The Mineralogical Record

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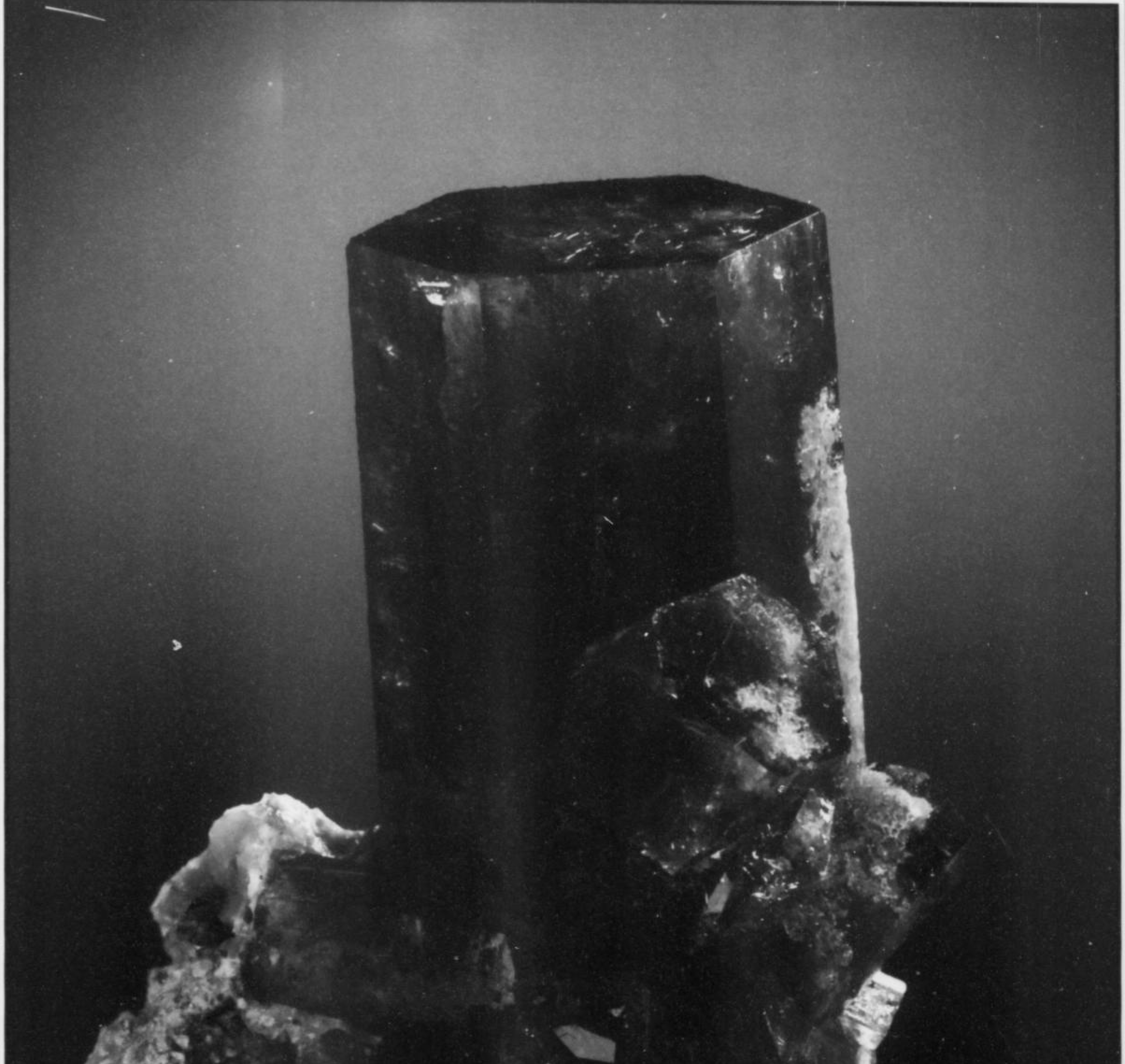

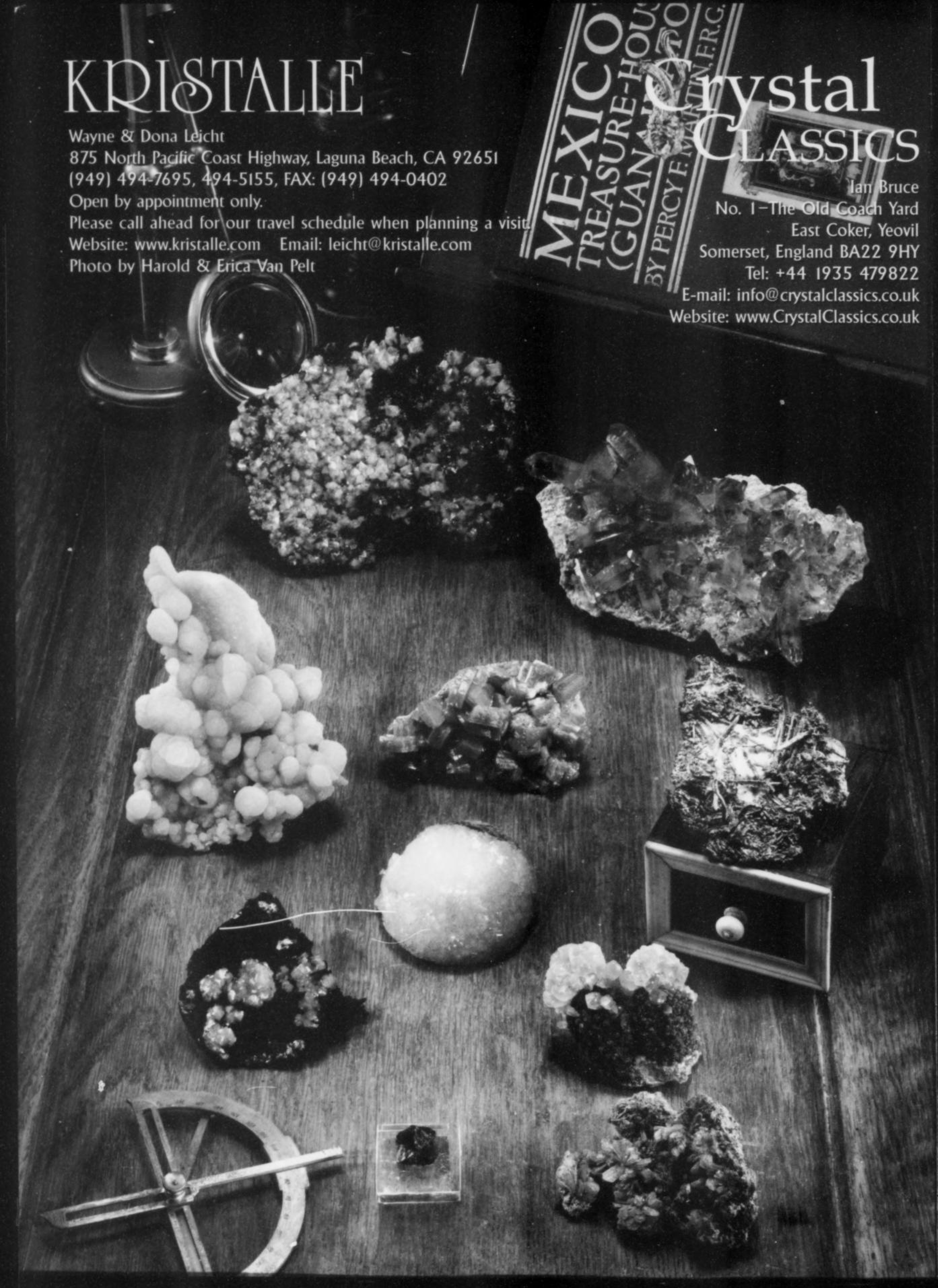
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The

Mineralogical Record

The International Magazine for Mineral Collectors

VOLUME 41 • NUMBER 6 NOVEMBER–DECEMBER 2010

Continued on page facing inside back cover

Articles

Columns

This issue was made possible in part by contributions from Philip G. Rust and the Fellows of the Mineralogical Record

COVER: RED BERYL crystals to 4 cm, from the Harris mine, Wah Wah Mountains, Beaver County, Utah. Peter Via collection, ex John Barlow collection; Joe Budd photo.

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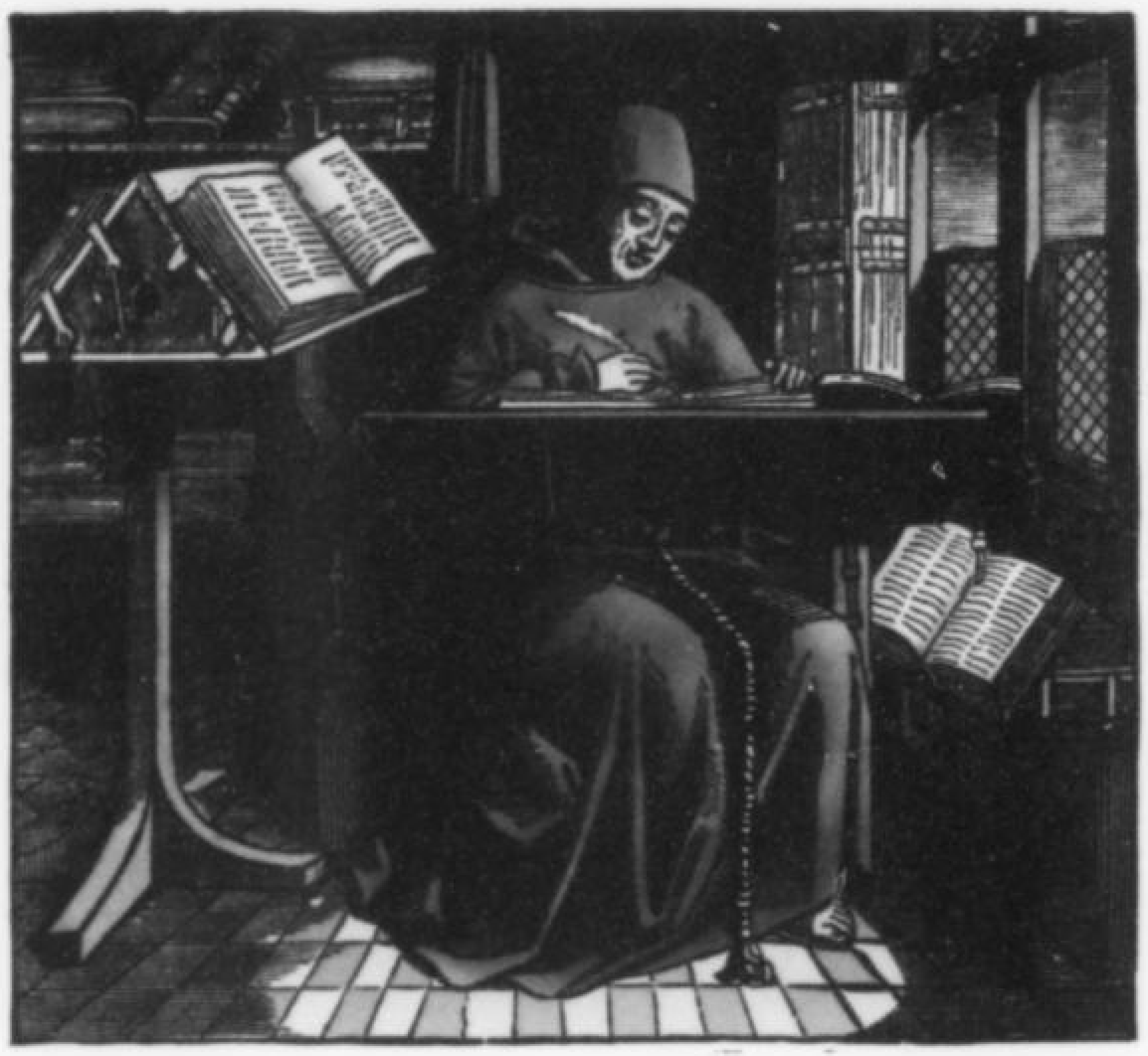


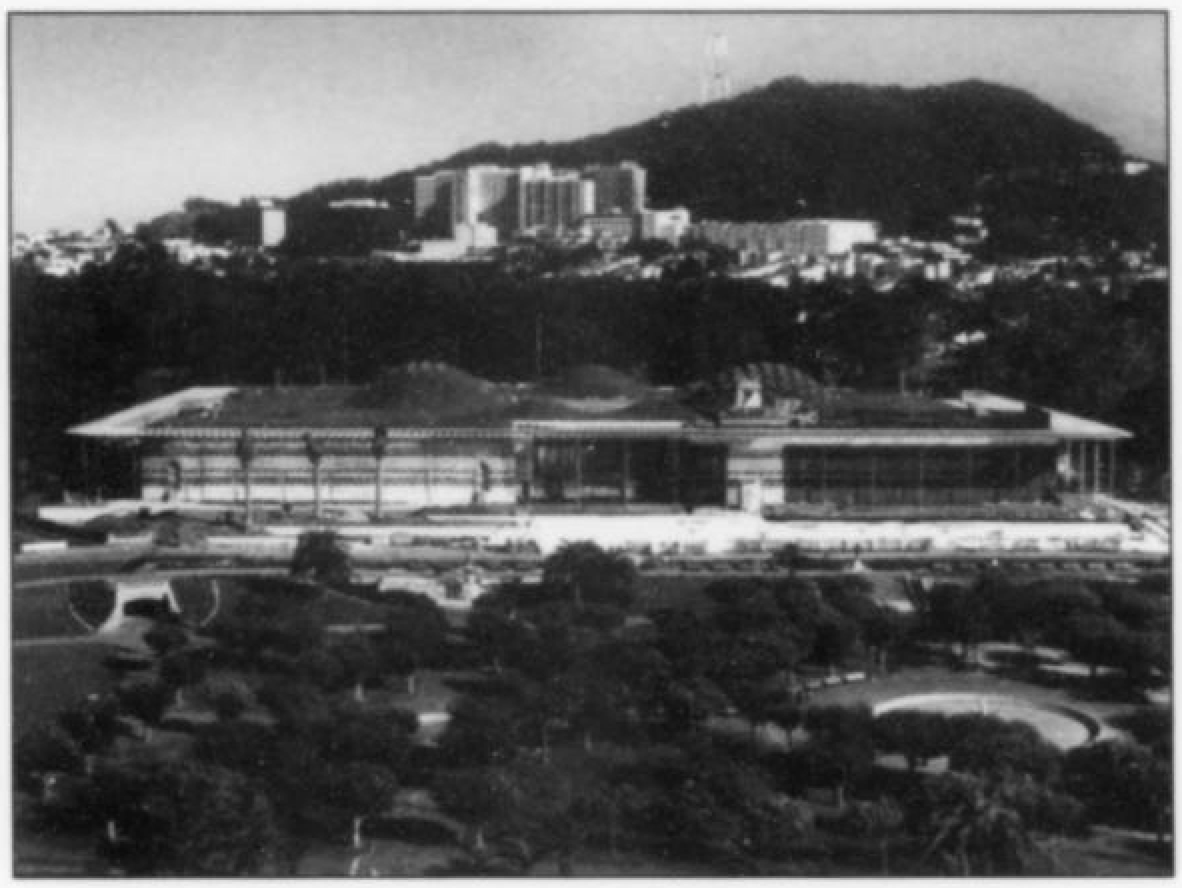
Notes from the Editors

Digital Microscope Wand

The 6-inch-long USB Microscope Wand magnifies small objects (including microcrystals) and displays them on your computer monitor or laptop screen. The 7-mm optics provide magnification between 10X and 200X, while a built-in LED illuminates the subject. A manual focus adjustment allows you to sharpen the image. The wand can be hand-held as shown, or mounted on a tabletop tripod stand which holds it in place. The wand plugs into any computer running Windows 7, Vista or XP. Images can be displayed as still shots or as video captured at 640 × 480-pixel resolution. Driver software is included.

This item has many potential uses for the mineral collector. We can imagine exploring cavities or crevices in a rock to see what crystals are hidden from easy viewing, searching crystal edges for fine-scale damage, examining crystal faces for growth features and thin coatings, examining fractures and joints to check for glue or other kinds of repairs, and providing visual aid when instructing a group of students.

The Microscope Wand is available from Hammacher Schlemmer (item 78340) for $149.95, and carries a lifetime guarantee. [www.hammacher.com/Product/78340]



The newly remodeled Museum of the California Academy of [*biological*] Sciences in San Farancisco.

The California Academy of Sciences

[The following note is by Steve Rubenstein, reprinted from the *San Francisco Chronicle,* September 3, 2010.]

When a man enters his 90s, he realizes he is not going to be around as long as a rock, and that it may be time to set matters right. San Francisco mineral collector Jack Halpern has spent the past several years trying to gently nudge the mighty California Academy of Sciences into restoring its own mineral collection to its former place of honor.

The newly remodeled academy in Golden Gate Park may be a splendid building with shrubbery on the roof and fluttering butterflies in the rain forest, Halpern said, but it committed the ghastly sin of purging its fabled gem and mineral hall, the chamber that captivated Halpern on his initial visit six decades ago and turned him into a rockhound. He has donated hundreds of specimens to the academy, worth tens of thousands of dollars. In return, he has received polite thank-you notes and absolutely no promise that his donated minerals will ever be exhibited to anyone.

A few months back, he wrote one last letter to the museum, urging the directors and the curators to set free their mineral collection that lies "hidden away in the basement of the Academy, unseen by the hordes," and please show it to somebody, anybody.

With the letter, he donated another $15,000 worth of mineral specimens. In response, he got another thank-you note saying the academy was "working on a way of displaying them."

The problem, said academy spokeswoman Stephanie Stone, is that there isn't enough room in one building to show everything.

"Our message is the evolution and sustainability of life on Earth," said Stone. "For that reason, the minerals all didn't make the cut as a dedicated, permanent space. We have other, more critical stories to tell."

Currently the only way to see the academy's minerals is to pony up $75 for a behind-the-scenes tour of the museum, which includes a quick peek into the basement vault, where a handful of minerals are on display. (That's on top of the $25 academy ticket price, said to be the highest admission charge for any U.S. science museum.)

Halpern said he understands. He's trying to be a good sport about the whole thing.

Cover Photos

Readers periodically express curiosity about how our cover photos are selected, especially those readers or dealers who think they might have a specimen with cover potential. Wonder no more: our selection process is fairly straightforward. There are five basic criteria for a cover photo:

(1) ***Professional quality:*** All cover photos must be high-resolution (4 × 5 transparency or digital format), and must show a reasonably professional skill in lighting, backgrounds, etc.

(2) ***Format:*** Cover photos must generally be taller than they are wide, in order to fit our vertically oriented cover configuration.

(3) ***Impact:*** Aside from the above technical considerations, our primary criterion is that we want a photo that will make as many readers as possible say "Wow!" when they take their issue out of the mailing envelope.

(4) ***Variety:*** We like to see photos of species that have not appeared previously on the cover for quite a while.

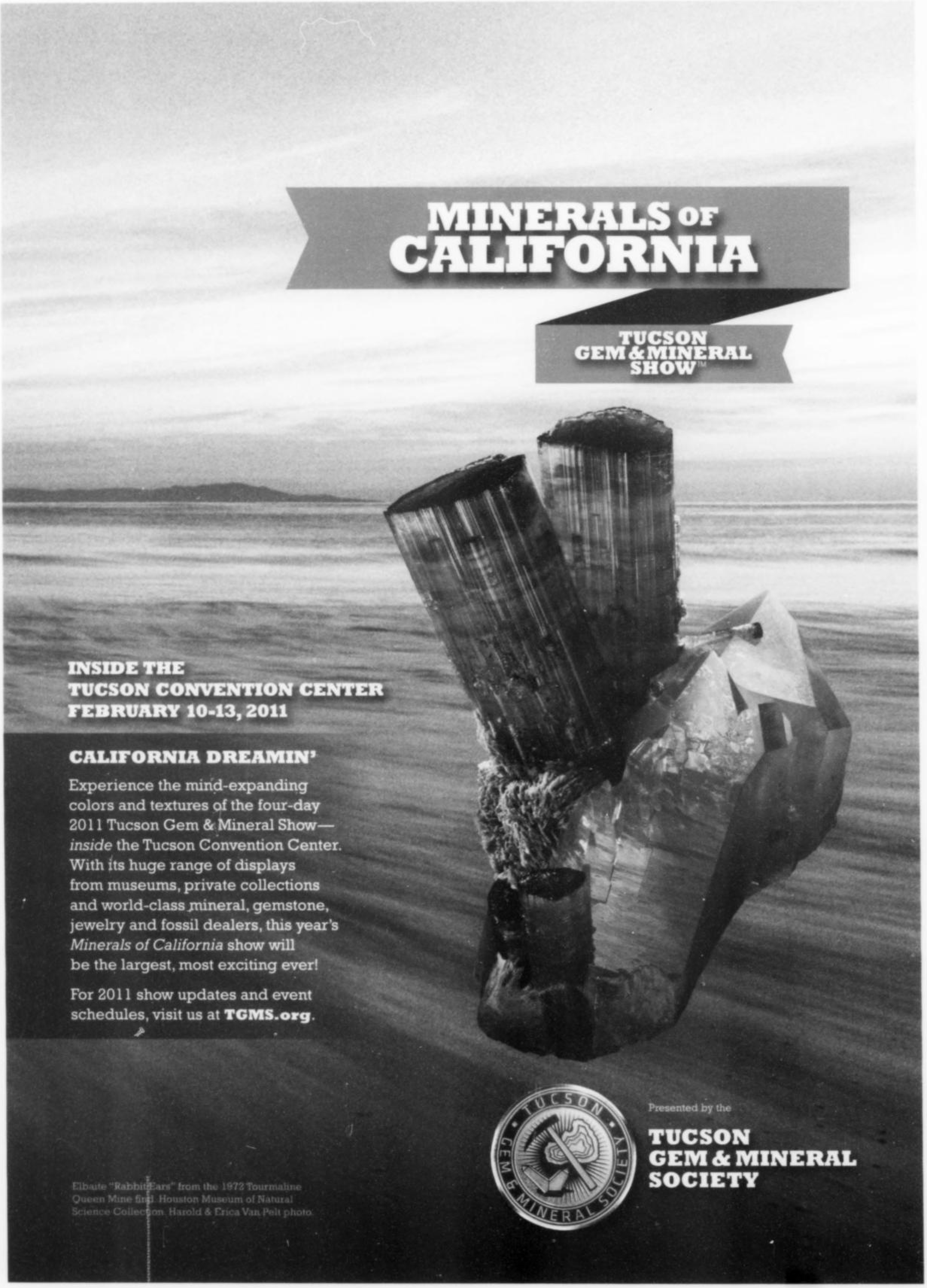
(5) ***Significance:*** Ideally, a cover specimen should be a "significant" example of whatever it is, rather than just a really good example.

(6) ***Topic:*** Sometimes we like to have a cover photo of a specimen that relates to an article inside that particular issue. We have generally not paid too much attention to this aspect in the past, preferring to concentrate on photos of specimens with impact, whatever they may be. However, special topic issues and supplements always have a topically appropriate cover photo, and in recent years we have given more attention to correlating covers with articles.

Given all these hurdles, it is quite an accomplishment when a photo finally appears on a cover. Our congratulations and thanks to all owners and photographers who have supplied us with beautiful photos of extraordinary specimens.

In practical terms, though, how do people go about actually getting their specimen on the cover of the *Mineralogical Record*? One approach is to send the editors a snapshot of a specimen, to determine whether they consider it cover-worthy before going to the expense of having a professional-quality photo taken. Or, if the specimen is exhibited at a major show where the editors are present, they can be asked to take a look and offer an opinion. A definitive answer cannot always be given, though; photographic quality can make a big difference. Sometimes the only way is to have the photo taken and submit it for consideration, without guarantees. Photos that we receive, and that we regard as acceptable for cover use, go into a folder to be reviewed the next time we need to prepare a cover.

