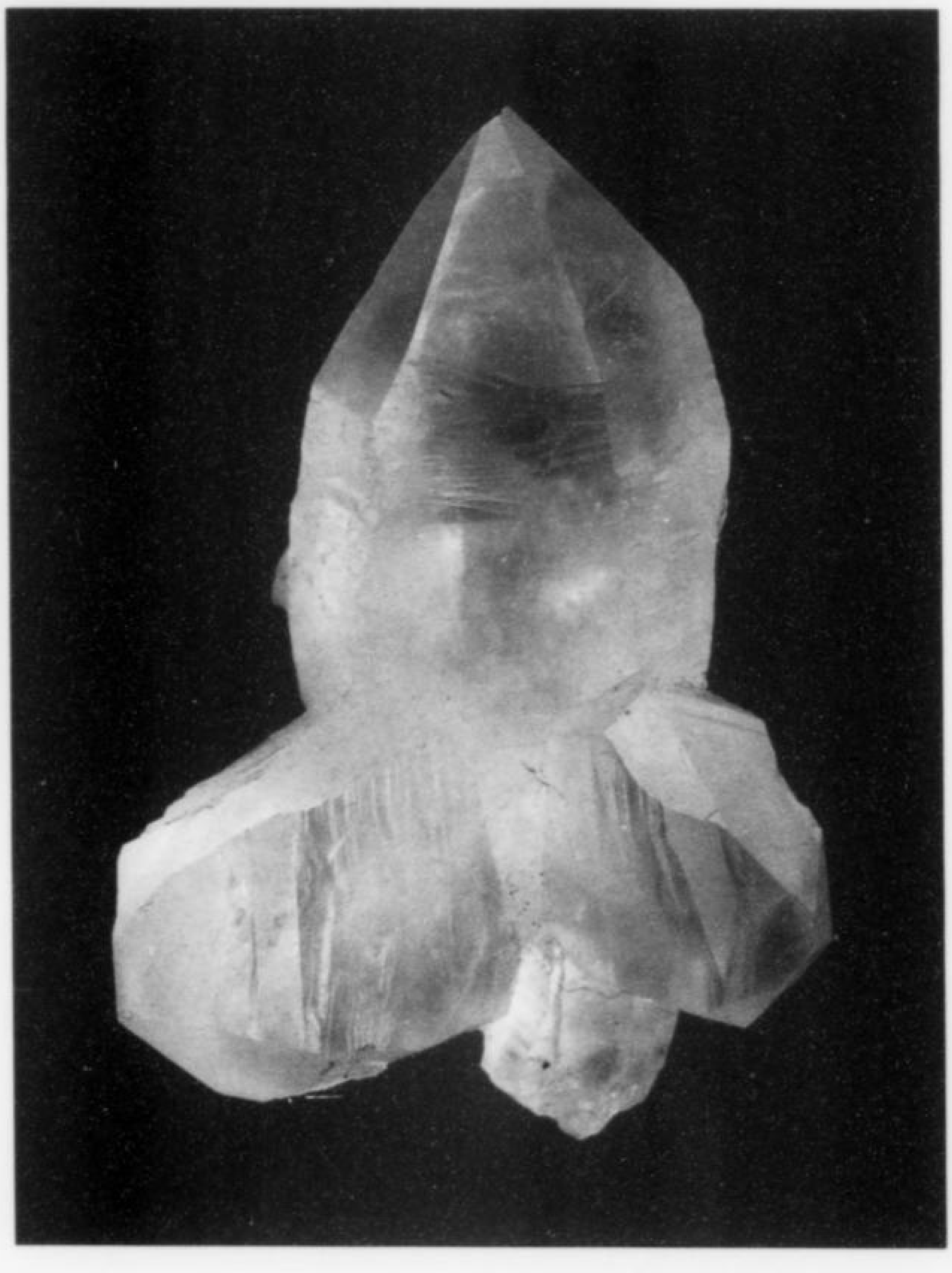


Figure 17. **Japan-law quartz twin, 5.3 cm, from Anohlamena, Tamatave, Madagascar.** ***Tropic Stone*** **specimen; Jeff Scovil photo.**

