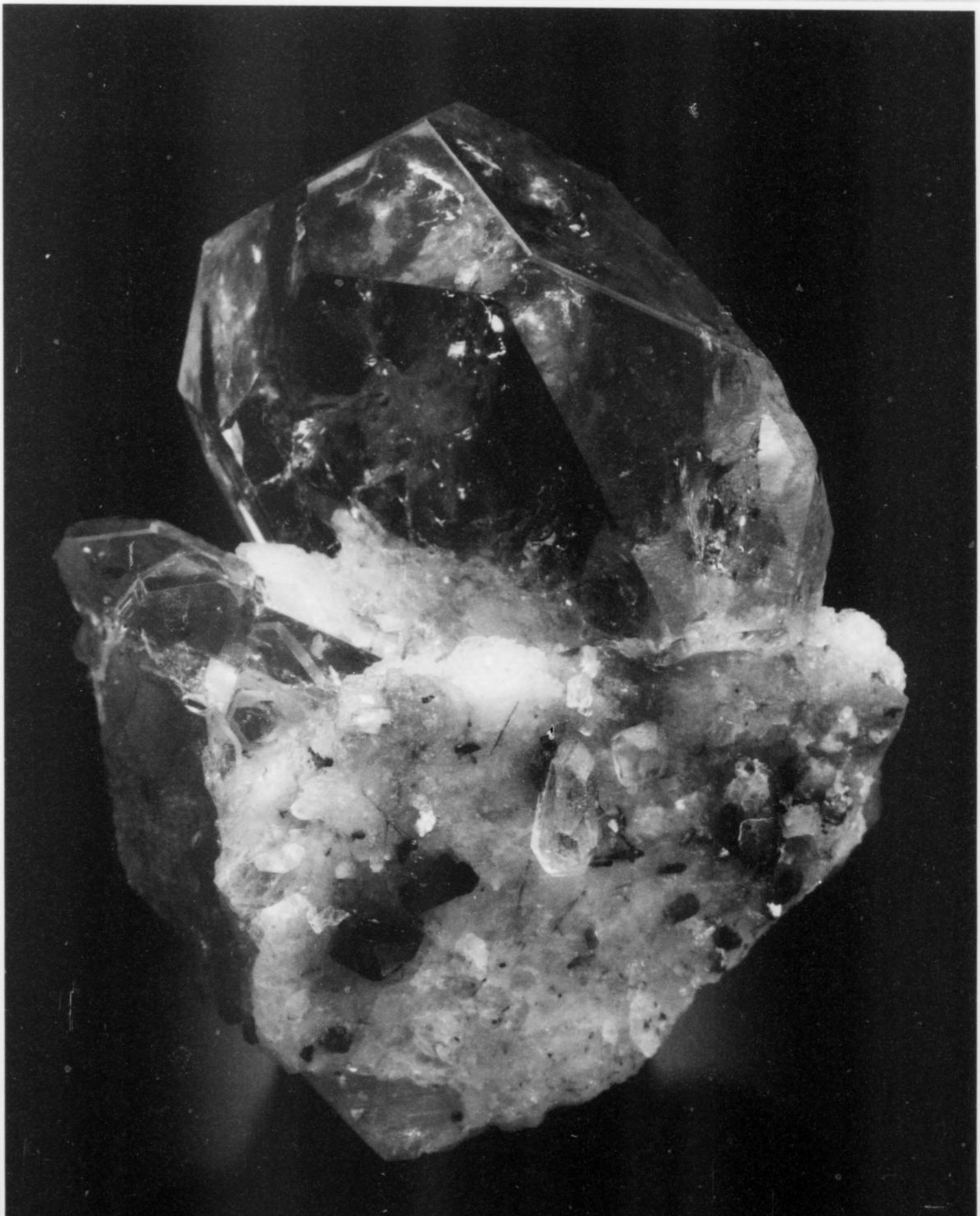
# THE MINERALOGICAL RECORD

NOVEMBER–DECEMBER 2005 VOLUME 36 NUMBER 6 $15



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THE
MINERALOGICAL
RECORD

**November–December 2005 Volume Thirty-six, Number Six**

# Articles



# Columns



COVER: BERYL crystal (variety *morganite*) on albite matrix, 6.6 cm, from Conselheiro Pena, Minas Gerais, Brazil. Sandor Fuss/Stuart Wilensky specimen; Jeff Scovil photo. For more on the minerals of Minas Gerais see Guido Steger's memoirs in this issue.

**The Mineralogical Record**
(ISSN 0026-4628) is published bi-monthly for $55 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.



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# notes from the EDITORS

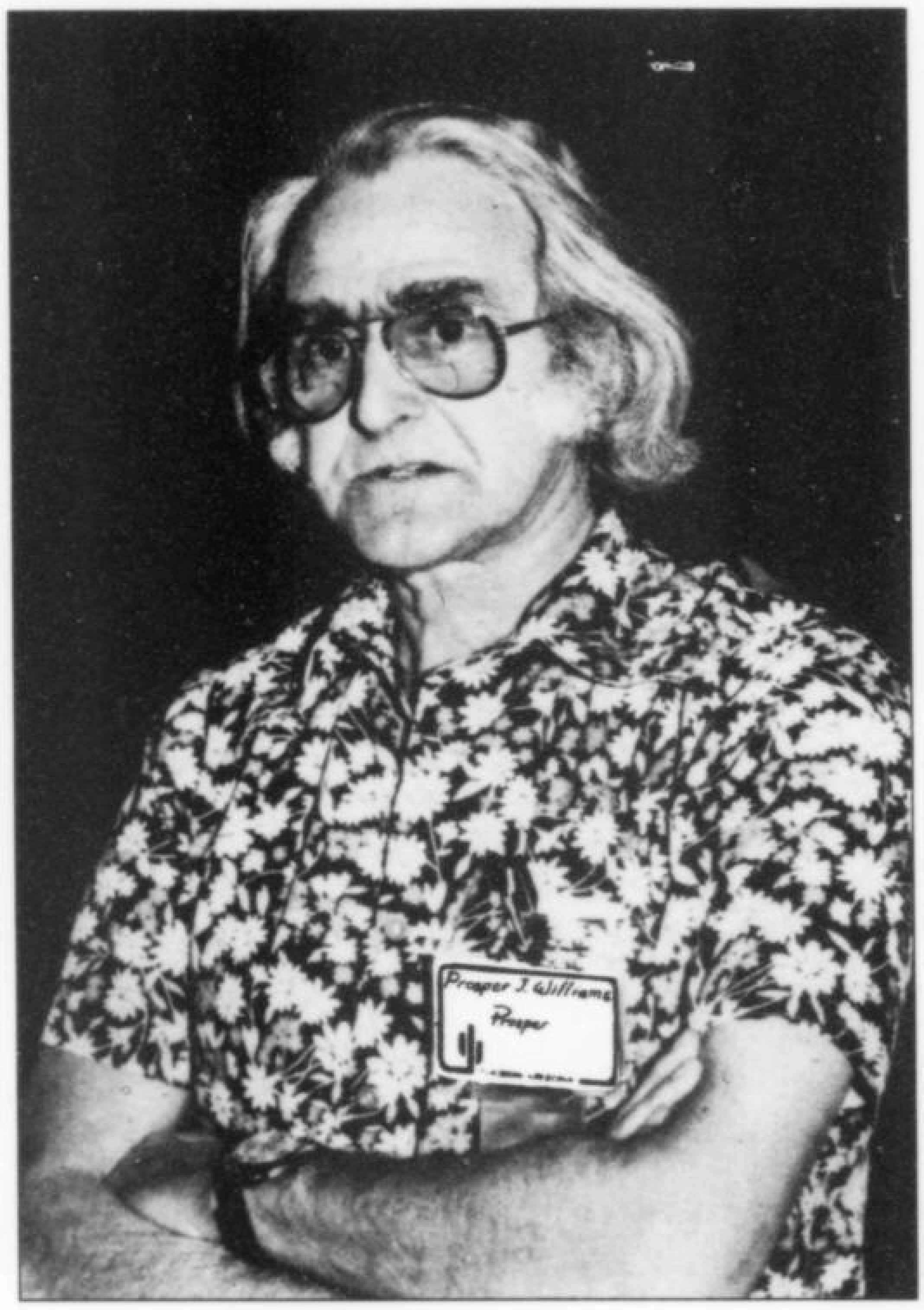
## Hand-Held Raman Spectrometer

For the field-oriented mineral collector and mineral show-goer who wants to have all the latest equipment (i.e. the best toys), there is now "The Rockhound," a portable hand-held device that promises to non-destructively identify minerals in the field by Raman spectroscopy analysis. This instrument is a spin-off of technology developed for NASA's Mars landers. Raman Spectroscopy is based on the Raman effect, which is the inelastic scattering of photons by molecules. The effect was discovered by the Indian physicist C. V. Raman in 1928. The Raman spectral signatures for different minerals tend to have sharp peaks that form a unique pattern, serving as "fingerprints" for each material.

The device weighs only 5 pounds and comes with a built-in library of 100 comparison spectra. Considering that there are over 4,000 mineral species, this is obviously a rudimentary database at best, but library development software is also supplied, allowing the user to load a much better database of mineral spectra for comparison with unknowns. Such a database has been prepared jointly by Robert Downs and Bonner Denton of the University of Arizona and George Rossman at Cal Tech; it can be accessed online at http://rruff.geo.arizona.edu/rruff/.

According to the promotional material, "This portable handheld unit is ideal for collectors because it can be taken to the field, clearance houses or exhibitions and specimens may be analyzed in only a few seconds." It even claims to identify (at least to a crude extent) cation mole fractions for $Ca^{+2}$, $Mg^{+2}$, and $Fe^{+2}$. And an image of the specimen can be captured on the screen for future identification.

"The Rockhound" is produced by DeltaNu LLC, a manufacturer of chemical-sensing equipment based in Laramie, Wyoming. One of these handy little gadgets will set you back $18,500. (Check out the company's website at www.deltanu.com.) This is the first hand-held Raman analyzer to reach the market, and, as might be expected, it is expensive and, according to Downs, it still has a few bugs to be worked out; other models are expected to appear on the market by Christmas. Judging by the way technology usually progresses, I would expect that as the years go by the price will come down, the size of the device will be reduced, and its performance will be improved. Someday we'll probably be able to buy a pen-light-sized analyzer for $100 that announces the species name when you point it at a specimen!



KENT ENGLAND

**Prosper J. Williams (1910–2001)**

## Died, Prosper J. Williams, 91

Many people in the mineral world remember Prosper ("Prop") Williams, the gracious and understated, silver-haired mineral dealer with the indefinable British/Australian/South African/Canadian accent. Prosper was famous for his Tsumeb specimens, and was honored in 1979 by the naming of *prosperite*, a calcium-zinc arsenate mineral from Tsumeb. He passed away November 16, 2001, at the age of 91.

Prosper John Williams was born in Port Elizabeth, South Africa, on October 27, 1910, the eldest of five brothers. He was the son of Lambert Williams (1872–1966) and Doris Ellen Dufaur-Clark (1887–1934). In 1918 the family moved to a remote South African seaside cottage in hopes of escaping the worldwide influenza epidemic, and soon after the end of World War I that same year the family moved to Hertfordshire County, England. They lived in various small towns, and when Prosper was 14 he attended a Waldorf-type school called the Priory in the town of Kings Langley. He and his brothers rode their bicycles the three miles to school and back, lighting their way with acetylene lamps in winter when days were short. In the evenings they would sit around the fire making raffia mats or knitting socks while their father read Dickens to them. Prosper became interested in art at a young age, probably thanks to the influence of his mother (an excellent artist in her own right, who died at the young age of 47), and he often accompanied her on outdoor drawing and painting excursions in England and later in South Africa.

In 1926, when Prosper was 16, he decided that he'd had enough of schooling and boarded a tramp steamer for Cape Town, South Africa with the hope of taking up farming. He stayed with his maternal uncle, who lived in Schoenmakerskop near Port Elizabeth, and worked on a citrus farm. There was no electricity or running water in his uncle's house; rainwater was used for drinking and cooking, and they swam in the ocean daily to keep clean. Prosper soon came to realize, however, that without money to buy a farm of his own he would never be a real success as a farmer. So instead he took a job in a produce broker's office.

In 1929 the rest of Prosper's family joined him in South Africa, and his father Lambert opened a basement-shop store in Cape Town called "The Red Door," selling a variety of household objects and artwork. Prosper joined them in Cape Town and got a job as a conveyancing clerk in a lawyer's office (Syfret, Godlonton, & Low). Prosper shared a studio with another artist, John Wright, and in his spare time enjoyed making advertising posters and landscape paintings for various clients, as well as producing illustrations for his father's poetry. It was at this time that his mother loaned him the money to buy his first car, a Singer, for £19. He also studied enough on his own to pass the Town Planning exam and joined the Town Planning Institute of Great Britain and of Landscape Architects.

In 1937 Prosper married Hilda Latsky, whom he had met in the law offices where he worked. With a small inheritance from his godfather they bought a house in Claremont and Prosper built a garage for it himself out of concrete blocks and automobile packing cases. In 1942, now with two daughters, he bought property in Oranjezicht where he had a two-story house built. He worked at building other houses, while also working for the Cape Town Planning Offices, and during the next few years they moved frequently, even acquiring a few acres of land that allowed Prosper to do a little farming, raising food for the family's own consumption.

Prosper continued producing artworks at every opportunity. One was published on the cover of *Huisgenoot* magazine, and other artworks of his were published as illustrations for poems; he even produced cartoons illustrating the lives of the "young set" in the 1930's. Prosper also illustrated two books: *Shiny and Shiness* by Kingfisher (Rustica Press) and *Drie Vroue*. He often did commission work for portraits and buildings, and was a regular at a wide variety of figure drawing sittings. His renderings of African wildlife were done with utmost attention to natural body positions and poses.

In 1962 Prosper and Hilda (who had by then divorced and then remarried each other) moved to Canada, where Prosper at first worked as a labor foreman to earn money which he used to purchase a store on Yonge Street in Toronto. The store was originally called the "Dutch Curiosity Shop" but he renamed it "Williams-Hildas," and it soon became the beginning of his dealership in mineral specimens. Prosper had been interested in minerals since the 1950's or perhaps even earlier, but he had never formed a personal mineral collection (and never did in the following years either). It is known that he had searched for diamonds around the Orange River in South Africa as early as 1932. He had also collected some agates in that area, and later purchased a quantity of rock for lapidary use which he had shipped to Canada after his move there. One day in Toronto a salesman brought some Mexican mineral specimens to the store and Prosper was so taken by their beauty that he began purchasing mineral specimens to feature in the shop—his labels proclaiming "for the choicest specimens." The store offered a variety of other goods as well, from jewelry to Dutch chocolates to medieval armor. Customers could learn lapidary skills in the lapidary shop upstairs run by Prosper's son John. Prosper also painted replicas of Bushman art on slabs of thin limestone and slate and sold these in the store, while also continuing to paint in oils and watercolor, but now the landscape scenes depicted Canadian vistas.

Prosper's enthusiasm for minerals became intense, and soon he was enrolling himself in mineralogy courses at Toronto Technical College. He learned that the Tsumeb mine in South-West Africa was producing some very beautiful mineral specimens for collectors, and so in 1964 he began making two trips a year to Tsumeb to buy specimens from the miners. Mineral collecting by the miners was nothing new at Tsumeb; they would mine around crystal pockets until lunchtime, then go in and fill their oversized lunch boxes with specimens. Mine management looked the other way as long as operations were not unduly disrupted. Prosper got along well with the miners and brought out substantial quantities of fine specimens regularly for many years.

Hilda left Prosper in 1966, and Prosper then sold the store to become a full-time mineral dealer. Thereafter he traveled regularly to shows in the U.S., and to producing mineral localities in Namibia and South Africa, and also became the first dealer to discover the specimen potential of the Jeffrey quarry in Asbestos, Quebec (where he had a virtual monopoly on the beautiful grossular and vesuvianite specimens for a while until other dealers became involved). He began driving to the Tucson Show every February, at first selling from his car and then later from a show booth. And whenever he had some free time he would draw or paint. He produced many pictures of mining scenes at important mineral localities, especially Tsumeb, and sold them to appreciative mineral collectors.

On one trip to Tsumeb in 1977 Prosper acquired two specimens that he could not identify, and he submitted them for identification to Bob Gait at the Royal Ontario Museum. One proved to be beudantite, but the other could not be identified with any known species. In 1979 Gait *et al.* formally published the description of the new species as *prosperite*.

Prosper sold his remaining mineral stock in 1980 to Rod and Helen Tyson and retired from the mineral world to relax and paint. In 1999 Prosper was diagnosed with mouth cancer; he returned to South Africa in 2000 to escape the cold, and died a year later, having produced paintings and pastel drawings virtually every day until his death.

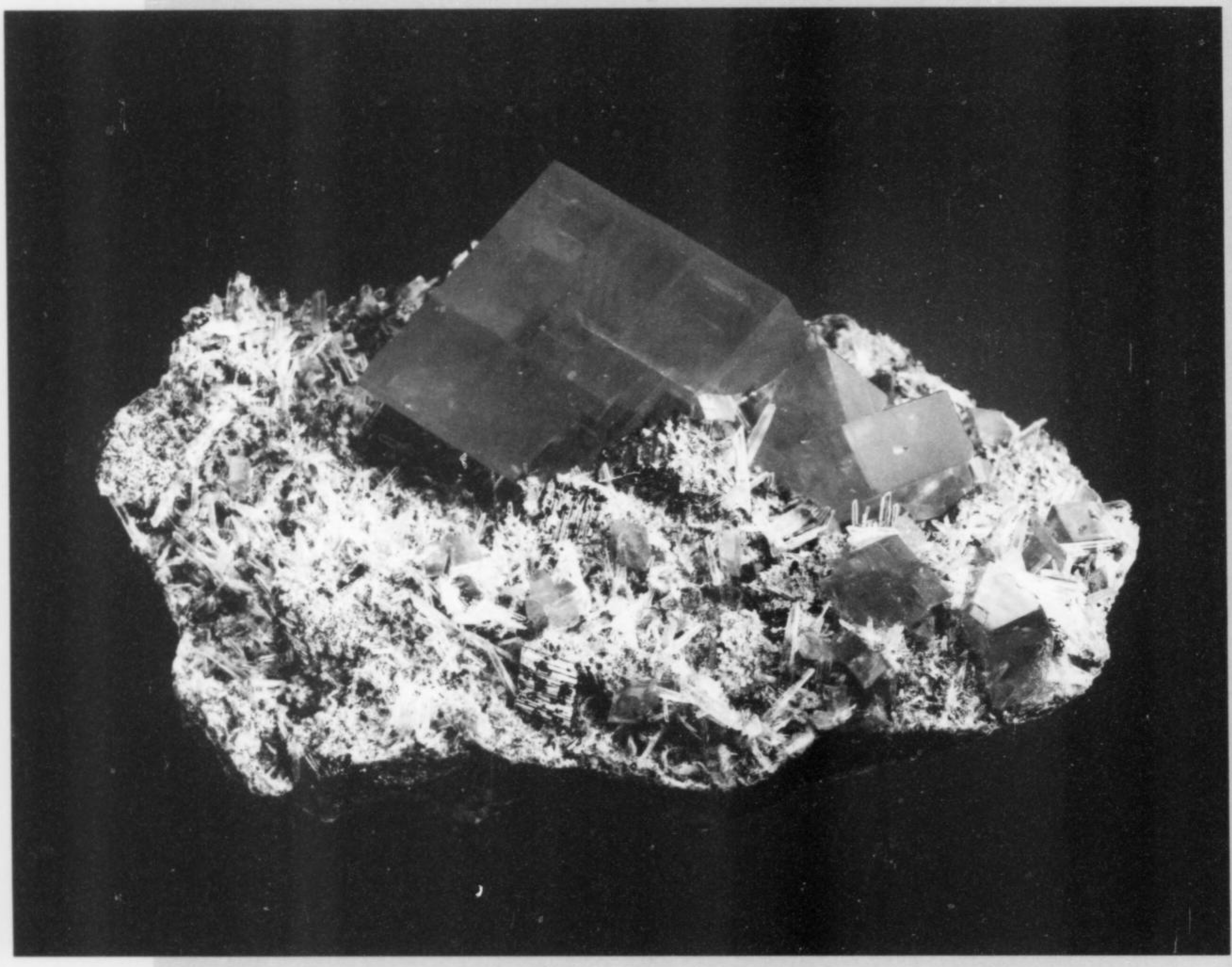
**WEW**

## Abstracts at MineralogicalRecord.com

We are pleased to announce the addition of another new feature to the Mineralogical Record website: *Abstracts of New Mineral Species* prepared by Dr. Joseph A. Mandarino, former Chairman of the International Mineralogical Association's Committee on New Minerals and Mineral Names, and senior author of *Fleischer's Glossary of Mineral Species*. We had been publishing these in the magazine as space permitted, but the large number of new species being described has been taxing our ability to keep up with them. Now we can present Joe's abstracts in a very timely manner (within days) instead of having to wait months as before. We can also include crystal drawings and illustrations. Therefore we would be pleased to include photos submitted by readers. Check through the current listings and see if perhaps you have a specimen photograph.

The abstracts can be accessed via either of two drop-down menus. The left one lists all of the species currently in the database in alphabetical order, so if you are looking for a particular species this will be the easiest way to find it. The other drop-down menu lists the same species, but according to year of publication (and alphabetical within each year). So if you are checking to see what species have been added recently, perhaps in order to update by hand your copy of the *Glossary*, this would be the place to check.

# *From the* Steve Neely Collection



RHODOCHROSITE with Pyrite and Quartz, 4.75 inches (main crystal 1.5 inches on edge), Nate's Pocket, Mine King Raise, Sweet Home mine, Alma, Colorado. Collector's Edge Minerals, Denver Show, Sept. 2003

Jeff Scovil Photo

Mimetite, Pingtuoling mine, China. Jeff Scovil photo.

# THE JACKSON'S CROSSROADS AMETHYST DEPOSIT

## WILKES COUNTY, GEORGIA

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*The Jackson's Crossroads occurrence in east-central Georgia, discovered in 1988, has recently produced some of the finest amethyst ever found in the United States. Rich purple color, brilliant luster, large crystal size and attractive clusters make the so-called "Wilkes County Jewels" world-class amethyst specimens. Mining continues at the site, and additional production is expected.*

### INTRODUCTION

Wilkes County, Georgia has long been known to produce fine-quality amethyst. In northwestern Wilkes County, about 9 miles by road west-northwest of the community of Tignall, is a truly world-class amethyst-producing area known as Jackson's Crossroads. Access is from Washington, Georgia north on Highway 17 to Tignall. At the traffic light in Tignall turn left on Independence Street, passing the Kum Bak Café. Stay on this road (which changes names, becoming Mallorysville Road), bearing left past the intersections with Wright Road and Bunch Road, for approximately 8 miles through the quiet and picturesque Georgia countryside to the small community of Jackson's Crossroads. Continue through town as the road name changes to Clark Station Church Road, for about seven tenths of a mile, and turn right on Hollis Norman Road (a dirt road). Proceed approximately 300 feet to the first new driveway, marked by orange stakes, and turn right. The pits are located in a pine thicket about 750 feet in from the road.

Under the partnership of two of the authors (Rodney Moore and Terry Ledford) the Jackson's Crossroads deposit has recently produced some of the finest amethyst ever found in the United States. The crystals exhibit a range of colors, from pale purple to rich royal purple, with relatively little smoky color compared to the quartz from other Piedmont amethyst occurrences. Hundreds of fine specimens were offered at the 2005 Tucson Gem & Mineral Show (Moore, 2005).

### HISTORY

The Jackson's Crossroads amethyst deposit is one of a large number of Appalachian amethyst occurrences in the Piedmont physiographic province (Cook and White, 1990). Amethyst mining in Wilkes County dates back to the 1920's, when Tiffany & Company mined a local deposit for gem-grade crystals. In 1966, Thom Campbell of South Carolina mined a nearby site with good success (Presset, 1981). It is

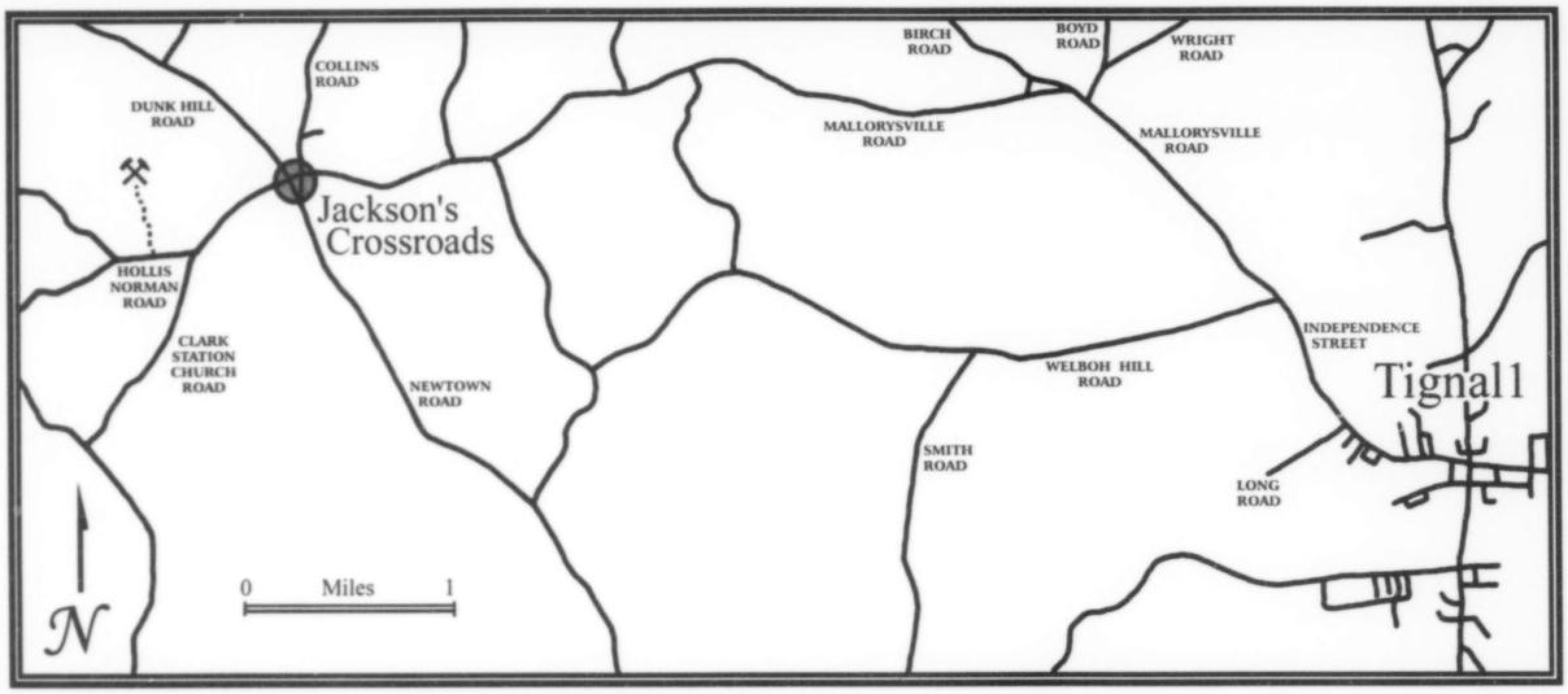




*Figure 1.* **Locality map.**

said that in 1970 some men digging a hole in which to hide moonshine also made a discovery of amethyst in the area. Around 1988 the site of the current discovery was logged for timber to produce paper. A fellow by the name of Plemmons happened upon the clear-cut area, and discovered the first beautiful, deep purple amethyst there.

Pine seedlings were planted as part of post-logging reclamation, and as they grew up collectors proceeded along a winding path through the new forest to dig by hand for amethyst. They excavated to a depth of about 9 feet, just barely scraping the top of the main deposit. In 2000, one of us (Rodney Moore) was granted permission to bring in a small piece of equipment to dig small exploratory holes. As time went on, the property changed hands, and permission was granted to bring in progressively larger equipment. Eventually, Moore purchased a small portion of the land and excavated for amethyst on a progressively larger scale. In 2005, two of us (Rodney Moore and Terry Ledford) formed a partnership to further expand the mining of the Jackson's Crossroads deposit. Today the partnership is hard at work producing fine specimens.

## COLLECTING

Local conditions make it challenging to collecting amethyst. A high groundwater table, combined with frequent rains in the area, produces a very wet collecting environment. A pump must always be on hand to dewater the pit. Then there is the mud, firmly backed by Georgia clay, which sticks to everything and camouflages the fine crystals. And in summer, the famous heat and humidity of the South can bring one to the point of exhaustion.

The current 1-acre workings consist of two pits, referred to as the front pit and the back pit. These pits, dug as deep as safety and the hardness of the rock permit, have yielded a surprising variety of crystals and pockets. After a portion of a pit has been worked, it is refilled, contoured, and restored so as to blend into the surrounding environment.

Currently, amethyst mining is performed under watchful eyes, with the help of a track hoe. The track hoe is first used to remove the upper clay-laden soils down to the unaltered host rock. Once the bedrock is reached, the track hoe operator scrapes the rock with the bucket, and the surface is then examined for signs of a pocket. When a pocket is opened, fine-grained, almost porcelaneous clay is encountered, and the track hoe is shut down. The miners then work around the pocket with bars, and carefully remove specimens by hand, with the clay still covering the pieces. The clay provides a layer of protection for the crystals, reducing damage until specimens can be cleaned and safely stored.

The first pit was excavated in the original area, which had been dug by hand by collectors for almost 20 years. These shallow workings yielded mostly boulders which could be broken to reveal very small, isolated cavities. The most likely places to find crystals were in the fissures where the ledges were broken and seamed with clay. Traditionally the best areas proved to be the undersides of boulders, which would occasionally have a depression that would contain colorless drusy-quartz-lined vugs containing nice clusters of gemmy amethyst crystals. Rarely, the hand digging would reveal large clay-filled pockets between large boulders, yielding up to 30 or so 2-inch crystals of amethyst.

On several occasions large, isolated, open pockets were encountered. A "rind" could be seen in these pockets, where the clear quartz druse lining the wall rock had separated from its backing. The bottoms of these pockets typically had a half inch of clay and scattered loose crystals that had fallen off the roof. Some of these

*Figure 2.* **Initial excavation of the back pit. Rodney Moore photo.**

crystals have a relatively clean interior, but are often covered with a thick black manganese powder or mud, and also a bit of iron oxide coating. More rarely encountered were open, hollow, medium-sized pockets devoid of clay. So-called vertical tubes, which yielded many specimens in the back pit, were completely absent in the front pit. On occasion, large, transparent, dark purple crystals were found in the front pit after a track hoe was finally brought in. Typically the front pit crystals are 1 inch or less and are very transparent with a pale purple color.

After we completed our work in the front pit, a backhoe was used to explore the back portion of the property. An area was found there, now referred to as the back pit, which contains crystals of such a dark purple color that they appear to be almost black. When we first began to dig in that area, the backhoe bucket rolled back pine needles, black loamy organic material, and top soil revealing a double handful of decent amethyst crystals. We thought this was the end of a small, isolated pocket, but the next scoop of the bucket turned up even more crystals. An examination of the shallow hole revealed the start of a long pocket series, the first "vertical tube" pocket to be discovered at the locality. At a depth of 14 inches, still in the top soil and not yet down to the where the saprolite begins, we saw very fine, lustrous crystals reflecting the sunlight.

The backhoe could only reach to a depth of about 12 feet, but it was clear that this tube continued farther downward. The crew was brought back the next week for an "emergency dig" with a large excavator that was able to reach down to a depth of 25 feet. The tube proved to extend downward for that entire distance, and today its root is in the bottom of the pit, covered with backfill. The vertical-tube pocket crystals are large and a dark, rich purple, with some showing skeletal growths and clay inclusions.

The second tube pocket was nearly missed, as excavation was halted only 6 inches above it. However, while walking over the bench cut we noticed a peculiar clay seam. The first strike with a pick into the clay seam gave a tell-tale ring of crystalline quartz. Within two hours about 50 pounds of large crystals had been recovered, including two that are nearly as large in diameter as milk jugs. After another 4 hours a total of about 100 pounds of fine amethyst had been recovered. Later, a third tube pocket was discovered. Digging in the back pit continues.

## GEOLOGY

The Jackson's Crossroads amethyst deposit is located south of the Brevard fault zone, between the Towaliga Fault and the Goat Rock Fault. This area is just above the fall line separating the coastal plane and its clay beds from the crystalline rocks of the Piedmont. The deposit is definitely not a pegmatite. The area geology has historically been reported to consist of a metadacite (Pickering and Murray, 1976; Lawton, 1977) with small granitic bodies along the metadacite boundaries. Observations made in excavations at the mine site suggest the host rock to be either a metadacite or a slightly metamorphosed granite. Hydrothermal silica deposition has altered the host rock, depositing quartz during at least two hydrothermal events.

The course-grained host rock with quartz stringers and pockets lies beneath residual "saprolite." Saprolite is developed from the prolonged weathering of the host rock, altering components such as feldspar to a thick, dense clay. This clay washes down into lower levels of the deposit, filling in the open cracks and pockets. The saprolite zone varies in thickness from 6 to 12 feet, and contains old decomposed amethyst pockets.

The crystalline pockets can be divided into three general types: (1) tube pockets, (2) offshoot pockets and (3) isolated pockets. The tube


*Figure 3.* **Collecting in the bottom of the back pit, showing a pocket with clay just below the bar to the left. This photo also shows the fracturing of the host rock, with hydrothermal silica deposition. Rodney Moore photo.**

*Figure 4.* **Amethystine quartz in a type two pocket, 25 cm across. Rodney Moore photo.**

pockets are the largest of the pockets at Jackson's Crossroads, reaching a maximum length of over 25 feet, and yielding the largest amethyst crystals. Tube pockets apparently served as the main channels for silica-rich solutions. When first encountered they appear to be single pockets but upon further excavation prove instead to be a series of connected pockets more or less vertically arranged.

The second category of amethyst pockets are offshoots from the tube pockets, and therefore occur in close proximity to them.

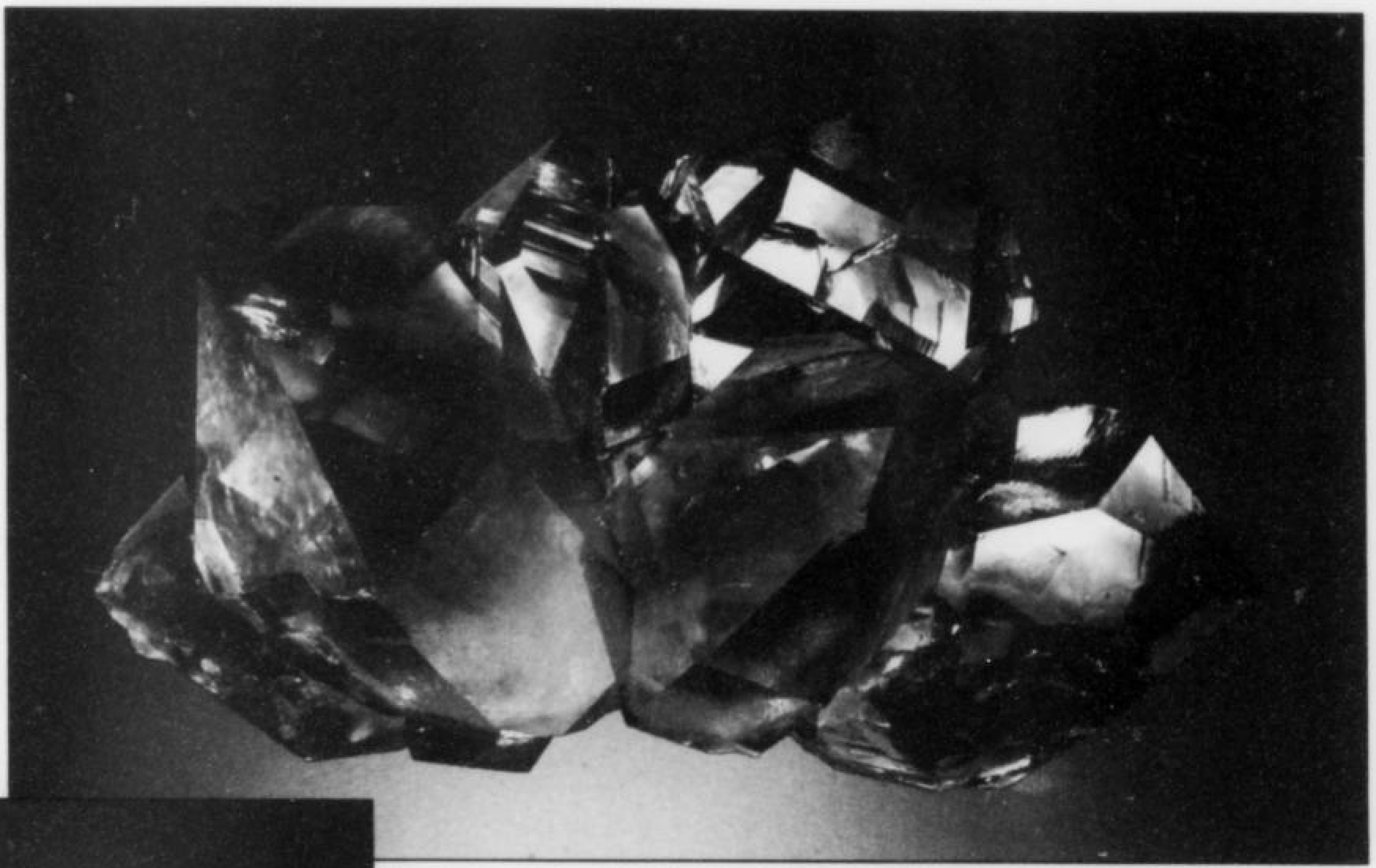


*Figure 5.* Amethystine quartz, 6.3 cm, from Jackson's Crossroads. Terry Ledford specimen; Jeff Scovil photo.

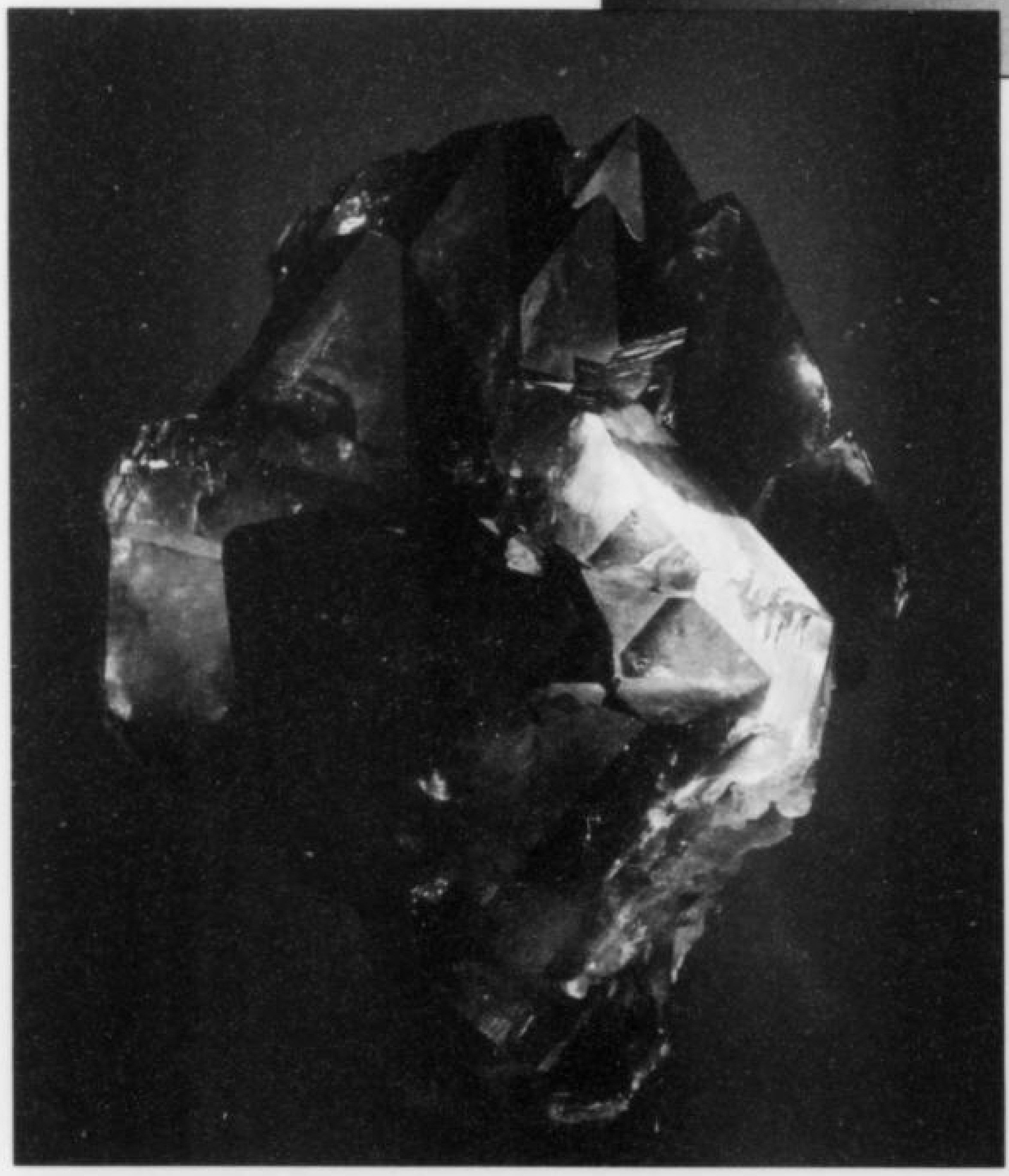


*Figure 6.* Amethystine quartz, 15 cm, from Jackson's Crossroads. Terry Ledford specimen; Jeff Scovil photo.