This is an egalitarian process in that special preference is not given to any particular collector, dealer, advertiser, donor or photographer. We appreciate all of these kind supporters of the *Record*, and are happy to consider photos from any source if they meet our needs.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Elbaite "Rabbit Ears" from the 1972 Tourmaline Queen Mine find. Houston Museum of Natural Science Collection. Harold & Erica Van Pelt photo.
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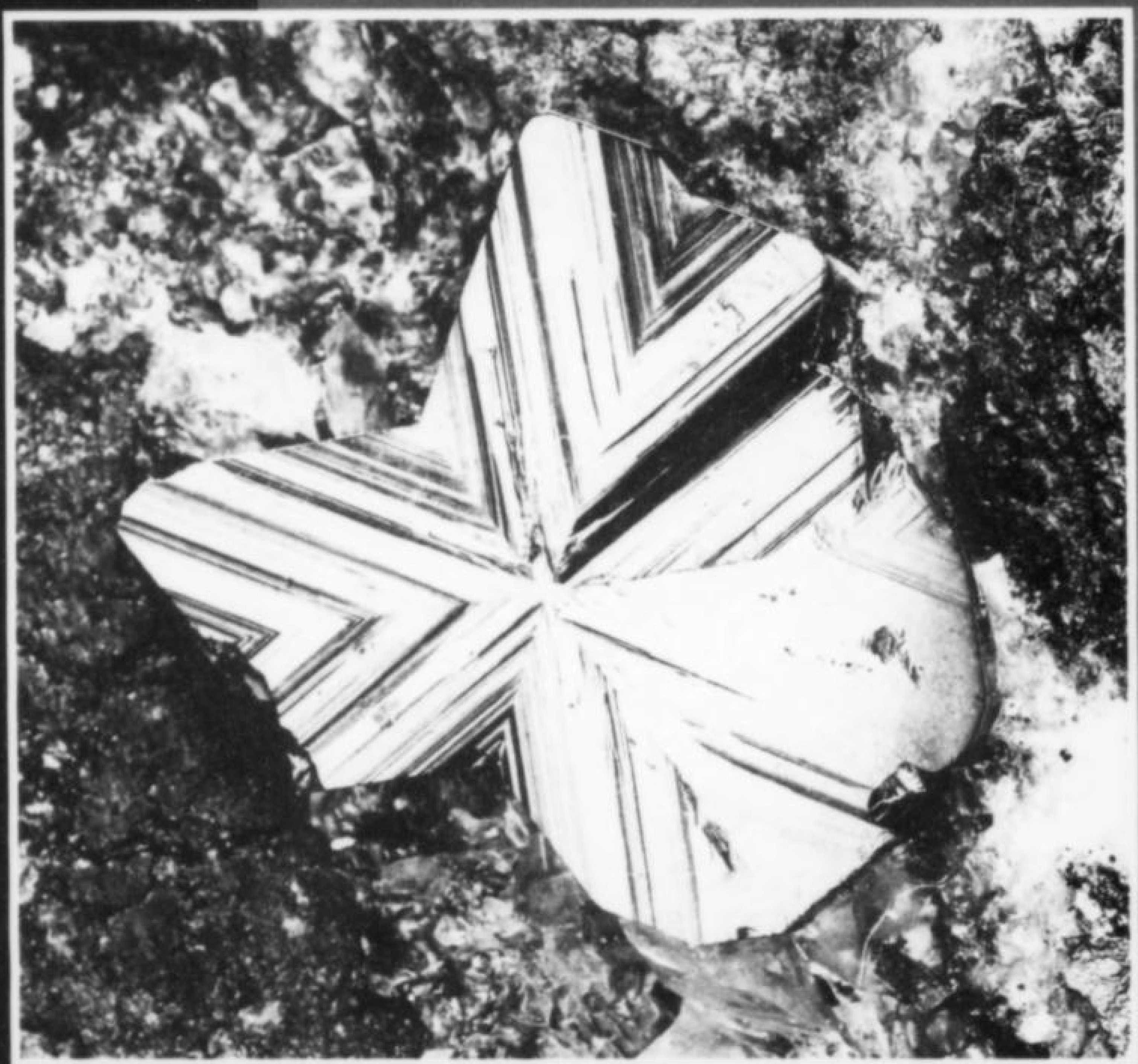


Ilfeld
Harz Mountains
Thuringia, Germany

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The world's finest crystal specimens of manganite came from small manganese workings near the town of Ilfeld (the type locality) at intervals between ca. 1700 and the final closure of the mines in 1922. The brilliant black manganite crystals are prized by mineral collectors worldwide, and so many were recovered that they still appear regularly on the market. Ilfeld is also the type locality for another manganese oxide: hausmannite.

INTRODUCTION

Mineral collectors everywhere know that the Harz Mountains in north-central Germany are exceptionally rich in metallic ore deposits, especially in the more rugged Upper Harz (*Oberharz*) in the northwestern sector. Most of the great and famous (and all now extinct) Harz mineral localities—Saint Andreasberg, Bad Grund, Clausthal-Zellerfeld, Altenau; the Rammelsberg mine, where mining for silver began in 968 A.D.—lie in the Upper Harz. However, the tiny manganese-mining district which flourished for two centuries near the town of Ilfeld lies in the Lower Harz (*Unterharz*), near the midpoint of the Harz massif's southern margin. The last mining activity near Ilfeld ceased in 1922, but the simple statement of Peter Bancroft (1984) that "Manganite is synonymous with Ilfeld" remains true today: this is without doubt the world's best locality for crystal specimens of the black manganese hydroxide. Rarely, the district has also provided good specimens of hausmannite, pyrolusite, pseudomorphs of hausmannite after manganite, and pseudomorphs of pyrolusite after calcite—but it is almost entirely to its wonderful manganite specimens that Ilfeld owes its fame in the world of mineral collecting.

The Harz Mountains consist of a geologically complex, oval-shaped massif measuring 110 km from northwest to southeast and a maximum of 35 km from north to south. Uplifted by block faulting during the Late Cretaceous, these self-contained "mountains" are actually a region of irregular rolling hills and terraced plateaus, with dense forests of spruce higher up and of beech and oak lower down. There are steep, rough stream drainages (with the occasional waterfall), and small caves in formations of limestone, dolomite and gypsum; wild canaries once lived in hillside fastnesses.

In German folk culture and in the high culture of the Romantic movement, the Harz were regarded as a sort of citadel of wild Nature: among romantic-age figures who sojourned there were the poets Heine and Schiller, the taleteller Hans Christian Andersen, and the great poet and amateur scientist Johann Wolfgang von Goethe (1749–1832). During the early 19th century Goethe, especially, came often to the Harz to pursue geological studies (and, probably, to pursue mineral specimens for his collection). Two scenes in his epic poem/drama *Faust* dramatize a legend of medieval *Walpurgisnacht* ("witches' night") celebrations held on May Eve (April 30/May 1)

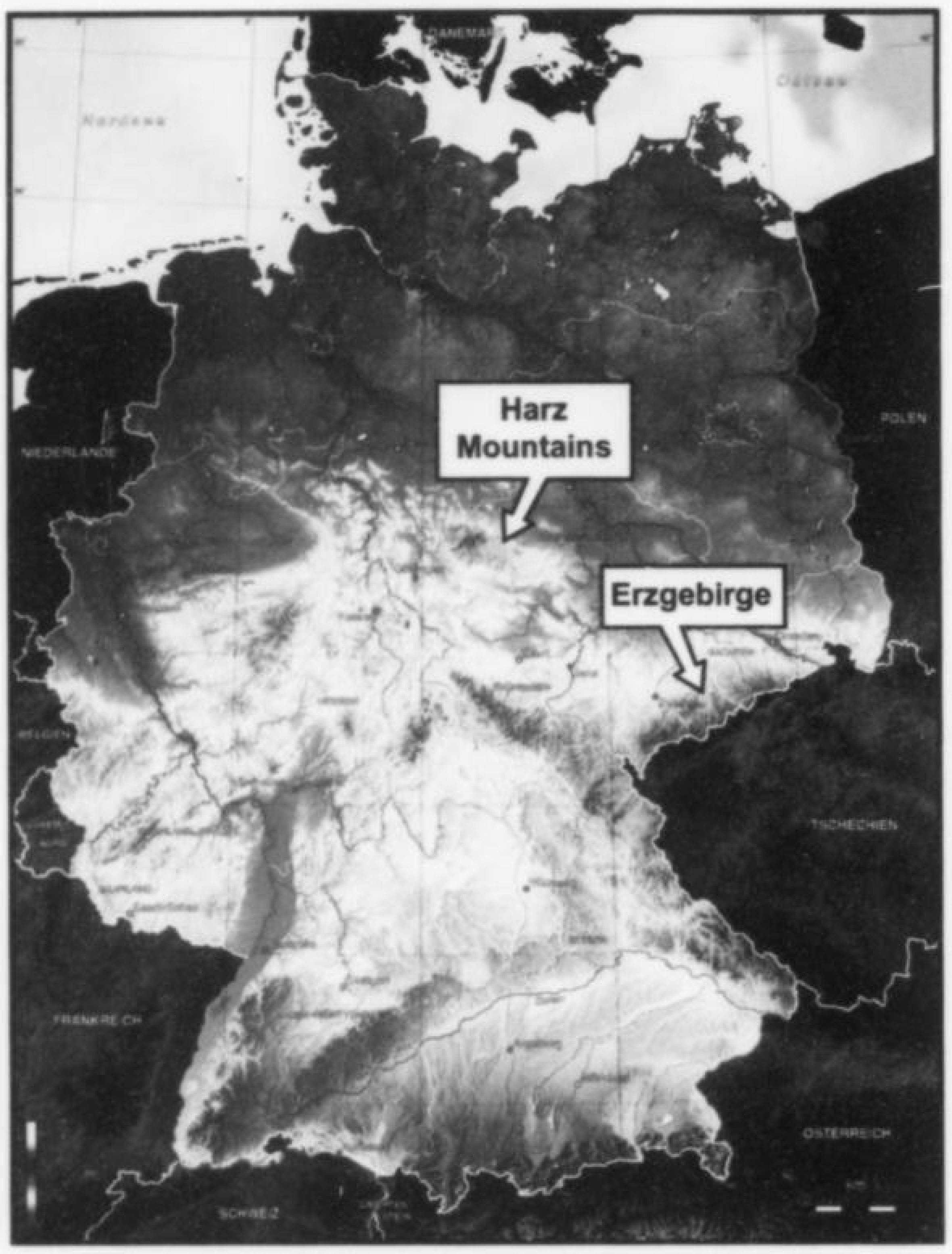


***Figure 1.* Topographic relief map showing the location of the Harz Mountains in Germany.**

on the Brocken, the highest peak of the Harz—with satanic powers ranging over the hilltops and in the dark glens.

Real 20th-century history offered up its own demons: Heinrich Himmler and other Nazi leaders toyed with the idea of setting up a *Festung* (fortress) in the Harz which would turn back the invading Allies. No such last stand ever occurred, although, for a few days after V-E Day, remnants of Waffen SS and *Volkssturm* units in the Harz did indeed play come-and-get-us with elements of the U.S. Fifth Armored Division (see en.wikipedia.org/wiki/Harz; Martin, 1950).

The Cold War boundary between the two Germanies sundered the western third of the Harz from the eastern two-thirds for more than four decades, but now, with artificial dividing lines down and all demons cast out, the beautiful hills attract tourists, vacationers, hikers and bikers, most of them Germans from other parts of the country, who seek a break from urbanized life or even, in Goethe's tradition, a sort of dreamy corrective to it. Some visitors—also following Goethe—are mineral collectors, and look for old ore dumps to dig on or mining museums to visit, or local collectors who might have surprises on view in parlor showcases.

LOCATION

The town of Ilfeld—present population about 3,000—straddles the valley of the little Behre River at a site 9 km north of Nordhausen and 3 km east of Appenrode. Politically, the town and nearby mines lie in the northernmost part of the German state of Thüringen (Thuringia), 10 km east of the old Cold War boundary and 20 km east of the famous Saint Andreasberg mining district. Recorded history for Ilfeld begins around the year 1100, when Count Elger I built a castle, the Ilburg, on a height overlooking the present site of the town. In 1154 the term "Ilevelt" first appeared in a document issued by the Saxon duke Henry the Lion, then passing through on a pilgrimage to the Holy Land. In 1189 Count Elger II and his wife Lutrude founded a monastery around which, in the mid-14th century, the village of Ilfeld began to grow. Chiefly known today (outside mineralogical circles) as a spa town and health resort, Ilfeld has remained through the centuries a quiet, bucolic place. Perhaps its busiest contemporary activities are the gatherings of hikers' and bikers' excursion tours bound for the forested hills, mainly those to the northwest of town, where manganese ore was once mined.

Excursionists often gather at an old half-timbered building called the *Braunsteinhaus*, about 2 km northwest of the center of Ilfeld. Named for *braunstein*, the old term for manganese oxide ore, the original Braunsteinhaus building served as a nexus of mining activity ever since it was first built during the 1750s near the mines on *Mönchenberg* ("Monk's Hill"). A few years later it was relocated 400 meters or so to the northeast, where mining was more active in the area soon to be called *Braunsteinzeche*. At various times in the late 18th century and throughout the 19th, when mining flourished, the house was expanded in stages, and satellite buildings, including a colliery, stamp mill, and storage sheds for mining equipment, were added, while the original building provided a headquarters for mine administration. In 1979 the former *Zechenhaus* ("colliery") at the Baunsteinhaus complex began its present career as a *Gaststätte* (restaurant/inn). Old, heavily overgrown dumps and the remains of prospect pits on the slopes of Harzeburg are easily reached on foot from this old dowager of a structure.

The belt of manganese ore veins begins in the *Silberbachtal* ("silver creek valley"), about 2.5 km northwest of the town of Ilfeld, and strikes generally west-northwest until ending at the *Holzapfelkopf* ("Crabapple Peak"), 1 km northeast of the town of Sülzhayn—a total length of about 5 kilometers. The ore veins and stringers were all quite small and nearly horizontal or roughly parallel with the surface, extending laterally for only about 10 to 15 meters, exceptionally 60 meters, and averaging 45 to 60 centimeters thick. Without exception the richest parts of the veins were less than 10 meters below the surface, pinching out or becoming barren of ore further down; such veins were colloquially called *Rasenläufern* ("sod runners"). All ore and specimens came from individual tiny prospects and shallow underground workings, few of which were ever given individual names. Since there was no single dominant mine, nearly all specimen labels say simply "Ilfeld," or occasionally "Sülzhayn" or "Appenrode."

The easternmost part of the mining area lay in the Silberbachtal, below the eastern slope of the hill called Harzeburg. During the 19th-century heyday of mining the so-called "Ilfeld-Mangan" mine area in Silberbachtal (one of the few workings to have received its own name) measured 2.1 million square meters, and produced chiefly pyrolusite and hausmannite ore from irregular stringers and pods (Rumscheidt, 1926). The ore zone was about 12 meters deep, striking 80° northwest and dipping between 76° and 80° to the southwest. It extended from the stream valley to the northeastern margin of the Harzeburg, where it ran around the hill's northern edge, finally joining the *Oberen Zug* ("upper course") of iron and manganese ore veins about 100 meters east of the Braunsteinhaus. There are traces of mining in the Silberbachtal before 1725, the earliest date of reliable written records for the region as a whole.

The Oberen Zug along the northern slopes of the Harzeburg included both iron and manganese ore veins, the latter concentrated immediately south of and upslope from the Braunsteinhaus. In this region of workings, generally called the *Braunsteinzeche* ("braunstein mining area"), manganite was the chief ore species. Like the Silberbachtal, it was characterized by irregular pods and stringers of ore; consequently, ore exploitation took place in quarry-like open pits and through very short, shallow adits driven into

Figure 2. **Postcard view of Ilfeld ca. 1890. U.S. Library of Congress collection.**

the slope of the Harzeburg from ground near a stream called the Salzwerferbach, almost at the southern portal of the Brainsteinhaus. The Braunsteinzeche area was, with Mönchenberg, one of the two sub-districts which produced the very finest known specimens of crystallized manganite (Rumscheidt, 1926).

However, the region's best, most economically valuable manganese *ore* was found on the Lower Harzeburg, along the *Unterer Zug* and *Mittlerer Zug* ("lower course" and "middle course") of veins running along the southwestern slopes of Harzeburg until ending at a westernmost point at the Salzwerferbach, where the vein system meets the deposits of the Braunsteinzeche. Today the Lower Harzeburg area harbors many remains of open pits and extensive (though overgrown) ore dumps, and is a main destination for hikers along the *Bergbauhistorischer Lehrpfad* ("Mining-Historical Teaching Trail").

On the other side of the Salzwerferbach and about 300 meters southwest of the Braunsteinhaus lies the hill called *Mönchenberg* (or *Kleine Mönchenberg*), where manganese and iron mining also began very early, i.e. before 1725 (Gaevert, 1981), and where manganite specimens equaling those of Braunsteinzeche were found occasionally (Rumscheidt, 1926). The remains of mining on Mönchenberg are clearly visible today, most of them dating from the late, brief period of work during World War I (Liessmann, 1997). The ore-bearing porphyry in this sub-district is brecciated and shot through with stringer veins and isolated pods (called *Trümern*) of manganese oxides, including good pyrolusite ore; the greatest ore concentrations reached 12 meters thick. During the 19th century an open pit was dug from the top of the hill to a depth of 63 meters, and ore was produced from veinlets and "nests" encountered in the quarry-like excavation (Luedecke, 1896; Bruhns, 1906; Rumscheidt, 1926).

Figure 3. **The *Braunsteinhaus* ("Manganite House"), once the headquarters of the Ilfeld manganese mining district.**

Manganese mining at other sites in the district was less well developed and less economically important. A zone of stringer veins was exploited on the hill called *Mühlberg*, about 800 meters northwest of the excavations on Mönchenberg, and more stringer veins were worked on *Hegersberg*, about 1 km due north of Mönchenberg and 700 meters north-northwest of the Braunsteinhaus. At a point on Hegersburg where two thick veins converged there was a concentration of excellent pyrolusite ore (Rumscheidt, 1926). Very small-scale, intermittent mining also took place on *Heiligenberg* ("Holy Hill") and *Liesenberg* ("Gleaning Hill"), further to the northwest.

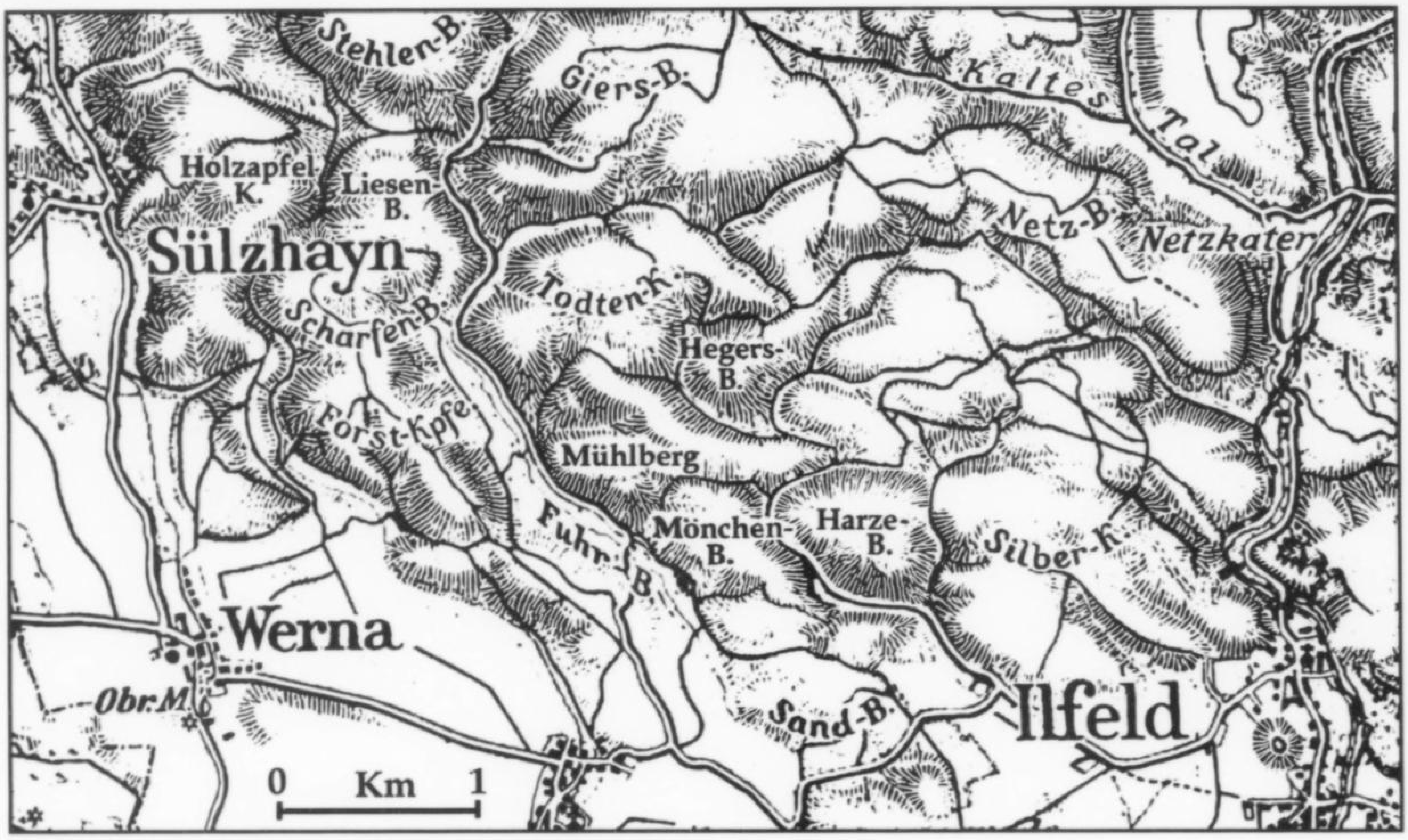


***Figure 4.* Map of the southern Harz Mountains manganese district between Sülzhayn and Ilfeld, showing the various hills ("hill" = *Berg* or *Kopf* in German). Adapted from a 1912 topographic map.**

The mining district terminated about 1 km northeast of Sülzhayn, on *Holzapfelkopf*. On this prominence a mine called the Bergmannshoffnung ("Miners' Hope"), begun in 1838, covered a surface area of 2 million square meters; it was a complex of branching open-pit excavations exploiting a system of ore veins which must have been (for the district) fairly extensive. In the 1920s, just after all mining had ceased, an exposed vein of high-grade manganese ore about 35 cm thick was still visible on Holzapfelkopf (Rumscheidt, 1926).

HISTORY

Iron Mining at Ilfeld

There were once at Ilfeld not only manganese mines, but also mines which exploited iron ore—massive red hematite occurring in veins running roughly parallel to the manganese veins and lying very near them. Hematite veins, for example, on the northern slope of Harzeburg, between the Silberbachtal and Braunsteinzeche manganese-mining areas, form the eastern part of the Oberer Zug system on Harzeburg (shown on the map in Fig. 11). These and other miniscule iron deposits were worked long before any manganese mining began. A letter of 1535 mentions iron mines called "God's Grace" and "Holy Trinity" located on Harzeburg, as well as other iron mines on Mönchenberg and at unspecified sites along the stream called the Sachswerferbach (www.manganit.de, 2010). According to Rumscheidt (1926), there was an iron-smelting facility in Ilfeld during some part of the 18th century, and organized exploitation of hematite ores in the Ilfeld district fed its operation. The same source goes on to say that iron mining at Ilfeld ended for good in the very early 19th century, when manganese mining took its place; Bruhns, however, wrote in 1906 that "red iron oxide ores are mined," together with manganese ores, on Mönchenberg. However unclear their history, it is quite clear that the iron ore occurrences of the Ilfeld district were small even compared to the manganese ore deposits there—and the literature contains no hint of any significant crystallized minerals having ever emerged from them. Accordingly, the historical survey below restricts its attention to the manganese ore veins of the Ilfeld district.

The late Middle Ages through the 18th century

Like many centuries-old mining districts, Ilfeld has a history that is preceded by cloudy legends and rumors out of "prehistory"—meaning, in this case, the late Middle Ages, when pulverized manganese oxide ores were employed in the manufacture of high-quality glass for making decorative objects and works of art. Exactly *how* braunstein was used to make glass was a trade secret closely kept by the glassmakers of Venice, already in the late Middle Ages a renowned glassmaking center. Braunstein being hard to procure in Italy, Venetian glassmakers (the legend goes) sent prospecting teams out into remote territories in search of it, perhaps beginning in the last third of the 15th century. To keep the purpose of their journeys secret (the legend continues), these explorers elaborated a system of myths and codes, and to keep up communication they scratched out secret signs on rock walls. They wore unusual "weather" capes and pointed hats, the hats reminiscent of cowls worn by members of some monastic orders. And such Venetians may or may not have come to the wild northern forests near Ilfeld, and they may or may not have discovered the manganese ore on Mönchenberg, which may or may not have been named for these travelers whom some observers called "monks" because of their hats and esoteric behaviors (Liessmann, 1997; www.manganit.de, 2010).