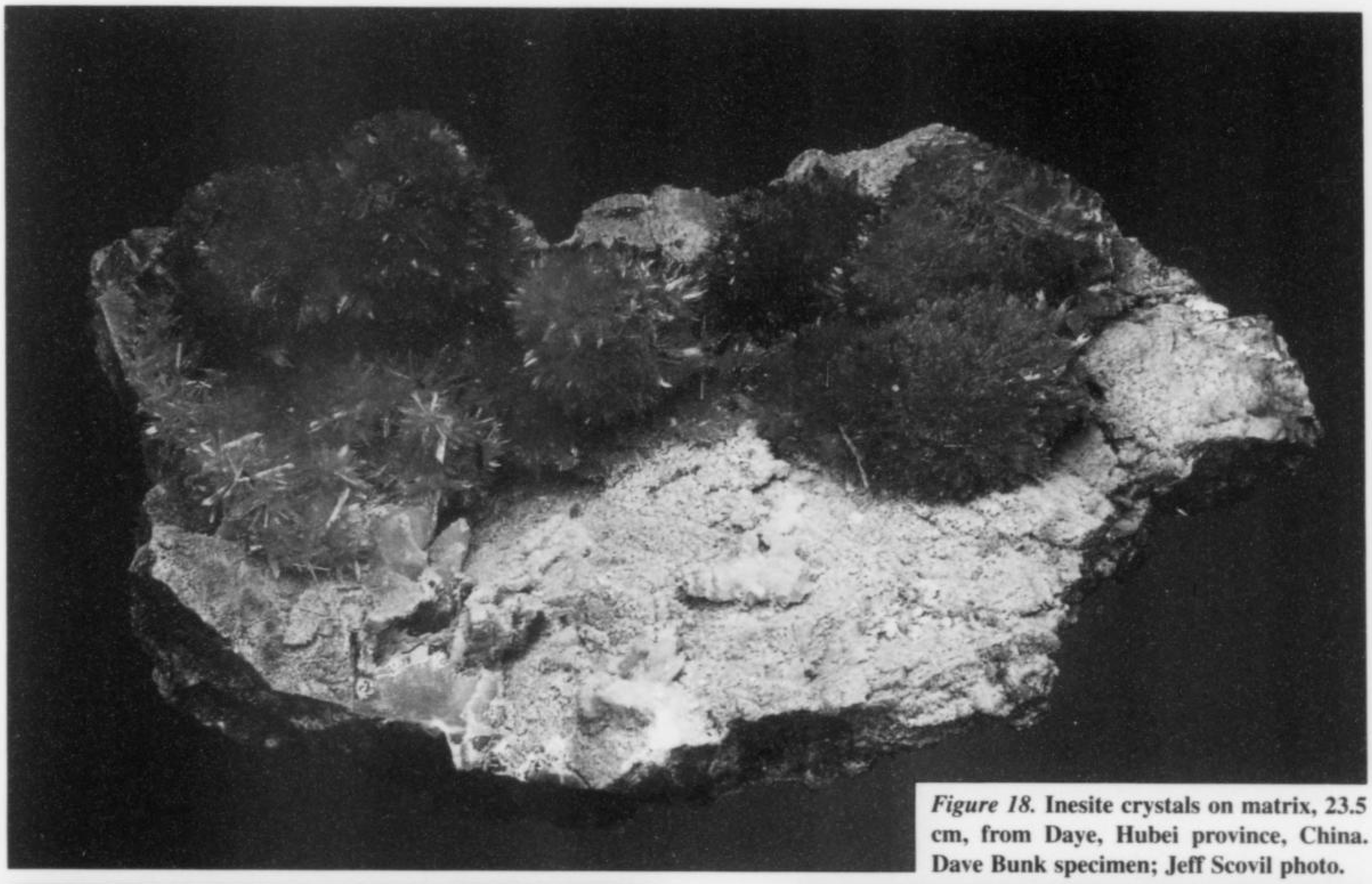


Figure 18. **Inesite crystals on matrix, 23.5 cm, from Daye, Hubei province, China. Dave Bunk specimen; Jeff Scovil photo.**

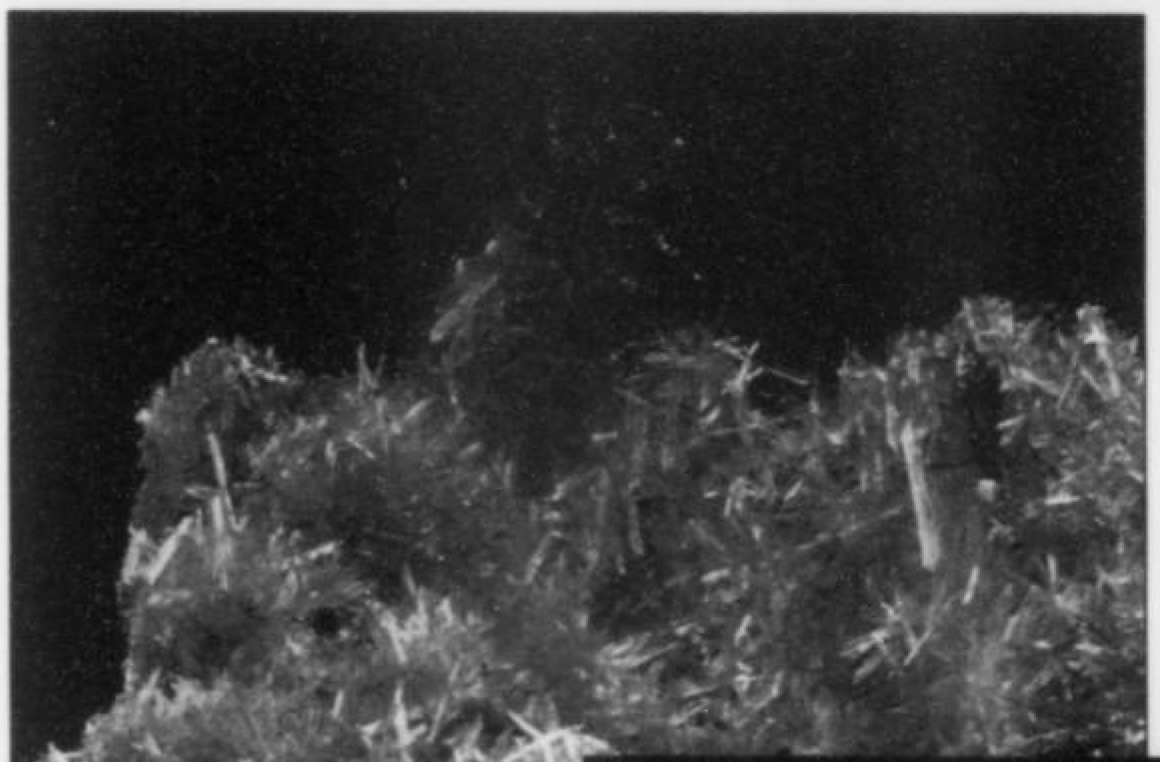


Figure 19. **Black hubeite on inesite, 5 cm across as shown, from Daye, Hubei province, China. Dan Weinrich specimen; Jeff Scovil photo.**