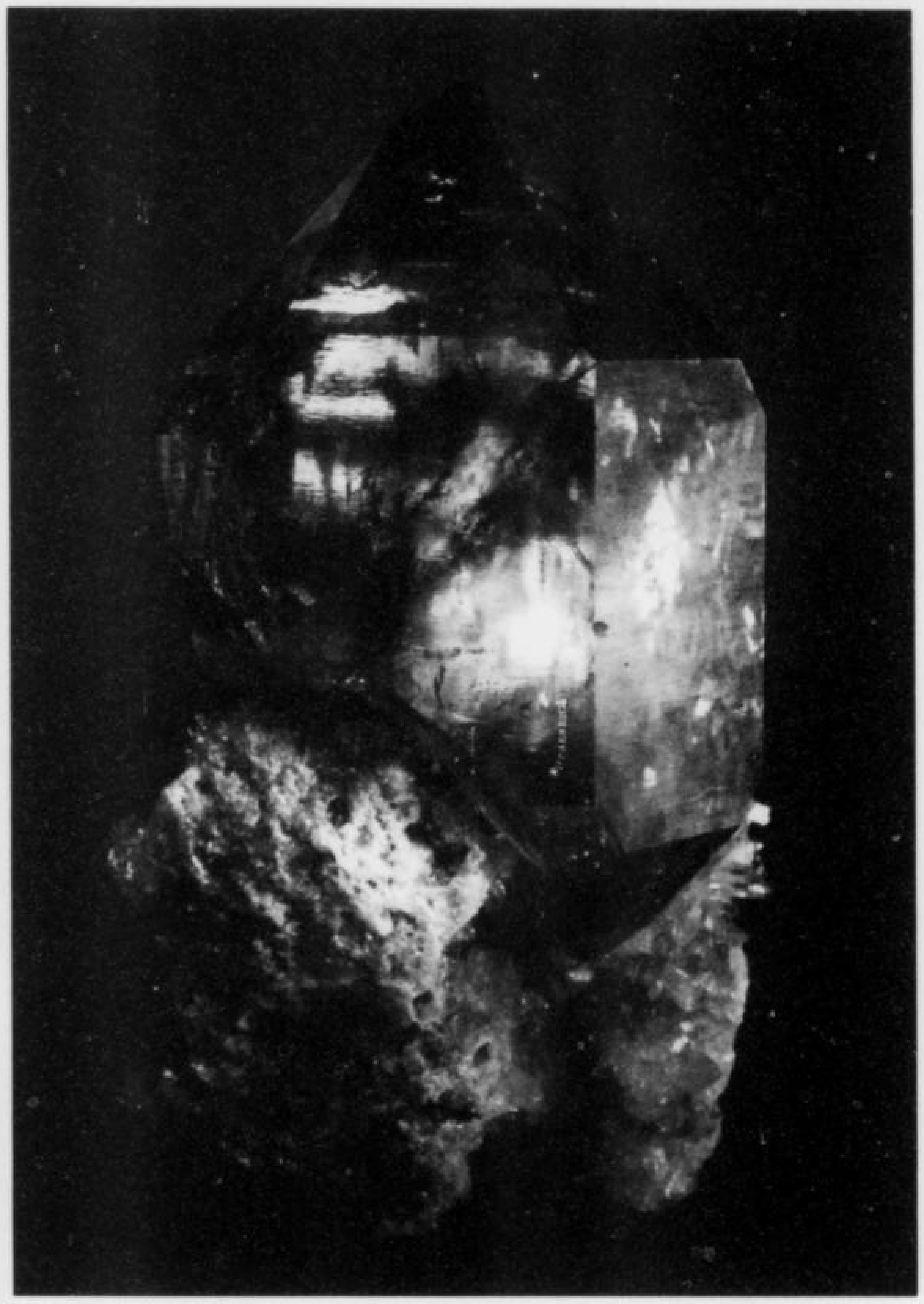


*Figure 7.* Amethystine quartz, 6.3 cm, from Jackson's Crossroads. Terry Ledford specimen; Jeff Scovil photo.

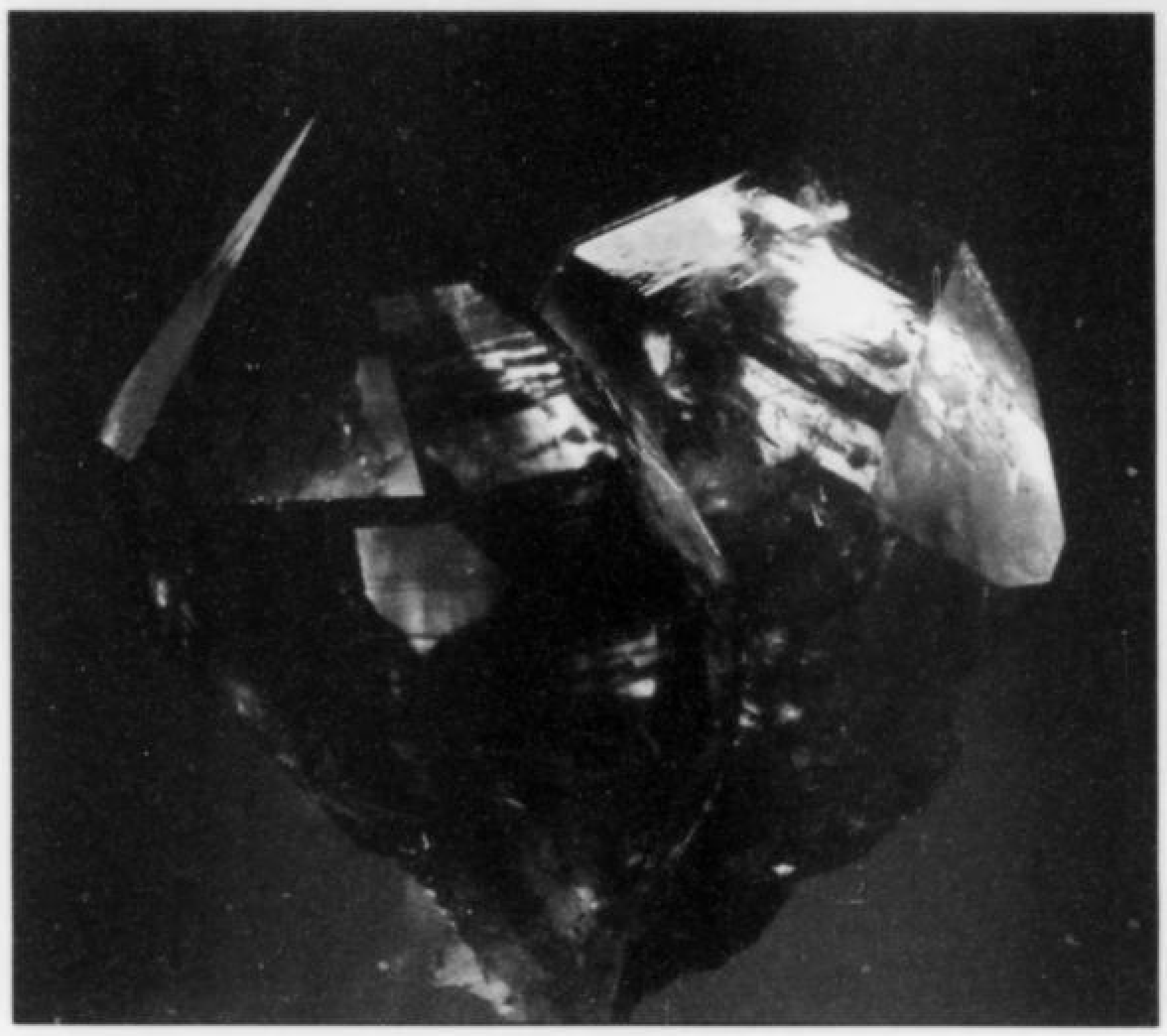


*Figure 8.* Amethystine quartz, 5.9 cm, from Jackson's Crossroads. Terry Ledford specimen; Jeff Scovil photo.

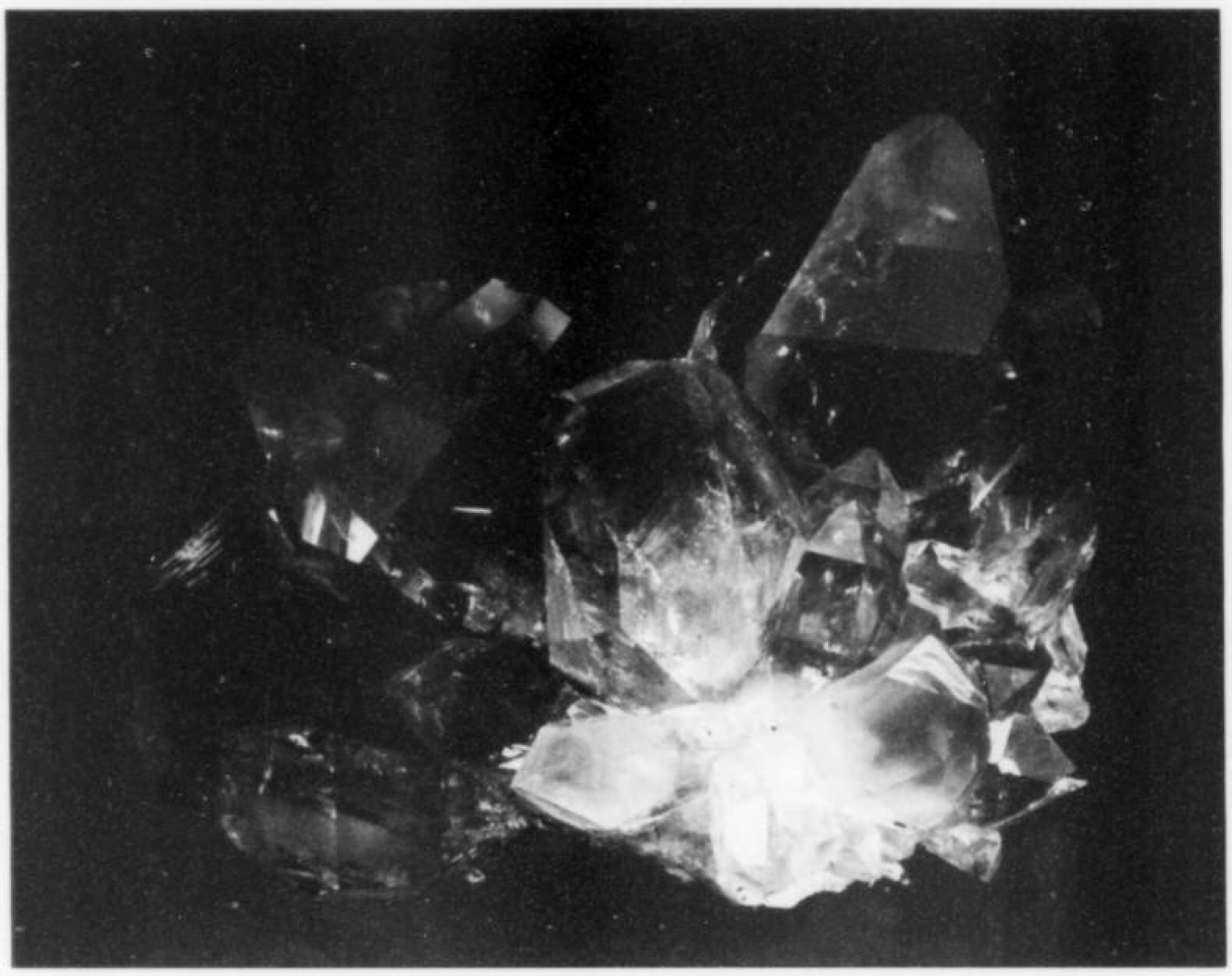


*Figure 9.* **Amethystine quartz, 6 cm, from Jackson's Crossroads. Terry Ledford specimen; Jeff Scovil photo.**

*Figure 10.* **Amethystine quartz thumbnail specimen, 2.5 cm, from Jackson's Crossroads. Wendell Wilson collection and photo.**

Offshoot pockets reach a maximum length of about 4 feet, and have generally been emplaced along vertical or horizontal fractures in the country rock. The amethyst crystals found in offshoot pockets are generally much smaller in size than those from the tube pockets.

The third category of pocket types are the isolated pockets within very hard, unaltered host rock. These pockets are small, generally between to 2 and 16 inches across.

Coloration and quality of amethyst in the various pockets vary widely. Fine purple color can be found in pockets from 2 inches to 20 feet in size. The Jackson's Crossroads deposit is generally lacking in smoky quartz, suggesting that there was not much aluminum present in the depositing solutions. The amethyst,

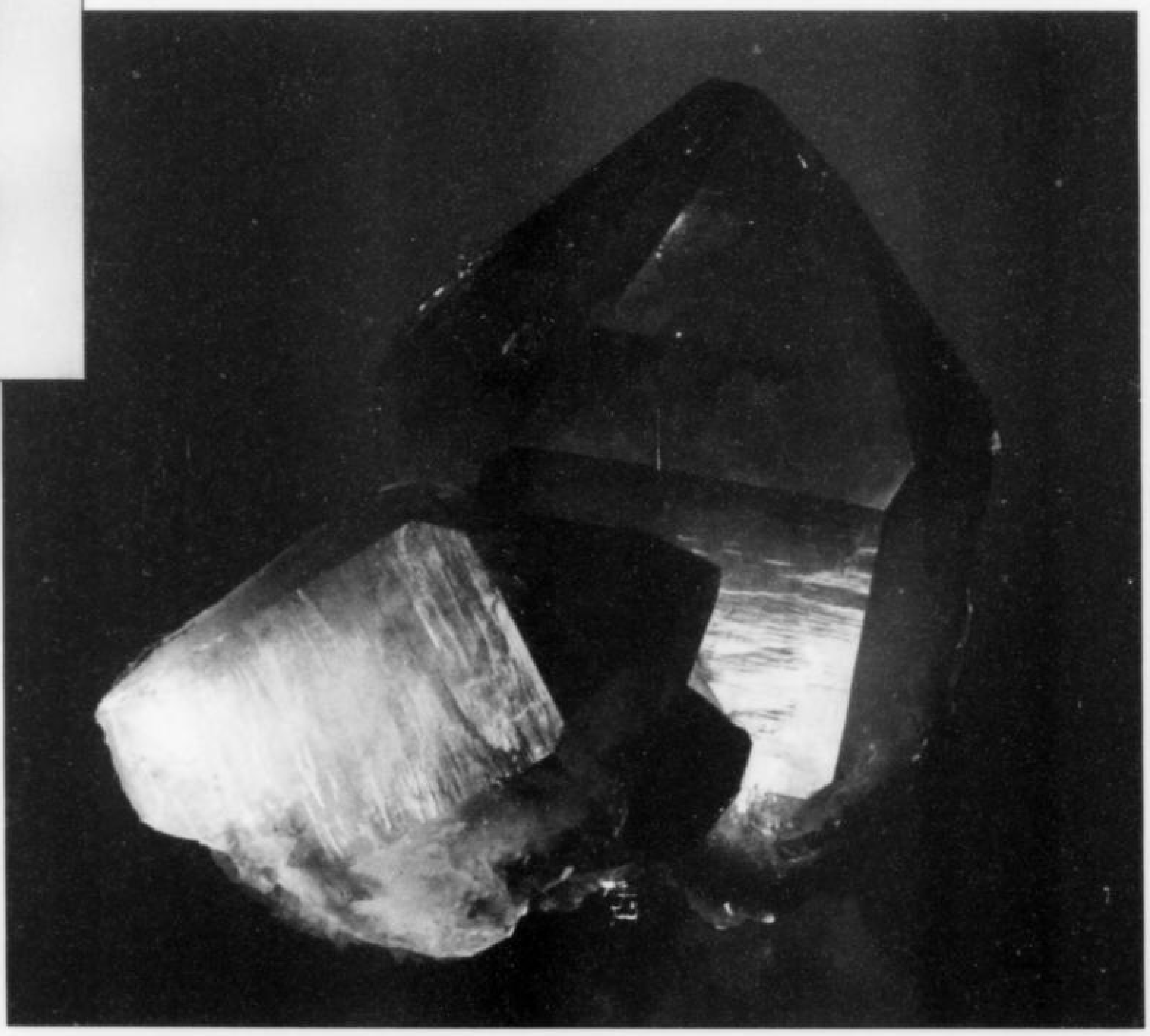


*Figure 11.* **Amethystine quartz, 9.3 cm, from Jackson's Crossroads. Terry Ledford specimen; Jeff Scovil photo.**

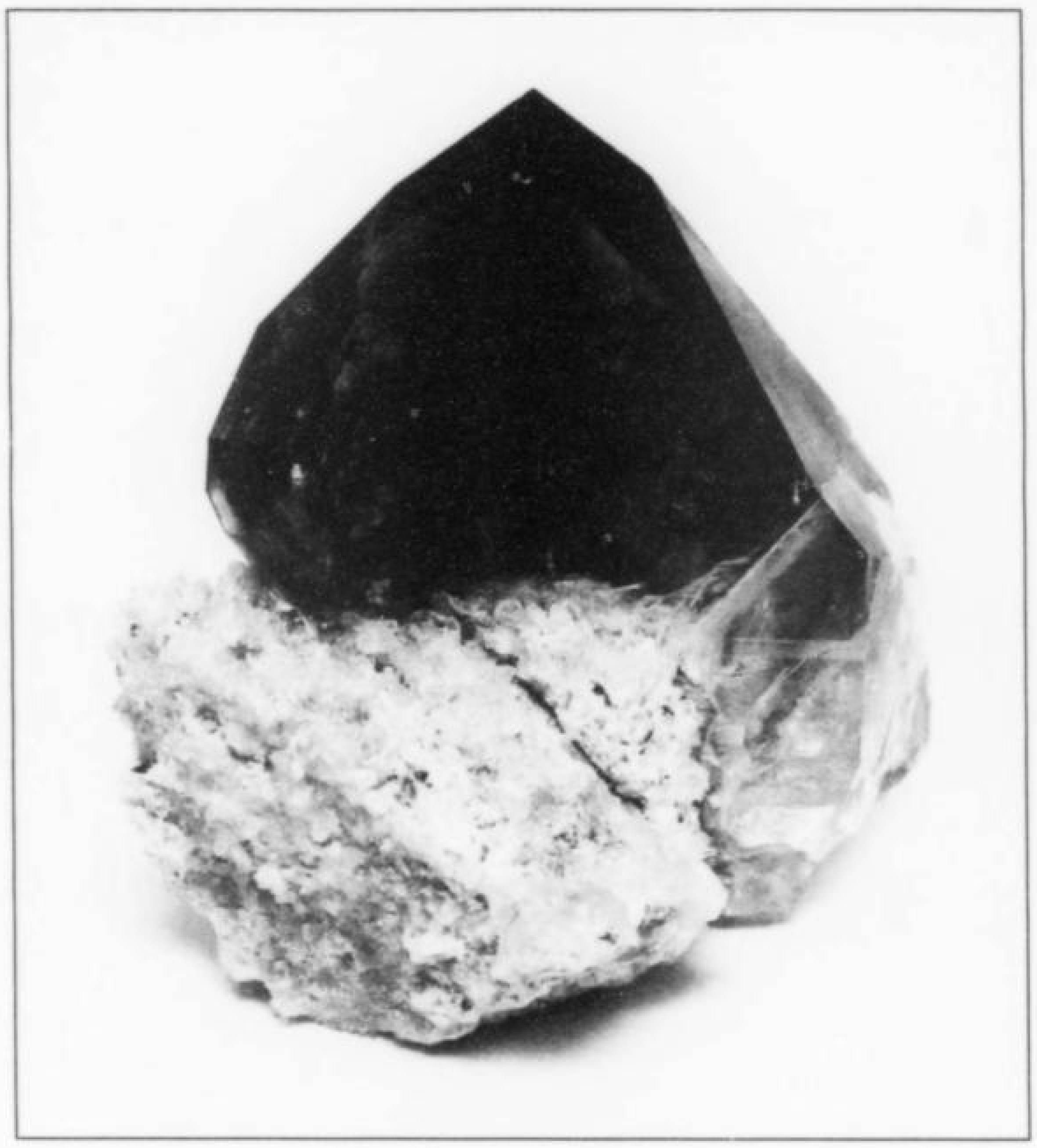


*Figure 12.* **Amethystine quartz, 5 cm, from Jackson's Crossroads. Paul Geffner specimen; Lisa Bennett photo.**

however, is a vibrant and very true purple, indicating an ample supply of iron ions in solution at the time of crystallization.

## QUARTZ

Quartz ($SiO_2$) is the principal mineral of interest at Jackson's Crossroads. Crystals from colorless to rich royal purple have been recovered. Most crystals are found within a pure, almost porcelaneous clay which has protected the crystals from the decomposing rock that surrounds them.

Colorless transparent quartz was the first to be deposited, and is of least interest to the collector. These crystals reach a maximum size of around 4 cm in length and 1 cm in diameter. Individually they are not very distinctive, but they do form some very pretty starburst-like groupings. The colorless quartz crystal druses also provide an attractive contrasting background to the deep purple amethyst crystals on matrix.

Exquisite, highly lustrous, royal purple amethyst is what makes Jackson's Crossroads a world-class locality. Amethyst occurs there in a wide range of colors, from pale violet to a rich royal purple. Single amethyst crystals can reach 20 cm in diameter, and crystal clusters reach 30 cm. The Jackson's Crossroads amethyst crystals are not elongated (as are the typical quartz crystals from other localities), but rather are stubby and equant, with similar length and width measurements. The larger crystals commonly occur in groups of two to six, whereas smaller crystals tend to cluster in groups of six to 20. Rarely, the amethystine crystal groups occur perched on first-generation colorless quartz to form beautiful matrix specimens.

The best amethyst crystals are gem-clear from top to bottom, a deep royal purple in color, and exhibit a mirror-like luster. Some crystals have mottled crystal faces, and occur in doubly terminated parallel-growth crystal groupings. Rare crystals contain growth inclusions of clay and fluids.

Jackson's Crossroads amethyst is remarkable in that most specimens can be cleaned very easily. After the crystals have been soaked in soapy water for a short while, the clay hydrates in the water, and then comes right off with a brush and a water gun, to reveal a very beautiful purple "Wilkes County Jewel."

For the gem collector, Jackson Crossroads amethyst can be faceted into outstanding gems of dark royal purple color with intense saturation, and a unique feature. The best gems display a pleochroic effect which the miners call "blue flash." When a faceted amethyst is viewed in one direction it displays a rich purple color, whereas from another direction an electric blue-purple color emerges.

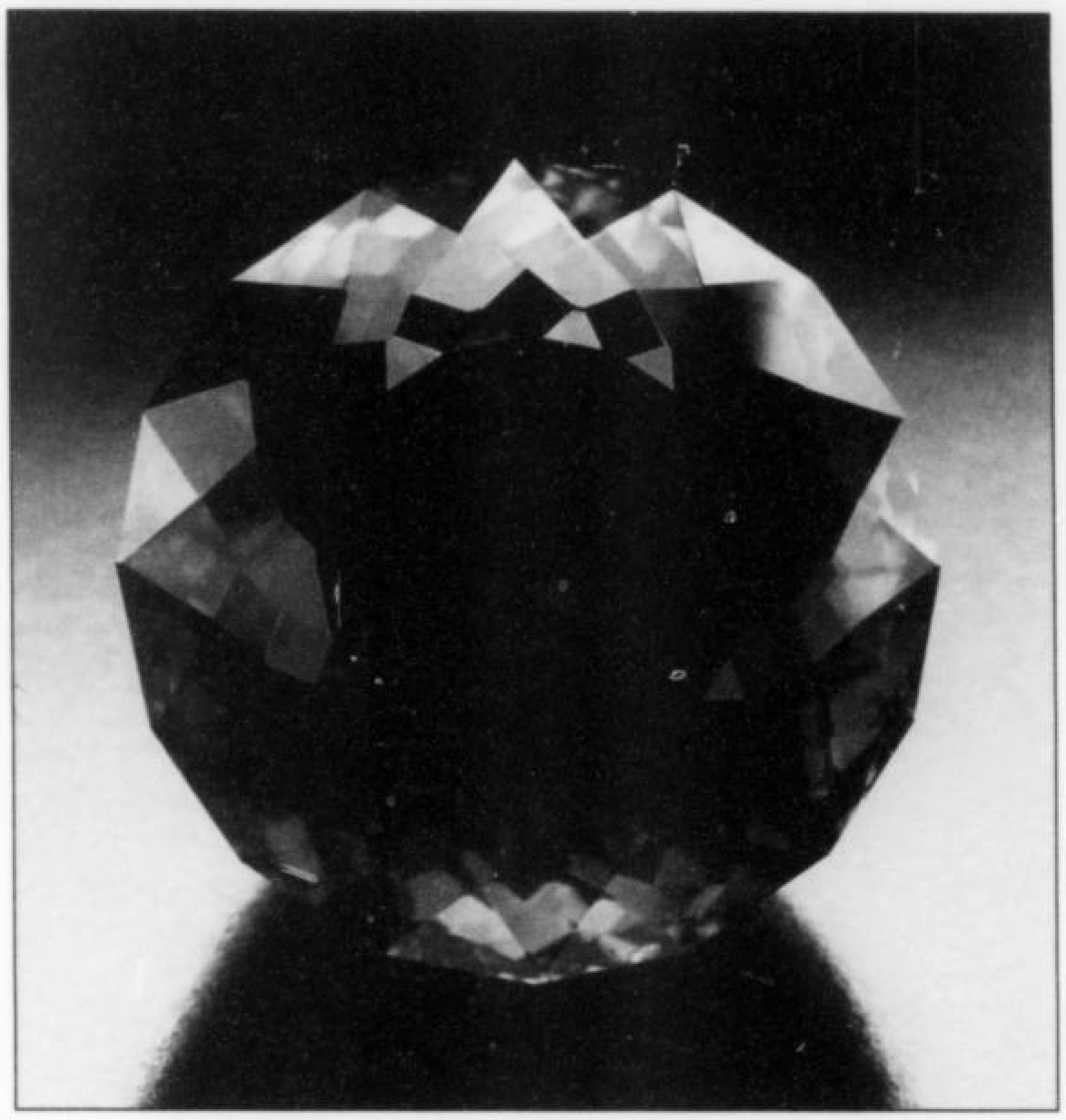


*Figure 13.* **Amethystine quartz, 48.35 ct., Portuguese round cut, from Jackson's Crossroads. Terry Ledford specimen; Jeff Scovil photo.**

## CONCLUSIONS

The Jackson's Crossroads amethyst deposit will no doubt yield more amethyst in the future, but whether crystals showing the deep rich color will continue to be found remains to be seen. There is currently active mining, and the plan is for the partnership to continue to mine for some time, but every deposit has its end. The overburden of the area keeps that day a mystery, but for right now it is nice to enjoy one of the unique beauties that nature has to present to us.

This deposit is on private land (see their website at www.dixieeuhedrals.net). Visitors are welcome, and collecting is allowed on a fee basis. Permission must first be obtained from the property owner (contact author Rodney Moore for more information, at the address given above).


## ACKNOWLEDGMENT

Our thanks to the editorial staff of the *Mineralogical Record* for their fine and speedy job editing our manuscript and preparing the locality map.


## BIBLIOGRAPHY


BROWN, D. L., and WILSON, W. E. (2001) The Rist and Ellis Tracts. *Mineralogical Record*, **32**, 129–140.

COOK, R. B. (1978) Minerals of Georgia: their properties and occurrences. *Georgia Department of Natural Resources, Bulletin* **92**, 189 p.

COOK, R. B., and WHITE, J. S. (1990) Amethyst occurrences of the eastern United States. *Mineralogical Record*, **21**, 204–205.

FURCRON, A. S., MUNYAN, A. C., PEYTON, G., and SMITH, R. W. (1938) *Mineral Resources of Georgia*, Atlanta, Georgia, Geological Survey, p. 5–7, 52–53.

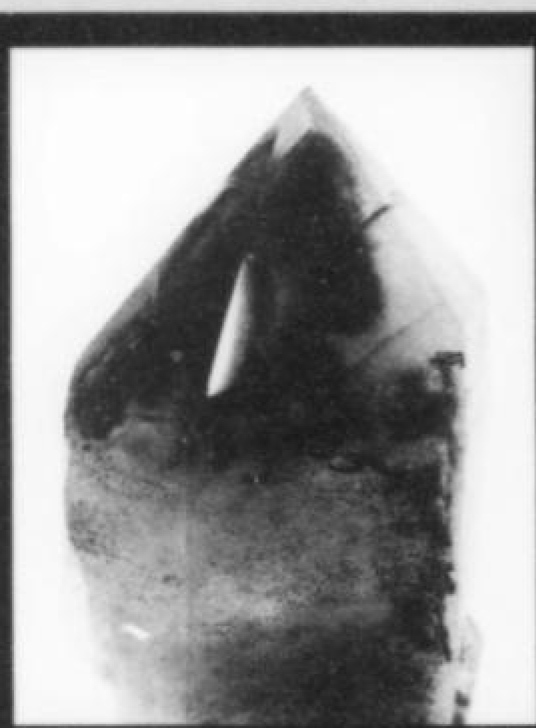
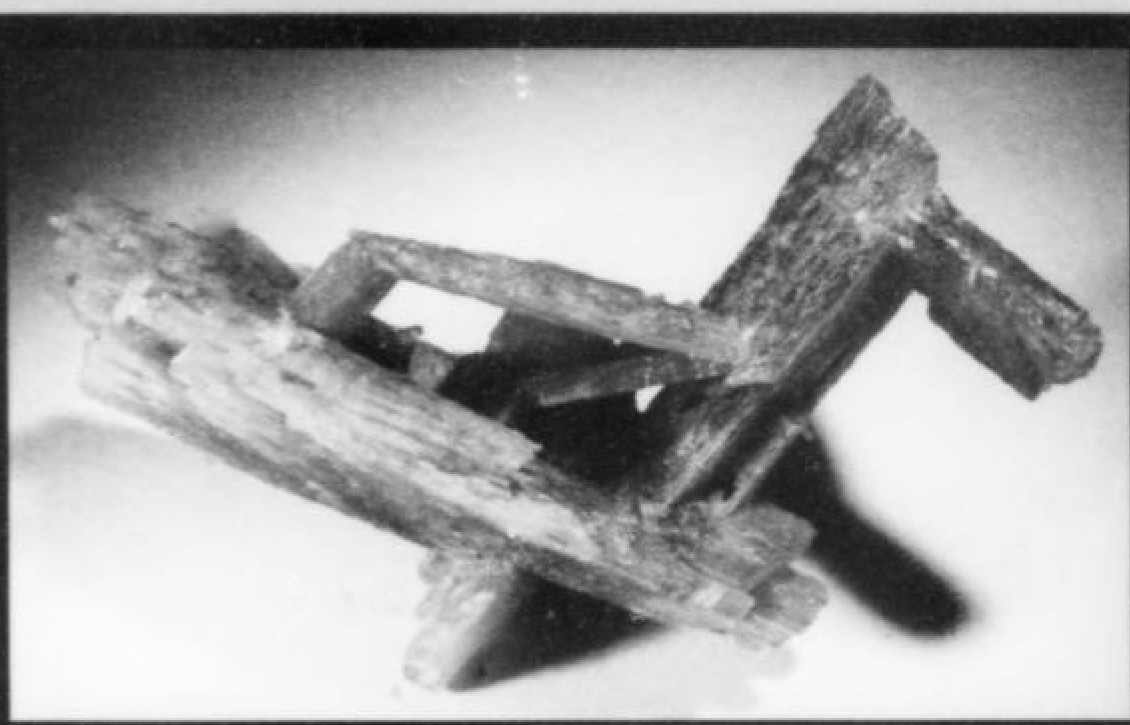
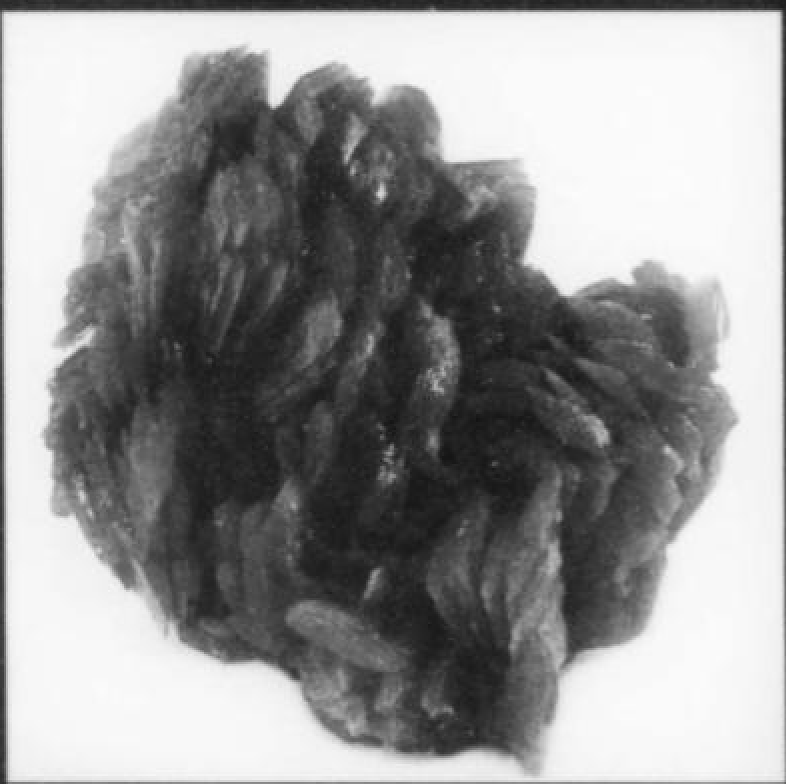
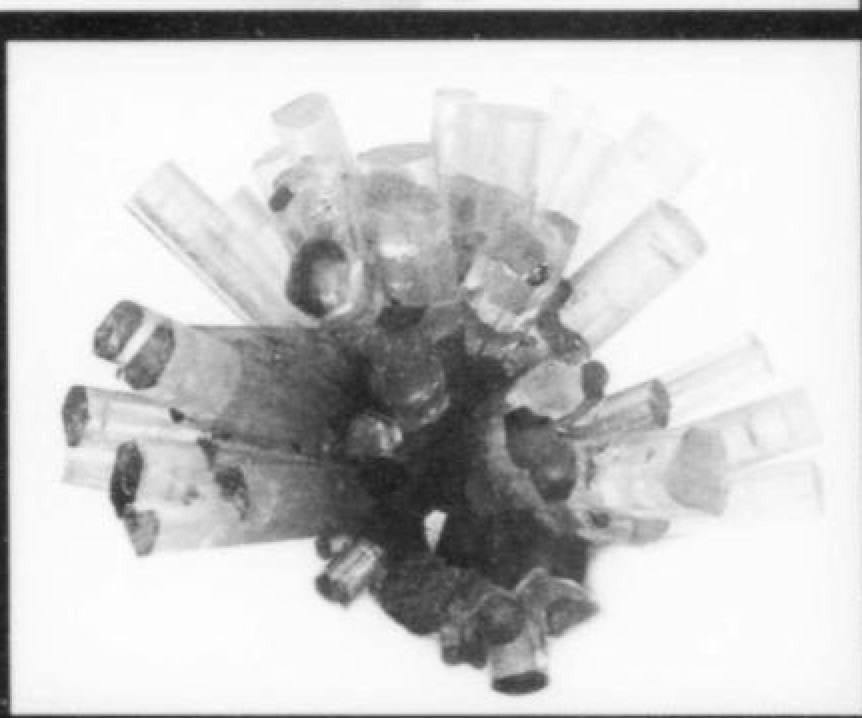
FURCRON, A. S. (1950) *Geological Provinces of Georgia and Their Principal Mineral Resources.* State of Georgia, Department of Mines, Mining and Geology, reprinted from Short Contributions to the Geology, Geography and Archeology of Georgia, *Georgia Geological Survey, Bulletin* **56**.

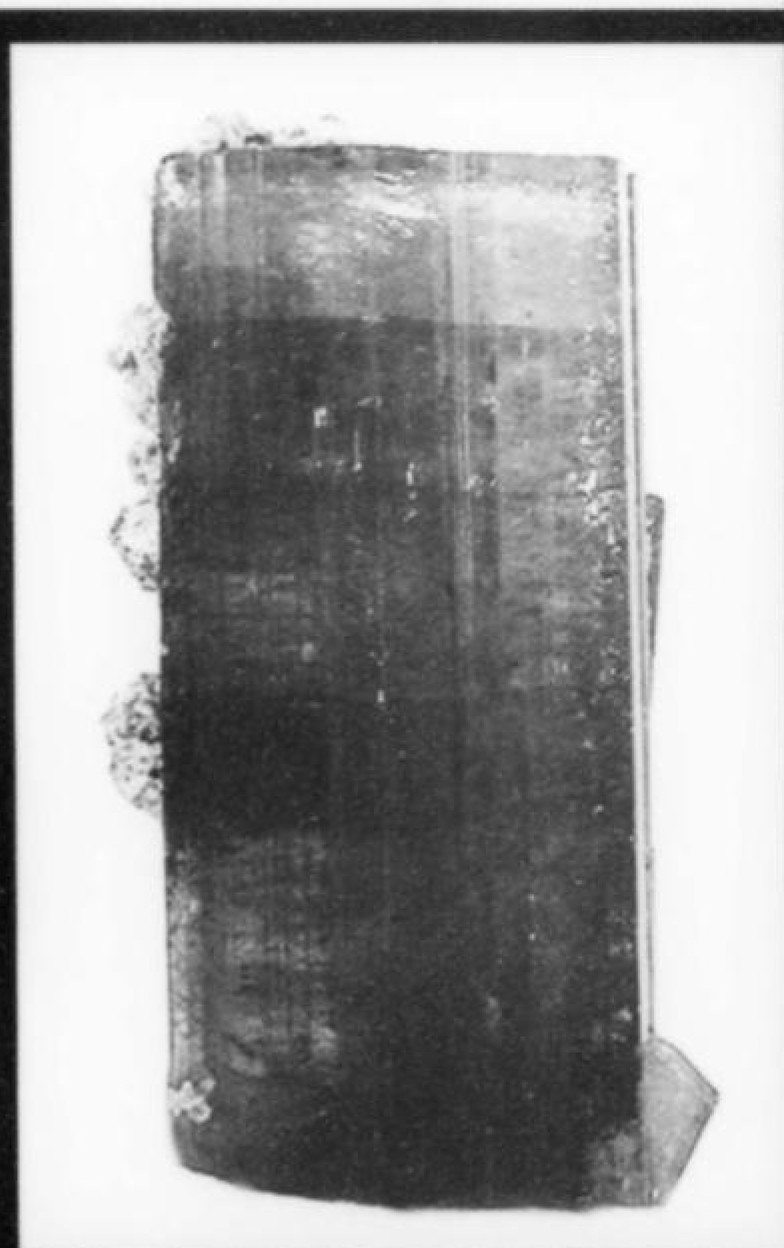
LAWTON, D. E. (1977) *Geologic Map of Georgia.* Georgia Geologic Survey.

MOORE, T. P. (2005) What's new in Minerals. *Mineralogical Record*, **36**, 285–301.

PICKERING, S. M., and MURRAY, J. B. (1976) *Geologic Map of Georgia.* Georgia Geological Survey.

PRESSET, M. R. (1981) Amethyst prospecting in the second Appalachian range. *Lapidary Journal*, **34**, 2528–2544.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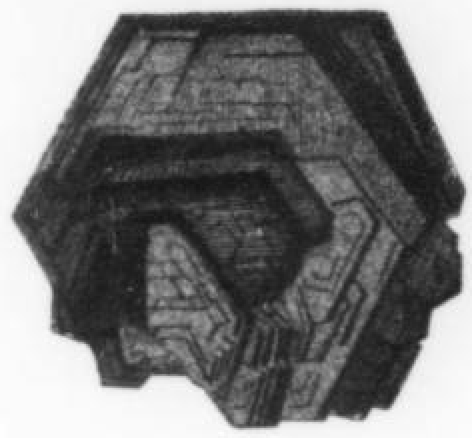

# Alpine "Iron Roses"

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*Brilliant black hematite and rarely ilmenite occur in some Alpine-type clefts as flower-like subparallel aggregates of offset crystals, aptly called "iron roses," which in turn are classifiable into a few types on the basis of morphology. Most of the classic localities lie in Switzerland, where tireless Strahlers continue to seek new iron rose clefts, though finding them is becoming more difficult. The following survey of major localities in Switzerland and elsewhere includes a Strahler's account of his spectacular iron rose discovery near Fibbia in 1979.*

## INTRODUCTION

When it comes to the common iron-oxide species hematite, collectors everywhere seem to reserve their highest respect for the crystal-aggregate habit known as the "iron rose" (German: *Eisenrose*), the finest examples of which come from Alpine-cleft occurrences, most of them in Switzerland. Like specimens of pink octahedral fluorite and Japan law-twinned quartz, iron rose hematite specimens have always been prized (and priced) as the ultra-elite representatives of their species, and this high valuation is made consistently throughout the mineral collecting world.

Most collectors (even in Europe) who number hematite iron roses among their favorites tend to be rather vague about just where the best examples come from, and their specimens' labels are often unhelpful. The problem is that iron roses do not come from single great mines which are easily named and pinpointed on maps, but from dozens (if not hundreds) of isolated clefts which *Strahlers* have always discovered as lucky strikes, one cleft at a time, one small handful of specimens at a time. Moreover, maps of Switzerland on any scale show us a buzzing complexity of names, and historical variations of names, and names in more than one language from map to map, of villages, mountains and mountain systems, valleys, stream drainages, glaciers, glacial moraine fields and informally named collecting sites. The number of tiny occurrences in this geographical wilderness which have yielded mineral specimens must be in the thousands. Compounding the confusion, there are major Swiss hematite specimens showing habits *other* than the iron-rose habit, and there are Swiss iron rose specimens, not of hematite, but of ilmenite, these being more or less indistinguishable by eye from the hematites.

If, for collecting purposes, it is a bit of a bother that these beautiful specimens do not come in huge numbers from large, single, easily identifiable mineral deposits, the cheering corollary is that, while famous localities like Freiberg, Franklin, Tsumeb and Ojuela may close and specimen production from them may utterly cease, Swiss iron roses will *never* entirely cease to be found: the market will always, sparingly and at random intervals, receive fresh discoveries. In the bazaar, we have only to know what to look for, and how to look.

## THE IRON ROSE AGGREGATE HABIT

Hematite forms many kinds of attractive specimens: great clusters of brilliant black, blocky or platy crystals (Brazil, South Africa); sharp crystals in groups with flashing iridescent colors (the Isle of Elba); delicate bonsai-tree-like groups of flattened, cavernous crystals formed by sublimation from volcanic gases (Morocco, Sicily, the Eifel region of Germany); botryoidal "kidney ore" masses (England, Michigan, Wisconsin) . . . and many more.

***Figure 1. (top)*** **A hematite "iron rose" illustrated in Kurr (1859).**

Thin-tabular, platy hematite crystals are common at many localities; these crystals generally have large, wide {0001} faces rimmed by positive and negative rhombohedrons {10$\bar{1}$0} and {01$\bar{1}$1}, in some cases also by first-order and second-order prisms {10$\bar{1}$0} and {11$\bar{2}$0} and/or dipyramids {11$\bar{2}$3}—the little "rims" outboard from the basal expanses, when wide enough to show faces at all, are commonly quite complex. Some of the finest specimens of this type, with the platy hematite crystals attached in many cases to sharp, rhombohedral magnesite crystals, come from Brumado, Bahia, Brazil.

Switzerland's best-known locality for hematite produces single platy crystals and crystal aggregates, but *does not* produce iron roses: this is Cavradischlucht, the lowermost part of Val Curnera, Tujetsch (formerly Val Tavetsch), on the western edge of Canton Graubünden. Here, clefts exposed in the steep gneissic walls of the gorge have been producing dramatic hematite specimens, with individual crystals to 10 cm across, for at least two centuries (Jahn, 2003). Typically these hematite crystals are platy, jet-black, and brilliantly lustrous, and perch singly and in parallel-growth aggregates on gneiss matrix and on the faces of large quartz crystals, with snow-white albite crystals. A distinguishing feature of hematite from Cavradischlucht is the lustrous, red-brown, acicular or bladed crystals of rutile that are often seen in epitactic overgrowth on the wide, flat hematite crystal faces; in some cases the rutile crystals almost wholly cover the hematite faces, and in other cases they rise from them in ridgelike formations or as small vertical sprays (Graeser, 1998; Jahn, 2003).