The earliest known written reference to mining around Ilfeld dates to 1535, when unknown parties filed mining claims on Har-

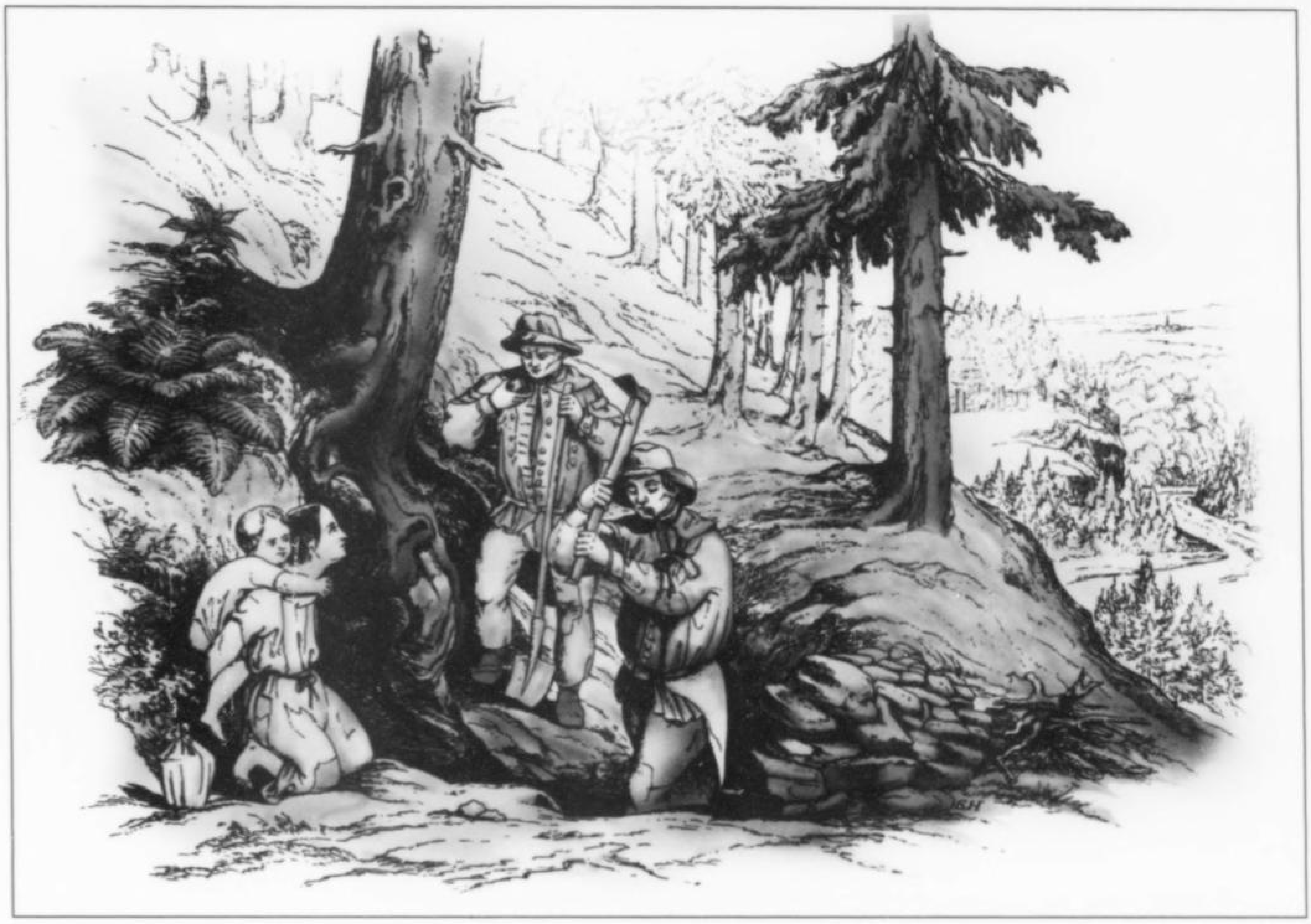


Figure 5. **Most of the manganite mined at Ilfeld came from strings of small surface workings where veins cropped out along forested hillsides, as in this illustration from Eduard Heuchler's *Die Bergknappen* (1857).**

zeburg. The old records make no reference to manganese ore or any other specific resource. Siemroth (1990) speculates that the manganese oxides may have been mistaken for silver ores, and the claims may have been filed by someone passing through from the silver-rich Erzgebirge or Mansfeld mining regions, or from Saint Andreasberg.

In his *De Re Metallica* (1546), the great Renaissance pioneer of mineralogy Georgius Agricola (1494–1555) noted that "stibnite" occurs near Ilfeld. More than two centuries later, in 1754, a Saxon mining official named Henkel observed sarcastically that "the all-around mining expert and country parson" Georgius Agricola must have mistaken black, prismatic crystals of manganese ore for "antimonio," as the antimony sulfide was then often called (Siemroth, 1990). After Agricola, in any case, there are no further mineralogical observations from Ilfeld for 175 years, i.e. until the 1720s.

In 1727 the physician and naturalist Franz Ernst Brückmann (1697–1753) published his *Magnalia Dei in Locis Subterraneis*, an ambitious work described by Schuh (2008) as a "guide to mining throughout Europe . . . [with] various descriptions of individual mines and entire districts and the materials mined." The work shows that manganese mining at Ilfeld was already under way, a passage in it reading:

> . . . on the hill called Mönnigsköpfe [= Mönchenberg?] . . . there is excellent braunstein ore which looks just like antimonio. The veins and stringers of ore are narrow and do not at all reach into the depths, but rather lie more or less on the surface. The stone is all sent to Holland, and a kentner here at the mines costs half a thaler. In 1724, 1,400 kentners were sent to Holland. (Quoted in German translations by Rumscheidt, 1926, and Siemroth, 1990)

A *kentner*—more commonly "zentner"—was a hundredweight: about 50 kg. Siemroth (1990), working with old production documents now in the public records office in Magdeburg, reports that between 1740 and 1785 an average of 200 zentners of Braunstein were exported yearly from Ilfeld to Holland, so, probably, Brückmann's "1,400 kentners" is an error for 140 zentners. In Holland, the braunstein was used in the preparation of a dark glaze for bricks and building stones, such as one sees (even today) on old buildings there. A 1797 report on the use of braunstein affirms that "such braunstein goes especially to Holland, where they like to use bricks and tiles which gain firmness and luster from it" (Siemroth, 1990).

In the early 18th century, most of the forested region between Ilfeld and Sülzhayn was the private property of the Count of Stolberg-Wernigerode, and the primitive manganese mines were overseen by this nobleman's Forest Administration. For decades before Brückmann's 1727 observations, the mines had suffered from haphazard exploitation, despoliation, and general chaotic conditions, and thus in August 1724, at the suggestion of a *Forstmeister* ("Master of the Forest") named Seibd, Mine Inspector J.G. Sander was appointed to survey the mine workings and to make recommendations for their improvement. His report, issued in January 1725, is full of well-focused, interesting facts, among them that (1) a "main shaft" on Harzeburg had reached a depth of 4 meters; (2) the vein on Heiligenberg was thick, but somewhat impure; (3) the old mines on Mönchenberg were closed and flooded, although good outcrops of fragmented braunstein were evident; (4) Silberbach had once yielded good ore but now lay dormant; thick veins were present which would bear further investigation.

Sander suggested that a plan for professional mining be set down, that the scope of mining be expanded, and the price of ore increased. By "professional" mining he chiefly meant a program of stoping to

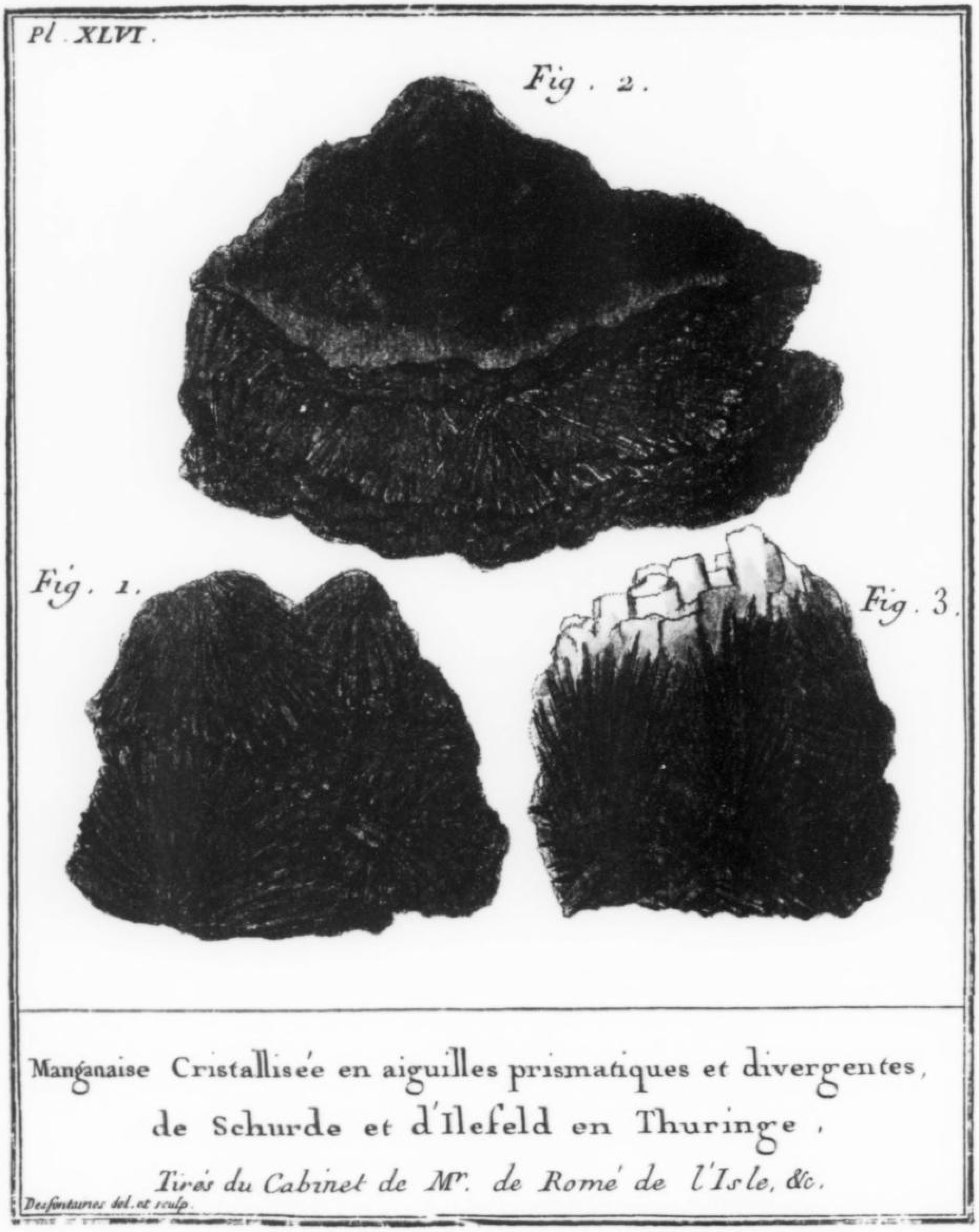
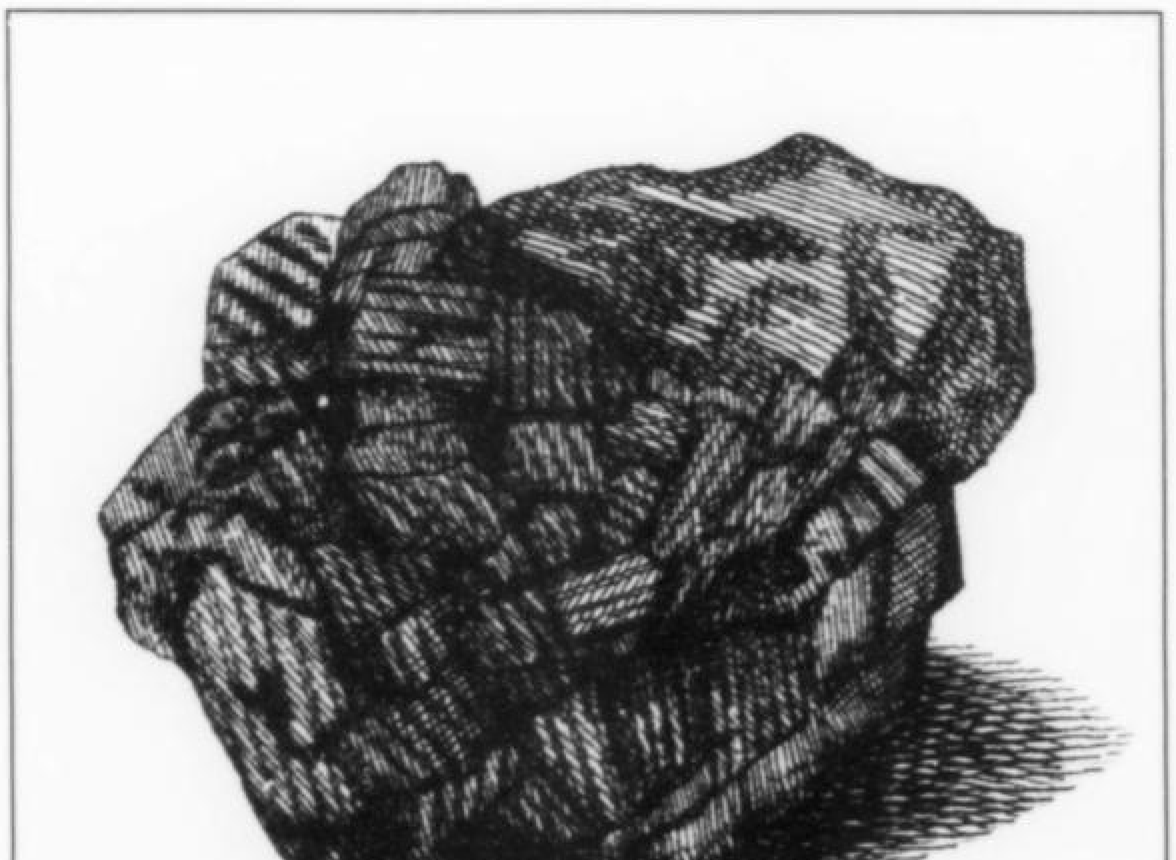


Figure 6. **Manganite from Ilfeld (Figs. 1 and 2) as shown in Fabien Gautier d'Agoty's *Histoire Naturelle Règne Minérals* (1781); from the collection of Jean-Baptiste Romé de l'Isle.**

Figure 7. **Manganite (or perhaps pyrolusite) from Ilfeld, as shown in Baumeister's *Des Mineralreichs* (1791).**



follow the braunstein veins upwards from the valleys—replacing the old, haphazard practice of digging shallow pits and ditches on the tops of hills. He also recommended that existing shafts should be deepened to ascertain whether and how the braunstein continued at depth (Gaevert, 1981).

The Count's Forest Administration accepted the recommendations and set to work on them at once, albeit not wholly as would be done today: in February 1725 a professional dowser was hired to locate with his divining rod all hitherto unknown braunstein veins. He reported that the richest veins lay on Mönchenberg and Heiligenberg, and suggested that mining efforts be focused on these sites and on the established ones on Harzeburg. In March 1725, free prospecting rights for all comers were proclaimed. Increased stoping was instituted, as per Sander's recommendation. By November 1739, *Forstmeister* Seibd could (and did) report that the mines were in excellent working order, though improving them had cost much money and trouble (Gaevert, 1981).

Throughout the 18th century, most of the orders for braunstein continued to come from Holland. Each year a few hundred zentners

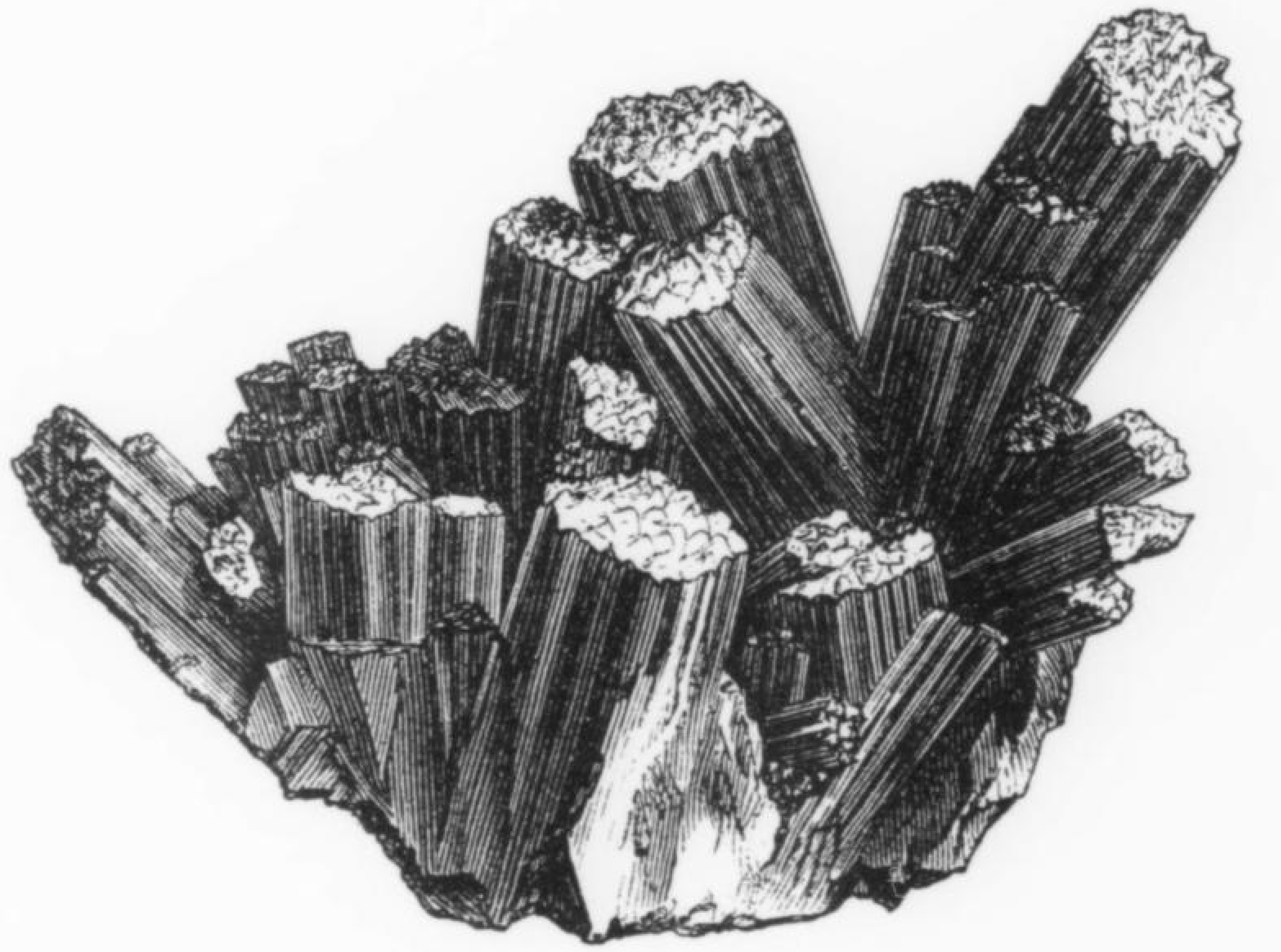


Figure 8. **Engraving of an Ilfeld manganite specimen by Hubert Clerget, published in Burat's *Minéralogie Appliquée* (1864).**

of manganese ore were taken in wagons from the Braunsteinhaus to a transshipment point in Wernigerode, and then, via Magdeburg (in care of a merchant named Tilebein), to Hamburg, from whence the barrels of ore were taken by ship to Amsterdam and Rotterdam. The names of some Dutch merchant buyers from the 1770s have been preserved: Boom in Rotterdam; Waeshoff, Heurn and Herchner in Amsterdam. But transporting ore over the Harz made for difficulties in the 18th century. During stops, farmers were paid to guard the ore wagons, but since during spring, summer and fall the farmers were almost exclusively occupied with their fields and properties, it was considered best to ship during winter, notwithstanding that most orders came in at other times of the year. When, in winter, the mountain roads grew perilous, care was taken to locate "good sleighing routes" to Wernigerode.

The scope and intensity of the mining work was directly dependent on orders for ore. When demand was great, the Forest Administration employed miners for days or weeks at a time, but when orders dwindled, miners were simply laid off indefinitely. Ore production levels, and the number of mines in use, fluctuated wildly. In 1730, in a second part of his *Magnalia Dei*, Brückmann reported that nearly all of the workings were dormant (Siemroth, 1990), but in 1740, an Amsterdam merchant named Gerhard having requested that 34 barrels of braunstein be sent to him as soon as possible, expanded crews took large quantities of ore from veins at four mining sites (Gaevert, 1981). In February 1759 only two miners were at work, and in 1766, when complaints from Holland came in to the effect that the braunstein received was "contaminated with earth" and of little value, sales fell off and dubious reserves accumulated.

In 1770 business picked up again thanks to large orders from the Amsterdam traders Waeshoff and Heurn; many miners were quickly hired and were paid by the hour to produce "quantities" of braunstein (Gaevert, 1981; Siemroth, 1990). In Holland—as later in Russia—the manganese oxides were still being used to make glazes for bricks, and for pottery and ceramic wares, and small amounts of manganese still found uses in glassmaking. The alloying of manganese with iron to make steel was fated to wait, of course, until a steel industry began to develop in the mid-19th century.

The 19th century

The 19th century, and in particular the decade of the 1830s, was a "golden age" of manganese mining at Ilfeld. At some time shortly before 1819 there was an administrative change: the Count of Stolberg-Wernigerode transferred authority over the mines from his Forest Service to his Mining Office, headquartered at Büchenberg, near Wernigerode. The *Bergschreiber* (~ "Secretary of Mining"), a man named Preu, concerned himself closely with the Ilfeld mines, often staying for long periods at the Braunsteinhaus to oversee mining and provide direct guidance to the working miners. His yearly reports, with budget estimates for each coming year, were reviewed by *Bergkommissar* C. F. Jasche, the representative of the Count's control board. Both of these men devoted themselves chiefly to improving the quality of the braunstein ores (Gaevert, 1981; Liessmann, 1997), for only thus could higher prices be charged and higher profits secured. The direction of the Ilfeld mines was in capable hands.

Support structures around the Braunsteinhaus were greatly improved. In October 1818, *Bergschreiber* Preu directed that a roomy enclosure be built where valuable ore could be hand-separated from barite, calcite and country rock (earlier this ore-sorting had taken place outdoors); the facility was finished in 1821. In 1819–1820 a stamp mill was added, where barite and clay could be separated from *Graubraunstein* (gray braunstein, the most impure kind of ore). A dam on Sachswerferbach was constructed, creating a pond from which water could be brought by ditches to the stamp mill—although it was only in rainy periods that the water of the tiny stream sufficed fully for the purpose (Liessmann, 1997). Comfortable living quarters for crew foremen and visiting officials were provided by an expanded *Zechenhaus* ("colliery house"), the core of the present-day restaurant—although accommodations remained very cramped for common miners who chose to stay overnight at the mines, as many did who sought "overtime" during the busy 1820s and 1830s. Along the routes by which ore was shipped from the Braunsteinhaus to Wernigerode and, by then, other transshipment points in the Harz, checkpoints were set up to monitor the delivery process and improve its efficiency (Gaevert, 2010).

In 1819, 34 men were at work in mines in the Braunsteinzeche, and more were hired in the next few years as operations expanded on Harzeburg, Mönchenberg, Heiligenberg and Hegersberg. Mining went on year-round at one or another of several sites, and orders for braunstein from within Germany were increasing, simplifying ore-shipment logistics. New uses for manganese were also being discovered, e.g. in dyes and inks and as an oxidation catalyst in the manufacture of bleaches. The chemical industry found that pyrolusite (MnO_2, called *mangansuperoxide*) was especially effective at releasing chlorine from hydrochloric acid (Bruhns, 1906).