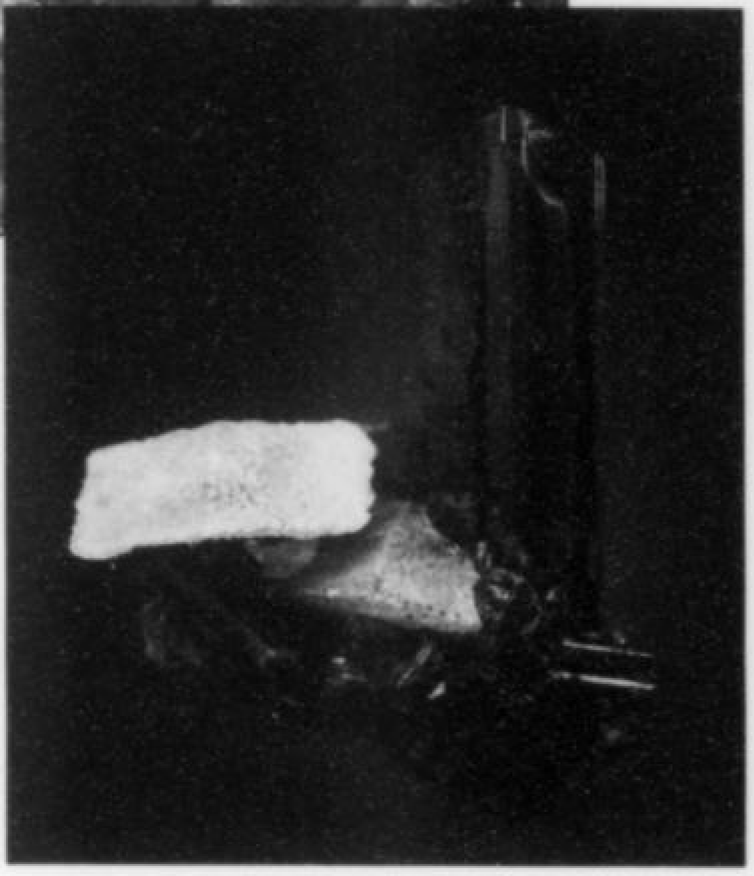


Figure 20. **Chalcocite with calcite, 2.8 cm, from the Telfer gold mine, Carnarvon, Western Australia. Dave Bunk specimen; Jeff Scovil photo.**