But, to repeat, hematite of the iron rose aggregate habit has not been found at Cavradischlucht. For reasons that remain a mystery, hematite at this locality does not crystallize in the distinctive rounded rosettes of offset crystals for which we reserve the term "iron rose." The growth of a true iron rose (or "rosette") begins with a single crystal from which others diverge outward, overlapping each other like the petals of a rose. At it grows, each crystal thickens slightly toward the outer margin, so that the end-product rose is considerably thicker at its edges than at its center, i.e. the rose is concave (Sinkankas, 1966). When the concavity is minimal, such that the viewer looking "in" still sees a fairly wide central expanse, the rose is said to be "open," but there exists a continuum between these "open" roses and almost completely "closed" ones, which are spherical forms showing only a small pit-like channel into the center.

Another way of classifying iron roses is to distinguish between those in which the individual crystals are fairly thick plates and those in which they are small and leafy. In the latter case the "exfoliated" (the commonly used German term is *aufgeblätterte*) rose appears feathery, and typically lacks the metallic brilliance of roses with larger and thicker crystals. Stalder *et al.* (1998) proposed that the metaphorical term "iron rose" applies best of all to the open formations of this sort. The smoothly curved *aufgeblätterte* roses are commonly grouped on matrix, either partially or tightly intergrown—making sparkling nests of little spheres (if closed) or Mickey Mouse ears (if open). However, much the more desirable specimens—it is communally felt—are those in which lustrous open roses composed of thicker crystals perch singly on snow-white feldspar matrix or on the faces of quartz prisms, perhaps with sparkling druses of orthoclase, albite, or other, rarer, Alpine-cleft species. Such roses very rarely exceed 5 cm across. The highest drama is reserved for the extremely rare large-miniature or small-cabinet specimens in which thick, flaring, lustrous roses themselves congregate in subparallel clusters—see the photo shown here (Fig. 21) of the 9-cm group collected, as will be recounted, by Bruno Schaub-Gottschalk in 1979.

The old, vexing problem of distinguishing Swiss hematite from Swiss *ilmenite* iron roses still poses difficulties. The problem is not so simple, as there seems to be no general morphological difference, or difference in the range of difference, between the two sorts of roses. Moreover, Swiss hematite is fairly high in titanium—ranging to 5% (Stalder *et al.*, 1998)—and, presumably because of this, it leaves a black streak, just as ilmenite does (so much for beginners' mineralogy texts which promise that hematite always leaves a red streak). While Swiss ilmenite is weakly magnetic and hematite is not, and while it may be possible to distinguish the forms of (scalenohedral) hematite from those of (rhombohedral) ilmenite in specimens with thicker crystals, the best distinguishing factor when associated species are present may be that the typical paragenesis of ilmenite clefts differs from that of hematite clefts; for example, brookite is found with ilmenite but not with hematite.

Some broad *tendencies* of difference may be, or at least seem, perceptible to the experienced eye: Bob Sullivan once remarked in his "Letter From Europe" column that ilmenite tends to be "a shiny black" while hematite "is more of a silvery dark gray color," and that hematite roses tend to be "tighter" than ilmenite roses. But confusion does not abate: in the same column Sullivan reports having seen (in the late 1970's) marketed specimens labeled as ilmenite roses from Piz Lucendro, and this locality is unequivocally reserved for hematite in Parker's exhaustive survey (1973) of Alpine occurrences. We seem to be stuck with the fact that chemical, X-ray or Raman spectroscopy analysis is required to distinguish with certainty between the two.

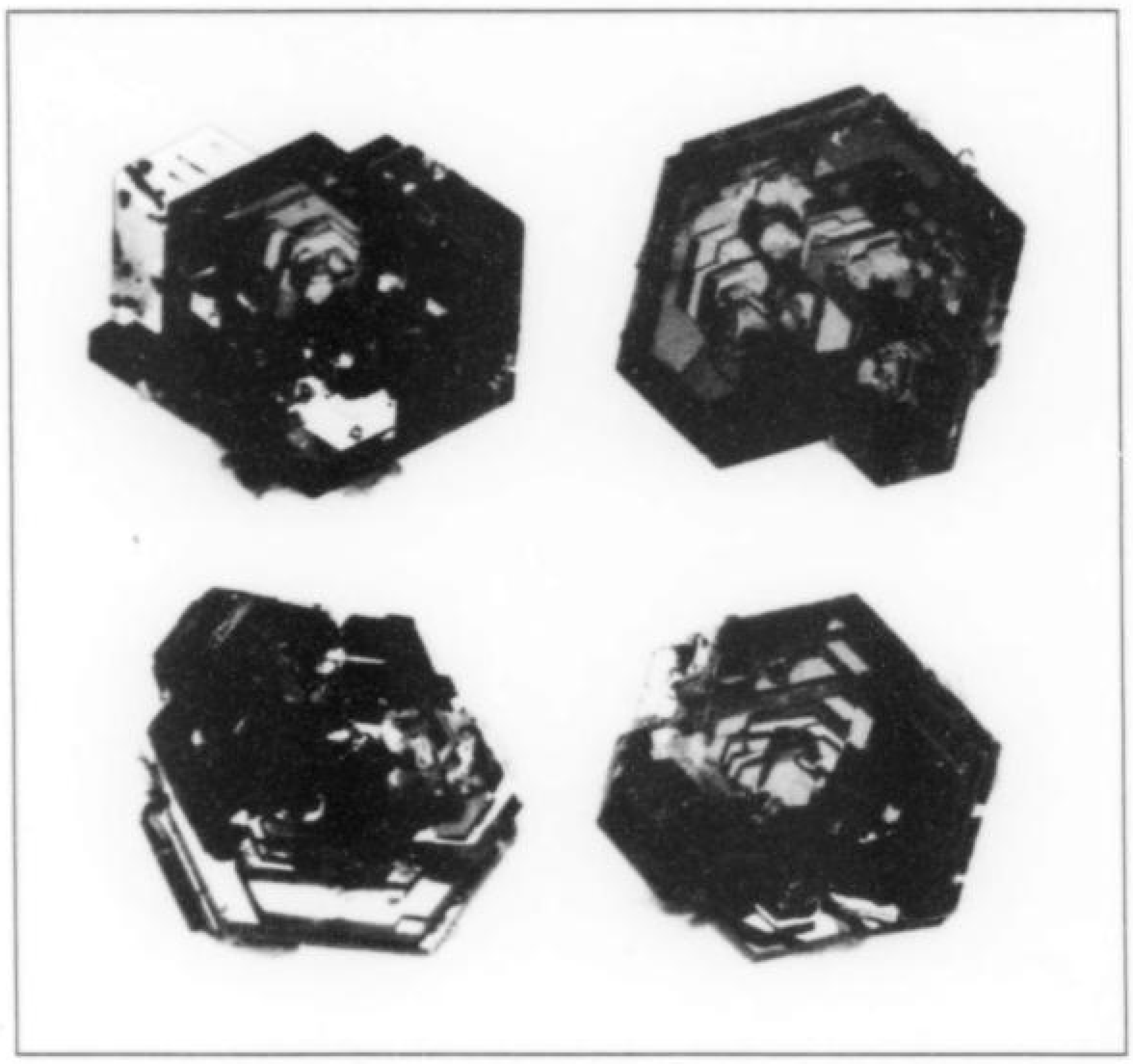


***Figure 2.* Hematite "iron roses" to 1.4 cm from near Quartzsite, Arizona. Bob Sullivan collection; Wendell Wilson photo (1980).**

## LOCALITIES

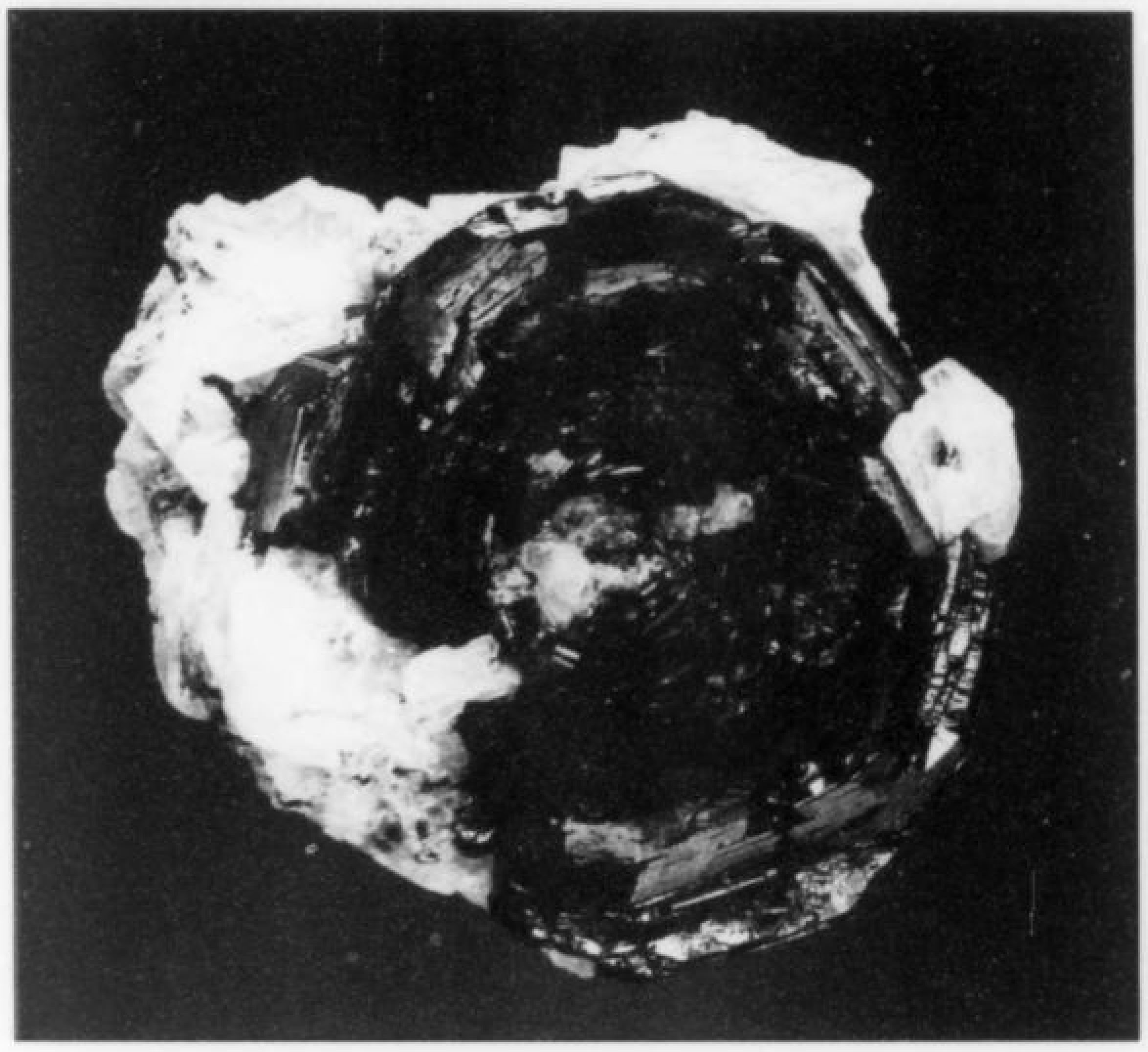
### Iron Roses Worldwide

Generalist collectors' experience has been that the term "iron rose" is nearly always preceded by "Swiss"; however, there are a few non-Swiss and non-Alpine cleft-type occurrences of specimens ranging in quality from presentable to very fine.

Exquisite thumbnail specimens (to 2.5 cm across) of perfect hematite iron roses from an unnamed claim near Quartzsite, Yuma County, **Arizona** were collected and marketed in the late 1970's (Sullivan, 1980; Anthony *et al.*, 1995). The little aggregates of thin, offset crystal plates are open, double-sided "floaters." Being true

*Figure 3.* **Partial hematite "iron rose" from the Veta Grande claim in the Dome Rock Mountains, Arizona. Arizona-Sonora Desert Museum collection; Wendell Wilson photo.**

*Figure 4.* **Ilmenite "iron rose," 6 cm, from Pakistan. Private collection; Jeff Scovil photo.**



roses, they are not to be confused with most of the wonderful specimens of isolated platy hematite crystals with quartz from the Veta Grande claim, about 20 miles away (Sprunger, 1980). The latter are probably North America's finest hematite specimens—but they are not usually in the iron rose habit, the specimen shown here (Fig. 3) being a rare exception and only a partial rose at that.

Miarolitic cavities in the granite of the Sawtooth batholith, in central **Idaho**, are best known for the smoky quartz, microcline and topaz crystals found at remote sites. Uncommonly, hematite iron roses reaching sizes to 3 cm also emerge from these cavities (Ream, 1989).

**Brazil** regularly produces attractive, in some cases very large, floater examples of hematite iron roses. Sinkankas (1966) illustrates a 5.6-cm rose from Burnier, Minas Gerais, and mentions Lago de Netto, near the topaz fields near Ouro Preto, as another iron rose locality. Indeed, the region of deeply weathered and kaolinized granitic rocks around Ouro Preto, best known for gemmy orange "Imperial" topaz crystals and for gem-quality euclase crystals, has steadily produced floater iron rose specimens for the collector market; they are generally much thicker and stouter than Swiss iron roses, and they reach an amazing 30 cm across. Cassedanne (1989) gives the Capão mine and the Bora prospect as exceptionally productive sites near Ouro Preto. Sharp, bright roses without matrix are fairly commonplace items among the stocks of many Brazilian dealers who attend mineral shows in the United States today: one especially impressive lot of specimens from Ouro Preto marketed in the mid-1990's contained sharp, lustrous black roses to 12 cm across (Scovil, 1996).

The complex metamorphic rocks of northeastern **Madagascar**, inland from the coastal town of Vohemar, contain Alpine-type vein mineralization whose most notable products are rutile, titanite, epidote, quartz and hematite; the last is occasionally found as large (but dull-lustered) aggregates of platy crystals displaying the classic iron rose habit (Pezzotta, 1999).

Skarn deposits on the Aegean island of Seriphos, **Greece**, are known for their excellent specimens of andradite, ilvaite, amethystine quartz and green (hedenbergite-included) quartz. Fair-quality hematite iron roses reaching 2 cm across occur in the skarns; composed of very thin crystals, they are medium-lustrous and rest on andradite and green quartz (Vogt, 1991).

We might expect hematite roses in the clefts associated with huge quartz veins exploited by the Dodo and Puiva mines in the Polar Urals of **Russia**, since these localities yield some Alpine-type mineral assemblages. No roses, however, have thus far been found in these mines, where hematite itself is a very minor constituent of the mineral assemblage. But, tantalizingly, Kolesar (1997) illustrates a gorgeous 2.6-cm hematite rose reportedly found in 1995 at a place called Pyrtyndyrma, in the Polar Urals.

In **India**, the spilitic basalts near Mumbai (Bombay) are famous for their zeolites, and this is the only region of the Deccan Plateau basalts where certain non-zeolite species, including hematite, occur. Ottens (2003) reports rare finds of small iron roses in the Dahisar quarry; in the mid-1990's a few specimens from this quarry with roses to 2 cm on drusy quartz were marketed (Robinson *et al.*, 1995).

Since the mid-1990's there have been exciting sporadic discoveries in what Europeans (and everyone else) were quick to recognize as "Alpine-type" clefts in amphibolites in the Northern Areas of **Pakistan**, particularly in the Shigar and Tormiq Valleys, Skardu district. Weerth (1997) remarks that when magnificent specimens of epidote, titanite, quartz, fluorapatite, rutile etc. from these new Pakistani localities reached the European market, their prices instantly were inflated beyond "normal" levels, simply because the new specimens so strongly resembled old cherished ones from Europe, especially from the Pinzgau region of the Austrian Alps. Conversely, prices for European old-timers, when occasionally they do come onto the market, are now also inflated, thanks to the increased awareness among collectors. Specimens

Figure 5. Ilmenite "iron rose" rimmed by epitactic rutile crystals, from Pakistan. Mark Mauthner collection; Jeff Scovil photo.

## Iron Roses of the Alps

Hematite is found, both as iron roses and other habits, in approximately half of the 30 distinct parageneses in Switzerland's Alpine clefts that have been classified in detail by Parker (1973), but the finest and most abundant iron roses are found in only one of these parageneses (to be described later). The typical host rocks are granites and granodiorites such as constitute both the Aar massif and the Gotthard massif directly south (see map in Graeser, 1998), in the mountainous region of south-central Switzerland which has always been prolific of mineral specimens of all kinds. Classic iron-rose collecting sites cluster most densely in an area on the northern edge of the Gotthard massif bounded roughly by the St. Gotthard Pass to the north, Mt. Prosa to the northeast, Mt. Fieund to the south and Piz Lucendro to the southwest, with the peak called Fibbia more or less in the center. This core region is the most important, but outside it, in Switzerland along the Swiss-Italian border and in parts of southern Austria, there is a noble roster of other Alpine iron rose localities. In fact, countless other small sites throughout central Europe have occasionally given up good specimens of iron roses (e.g. the small specimen from Alsace, France, pictured here); the list of European localities below is nothing like "complete," nor could any such list be so, given the myriad number of cleft occurrences.

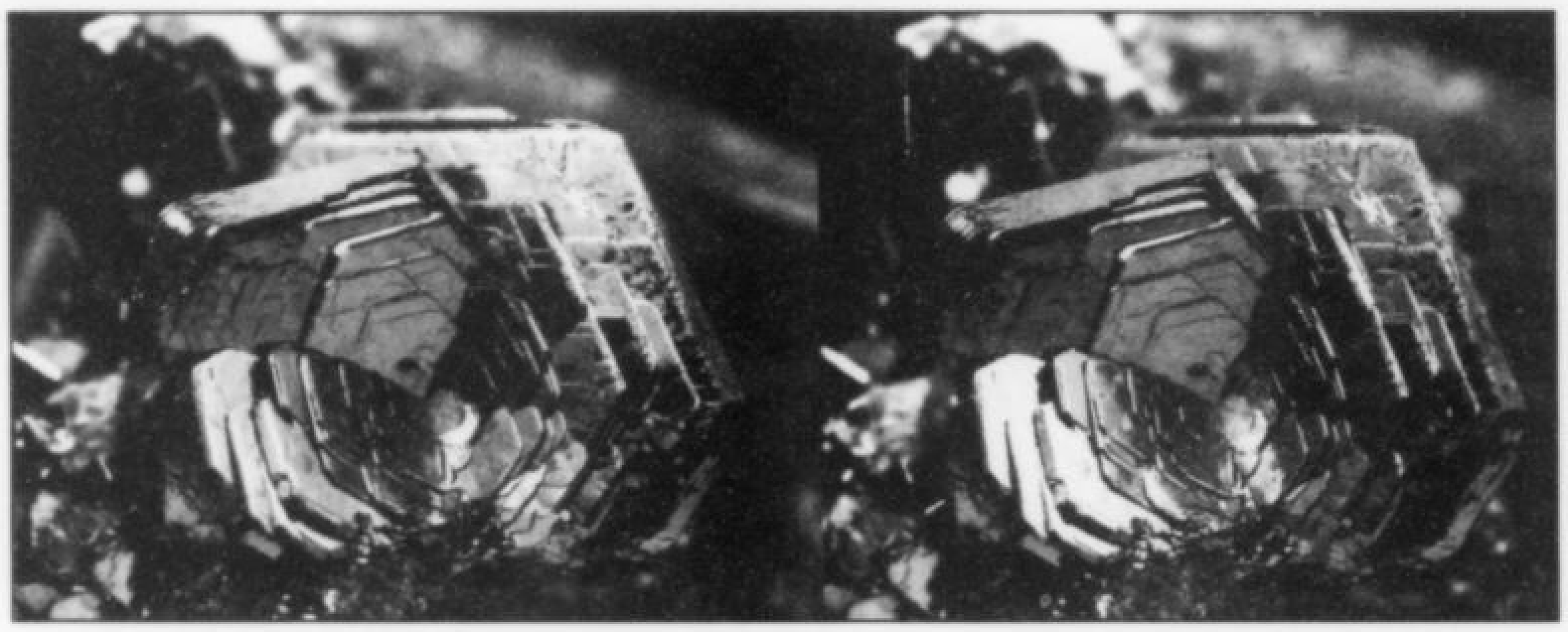


Figure 6. Hematite "iron rose" (stereopair), 1 cm, from Rimbach, Alsace, France. Eric Offermann collection and photo.

showing crisp, open, double-sided hematite roses to 3 cm perching on feldspar matrix, looking very much like the famous specimens from the St. Gotthard region, emerged from at least two sites in the upper Tormiq Valley of Pakistan during the mid-1990's (Weerth, 1997). At about the same time Dudley Blauwet obtained the first beautiful *ilmenite* rose specimens from Tormiq, with sharp, brilliant roses to 2 cm on white feldspar (Robinson *et al.*, 1992)—a color photo of a lovely matrix specimen with about ten partly intergrown ilmenite roses appears in Hammer and Weerth (2004).

Among the great market influx of mineral specimens from **China** during the last decade of the 20th century there have been rather liberal supplies of beautiful specimens, to cabinet size, consisting of clusters of hematite-included quartz crystals decorated by nests and garlands of intergrown hematite iron roses around their bases, where the quartz prisms meet the massive hematite of the matrix. The transparent quartz crystals are colored pale to rusty red by finely divided included hematite; the iron roses, averaging 1 to 3 cm across, are closed, leafy, spherical and not particularly lustrous. As is commonly the case for newly imported Chinese specimens, the locality has been a puzzle: one dealer reported that it lies somewhere in Jiangxi Province (Moore, 2000) but, three years later, another reported that there are two localities producing closely similar specimens, one in Sichuan and one in Guangdong (Moore, 2003). According to Ottens (2004), at least some of the quartz/iron rose specimens come from small hematite mines near the village of Jinlong, not far from the larger town of Shangping, Guangdong Province.

The **Zillertal Alps of Austria**, a westward extension of the Hohe Tauern range, lie just north of the Austrian-Italian border, about 250 kilometers east of St. Gotthard. Immediately to the south of the mountains, in Italy, the little valley called Ahrntal (German) or Valle Aurina (Italian) strikes southwest from the Grossvenediger and Dreiherrnspitze peaks. This famous collecting area is about 15 km due west of the town of Prägraten, in the Austrian state of Ost Tirol (East Tyrol). Iron roses have emerged for many decades from collecting sites high in the Zillertal Alps and lower down, in the Ahrntal. Gramaccioli (1975) mentions beautiful specimens from *Schlegeisstollen, Zillertal Alps/Tirol* and from the *Dorferalpe*, *Froßnitzalpe*, and other places near Prägraten/Osttirol. Niedermayr (1986) cites iron roses reaching 15 cm from *Saurüssel* in the Zillertal Alps. In the autumn of 1990, a site near *Mörchnerkar*, Zillertal Alps, produced a handful of very sharp, lustrous iron roses to more than 2 cm across (Bode, 1991). Clefts exposed along the tiny stream drainage called *Röttal, east of Kasern* in the Ahrntal, produce iron roses to 3 cm with oriented overgrowths of rutile, associated with yellow titanite crystals (Fettel, 1986).

Another international-border area known for coming up roses has at its southwesternmost point the **Ritter Pass**, cresting the Helsenhorn between the Swiss canton of Wallis (French: Valais) and the Italian province of Piedmont. Crystalline gneisses here are continuous with those of the Swiss Binntal to the north and, like them, have produced very fine hematite roses, mostly in decades long past, although a few brilliant, presumably freshly collected thumbnail specimens from the Ritter Pass were marketed in Europe in 1978 (Sullivan, 1979). The Ritter Pass area enjoys the

*Figure 7.* **The Tälli glacier area in the Binn Valley, Canton Wallis, Switzerland, where "iron roses" are found. Ofenhorn Mountain is visible in the distance. Thomas Schüpbach photo.**

distinction of having produced the largest single hematite iron rose ever found in the Swiss/Italian Alps—10 cm across the face. The specimen was collected at the beginning of the 20th century by the *Strahler* Anton Imhof, and belongs now to the University of Bern (Parker, 1973; Gramaccioli, 1975); it was found on the Italian side of the pass (Weibel, 1966). Other clefts in the mountains along the international border as it runs roughly northeast from the pass have produced good iron roses to 4 cm; locality citations include *Chummibort*, *Wannigletscher*, *Chriegalptal* and *Schinhörn* (Stalder *et al.*, 1998).

Fly about 8 km due north from the Ritter Pass and you are in (or over) the little east-west-striking stream valley called the **Binntal** (Binnental, Binnatal), Wallis, Switzerland. This wonderfully scenic valley (see the pictures in Bancroft, 1984) is beloved of mineral collectors because it contains the famous Lengenbach marble quarry, with its suite of rare sulfosalts. The area is also mineralogically famous because, during the late 19th century, superb brown anatase crystals and razor-edged magnetite octahedrons were collected in some quantity from gneiss clefts of the so-called *Lercheltini zone*, exposed at many sites in the valley. Hematite occurs in the Binntal as sharp, in some cases iridescent, iron roses (Graeser, 1995a), as well as in other habits: odd-looking pseudomorphs of epitactically intergrown ilmenite, magnetite and rutile after hematite were found recently in the Lercheltini zone (Graeser, 1995b).

A further 5 km north from the Binntal lies the Rhône River valley (called Goms) and, on the river's north bank, the village of **Fiesch**. In the late 19th century, good hematite iron rose specimens were found at a collecting site called *Gorpi*, near Fiesch; some of these roses show epitactic overgrowths of acicular red rutile crystals (Parker, 1973).

Ten kilometers upstream along the Rhône from Fiesch lies the village of **Reckingen**, and, just northwest of the village, a little drainage called alternatively the *Rekkingertal* and the *Bächital*. In the late 19th and early 20th centuries, some of Switzerland's best phenakite crystals—colorless prisms to 3.8 cm, some in parallel-growth aggregates—were collected from clefts in this tiny valley, as were superb hematite roses. These roses are composed of thin crystals in perfect offset arrangements, and really do look exactly like roses; they are associated with quartz, orthoclase, stilbite and calcite (Weibel, 1966; Parker, 1973; Gramaccioli, 1975). The first finds date from the 1880's, but the clefts were especially prolific during and just after World War I. In 1922, Joseph Walter recovered what are probably the best extant examples of Reckingen iron rose specimens, with individual roses to 4 cm across (Parker, 1973).

Continuing upstream along the Rhône River valley we come,

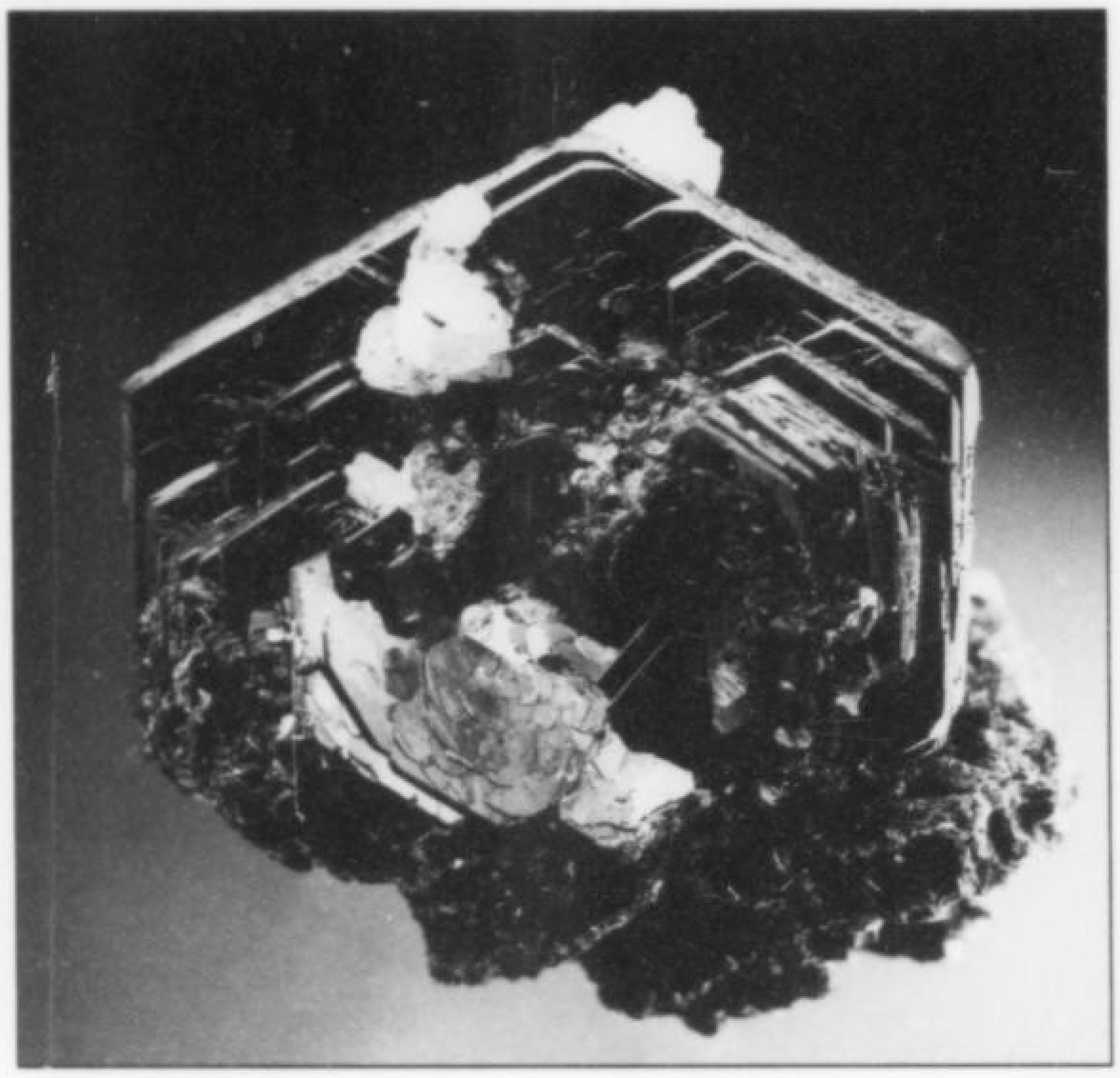


*Figure 8.* **Hematite "iron rose," 2.3 cm diameter, with rutile, muscovite and orthoclase, from the Tälli glacier, Binntal, Wallis, Switzerland. Thomas Schüpbach collection and photo.**

*Figure 9.* **Hematite "iron rose," 2.6 cm diameter, with rutile, muscovite, siderite and orthoclase, from the Tälli glacier, Binntal, Wallis, Switzerland. Thomas Schüpbach collection and photo.**

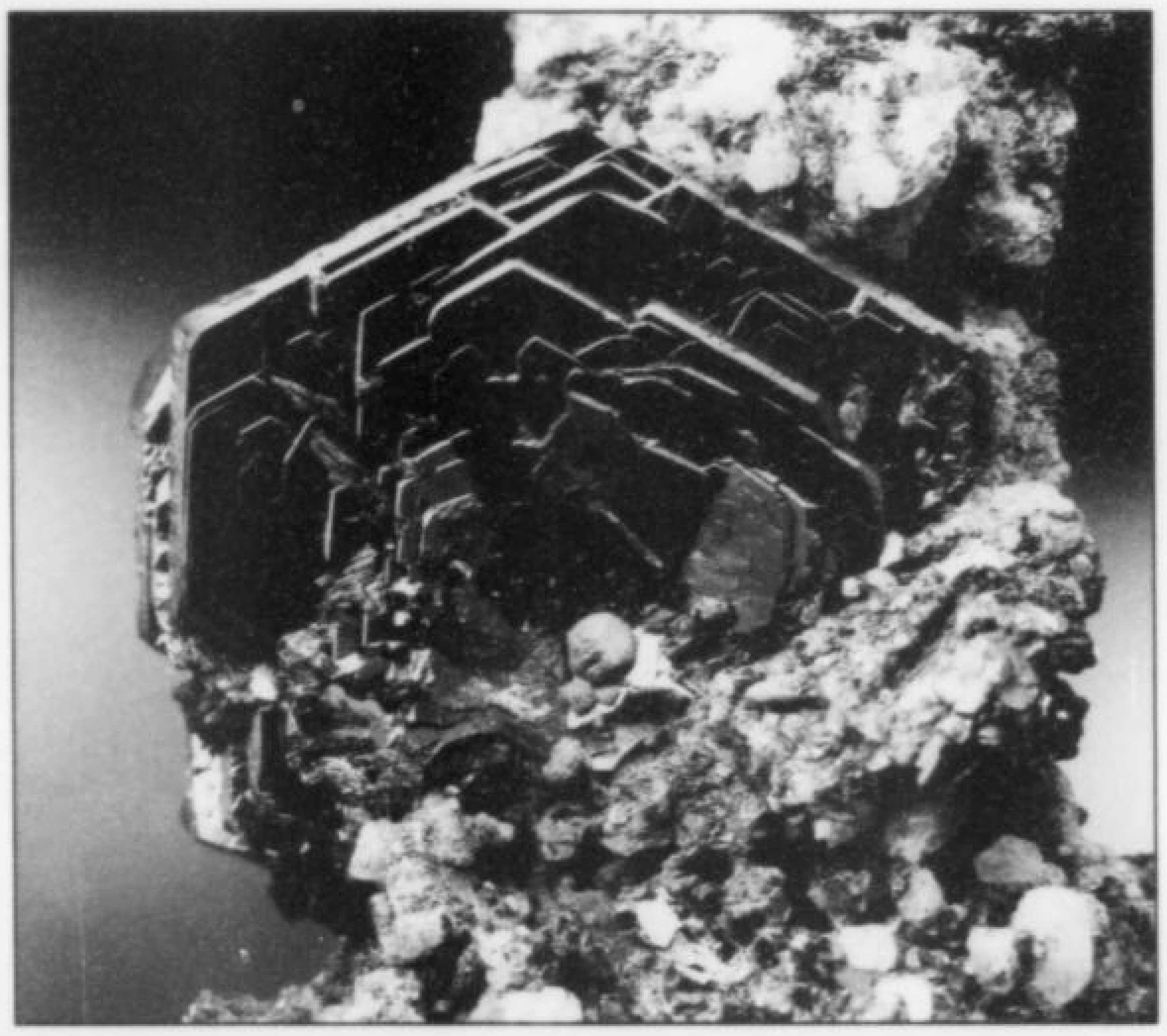
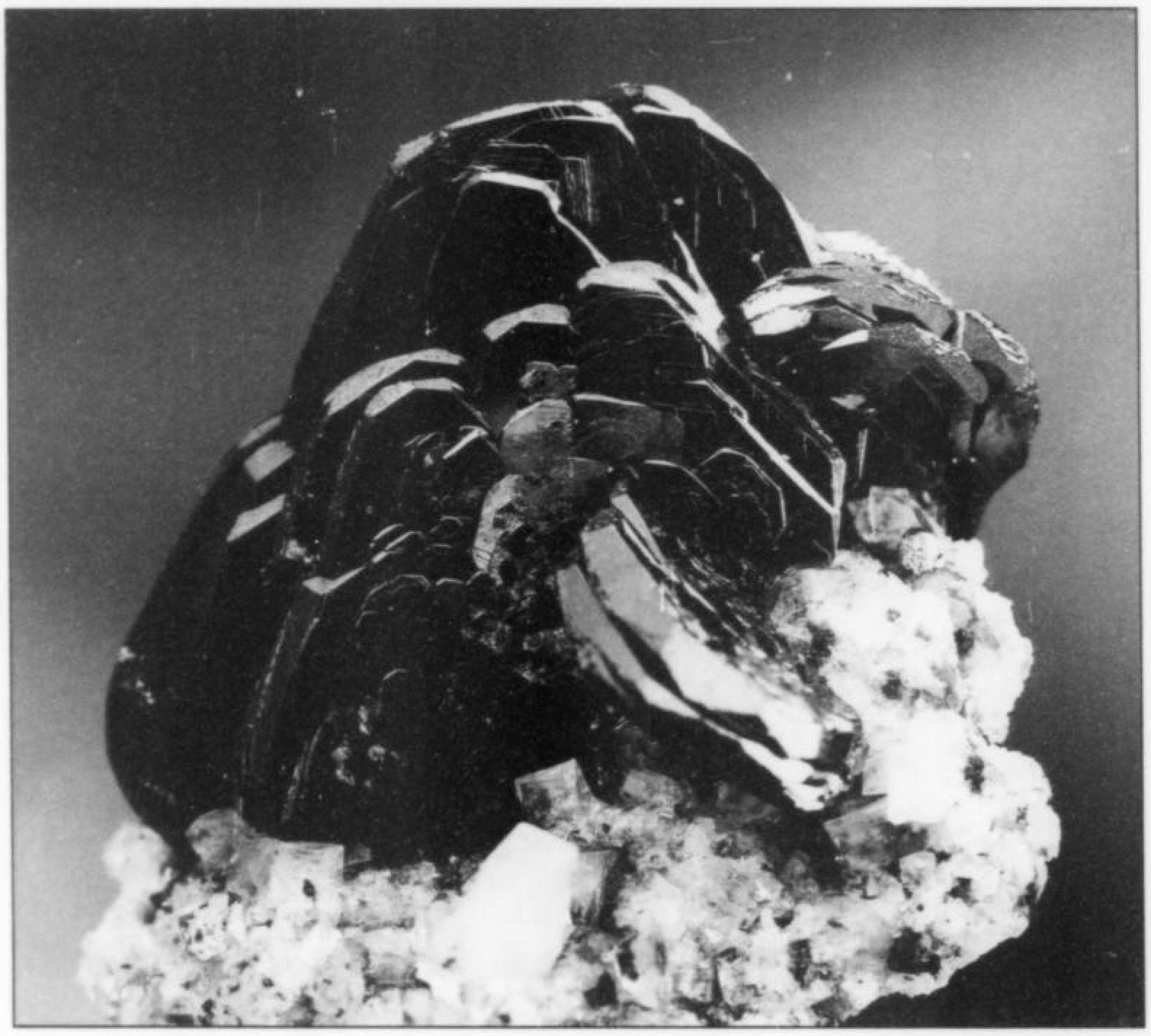


*Figure 10.* **Hematite "iron rose," 2.3 cm, on matrix from Riggi, Lercheltini zone, Binntal, Wallis, Switzerland. Christine and Res Berger collection; Thomas Schüpbach photo.**



about 13 km northeast of Reckingen, to the confluence with the Haslital coming in from the north, and the area, just east of that, of the Rhône Glacier and of the **Grimsel Pass**. Below the tiny lake called *Trübtensee*, west of the pass, a *Strahler* named Lucek in 1955 collected many specimens showing small, half closed iron roses resting on aplite matrix with quartz, fluorapatite, pyrite, and corroded crystals of the very rare species kainosite. Similar specimens were found in 1963 by Walter Hofer near the glacier's flank, opposite the Hotel Belvédère; one beautiful specimen from this discovery is a quartz crystal enclosed by a wreath of intergrown hematite roses (Parker, 1973).

Five kilometers east of the Grimsel Pass is the **Furka Pass**, connecting the Swiss cantons of Wallis and Uri (we are now very near the St.Gotthard-Fibbia-Piz Lucendro "core" area, which begins only about 10 km to the southeast). The area between the Furka Pass and the peak of the Furkahorn to the north has only fairly recently produced important hematite iron rose specimens, only sparse, tiny ones having been noted earlier (Parker, 1973). In 1975 and 1976 the "extreme" *Strahler* Kaspar Fahner (for some information about him see Bancroft, 1984) collected a number of wonderful hematite roses to 6 cm across, associated in some cases with pink fluorite crystals (Burger, 1979).

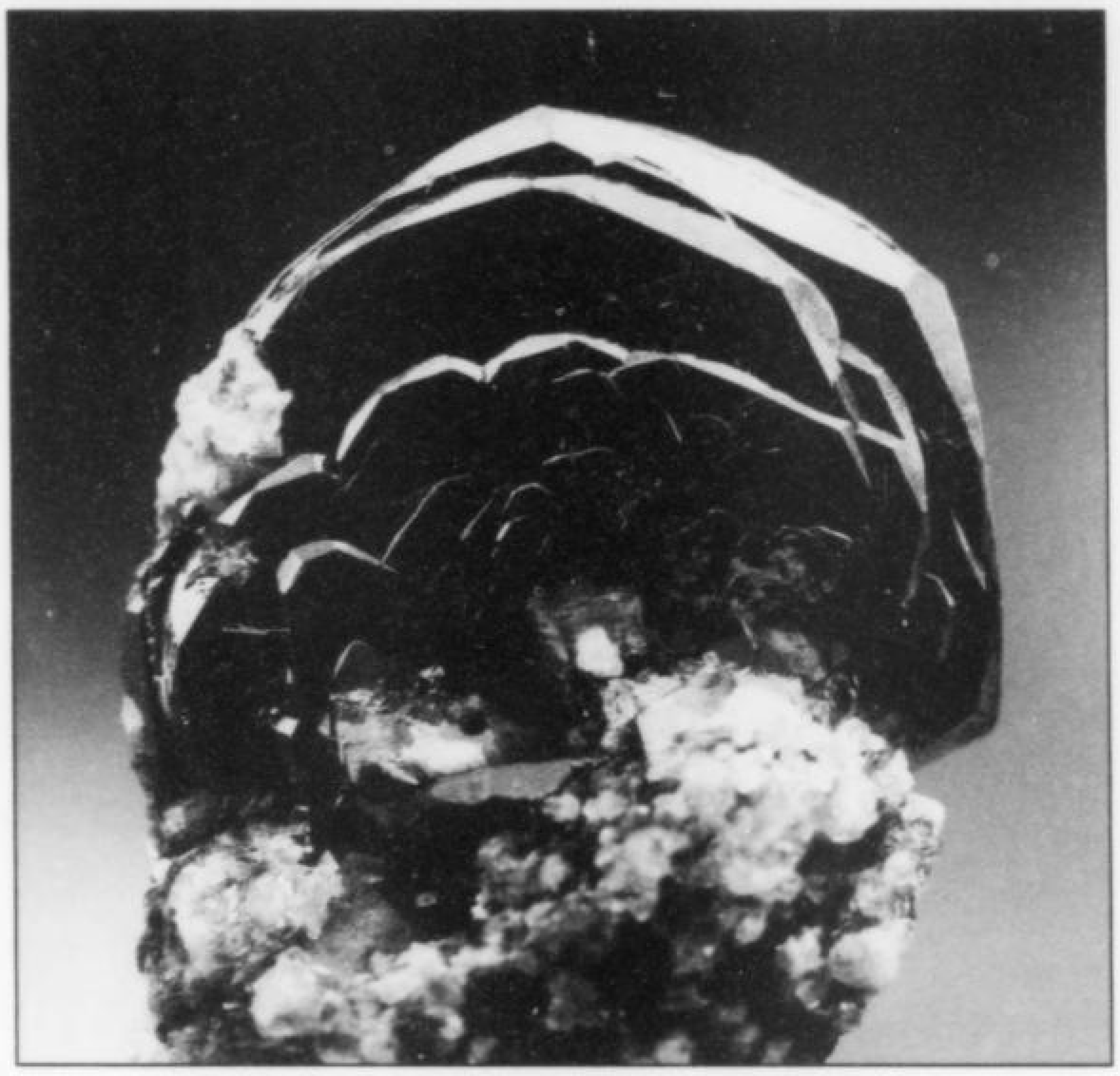


*Figure 11.* **Hematite "iron rose," 1.9 cm, on matrix from Riggi, Lercheltini zone, Binntal, Wallis, Switzerland. Christine and Res Berger collection; Thomas Schüpbach photo.**

As mentioned, the cleft paragenesis in which ilmenite instead of hematite is found as iron roses is somewhat different from the hematite paragenesis, according to the classification of Parker (1973). In ilmenite as opposed to hematite clefts, transparent orthoclase ("adularia") is less plentiful and zeolites are absent, but the titanium oxides rutile, brookite and anatase are fairly common. Ilmenite roses are so much rarer than hematite roses in Switzerland because richly mineralized clefts of the ilmenite paragenesis are widely exposed only in the **Maderanertal**, Canton Uri, about 30 km northeast of St. Gotthard. Experienced collectors will recognize this as the locality for many of the magnificent Swiss brookite specimens seen in old collections.