In 1835, 72 mine workers produced 5,048 zentners of manganese ore (Liessmann, 1997). In 1836, the all-time record year (before the brief period during the First World War, when "modern" technologies were applied), 5,613 zentners of ore were won by a work force of 94 men (Rumscheidt, 1926). This success inspired management to prospect in areas farther to the northwest from the Braunsteinhaus, such as on Liesenburg and Holzapfelkopf. On the latter hill a rich pyrolusite orebody was discovered, and in 1838 the Bergmannshoffnung mine was begun. Another bright spot in the 1830s was the Count's institution of a miners' provident fund to make money available to miners' widows and orphans: a modest "welfare" system which nonetheless added a burden to mining budgets (Gaevert, 1981).

But any ideas of steady, long-term growth were ruled out by the patchy nature of the ore deposits and related economic uncertainties. The veins and stringers of ore kept giving out, and new veins and stringers were not always located quickly. Sales of reserves were spotty; in times of low productivity there was not always enough ore on hand to fill orders. The market price of manganese remained subject to large fluctuations. Short-notice hiring of miners was difficult, as the men in question had all too commonly been laid off in the past and preferred to take more stable jobs.

In the 1830s Russia replaced Holland as the chief foreign customer for braunstein (which the Russians used chiefly in making a chemical bleach for glass manufacture), and the logistics of filling orders became much more challenging than they had previously been. The successes of the mid-1830s very soon gave way to hard times. By 1840 the number of miners at work, 94 in 1836, was down to about 20 (Gaevert, 1981), and in 1849 the production of braunstein was less than 7% of what it had been 13 years earlier (Rumscheidt, 1926). By 1859, only eight men were mining and refining ore at the Braunsteinzeche.

In 1865, Otto von Bismarck was beginning his project of unifying a German Empire under the domination of Prussia, and the powers of local rulers such as the Count of Stolberg-Wernigerode were beginning to erode. On June 24, 1865, a general Prussian mining code was instituted; among its local effects was that the control of the Ilfeld manganese mines now fell to the Hanoverian Mining Office at Clausthal, although the Count's old Mining Office retained supervisory responsibility. In 1869, under the new law according to which all prospecting rights had to be procured from Prussian state agencies, the Count of Stolberg-Wernigerode laid formal claim to two areas, each 22 km^2, called "Braunsteinzeche" and "Bergmannshoffnung," encompassing all of the known manganese ore occurrences near Ilfeld. The claim was granted, and thus the Count regained the right to work "his" ore deposits. Already by then, though, it was clear that the mining district was in economic decline.

Foreign orders for braunstein came almost to a halt during the Franco-Prussian War of 1870–1871. By 1875, orders were up again, technical improvements at the mine sites were being made, and production rose. In 1876, economic fluctuations brought on a plunge in orders, and work in the mines almost totally ceased. By this time, a major contributing factor to the decline of the mines was the influx of cheap manganese ores from new mines in Spain and India. In early 1877, surprisingly, orders for braunstein from Ilfeld rose sharply again; in 1880, with contributions from some rich veins on Hegersberg, about 1,500 zentners of ore were produced. But production fell off steadily once more after 1882. In 1890 only 98 zentners of ore were produced, and the Count began to entertain the idea of ceasing all mine operations.

An entrepreneur from Nordhausen, Eduard Gossel, offered to lease the mines from the Mine Office and continue mining. The Office was tempted to grant the lease, but since, in the judgment of *Bergmeister* W. Schleifenbaum, it was highly questionable whether Gossel could mine at a profit, negotiations were broken off. Schleifenbaum pointed out that manganese ores were now being recovered cheaply in Spain and in the Caucasus, while the use of high-quality Ilfeld braunstein in glass manufacture was declining. And, anyway, minable Ilfeld reserves seemed still confined to *Rasenläufer* veins just under the surface, most known examples of which were almost completely mined out (Rumscheidt, 1926; Gaevert, 1981).

Early in 1891 the buildings around the Braunsteinhaus, with their entire inventories, were sold off, and the Ilfeld district went dormant until 1916.

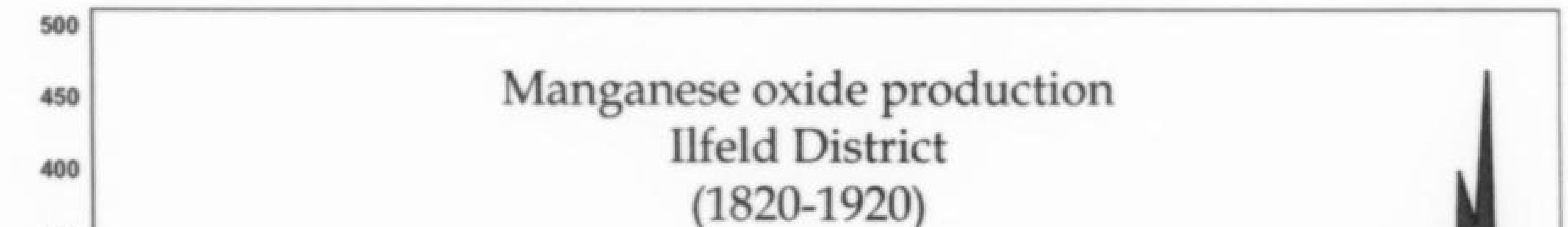


***Figure 9.* Manganese oxide production from the Ilfeld district (1820–1920), plotted from data given by Rumscheidt (1926).**

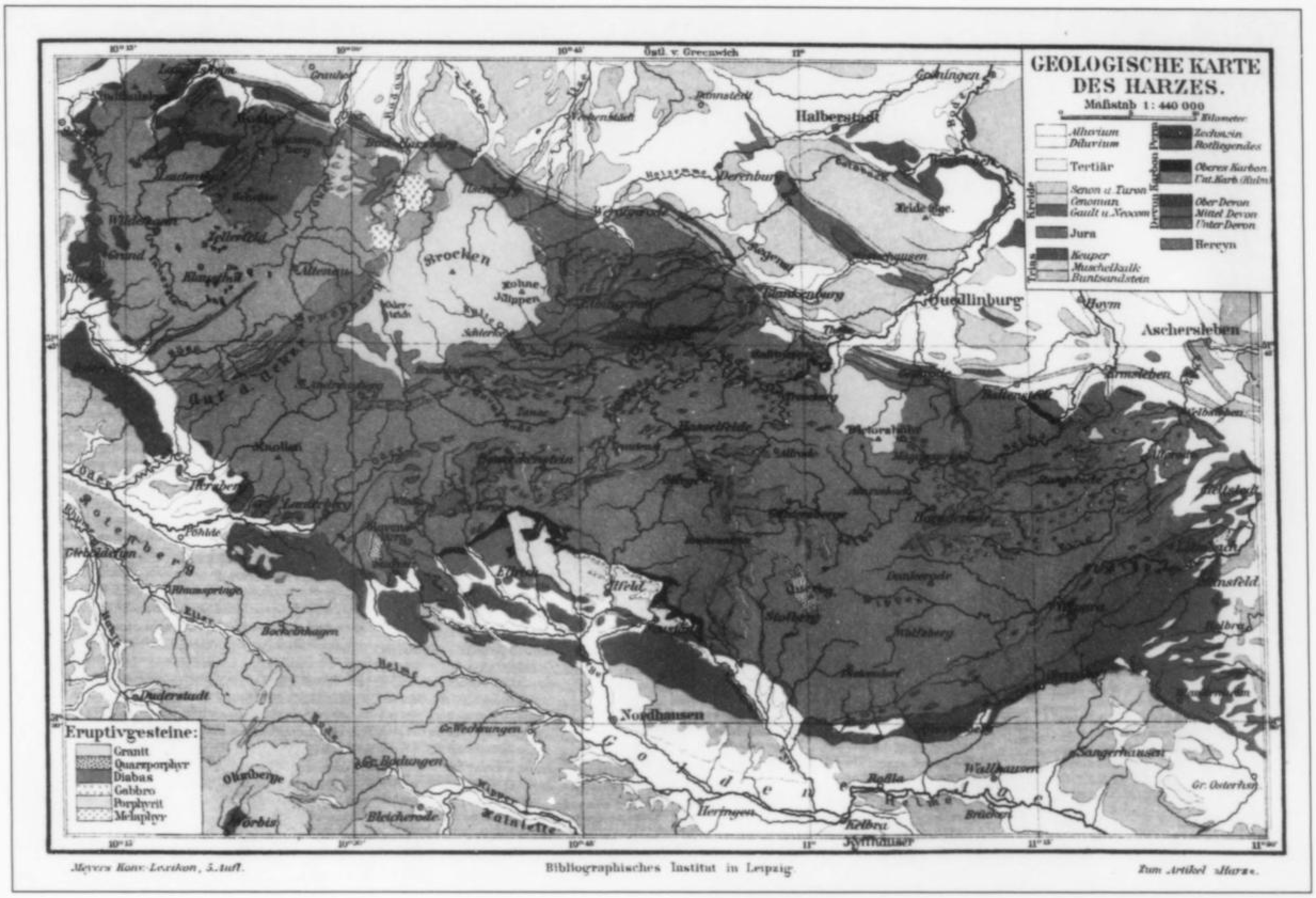


Figure 10. (above) **Geologic map of the Harz Mountains published by the Bibliographisches Institut in Leipzig (1895).** ***(right)*** **Detail of the Ilfeld area.**

Last Operations: 1916–1922

During World War I, with Germany cut off from global commerce by the British naval blockade, it became vital to exploit domestic resources as fully as possible. Manganese was now needed for alloying steel, and hence was a valuable strategic metal. In 1916 the *Südharzer Schwerspatwerke Max Döring* ("Max Döring Southern Harz Barite Company"), the first commercial firm ever to become involved with manganese mining at Ilfeld, leased the old mines from the Count's Mining Office. The company's plan was to reactivate not only the central mines at Braunsteinzeche and on Mönchenberg and the southern slopes of Harzeburg, but also the Ilfeld-Mangan mine in Silberbachtal and the Bergmannshoffnung mine on Holzapfelkopf.

During the previous 26 years the mine workings in general, and in particular the shallow underground adits, had deteriorated badly, so an 84-person crew (including women) was set to work in removing debris, repairing the adits, and deepening some of the old shafts. No new ore was produced for several months, but by the end of 1916, 8,000 zentners of manganese oxides had been won—2,400 zentners more than had emerged during the peak year of 1836. The difference was a result of improved technology: the use of mechanical drills attached to air compressors enabled the ore to be extracted far more efficiently than it had been in the 18th and 19th centuries. However, just as in those centuries, the ore was taken in carts to the Zechenhaus and there sorted by hand, processed lightly, and shipped out of the district in wooden barrels (Gaevert, 1981).

In 1917 the Max Döring company was taken over, and the lease to the mines acquired, by the Dresden firm of Pretzschmer und Fritzsching, and intensive mining continued. Large quantities of ore (for Ilfeld) emerged each year up to and including 1921. But after the Versailles Treaty was signed and the blockade lifted in 1919, competition from foreign sources resumed, and, even more discouragingly, the known major zones of ore were almost exhausted and there had been no indications of new ones. On April 1, 1921, all mining around the Braunsteinhaus ceased. On March 31, 1922, the last shift finished work at Ilfeld-Mangan in Silberbachtal, and

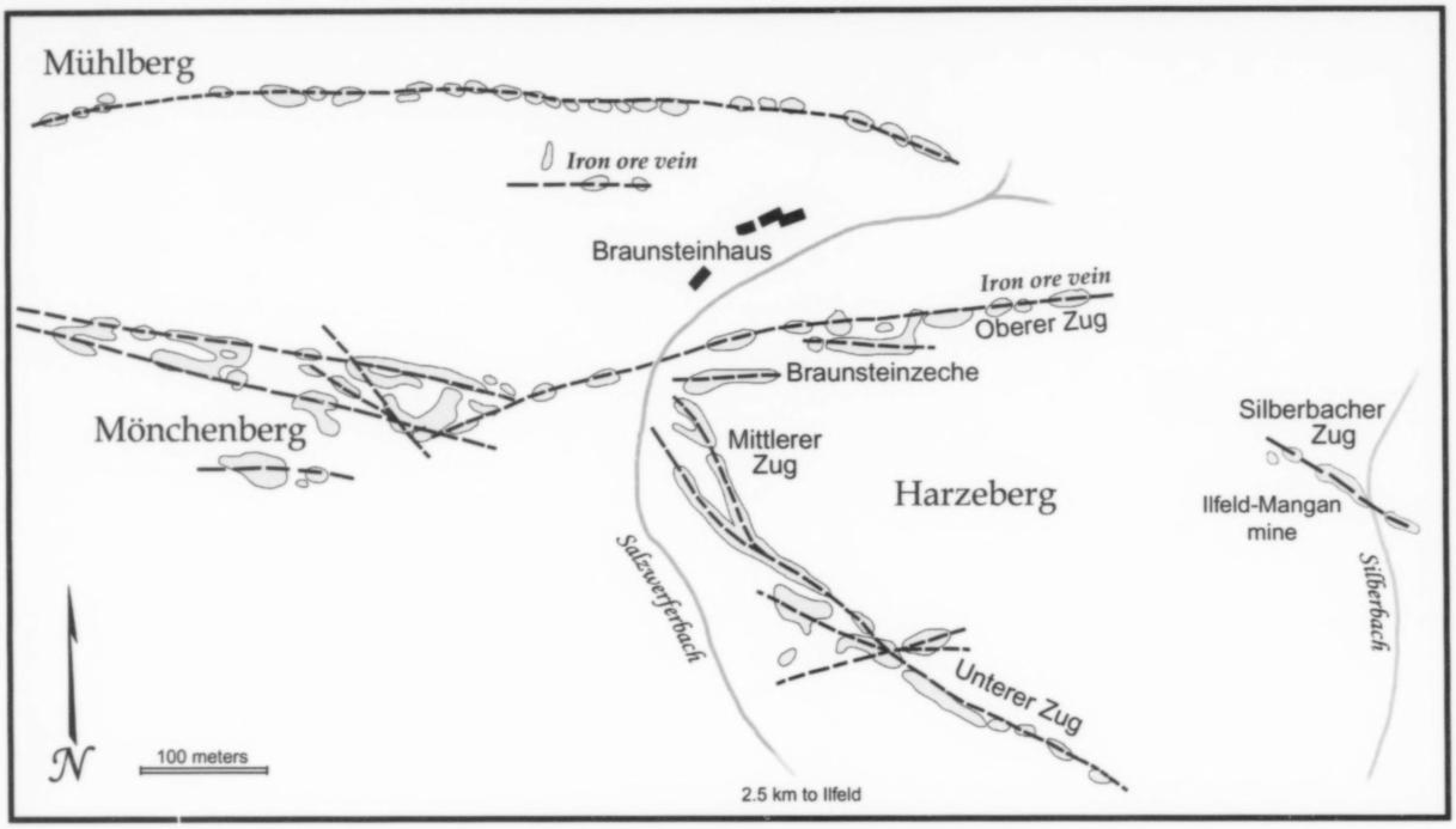


Figure 11. **Major veins (dashed lines) and mine workings (gray) in the Ilfeld district (after Liessmann, 1997).**

with this final closure the history of manganese mining at Ilfeld came to an end (Rumscheidt, 1926; Gaevert, 1981).

Although economic circumstances for a renewal of mining briefly looked favorable during the 1930s, no new activities came about in that decade or during the Second World War. For 88 years now the mine sites have known only visitors who dig ferociously in the old dumps for manganite crystals (see later, under "Collecting Manganite"), and docile hikers who follow the *Bergbauhistorischer Lehrpfad* onto the overgrown slopes of Harzeburg and Mönchenberg.

Production

Rumscheidt (1926) offers a total accounting of the production of manganese ore in the Ilfeld district. If one adds together the precisely known production figures for 1819–1890 and 1916–1922 (see Fig. 9), and if for the period 1724–1818 one assumes an average production of 300 zentners per year (a plausible figure, judging from 18th-century documents), one can calculate a total production of about 10,000 tonnes of manganese ore for the whole period 1724–1922. Comparing this with the world's total production of *24 million* tonnes of manganese ore in a single year, 1978, reveals the economic insignificance of the Ilfeld occurrence. It is likely that in 1978 (or any later year), the original Ilfeld deposit would never have been mined—unless it were to retrieve showy collector specimens of manganite.

For that matter, these would have been superb "specimen mines," but for that they were wrongly located in time and place. As fate had it, the mining of this trivially tiny deposit (as one may safely call it) over two centuries made for no special boons to civilization. A few pretty hillsides were violated; a few men found very unsteady employment; manganese oxides went to serve casual decorative ends in some corners of Europe; and financial profits went to enrich the estates of the Counts of Stolberg-Wernigerode. The best, longest-lasting remainders of mining at Ilfeld are the magnificent manganite specimens that may be seen today in museum and private collections worldwide.

GEOLOGY AND MINERALIZATION

The Harz Mountains as a whole are characterized by very complex geology, with diverse rock types forming an intricate patchwork (see map) representing the eroded roots of what were once mountains formed by the Hercynian (also called the Variscan) Orogeny that took place during the Carboniferous period some 350–300 million years ago. During the Cretaceous (140–67 million years ago), block faulting, especially on the northern edge of the Harz, uplifted the mountain roots, forming the present massif, some of which was probably an island in the shallow sea which covered northern Europe in Late Cretaceous times. The Harz are bounded by fairly sharp scarps on their northern and northwestern margins and dip in a gentle, generally uniform way toward their southern margin.

Quite aside from their mineral deposits, the Harz have always been a fertile field for geological study. One area around Goslar is so complex that German geologists call it the "classic [or golden] square mile of geology"—the reference being to a 7.5 km-long "Prussian mile." The term "Hercynian," referring in Europe both to the Carboniferous-age orogeny and to a specific strike direction—northwest-southeast, as for the Harz as a whole—is derived from a Latin version of the word "Harz."

The manganese ore veins of the Ilfeld district are associated exclusively with porphyritic igneous rocks which alternate with sedimentary rocks in the Ilfeld Basin. This basin is a synclinal structure (Luedecke, 1896; Sansoni, 1971) with a long axis running for about 20 km along the southern rim of the Harz, between Bad Sachsa on the west and Neustadt on the east; the town of Ilfeld lies within its eastern third.

The Ilfeld Basin was filled by sediments and eruptive rocks during Lower Permian (called in Germany *Rotliegendes*) times. The lowermost sedimentary rocks, unconformably overlying Devonian-age shales and graywackes, are conglomerates whose beds reach 50 meters thick (Luedecke, 1896; Sansoni, 1971). Immediately overlying the conglomerates are gray sandstones and clayey shales, the latter shot through with seams of coal (not minable) to 1.6 meters thick. At the top of the sequence come conglomeritic sandstones and red-colored clayey shales, with some irregular, localized limestone units.

All of the sedimentary rocks above the lowest conglomerates are intercalated with flows of extrusive igneous rocks from at least two eruptive episodes, representing the last volcanism in the Harz (Sansoni, 1971). The eruptions produced three basic rock types: tuffs, and two denser, porphyritic types which the German literature calls *melanophyres* and *porphyrites*. The tuffs are rich in pumice, some units containing only a bottle-green glass in foamy masses (Hornung, 1894). They are nowhere observed to host manganese ore veins. "Melanophyre" is "a broad term . . . for any dark-colored porphyritic igneous rock having a fine-grained groundmass" (Jackson, 1997). The melanophyres of the Ilfeld Basin, which come from the earlier or earliest of the eruptive episodes, are brown to black, with a fine-grained groundmass composed of oligoclase, augite, biotite, apatite and magnetite, with phenocrysts, most of which are tabular crystals of augite (Luedecke, 1896). "Porphyrite" is a term "originally used to distinguish porphyries that contain plagioclase phenocrysts from those that contain alkali feldspar phenocrysts" (Jackson, 1997). The porphyrites of the Ilfeld Basin have plagioclase (oligoclase and andesine), and in some cases spessartine, as phenocrysts in a dark, fine-grained groundmass similar to that of the melanophyres (Luedecke, 1896). Agate nodules that have weathered out from some porphyrites are found at scattered sites between Ilfeld and Bad Sachsa (Siemroth, 1990).

Near-surface, weathered and partially altered porphyrite (sometimes called "bronzite porphyrite") largely determines the morphology of the region and is the exclusive host rock for the manganese ore veins, which have never been observed to penetrate surrounding sedimentary rocks. Both the manganese oxide veins and the nearby hematite veins resulted from low-temperature hydrothermal activity which accompanied tectonic movements during Permian time (Rumscheidt, 1926). Haake *et al.* (1994) distinguish between late Lower Permian ("Rotliegendes") hydrothermal activity, which formed the hematite veins, and Upper Permian ("Zechstein") activity which formed the manganese oxide veins. The metal-bearing solutions which filled clefts and fissures in the porphyrites, creating the ore veins, percolated also into the most narrow openings, forming impregnation zones characterized not by discrete veins but by dense "nests" of stringers and pods (*Trümern*), and causing some brecciation of the porphyrite. The *trümern* zones were commonly mined in open-pit excavations, the largest of which were those on Mönchenberg.

Some of the hydrothermal solutions may have descended into the porphyrites from overlying Zechstein-age rocks (now eroded away), while other solutions may have traveled laterally, bearing metals leached from the porphyrites themselves, while still others may have ascended from plutons, forming hot springs on land surfaces then exposed (Stahl and Ebert, 1952). As noted earlier, the coherent veins of manganese oxides are seldom more than 15 meters long and 60 cm thick. Mining sometimes pursued the *trümern* zones to depths greater than 60 meters, but more commonly the best ore lay in the coherent veins, much closer to the surface. At depths below about 50 meters, minable veins typically give way to mineralogically and economically uninteresting veins of massive hematite, barite, and quartz.

Gangue species in the manganese veins most commonly included barite, calcite and quartz; rarely, aragonite and siderite occur; extremely rarely (and only in Silberbachtal), rhodochrosite was found. The manganese ore species of the veins are braunite, hausmannite, cryptomelane, "wad" and most commonly, and of greatest economic significance, pyrolusite and manganite. The old miners called the ore veins which carried the beautiful crystals of manganite *Schlackengänge* ("cinder veins"); they called the solidly filled veins of massive ore *Schalengänge* ("shell veins").

MINERALS

Aragonite $CaCO_3$

Aragonite was noted by Zincken (1825) as a rare component of the gangue; the existence of crystals from Ilfeld is doubtful.

Barite $BaSO_4$

Barite is the most common of the gangue species of the manganese veins. It did not form contemporaneously with the manganese oxides but was deposited later, possibly during Late Permian or early Triassic

Figure 12. **Calcite crystals in manganite crystal cluster, 6.1 cm, from Ilfeld. Rob Lavinsky (*The Arkenstone*) specimen and photo.**

times (Haake *et al.*, 1994). Accordingly the barite and calcite masses are not attached to vein walls but rather form fillings and stringers along the centers of veins (Sansoni, 1971; Siemroth, 1990; Haake *et al.*, 1994). The barite may have come from hydrothermal solutions which had leached barium from small halite deposits elsewhere in the Harz, then descended to the porphyrites through overlying Late Permian (*Zechstein*) sandstone units (Stahl and Ebert, 1952).

The barite of the ore veins is white, opaque, coarse-grained and very pure (Rumscheidt, 1926). Tantalizingly, the early 19th-century *Bergkommissar* C. F. Jasche referred in print, without elaboration, to "very large" crystals of barite found in the manganese veins (Jasche, 1838). Siemroth (1990) mentions crystals of barite rarely found overgrown on manganite crystals; Dameron (2008) notes that at Ilfeld barite "occurs (rarely) in white tabular crystals, somewhat thick" with manganite. In short, significant crystallized barite specimens from Ilfeld exist but are extremely rare. The massive, snow-white vein-filling material, when present on specimens, provides a striking contrast to the gleaming black manganite crystals.

Braunite $Mn^{2+}Mn_6^{3+}SiO_{12}$

Braunite occurs in good crystals in the manganese deposit at Öhrenstock near Ilmenau, in the Thuringian Forest about 100 km south of Ilfeld, but in the Ilfeld manganese veins it did not form good macrospecimens— lustrous crystals to 5 mm have been noted rarely, and braunite pseudomorphs after manganite occasionally have appeared (www.manganit.de, 2010). Ludecke (1896) and Sansoni (1971) mentioned braunite as an ore species found mixed in small amounts with others at Ilfeld.