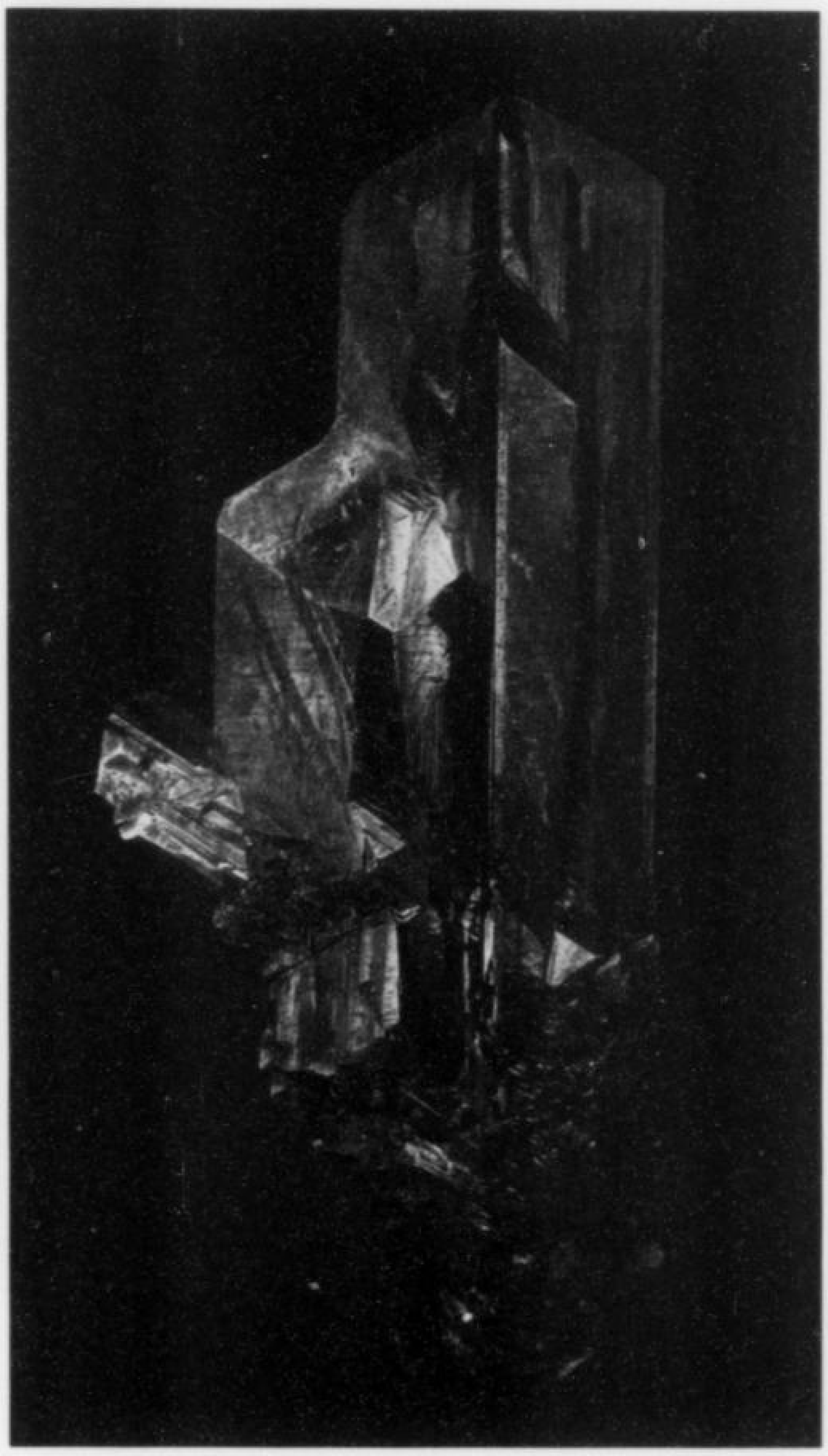


Figure 21. (right) **Chalcocite, 5.3 cm, from the Telfer gold mine, Carnarvon, Western Australia.** ***Mineral World*** **specimen; Jeff Scovil photo.**

overall peaked-triangular form. Dudley sold the cute, pink, spherical thumbnails for around $50.

A quarry called the Ton Glo Shan, in Hubei Province, China, has flooded the market in Tucson this year with very unusual-looking specimens in which the main players are **inesite**, **manganbabingtonite**, and **hubeite**. Hubeite is a new species, IMA-approved but not yet published; Jordi Fabre has documentation of recent work showing its composition: close to manganbabingtonite but distinct from it. These specimens tend to be flat plates, either with gray quartzite matrix or with interlocking webbings of acicular inesite crystals. On these bases perch dense, brownish black, brushy clusters and rosettes of manganbabingtonite, and then, sometimes, hubeite as tiny, paler brown needles. The inesite rivals the best in the world; the delicate glassy pink crystals look entirely different from the inesite from South Africa and California, but can make very impressive specimens when they are strewn by the zillions over matrix, or compose those lacy plates all on their own. On a few specimens there are also amethystine quartz crystals and tabular, clear apophyllite crystals to 1 cm. Dealers all over the show had at least a little of this material, and Ernesto Ossola had four or five large flats out on his patio in the Executive Inn. Noteworthy also were the supplies of Jordi Fabre, Renato Pagano, Dan Weinrich, Dave Bunk (who, again, had "the" specimen), and *China Minerals & Gems* (USA office: P.O. Box 185, Temple City, CA 91780).

What else is new from China? As usual, far too much to do justice to here . . . but there were three radically larger and better crystals of that quartzlike **calcite** that I reported on from Denver. At that show I was given "Shizhuyuan mine, Hunan" as the locality, whereas here in Tucson I was given "Hua Zhou mine, Guangxi"—though they're clearly the same material. Anyway, these calcite crystals look at first glance like normal prismatic quartz crystals, because of the uneven development of the terminal rhombohedron faces. Rob Lavinsky had three new crystals, each 1.5 x 1.5 x 5 cm, water-clear and bright, yet somehow soft and silky.

Ken Roberts of *Collector's Edge* was showing off a few large specimens—of which there were about 25 at *Collector's Edge*, he said—of a very peculiar **sceptered quartz** just out of the Shang Bao mine, Leiyang County, Hunan Province (the locality for those dodecahedron-modified purple fluorite cubes last seen in Denver). The quartz specimens, found last May, reached the American market in December. They are hard to describe, but here goes: the "scepter" part of each crystal in each group looks, itself, like a conventional quartz group, with lustrous milky prisms in tight parallel growth. But each of these "scepters" sits on a very thin, delicate stem of corroded milky quartz, which is all that's left of what should be the bottom half of the overall compound crystal. It's as if the crystal groups had been half-submerged in some acidic watercourse, the corrosive solutions eating away their bottom halves while leaving the top halves untouched. In one extraordinary 45 cm-wide specimen, the effect is of a forest, the clean upper crystals or "scepters" intergrown in a canopy, the trees' supporting trunks visible on a side view. In the smaller specimens that I saw—none smaller, though, than about 6 x 6 cm—the top-heavy scepter crystals either jut out at various angles or lean in together, touching tops over a corroded marshland of scepterless stalks. There are minor associations of corroded yellow calcite masses and 1-cm pyrite cubes.