In the Maderanertal, a small stream flows west-southwest from a mountain massif whose highest peak is the Scherhorn; the ilmenite-bearing clefts are found along several tributaries, and on some mountain flanks to the south. In the little gorge of the *Lungental*, small but sharp ilmenite roses with anatase, brookite and pyrite crystals were found during the 1960's (Parker, 1973); in another gorge, the *Staldental*, fine, lustrous open ilmenite roses to 4 cm occur (Stalder *et al*, 1998); at *Brunnital*, in the uppermost Maderanertal, a cleft containing beautiful ilmenite roses to 3.5 cm across was opened in 1969 (Parker, 1973).

Two outlier localities for ilmenite roses, more than 30 km west-southwest of the Maderanertal region and 10 km north of the Grimsel Pass, are the old collecting sites known as *Rotlaui* and *Kammegg*, just east of the village of **Gutannen** in the Haslital. Ilmenite roses to 3 cm across found many decades ago in these clefts were originally described as hematite (Parker, 1973; Stalder *et al.*, 1998).

What are probably Switzerland's best-ever ilmenite rose specimens were collected by Franco Isepponi in October 1987 from a cleft on the western flank of the *Tschingelstock*, a mountain a few kilometers south of the upper reaches of the Maderanertal, near the Brunnital tributary. Isepponi's narrative of the collecting experience appears in the February 2000 issue of *Schweizer Strahler*, which also contains Bruno Schaub-Gottschalk's account of his *Jahrhundertfund* ("find of the century") of hematite iron roses at St. Gotthard. The *Strahler* and a companion discovered the cleft in 1979, but snow and ice had covered it for eight years thereafter. Finding it accessible once again, Isepponi, braving a gathering blizzard, lay prone on the freezing ground, wormed into the cleft, and extracted a handful of specimens showing brilliantly lustrous, jet-black, superbly sharp, ilmenite roses in partially intergrown groups to 3.6 cm. Some of the specimens occurred as floaters in the profuse chlorite sand of the cleft, while others came out as matrix pieces. Removal of an enclosing clay layer revealed that the ilmenite crystals, ranging from leafy to thick, comprise perfect open roses of matchless aesthetic quality (see photos).

*Figure 12.* **Hematite "iron rose," 2.4 cm, on matrix from Mt. Cherbadung, Binntal, Wallis, Switzerland. Hugo Nellen collection; Thomas Schüpbach photo.**

**Classic Roses of St. Gotthard-Fibbia-Piz Lucendro**

A census of the photographs of Swiss hematite iron roses offered in reference sources would show that at least 75% of these gorgeous specimens come from the tiny area of Mt. Prosa-St. Gotthard-Fibbia-Piz Lucendro, straddling the border between Uri and Tessin (Italian: Ticino) cantons. Even if we consider (as I do here) the St. Gotthard Pass, running due north towards Andermatt, as part of this core area, the rose garden does not grow very much larger: the richest area of productive clefts measures perhaps 30 $km^2$.

Geologically the region lies on the northern margin of the Gotthard massif, characterized by crystalline granite and granodiorite; the hematite clefts occur most abundantly of all in aplitic granite gneiss. Mineralization in these clefts is dominated by quartz, orthoclase of the "adularia" type, albite, and chlorite-group minerals. Important subordinate species include muscovite, calcite, and zeolites (especially stilbite); occasionally, rutile, fluorapatite, titanite, phenakite, bertrandite and rare-earth-element species are found in the clefts, in nearly all cases as microcrystals (Parker, 1973; Amacher, 1982; Graeser, 1998).

St. Gotthard-Fibbia, having long been a happy hunting ground for *Strahlers*, has yielded fine specimens of several of these associated species. Its sharp-edged orthoclase ("adularia") crystals are probably Switzerland's best. Measuring up to several centimeters across, the orthoclase crystals are lustrous, milky white, and translucent, and some show schiller, for a beautiful moonstone effect. Single crystals, twins (mostly of the Baveno type), and interpenetrating "fourlings" commonly form parallel aggregates stretched along a common axis, comprising stacks in what is called


*Figure 13.* **Occurrence areas in Switzerland (shaded pink) for Alpine hematite and ilmenite "iron roses."**

the "Fibbia habit." Green, finely divided chlorite may dust the pearly white "adularia" faces, or may form zoned inclusions just below selected side faces, leaving terminations clear.

Quartz is found in the clefts as transparent, colorless crystals (smoky quartz is uncommon), some coming to points in the "Tessin" habit, many exhibiting Dauphiné twinning. Most of the quartz crystals are found detached in the pockets, and some have healed and regrown as doubly terminated floaters (quartz crystal clusters are rare). Fluorapatite occasionally appears as face-rich hexagonal-tabular crystals, transparent and colorless to pale violet, exceptionally reaching 1 cm. Rutile crystals are seen uncommonly on and near the hematite roses, and druses of stilbite crystals may partially coat quartz. The exotica of the clefts include colorless crystals to 2 cm long, once misidentified as tourmaline, which are in fact phenakite, and tiny colorless to pale blue, face-rich crystals of bertrandite. In the early 1980's Peter Amacher collected sharp, pale green xenotime crystals to 2 cm long in an iron rose cleft at Fibbia, and at about the same time he found tiny but sharp and lustrous, honey-yellow to greenish floater crystals of anatase in another, nearby cleft (Amacher, 1982).

The modern history of recorded iron rose-gathering in the core area began in 1810, when superb open roses composed of perfectly offset, medium-thick to leafy hematite crystals were collected from a large cleft on Piz Lucendro, northeast of Lucendro Pass. When these specimens found their ways to museum collections worldwide, Piz Lucendro became what we would now call an "instant classic" locality, and by the middle of the 19th century the excavations of *Strahlers* had merged in a virtual "specimen mine"

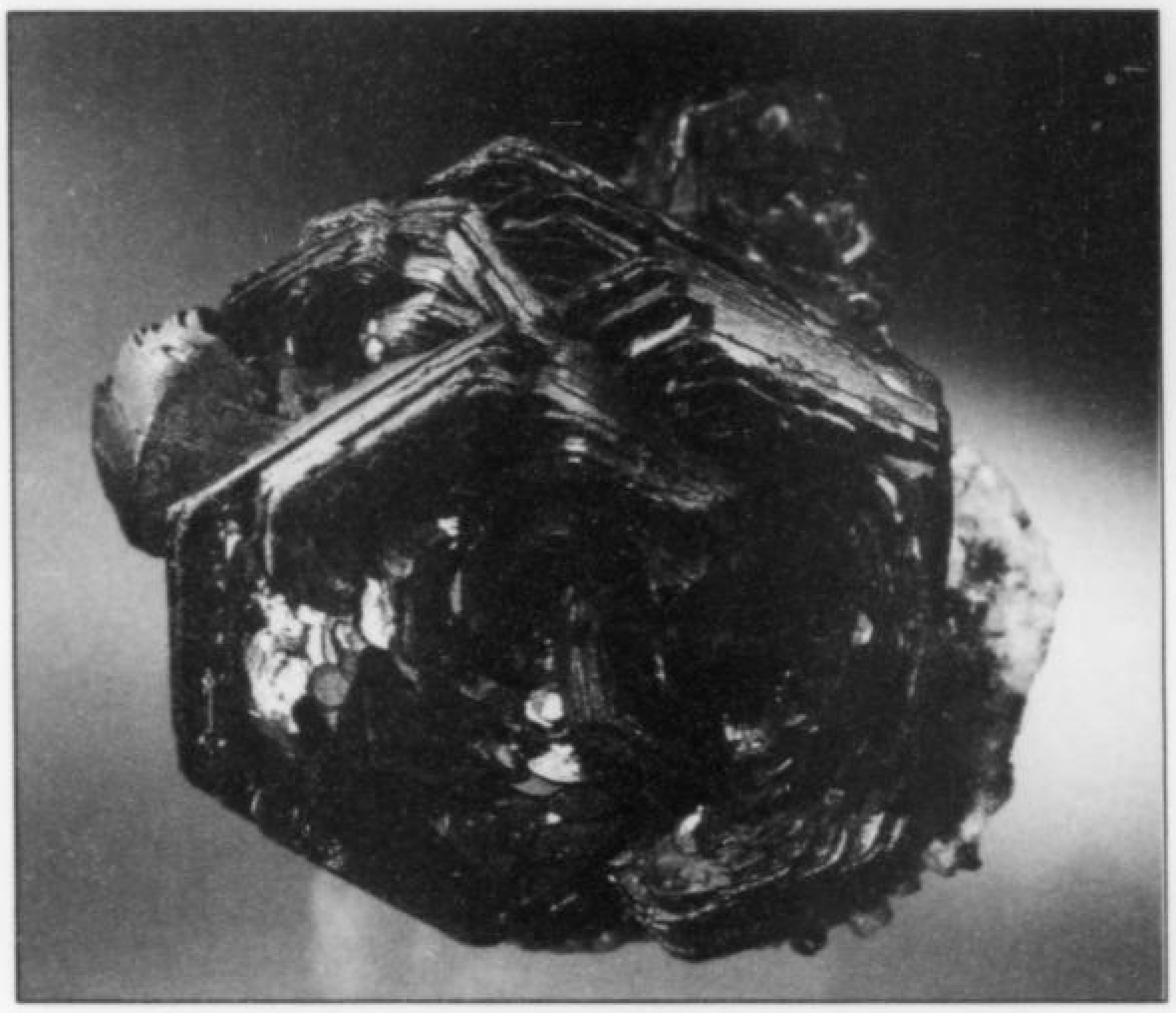


*Figure 14.* **Hematite, cluster of "iron roses," 5.5 cm across on matrix, from Mt. Fieund, St. Gotthard, Ticino, Switzerland. Bruno Schaub-Gottschalk collection; Thomas Schüpbach photo.**

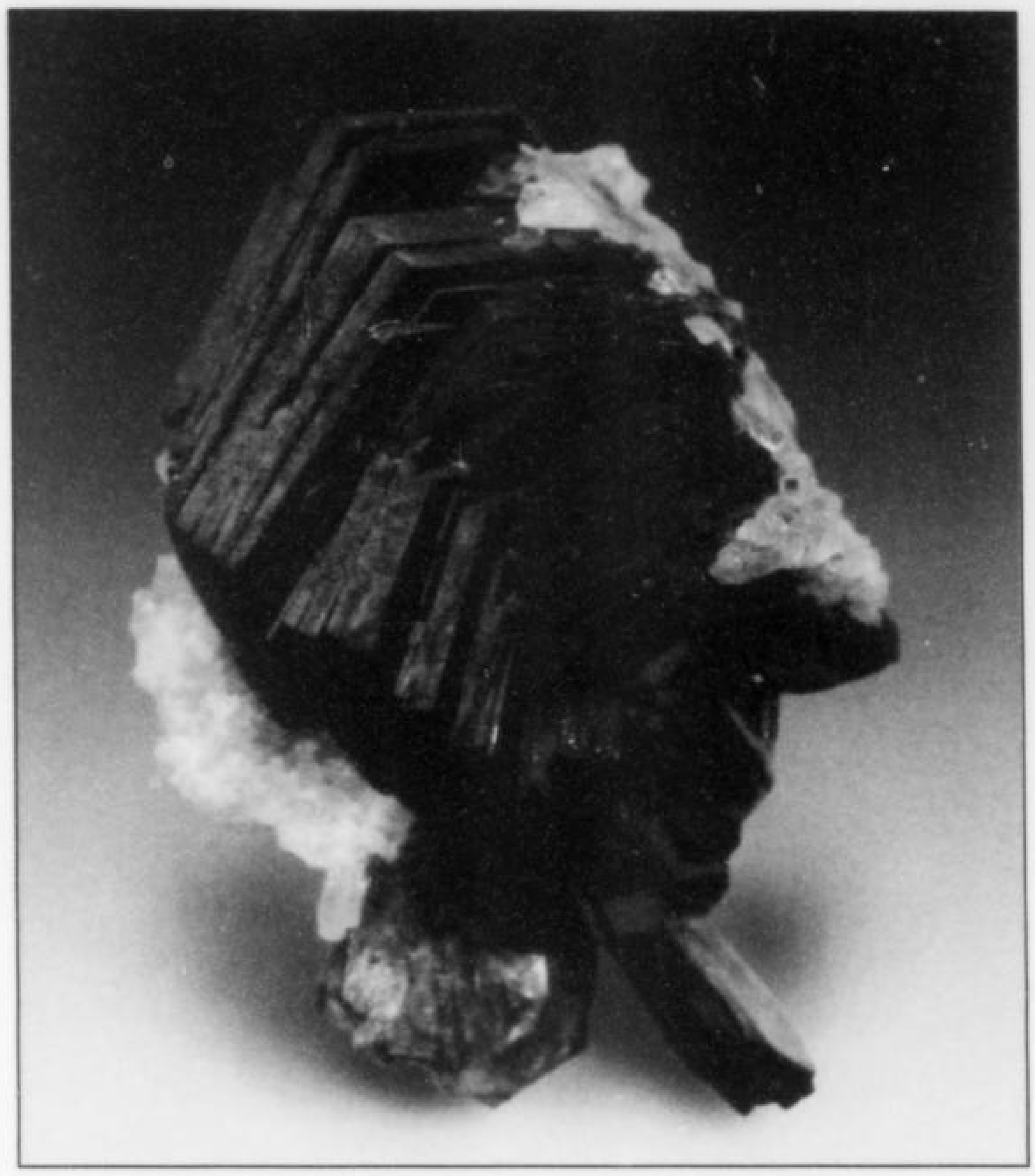


*Figure 15.* **Hematite "iron rose," 2.5 cm, from Piz Lucendro, Uri, Switzerland. Collected in summer 1998 by Vladimir Pusek. Tom Moore collection; Wendell Wilson scanner photo.**

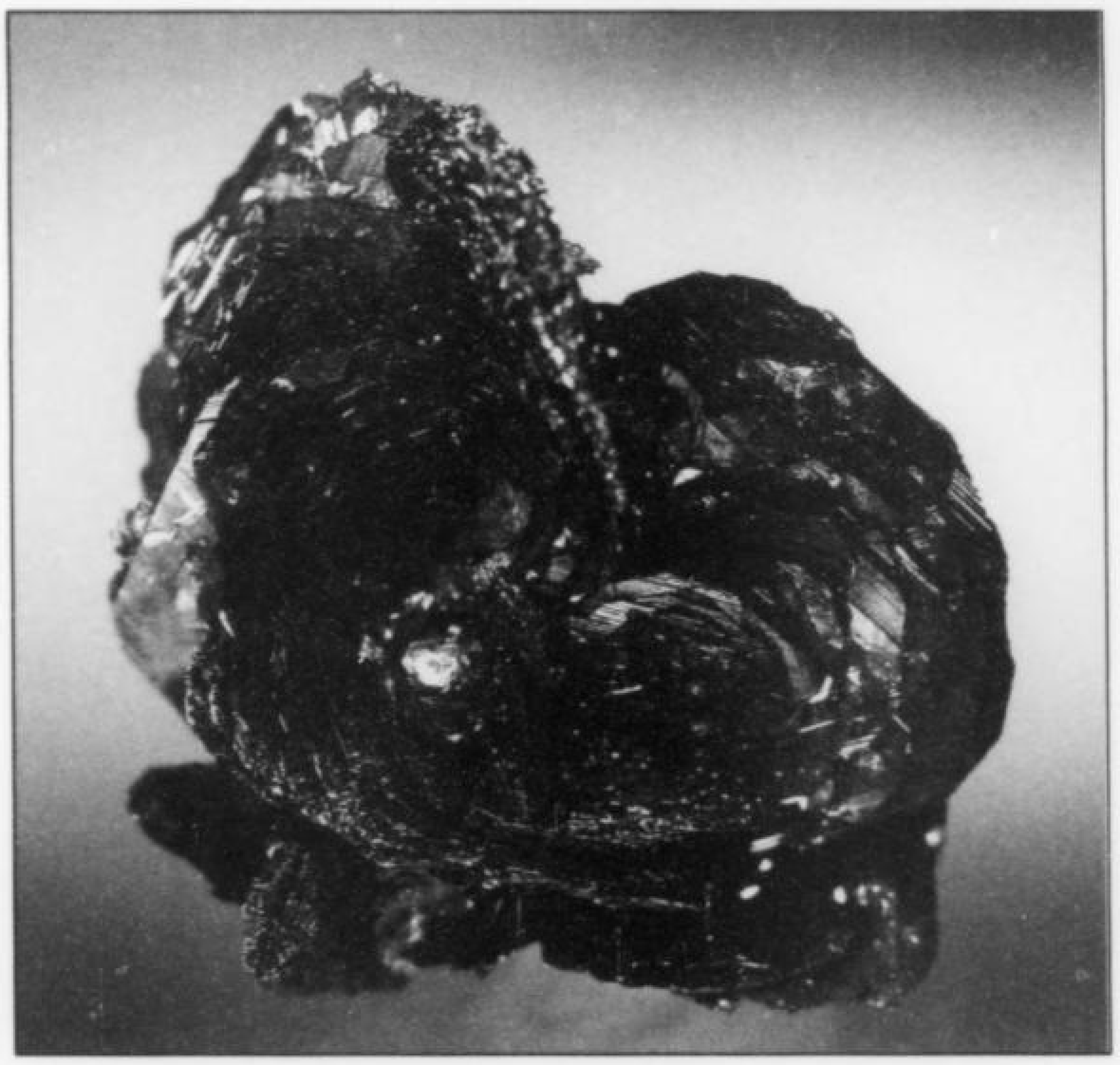


*Figure 16.* **Ilmenite, cluster of "iron roses," 3.6 cm, from Tschingelstock, above Disentis, Graubünden, Switzerland. Franco Isepponi collection; Thomas Schüpbach photo.**

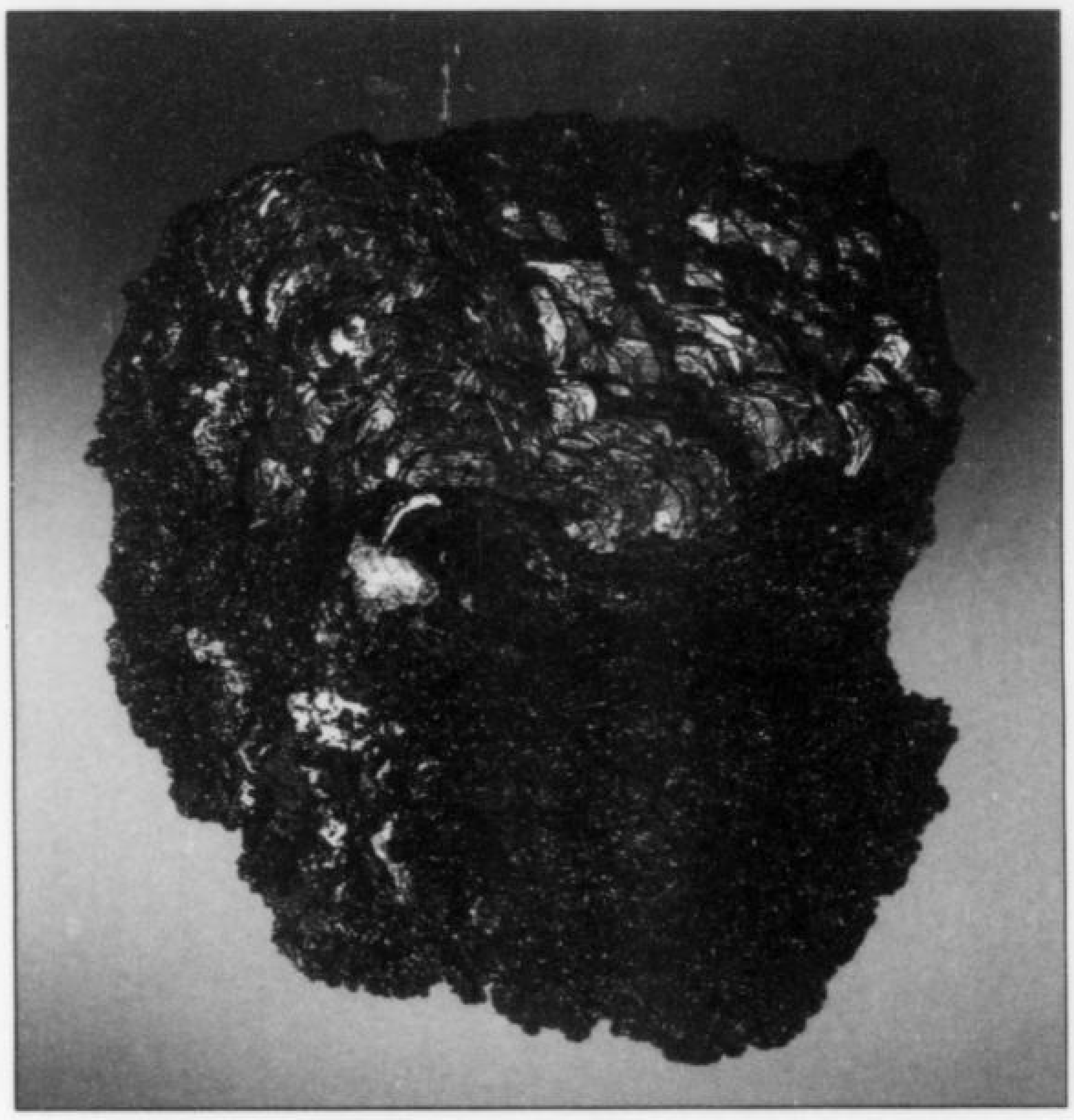


*Figure 17.* **Ilmenite "iron rose," 3.1 cm, from Tschingelstock, above Disentis, Graubünden, Switzerland. Franco Isepponi collection; Thomas Schüpbach photo.**

exploiting what had turned out to be a very extensive system of clefts (Parker, 1973; Stalder *et al.*, 1998). The enterprise ended in 1925, when the whole area was destroyed by explosives during construction work on Lucendro Pass (Stalder *et al.*, 1998). Since then, Piz Lucendro, in the southwestern corner of the iron-rose garden, has been considered an exhausted collecting area . . . but don't tell that to Slovak-born *Strahler* Vladimir Pusec, who appeared at the 1999 Tucson show with a number of brilliant thumbnail specimens of hematite iron roses which he had collected on Piz Lucendro in the summer of 1998 (Moore, 1999).

Although also considered generally worked-out, the area between Fibbia, just east of Piz Lucendro, and Alpe di Fieud, 2 km to the south, remains a place where "a few staunch collectors . . . with much patience, luck and year-round persistence, still make discoveries in the much-traversed mountain crests and hollows" (Amacher, 1982). Iron rose specimens which may still trickle out from this area show lustrous hematite crystals arrayed in compact open roses, exceptionally to 8 cm (Stalder *et al.*, 1998), with typical

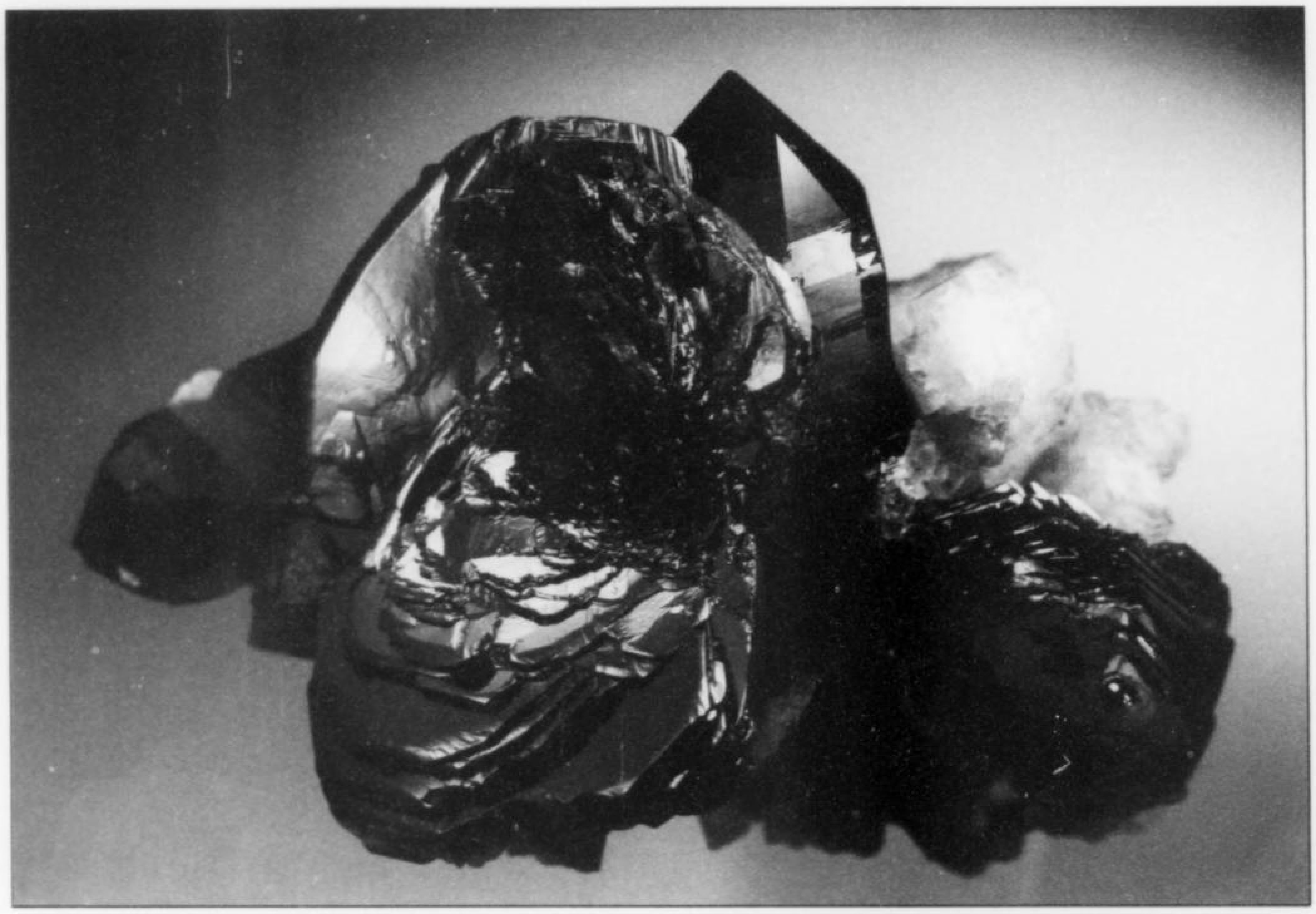


*Figure 18.* Hematite, cluster of "iron roses," 3.2 cm, with smoky quartz crystals, from Fibbia, Uri, Switzerland. Bruno Schaub-Gottschalk collection; Thomas Schüpbach photo.

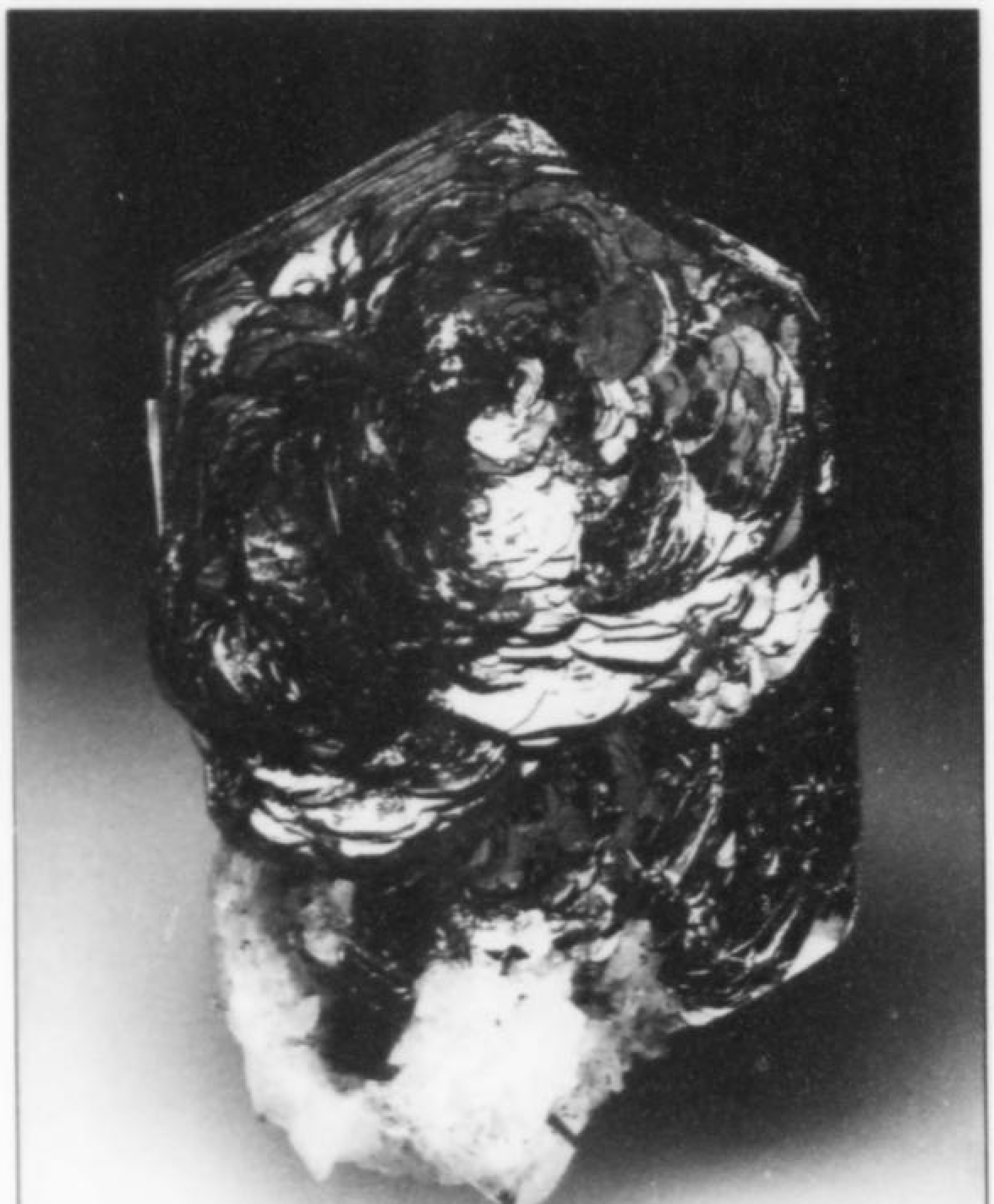


*Figure 19.* Hematite "iron rose," 7 cm, from Fibbia, Uri, Switzerland. Harvard collection; Wendell Wilson photo.

*Figure 20.* Hematite "iron rose," 4.5 cm, from Fibbia, Uri, Switzerland. Smithsonian collection. This specimen was originally in the collection of Gustav Seligmann (1849–1920) of Koblenz, Germany, after whom seligmannite was named; it was acquired with the rest of his collection by the Smithsonian, and it was illustrated on Plate 28 of Reinhard Braun's *The Mineral Kingdom* (1908). Wendell Wilson photo.

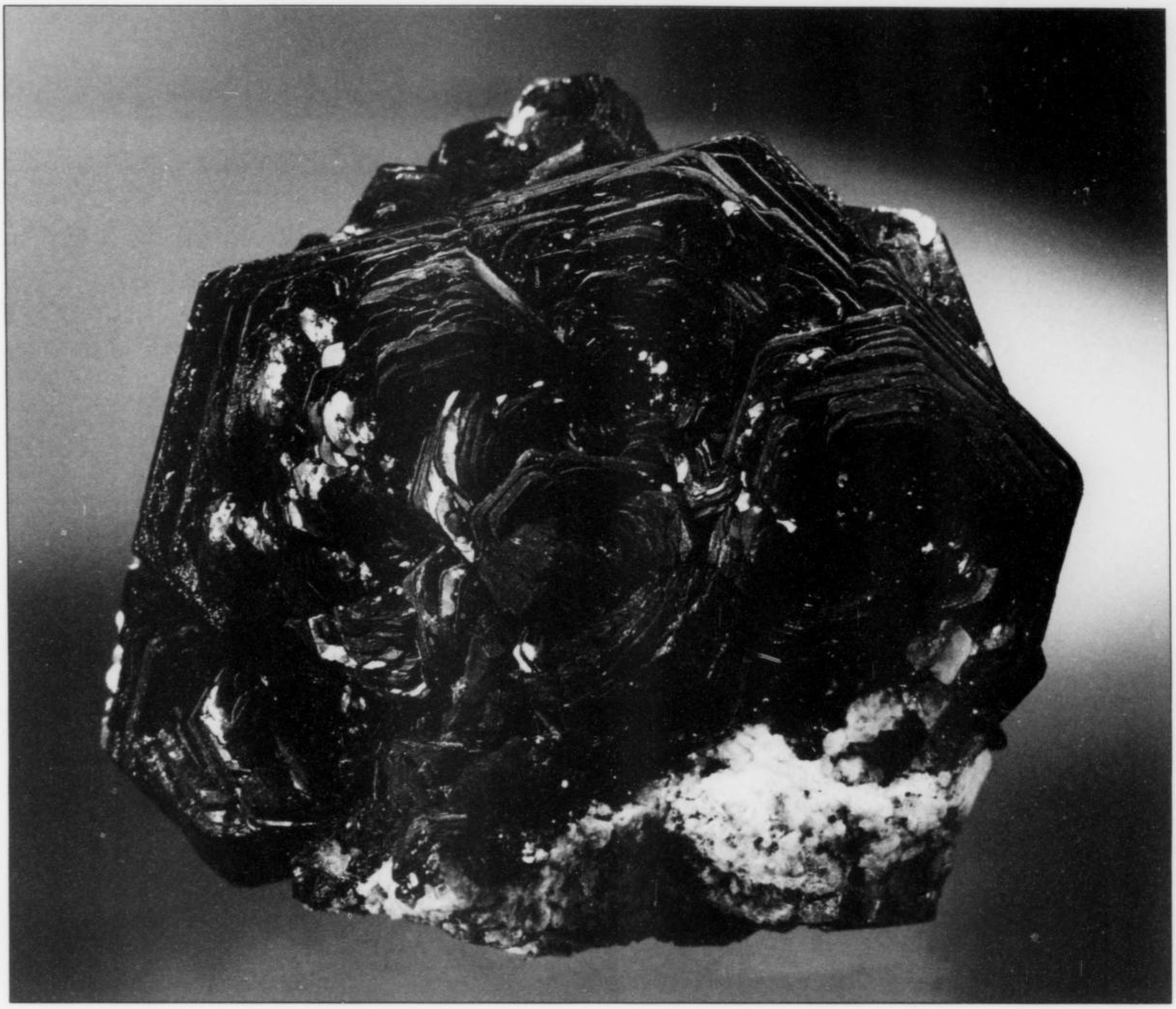


*Figure 21.* **Hematite, cluster of "iron roses," 9 cm across on matrix, from Alpe di Fieud, St. Gotthard, Ticino, Switzerland. This is the great specimen collected in 1979 by Bruno Schaub-Gottschalk, as recounted in his narrative. Bruno Schaub-Gottschalk collection; Thomas Schüpbach photo.**

associations as described above; the labels unfortunately are unlikely to give names to collecting sites, but rather will simply say "Fibbia" or "La Fibbia."

Between 1962 and 1964, a surface road was built from Fibbia, through Val Tremola to the east, and thence north, to intersect what would become the south portal of the road tunnel under the Gotthard Pass. Blasting during work on the surface road revealed many mineralized clefts between Fibbia and Mt. Prosa, these yielding fine specimens of about 15 species including fluorapatite, rutile, titanite, stilbite, phenakite and pink fluorite—and one cleft, exposed in 1962, produced hematite roses sprinkled with sheaf-shaped clusters of stilbite crystals (Parker, 1973). On the eastern flank of Mt. Prosa, large, lustrous hematite roses with unusually thick crystals had been found in 1943 by C. Taddei (Parker, 1973), but it was the work that began nearby, in the early 1970's, at what would be the southern portal of the road tunnel, which rekindled real excitement among collectors of Swiss Alpine minerals. Extremely sharp hematite roses to 4 cm (Stalder *et al.*, 1998) emerged from a number of the myriad clefts encountered under the Gotthard Pass, together with fine specimens of a number of other species from the Alpine menu. Near what would later be the northern end of the tunnel, surface road construction during the 1960's at Hospental, 3 km southwest of Andermatt, encountered abundant hematite roses associated with quartz, stilbite and biotite (Weibel, 1966).

## A Find of the Century on Alpe di Fieud

Like field collectors everywhere, Swiss *Strahlers* accumulate and cherish stories of their adventures. The cover photo of the February 2000 issue of *Schweizer Strahler* (Fig. 21) displays what is arguably the finest hematite iron rose specimen ever found in Switzerland—certainly, at any rate, one of the largest. This magnificent 9-cm cluster of intergrown roses on matrix was collected in 1979 from a cleft on Mt. Fieund by the veteran *Strahler* Bruno Schaub-Gottschalk, who briefly retold the story inside the same issue of *Schweizer Strahler*. Like many *Strahlers'* stories, this one is redolent of what we might as well call *Strahlerkultur*; I can only hope that its flavor is not entirely washed out by my translation, below. To introduce the story it must be mentioned that some

*Strahlers* prospect for clefts with what amounts to the Swiss equivalent of a dowsing rod. They ascend the mountain slopes while holding out before them a device they call a *Pendel*. A weight dangles on the end of a chain from a cradle held in the outstretched hand, and when the weight begins to swing back and forth (like a *pendulum*), it is thought to be sensing a cleft nearby. To be sure, not all contemporary *Strahlers* employ the *Pendel*, but the fact is that a pretty fair number of the older ones do (Thilo Arlt, personal communication, 2005). After all, they probably think, what is the harm (and what might be the profit??) of cleaving to the old beliefs and half-beliefs? Trusting in someone who cleaved to this particular old belief certainly led Herr Schaub-Gottschalk in a profitable direction . . . .

For more than 30 years I worked at the same collecting site at Fibbia, bringing to light countless finds of iron roses, adularia, stilbite, bazzite, xenotime, apatite and smoky quartz—and, on one occasion, pink fluorite and phenakite.

During the first three years the work was very difficult, since the collecting site was completely obscured by rubble. From the beginning I knew that further finds could only be made through the greatest exertions to clear away the rubble.

In 1970 I came to know a *Pendler,* Franz Walker, who lived in the same house as I did in Flüelen. He offered to guide me to a site where iron roses could be collected. At 4:00 on a Friday morning he led me to the Alpe di Fieud (Gotthard). We were already on the mountain when the sun rose, and I spread a map on the ground. With his *Pendel* in hand, Franz Walker stood there like a caveman, and I trusted the thing to go before us and lead the way. At first the *Pendel* was still, but then it began to vibrate, first slowly, then faster, indicating that this area was a good place to look for iron roses. He told me that some hard work lay ahead, since, he thought, two or three meters of digging would be necessary.

In fact, three long, hard years would pass before success finally came—but in the meantime I had forgotten Franz's prediction. When we talked, and when he inspected the beautiful finds I had made, he reminded me of how he had told me three years before that there were beautiful iron roses there. Well, we believe what we want to believe, and I believed then that it was all simply a matter of chance.

It was winter, and the *Pendler* Franz Walker was visiting me in my new home in Steinerberg. He again offered to *Pendeln* for me, if I would give him a specimen to work with, and my *Strahler*'s staff. Fourteen days later he gave me back the iron rose specimen and my staff, and said, "Bruno, you will find, just once, an iron rose such as all collectors around the world will envy, if you want to find one." It was very truly said, but I could not and would not believe it.

On August 5, 1979, at 1:20 P.M., I opened a cleft 40 cm wide and 1 meter and 20 cm long. On the roof there were merely small adularia crystals, but on the floor, attached to the country rock, there were iron roses, all perfectly formed, measuring between 4 and 6 cm. At the back of the cleft there were rhombohedral calcite crystals and three uncorroded pink fluorites, one of which measured 6 cm on edge and had a small smoky quartz crystal on it.

Exploring a fissure in the roof, I suddenly felt something heavy in my hand . . . I felt as if struck by lightning. In the narrow opening, which kept filling with water, I first saw nothing at all, then saw something which made me say "something crazy is happening!" All of a sudden I no longer felt as if I was freezing in the snow-melt water. Carefully I crawled backwards out of the cleft and into the daylight. And then in my trembling hand I saw what I had just brought forth from out of its millions of years of dark existence. It was indeed an iron rose, still attached to matrix, and remarkably it was developed on both sides: a truly sensational, world-class specimen measuring 9 cm across and weighing 420 grams!

The question may again be posed: can one really find an iron rose by *pendeling,* or is finding it merely a happy accident? I must say that I don't really know. But one thing is surely true: this is the story of the discovery of the largest iron rose ever found . . . .

## CONCLUSION

You probably won't use a *Pendel* to find a Swiss iron rose specimen on the floor of the next big mineral show you attend, but to find one anywhere on the market today you *will* need persistence, perhaps a good contact or two, and luck. Noting the present extreme rarity of these specimens on the market, it will not do to rationalize that the "really good recent ones" are being hoarded in Switzerland, for likely the fact is that very few recently collected specimens of any consequence exist. The richest regions of iron rose clefts are approaching effective exhaustion, but, as pointed out earlier, these regions, never mind the rest of Switzerland and of the Alps in general, cannot by their very nature be entirely stripped clean. With luck, love for their craft, and persistence, the *Strahlers*, perhaps dogging the paths of the road-builders and tunnel-borers, continue in more ways than one to follow the poet Herrick's advice . . . "Gather ye rosebuds while ye may. . . ."

## ACKNOWLEDGMENTS

I am grateful to Thilo Arlt of *Schweizer Strahler* for allowing me to translate and present here the collecting story by Bruno Schaub-Gottschalk, and equally grateful to Thomas Schüpbach for granting the *Mineralogical Record* permission to publish his excellent photographs.

## BIBLIOGRAPHY

AMACHER, P. (1982) Die Fibbia. *Lapis*, **7** (7/8), 28–30.

ANTHONY, J. W., WILLIAMS, S. A., BIDEAUX, R. A., and GRANT, R. W. (1995) *Mineralogy of Arizona*. Tucson: University of Arizona Press. 508 pages.

BANCROFT, P. (1984) *Gem & Crystal Treasures*. Fallbrook, CA: Western Enterprises/Mineralogical Record. 488 pages.

BODE, R., Ed. (1991) Micromounter-News. *Mineralien Welt*, **2** (4), 12–13.

BURGER, W. (1979) Ein Besuch bei Strahler und Bergführer Kaspar Fahner. *Lapis*, **4** (9), 24.

CASSEDANNE, J. P. (1989) The Ouro Preto topaz mines. *Mineralogical Record*, **20**, 221–233.