Calcite $CaCO_3$

Calcite is, after barite, the second most common gangue species in the manganese veins, and like barite it occurs in the central parts of veins, commonly overlying or intergrown with manganite crystals. Jasche (1838) noted "large and excellent" calcite crystals from the manganese ore veins, as well as attractive specimens showing acicular calcite crystals sprinkled on and between manganite crystals. The color of these calcite crystals is not specified, but quite likely they are gray or black. Zincken (1825) described Ilfeld calcite tinted by inclusions of manganese oxides which the old miners called *Mangankalk*. Jasche (1838) mentioned specimens showing pyrolusite pseudomorphs after large calcite crystals (see under Pyrolusite), as well as gray pyrolusite pseudocrystals covered by a later generation of calcite (Jaschke, 1838). Siemroth (1990) writes that scalenohedral calcite crystals to 10 cm long were found on the old mine dumps at some time or times after mining ended in 1922.

Cryptomelane $K_{1-1.5}(Mn^{4+},Mn^{2+})_8O_{16}$

Cryptomelane, described formally as a species in 1982, has a name which comes from the Greek words for "hidden" and "black," since in practice it is often hard to distinguish from other black, massive manganese oxides with which it mixes intimately (www.mindat.org, 2010). Some earthy black masses of manganese oxide ore mined about 175 years ago at Ilfeld showed hardened, reniform surfaces (Jasche, 1838) typical of cyptomelane.

Groutite α-MnO(OH)

Groutite, an orthorhombic trimorph of (monoclinic) manganite and feitknechtite, is a rare species known in good specimens chiefly from the Iron Range of Minnesota (in 1980 some superb specimens were collected in the Roberts mine, Cayuna Range, Crow Wing County). In January 2006, some local collectors gained temporary access to old underground workings somewhere in the Ilfeld district (see under "Collecting Manganite"), and a very few of the 300 or so fair-to-good specimens of manganite which they extracted sport black, free-standing, leafy crystals of groutite (www.manganit.de, 2010) According to Gunnar Färber (personal communication, 2008), these crystals exceptionally reach 2 cm.

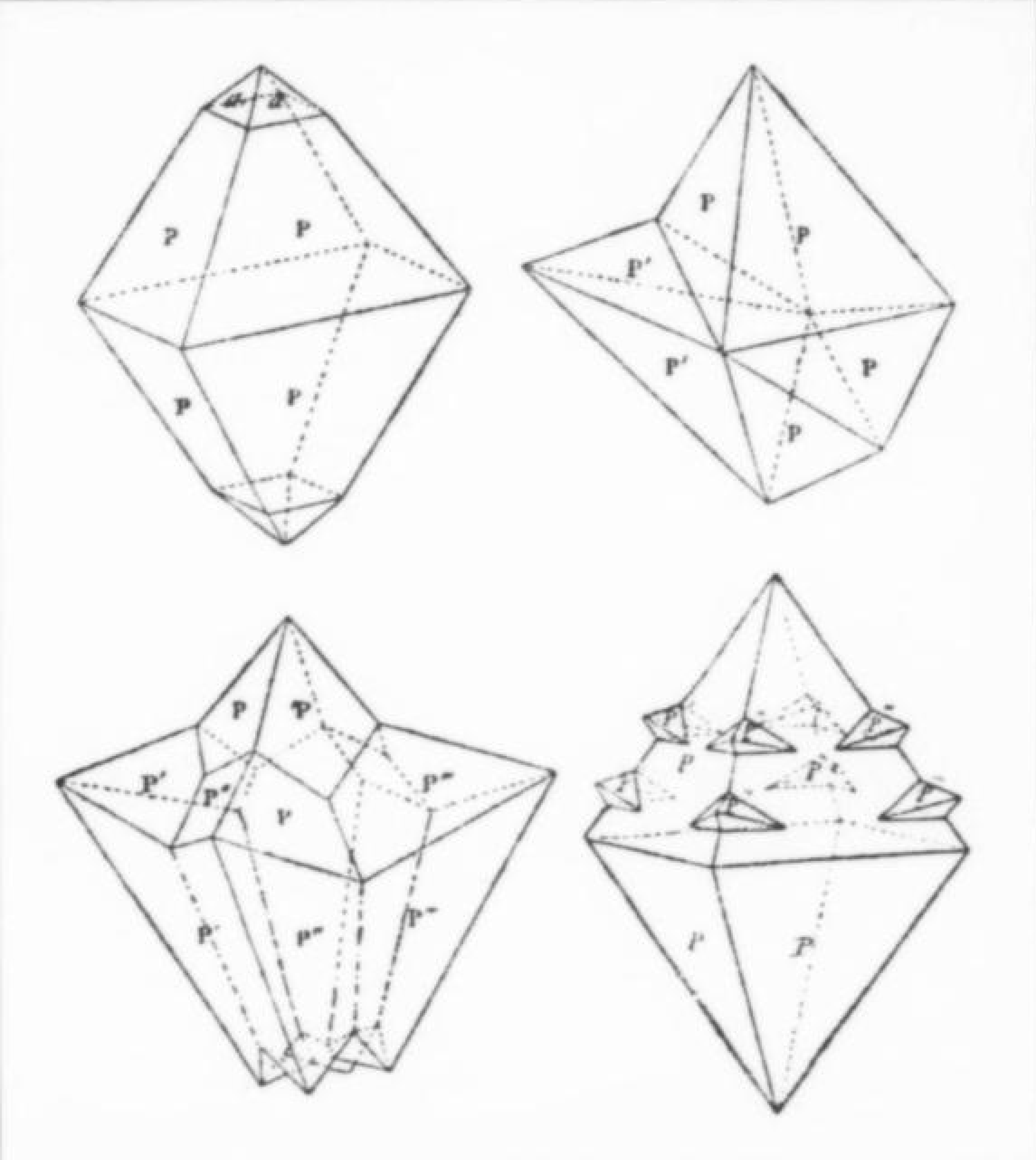


Figure 13. **Crystal drawings of twinned hausmannite crystals from Ilfeld; from Haidenger (1826) (lower right) and Mohs (1824).**

Figure 14. **Hausmannite crystals to 7 mm, from Ilfeld. Peter Haas photo.**

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

With Öhrenstock/Ilmenau (see above under Braunite), Ilfeld is the type locality for hausmannite, described in 1813 and named for J. F. L. Hausmann (1782–1859), Professor of Mineralogy at the University of Göttingen. Hausmannite was one of the more abundant manganese ore species in the Ilfeld district, occurring in gray, foliated masses and in compact masses of radiating acicular crystals. The latter specimens, resembling hematite, show a shimmering reddish color and brownish red streak. Around 1818, large, plumose aggregates of hausmannite ore of this type were found commonly, but by 20 years later they had become rare (Jasche, 1838). The ore produced in early times from irregular pods and stringers (*Trümern*) in the Silberbach area was chiefly hausmannite and pyrolusite (Rumscheid, 1926). In 1844 a 30 cm-thick vein of hausmannite was mined on Harzeburg (Siemroth, 1990).

Before the wonderful hausmannite specimens of the N'Chwaning and Wessels mines in South Africa began emerging in the early 1990s, the finest "classic" hausmannites came from Öhrenstock/Ilmenau and from the manganese orebody at Långban, Sweden, both localities having produced specimens showing sharp hausmannite crystals to 2 cm. Sansoni (1971) observed that, besides the manganites of Ilfeld, "only the hausmannites . . . have acquired a reputation. They have been . . . compared favorably with the hausmannites of Långban and Öhrenstock." Bipyramidal, pseudo-octahedral hausmannite crystals found long ago in cavities in massive ore at Ilfeld measure only around 1 cm (Jasche, 1838), but Haake *et al.* (1994) wrote without elaboration that hausmannite crystals to 5 cm were found rarely at Ilfeld. Hausmannite specimens showing crystals to 2 cm have been found "in the recent past," presumably on the dumps (www.manganit.de, 2010). According to Siemroth (1990), some dump specimens from post-mining times, after removal of calcite vein fillings with HCl, show tetragonal-bipyramidal hausmannite crystals to 6 mm. In 2003–2004 a dump find yielded specimens showing 3-cm hausmannite pseudomorphs after manganite (see "Collecting Manganite," below); hausmannite pseudomorphs after calcite crystals are also known from Ilfeld (www.manganit.de, 2010).

Hematite α-Fe_2O_3

As already noted, small veins of massive red hematite also occur in the Ilfeld district, in some cases very near the manganese veins. Although the two kinds of ore veins are thought to have formed independently (the hematite veins somewhat earlier), iron oxides occur in small amounts in the manganese veins and vice versa (Rumscheid, 1926; Haake *et al.*, 1994). No free crystals of hematite have been found in the Ilfeld district, but lustrous black concretions of globular hematite, known colloquially as *Glasköpfe* ("glass heads"), were occasionally found in ore dumps at the *Oberen Zug* ("upper course") on the northern slope of Harzeburg, where small workings once exploited iron ore veins. Some globular hematite specimens from Harzeburg reach fist size (Rumscheidt, 1926).

Hollandite $Ba(Mn^{4+},Mn^{2+})_8O_{16}$

Hollandite occurs rarely at Ilfeld as druses of tiny crystals in fissures in massive manganese ores, or encrusting barite (www.manganit.de, 2010).

Kaolinite $Al_2Si_2O_5(OH)_4$

Kaolinite (called *Steinmark* by the miners) is a minor constituent of the ore veins, having been found there both as pulverulent and hardened forms. Rarely it is white; much more commonly it is pink to pale red or, when suffused by manganese oxides, pale to dark gray (Zincken, 1825; Jasche, 1838).

Manganite $Mn^{3+}O(OH)$

The mineral we know today as manganite was first identified as a manganese oxide mineral by Jean-Baptiste Louis Romé de l'Isle (1736–1790) in the first edition of his *Essai de Cristallographie* (1772); he called it *manganaise cristallisé*, and noted the confusion it had caused among previous authors:

> If it one excludes Mr. Cronstedt, who called it a particular kind of magnesia, and Mr. Linnaeus, who categorizes it as a kind of the molybdenum, all the other authors have put manganese oxide among the iron ore minerals, though Mr. Pott is correct in saying that, when it is pure, it does not contain any [iron]. Mr. Sage, according to the assays which he made of this substance, having found [erroneously] that it contained 70 pounds of zinc per quintal [100 kg], concluded that it must be one of the richest ores of this metal. Manganese oxide crystallizes in clusters composed of prisms which radiate out from a center, like some ore minerals of antimony, with which it is often confused, considering its similar color, and the sooty way in which it stains the fingers. These prisms are oblong, tetragonal rhomboidal (see the crystallographic table entry no.73); they are like the calamine drawing shown on plate 5, figure 9, but different from the crystals of calamine that I have observed in that they are striated along to their length.

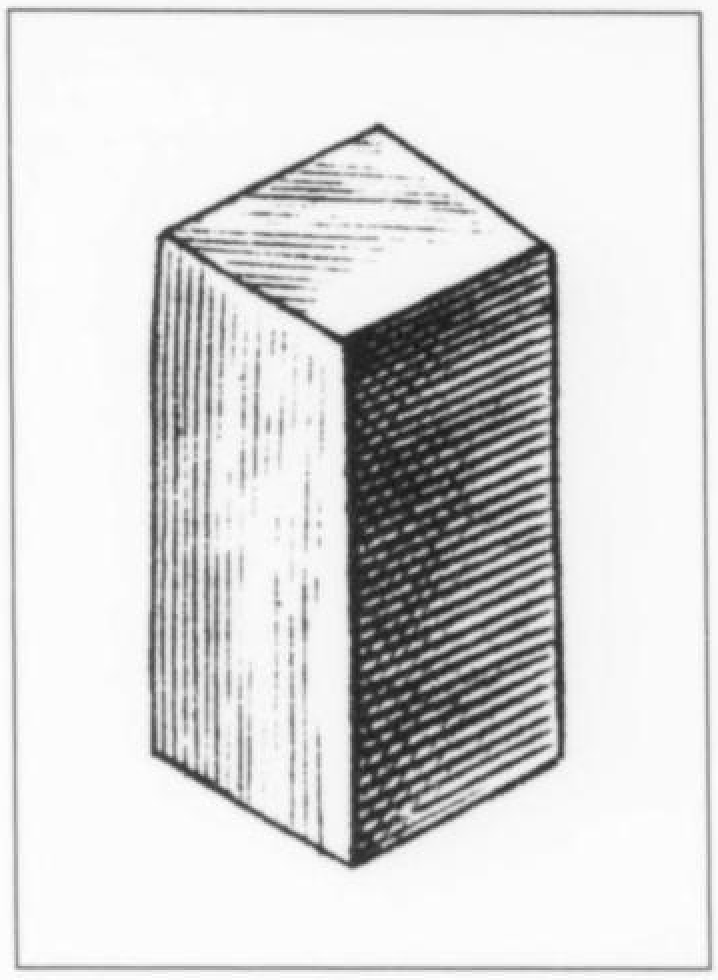


Figure 15. **Crystal drawing by Rome de l'Isle from his *Essai de Cristallographie* (1772), who writes in his text that manganite crystals are like this (probably from Ilfeld, as he had such specimens in his personal collection) but are vertically striated.**

Romé de l'Isle loaned two specimens of Ilfeld manganite from his personal collection to Fabien Gautier d'Agoty to illustrate in his *Histoire Naturelle Règne Minéral* (1781), the first book in the history of mineralogy to contain mineral illustrations with printed (rather than hand-painted) colors. The divergent clusters are composed of crystals that are thinner than the typical specimens familiar to collectors today, and it is easy to see why this habit of manganite was called "radiating."

In the late 1780s Ignaz von Born, the famous mineralogist in Vienna, assembled an extensive collection of minerals for one of his patrons, Miss Eleanore de Raab. His description of the contents of the collection (Born, 1790) included a fine Ilfeld manganite ("oxide de manganèse cristallisé"), in "glistening gray prisms having a metallic luster, rather thick and interlaced with each other."

Another early illustration appeared when Joseph Baumeister (1750–1819) illustrated a hand-colored specimen of braunstein from Thuringia (probably Ilfeld) in his 1791 book on minerals for young readers. The engraving is somewhat crude, and might actually depict a pyrolusite crystal cluster instead of a manganite.

In 1789 Werner had introduced an array of German terms based on physical appearance and habit, generally as variations of *Braunsteinerz* ("manganese ore"). Widenmann (1794) described *strahliger* ("radiating") braunstein from "Ilefeld am Hartze." Jameson (1805), in his summary of localities for the "radiating gray manganese ore"

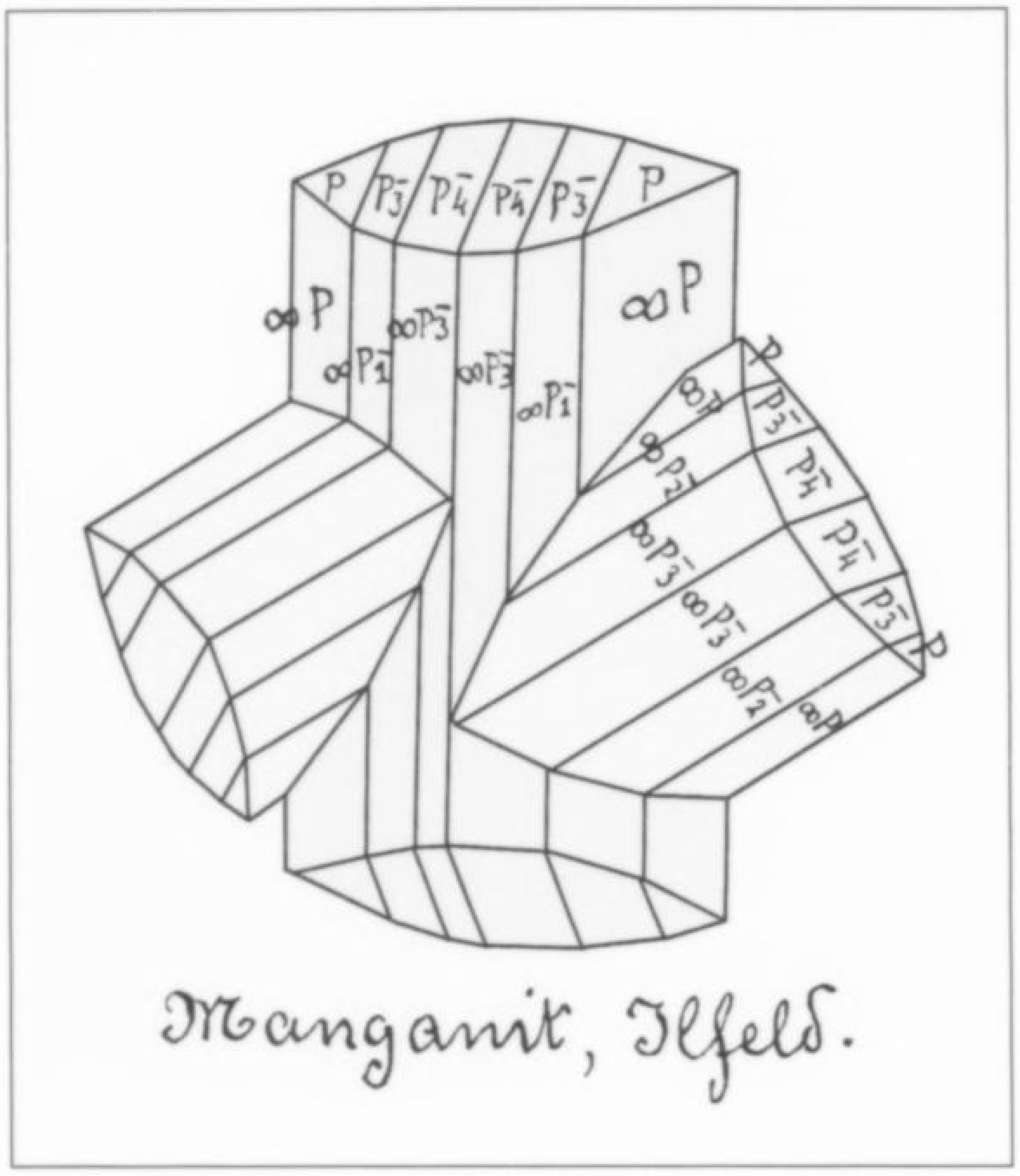


***Figure 16.* Unpublished sketch of an Ilfeld manganite twin accompanying a specimen sold ca. 1890. Courtesy of Rob Lavinsky (*The Arkenstone*).**

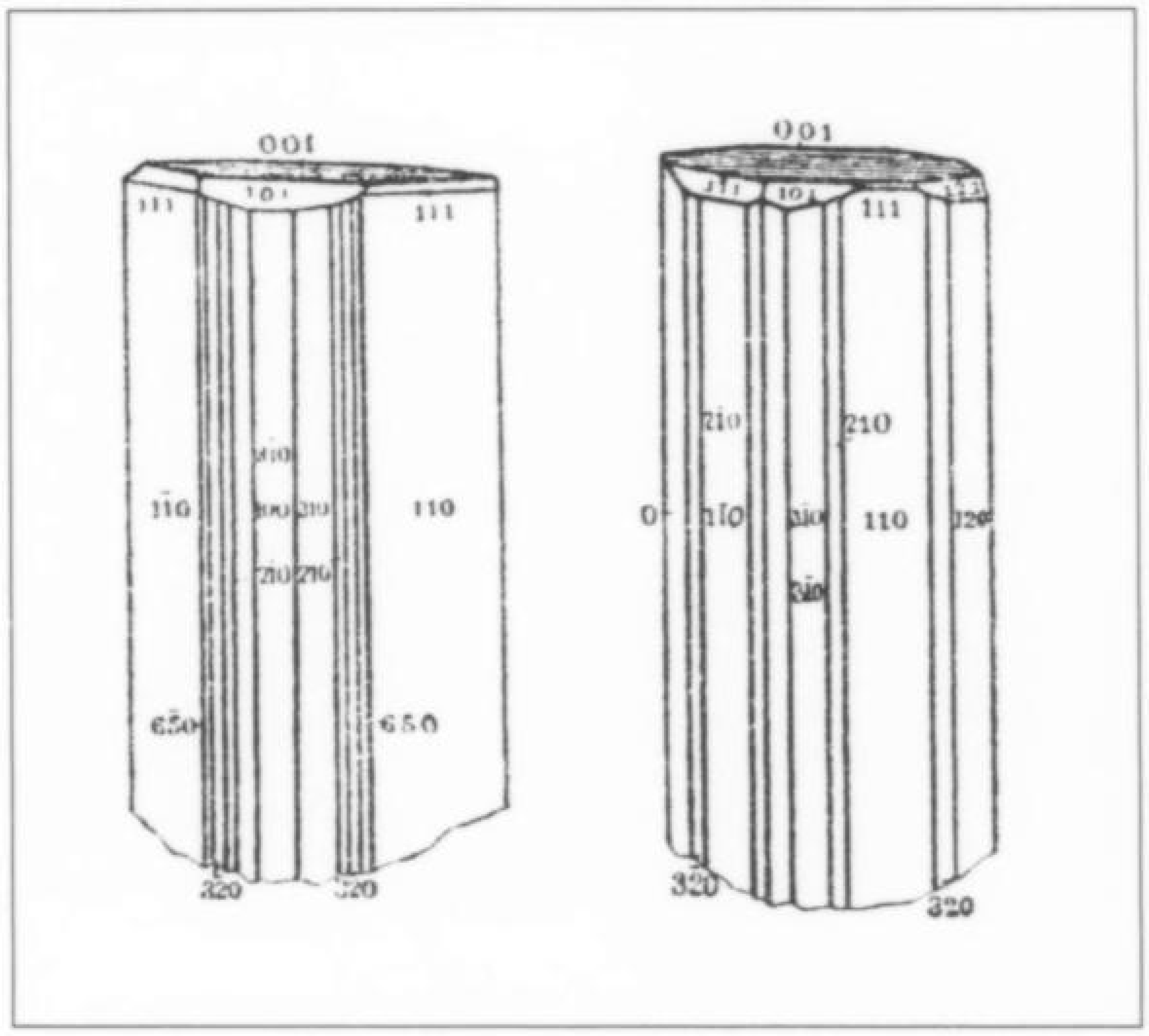


***Figure 17.* Crystal drawings of Ilfeld manganite from Zambonini (1901).**

and the "foliated gray manganese ore" of Werner, lists "Ilefeld in the Hartz." Breithaupt (1823), in summarizing the manganese oxides, listed among the Ilfeld minerals what he called *Weichmanganerz* ("soft manganese ore"), meaning the "usual so-called gray braunstein or gray manganerz"; *Schwarzmanganerz* ("black manganese ore" or Werner's "black braunstein") and *Glanzmanganerz* ("lustrous manganese ore"). The latter he described as occurring in "wonderful rhombic-prismatic crystals," noting that Ilfeld was the only locality known to him where such fine crystals occur—an observation which is still true today.

William Haidinger (1826) wrote in the *Edinburgh Journal of Science* that "Few species in mineralogy have been so incorrectly described as the ores of manganese, and, in particular, the most common one among them, the prismatoidal manganese-ore." The various black oxides and hydroxides of manganese have indeed proven difficult for professional mineralogists and casual mineral collectors alike to distinguish, as all are black, many are poorly crystallized, and their compositions can include several subordinate components (such as OH, Ba and K). And at many localities, including Ilfeld, they can be found confusingly mixed together.