Ian Bruce, in his scorodite-filled room, showed me a couple of very good specimens of **columbite**, selected from ten or so which he said had been found recently on old mine dumps at Spargoville, Western Australia. Very sharp, black (not lustrous), orthorhombic columbite prisms to 4 cm are half embedded in white matrix; there are also a few loose thumbnail crystals.

It just so happens that this whole report's most exciting what's new, the one that inspired the most intense buzzings throughout the show week, the one that most commonly caused the worst cases of coldsweat fever and longing, etc., comes dead last here because it is from Australia. We now have to entertain the thought that perhaps the locality with the best claim to the title "world's best" source of **chalcocite** crystal specimens is the now-inactive Telfer gold mine near Carnarvon, Western Australia. These amazing chalcocites were being shown in an out-of-the-way room at the InnSuites by Tom Kapitany of *Crystal World* (20 FiveWays Boulevard, Keysborough, Victoria, Australia 3173). About two years ago, in the closing days of the mine, Tom told me, a few hundred of the specimens were collected from the upper levels, and he had most of them in Tucson, from thumbnails up to a 6 x 6 cm cluster. Each chalcocite crystal is a greatly elongated, supersharp, upstanding cruciform twin, the two long blades penetrating each other at close to 90°. These are metallic black and brilliantly lustrous, untarnished (so far), although there is some slight malachite staining here and there. The matrix, when present, is a white/brown gossany calcite, with occasional flattened 1-cm calcite rhombohedrons. As you have gathered, these are absolutely superlative chalcocite specimens (despite a bit of chipping on some), and of an entirely different appearance than their brethren from Wisconsin, Connecticut, Dzhezkazgan and Tsumeb. There is a slight resemblance to some of the old chalcocites from Cornwall, but these, of course, are likely to be more tarnished and sooty. The best of the thumbnails were priced from $2000 to $3000 . . . and it's a measure of the quality of the stuff that some experienced hands were willing to pay these prices. How's that for ending the tour on a strong note?

Displays

Every year, the prospect and process of writing about the displays at the Main Show threaten to turn all superlatives into clichés; "fabulous" and "fantastic" and "stunning" just become meaningless terms after awhile. But never has the problem seemed so severe and insoluble as it does now, for this, the Russian Minerals and Gem Art year. Never have I felt such a need to apologize in advance for omitting all mention of some fine displays, while merely listing the major eye-feasts without dilating on them, fabulous/fantastic/stunning piece by piece. It's not only my opinion, but also that of many others I've spoken to, that this year's show has been a particularly spectacular one for displays.

The "Russian" (in operational parlance, former Soviet Union) specimens in these dozens of (oh, all right) *fantastic* cases were from both the Czarist and the post–Cold War eras. Of the cases devoted generally to exceptional ex–Soviet Union minerals, some standouts were those of John and Claudia Watson; Georges and Diego Claeys; the Czech dealership of *KARP*; the Carnegie Museum (how about a euhedral 3-cm native tellurium crystal from Uzbekistan?); Harvard; Bill and Carol Smith; Pennsylvania State University; Carolyn Manchester; the Rice Northwest Museum; Roz and Norm Pellman; Bill Pinch (heavy on extremely rare species); and the Smithsonian (with a Dzhezkazgan betekhtinite plate, loaded with large crystals, a foot high). Subspecialty cases included former-U.S.S.R. calcite, by the Cincinnati Museum of Natural History; Dalnegorsk calcite, by Victor Yount (with 60 tremendous pieces, miniature to behemoth); Karaoba, Kazakhstan fluorite/apatite/bertrandite superspecimens, by Martin Zinn; "Russian Metallics," by *Collector's Edge*; and Russian-related "Mineralogical Collectibles," by Herb and Moni Obodda. Stay tuned for more out of Russia later.

Cases on other themes were wonderful in their diversity: e.g. azurite thumbnails and miniatures by Jim and Dawn Minette (with an S-shaped arrangement down the middle, of 16 lush, sharp old

Bisbee azurite rosettes); Tsumeb azurite, by Marshall Sussman, with about 35 superlative pieces; old English classics, by Lindsey Greenbank (supplementing more of the same for sale at his booth); world-wide miniatures, by Kent England; a spectacular general case by Daniel Trinchillo Sr. and Jr. and Marcus Budil (a big, colorful, extravagant selection of fine, large specimens of everything); North American barites, by Bill and Diana Dameron; Rhodope Mountains, Bulgaria sphalerites, by Alexander Dikov (with beautiful faceted sphalerite brilliants); gem crystals from Karur, India, by *Superb Minerals, India* (with a log-like, richly colored, terminated gem aquamarine a foot and a half high); two cases of Keokuk, Iowa, geodes, by *Nature Arts Company,* Phoenix; personally collected specimens (great ones!) by Al Ordway; minerals of Asbestos, Quebec, by the Royal Ontario Museum; Wessels and N'Chwaning mines, South Africa specimens, by Catherine Woest (including a lustrous, sharp, jet-black 2 x 2 x 4-cm gaudefroyite prism); minerals of Mt. Malosa, Malawi, by the Natural History Museum of Milan; and San Diego County, California, gem minerals, by the Natural History Museum of Los Angeles County.