FETTAL, M. (1986) Mineralfundstellen bei Kasern im inneren Ahrntal/Südtirol. *Lapis*, **11** (9), 11–15.

GRAESER, S. (1995a) Gischihorn (Pizzo Cornera) und Ritterpass. *Lapis*, **20** (7/8), 65–67.

GRAESER, S. (1995b) Lärcheltini, Binntal: klassische anatas-Fundstellen. *Lapis*, **20** (7/8), 24–32.

GRAESER, S. (1998) Alpine minerals. *Rocks & Minerals*, **73** (1), 14–32.

GRAMACCIOLI, C. M. (1975) *Die Mineralien der Alpen, Band 1*. Stuttgart: Franckh'she Verlagshandlung. 264 pages.

HAMMER, V. M. F. and WEERTH, A. (2004) Pakistan's Alpine-type clefts: Rivaling the classic Alps. In ExtraLapis English #6, *Pakistan: Minerals, Mountains & Majesty*. East Hampton, CT: Lapis International LLC, 72–77.

ISEPPONI, F. (2000) Wind und Unwetter beim Ilmenitrosen-Fund 1987. *Schweizer Strahler*, **12** (1), 25–26.

JAHN, S. (2003) Die Cavradi-Schlucht. *Mineralien-Welt*, **14** (6), 18–38.

KOLESAR, P. (1997) Geographie, Bergbau, Geologie und Lagerstätten des Urals. *Lapis*, **22** (7/8), 13–24.

KURR, J. G. von (1859) *The Mineral Kingdom*. Edmonston & Douglas, Edinburgh, Plate 18, Figure 20.

MOORE, T. (1999) What's new in minerals: Tucson Show 1999. *Mineralogical Record*, **30**, 211–224, 238.

MOORE, T. (2000) What's new in minerals: Tucson Show 2000. *Mineralogical Record*, **31**, 273–286.

MOORE, T. (2003) What's new in minerals: Tucson Show 2003. *Mineralogical Record*, **34**, 275–285.

NIEDERMAYR, G. (1986) Mineral localities in Austria. *Mineralogical Record*, **17**, 105–110.

OTTENS, B. (2003) Minerals of the Deccan Traps, India. *Mineralogical Record*, **34**, 1–79.

OTTENS, B. (2004) Quarz: von Zeptern und Japanerzwillingen. *extraLapis* No. 26/27, 88–99.

PARKER, R. L. (1973) *Die Mineralfunde der Schweiz*. Basel: Wepf & Co. Verlag. 433 pages.

PEZZOTTA, F. (1999) ExtraLapis English #1, *Madagascar*. East Hampton, CT: Lapis International LLC. 97 pages.

REAM, L. R. (1989) *Idaho Minerals*. Coeur d'Alene: L. R. Ream Publishing. 329 pages.

ROBINSON, G. W., KING, V. T., ASSELBORN, E., CURETON, F., TSCHERNICH, R., and SIELECKI, R. (1992) What's new in minerals? *Mineralogical Record*, **23**, 423–437.

ROBINSON, G. W., KING, V. T., SCOVIL, J., and CURETON, F. (1995). World review of mineral discoveries, 1993–1994. *Mineralogical Record*, **26**, 475–499.

SCHAUB-GOTTSCHALK, B. (2000) Die Eisenrose vom Gotthard, ein Jahrhundertfund. *Schweizer Strahler*, **12** (1), 1–5.

SCOVIL, J. R. (1996) Costa Mesa show 1996. *Mineralogical Record*, **27**, 452.

SINKANKAS, J. (1966) *Mineralogy for Amateurs*. Van Nostrand Reinhold Company. 585 pages.

SPRUNGER, M. (1980) Hematite from the Dome Rock Mountains near Quartzsite, Arizona. *Mineralogical Record*, **11**, 227–229.

STALDER, H-A. (1984) Die Mineralien des Gotthard-Strassentunnels. *Magma*, **4**/84, 43–58.

STALDER, H-A., EMBREY, P., GRAESER, S., and NOWACKI, W. (1978) *Die Mineralien des Binntales*. Bern: Naturhistorisches Museum. 143 pages.

STALDER, H-A., WAGNER, A., GRAESER, S., and STUKER, P. (1998) *Mineralienlexikon der Schweiz*. Basel: Wepf Verlag. 579 pages.

SULLIVAN, B. (1979) Letter from Europe. *Mineralogical Record*, **10**, 121–124.

SULLIVAN, B. (1980) Letter from Europe. *Mineralogical Record*, **11**, 315–318.

VOGT, M. (1991) Serifos—die Mineralien-Insel in der griechischen Ägäis. *Lapis*, **16** (4), 26–37.

WEERTH, A. (1997) Alpine Neuheiten aus dem Karakorum. *Lapis*, **22** (1), 13–22.

WEIBEL, M. (1966) *A Guide to the Minerals of Switzerland*. London/New York/Sydney: Interscience Publishers. 123 pages.

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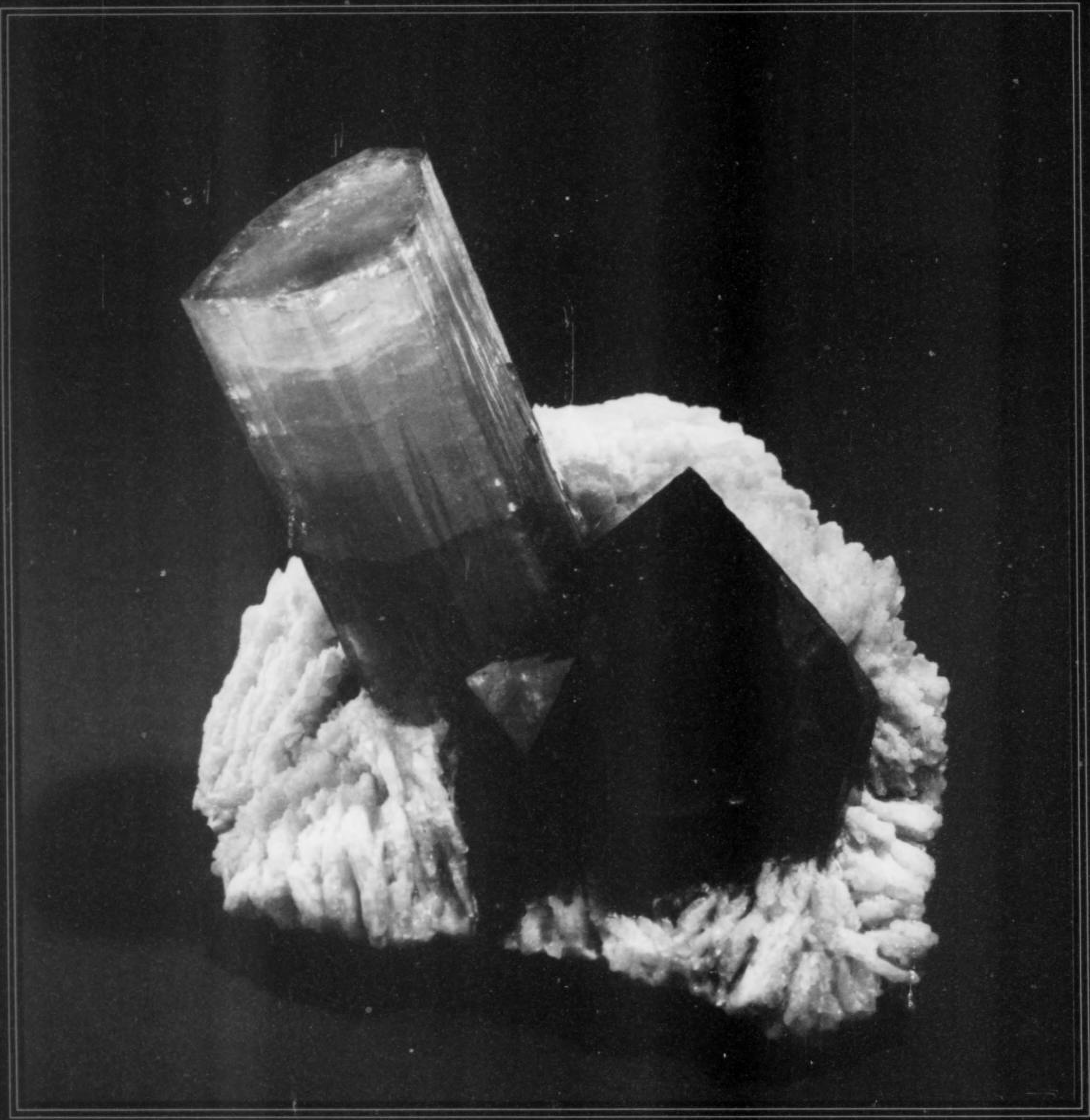

# Collecting Cavansite in the Wagholi Quarry Complex
## Pune, Maharashtra, India


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*Beautiful specimens of deep blue cavansite from the Wagholi quarry complex have been a staple of the international mineral specimen market for a number of years. The excitement began in 1988, when abundant cavansite mineralization was discovered in a horizon of economically worthless andesite below a thick layer of building stone-quality basalt in a recently opened quarrying zone near the city of Pune. Active recovery of cavansite specimens by increasingly experienced collectors continues today.*


### INTRODUCTION

Cavansite, the vividly blue hydrated silicate of calcium and vanadium, has been making news in the mineral-collecting world since the discovery of abundant specimens at Wagholi, near Pune (Poona) in 1988 (Wilke *et al.*, 1989), and the subsequent debut of these beautiful specimens on the international mineral show circuit the following year (Wilson, 1989; Robinson and King, 1989; Moore, 1989). Despite the familiarity and popularity of cavansite, little is generally known about the quarries in which it is found, or about how the specimens are collected. This short essay will provide some additional information of interest to collectors.

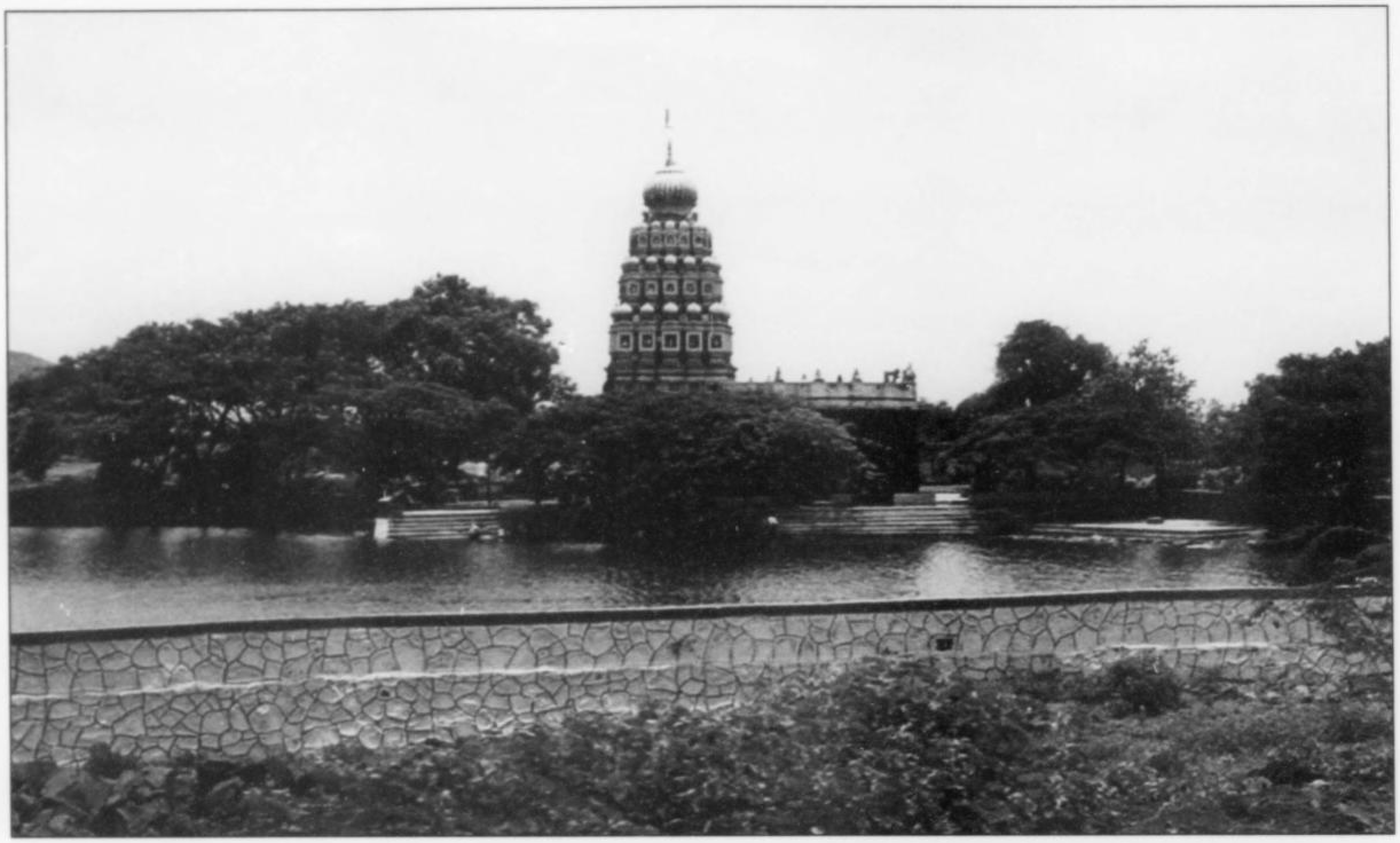
### HISTORY

Cavansite is found in a complex of stone quarries which lies about 1 kilometer from the village of Wagholi. The locality name is derived from the word *wagh*, which means "tigers" in the local language. Tiger predations were a problem in previous centuries; 265 years ago, when the menace from tigers was increasing, the local feudal chief instructed his people to build a temple in which to pray and appease the god who had power over tigers; this temple is known as Wagheswar Mandir, "the Temple of the Lord of Tigers," and it still stands in Wagholi today.

Wagholi lies 25 km east of the city of Pune (pronounced "Poonay," the former Poona), on the main Pune-Ahmednagar highway. Until about 30 years ago, Wagholi was a sleepy little town surrounded by agricultural fields, its economy based solely on farming and on supplying milk and fresh vegetables to Pune. Every morning the farmers could be seen pedaling down the road to Pune, cans of milk and sacks of vegetables dangling from their bicycles.

Pune itself is a large city, a cradle of education and the fine arts, with many educational institutions more than a hundred years old. It was a favorite city of the British during the colonial period. After India gained independence in 1947, Pune became a center of emerging industrialization; the coming of major industries such as automobile manufacture and electronics brought about rapid changes in the lifestyle of the citizens of Pune and the surrounding region.

For one thing, industrialization led to a large influx of job-seekers and consequently a population explosion. During the 1970's there was feverish housing construction activity in Pune, first of shanty towns and low-income housing developments, then of modern apartment buildings and more upscale homes. When the city proper could accommodate no more new construction, builders and promoters turned their attention to the surrounding countryside, which



was soon abuzz with housing projects. The village of Wagholi, once separated from Pune by 25 rural kilometers, is now in effect a suburb of Pune; in fact, the building activity has now crept a further 5 km out from Wagholi, along the Pune-Admednagar road.

This urbanization was a death knell for the stone quarries just outside Pune, which had been operating for more than half a century and were already famous among mineral collectors for their spectacular specimens, particularly of green fluorapophyllite. As at the Pashan, Chinchwad and Erandawna quarries, the state government, the building lobbies, and those concerned with the environment all united to exert intense pressure on the quarry owners to cease blasting and close down the quarries. The government ordered the establishment of new quarrying zones, to be no closer to the city center than 25 km. The old specimen-producing quarries had to be abandoned, and were soon closely surrounded by new neighborhoods of houses and apartment buildings.

Among the quarry zones farther out from Pune which were begun or greatly expanded during the 1980's are the Moshi, Shindawnay and Wagholi zones. No significant mineral specimens have been found in the first two of these, but the Wagholi zone was destined to yield a flood of dramatic specimens of cavansite from two large, adjacent quarries, both of which had been in existence since the mid-1970's.

In the Wagholi quarry zone, a sill of hard, compact, black "*aa*" basalt averaging more than 10 meters thick is underlain by a 60-cm to 1.5-meter-thick flow of reddish, andesitic "*pahoehoe*" (for definitions of these terms see Ottens, 2003). While the overlying aa makes excellent building stone, the pahoehoe beneath it is unsuitable for building because it is too soft, amygdaloidal, and full of mineralized vesicles. The pahoehoe layer is traceable for about 50 square km around Wagholi, ending abruptly at Theur in the south, Markal in the north, Shikrapur in the east and Moshi in the west.

The quarry operators at Wagholi have sought to exploit the aa sill as intensively as possible while not wasting money and time on the underlying pahoehoe unit. Even though a further layer of aa, from 20 to more than 30 meters thick, is known to be present *below*

***Figure 1.*** **The Wagholi Temple, *Wagheswar Mandir* ("The Temple of the Lord of Tigers"), built at Wagholi around 1740 A.D.**

***Figure 2.*** **The author holding a particularly large and fine matrix specimen of cavansite recently collected from the Wagholi quarry.**

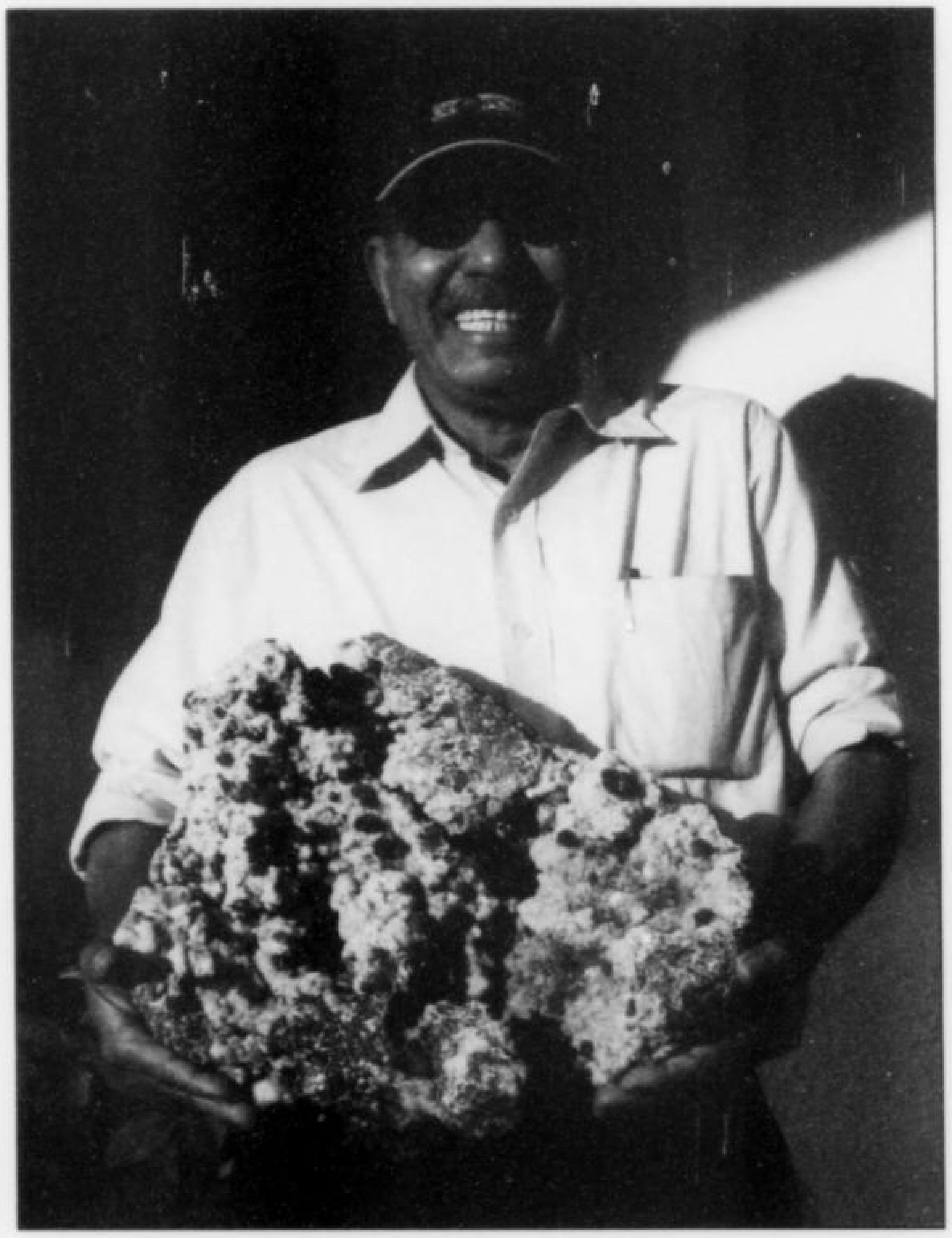


*Figure 3.* **Drilling blast holes for the purpose of removing the overlying layer of compact *aa* basalt from the cavansite-producing andesitic *pahoehoe* horizon.**

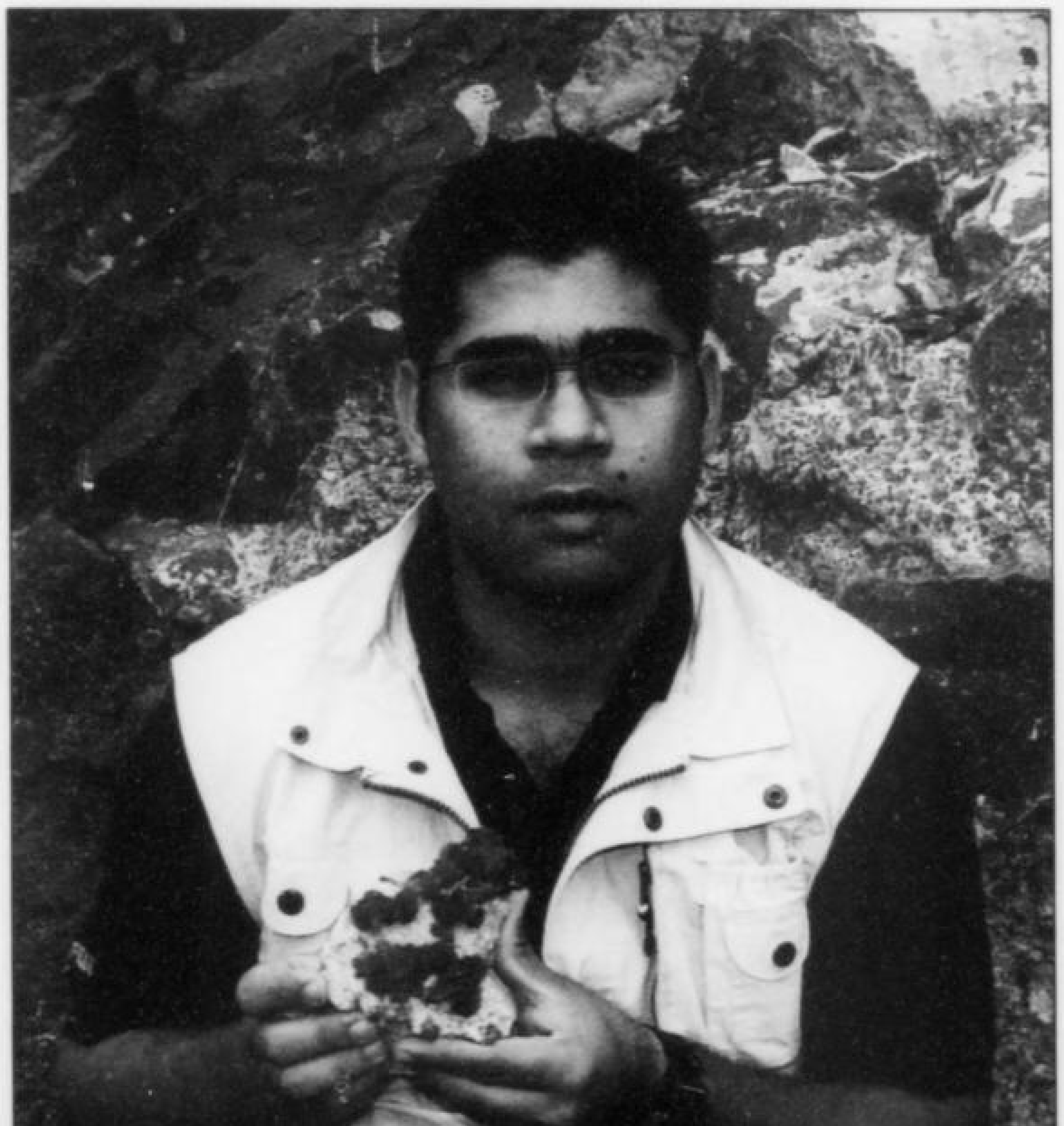


*Figure 4.* **The author's son, Sami Makki, holding a superb cavansite small-cabinet specimen.**

the relatively thin pahoehoe layer, the operators cease excavating downwards once they hit the pahoehoe. Quarrying worthless (to them) pahoehoe would involve the same expense as quarrying aa, and they would still have to pay royalties to the government even though the pahoehoe is unsalable. In addition, making the quarries too deep would cause inconveniently deep pools of rainwater to gather at the bottom; and the deeper the quarries go the harder it is for trucks to haul out rock as the quarry roads grow ever more steeply inclined. Therefore, instead of digging into the pahoehoe "floor," the owners prefer to expand the quarries horizonally until reaching the limits established by land ownership (eight of the ten now-active quarries in the Wagholi zone have 5 acres or less in which to keep taking new lateral "bites" of aa basalt).

If the cavansite-bearing pahoehoe rock had been quarried since the early days of large-scale exploitation of the Wagholi zone, cavansite specimens from Wagholi would have been as abundant as, say, fluorapophyllite from Jalgaon or stilbite-stellerite from Nasik have been since about 1980.

## COLLECTING CAVANSITE

There are about 40 quarries in the Wagholi quarry complex, but only four of these sporadically produce cavansite. Each quarry pit is known by the name of its owner, who in most cases is also the owner of the tract of land on which the quarry has been developed. In a very few cases, the land does not belong to the operator, who has merely rented the quarry pit. If in these cases the pit operates for five years or more, it takes the name of the operator; otherwise the excavation is perpetually named after the landowner.

The quarry in which the first cavansite strike occurred was run at the time by Arvind Bhale, and is known today as the Dhoot quarry, after the surname of the landowner. A standing pipe of brecciated rock about 6 meters tall was found to contain cavansite near its

*Figure 5.* A flat of freshly collected cavansite specimens.

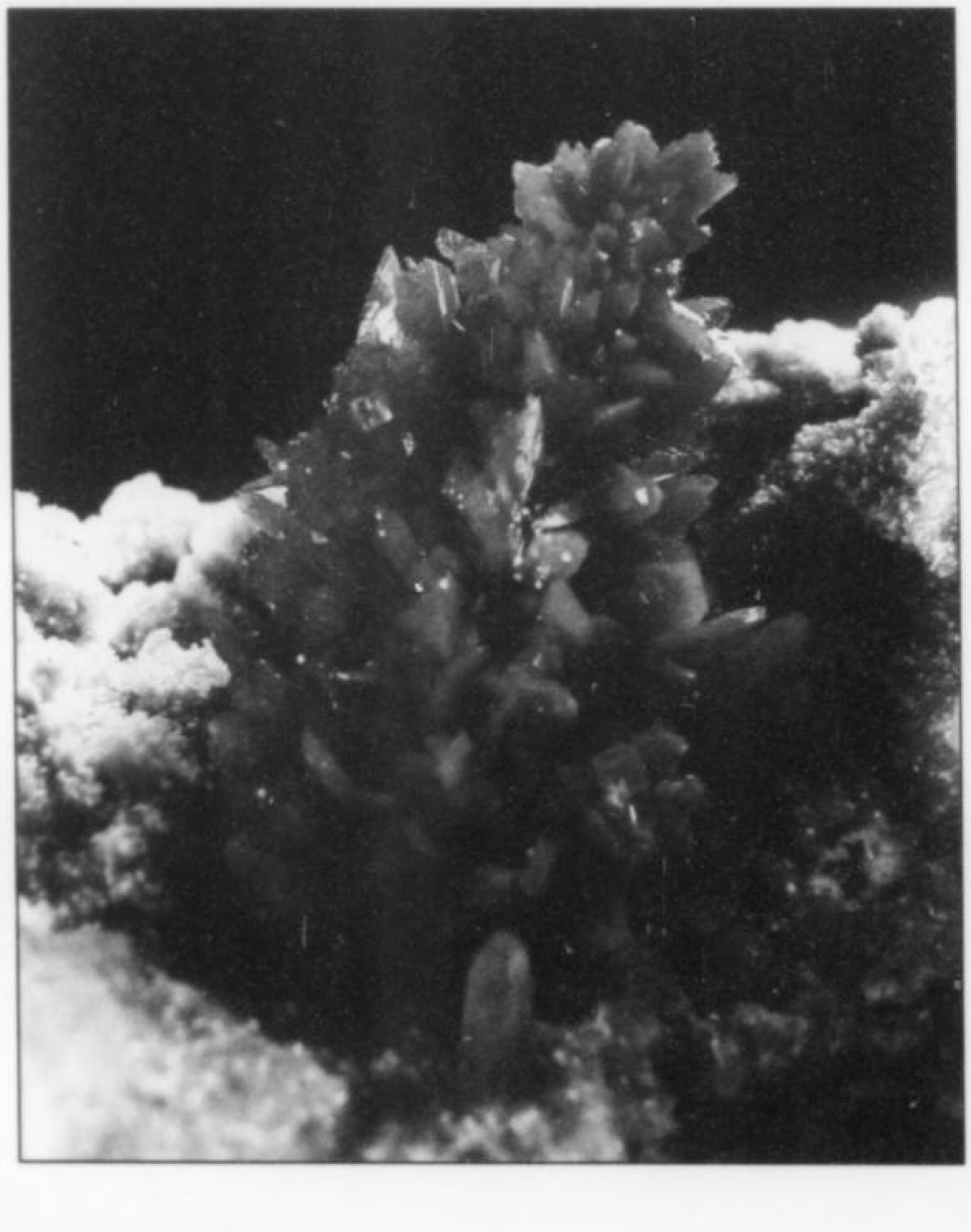


*Figure 6.* Pentagonite crystal cluster, about 1.5 cm, from Wagholi. Wendell Wilson photo.

*Figure 7.* A cavansite "bow tie" about 5 mm across. Wendell Wilson photo.

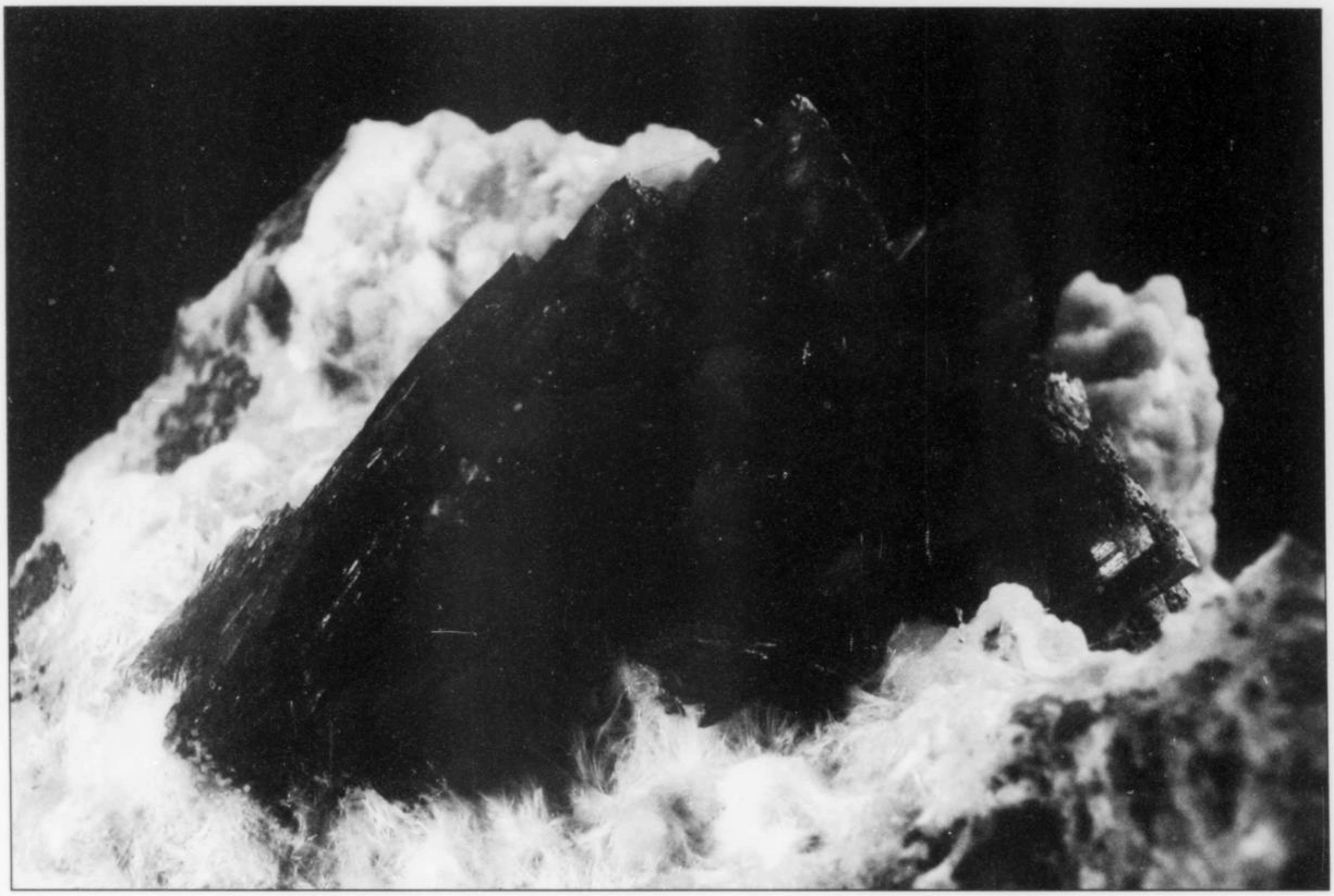


*Figure 8.* **Cavansite crystal cluster showing more or less parallel growth, 3.5 cm across, on matrix with mordenite, from Wagholi. Makki specimen; Wendell Wilson photo.**

base at the level of the quarry floor. This column was removed, and excavation in search of more cavansite then proceeded downward for another 6 meters below the floor of the quarry. For a thorough account of this first, furious collecting period, which commenced in 1988, see Wilke *et al.* (1989) and Kothavala (1991). The Dhoot quarry produced what are still probably the best, though not the largest, spherical clusters of cavansite. In subsequent years, Bhale cut down on his cavansite-producing activity in the quarry, while other collectors sought cavansite in nearby quarries.

Today, cavansite specimens are collected primarily by a few experienced people, the present author among them. A few collectors actually stay at the quarries from dawn to dusk, watching the blasting of rock and the removal of debris and rubble, noticing when crystal vugs are exposed. Quarry workers who chance upon a cavansite vug at the bottom of the aa layer hurriedly and stealthily remove whatever specimens they can before their regular working hours end: the owners of the quarries loathe any thought or mention of cavansite, since their quotas for producing building stone are compromised when the workers pause for significant periods to collect mineral specimens. Such was the situation in 1990 (Kothavala, 1991), and it remains the same today, although recent years have seen no discoveries as spectacular as those of 1988–1990.

Crystallized cavansite is found sporadically in the quarry floors, in small vugs and irregular cavities filled with heulandite and stilbite. A typical cavansite vug is not like the horizontal, level-floored cavities in which apophyllite, heulandite, scolecite and stilbite are generally found. Rather, it is sinuous and twisting, and it varies unpredictably in height and width. Typically it is lined by tiny, intergrown and matted crystals of stilbite and heulandite and interrupted by blobs of basalt protruding into it. If the cavity is poor in cavansite, the bright blue spheres are sparse and widely separated among the white zeolite matting, but in richer cavities the cavansite spheres will be clustered and partially intergrown over wide areas.

When a cavansite vug is exposed, the experienced collectors use only very heavy tools (a 10-kg sledgehammer and a chisel 60 cm long and more than 2 cm thick) to remove specimens. This is because a blow from the heavy sledgehammer delivers a concentrated push to the flat tip of the long, heavy chisel. If, instead, a hammer weighing only 2 kg or 5 kg is used, the chisel will vibrate and jump, sending a more jarring shock wave through the rock; cavansite spherules are then more likely to break free, and large, potentially fine matrix specimens may be ruined. For the same reasons, heavy tools are also used to extract fine specimens of fluorapophyllite and scolecite.

A method has been developed by some collectors to reinforce specimens while they are still inside the cavities. Delicate specimens, such as stalactiform towers of apophyllite with heulandite crystals or bowtie-shaped stilbite aggregates lightly attached, are irrigated with a solution of Crazy-glue so that they can withstand the hammer blows of the extraction process. In effect, the specimens are glued even before they are separated from the mother rock. I had the misfortune of unknowingly buying a specimen of pentagonite which had been glued *in situ* in this way, and after carefully trimming it I sold it to a prominent collector. The transaction brought temporary infamy to me, despite my 40 years' record of honest and reputable dealing.

## DISTRIBUTION OF CAVANSITE

In the quarries of the Wagholi complex where it occurs, cavansite is associated variously with calcite, hematite, mordenite and

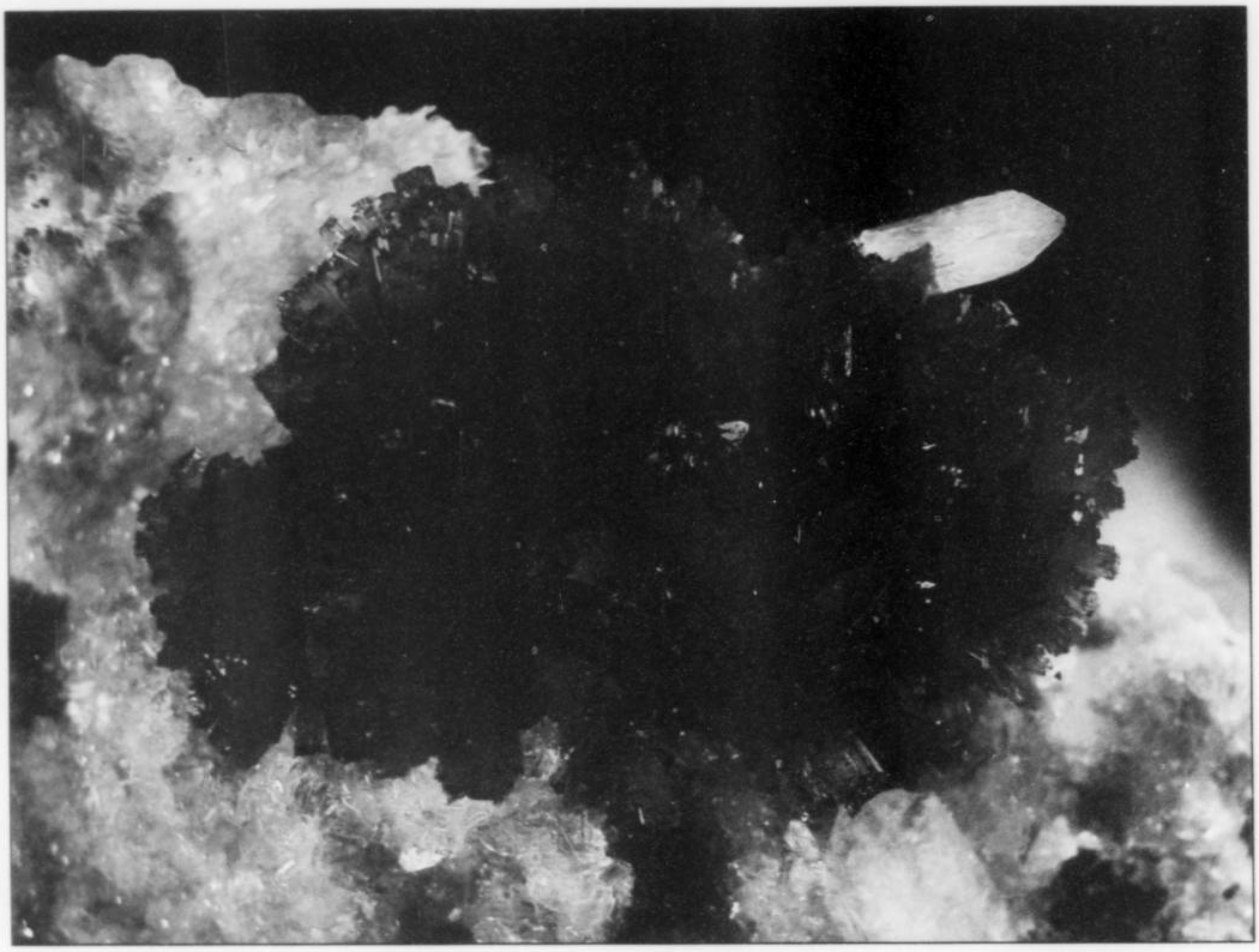


***Figure 9.*** **Cavansite crystal cluster, 2 cm, on matrix. Makki specimen; Wendell Wilson photo.**

pentagonite, as well as with the more familiar stilbite, heulandite and pale green fluorapophyllite.

In one quarry which lies 2 km northeast of the main group of quarries, cavansite spherules rest on beds of fibrous mordenite crystals, and cavansite "bowties," commonly also resting on mordenite, are found; I have collected bowtie-shaped aggregates measuring from 3 mm to 1.5 cm long at this site (one is illustrated here).

A quarry lying in what is known as the "Number 4 area" mainly produces pentagonite, with very little cavansite. The isolated acicular crystals and crystal sprays of pentagonite are found in vesicles in a reddish, compact basalt which forms a belt under a thick layer of hard, compact, black basalt. In general, pentagonite-bearing rock underlies cavansite-bearing rock in this quarry; in rare cases I have found both species in the same horizon, and I have collected a few specimens showing cavansite spherules and pentagonite together.

I have also collected attractive specimens showing tiny, bladed cavansite crystals resting on and penetrating tiny, petal-like bladed crystals of white stilbite. One cavity was entirely filled with floater specimens of stilbite/cavansite, and we took out many fine, small crystal clusters.

Although the collectors (like me) and the runners who deal in mineral specimens know the cavansite-producing quarries by the names of their owners, those names are not publicized, because the authorities grant permission only for the extraction of basalt, so most quarry owners don't want their names associated with the collecting of mineral specimens.

In India, as in many parts of the world, professional mineral specimen collecting is not well understood or recognized as a scientific and commercial activity. Consequently it is a gray area, and official guidelines or regulations governing it are lacking. This absence of legal recognition causes confusion, and results in harassment by the authorities. Thus mineral collecting ventures must be low-profile.

It is high time that the authorities acquire an understanding of the dynamics of mineral specimen collecting and the worldwide commercial and scientific interest that supports it. When the specimens are sold at mineral shows and elsewhere, an economic chain is completed in which all parties involved reap, with delight, the fruits of many labors, and augment the economy of the nation.

## CONCLUSION

Future supplies of cavansite specimens from the Wagholi zone are uncertain. One cannot know when or if another large discovery will occur, but as long as quarrying operations continue, there is hope. Of course, nothing lasts forever, even in the Deccan Traps, and ultimately the cavansite and pentagonite specimen material which now seems so common on the mineral market will become rare.