Until 1828, mineralogists customarily used the term "prismatoidal manganese ore" for manganite (Mohs, 1825; Haidinger, 1826)—considering it among other black manganese species including "pyramidal manganese ore" (hausmannite), "brachytypous manganese ore" (braunite), "prismatic manganese ore" (pyrolusite) and "uncleavable mangar.se ore" ("psilomelane," now discredited in favor of cryptomelane). All of these quaint-sounding terms are employed in the course of the crystallographic examinations of manganese ores by Haidinger (1826) and the chemical examinations of them by Turner (1828); but it is Turner who employs in print for the first time the now-familiar species names, including

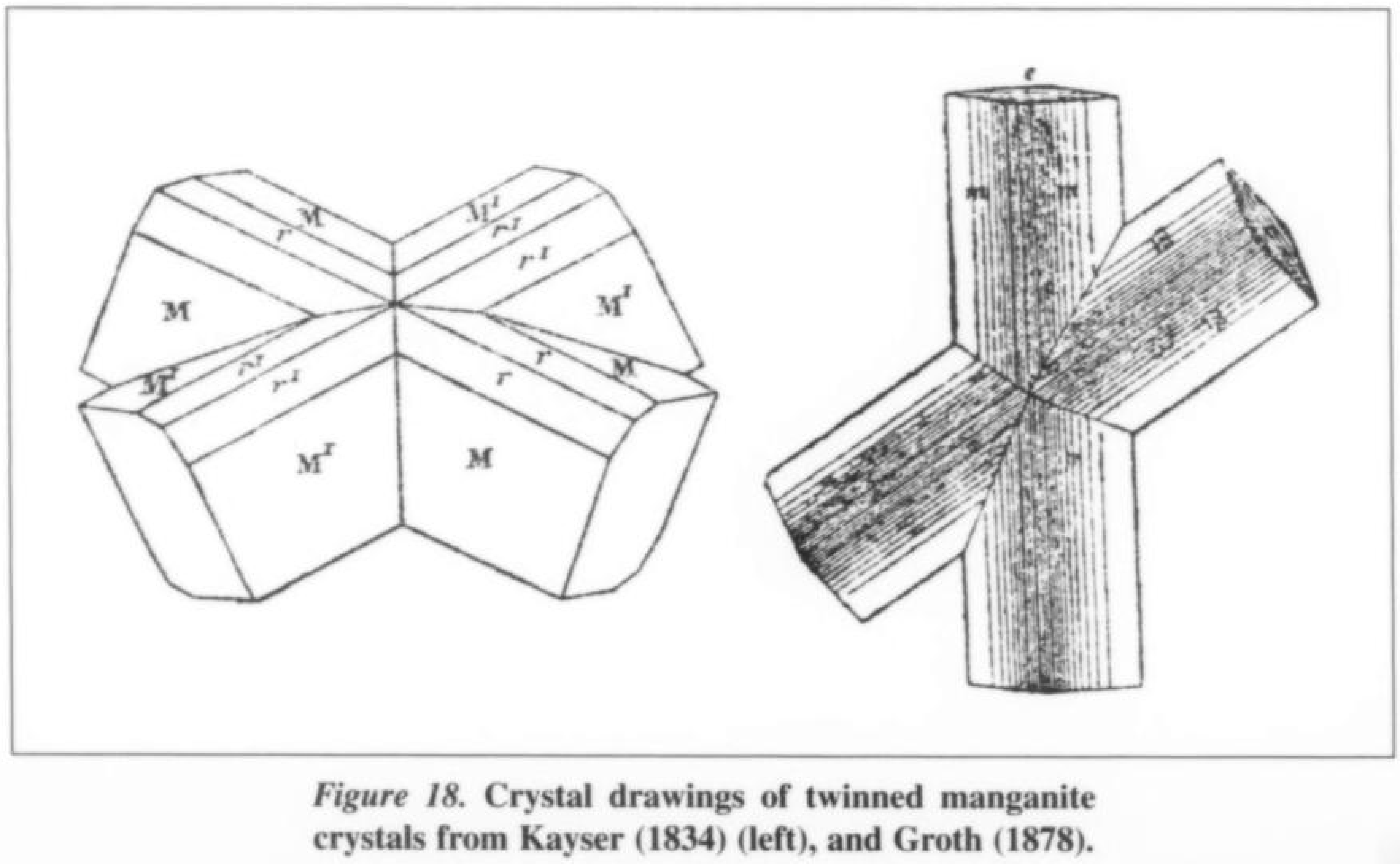


***Figure 18.* Crystal drawings of twinned manganite crystals from Kayser (1834) (left), and Groth (1878).**

Figure 19. **Ilfeld manganite specimens illustrated in Reinhard Braun's *Das Mineralreich* (1906).**

"manganite." Both writers specify that their working samples of the "prismatoidal" ore had come from Ilfeld, and were excellently crystallized; thus Ilfeld is now considered to be the type locality for manganite. More than a century later, Buerger (1936), also working with Ilfeld specimens, derived the symmetry and crystal structure of manganite, showing it to be monoclinic, not orthorhombic as had previously been believed.

Of course, most of the manganite of the Ilfeld district came in massive form and was mined from the *Schalengänge* ("shell veins"), together with the other black manganese ores. Sansoni (1971) also mentions flat-lying aggregates of fibrous manganite crystals, with individuals to several centimeters long and only 1 to 3 mm thick. Superbly well-crystallized manganite came only from the *Schlackengänge* ("cinder veins"), mostly in upper levels of the workings, i.e. from the *Rasenläufer* ("sod runner") veins or shallow open-pit excavations, pre-eminently in Braunsteinzeche and on Mönchenberg (Rumscheidt, 1926).

Ilfeld manganite crystals have been figured by a number of early mineralogists including Mohs (1824), Haidinger (1826, 1827), Kayser (1834), Lévy (1837), Presl (1837), Sadebeck (1876), Groth (1878) and Zambonini (1901). Luedecke (1896) provided detailed descriptions of various Ilfeld manganite crystal habits, resolving these into four broad categories, as follows. **Type I** consists of columnar crystals which are simple combinations of striated {110} prism faces and flat {001} pinacoid faces. Some Type I crystals form oblique twins, with two simple prismatic crystals crossing at angles near 60°. **Type II** crystals are also columnar but show several different prismatic forms (including {100}, {210} and {120}) in combination which appear as parallel columns, giving a "bundled" appearance. A zone of macropyramids (including {101}, {111}, {121}, {515}, {212}, {313}, {021}, and {2.0.15}) occurs as modifications around the edges where prisms and pinacoids meet. **Type III** crystals have arrays of small faces in place of the simple pinacoid {001} face, forming complex, wedge-shaped terminations; some crystals of this type also form oblique twins. In some cases a single crystal may be terminated by multiple tiny chisel-shaped points (macrodomes) in an array approximating a pinacoid. A specimen of this habit was beautifully illustrated in a finely detailed steel-plate engraving by

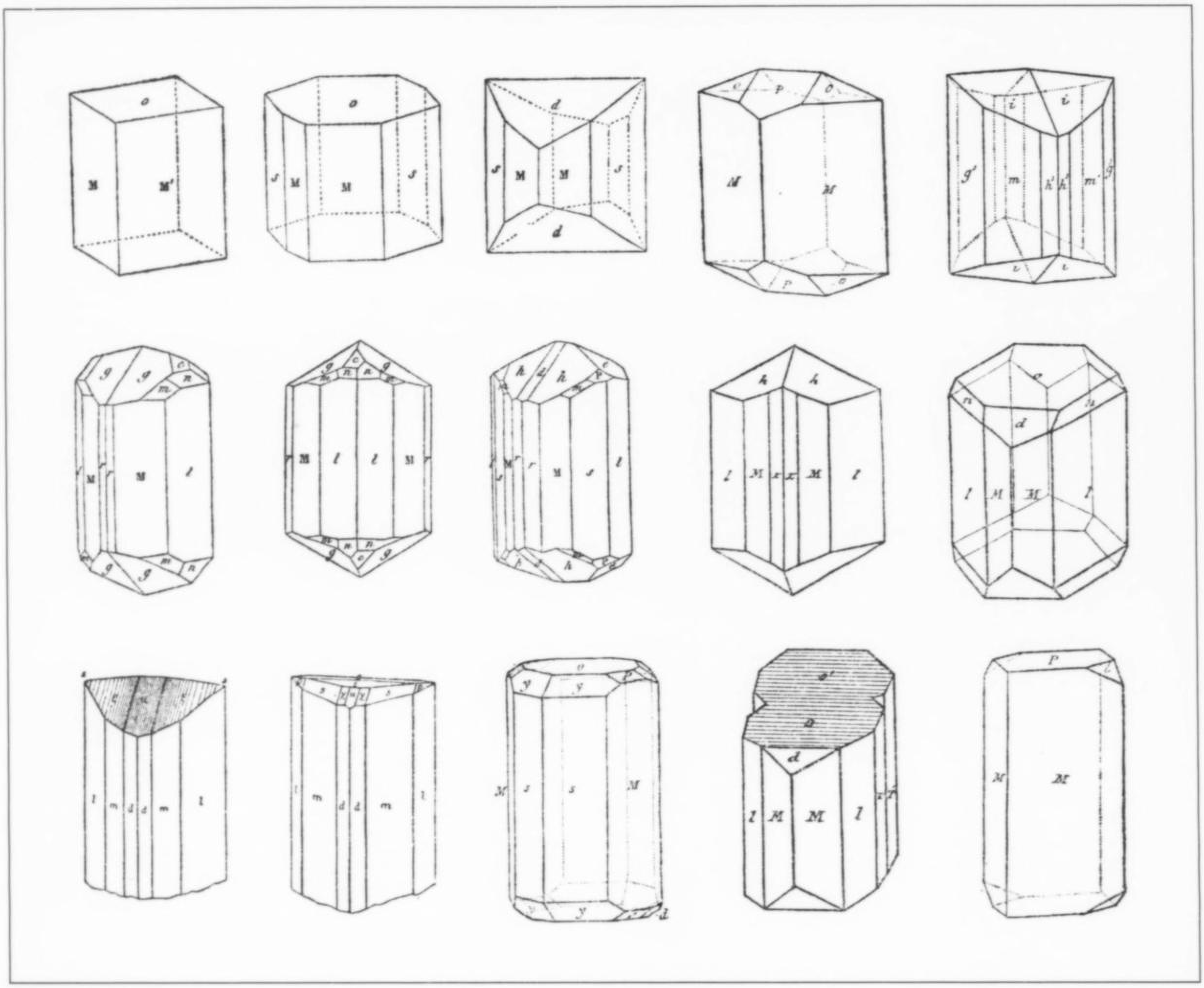


Figure 20. **Crystal drawings of Ilfeld manganite from Haidinger (1827), Mohs (1824), Lévy (1837), Presl (1837) and Groth (1878).**

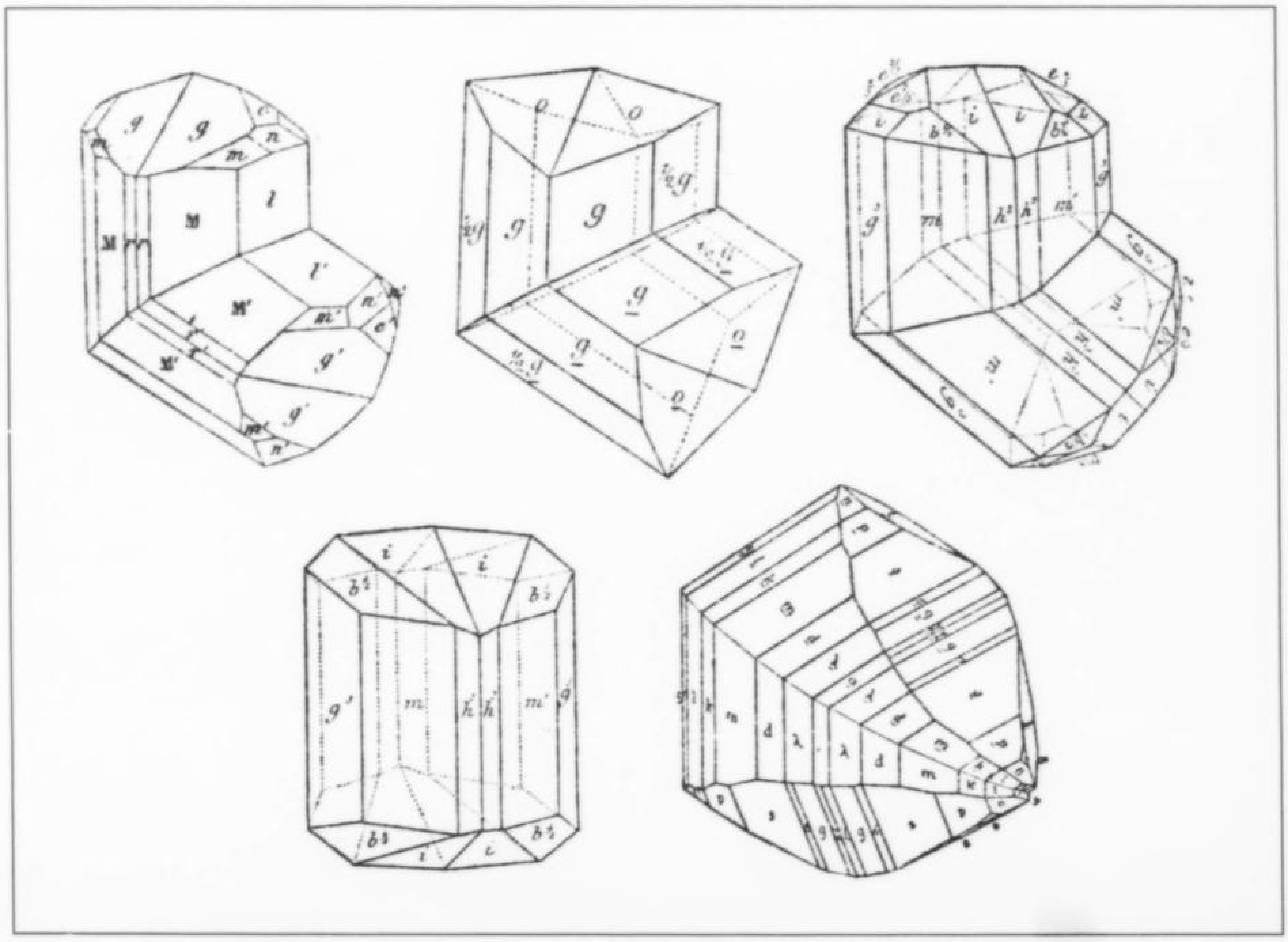


Figure 21. **Crystal drawings of twinned Ilfeld manganite from Haidinger (1826), Lévy (1837), Sadebeck (1876) and Groth (1878).**

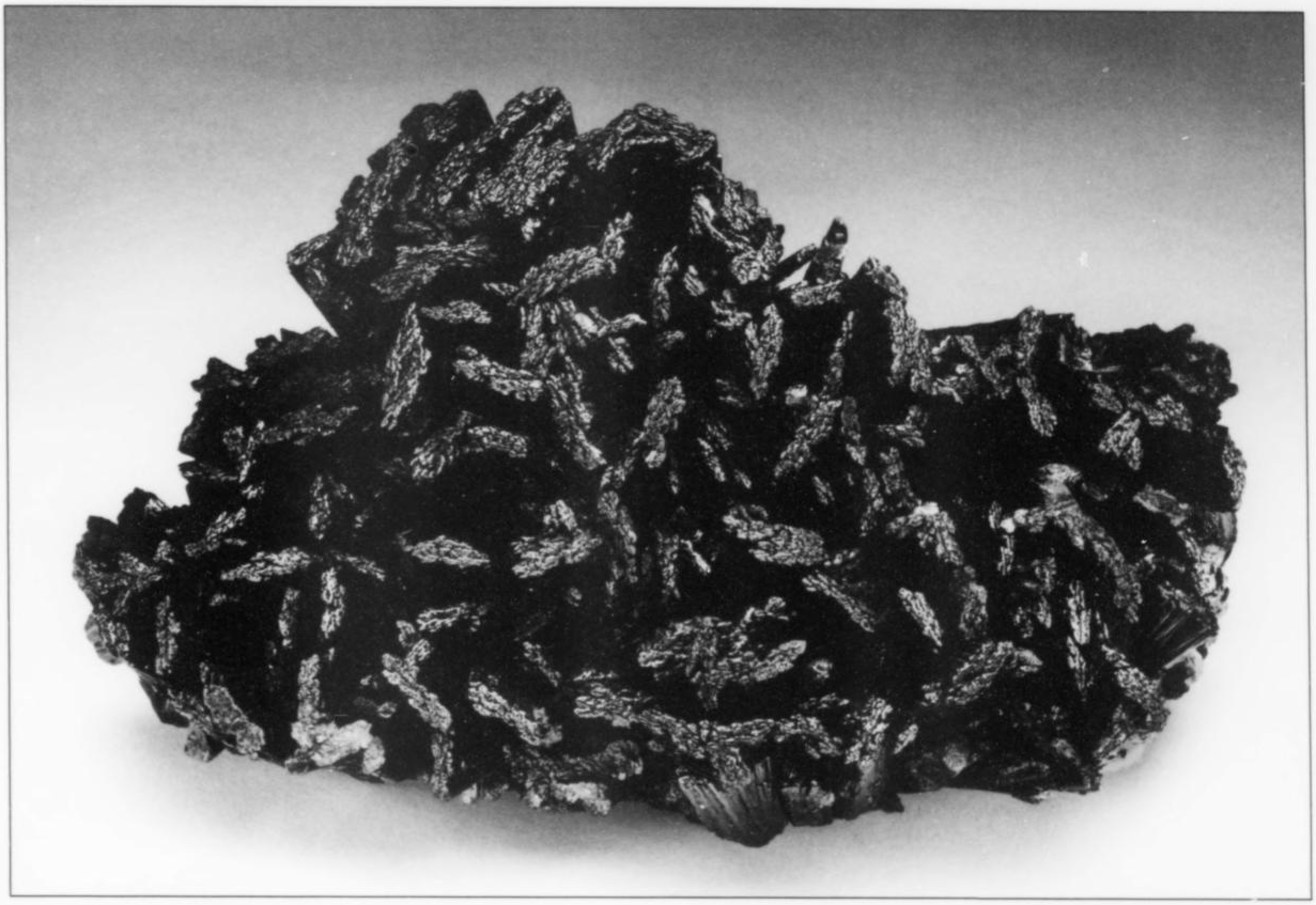
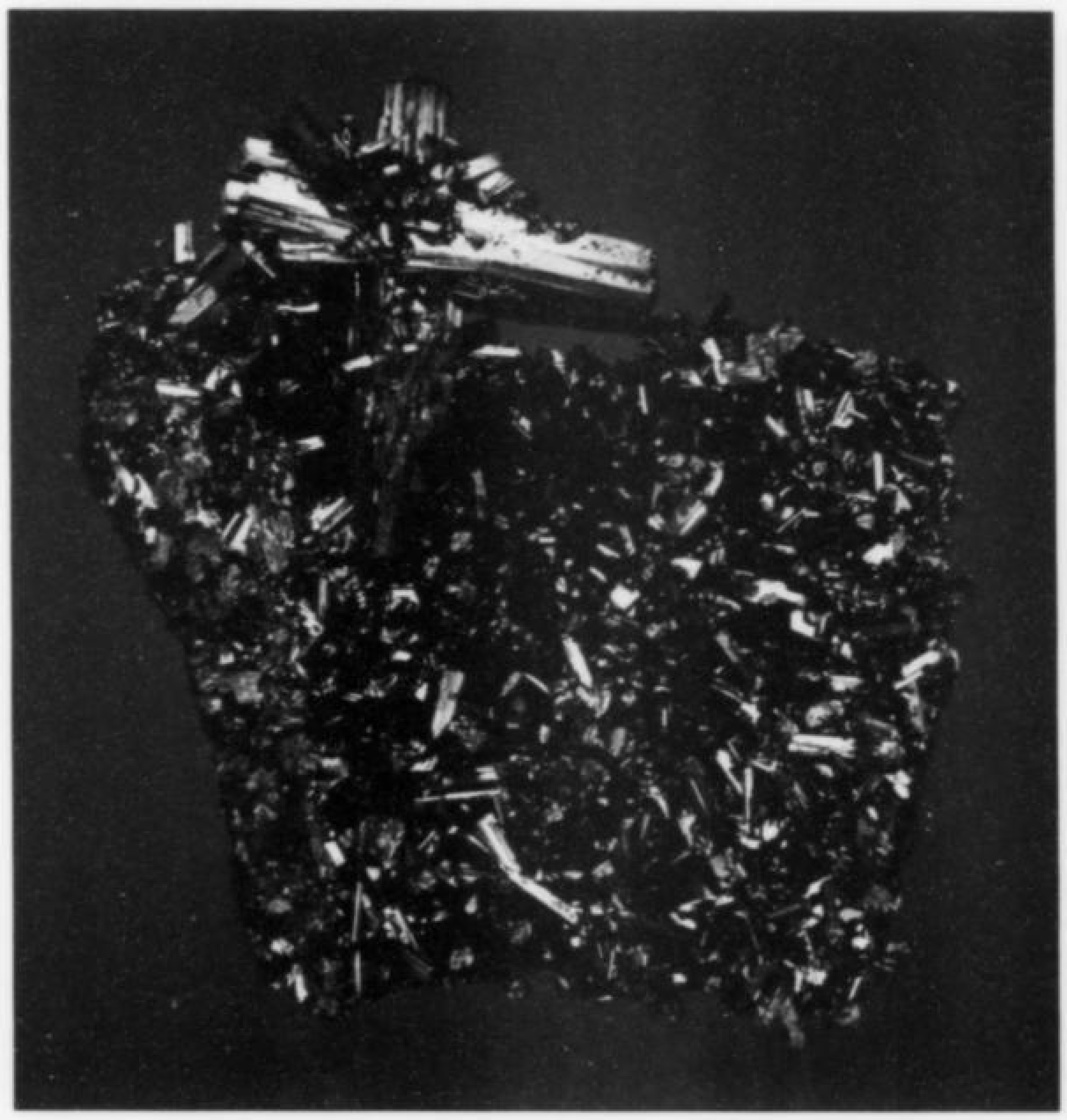


Figure 22. Manganite crystals (flattened prismatic habit), 21.5 cm, from Ilfeld. Gail and Jim Spann collection, ex Washington A. Roebling collection; Jeff Scovil photo.

Figure 23. Manganite with cross-like crystal intergrowth, 6.5 cm, from Ilfeld. Wendel Minerals specimen; Jeff Scovil photo.



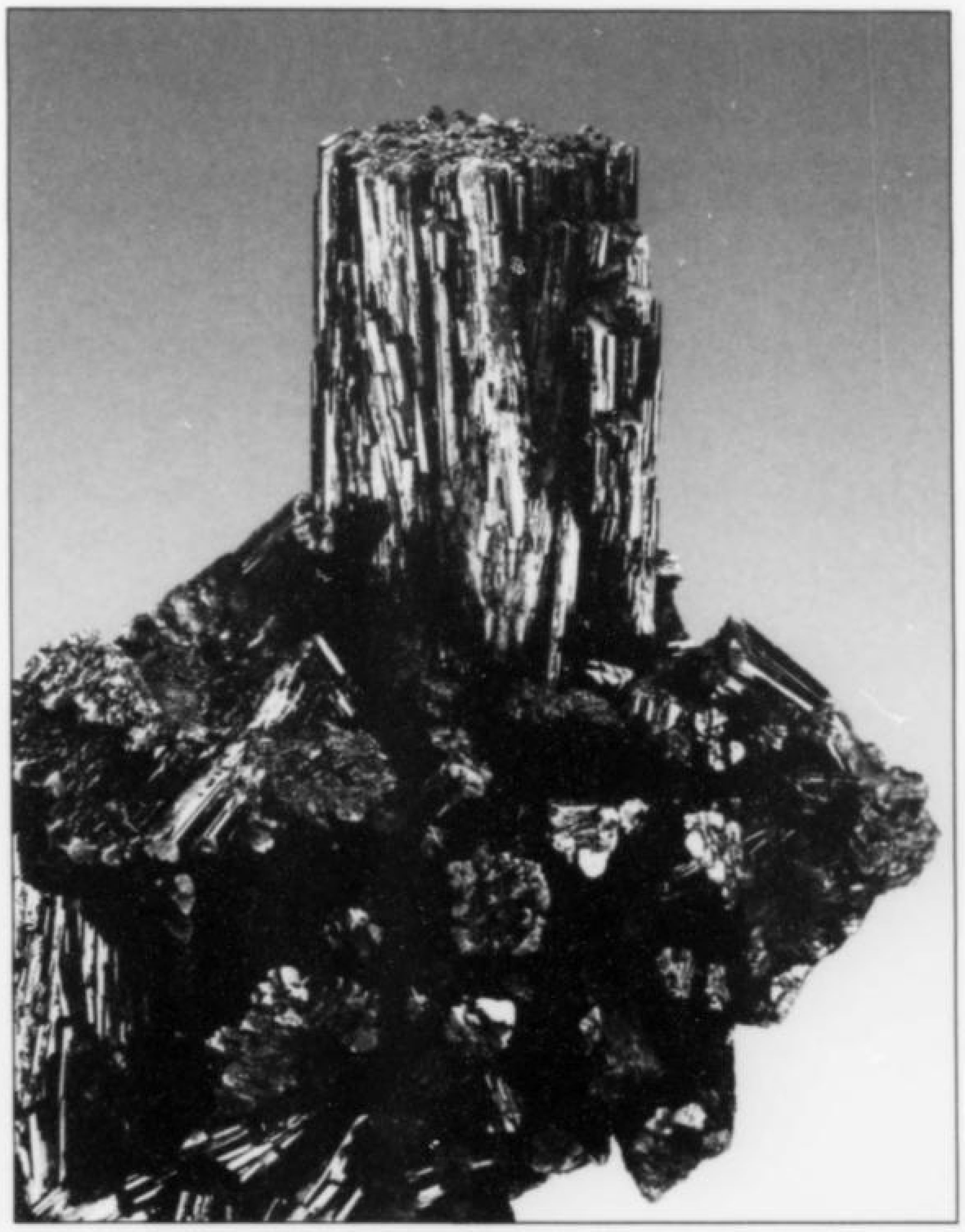


Figure 24. Manganite crystal cluster, 11.2 cm, from Ilfeld. Wayne Thompson specimen, Jeff Scovil photo.