A case called "Some Eastern Influence," by 19-year-old James Zigras of Paramus, New Jersey, had a built-in appeal for me, but also appealed to everyone else with, among others, a thick, terminated, gemmy, pale orange 3-cm prism of willemite from Franklin; four enormous, gemmy green elbaite crystals from the Gillette quarry, Connecticut; and the rich purple 4-cm Pulsifer apatite pictured in Bancroft's *Gem & Crystal Treasures.* And Gene Meieran again scored very big for organizing three spacious and lavish donor cases, the specimens on temporary loan from a host of top museums and private collections. This year's theme for the donor cases was Face-Centered Native Elements, and surely you never saw in your life so many world-class specimens of gold, copper, silver and lead, and such a lot of fine diamonds.

A final paragraph must be devoted to some remarkable display items *other* than mineral specimens. I especially enjoyed Cal Graeber's artistically presented case on antique German miners' uniforms, books, a microscope, and, yes, specimens after all, antique German-type. Then there was Wendell Wilson's case, with six of his paintings of specimens in three mediums (watercolor, oil on canvas, gouache on vellum), all so beautiful that they were as much a treat to look at as the specimens themselves would have been. And lastly there was the thing that probably 90% of the general public came principally to admire: 30 pieces out of the *Forbes* Magazine Collection of *objets d'art* by the late 19th-century jeweller to the Czars, Peter Carl Fabergé, and a further 30 Russian-related pieces from other collections. Two years of hard work by the Tucson Show committee secured these exotic, unthinkably valuable objects for display here; thanks are also due, of course, for the cooperation of the Forbes Museum and the other institutions. Around the show floor were cases with things like two giant vases of Russian malachite (Lizzadro Museum of Lapidary Arts collection), gemstone carvings of everyday life in Old Russia (Denver Museum of Nature and Science—formerly called the Denver Museum of Natural History), and carved Russian gemstones for impressing wax to seal documents (Hillwood Museum, Washington, D.C.). Certainly, though, the stars of the show were the Fabergé pieces—from soldiers to samovars, brooches, ashtrays, a jade gum pot, and a huge bejewelled Imperial writing portfolio, all these in a single case in the center of the hall, watched over by a troop of burly police officers in black uniforms. Across from it reposed the star of the stars of the show: the Imperial Renaissance Easter Egg, made by Fabergé for Czar Alexander III and given by him to the Czarina Alexandra in 1894. This is one of only about 20 surviving Fabergé Easter eggs in the world, and when I looked in at the ropeline surrounding it, a uniformed officer of the Tucson Police Department was not only guarding it but self-assuredly answering questions about it, discoursing knowledgeably about Czarist Russia and having a wonderful time.

Winners

The winner of the **Carnegie Mineralogical Award** this year was F. John Barlow, not only for building a fabulous collection and publishing a fabulous book about it, but for his philanthropic endeavors (establishing an endowed teaching position at the University of Wisconsin, support for the Appleton Children's Museum, establishing the F. John Barlow Planetarium, and making major donations to the Weis Earth Sciences Museum).

The winner of the **Desautels Award** for best case of minerals in the show: Les Presmyk. Winner of the **Lidstrom Award** for best specimen: James Zigras (that purple Pulsifer apatite). Winner of the **Friends of Mineralogy Award** for best article of the year: Bill Henderson, Pete Richards and Don Howard for "Elongated twins of sodalite and other isometric minerals." Check it out if you haven't read it.

So that's it—another Tucson Show in the can, and for memory's archives. May all of your mineral adventures bring you as much fulfillment and fun as mine have, these past eight days.

Notes from the Editor *(continued from p. 170)*

ish colonial and Latin American coins,* had this to say in his Spring 2001 price list:

> The combination of stock market losses and election year jitters in 2000 made the coin business pitifully slow: I must have dropped 500 people from my mailing list, including tons of formerly insatiable jewelers, while old inventory just got cheaper and cheaper. Supply has been fairly good, however, as the weak *peseta* has caused material to drift back over the Atlantic [from Spain] at a great rate, and investor-collectors all over have had to sell their coins to cover stock market losses. "Y2K" also saw the transformation of the World Wide Web/Internet into a quick and easy vehicle for dealers and non-dealers alike to sell all kinds of things, the unfortunate atmosphere of "caveat emptor" notwithstanding. Big coin shows, once the ritual bread-and-butter of dealers like me, are now nothing but wholesale powwows that effectively end the same day doors open. Dealers who once issued regular catalogs now go many months or even years between volumes. [But] to those who ask when they should buy, I say buy it when you see it. Within reason, price is immaterial if you really want to enjoy collecting. The bear market won't last forever, and before you know it once again you will have trouble finding the items you want.

Fortunately, the mineral collecting world is probably not so dependent upon stock market profits as coin collecting. Supplies, however, are strong and many prices are very reasonable. See Tom Moore's report on the Tucson Show in this issue for many examples.