## BIBLIOGRAPHY


KOTHAVALA, R. Z. (1991) The Wagholi cavansite locality near Poona, India. *Mineralogical Record*, **22**, 415–420.

MOORE, T. (1989) Notes from Europe. *Mineralogical Record*, **20**, 483–486.

OTTENS, B. (2003) Minerals of the Deccan Traps, India. *Mineralogical Record*, **34**, 1–82.

ROBINSON, G. W., and KING, V. T. (1989) What's new in minerals? *Mineralogical Record*, **20**, 387–399.

WILKE, H-J., SCHNORRER-KÖHLER, G., and BHALE, A. (1989) Cavansit aus Indien. *Lapis*, **14**, 39–42.

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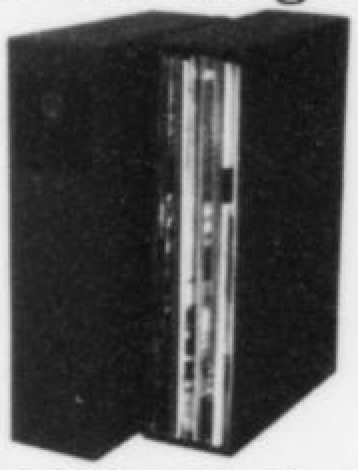

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E-Mail: execdir@ pfeifferfoundation.org
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Tel: (505) 835-5140
E-Mail: vwlueth@nmt.edu
Fax: (505) 835-6333
Associate Curator: Robert Eveleth
Tel: (505) 835-5325
E-mail: beveleth@gis.nmt.edu
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Website: http://www.desertmuseum.org
Curator, Mineralogy: Anna M. Domitrovic
Tel: (520) 883-3033
E-mail: adomitrovic@desertmuseum.org
2021 N. Kinney Road
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Tel: (604) 822-6992
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Curator: Dr. Jeffrey E. Post
e-mail: minerals@nmnh.si.edu
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**Washington,** DC 20560-0119
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Director and Curator: Jose Santamaria
Tel: (770) 386-0576 x 401
Fax: (770) 386-0600
51 Mineral Museum Dr.
**White,** GA 30184
Mailing Address:
P.O. Box 3663
White, GA 30184
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**Newark**, DE 19716
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I-20121 **Milano,** Italy
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Specialty: Minerals of India

*Reinvestigation of*

# DIOPTASE-PLANCHÉITE PSEUDOMORPHS

*after Calcite*

## FROM THE TANTARA COPPER DEPOSIT KATANGA, REPUBLIQUE DU CONGO


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*In 1920 some very interesting and attractive pseudomorphs were recovered from the Tantara copper desposit in what was then the Belgian Congo. While showing the scalenohedral morphology of calcite, the crystals consist instead of dioptase, planchéite, and perhaps also shattuckite. We located the original specimens from this find in order to resolve a controversy about their mineralogy that dates back to 1925–1926.*


## INTRODUCTION

Planchéite was first described by Lacroix (1908), based on specimens from Mindouli (in what was then the French Congo) which had been supplied to him by a French explorer, Mr. Planché. Schoep (1920) described planchéite from the Tantara copper deposit, Katanga, Republic of the Congo (then the Belgian Congo), as a blue, fibrous, compact mineral occurring in radiating spherules. Tantara planchéite occurs with malachite, cuprite and goethite in the dolomitic beds of the calcarous Kakontwe Formation (Schoep, 1932).

Buttgenbach (1925) mentioned that in the Tantara copper deposit scalenohedral pseudomorphs of dioptase after calcite occur in which the dioptase has, in turn, been partially altered to planchéite and "katangite." ("Katangite" was later discredited by Van Oosterwijck-Gastouche (1968), who identified it as a microcrystalline variety of planchéite.) A year later Hacquart (1926) stated that these rare pseudomorphs were instead composed of a mixture of shattuckite and planchéite with remnant dioptase.

Buttgenbach (1925) and Hacquart (1926) therefore disagreed on the presence of shattuckite in these specimens. The goal of our investigation was to clarify this ambiguity surrounding the Tantara pseudomorphs through a study of the original specimen from the

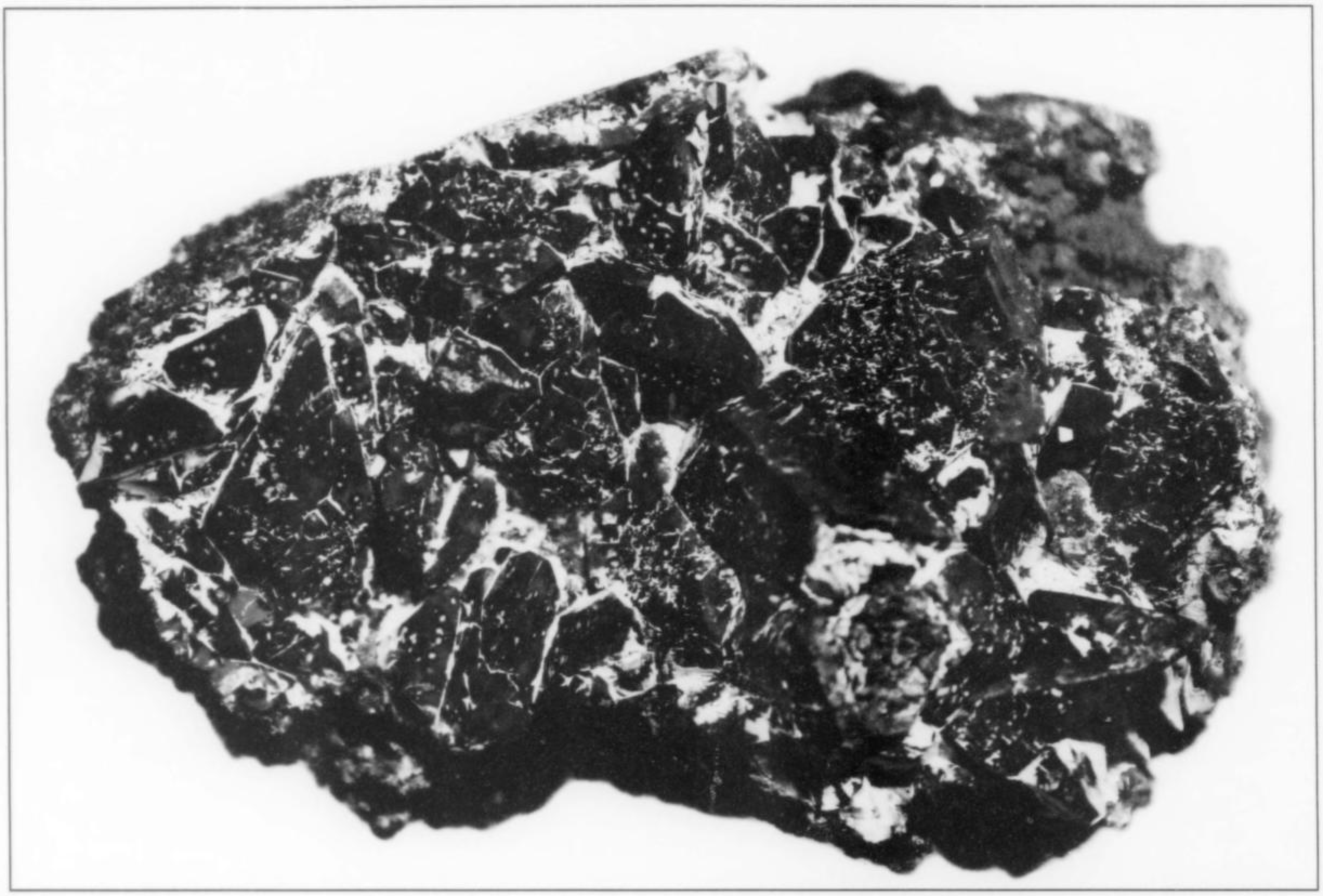

*Figure 1.* **Planchéite, 6 cm, partially pseudomorphic after dioptase pseudomorphs after calcite crystals from Tantara, Katanga, République Démocratique du Congo. Private collection Renaud Vochten; Alfred Schallenberg photo.**

*Figure 2.* **Planchéite, 3 cm, partially pseudomorphic after dioptase pseudomorphs after calcite crystals from Tantara, Katanga, République Démocratique du Congo. Private collection Paul De Bondt; Alfred Schallenberg photo.**

mineral collection of Schoep, which is now in the private collection of one of the authors (RV). We attempted to determine, through several different analytical methods, whether shattuckite forms a part of these pseudomorphs.

## SPECIMEN DESCRIPTION

The original Schoep specimen consists of a group of emerald-green scalenohedral pseudomorphs of dioptase after calcite in which some portions of the crystals show an azure-blue color (Figs. 1, 2 and 3). The size of the crystals varies between 5 and 10 mm. The blue color can be explained by two possible transformations: dioptase (space group $R\bar{3}$) into shattuckite (space group *Pcab*) represented by reaction (1), or dioptase into planchéite (*Pcnb*), represented by reaction (2):

(1.) $5Cu_6(Si_6O_{18})\cdot 6H_2O \rightarrow 6Cu_5(SiO_3)_4(OH)_2 + 6SiO_2 + 24\ H_2O$
(dioptase) (shattuckite)

(2.) $4Cu_6(Si_6O_{18})\cdot 6H_2O \rightarrow 3Cu_8(Si_8O_{22})(OH)_4\cdot H_2O + 15H_2O$
(dioptase) (planchéite)

The transformation of dioptase into shatttuckite supposes the

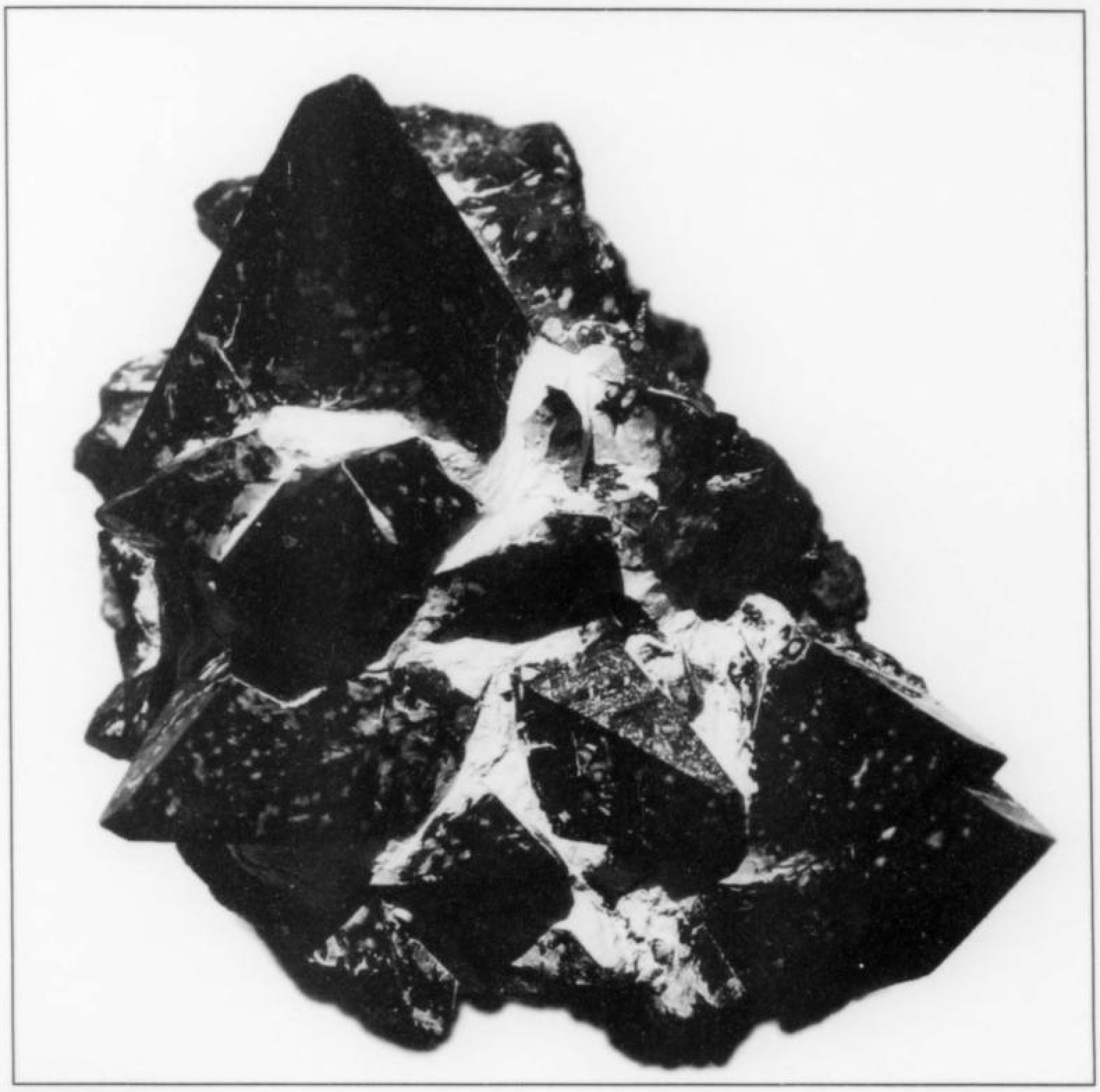

***Figure 3.*** **Planchéite, 2.5 cm, partially pseudomorphic after dioptase pseudomorphs after calcite crystals from Tantara, Katanga, République Démocratique du Congo. Private collection of Claude Hootelé; Alfred Schallenberg photo.**

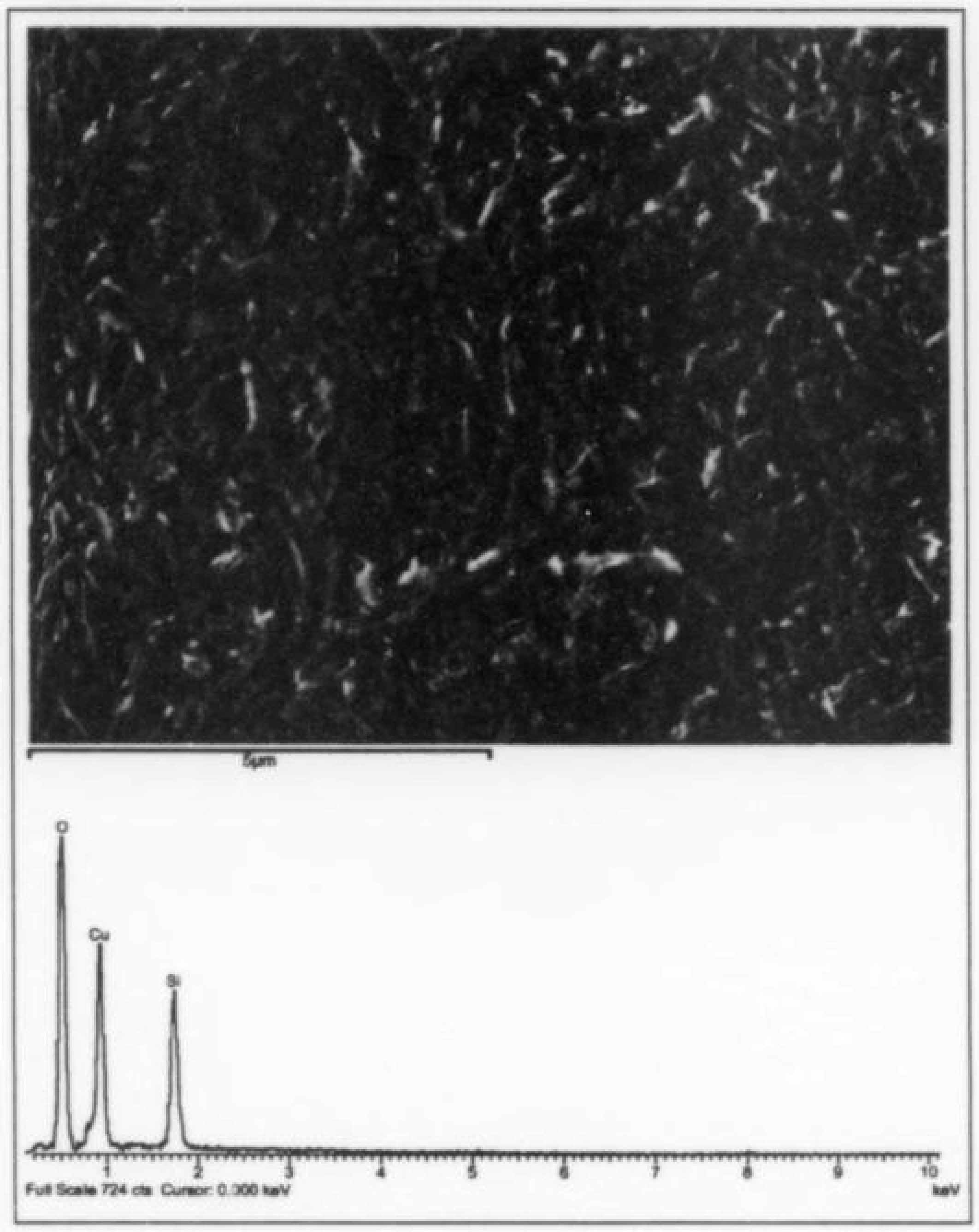


***Figure 4.*** **SEM photograph of planchéite. EDS qualitative element analysis with EDAX.**

formation of amorphous or crystalline $SiO_2$, but the crystalline phase has not been detected by X-ray diffraction.

## SCANNING ELECTRON MICROSCOPY

The SEM photography and the determination of the elements present were carried out utilizing a JEOL JSM-5510 scanning electron microscope coupled to an electron probe microanalyzer, operating at 10 kV in the energy-dispersive mode, with a beam size of 40 ηm. The SEM photograph shown here (Fig. 4) reveals a large number of irregularly intergrown crystals. Readings taken at more then 20 separate points show only three elements present (oxygen, copper and silicon).

## THERMAL STABILITY

The thermal stability of the specimen was investigated by thermogravimetric analysis (TGA). A TA-Instruments 2950 thermogravimetric analyzer was used with an applied heating rate of 2° C/minute and a nitrogen flow of 30 ml/minute. The TGA-curve and its derivative are shown here in Figure 5. In the temperature range 18–925° C a total weight loss of 11.21% was recorded. Between 18 and 275° C only zeolitic water was lost, whereas between 275 and 615° C 4.6% of water was lost, corresponding to the loss of 3 molecules of water in planchéite as described in the following reactions.

(3.) $Cu_8(Si_8O_{22})(OH)_4{\cdot}H_2O \rightarrow Cu_8(Si_8O_{22})(OH)_4 + H_2O$
(planchéite) dehydrated planchéite

(4.) $Cu_8(Si_8O_{22})(OH)_4 \rightarrow 8CuO + 8SiO_2 + 2H_2O$
(dehydrated planchéite) (tenorite)

CuO and $SiO_2$ are stable in the temperature range 615–700° C. In the range 700–915° CuO is converted in $Cu_2O$ and oxygen. The loss of oxygen equaled 5.95%, compared to the theoretical value of 5.46% (reaction 5).

(5.) $8CuO \rightarrow 4Cu_2O + 2O_2$
(tenorite) (cuprite)

The thermal decomposition of planchéite can therefore be summarized as:

(6.) $Cu_8(Si_8O_{22})(OH)_4{\cdot}H_2O \rightarrow 4Cu_2O + 8SiO_2 + 3H_2O + 2O_2$
(planchéite) (cuprite) (silica)

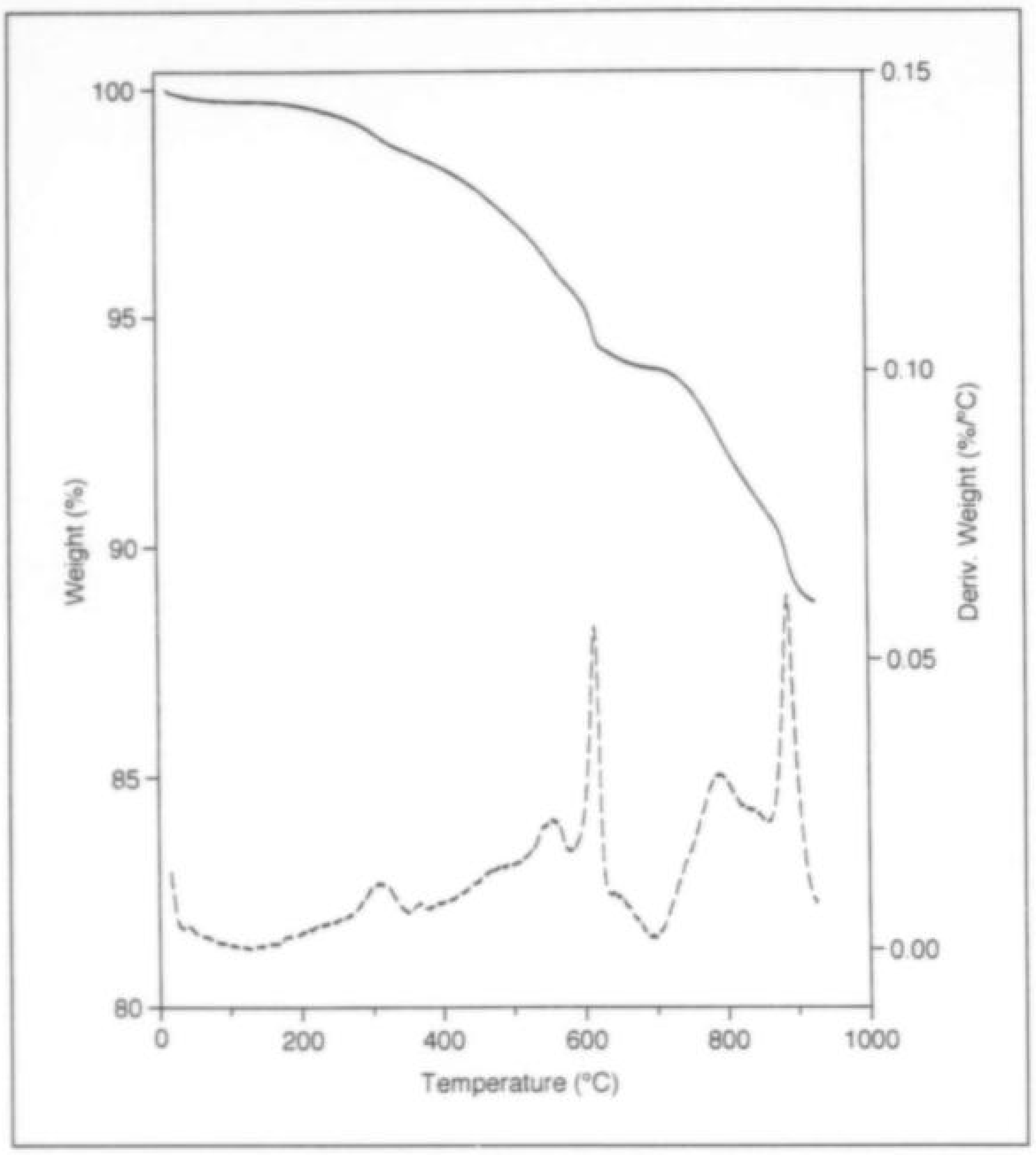


*Figure 5.* **Thermal decomposition of planchéite.**

The thermal decomposition spectrum of the specimen compares favourably with that of pure planchéite from Mindigi, Kambove, Katanga, Republic of the Congo.

## X-RAY POWDER DIFFRACTION

X-ray powder diffraction data were recorded at 40 kV and 20 mA using Cu K$\alpha_1$ ($\lambda$ = 1.54059 Å) and a Guinier-Hägg camera with a diameter of 100 mm. Silicon powder (NBS-640) was used as a calibration standard. Relative intensities of the diffraction lines were measured with an LS20 line scanner (Key Instruments, Täby, Sweden). The spectrum shows a number of lines that plancheite and shattuckite have in common, but some important lines ($I$ = 100 and $I$ = 50) of shattuckite are missing, confirming the absence of shattuckite in the sample. The spectrum corresponds to that of planchéite, ICDD card # 290576.

## INFRARED SPECTROSCOPY

The infrared spectrum was recorded by using the KBr dispersion technique (1 mg sample in 300 mg KBr) with a Bruker Vector 22 Fourier Transform Infrared Spectrometer covering the range 400–4000 cm$^{-1}$. Figure 6 shows the infrared absorption spectrum of the mineral. Comparing it to the spectrum of planchéite from Mindigi, we conclude that the minerals are identical. Unfortunately with this experiment one cannot exclude the existence of shattuckite.

The most important feature of the infrared spectrum can be explained from the structure. The infrared spectrum shows a broad band at ~3400 cm$^{-1}$ and a weaker absorption band at 1663 cm$^{-1}$ (overtone of the water-bending vibration), confirming the presence of water in the structure (Farmer, 1974); the plancheite structure contains water whereas the shattuckite structure does not. The sharp absorption peak at 3600 cm$^{-1}$ is compatible with the presence of OH in the structure (both minerals contain OH, so this is not diagnostic for distinguishing the two). According to Farmer (1974), the absorption band at 1018 cm$^{-1}$ corresponds with the out-of-plane bending of Si-O, whereas the Si-O bending and the Si-O stretching vibrations occur at 400–550 cm$^{-1}$ and 970–1070 cm$^{-1}$ respectively. The absorption band at 660 cm$^{-1}$ can be attributed to the OH liberation.

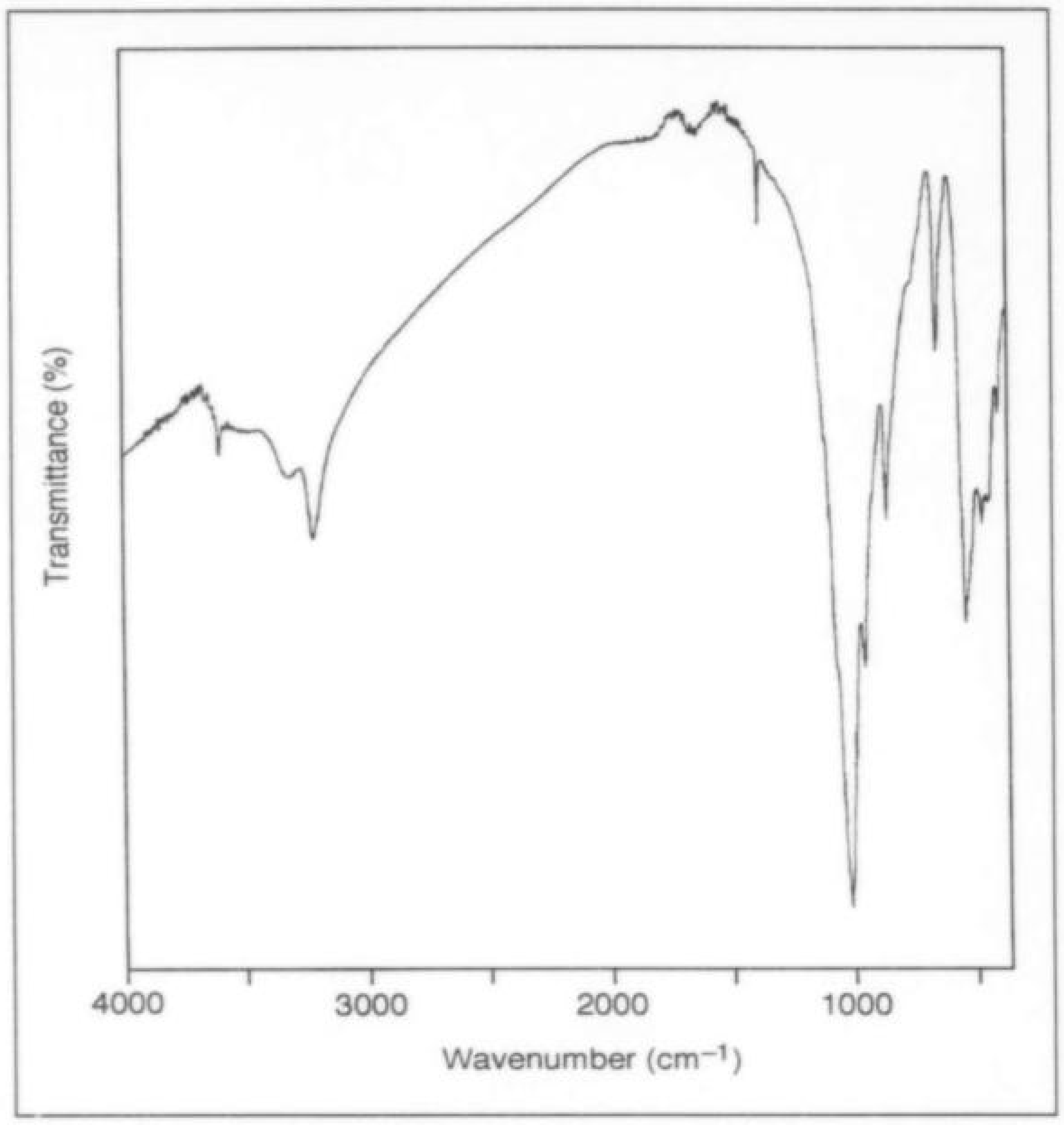


*Figure 6.* **Fourier transform infrared spectrum of planchéite.**

## CONCLUSION

This study concludes from thermogravimetric analysis and X-ray powder diffraction that a specimen of a dioptase pseudomorph after calcite from the Tantara copper deposit (Republic of the Congo) has been partially transformed into planchéite, and that no shattuckite is present. The results confirm the proposition of Buttgenbach (1925) about the transformation of dioptase into planchéite, and disagree with the results of Hacquart (1926) regarding the existence of shattuckite in the specimen.


## ACKNOWLEDGMENTS

The authors wish to thank J. Eysermans of EMAT (Universiteit Antwerpen) for taking the SEM photographs and A. Schallenberg of EMAT (University Antwerp) for making the color photographs.


## REFERENCES


BUTTGENBACH, H. (1925) Minéralogie du Congo Belge. *Bulletin de la Société Royale des Sciences, Liége*, XIII.

FARMER, V. C. (1974) The infrared spectra of minerals. *Mineralogical Society*, London, 539 p.

HACQUART, A. (1926) Pseudomorphose de cristeaux de calcite en shattuckite-planchéite et en dioptase. *Annales de la Société Géolologique de Belgique, Liège*, **49**, 90–94.

LACROIX, A. (1908) Sur une nouvelle espècie minérale, provenant du Congo française. *Compte rendu Acad. Sci.*, **146**, 722–725.

SCHOEP, A. (1921) Sur un minéral nouveau pour le Katanga. *Annales de la Société Géolologique de Belgique, Liège*, **44**, CII.

SCHOEF, A. (1932) Les minéraux du gîte cuprifère de Tantara. *Annales du musée du Congc belge, Tervuren*, **3**, 11.

STRUNZ H., and NICKEL, E. H. (2001) *Strunz Mineralogical Tables*, E. Schweizerbart'sche Verlagsbuchhandlung, Science Publishers, 9ed, Stuttgart 2004, 870 p.

VAN OOSTERWIJCK-GASTOUCHE, M. C. (1968) Sur la nomenclature de certains silicates de cuivre de Katanga. Le problème de planchéite, shattuckite, bisbéite et katangite. *Annales de la Société Géolologique de Belgique, Liège*, **91**, 401.

# Pencil Garnet

## *From the Haramosh Mountains Near Gilgit, Pakistan*

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*Some unusual garnet crystals from the Haramosh mountains, near Gilgit, Pakistan, show what at first appears to be an impossible morphology for a garnet: a first-order hexagonal prism terminated by a second-order hexagonal pyramid. However, X-ray diffraction and chemical analysis confirm its identity as a garnet and the crystals are optically isotropic in cross-polarized light, indicating cubic symmetry.*

### INTRODUCTION

About 20 years ago, some very unusual crystals of garnet from the Haramosh Mountains, near Gilgit, Pakistan, came on the market. The crystals are elongated in one direction (Fig. 1) and appear to have a very strange morphology, a first-order hexagonal prism terminated by a second-order hexagonal pyramid. The geology and mineralogy of this region are covered in detail by Kazmi *et al.* (1985) who report that almandine and spessartine are common constituents of the granitic pegmatites of the region, and they note the presence of elongated spessartine with a quartz core. One of us (WWP) acquired some excellent crystals of this garnet, affording the opportunity to record the details of this rather unusual overgrowth.

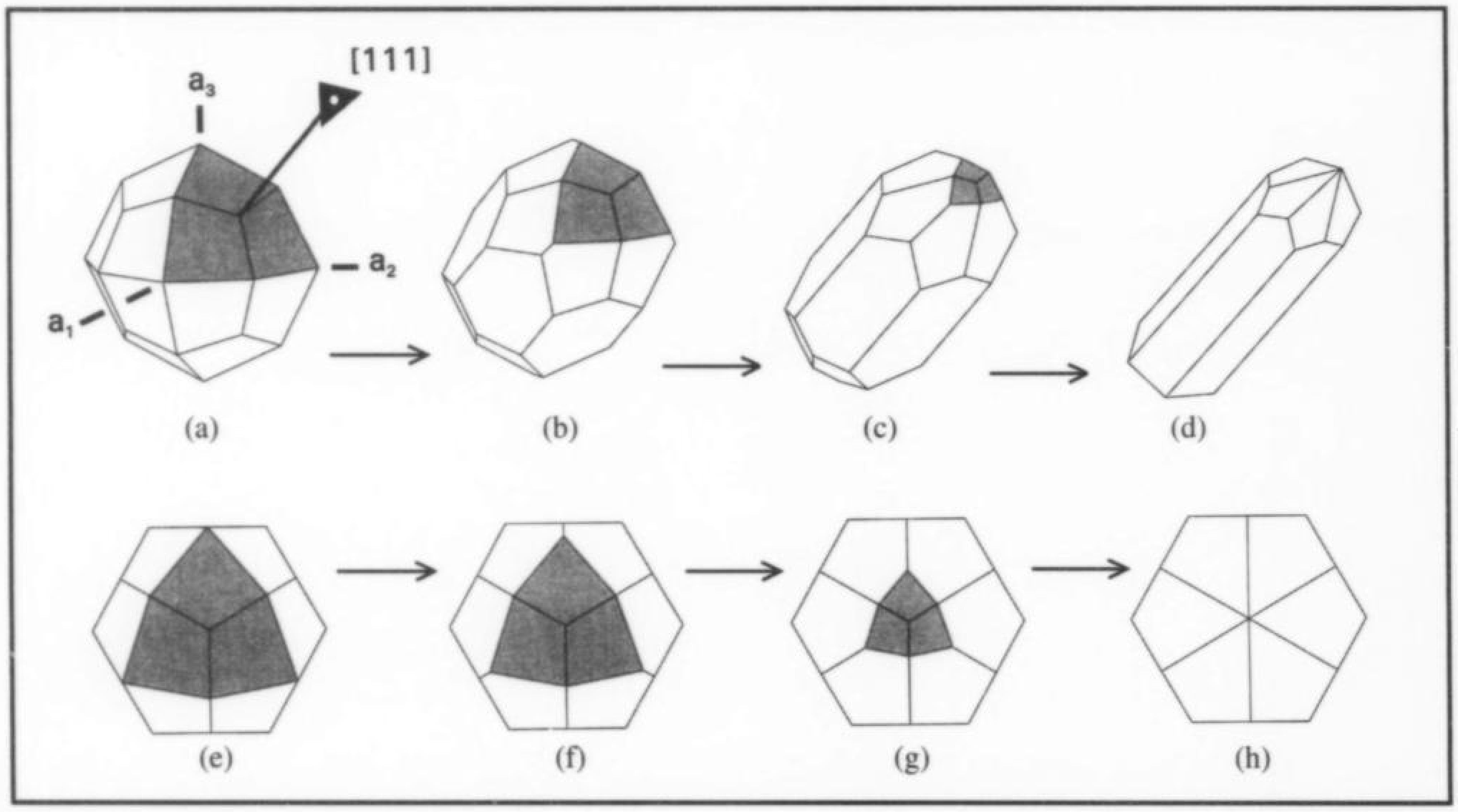
### CHEMICAL COMPOSITION OF THE GARNET

Polished thin-sections perpendicular to the elongated direction of the crystals were first examined in plane-polarized and cross-polarized light. Each crystal consists of a core of quartz, surrounded by garnet that is extinct in cross-polarized light, indicating that the garnet overgrowth is structurally contiguous with the quartz core.

Electron probe microanalysis was done on a CAMECA SX-50 equipped with three wavelength-dispersive spectrometers at an excitation voltage of 20 kV, a sample current of 20 nA and a beam diameter of 5 microns. The garnet was analyzed for Si, Al, Ti, Fe, Mn, Mg and Ca using the following standards: Si, Mg (pyrope); Al, Mn (spessartine); Ti (titanite); Fe (fayalite); Ca (diopside); V, Cr, Zn, P, Na, V, Cr, Sr, Y, Zr and Sn were sought but not detected. The data were reduced using the PAP routine of Pouchou and Pichoir (1985). A typical analysis (mean of 10 points) is given in Table 1, together with the empirical formula based on 12 oxygen atoms pfu (per formula unit). The analysis shows that the garnet is an almandine, but with a very high spessartine component: $Almandine_{54}$ $Spessatine_{45}$ $Pyrope_1$. Refinement of the unit-cell dimension gave a = 11.570(1) Å, which is in accord with the analyzed composition.

***Figure 1.*** **Two views of a pencil garnet crystal from the Haramosh mountains, near Gilgit, Pakistan; the crystal is 14 mm in diameter and 32 mm long. Photograph by Al Patterson, Bill Pinch specimen.**

***Figure 2.*** **Conceptual representation of the formation of a pseudohexagonal prism and pyramid by distortion of a {112} trapezohedron; the upper set of figures show a perspective view of the process, and the lower set of figures shows the crystal above viewed down [111]. The (112), (121) and (211) faces are shaded in all figures.**



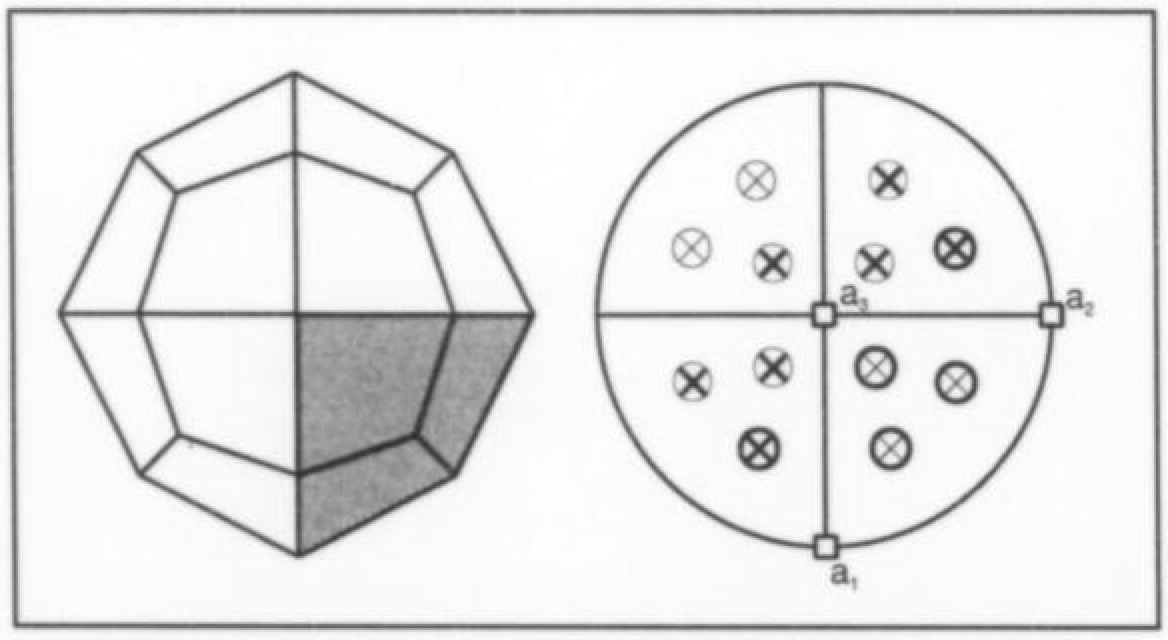




***Figure 3.*** **Left: the {112} trapezohedron viewed down [001] with the (112), (121) and (211) faces shaded; right: stereographic projection of the faces of the trapezohedron, coded to show which faces are observed (heavy symbols) and not observed (light symbols); crosses indicate faces with positive l values, circles indicate faces with negative l values.**

## CRYSTALLOGRAPHY

Examination of the elongated crystal shown in Figure 1 reveals that two distinct morphological forms are present. The dominant form is the trapezohedron {211} and the minor form is the rhombic dodecahedron {110}. As a result of the unusual habit, not all faces of each form are present. This situation is illustrated schematically in Figure 2. Figure 2a shows the trapezohedron {112}, a closed form with 24 faces; the faces (112), (121) and (211) are shaded and the [111] direction is indicated. If the crystal is elongated along the [111] direction (Fig. 2b,c), the faces (112), (121) and (211) gradually become smaller until they vanish (Fig. 2d). Figures 2e through 2h shown the corresponding views of the crystals down [111]; the triplet of faces becomes smaller and eventually disappears. As this conceptual process occurs, the $(1\bar{1}1)$, $(2\bar{1}\bar{1})$, $(\bar{1}\bar{1}2)$, $(11\bar{2})$, $(\bar{2}11)$ and $(\bar{1}2\bar{1})$ faces elongate to form a pseudohexagonal prism with its long axis along [111] while the $(2\bar{1}1)$, $(1\bar{1}2)$, $(\bar{1}12)$, $(\bar{1}21)$, $(12\bar{1})$ and $(21\bar{1})$ faces become the pseudohexagonal pyramid. The axis of garnet elongation (parallel to the [111] three-fold

*Table 1.* **Chemical composition (wt.%) and formula (*apfu*) for pencil garnet from the Haramosh Mountains, Pakistan.**

| | | | |
|---|---|---|---|
| $SiO_2$ | 35.73 | Si | 2.970 |
| $Al_2O_3$ | 20.53 | Al | 0.030 |
| $TiO_2$ | 0.03 | Sum | 3.000 |
| FeO | 23.32 | | |
| MnO | 19.47 | Al | 1.982 |
| MgO | 0.03 | Ti | 0.002 |
| CaO | 0.47 | Sum | 1.984 |
| Sum | 99.58 | | |
| | | $Fe^{2+}$ | 1.621 |
| | | $Mn^{2+}$ | 1.371 |
| | | Mg | 0.004 |
| | | Ca | 0.042 |
| | | Sum | 3.038 |

axis) coincides with the trigonal axis of the core quartz crystal.

The development of the different faces of this form is illustrated in Figure 3 which shows a stereographic representation of the faces of the trapezohedron. Crosses indicate faces projected onto the northern hemisphere, circles indicate faces projected onto the southern hemisphere, faces noted with heavy symbols occur on the garnet [*i.e.*, $(1\bar{2}1)$, $(2\bar{1}\bar{1})$, $(\bar{1}\bar{1}2)$, $(11\bar{2})$, $(\bar{2}11)$, $(\bar{1}2\bar{1})$, $(2\bar{1}1)$, $(1\bar{1}2)$, $(\bar{1}12)$, $(\bar{1}21)$, $(12\bar{1})$ and $(21\bar{1})$] and light symbols indicate faces of the trapezohedron that do not occur on the garnet [*i.e.*, (211), (112), (121), $(1\bar{2}\bar{1})$, $(1\bar{1}\bar{2})$, $(\bar{2}1\bar{1})$, $(\bar{1}1\bar{2})$, $(\bar{1}\bar{2}1)$, $(\bar{2}\bar{1}1)$, $(\bar{1}\bar{1}\bar{2})$, $(\bar{2}\bar{1}\bar{1})$ and $(\bar{1}\bar{2}\bar{1})$].