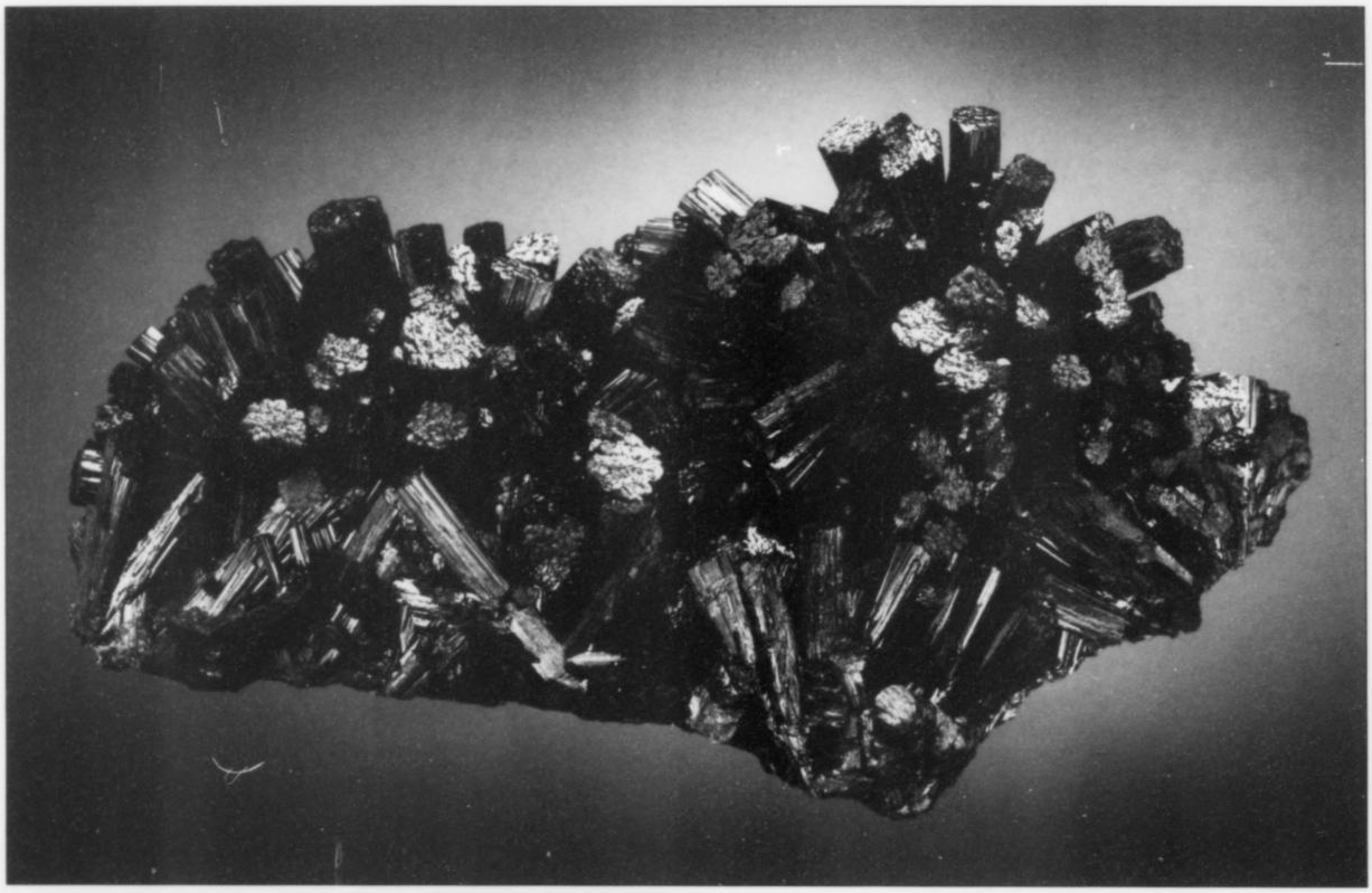
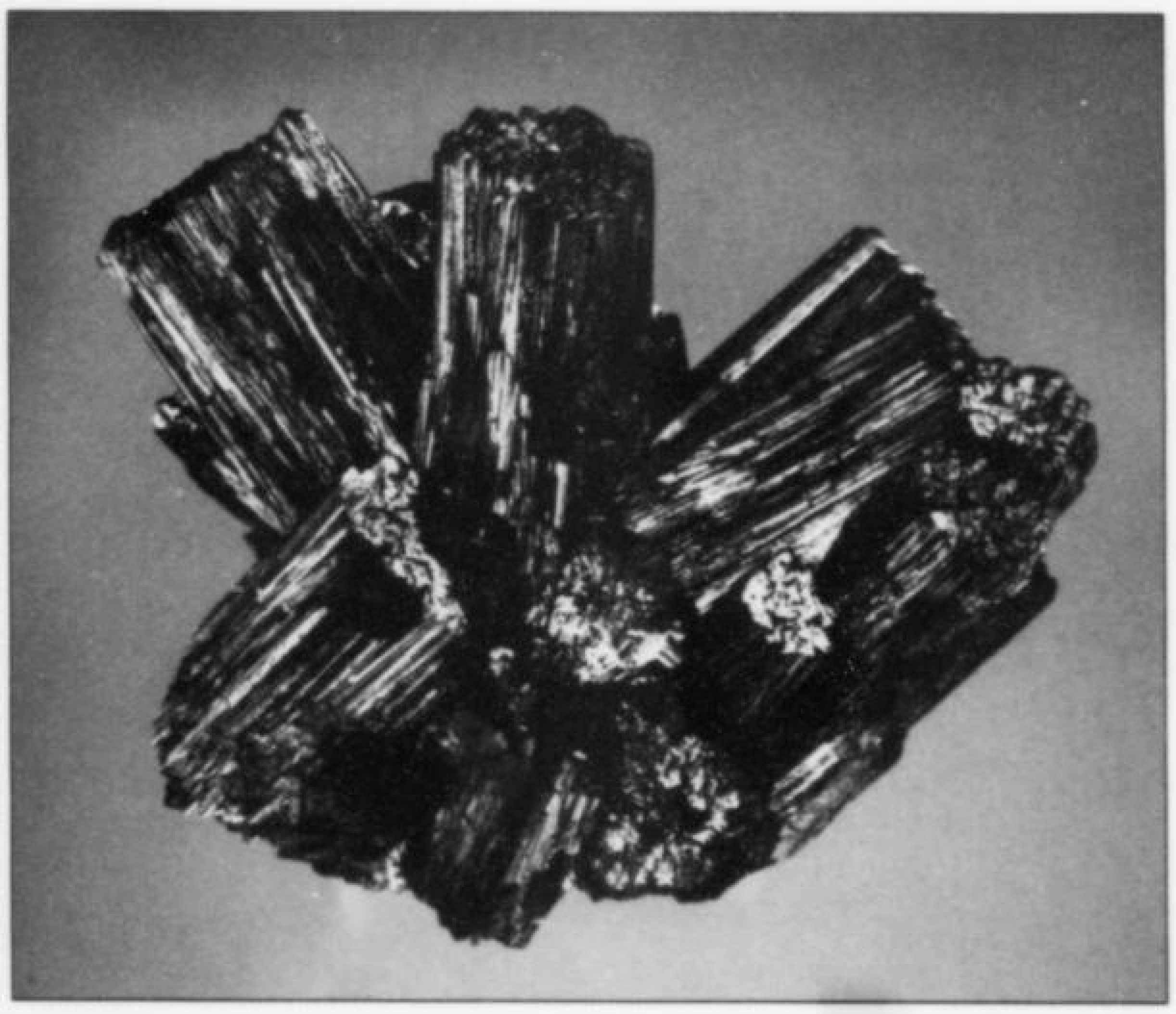


Figure 25. Manganite crystal cluster, 16 cm, from Ilfeld. Steve Smale collection; Jeff Scovil photo.

Figure 26. Manganite crystals with barite, 6.8 cm, from Ilfeld. Marvin Rausch collection; Jeff Scovil photo.

Figure 27. Manganite crystal cluster, 6.9 cm, from Ilfeld. Sandor Fuss collection; Jeff Scovil photo.



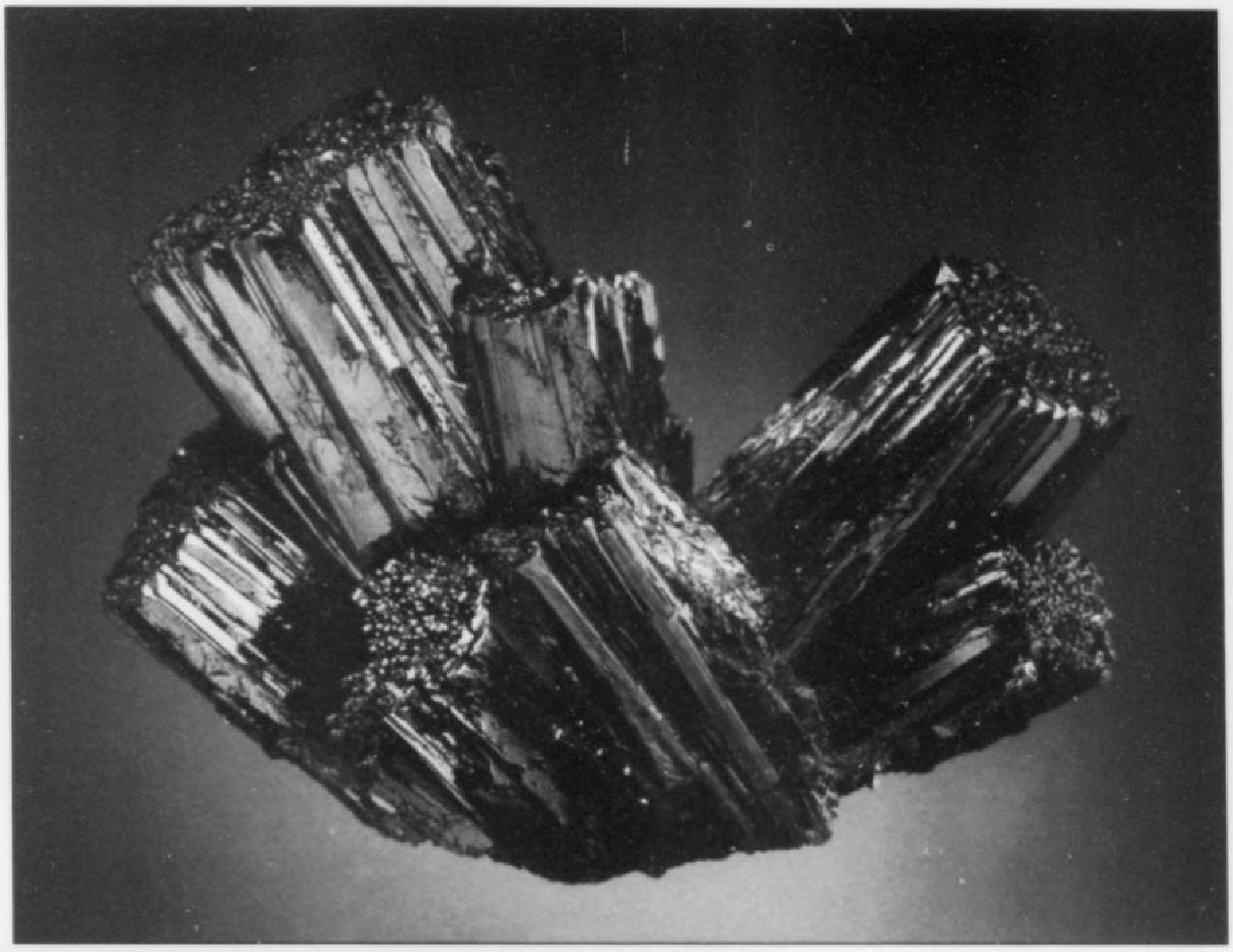


Figure 28. Manganite crystal cluster, 4.3 cm, from Ilfeld. Kent England specimen; Jeff Scovil photo.

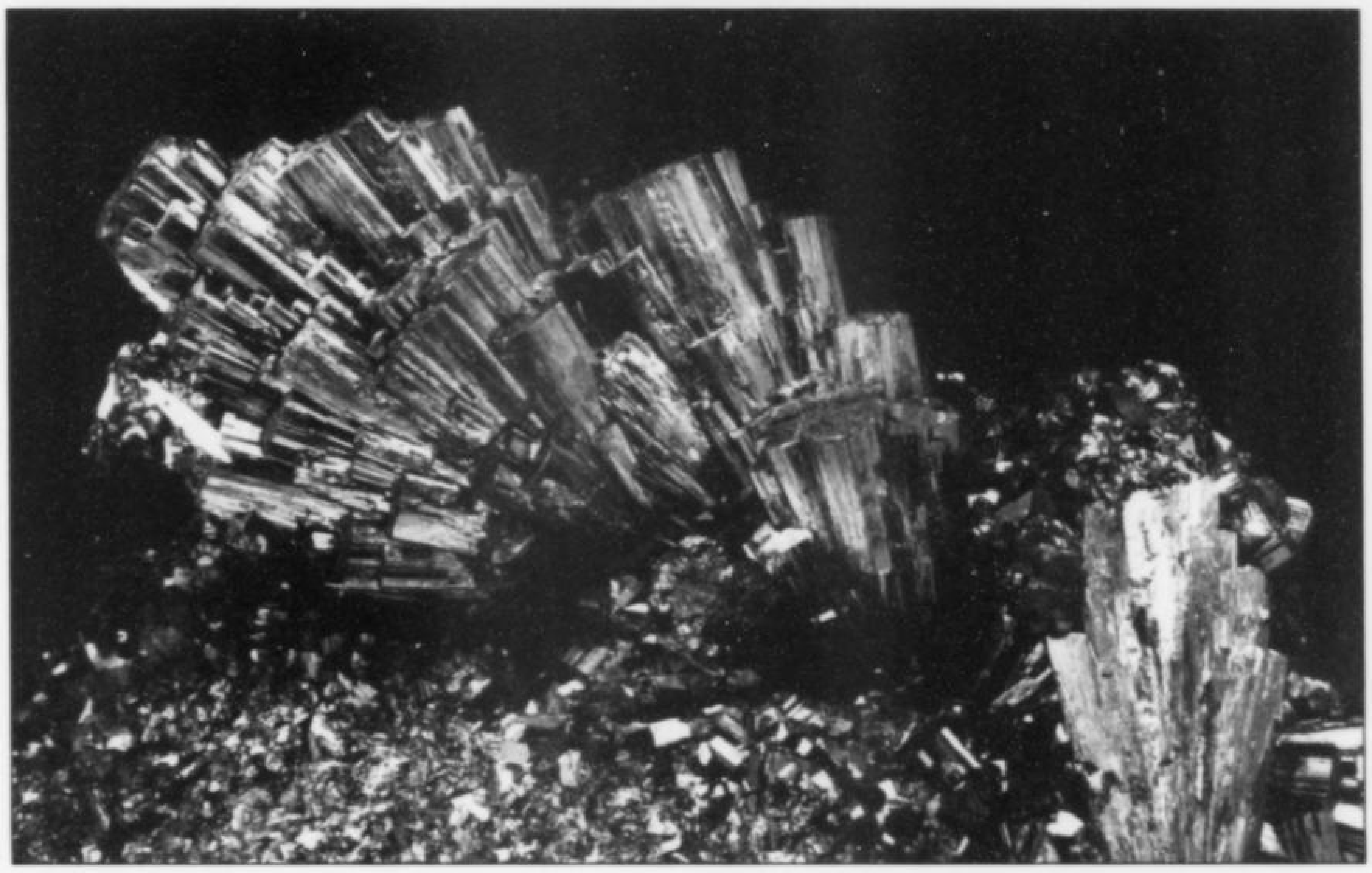


Figure 29. Manganite crystals in a fan-like cluster, 8.5 cm, from Ilfeld. Russ Behnke collection; Jeff Scovil photo.

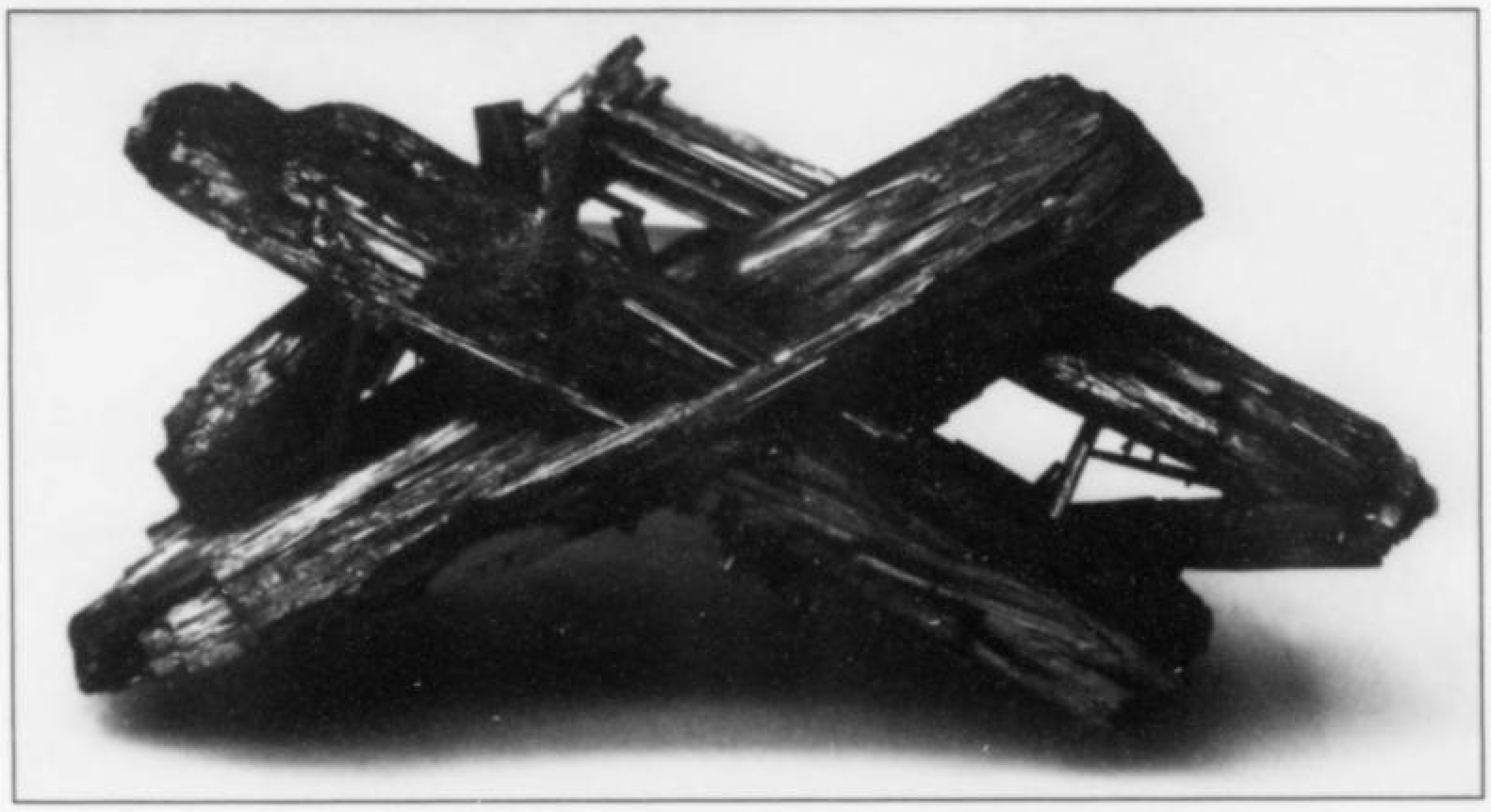


Figure 30. Manganite crystal twin (?), about 6 cm, from Ilfeld. Specimen and photo: Mineralogisch-Petrographisches Museum Bonn.

Figure 31. **Manganite crystal cluster with barite, 10.5 cm, from Ilfeld. Marvin Rausch collection; Jeff Scovil photo.**

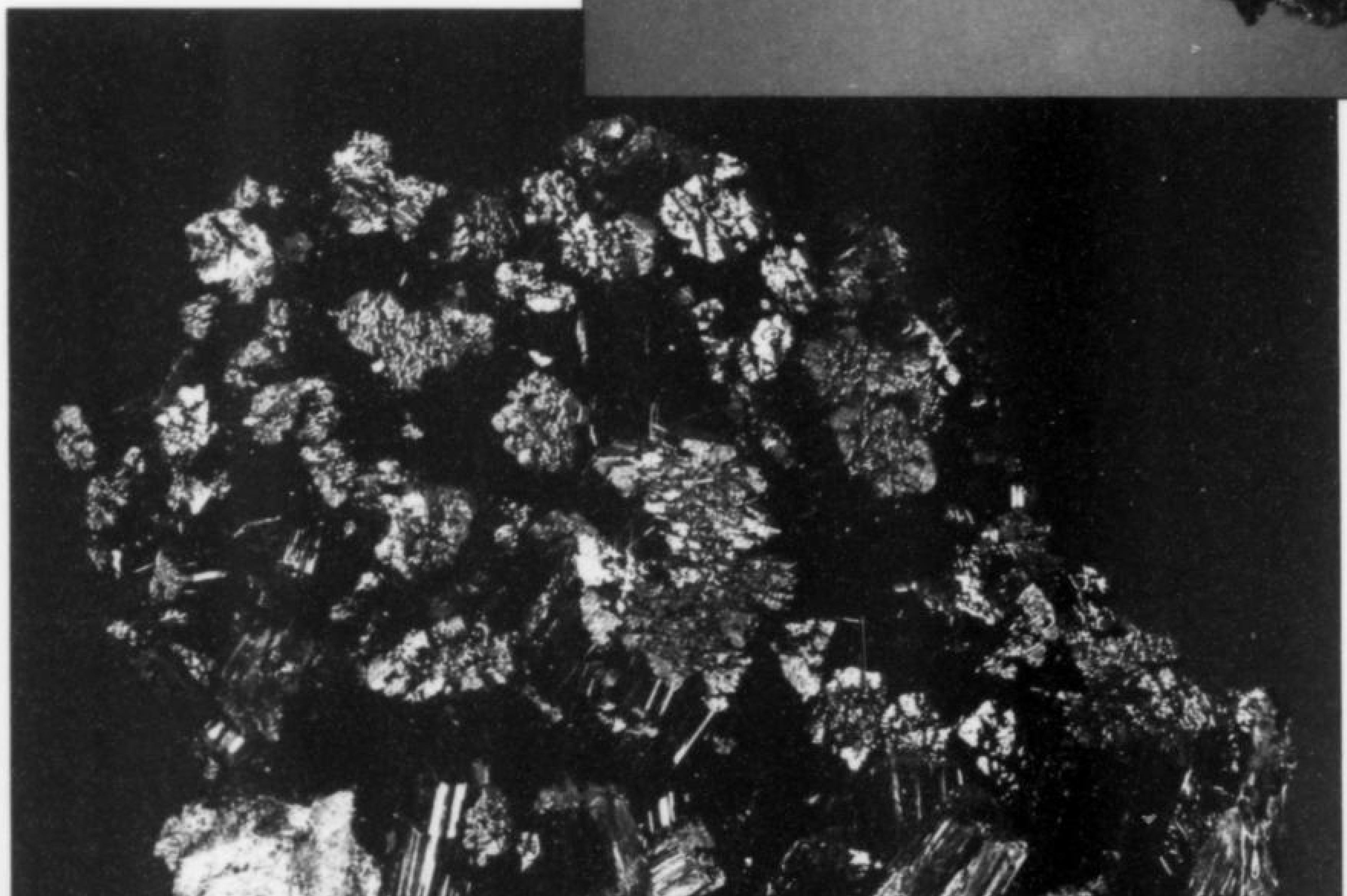


Figure 32. **Manganite crystal cluster, 9.4 cm, from Ilfeld.** ***Mineral Masterpieces*** **specimen; photo courtesy of Tom Spann.**

Hubert Clerget, published in Burat's *Minéralogie Appliquée* (1864). **Type IV** crystals are the most face-rich, with macropyramids predominating, and are always twinned, but are small, appearing in druses in massive manganite; individuals are equant, with dozens of forms shown by myriads of tiny faces.