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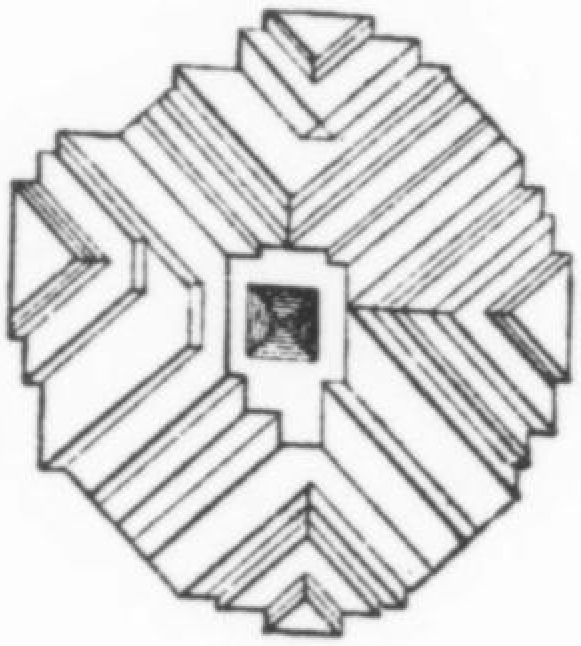

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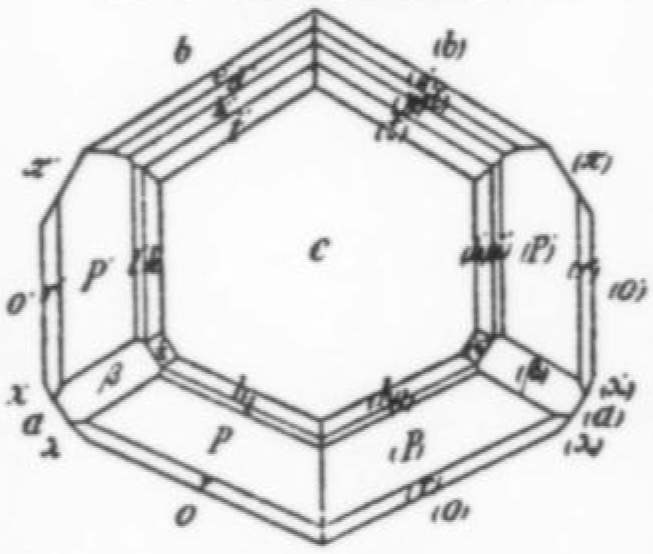

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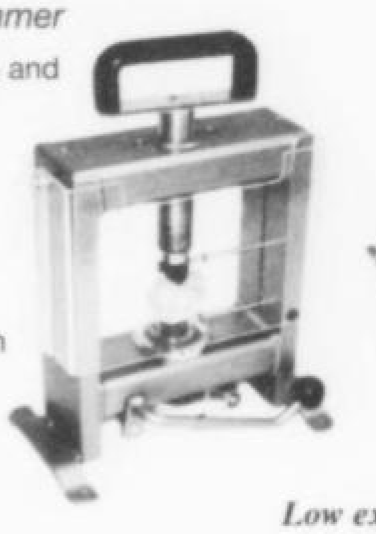

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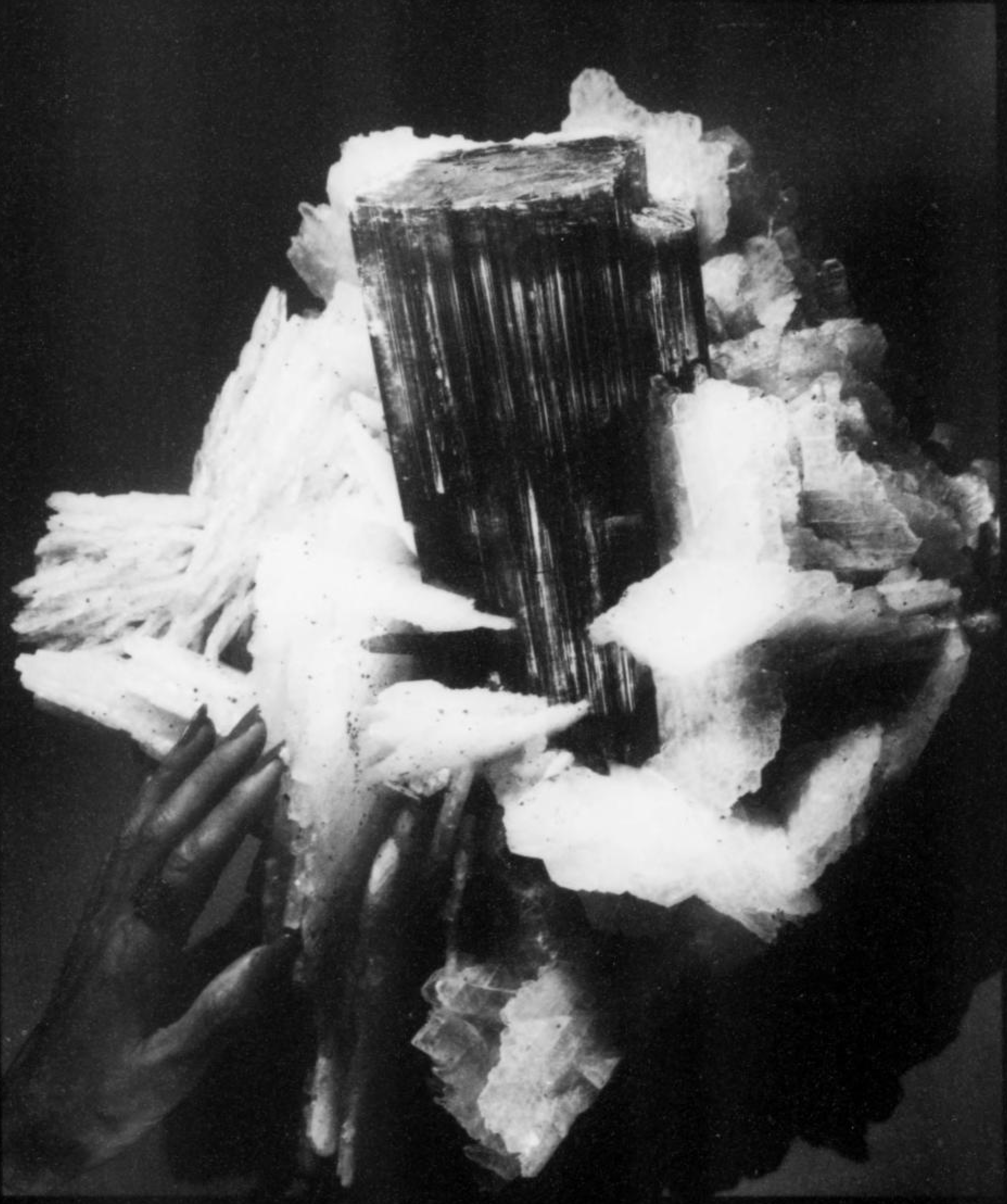