In addition to the trapezohedral faces, there are also some faces of the rhombic dodecahedron {110} present: $(1\bar{1}0)$, $(10\bar{1})$, $(01\bar{1})$, $(\bar{1}10)$, $(\bar{1}01)$ and $(0\bar{1}1)$ that appear to form a second-order pseudohexagonal prism. In the crystal shown in Figure 1, only two of these faces are moderately developed and the other four are only just discernible.


## ACKNOWLEDGEMENTS

We thank Mark Cooper for preparation of Figures 2 and 3. FCH was supported by a Canada Research Chair and by Equipment and Discovery Grants from the Natural Sciences and Engineering Research Council of Canada.


## REFERENCES


KAZMI, A. H., PETERS, J. J., and OBODDA, H. P. (1985) Gem pegmatites of the Shingus-Dusso area, Gilgit, Pakistan. *Mineralogical Record*, **16**, 393–411.

POUCHOU, J. L., and PICHOIR, F. (1985) "PAP" φ(ρZ) procedure for improved quantitative microanalysis. In *Microbeam Analysis* (J. T. Armstrong, ed.) San Francisco Press, San Francisco, California (104–106).

*Memoirs of a Mineral Collector—Part I:*

# Fifty-Nine Treasure Hunts in Minas Gerais, 1969–2005

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*The author has been visiting mines and mineral occurrences in Brazil for 36 years, and has seen many now-famous discoveries. Fifty-nine (and counting) mineralogical tours have taken him from his home in Austria to such enticing sites as the Virgem da Lapa, Golconda, Santa Rosa, Sapo and Morganite mines and the Ouro Preto topaz fields, and to the warehouses, shops and homes of numerous Brazilian mineral miners and dealers. And he was also among the first non-Brazilians to see the great specimens of Jonas mine elbaite, discovered in 1978. Following are the records, verbal and photographic, of more than three decades of journeys to Minas Gerais.*

## 1969

### Welcome to Brazil: Ouro Preto, Santa Rosa mine

Brazil: the name sings of magic to a seasoned mineral collector. To me, from the beginning, it has sung particularly of crystals as found in their natural settings.

Our Super DC-8, with 204 passengers, landed smoothly in Rio de Janeiro on that November day in 1969. We had come here as collectors with somewhat conflicting interests. As a collector of mineral crystals, I was not primarily interested in gems, although I was certainly not averse to bringing home a few precious stones. The rest of our party consisted of three doctors, a jeweler, and a naturalized Brazilian who was waiting in Rio to meet us.

It was November 10, 1969, and in Rio a rainy spring day which promised greenhouse temperatures was beginning. The great size of this beautiful world capital surprised me, but the city did not greet us in a particularly friendly way. A bag was missing from our luggage, and during the resulting delay of several days the rain prevented us from doing much satisfactory sightseeing. Although uncomfortable with having little to do, we were happy to take pleasant evening walks and eat luxurious meals. In Brazil the European palate is seduced by fantastic-tasting fruits and by styles of cooking which we found totally unfamiliar.

At last the missing luggage reappeared. Luckily it proved


***Figure 1.*** **The Ouro Preto School of Mines, home to a superb mineral collection. Wendell Wilson photo.**

possible to renew lapsed appointments with important people, and soon, armed with the best recommendations (worth their weight in gold here) we began our safari into the interior.

Traveling in a rented car and a second passenger car driven by our local guide, we enjoyed a lively journey through the virgin forest of Guanabara, a botanical wonder-world, arriving at last within the borders of the land of the crystal-seeker: the state of Minas Gerais. The asphalt ribbon of the road proceeded monotonously over the red lateritic soil of the hilly countryside. In the few isolated towns and settlements, dark-skinned, colorfully dressed people who seemed distrustful without seeming really unfriendly surrounded us. As soon as we turned off the main highway, the state of the roads deteriorated noticeably and our shiny vehicles developed problems.

When we arrived in Ouro Preto, a phone call from our consul reached us. Were we still alive? Yes, we were, despite these cars we'd been traveling in. Why did he ask? We heard to our horror that one of the cars had no front axle and no front shock absorber; the rental agency had made a mistake in letting us take the car. That explained all the rattling during the trip, and why the driver had had to steer the wrong way while negotiating curves. The vehicle received the service it needed, and slowly we recovered our nerves—but only slowly, since the humid heat of this place was giving us the blind staggers.

Now, though, it was onward to visit our first mine! Our mechanical steed now gave us a much better ride, and kilometer after kilometer stroked by. Gusts of rain wet the blacktop, and ahead of us a big tractor had skidded on the slippery surface and gone partly off the road. Up hill and down dale we went, at last reaching Rodrigo Silva, the last village before the topaz mines of Ouro Preto.

We presented ourselves to the deputy of the mine owner, who received us jovially and personally took us in a jeep to the mine, about 40 minutes' drive away. We could see that the rocks cropping out along the way were extremely friable; one could shatter them to pieces with one's bare fists. At the mine, thanks to this first contact between our language-capable neo-Brazilian and the local villagers, it proved possible to buy some specimens of the famous amber-colored "imperial" topaz of the region, although I was able only to get some "reference" pieces, hardly suitable for display.

In Ouro Preto, a steep-lying city with many monuments, the wonderful mineral collection of the mining school was on view. The gemstone section was very rich, and provided a good cross-section of the mineral treasures of Minas Gerais.

Distances in Brazil are enormous: the ribbon of the road seemed endless as we drove on to Governador Valadares, realizing forcibly that Brazil is about the size of Europe. Once we ran over a green mamba—an extremely deadly poisonous snake. Very near the edge of the road was the rim of a primeval forest which eternally hides the land under its thick, undisturbed canopy. To reclaim this land, and to provide people from the interior with access to the wider world, Brasilia, a new capital city, was soon to be built.

Governador Valadares is the center of the precious-stone industry, and the better-known dealers here did not seem at all interested in small-scale business. Casual customers, such as humble mineral collectors with little money, were best advised to seek out only small dealers. We saw no fabulous museum pieces this way, but we did encounter reasonable prices and were able to pick up a few nice specimens. One major mineral dealer frankly refused to sell us anything because, he said, he sold only wholesale lots. He had beautiful tourmaline specimens, but sold them only in lots of a dozen at least . . . at the "best price." During the brief time of this first adventure in Valadares I found only one business openly advertised as a mineral shop. Making connections

*Figure 2.* **Traveling to Governador Valadares along the main Rio-Bahia road, through the hill country of Minas Gerais.**

with others might have been possible, but, I realized, it would have taken days and would have required a command of the language.

In the interior of the country, languid nature had impressed her stamp on people and relationships, and making plans about schedules and routes seemed an illusion. Stormy weather was then prevailing over vast expanses, and flooding prevented us from traveling to the Tres Barras aquamarine mine. Teofilo Otoni, a city in northern Minas Gerais, is known as a locality for many gem species—and here we encountered a fact about many locality designations referring to wide tracts of land. Most of the prospects which had been dug in the red laterite had no names; thus it was very hard to assign a precise designation to any particular find. The Brazilian "Strahlers," called *garimpeiros*, were usually illiterate, and often did not know, any more than the dealers who bought their wares did, which specimen came from which place.

Only large mines and mine complexes, which by virtue of their productivity had attracted permanent settlements, had definite names. Such was the case for the Santa Rosa mine near Itambacuri, then already famous as a source of multicolored tourmaline. Armed with the permission of the mine owner, we set out for Santa Rosa, where few Europeans had been before us. Our jeep, equipped with four-wheel drive and all-weather tires, climbed in the hot morning through the forest wilderness around Itambacuri. We encountered *garimpeiros* on galloping horses. We had to "restore" some bridges before we could duly admire the control with which our driver negotiated the old beams of their decks.

Pre-arranged horn signals announced our arrival at a private road, sparing us any unpleasant surprises. It was a Sunday, and the miners were not working. My blue-peaked cap with a tassel excited a special interest in them.

Soon we were standing before the entrance tunnel—a narrow opening, half as tall as a man, in pegmatite. In front of it there were trenches a meter deep and at least a meter wide. Carefully, curiously, I pressed forward into the tunnel, moving by decimeters into this blind, moisture-swollen mouth of Hell. In the dim light from the portal behind me I saw a snake on the ground. I recognized it as a viper (the locals later told me soberly that it was a cobra), certainly dead . . . but then again I couldn't be wholly sure . . .

To be on the safe side I picked up a stick lying nearby, lifted the snake in the air, and left this hospitable spot. Outside, in sunlight, our doctor and tour leader was standing, legs far apart, in front of an open trench. As soon as he saw me, and saw the snake hanging down on both sides of the stick, our masterful tour leader jumped, and pallor covered his face; sweat droplets appeared instantaneously on his forehead. Then his rather pudgy body performed an act that would normally have been impossible for it: he leaped over the trench. On its other side he stood gasping and trembling. To calm him, I called to him, "Doctor, the snake is dead!" I shouldn't have done that. Still panting from his daring leap, and still panicking from the hypothetical thought of a snake bite, the doctor reflexively let loose a barrage of abuse and insults, thus redeeming his honor as an "old trooper."

Hard by the primitive wooden huts of Santa Rosa lay the burrows of the shafts and tunnels. We wanted to descend into Mother Earth, and two mine workers were available as guides. We entered a tunnel 1.4 meters high and 40 centimeters wide, its entryway supported by wooden beams. The temperature inside was between 40 and 50 Celsius, and the humidity was 100%. The rock was so friable that the tunnel walls started to crumble with only light blows from hammers. We stooped, crept and crawled until we were soaked with sweat, and then when we paused for breath we began to look about us eagerly for colossal tourmaline crystals.

At the time this mine was not very viable economically; most of the regular *garimpeiros* were off seeking their luck elsewhere. But about 60 were still here, and it was expected that when a great find was made again the rest of them would hurry here like swarming ants, to partake in the new prosperity. The work was done entirely by hand, in narrow spaces and under harsh conditions—a European would find it impossible to tolerate such hardships. I succeeded in finding a very nice, gemmy green elbaite crystal about 4 cm long and wide. In the huts above ground we saw a few multicolored tourmalines, the largest measuring 10 cm; the crystals were not terminated, but their colors were wonderful. Here at the mine the asking prices for these specimens were so enormous that we had to pass on buying them.

Despite the small material rewards, we found this mine visit extremely interesting and instructive. We had gained a clearer idea of the places in which gemstones are found, and we now knew the localities of some of our showpieces. On the drive back to Itambacuri we saw an armadillo, and a brief, heavy downpour threatened to render the road impassable. These experiences further enriched and enlivened our day-trip.

Back in Teofilo Otoni we looked for more gemstone sellers, and many beautiful pieces were shown to us; however, the best of them were so expensive that owning them had to remain just a fantasy. Moreover, we had learned that finding such specimens in the mines for ourselves would be very difficult. Shortage of time, impassable terrain, the lack of official authorization, and the presence of danger all dampened individual initiative. All the same, I had been able to acquire a few exceptional specimens during this safari, e.g. a 14 cm-long dravite crystal group, a terminated green elbaite crystal 14 cm long and 4 cm thick, a water-clear topaz crystal weighing 500 grams, and a few titanite crystals to 6 cm.

Now we had a few kilograms of minerals in our travel bags. But the search had left us, finally, with a certain weariness with our own visions, one might say a certain "stone blindness." The climate and the vagabond-like style of travel, as well as the annoyance of increasingly common toll stations along the road, led us now to call a retreat. (The toll stations occurred at intervals of 50 to 150 km; we had grown unhappy with the idea of paying frequent "duties" on specimens which had been expensive to begin with.) Having chosen to make our return trip through the state of Espirito Santo, where tolls were levied less often, we succeeded, mostly by dumb luck, in having a drive free of disturbing developments. Passing through Guarapari, where radioactive monazite sand had brought a purportedly curative bath facility into being, we hurried along the coast to Rio.

Gorgeous weather had accompanied us now for days. The members of the gemstone safari plunged into the "crystal" floods of the Copacabana; besides swimming, we wanted to soak up the sunrays. A trip to the Corcovado, where a gigantic statue of Christ spread its arms wide over Rio, provided unforgettable views over the city and over the cliffs that rose steeply above the blue flood of the ocean. The Favelas, the city's poor quarter, hung like a cluster of swallows' nests on the cliffs, not far from the forest which ringed the city above Sugarloaf Mountain to the north.

Twice we drove all around Sugarloaf—although, both times, we were forced to make emergency stops because of fires in the engine. And we had to forego our planned visit to the snake farm in São Paulo. In the city at that time there was a threat of flooding and of outbreaks of contagious disease . . . and it was time for us to begin our trip back home to Austria.

While our jet took off from the runway, the great city glittered behind us, in myriad night-lights. Traveling home with us were gem-crystal specimens from Minas Gerais, the El Dorado of crystal-seekers. Goodbye, Brazil!

# 1971

### A Viewing Experience

I had accepted an invitation from an acquaintance, Ilia Deleff, a mineral dealer in Governador Valdares, to inspect his crystal warehouse. Shirtsleeves rolled up and collar open, he greeted me warmly and led me to a central room. Brazilian workers in wide-brimmed sombreros were either sitting around or working in monotonous, uniform rhythms. The temperature was remarkably high, and everyone was sweating heavily. It was January 1971, and at home, in central Europe, there was extreme cold and much snow. Thinking about it, I realized that I was obliged to be happy, having found such warmth here.

I examined a display of large crystal specimens that was set up just outside a large central room in the warehouse. Realizing that this was just an appetizer, I was a bit perplexed: I had never before seen so many specimens as fine as these! Beautifully formed quartz crystal groups stood or lay all around, many of them more than a meter across. Several groups were completely transparent, and they ranged from colorless "rock crystal" through quite black smoky quartz. I gazed all around, and touched some of the specimens to assure myself that I was not dreaming. "Decorator" quartz specimens, huge crystals of amazonite, and huge terminated crystals of black tourmaline were all on hand. My host, standing nearby, visibly savored my delight.

An amethyst geode weighing at least a ton attracted my attention. The deep violet crystals in the narrow tubular neck on its top receded, disappearing, from the observer. This museum piece resembled a multi-dimensional coral specimen.

I would gladly have spent days there, examining everything in detail. To visit this place was to see extremely large specimens; thus I felt like a mountaineer suddenly finding himself in the high Alps. A lamp was brought to illuminate a large, transparent smoky quartz crystal from the rear. This splendid specimen glowed like a star, richly reddish brown.

Slowly but surely, however, I grew "stone blind" until, exhausted, I sat down. A person sitting nearby was a fellow German-speaker, and knew much about Brazil and its minerals . . .

# 1973

### Santa Rosa mine

In radiant weather, our bus traveled through the tropical Brazilian landscape, rich with luxuriant vegetation. Shortly after Rio de Janeiro the coastal hills greeted us, and the bus climbed higher, taking wide curves. The roadside was lined with banana trees; with other huge tropical trees overgrown by parasitical plants; with gorgeous shrubs whose flowers were intensely red. At intervals, waterfalls tumbled over the steep cliffs and lost themselves in cracks in the earth. Again I was under the spell of this wonderfully exotic place, and my study-tour companions proclaimed themselves likewise enchanted.

The group which had embarked on this Easter 1973 gemstone-study trip to Brazil consisted of one Swiss, five Germans, one Dutchman and three Austrians, and we were now bound for the interior—for Minas Gerais. Our initial sojourn in Rio, the world's

*Figure 3.* **In a tunnel entrance to the Santa Rosa mine, Itambacuri, Minas Gerais.**

*Figure 4.* **Washing of recently mined tourmaline and quartz crystals at the Santa Rosa mine. After washing, the crystals are scraped and further "cleaned" with a butcher knife—and thereby countless small crystals of rare accessory minerals are lost.**

most beautiful city, had taken only one day, and we had quickly made contact there with "mineral people." Crystals and faceted stones alike had been available at reasonable prices from some private people. The gemstone magnate Jules Sauer, the owner of the Cruzeiro tourmaline mine, had treated us to a display showing off the variety and plenitude of Brazilian crystals. So many precious things!

On the following day, in the comfortably furnished bus, the members of the group I was leading were keeping very busy trying to frame the fast-moving images of the landscape in their cameras' viewfinders. Soon we reached the highest point of the coastal hills, at an elevation of 1000 meters, and almost immediately the character of the land was transformed. The road descended rapidly to a brown river, and we saw typical South American settlements nestled harmoniously among stands of trees. Lines of hills appeared, and in the crease of a valley we rolled smoothly north. Most of the houses in the villages were of a simple type, but occasionally manor houses came into view, their spaciousness, dignity and aesthetic refinement bespeaking the high social place of their owners.

Although these impressions were strong, our gazes began to grow tired, and faces once tense with curiosity began to relax. The travelers began taking short naps; rest stops now and then broke up the journey. Throughout, though, we remained alert for photo opportunities: lovely almond-eyed girls in exotic costumes; the expressive faces of farm laborers; colorful, bustling village markets . . . there were more than enough.

Hours passed in conversation until, at last, the red light of late afternoon was illuminating the erosional patterns on the laterite hills, and turning huge termite mounds purple. We began to discern, one by one, the dark entrances of mine tunnels on nearby hillsides! Lepidolite dumps (well-known signs of gemstone occurrences) were piled outside of the openings. And now the first hillside houses of Governador Valadares came suddenly into view; they rested on the slopes of a taller than average "sugarloaf" mountain called Ibituruna, at whose base the red-brown Rio Doce flowed by in slow majesty. "Patience," the river seemed to whisper—a word holding much of life's wisdom for people who live in these latitudes.

Patience, however, is certainly not a distinguishing characteristic of Europeans. No sooner had we checked in at our hotel and briefly refreshed ourselves than we were again on the go. As it happened, one of the few official mineral dealers in Governador Valadares was taking inventory just then, and he put us off until a few days later. Nevertheless, since by then I already had a fairly wide circle of local acquaintances, intensive shopping (as well as sightseeing) could go on until well into the evening. Patience, gentlemen— we are just beginning our trek into Minas Gerais.

Our day concluded with a magnificent view from the high windows of our hotel rooms. The city's glitter hung magically in the dark, and a loud, joyous clamor swelled up from everywhere below us. Occasionally, faint samba rhythms rose to our ears; the wind seemed to carry the sound from houses where the day was being closed with festive elation. Palm fronds caressed the half-shadows like wide-open arms, as if to say that we were welcome here, in this place blessed by nature with so many gifts.

The morning of April 18, 1973, saw us once again under way. Teofilo Otoni, the city at the heart of the colored-gemstone business, was our goal. We hurried forward at 80 km/hour, as if in seven-league boots. Primeval forest with a continuous canopy came into view, and massive cones of granite with dark perpendicular banding surprised our eyes. Yes, our powers of mineralogical observation would be getting a big test today.

An acquaintance of mine in Teofilo Otoni, Dr. Jacinto Ganem Neto, had an extremely rich collection, and visiting him was our first goal. I had told him that we were coming, so I knew that we would find this king of crystals at home. He received us with genuine Brazilian hospitality, and, after a short conversation, allowed us to marvel at his collection. He showed obvious pleasure at our entranced expressions and our perhaps insufficiently stifled exclamations of wonder. What a lot of things to see! Beautiful colored tourmaline crystals, to 20 cm long and terminated, lay before us: matchless things, world-class specimens! There were 12 bicolored red/green scepter tourmaline crystals of highest quality; brazilianite matrix specimens 30 cm wide; superbly crystallized rose quartz clusters with childrenite rosettes; doubly terminated herderite crystals more than 10 cm long, on matrix; morganite crystals with phantoms; euclase crystals to 6 cm, the smaller ones richly colored. But one isolated tourmaline crystal would stay particularly in my memory. Twenty cm long and of a wonderful green color, it has one convex and one flat termination, and a doubly terminated quartz crystal lies across it.

One of our party was able to acquire a large green tourmaline with a beautiful, colorless, doubly terminated quartz crystal angled between prism and basal faces. No wonder that we imagined ourselves to be in the Mecca of crystals and gems here! The hours seemed to fly by, and the courteous host did not tire of showing us piece after piece of his wonder-world. The sun was already low when we took our friendly departure and, with some newly won treasures, covered the short distance to our hotel. We were still excited by what we had seen, but were already restlessly looking forward to moving on to the next mine owners, cutters, and collectors.

For some members of our party the night's rest began very late. Through friends I was able to offer them a chance to enjoy some real South American singing, dancing, and general gaiety. We

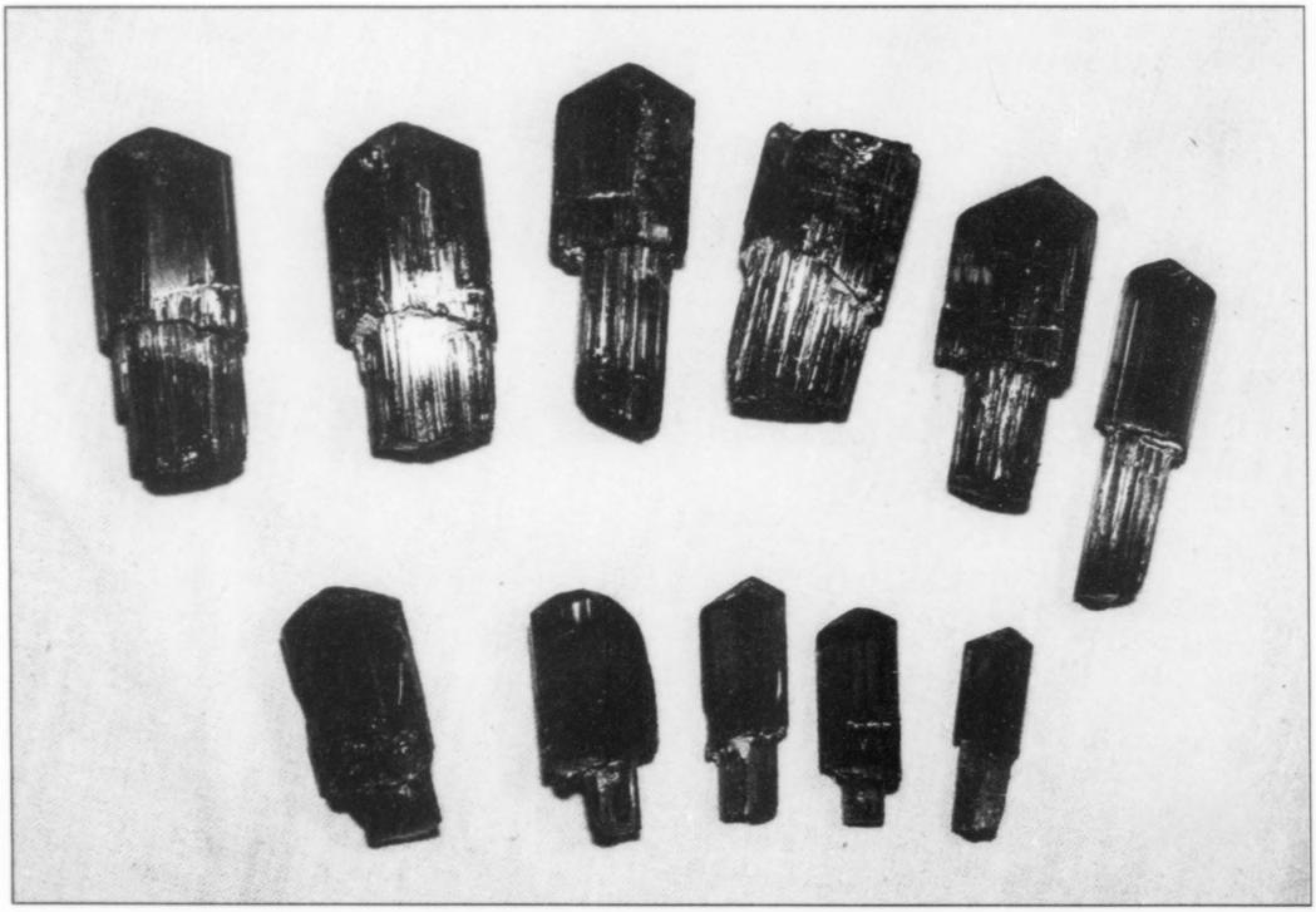


***Figure 5*. Elbaite, loose scepter crystals to 5 cm, bicolored green and red, from the Santa Rosa mine, Minas Gerais, Brazil. Displayed at shop of Jacinto Ganem Neto, Teofilo Otoni, 1973. Guido Steger photo.**

*Figure 6.* **Governador Valadares. Wendell Wilson photo.**

made lasting memories out of the melodious voices of the señoritas, the soft and insinuating music of Brazilian troubadours, and the virtuosity of the youthful guitar players. The mistress of the house kept serving us—past midnight—with foods prepared European-style, and the grandmother of the family sang a tender folk song. Our ever-goodhumored "Haro" smoothly mimed an interpretation of a popular song—and our hosts were well able to understand his performance, once good will was brought to bear.

On the next day we were scheduled to visit the Santa Rosa mine. Punctually, as arranged, the jeeps appeared in front of the hotel. Soon, in great good spirits, we were riding off on the barely passable road, through the clouds of dust we raised after leaving the asphalt-surfaced highway and entering rough terrain. It was a beautiful day, and we rode over the sticks and stones in high expectation. From Itambacuri it was about 45 kilometers to the mine. Our jeeps, passing foaming cascades of waterfalls, gallantly climbed uphill. From time to time, wild-looking horsemen crossed our path, hands held high as they gripped the reins, their sharply cut, moustached faces shadowed by their sombreros. Images from almost-forgotten movies awoke in my memory, but it was neither the time nor the place for pondering these: suddenly the shock absorber began to suffer major damage from malicious stones and potholes, and I was thrust back into reality.

Finally the Santa Rosa mine lay before us. Thanks to countless borings and tunnelings, this hill had long since become famous in mineral-collecting circles: many of the best tourmalines in existence had come from here! The brilliant glitter of the lepidolite dump reminded us not to expose our uncovered skin to the merciless sun for too long; the ultraviolet component of sunlight can be as damaging here as on the face of a glacier in the high mountains.

The first jeep had already driven past the first tunnel opening. Recent violent downpours had deeply channeled the road and made it almost impassable. When we four travelers had circled above a steep cut (our driver having mistakenly taken us on a little detour), we were laughed at by those who had arrived before us.

Since my first visit to Santa Rosa in 1968 the place had changed quite substantially. Where formerly there had been bustling activity, only a few *garimpeiros* were huddling about in these days before Easter 1973; there were many fewer huts, and the central depot was yawningly empty. Only one vault contained small bags of tourmaline; the bags were padlocked, and the key was in the safekeeping of the mine owner in Itambacuri. Well, many of the spoils here were probably not remarkable anyway, so we resolved to explore the mine for ourselves. A few of the available *garimpeiros* were willing to act as guides, and these led the way over steep terrain and through grass taller than a man. We reached the mouth of a tunnel. Some of our party entrusted themselves to the dark hole, and a little later I followed. Certainly I knew in general what mines are like, but still I wanted to experience again what it's like to find gems underground, and I wanted to see the present state of the workings. Ahead of me, now and then, in a regular rhythm, I heard muffled sounds and broken outcries, signaling collisions of the heads of the people in front of me with the mine's crossbeams, which were situated (as far as I could determine) about 1.6 meters high in the tunnels. The tunnels themselves tapered upwards, and were barely shoulder-wide; they were slippery-sided and crude, and it took a while for my companions to get used to this unfamiliar environment.

Claustrophobic conditions, danger, heat, 100% humidity—all these are the usual conditions endured by the local gem-seekers, the *garimpeiros*. They had been shaped by and stamped with these realities. It would hardly be possible for a European miner to undertake hard physical labor under the same circumstances.

Streaming with sweat and panting through wide-open mouths, some of the participants on my tour straggled out again into the daylight. They walked around in short circles, and there was a barely stifled curse. Now they knew what it means to dig precious stones! Haro reached for his wallet and pulled out 50 cruzeiros for his guide: a princely sum for a fellow man whose fate it was, apparently, to receive a minimum of reward for a maximum of work done, day in and day out. "Now," Haro said, "I appreciate my tourmalines much, much more."

On the following day we returned to Governador Valadares. From morning until late at night we kept very busy scrounging for crystals, studying them, learning about localities, and acquiring particular pieces. A few of us prepared shipments for export. Transparent "fenster" quartz, smoky quartz, colorless quartz, exceptional amazonite, topaz, tourmaline, beryl—during these days we handled much that Minas Gerais has to offer. We no longer bothered with inventories; hours dwindled to minutes. And these were only the specimens to be found in Valadares . . .

Late into the night we worked to get everything safely packed. One of us in particular worked with extreme care, and worried obsessively about his export shipment. He bestowed drinking money to make sure that his packing assistants brought special diligence to their task; he kept constant watch and did everything possible to ensure that the minerals were safely stowed away and would suffer no damage from human misjudgment during transport. An example worth following!

On the last day, in Rio, we found some emerald specimens, and I acquired a perfectly formed white topaz crystal that weighs more than 5 kg. I was able to help Uwe Niemeyer, a German mineral dealer who was now a friend, to acquire a pale blue, 4-kg topaz crystal. On the evening of the return flight, in small groups, we prowled about casually in the city that sprawls below Sugarloaf Mountain. After a refreshing swim under evening skies we returned to the hotel: departure time was near.

The shadows of night were lying over Rio by the time the howling of our giant bird's jet engines had reached full strength, and we rose from the runway. Now we were airborne, and under us spread the ocean of light of the dreaming city. Our last glimpse of Brazil already was calling forth a yearning to return, a desire to dream the dream of South America yet again . . . *saudade do Brasil.*

# 1975

**Virgem da Lapa mine**

Since early in 1975 a major Brazilian gemstone mine had become widely known: the Virgem da Lapa topaz mine. Discovered in 1973, the deposit had been intensively mined since late 1974. It lies in the northeastern part of the state of Minas Gerais, 690 km by air from Rio de Janeiro, west-northwest of Araçuai and east of Montesclaro, 76 km from the main connecting road to Bahia.

Mica schists and gneisses compose the crystalline basement rock. Sandstone and quartzite units are interlayered in these rocks, and bodies of granitic rocks, including gem-rich pegmatites, intermittently protrude as outcrops. The country rocks are of Precambrian age, whereas the erosional deposits overlying them date from the Tertiary. In quartz-lined cavities in the pegmatites, wonderful blue topaz crystals and large tourmaline crystals occur, associated with platy albite and lepidolite. Beryl, including aquamarine, is sparsely intergrown with the feldspars of the pegmatites.

Blue topaz crystals on matrix from Virgem da Lapa are rare, and these splendid specimens therefore have always been cherished, and certainly were so in 1975. The topaz crystals perch on quartz, on feldspar, and on an unusual-looking lepidolite which is characteristic of the locality: yellow to brown to violet wormlike aggregates. Fine crystals of aquamarine on feldspar matrix also are found at this locality.

In July of 1975, I went to seek out the mine. In Governador Valdares I arranged to travel by jeep to Virgem da Lapa with a good acquaintance of mine, a former *garimpeiro* who by that time had become a gemstone dealer. I traveled early on the following day to Teofilo Otoni, where I would be picked up for the excursion to the mine. On the appointed date, I waited all day at the hotel—in vain. In the evening, just as I was preparing for my night's sleep, a

***Figure 7.*** **A perfect blue topaz crystal from Virgem da Lapa, displayed by Jacinto Ganem Neto in Teofilo Otoni.**

*Figure 8.* **Virgem da Lapa mine: primitive buildings for storage and overnight stays, 1974. Guido Steger photo.**

Brazilian friend stated his willingness to take me in his vehicle to my destination. On the next morning we thundered off. Fura's jeep was quite old and battered, but on good roads the old veteran cruised smartly along, and felt safe enough.

The first landscape we entered was rank with tropical vegetation. At times, areas marked by mining in secondary deposits came up almost to the edge of the roadway. Near Marambaia we took advantage of the fine weather and sought out a large aquamarine mine called Pontalete, in a small nearby valley, but, finding little of interest, we soon were continuing on our journey. Near Padre Paraiso the topography and vegetation changed completely. The characteristic flora of moist, tropical climates receded, and the region we entered now was wide and open, with low, sparsely vegetated hills. Soon I could make out farms amid cultivated fields.

Finally we had to leave the good asphalt road which led on to Salvador, and proceed in the direction of Araçuai on a wide but extremely poor and dusty road. My driver took joy in traversing this "runway" with lightning speed—so that we wouldn't notice its roughness, he said. But passages of limited visibility caused by the whirling dust forced him to apply the brake pedal. We made a joke of this: he was evidently determined to test my horsemanship as I rode along in the saddle of this gasoline-eating steed. When eventually I tried a braking move myself by applying the top of my head to the roof of the jeep, he calmed down, deciding that rodeo wasn't so interesting after all.

In Taquaral, a little town just before Araçuai, we disembarked, covered with dust and thoroughly rattled. Here I met Acentino, a not very young but very energetic farmer, whose *noiva* (fiancée) was remarkably pretty. Acentino was also involved in minerals, and told us about new finds of diamonds, gold, uranium and other rarities along the Jequitinhonha River. After a huge meal we went to see his fruit plantation, which stretched along the banks of the river. Mango trees, with their highly edible fruits (which we sampled), stood among the orange trees in their groves. After this side trip the head of the household introduced us to José Estradea, owner of a rubellite (red elbaite) mine near Taquaral.

Finally we continued our trek. Like a comet with a long dust trail we thundered on, surmounting potholes and rocks and hillocks; we passed Araçuai, and at sundown, after a further hour's ride, we reached the village of Virgem da Lapa, after which the mine was named.

In the very modest "hotel" where we had pre-arranged to stay, there could be no thought of sleep: massive clouds of mosquitos fell upon us. There were no mosquito nets, so I sought shelter under the bedclothes. I stuck the end of my nose out, like a periscope, and at once I became the target of an attack of the blood-suckers who so far had been disappointed in their quest for a good night's meal. So many of them fell victim to me in the maelstrom around my organ of smell that my handkerchief became a heroes' grave.

In the gray light of earliest morning we sat behind the wheel again, and our jeep labored up onto the dusty laterite road. We passed an abandoned mine, crossed a dry stream bed, clambered over flat-lying rock outcrops, and drove through a forest. We had long since left the easy road and were now experiencing a roadway paved with corrugated iron sheets—not good for the digestion. At last, after we had bounced over every bump for an endless 25 kilometers, we entered the area of the mine.

*Figure 9.* **Smoky quartz from an unknown locality in Minas Gerais, Brazil, displayed by dealer in Teofilo Otoni, 1976. Guido Steger photo.**

A remarkable scene presented itself: the whole hillside, riddled with holes, suggested a giant building-construction site. Machines clattered, and crude shanties supported by wooden poles rose against the morning's blue sky. One's gaze could wander widely over unending chains of hills to the far horizon. Now, I thought, I am at the famous Virgem da Lapa gemstone mine, source of the blue topaz and green aquamarine crystals that are astonishing people everywhere!

The *garimpeiros* seemed not to be in any particular hurry this morning; soon we fell into conversation with them. In this way I learned that my friend Luizelio Barreto, for whom I had waited so long in Teofilo Otoni, had already arrived at the mine, indeed, on the previous day, bringing with him a load of the explosives which had been desperately needed, and in his drive here he had been compelled to avoid all towns and to detour around all government outposts while on his dangerous errand. So now I knew why he hadn't shown up to fetch me. Under those circumstances it was for the best, anyway, since I would have had no wish to accompany him and the dynamite. Also the *garimpeiros* told me that just a few days ago one of their comrades had lost his life because dynamite had been handled improperly. The police had gotten wind of it and had made difficulties.

Now I began my tour of the mine area. Lone people were searching over the dumps, and many miners were bringing waste rock out of the tunnels that served the workings. For a while I joined in the search for minerals, and made a few discoveries; however, for Virgem da Lapa they were unimpressive. I was shown a few topaz crystals with high asking prices. The finest specimens, I gathered, had left the mine site the evening before, in the company of my amigo, Barreto.

Miners with their mining tools, thoroughly filthy, were emerging from the tunnels. Visibly uneasy, they stole glances back at one tunnel opening. Suddenly, strong explosions shook the whole area of the mine. Barreto must have brought powerful explosives with him; the earth kept vibrating for a long time. Considerable fireworks were now breaking out in the bosom of Mother Earth, surely liberating many tourmaline and topaz specimens.

*Figure 10.* **Blue-green elbaite crystal group from the Viadinho mine, Minas Gerais, Brazil, held by Jacinto Ganem Neto, 1978. Guido Steger photo.**

Unfortunately I couldn't wait to see this abundance; I had only half a day to spend at the mine. With a heavy heart I took my leave of this place, then so productive, in order to start the trip back to Teofilo Otoni. Fura, behind the wheel, laughed at me because he knew that Virgem da Lapa was going to prove productive for me personally after all—thanks to my sometimes unreliable but still very good friend Barreto, whom I would soon see in Governador Valadares!

Virgem da Lapa—one more great experience. I hoped it would remain productive for all of us who find joy in the beauty of crystals: the beauty that can turn every working day into a Sunday!

# 1980

**Jonas mine, Golconda mine**

The tour and mineralogical study trip which I led to Brazil in 1980 was extremely interesting. The seven participants took a

*Figure 11.* **Landscape along the road to Teofilo Otoni, with Bomeliades growing in crevices on the steep hillsides.**

Boeing 707 of the Brazilian VARIG line out of the Frankfurt/Main Airport; the plane touched down briefly in Lisbon and made a night landing at Rio de Janeiro. Early the next morning we sought out our first dealers and crystal warehouses, and soon we were standing before aquamarine crystals with cross-sections wide enough to sit on. Topaz crystals to 15 kg were also on hand, and the shelving, loaded with gigantic mineral specimens, gave the impression of a prodigious cave of crystals, summoning astounded shakings of heads.

Jules Sauer of Amsterdam had a fantastic mineralogical museum, especially strong in precious stones, in the Ipanema quarter of Rio de Janeiro; he ran the second biggest jewelry business in South America, and owned several gemstone mines. When we visited his warehouse tremendous specimens from the Jonas rubellite mine were especially prominent. The shelves also held a few distinctive specimens of dark green Cruzeiro-mine tourmaline. The days in Rio went by too quickly, what with touring the city, examining crystals, and making contacts with mineral people.

Then, early one morning, we were again on the road in a comfortably furnished bus of the Rio Doce line. The way led past the bizarre coastal hills and in the direction of that mineral El Dorado, Minas Gerais. Odd-looking towers of rock rose steeply above us like the fingers of God. In the glowing light of the early evening we arrived at "crystal city," Governador Valadares. In show windows here one saw crystals constantly—although whoever wanted something special needed to have good connections and to be familiar with "sources" in the surrounding countryside.

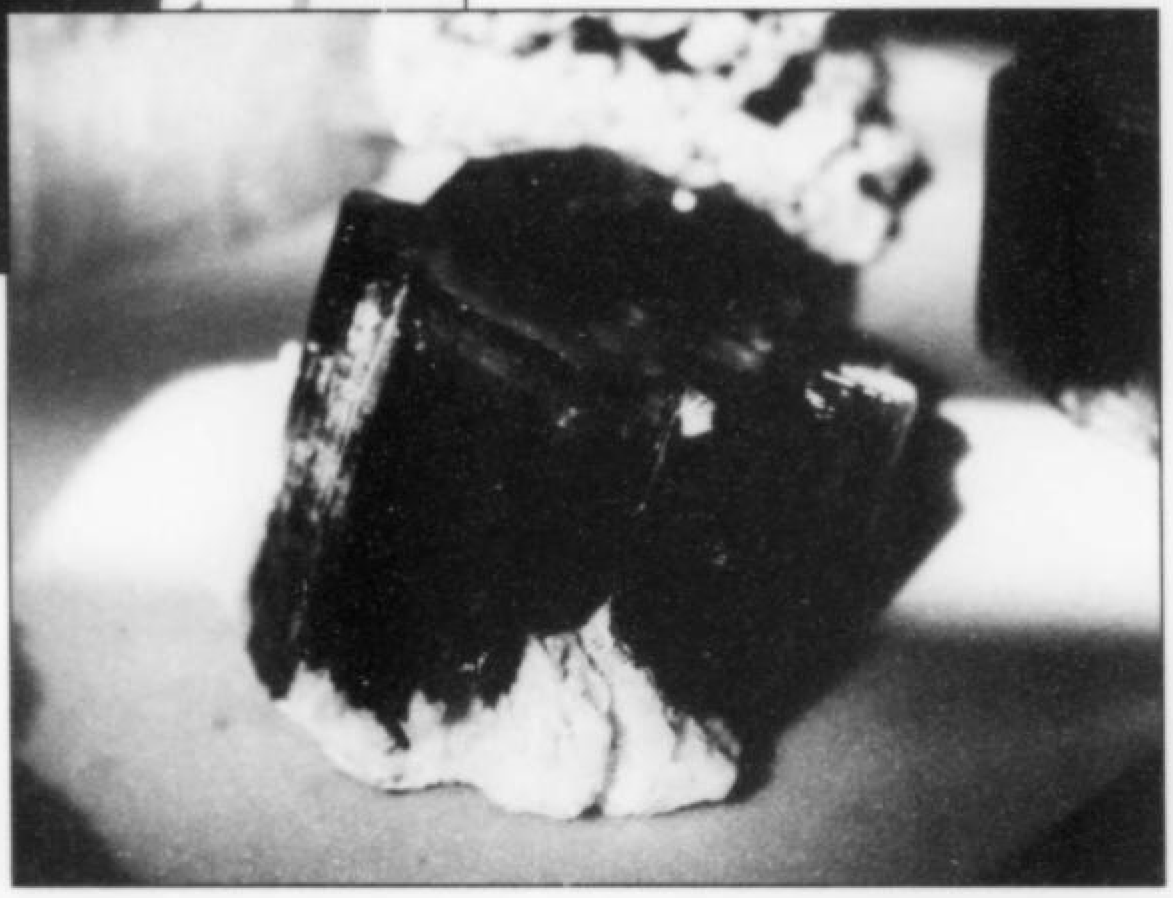
In those days the mineral "filling stations" in town—the headquarters of mine owners, gemstone prospectors, and dealers of opportunity—often had wonderful specimens, although the quality and abundance of their offerings was highly variable. What you found was a thing of the moment, a matter of luck and, of course, of financial circumstances. Sometimes you found that good old contacts had faded away and new people had established themselves. Thus, until late in the evenings we had visited crystal galleries, gemstone depots, the narrow and cluttered rooms of private collectors, and the roomy halls of well-known dealers, admiring faceted gemstones, fingering major specimens—two days had already flown by!