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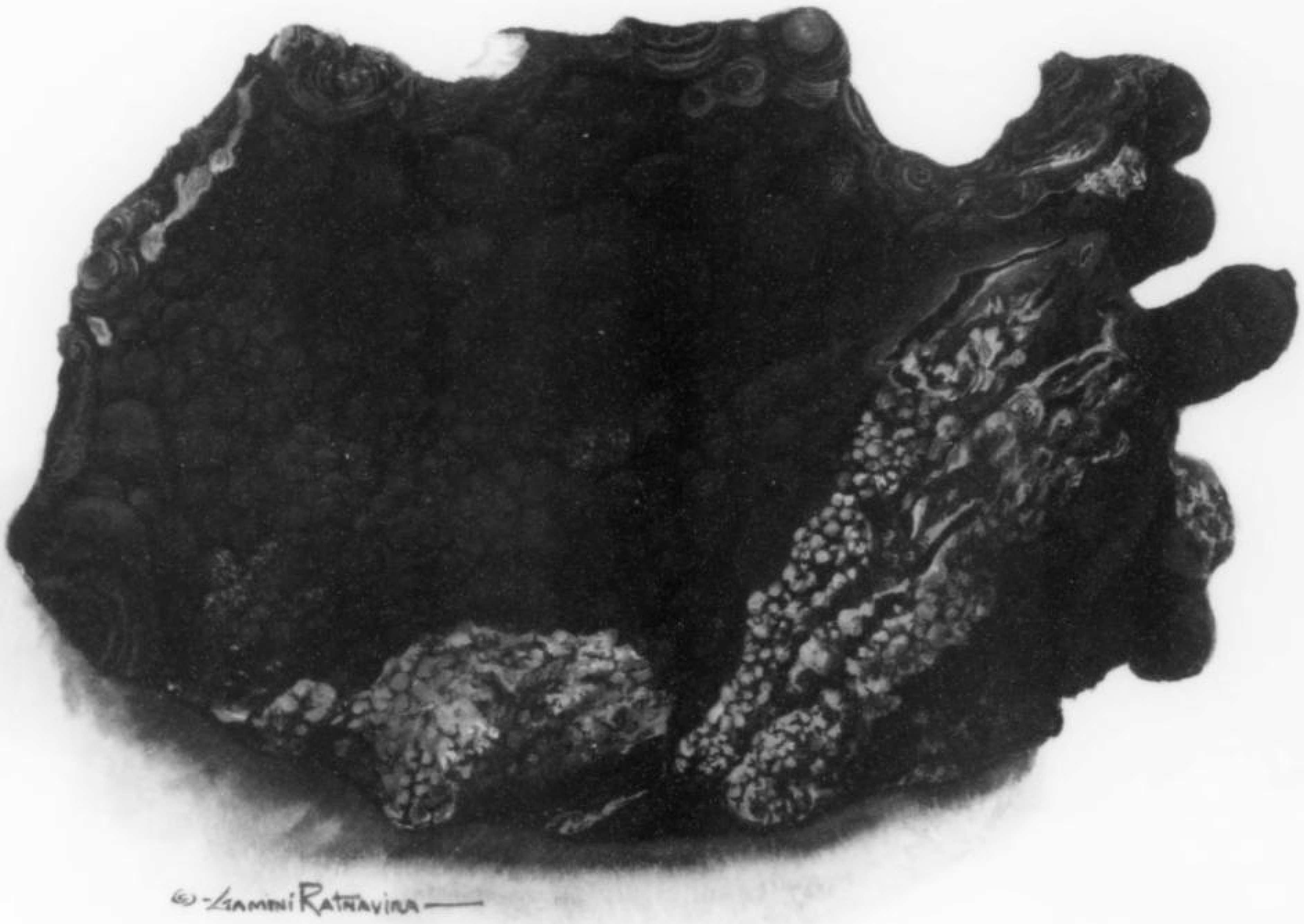

Azurite with malachite, Bisbee

by Gamini Ratnavira