The bus brought us to Teofilo Otoni, a typical South American city, with myriad whirlings of human activity; sloths living in the canopies of the trees in the main plaza; innumerable street merchants and street-lapidaries; whirring hummingbirds; and always, of course, crystal storehouses to be discovered. My friend Dr. Jacinto, the South American "crystal king," greeted us in his usual friendly way and spent hours showing us outstanding items from the mineralogical wonderland that is Brazil. He had specimens of the best quality, with crystals of the most perfect development, such as any museum would put in places of honor: multicolored and doubly terminated tourmaline crystals weighing more than a kilogram; cutting-quality tourmaline scepter crystals with red stems and green heads (which I reported in print, a few years later, to a mostly unbelieving readership); plates of rose quartz crystals, decorated with eosphorite crystals, more than 40 cm wide; sharp blue topaz crystals of various sizes; blue single crystals of aquamarine with wonderful terminations, rich in secondary faces.

This intense inspection, lasting for hours, made us tired, again almost "stone-blind." But we quickly recovered when we had taken

*Figure 12.* **Ailton Barbosa and his son Renato at home in 1979 with the largest elbaite crystal from the discovery of 1978: the "Foquete" ("Rocket"), 104 cm long, with milky quartz crystals around the base. Guido Steger photo.**

*Figure 13.* **Elbaite, weight 10 kilograms, from the Jonas mine, Itatiaia, Minas Gerais, Brazil. Specimen from the discovery of 1978; photo taken by Guido Steger in 1979 at the home of Ailton Barbosa in Governador Valadares.**



our places in comfortable wicker chairs in the "Garden of Giant Stones" among crystals of colorless quartz, smoky quartz, amazonite, etc., half a meter high, populating an expanse of lawn like garden dwarfs. After some conversation about possibilities for new discoveries, and about the land and people, we took a warm departure from Senhor Jacinto.

We visited Agenor Tavares, a specialist in faceted stones and the owner of a large aquamarine mine near Vitorio de Conquista which produces fabulous gemstones. At Agenor's place we saw his new, very large aquamarine crystals, many of highest quality. Also he showed us a dreamlike collection of cut gems, from 3-carat alexandrites with distinct red/green color change to 1000-carat blue topaz and aquamarine gemstones. As a novelty he also displayed a 10-cm gold nugget from a region in Serra Pelada, in the state of Paraíba.

On the following day we were invited to Governador Valadares to visit one of the two former leaseholders of the Jonas rubellite mine at Itatiaia. This former *garimpeiro* was now well situated, the father in a family of four; his daughter was a real beauty. In his yard stood large mineral specimens of diverse sorts, including geodes being used as flower planters. Inside the house there were things to be seen everywhere, including specimens from a recent find of fan-shaped aggregates of rose-violet tourmaline crystals . . . and here a brief digression, and a brief trip back in time, is in order.

In early 1978 the *garimpeiro* Ailton Barbosa of Governador Valadares, with five companions, decided to try his luck again in an old mine. Insignificant finds were the skimpy result of the group's first investigations. The leaseholder, Jonas de Souza Lima, a mineral dealer from Governador Valadares, was no longer willing to fritter away his money on exploration work. But Ailton was successful in persuading his patron, Jonas, to permit one more short period of work in the mine. Ailton drove tunnels deep into the Itatiaia pegmatite, and after 60 meters he breached a small pocket; filled with sand and water, the pocket contained some acicular crystals of green tourmaline. Water trickled from above along a fissure, inspiring Ailton to work upwards. To open the much larger pocket above, he employed dynamite—carefully, to be sure, and in small quantities, so as not to destroy any pocket contents. The drill chewed deeper into the mountain. Suddenly a block of rock fell away, exposing a grotto. Spellbound, the miners stood before a great pocket of amazing beauty. In the light of the lamps, fabulous crystals shimmered and glowed: the lustrous, terminated, deep red rubellite crystals had grown to amazing sizes, like petals of giant flowers, on feldspar; some were doubly terminated.

Many experts agree that this is the greatest single discovery of tourmaline, in terms of the size and quality of the crystals, ever

*Figure 14.* **Ailton Barbosa with two specimens from the great discovery of elbaite at the Jonas mine, Itatiaia, Minas Gerais, Brazil, in 1978. Guido Steger photo (1980).**

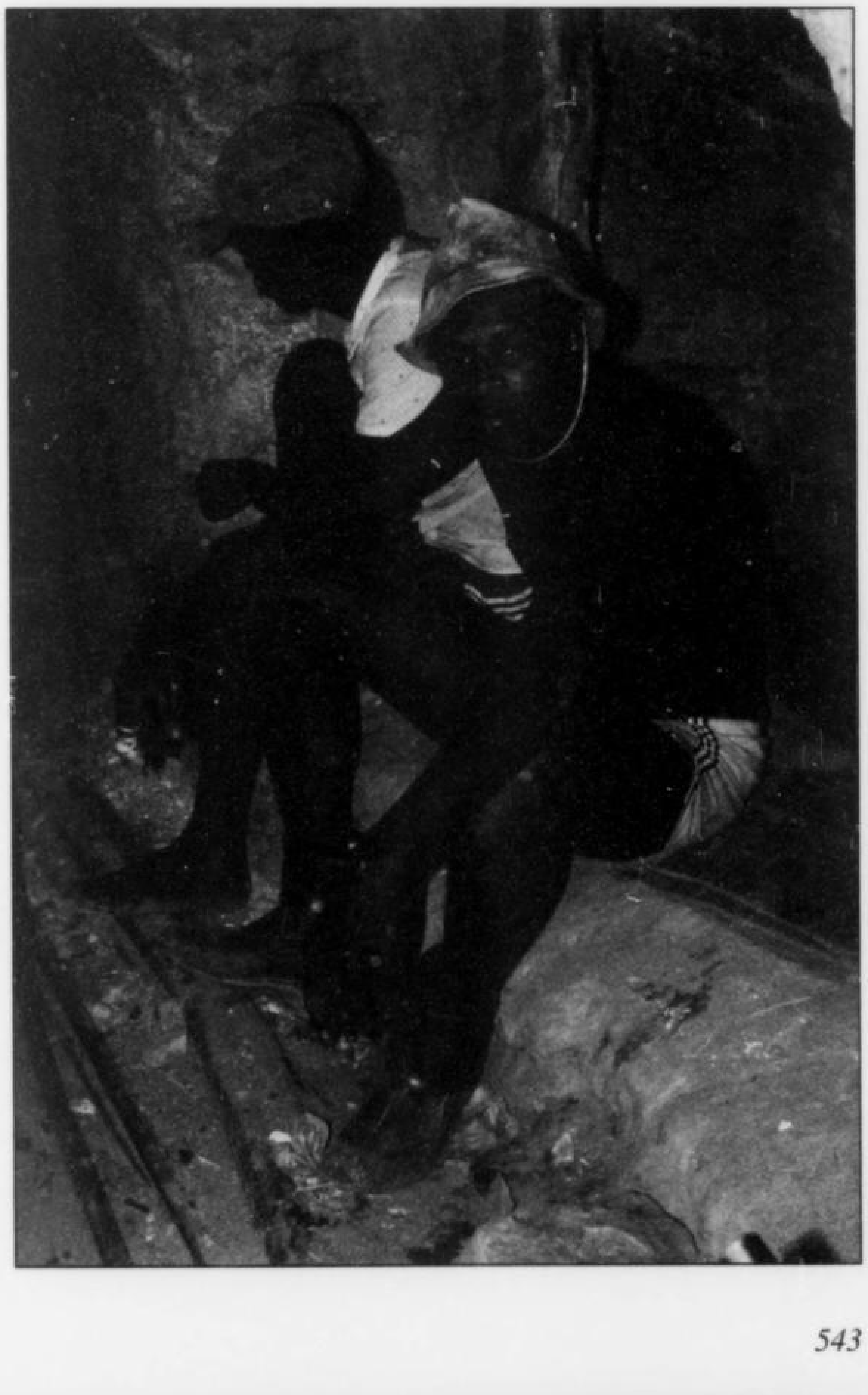


*Figure 15. Garimpeiros* **taking a break in the Jonas mine, 1982. Guido Steger photo.**

made in South America, and perhaps the world. The pocket was 2 meters wide and 2.5 meters high. The extraordinarily valuable crystal groups had to be collected from overhead with primitive tools in dangerous and very difficult circumstances. Exceptional precautions were necessary in order to free the crystals from the rock and take them out undamaged. Some of the world-class specimens which emerged were given individual names, e.g. Joninha, Foquete, Tarungo, Flor de Lice. The prices asked for them climbed far beyond anything known before, and many interested parties, understandably, hesitated at first to buy—but did not keep hesitating for long. News of the sensational discovery spread rapidly throughout the region and throughout the mineral world, and a run on Jonas mine tourmaline specimens commenced.

Now it was 1980, and my group was about to visit one of my oldest acquaintances in Governador Valadares, Jonas de Souza Lima, who owned the most valuable tourmaline specimens in the world. We went to see them as pilgrims go to a holy shrine. Senhor Jonas (as he was called) first showed us the "Tarungo," an organ-pipe-shaped rubellite crystal weighing 80 kg, which he kept in a separate vault. The audience was left breathless: we had never seen anything remotely comparable to it. Then Jonas took us into his study, where, in a well-secured area, he kept more world-famous specimens, truly wonders: "Joninha" (named after his wife), 350 kg, two huge terminated rubellite crystals in a beautifully composed group with albite rosettes and quartz crystals, surely the

*Figure 16.* **In the area of the Golconda tourmaline mine, near Chonin, 1982. The mine's owner at the time of the photograph was Ailton Barbosa, discoverer of the famous Itatiaia elbaite. The pegmatite-bearing layers are clearly visible in this picture. There is no shortage of large quartz crystals here, and as long as no gemstones are found the costs of the mining are covered to some extent by sales of industrial quartz and mica. Guido Steger photo.**

most spectacular crystal specimen in the world; "Foquete," also known as "the rocket," 150 kg, a column of red crystals 104 cm high, terminated and of excellent quality, rising from a group of doubly terminated quartz crystals; "Flor de Lice," 65 kg, a "flower" consisting of a large red tourmaline crystal encircled by quartz crystals and feldspar.

Sometimes, while showing off his treasures like this, Jonas would be wearing two bullet belts like sashes and carrying a revolver and a shotgun. Standing there, legs spread wide, with a stubble of beard and an eloquent grin on his face, he looked like a Mexican desperado. Armed to the teeth, he was guarding his treasures personally. Despite our long acquaintance, Senhor Jonas was always reluctant to allow photography. On this occasion he permitted me to photograph only "Tarungo" and "Flor de Lice."

The time had come for us to take a close look at the Jonas mine for ourselves. Of course, for quite a while already the coveted rubellite with the violet cast had not been found at the mine; still, we were not about to let the chance to see the place slip by us. The trip will always remain unforgettable to me. We picked up gemstone specimens, studied the mine's interior, observed ongoing work in the tunnels, talked with the miners and learned their customary methods, and even reached out longingly to touch the cross-sections of tourmaline crystal stumps in the tunnel walls. The journey itself, in both directions, was an adventure, with fords over the river, car troubles, wildly romantic scenery, and the drive back at night under starry Brazilian skies.

The next morning's sunrise found us nearing the Golconda tourmaline mine. This excursion, too, brought adventure, deepened our knowledge of the landscape, and provided the joys of personal discovery. Besides several kilograms of quartz crystals, we collected many modest tourmaline specimens. We climbed over piles of mica; feldspar crystals cut grooves into the soles of our shoes. But, too soon, we had to leave this great and charismatic locality.

Back in Valadares we finally succeeded in finding a certain store with Jonas mine rubellite crystals; they belonged to the man who then held the lease on the mine. Senhor Dilermano was only willing to sell these huge, expensive rubellites as a complete lot—what a shame! (In the time since this visit, Senhor Dilermano disposed of almost the whole contents of his shop, and now there is no Jonas mine rubellite to be purchased in all of Brazil.)

Later I was able to locate a few of the transitory dealers and mine owners I knew in Belo Horizonte and Montesclaros. As is usual in Brazil, they had new addresses and new telephone numbers, but also new finds to tell me about. These included quartz crystal groups weighing tons, amethyst resembling some that we know from the Austrian Alps, and beautiful pink apatite crystals perched well on feldspar; the Brazilians call these latter crystals "natural gems."

We stayed considerably longer in the interior than we had planned to. A final bus ride by way of Belo Horizonte, capital of the state of Minas Gerais, brought the members of the study tour to Ouro Preto, formerly a rich gold-mining town, now partly preserved in colonial style. Many baroque churches and museum-like secular buildings lined the streets, which were narrow and deep. This very interesting city hosts a mining school and possesses the best mineralogical museum in Brazil, with a special emphasis on minerals of the region (there is a special sub-collection of "imperial" topaz and euclase). The landscape around Ouro Preto is Alpine-looking, the water is good, and the climate is pleasant; we felt healthier here than on the hot, humid coast.

There remained one more quick buying trip, this time to Rodrigo Silva, the rough, picturesque town where miners who work at the nearby topaz fields live. After pleasant strolls down the photogenic alleys of the former regional capital, Vila Rica, it was back to Rio, and farewell at last to Minas Gerais. Brazil: one word for so much that we had experienced, seen and enjoyed. We would come again.

# 1982

**Golconda mine, Ouro Preto, Rodrigo Silva**

In 1982 we were in for another fascinating experience in Brazil! Under blue skies and a burning sun, my big group of 17 enthusiasts rode in two Volkswagen buses through the neighborhoods of Rio (the city center, Gloria, Flamengo, Botafogo, Leme, Ipanema) to Leblon, to spend a short but pleasure-filled hour on one of the city's most beautiful beaches. The surroundings of this world-city are unique: wide bays, kilometer-long beaches, steep conical hills, and tropical forests. Harpuador, a rocky point of land, offered us a magnificent natural spectacle: wild sea waves break here, and columns of water rise to 30 meters high—a grand view!

Shortly afterwards we were sitting comfortably in the sales room of an acquaintance of mine, a jeweler, and admiring cases full of gemstones and gem carvings of various kinds and qualities. Necklaces, agate slabs, carved stone figures, and minerals in their natural state filled the shelves. This "appetizer" was stimulating, and soon we were strolling on Avenida Atlantica, where the best South American jewelry concerns have their outlets. Choice items were on display in the show windows; a well-composed specimen of Jonas mine rubellite weighing 85 kg was especially impressive. Not neglecting the joys of the palate, we sought out the Jardim specialty restaurant and treated ourselves to a large *Spiessbraten* (in Brazil this grilled pork delicacy is called a *churrasco*), whose artful preparation won our approval. Finally we came to the mineral depot of the second biggest South American jewelry business, that of Jules Sauer, in Rua Mexico in the center of Rio, and gained entrance to work areas which were "furnished" with gigantic tourmaline specimens. By this time, however, most members of our group were too tired to concentrate any longer, and wanted to return to the hotel. The enormous pyrite specimens from Jacobina, the tourmalines from Itatiaia weighing 60 and 65 kg, the bicolored tourmaline from the Cruzeiro mine and the massive amethyst geodes from Rio Grande do Sul had finished us off—that was enough for today.

On the next morning the bus brought us first to the tropical hills on the coast. Soon it was climbing to high elevations, the road frequently traversing undisturbed forests. Groups of trees overgrown by parasitical plants, with orchids and bromeliads, seemed to reach out for us as we passed. Chains of mountains, forested on their peaks, appeared in the distance. Among them were bizarrely shaped towers of granite, the highest of which, a natural obelisk, is called the "Finger of God"; in clear weather Rio is visible from its summit. But as we descended the scenery quickly changed, and now the landscape brimmed with alluring valleys and rivers.

Late in the afternoon we reached Governador Valadares, a world capital for crystal-seekers. We could hardly wait to make our first visits to the mineral dealers and gem prospectors. For very reasonable prices we had soon acquired blue kyanite of an intensity of color we'd never seen before, and soon again we were searching for new specimen sources. We handled and marveled at huge smoky quartz groups, great specimens of colorless quartz, black smoky quartz specimens weighing 180 kg, amethysts as big as bathtubs, amazonite, sodalite, "crocodile" quartz . . . until, weary from so much looking, questioning, understanding, and happy about having bought so many showpieces, we finally went to dinner.

*Figure 17.* **Elbaite, 20 cm, from the Viadinho mine, Minas Gerais, Brazil. Displayed by Jacinto Ganem Neto at his home in Teofilo Otoni, 1986. Guido Steger photo.**

On the next day, after an ample breakfast, we were under way again. Mineral dealers, private collectors, gemstone accumulations, and crystal warehouses were all brought "under the lens" in turn, and specimens were examined, admired, and photographed. The selection was more than rich: what do you do when you cannot take it all with you? At lunch almost nothing was said; we were all too preoccupied. While the sun was coloring the horizon red, 17 mineralogical hobbyists returned wearily to their hotel.

And then on to Golconda! How the whole area of the mine had changed since our last visit! The entire mountain was now riddled with holes. Where previously the tunnel entrances had seemed sadly disused, there were new ones gaping now, *garimpeiros* were working busily, and new huts had been built. Golconda was producing again! By evening, Ailton Barbosa, discoverer of the great Jonas mine tourmaline and now co-owner of the Golconda mine, had shown us many new tourmalines from the Golconda, and it had been agreed that a local prospector would lead us into the tunnels.

It turned out to be a wonderful mine tour. Having discovered small pockets containing beautiful green, transparent tourmalines, a few of which have doubly terminated quartz crystals on them, the travelers, beaming, emerged from the tunnel, hands full of tourmaline; and everywhere we could simply pluck 20-kg quartz crystals out of the soil. We found garnets and autunite, feldspar and lepidolite. On the return trip we stopped to rest on the shallow bank of a river, and saw local people washing the sand for black columbite crystals. Our companion Rott pulled a quartz crystal weighing several kilograms out of the streambed (it is a scepter, with a head of darker quartz), and Herb Weber washed his specimens of green tourmaline in the stream. The group, in fact, swarmed all over the stream, finding one thing here, another thing there. Karl Jellinek hauled the quartz crystal group he had found to the car, undeterred by its weight; he said it would always remind him of this Golconda trip.

On Friday the crystal warriors set out eagerly for the town which would be the gemological high point of their journey: Teofilo Otoni. First, a two-hour bus ride brought us to Itambacuri, an idyllic little town where many mine owners lived. We went to the house of Don José Gomez, proprietor of the Santa Rosa tourmaline mine. He himself was not at home, but his wife permitted us to see and to photograph "the most beautiful calcite in the world," a rose-shaped crystal cluster about 30 cm across, the petals wonderfully aligned and transparent along their edges, suggesting gemmy euclase crystals.

This specimen made a tremendous impression on me, and I have always considered it to be the world's finest calcite. I wanted to show it to my fellow travelers on a later mineralogical study-tour, by which time Don Gomez had sold off the wonderful tourmalines he had gathered, but he had been unable to part with the calcite rose. One of my companions on this later study tour, a German dealer, turned up his nose and said self-importantly, "Herr Steger, do you think I haven't already sold plenty of beautiful calcite roses?" But then we were standing before the specimen. Don Gomez had taken it out of its own special showcase and now presented it proudly: a snow-white crystal cluster 30 cm across, with crystal "petals" resembling euclase crystals arrayed in a circle. At the circle's center is a vertical aggregate of terraced scalenohedrons ending in a spearpoint. The spectacle was disorienting. No one spoke a word—not even a "fabulous" or "fantastic." It couldn't have been quieter in a church. Our formerly outspoken friend also seemed to have lost the power of speech: was he praying, perhaps?

Half an hour after leaving Itambacuri we reached Teofilo Otoni, the world's greatest gem-cutting center. This city was founded by German colonists, but has a typically South American character, with market stalls, street vendors, many people traversing the bumpy streets, tame animals in the trees: a colorful scene, shot after shot offering itself to the photographer.

Once again we had the appointment to visit the hospitable Dr. Jacinto, the uncrowned king of Brazilian gemstones. And the pieces he showed us once again bordered on the otherworldly—our wonder at so much beauty would stay with us for a long time. Super-specimens were brought out one after another: multicolored tourmaline crystals on quartz crystals, blue topaz on feldspar or lepidolite, and seemingly whatever else the mineral-lover could wish. Hours of looking, commenting, and asking questions created a kind of crystal-intoxication. Our eyes remained fixed, spellbound, on the glistening prisms, terminal faces, and combinations of forms. For some of us, it was like living inside a dream.

On the next day, while a part of our group set out to visit two aquamarine mines near Tres Barras, the others were drawn, as if by enchantment, back to the "precious stone" warehouse of Dr. Jacinto. New suites of minerals were displayed, and the new finds from Coronel Murta particularly impressed us: tourmaline prisms which are pink at the base but change to an intense gemmy green at the termination. Many specimens soon found themselves in the hands of new owners.

Then it was on to Belo Horizonte, a city of a million people in the greatest iron-mining region on earth, and the capital of the state of Minas Gerais. For hours the variegated landscape passed by the windows of our comfortable bus. Finally, as the bus rounded the cliffs at the crest of a hill, we saw the city spread at our feet: a huge sea of dwellings ringed by a chain of hills from which gold, iron and precious stones are extracted. We disembarked at a luxury hotel, and did not take long to discover that the swimming pool was on the roof terrace on the 15th floor.

Ouro Preto, a very special topaz locality, is reachable in two hours by bus from Belo Horizonte. Golden ("imperial") topaz is found there, and commands enormous prices because of its special beauty. Found very rarely in association with the amber-colored

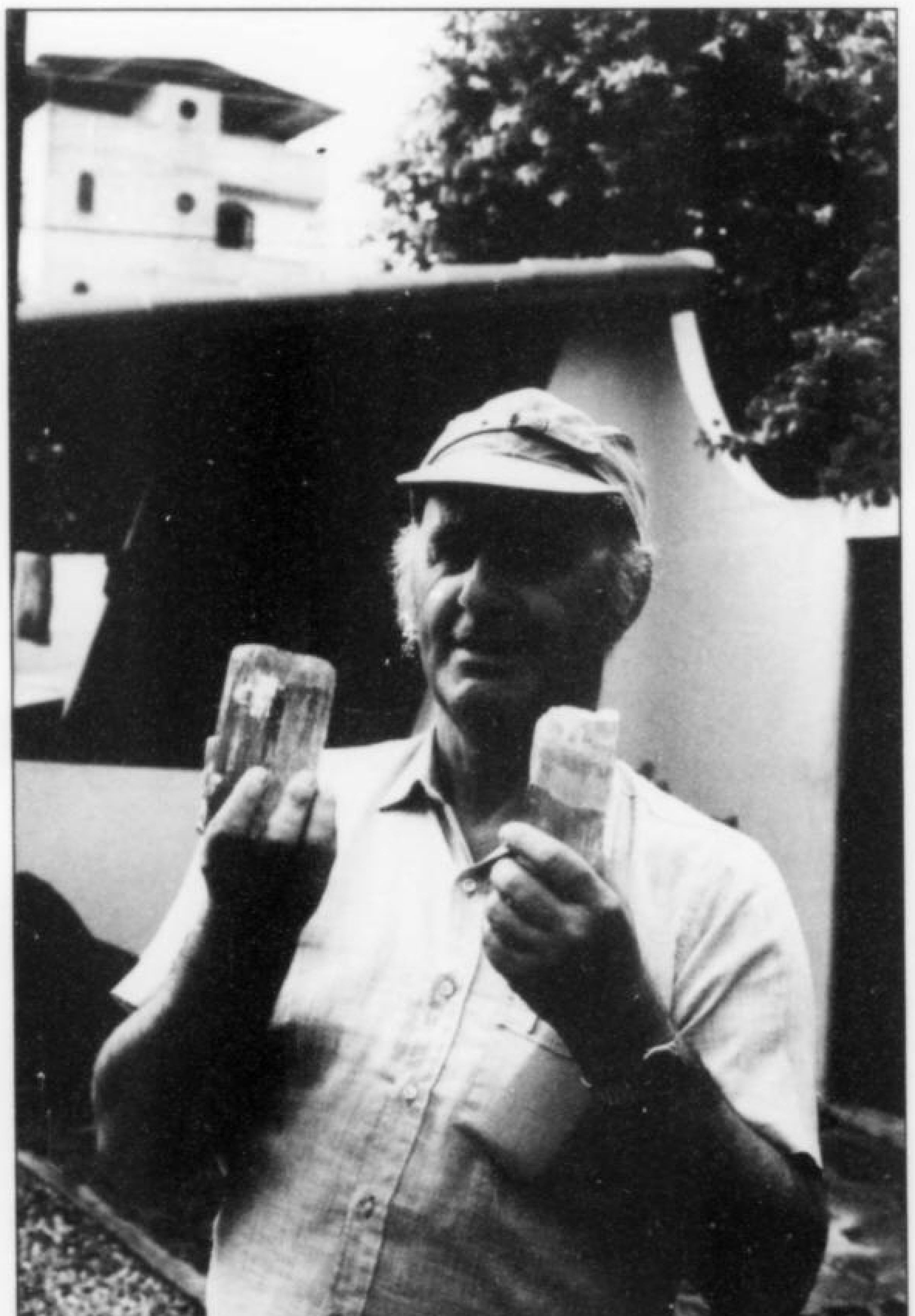


***Figure 18.*** **The author holding two aquamarine crystals from the Jaqueto mine, Minas Gerais, Brazil. 1994.**

***Figure 19.* Brazilianite crystals on matrix, 35 cm, from Linópolis area, Minas Gerais, Brazil. Displayed by dealer in Governador Valadares, 1990. Guido Steger photo.**

topaz crystals are crystals of euclase, a gemstone for connoisseurs. Ouro Preto, reposing in a pleasantly Alpine-like landscape, is a real architectural jewel, and we enjoyed seeing once more the baroque style of colonial times, and the many monuments. Every dilapidated old house has been rebuilt in the original style. The historic old gold-mining capital is full of churches, aristocrats' townhouses, romantic plazas, and narrow, steep alleyways. The mining academy and its mineralogical museum testify to the central place of this former capital city of Minas Gerais in the mining industry.

A rented motorbus took us to a destination of special interest: Rodrigo Silva, the site of some topaz mines. The tour members learned of the methods, and difficulties, of mining golden topaz, and some of them found some crystals. The ground was extremely muddy, and some of the members lost their shoes in the deep slime.

After this very instructive side trip, during which we also learned about the second great "imperial" topaz mine, at Vermelhão, we left the city, and late in the evening we reached Belo Horizonte again.

The tour having come to an end, the travelers flew back to Rio, where most remained for another week, getting to know Brazil better—Sugarloaf Mountain, the Corcovado, the bathing beaches, the botanical garden, the Petropolis, Iguassu Falls. In quiet, leisure hours in the future, or in contemplation of our new treasures, many scenes would pass before our mind's eye, and "Do you know what?" we would say to companions then, "One time, in Brazil . . ."

# 1998

### Sapo mine

The Sapo mine, in Minas Gerais, Brazil, had by 1998 produced brightly colorful, bicolored tourmaline crystals for about five years. The pegmatite was discovered by prospectors in 1992, and production of gemstone stock began in 1993. Some of the tourmaline crystals are zoned in the "watermelon" style while others display parallel bands of red and green. The crystals range from gemstone-cutting quality through opaque (but bright green); in many cases they compose handsome groups of fantastically varied forms. These attractive specimens reach impressive sizes—to more than a meter across.

The Sapo mine lies in the Conselheiro Pena region, about 130 km east of Governador Valadares, a major administrative center of the state of Minas Gerais. The region is fascinating: a hilly landscape with distinct summits, shot through with prominent rose-violet erosional features which interrupt the luxuriant tropical vegetation. Beyond this prospect looms a bizarre formation of steep, toothlike rocks.

In 1998, the year of my visit, the mine's owner was Senhor Martin Clovis Coelho, nicknamed "Baiano," a big mineral dealer of Governador Valadares. The proprietor of the land was a farm owner who received 20% of the revenues from the mine. Fifteen *garimpeiros* were employed; most stayed in Governador Valadares on weekends and otherwise lived in lodgings near the mine. They received 15% of the profits.

There were about 250 meters of tunnels, the deepest just 15 m below the surface—a big problem during heavy rainstorms. Since the mine lay in a valley floor between the hills, and under layered deposits of sand and gravel, there was always a danger of the ground becoming flooded and in that case production was broken off for a time.

Geologically, a basement of schist and gneiss is overlain by lateritic soil and by layers of sand and gravel. The basement rock is injected by quartzite and by granite and pegmatite lenses; the latter, which stand out conspicuously, are the gemstone-bearing units.

*Figure 20.* **Approaching the Lavra do Sapo mine. The laterite road runs past the dumps and the first of the mine openings.**

These geological formations are of Precambrian age, while the sedimentary deposits date from the Tertiary.

The most important mineral species found include elbaite (red "rubellite" and bicolored, the latter showing either parallel bands or watermelon-configured zones, as well as green and blue varieties), dravite, schorl, beryl (morganite, rarely goshenite and aquamarine), hydroxyl-herderite, columbite-group minerals, fluorapatite and albite. The production of colored varieties of quartz as of 1998 was 70,000 kg of "crocodile" quartz, 20,000 kg of transparent "fenster" quartz, and 10,000 kg of citrine.

On November 20, 1998 we set out for a visit to the Lavro da Sapo pegmatite. A wonderful warm summer day had dawned. The mine's owner, an affable, sociable Brazilian, picked me up at the Hotel Realminas in Governador Valadares. Lazily smoking cigarettes while still attending vigilantly to the road, he sat beside me and fatalistically steered the big truck which had just been brought out of the mine and into the city to have a defective compressor repaired. We conversed freely, and thus I picked up interesting information.

The blacktop road ran along the mighty Rio Doce for about 100 km, and then came to a fork: straight ahead for Resplendor, left for Goiabeira and Mantenha. We took the Goiabeira turnoff, the road remaining blacktopped for a short while but beginning to ascend, and soon the rubber hoofprints of our gasoline-eating steed were showing up in the red-brown-violet iron oxide dust of an eroded roadbed. The road climbed ever higher in a series of curves. We were shaken and vibrated through and through: this part of the trip was unhealthy for the digestion, never mind the integrity of the spinal column. To traverse this band of laterite in bad weather would clearly be dangerous; one would have to deal with a chaos of slippery sludge.

Around every curve we saw new kinds of plant life and rock formations. A farm flitted by us, and a few kilometers before the picturesque town of Goiabeira, silvery, glittering dumps at last appeared. *Garimpeiros* were working in front of the holes, as tall as a man, which speckled the hillsides. A group of mine workers was gathered with the shift boss under a shady tree. While the boss was issuing instructions and paying wages, I surveyed the dump in the hot sunlight, poked about, and took photographs. It turned out that this was only a "showplace" working: Senhor Baiano operated many more mines in the area.

Soon we continued our drive, and after 15 more minutes of intense rattling over potholes and hummocks we reached the Sapo mine. In the hilly landscape, at the foot of a towering sugarloaf mountain, a flat, sandy valley spread before us. Violet-colored erosion gullies descended threateningly. A farm was visible, as were miners industriously at work. Serving apparently as their homes were two wide, colorfully painted huts—as if to make a pretty picture on a TV screen. Various pieces of mining equipment were being taken out of the huts, and nearby, waste material (sand) was being taken in buckets out of a shaft. A winding cable transported a miner into the depths—only seven meters. The shaft's walls were secured by concrete rings more than a meter in diameter. At eight meters the shaft reached rock and ended its descent; from here the tunnels, 250 meters of them altogether, branched out. It was from this shaft that crystals were routinely brought up and into the light of day.

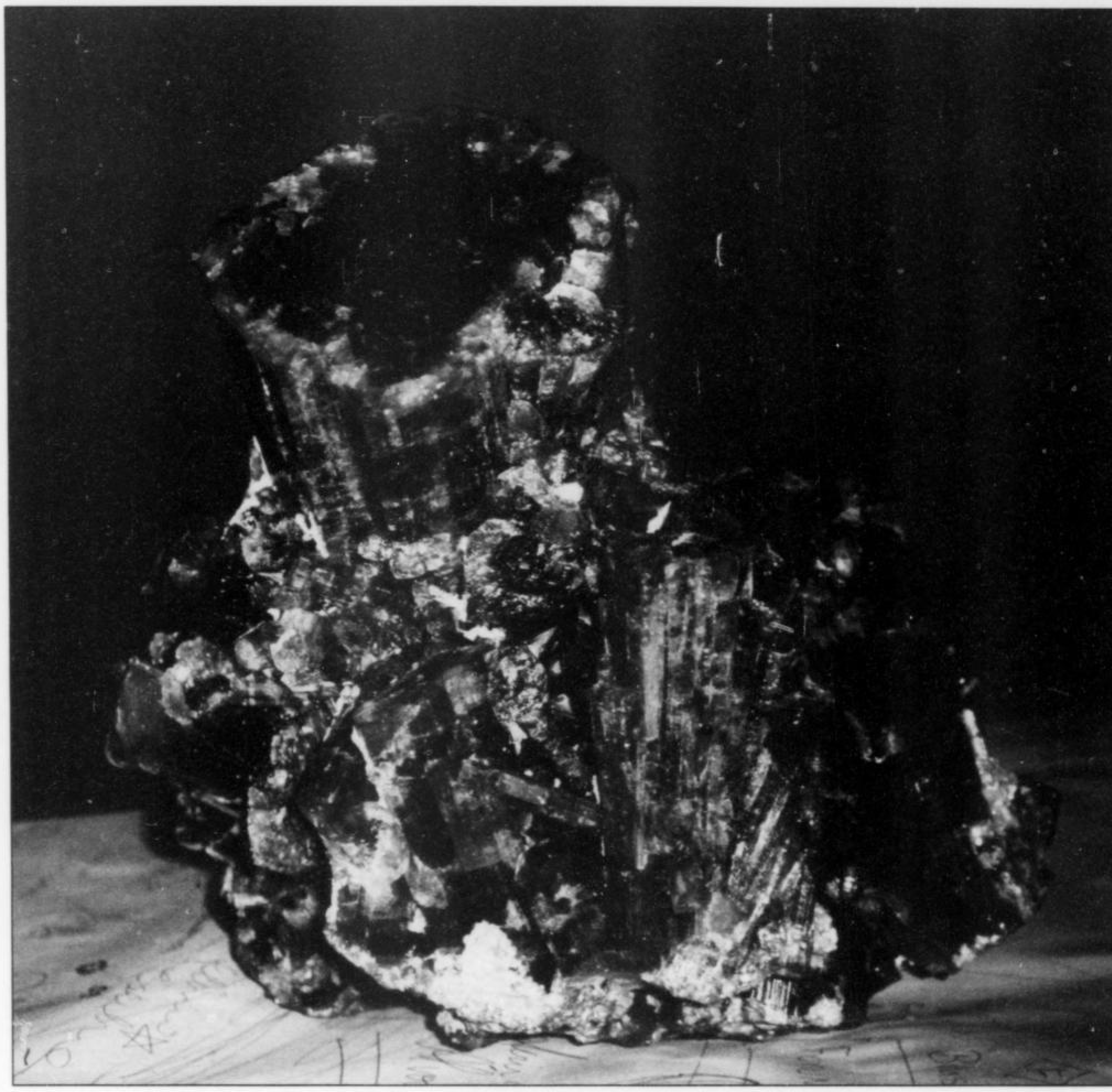


***Figure 21.*** **Elbaite, 20 cm, Sapo mine, Minas Gerais, Brazil. A fine cluster of "watermelon" elbaite crystals (red interiors, green outer zones), displayed at the warehouse of Martins Clovis Coelho ("Baiano") in Governador Valadares, 1999.**

The *Padrão* knew of my interest in entering some of the tunnels. Preparing myself, I took off my long pants and put on a pair of shorts that I had brought with me, and put on rubber boots. Very soon I was moving, through watercourses, puddles and mini-pools, along a narrow tunnel, following my guide and friend of the moment, on a zigzag course, at times in a full, knee-deep crouch. I had to be terribly careful to see that the jagged rocks of the tunnel ceiling didn't rip at the skin of my head (for I had forgotten to wear a helmet) and possibly scalp me. Once in a while the tunnel widened and I could walk upright, but sharp, rocky protrusions left and right warned me not to be careless. Abrupt shifts in the level of the tunnel floor also demanded maximum alertness. There were very few wooden support beams, and those only in the central part of the tunnel. Electric cables and air hoses were fastened to the walls throughout the tunnel's course. In several spots, miners toiled with their drills to make shot holes. Charges of dynamite would be inserted, and the holes sealed; blasts would be prepared like this in nine separate places, and they would all be set off at the same time this evening.

Martin Clovis Coelho or "Baiano," the experienced former *garimpeiro*, examined the strike of the gemstone-bearing pegmatite and gave directions concerning where, and how much farther, the work should proceed. Now and then he pointed out to me the places where gems had been found; in the light of the lamps he showed me the traces of blue and red tourmalines still visible where the crystals had been attached. Finally, after 30 minutes, filthy and breathless and wet through and through and streaming with sweat from the underground heat, we were back at the tunnel entrance. A few more gymnastic turns on the winding cable, and we were bathed in daylight and fresh air once again.

Whoever enters such an underground mine will come truly to appreciate what difficulty, hard labor, and danger miners must undergo to wrest gemstones and other minerals from the earth. Also, it should be remembered that mine owners must take enormous financial risks to make possible the discovery, extraction and safe transport of the gemstones and specimens.

Of all my visits to mines in the course of 30 years, this one was the most rewarding!

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**To be Continued**

**Statement of Ownership, Management, and Circulation**

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THE MINERALOGICAL RECORD — SEPT OCT 2005

| | | |
|---|---|---|
| a. | 7337 | 6959 |
| b. (1) | 4198 | 3417 |
| b. (2) | | |
| b. (3) | 948 | 1731 |
| b. (4) | | |
| c. | 5146 | 5148 |
| d. (1) | 64 | 49 |
| d. (2) | | |
| d. (3) | | |
| e. | 7 | 6 |
| f. | 71 | 55 |
| g. | 5217 | 5203 |
| h. | 2120 | 1756 |
| i. | 7337 | 6959 |
| j. | 98.64% | 98.94% |

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# Mineralogical Record



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| | |
|---|---|
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| March-April issue | Dec. 15 |
| May-June issue | Feb. 15 |
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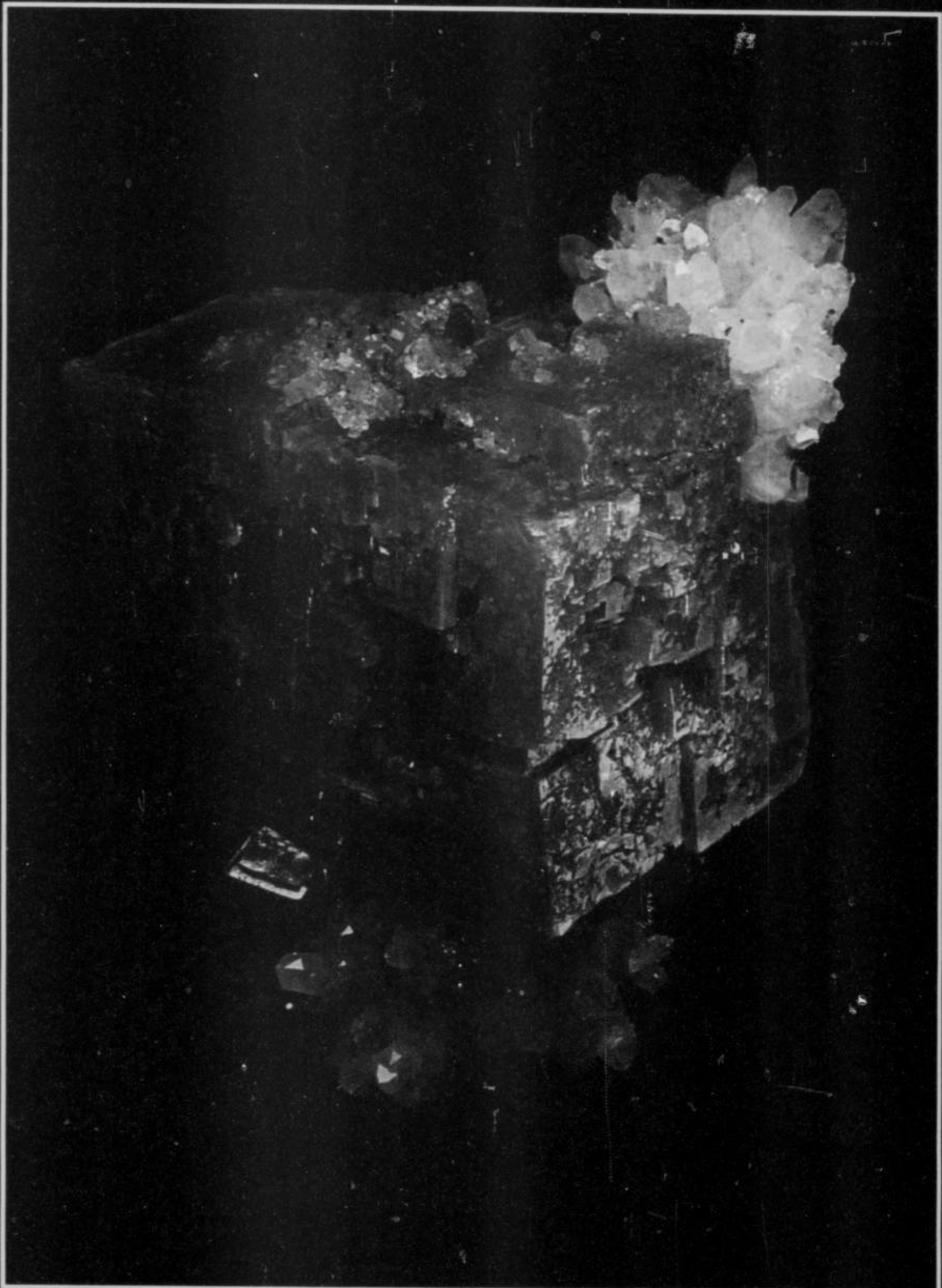
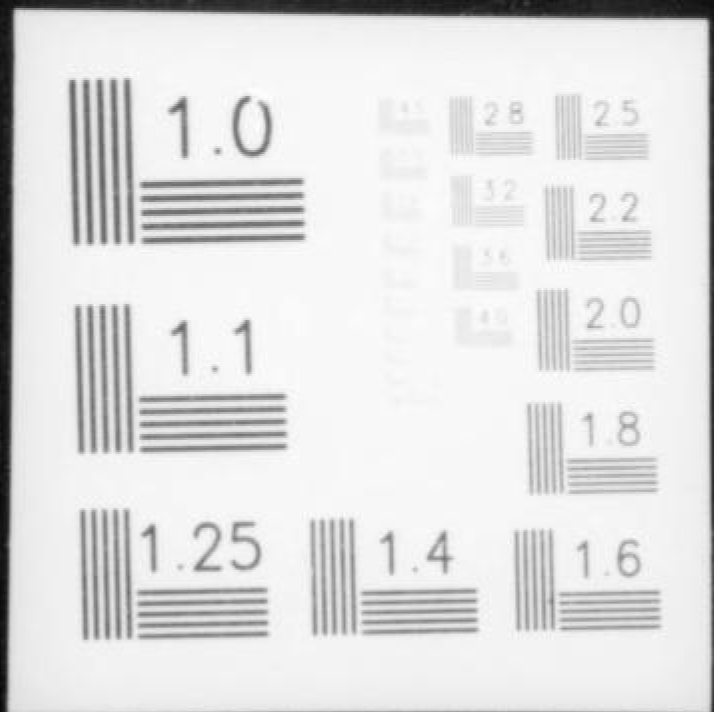


Rhodochrosite with Quartz, Mountain Monarch mine, Ouray Co., Colorado. Jeff Scovil photo.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