In the finest specimens, Ilfeld manganite is jet-black to steel-gray, with strong metallic luster. In matrix specimens the manganite crystals rest either on porphyrite country rock or on massive manganite; white barite and/or calcite (having been deposited later) are present only in the interstices between crystals, and as overgrowths. The largest Ilfeld manganite crystals reach 10 cm long and 2 cm in diameter, and there exist crystal plates to several tens of centimeters square, with 40 to 50 finger-long manganite crystals rising from flat bases where the vein contacted porphyrite (Siemroth, 1990).

Nsutite $Mn^{2+}_xMn^{4+}_{1-x}O_{2-2x}(OH)_{2x}$

Nsutite has been found, mixed with hollandite and other manganese oxide species, in a single Ilfeld specimen; tiny nsutite pseudomorphs after manganite crystals are discernible on the specimen (www.manganit.de, 2010).

Polianite

The old term "polianite" is sometimes still used to refer to pyrolusite pseudomorphs after manganite (Bayliss, 2000).

Psilomelane

Psilomelane, corresponding to Haidinger's "uncleavable manganese ore," was the name given to some dull black, sometimes reniform, massive specimens and, presumably, to whichever massive, dull black manganese ores were not instead designated "wad." Although still in widespread use among mineral collectors, "psilomelane" properly does not denote a valid species but rather a mixture of cryptomelane, romanèchite, hollandite and birnessite (Bayliss, 2000). Many "psilomelane" specimens from Ilfeld are probably in large part cryptomelane.

Pyrolusite $Mn^{4+}O_2$

Pyrolusite, sometimes referred to in early literature as "warwickite," occurs commonly at Ilfeld, and was, with manganite, one of the two most important ore species of the district. In fact, Siemroth (1990) argues that pyrolusite may have been taken out in greater quantity than manganite during some periods in the 19th century. Drawing inferences from the old mining documents, he wrote that in 1858, apparently, the ratio of manganite to pyrolusite in extracted ores was 2:1, but that by 1877 it had become 1:2.

Typically, pyrolusite specimens from Ilfeld show feathery bundles of acicular, steel-gray crystals lining vugs in massive manganese oxides, or radiating aggregates of fibrous crystals. More interestingly, good specimens of pyrolusite pseudomorphs after manganite ("polianite") or after calcite are known from the district. The "polianite" specimens show steel-gray, commonly lustrous, columnar crystals closely resembling unaltered manganite. The calcite pseudomorphs are dull to sub-metallic gray replacements of rough-surfaced scalenohedral calcite crystals to 10 cm, alone and in groups on massive gray manganese ore, in some cases with overgrowths of a later generation of calcite (Jasche, 1838; Sillem, 1852). Such specimens may be very old: C. F. Jasche wrote in 1838 that good examples were found "several years ago" on Harzeburg. To these pseudomorphs he applied the term *Afterkrystalle*—leaving one to wonder just what, in the early 19th century, led a German mineralogist to borrow the English word "after" when constructing a new single-word term for pseudomorphs.

Quartz SiO_2

Massive quartz occurs in the deeper ore veins with manganese minerals, and may be associated with barite, calcite and hematite at the deepest explored levels, where the manganese ore-bearing veins have pinched out. Only rarely is the quartz in the manganese veins clean and white; in most cases it is shot through by manganese oxides and is gray. Miners called this hard, gray vein material *Mangankiesel* ("manganiferous flint") (Zincken, 1825).

Ramsdellite $Mn^{4+}O_2$

Ramsdellite has been identified on only two specimens from Ilfeld. Both show lens-shaped aggregates of black microcrystals which are ramsdellite in their cores, pyrolusite in their outer zones; for both specimens the matrix is quartz (www.manganit.de, 2010).

Rhodochrosite $MnCO_3$

White, pink and brown grains of rhodochrosite were found rarely with the manganese ores of the Ilfeld-Mangan mine in Silberbachtal (Rumscheidt, 1926; Sansoni, 1971). Very rarely, rhodochrosite forms pseudomorphs after microcrystals of manganite and hausmannite (www.manganit.de, 2010).

Romanèchite $(Ba,H_2O)_2(Mn^{4+},Mn^{3+})_5O_{10}$

Druses of lustrous black microcrystals of romanèchite are rarely seen coating barite in specimens from Ilfeld (www.manganit.de, 2010).

Siderite $FeCO_3$

Massive siderite, much of it shot through with fine-grained manganese oxides and hematite, is a minor constituent of the gangue fillings of the ore veins (Zincken, 1825; Rumscheidt, 1926).

Wad

Earthy, dull black, mixed manganese oxides have historically been denoted by the etherially poetic term "wad." One is tempted to speculate that it was perhaps named in honor of the Danish mineralogist and mineral collector Gregers Wad (1755–1832).

Figure 33. **Pyrolusite, 7.7 cm, from Ilfeld. Rob Lavinsky (*The Arkenstone*) specimen and photo.**

However, the term "black wad" first appears in Richard Kirwan's *Elements of Mineralogy* (1784), at which time Gregers Wad was still contemplating a career in philology and had yet to make a name for himself in mineralogy. Most likely "wad" was a Derbyshire miner's term, as that was where Kirwan's "black wad" had been found. In any case, it is now best taken, according to Bayliss (2000), as referring to a mixture of pyrolusite, manganite, cryptomelane and romanèchite. Zincken (1825) mentions an ocherous "wad" mixed with siderite which was mined on Harzeburg and in Silberbach in the very early 19th century, but Rumscheidt (1926) writes that "wad" was encountered in the Ilfeld district only on Liesenberg. Given the term's imprecision, it is not surprising that there are different accounts of which sites in the Ilfeld district gave up their wads.

COLLECTING MANGANITE

Of course, we would very much like to have first-person accounts of discoveries of major crystallized manganite specimens, and of their dispositions, during any of the active mining periods at Ilfeld—but, according to Siemroth (1990), the old documents on file in the records office at Magdeburg hold no clue to any such specimen finds, and no stories about them have turned up elsewhere.

One very early commercial reference to Ilfeld manganite specimens is an 1831 mineral dealer's catalog issued by J. Lommel's *Heidelberger Mineralien-Comptoir*. He offers "Manganerz, strahliges grau [= radiating gray], Ilefeld, Ilmenau, 15 kr. – 10 fl." And "Mangan, Hyperoxide, Ilefeld, Ilmenau. 24 kr. – 4 fl." Ten florins in those days was quite a bit of money, equal to more than an ounce of gold. It is clear that well-crystallized Ilfeld manganite specimens were highly valued if collectors were willing to pay a silver-dollar-sized gold coin for a single example.

There are also faint indications in the general literature. The early 19th-century *Bergkommissar* C. F. Jasche adds the following paragraph to his thorough account (1838) of the mines as they were during the 1830s:

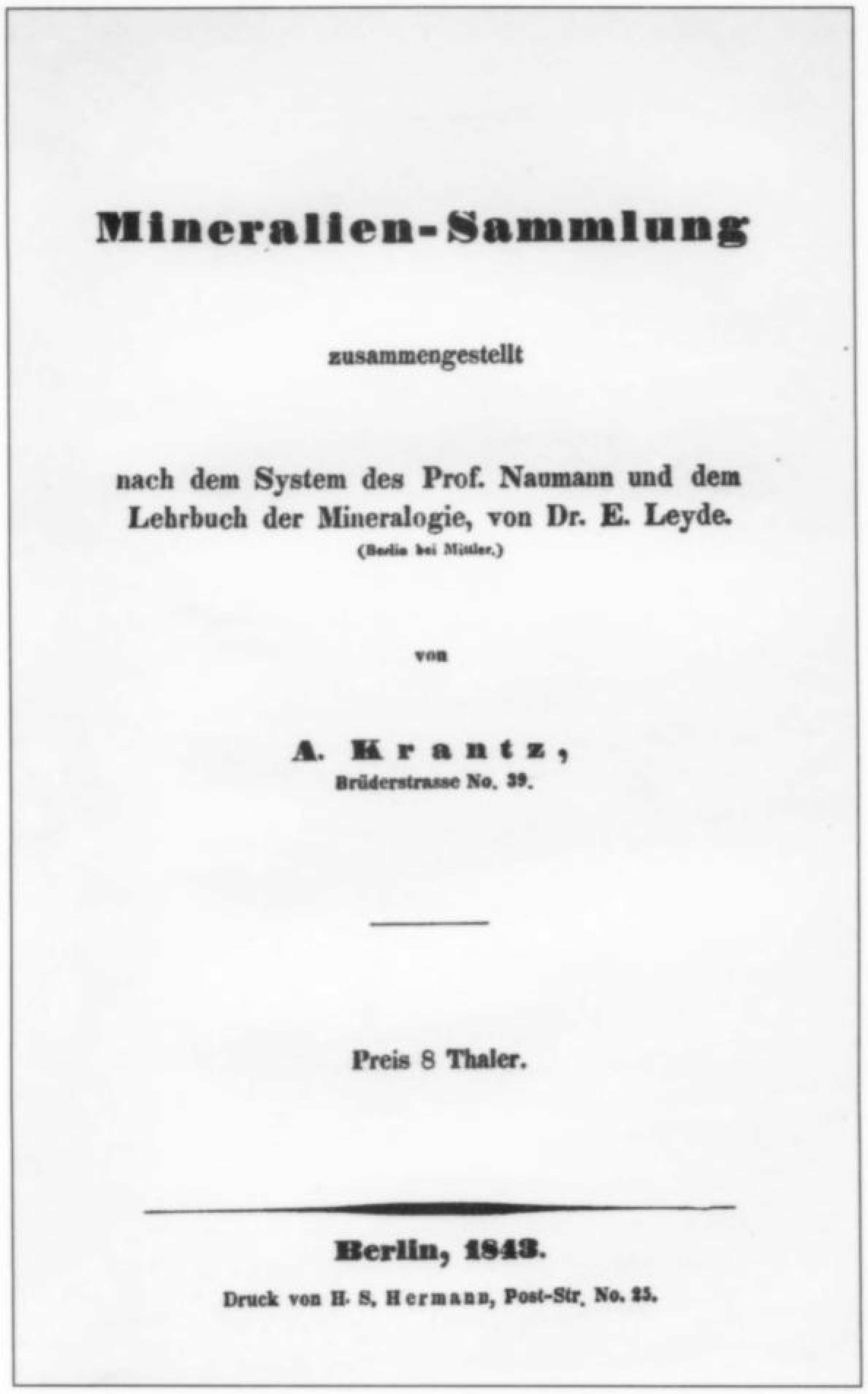
> The author has a number of duplicates of specimens of most of the manganiferous minerals described above. He would be willing to let these go as trades or sales—for low prices—to friends of mineralogy.

In 1835, at a time when unusually bountiful yields of manganese ore were being won, "wonderful manganite specimens were encountered . . . and were separately collected and sold, bringing in substantial proceeds" (Gaevert, 1981). This passage suggests that the Count's Mining Office itself decided, at least in that year, to supplement profits from sales of ore with profits from the sale of crystal specimens. There is no telling what quantity of specimens reached the market in this way, but the "substantial proceeds" clearly suggests that the quantity was substantial as well. Nevertheless, such enterprise by miners in their private capacities was harshly punished: the "thievery" of crystal specimens, even if the purpose was just to display them in the miners' homes, was grounds for summary dismissal (Gaevert, 1981; Liessmann, 1997), suggesting that the value of good crystal specimens was well known at that time.

An 1843 catalog of the mineral dealership of Dr. August Kranz (1809–1872) in Berlin offered "Glanzmangan" and "Braunstein," . . . "im Porphyr bei Ihlefeld im Harz."

As the 19th century wore on, the reputation of the Ilfeld mines for manganite specimens flourished:

> Around 1860 . . . [Ilfeld] mining people were known not so much for the good quality and large quantities of their ore, but for the beauty and size of the manganite crystals which were being found. (Gaevert, 1981)


Mineralien-Sammlung

zusammengestellt

nach dem System des Prof. Naumann und dem Lehrbuch der Mineralogie, von Dr. E. Leyde.
(Berlin bei Mittler.)

von

A. Krantz,
Brüderstrasse No. 39.

Preis 8 Thaler.

Berlin, 1843.
Druck von H. S. Hermann, Post-Str. No. 25.

Figure 34. **Title page of the 1843 Krantz catalog offering Ilfeld manganite specimens (Mineralogical Record Library).**

The passage implies that some "mining people" were keeping up an underground trade in collector specimens—nor were the Count's own agents entirely inactive in this regard. In 1892—just after the mines had closed—two zentners of "type one manganese ore" (manganite) and two zentners of "type three manganese ore" (hausmannite) were sold to the Krantz firm, by then under the direction of Dr. Friedrich Krantz in Bonn (Siemroth, 1990). That the weight was so low (for ore) and that Krantz was a mineral-specimen dealership imply that this shipment consisted not of raw ore but of collector-quality specimens.

There are no records—not even hints—of specimen discoveries during the final period of mining in 1916–1922, even though by this time the excellence of Ilfeld manganite was widely known, and even though much larger quantities of ore per year were moved in this last phase of mining than during earlier phases. We might have expected that more crystal specimens would have been found as well.

According to Sansoni (1971), mineral dealers during the 1920s typically charged from 60 to 100 Deutschmarks for a "good display specimen" of Ilfeld manganite. Given the calamitous inflation that visited Germany in that decade, it seems impossible to "translate" this into a modern-equivalent sum.

As mentioned at the beginning, the Ilfeld region has attracted myriad hikers, bikers, nature-excursionists and mineral collectors during the 88 years since mining ceased. For some decades, visitors

Collecting Manganite at Ilfeld after 1922

by **Gunnar Färber**
(translated by Thomas Moore)

The Ilfeld locality has remained of great interest to collectors ever since active mining ended there in 1922. Before and during World War II the district was once more energetically prospected for manganese, but under the economic conditions which then prevailed a re-activation of mining was out of the question. In the 1970s and 1980s, an agency of the government of East Germany conducted an intensive reworking of the old dumps with the goal of collecting manganite specimens and selling them for foreign exchange on the international mineral market. This work went on over several years, during which time it was shown that a professional search for mineral specimens could yield lucrative results. The search took place exclusively on the old dumps, and the finds were satisfactory enough that no attempts were made to collect in the underground workings. During the time of the former East Germany the Ilfeld dumps were accessible to all collectors, and many good specimens were recovered.

Collecting at Ilfeld became more popular but also more difficult after German reunification. Large groups of collectors from West Germany and beyond descended upon Ilfeld; collectors' clubs arrived by the busloads during the summers, and on almost every weekend, 50 to 100 people were turning over the dumps—resulting in some serious accidents, which worried the local authorities. This intensive exploitation quickly exhausted the once-productive dumps, to the understandable frustration of many local collectors.

In the mid-1990s a few of these local collectors renewed their interest. They succeeded in procuring old mine maps showing extensive layouts of old shafts, adits and dumps, and with the help of these maps they pinpointed many promising workings. Over the decades and centuries the entrances to the old adits had been largely filled in, and the corresponding dumps had been obscured by forest growth. Without the old maps no overview of the mining area would have been possible. Today the traces of most of these former workings are almost invisible, although there are many overgrown dumps on the surface; a former little valley [Salzwerferbach?—Ed.], as indicated on the old maps, is entirely filled in by dump material.

For about the past 15 years a few local collectors have more or less constantly been on the hunt for minerals at Ilfeld. They have persisted in penetrating the branching system of shallow tunnels, and they have often made fine discoveries. Since it is only mineral specimens which have been sought, large underground dumps have accumulated—there is no reason to take out material containing no crystals.

The most spectacular of the recent finds took place in autumn of 2003. A large oak tree, estimated to have been 400 years old, was uprooted by a storm, and a centuries-old ore dump beneath it was revealed and rendered accessible. This was an "original" dump previously unknown to collectors. During the very cold and snowy winter, a substantial number of excellent specimens showing hausmannite pseudomorphs after manganite were collected. Hundreds of rich pieces show columnar pseudocrystals reaching 6 cm long.

In 2008 a new vein of ore was discovered, and several hundred fine manganite specimens were collected from it. In the same year, very fine groutite crystals were found, and newly discovered dumps gave up other interesting finds. Some localized dumps have been shown to contain distinctive mineral suites, not necessarily including manganite; for example, one dump was located which yielded large pyrolusite specimens, and superb pseudomorphs of pyrolusite after calcite crystals.

Collecting at Ilfeld today is legally problematic. The forest and mining authorities would like to prevent all collecting activities, and no official permission to collect may be obtained. The local mining office is responsible for the security of the old workings—but since the responsible authorities in Ilfeld have not enclosed the old dumps with a high fence, or marked them with warning signs, no such "security" has been provided.

According to general mining law in Germany, any unauthorized person who enters an old mine shaft or adit is committing "housebreaking, regardless of whether the door stands open, or whether anyone is at home, or even whether anyone resides there." Whoever collects manganite underground at Ilfeld can also be charged with theft of ore, in addition to the trespassing charge.

Above-ground collecting is a different matter. Since the mid-1990s, with the establishment of the Harz National Park, the collecting of minerals in the Harz has generally been tightly restricted by many new regulations. Ilfeld, however, lies outside the boundaries of the Harz National Park; accordingly there is no basic legal prohibition against collecting on the dumps at Ilfeld, especially as, legally, a mine dump is not a forest floor, and therefore cannot fall within the jurisdiction of the forest administration. The forestry office is certainly not pleased when people collect on the dumps, but it lacks jurisdiction, and, as mentioned, no mining agency has provided security for the dumps. There are in Germany many places marked by warning signs that read "trespassing forbidden by the mining police"—but in this case there are no mining police, and the municipal police are not responsible for enforcing regulations against collecting.

dug freely in the old dumps, and even ventured into the few accessible shallow adits, in search of crystals (see sidebar: "Collecting manganite after 1922"). Naturally, such ventures caused disagreeable levels of environmental degradation. The diggings in old dumps on the slopes of Harzeburg, near the Braunsteinhaus and along the way of the *Bergbauhistorischer Lehrpfad* were sometimes extensive enough to have undermined large trees: beeches with diameters of more than 30 cm were brought down (Siemroth,1990). The same writer comments:

> I myself have seen how collectors from the *Bundesrepublik* [the former West Germany] have "mined" the dumps hydromechanically by means of a motorized pump placed into a stream at the foot of Harzeburg. Such merciless proceedings against Nature don't bear thinking of!

In 2003 there was a significant dump find of specimens showing hausmannite pseudomorphs after manganite, with dull black, prismatic pseudocrystals shot through, or protruding from, massive manganese oxide matrix. A few of the specimens were marketed at the 2004 Munich Show (Moore, 2005). In 2008 another discovery on the dumps yielded a few hundred fair-to-excellent specimens showing open seams lined by bright, sharp manganite crystals, with individuals mostly around 1 cm but exceptionally to 5 cm. The matrix is massive black manganite, and there are some subhedral white barite crystals, and, on a very few of the specimens, 2-cm metallic black crystals of the rare species groutite. About 30 of the new specimens, ranging from 4 to 10 cm across, were offered at the 2008 Tucson Show (Moore, 2008). For more on these and other modern discoveries at Ilfeld, see the sidebar "Collecting Manganite after 1922."

ACKNOWLEDGMENTS

My thanks to Wendell Wilson for assistance with the early mineralogical references and dealer catalogs (nearly all of them found in the extraordinary Mineralogical Record Library), for the translations of the Romé de l'Isle and Born descriptions of manganite, and for gathering most of the illustrations and preparing the maps. Thanks also to Gunnar Färber for providing the sidebar with its updated account of collecting at Ilfeld.

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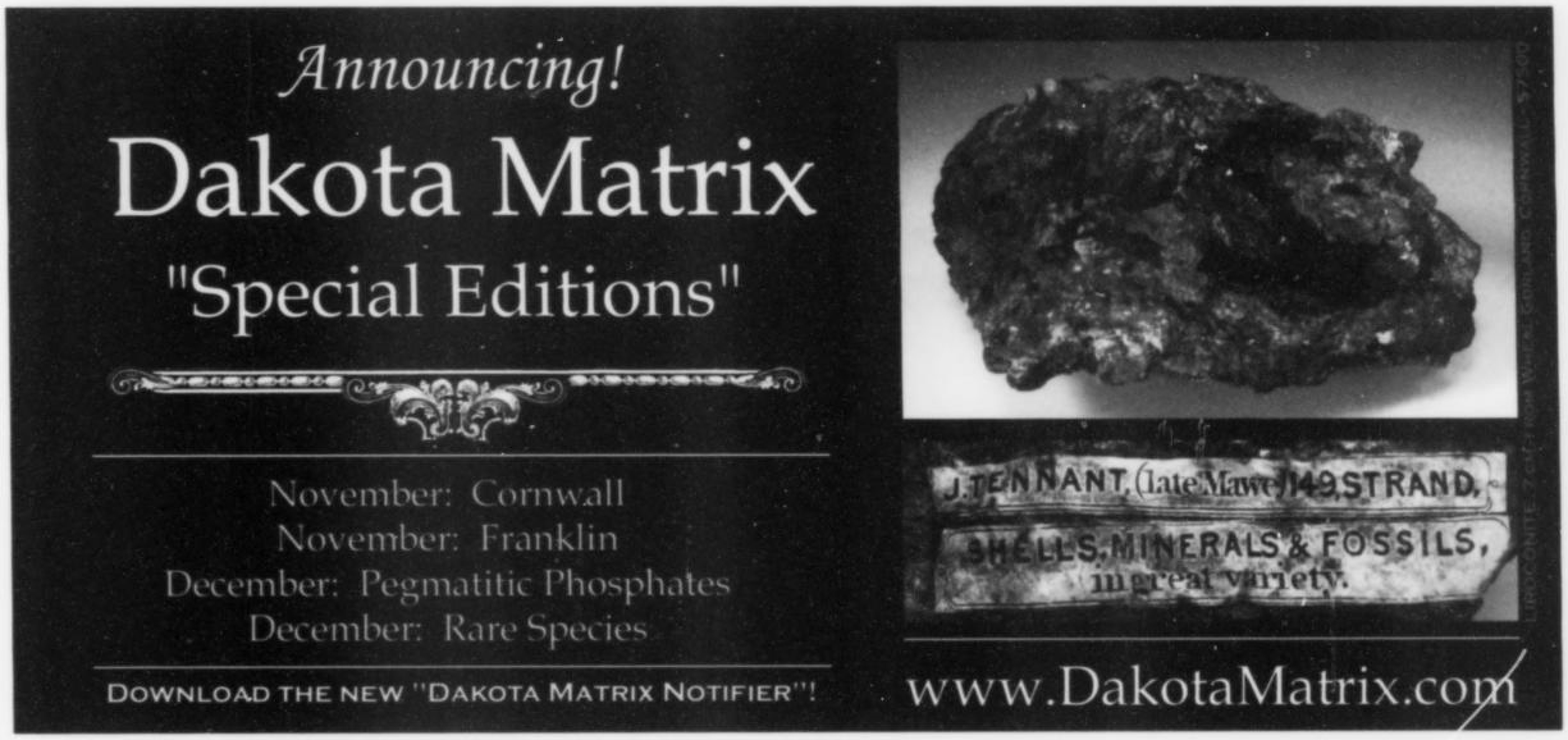

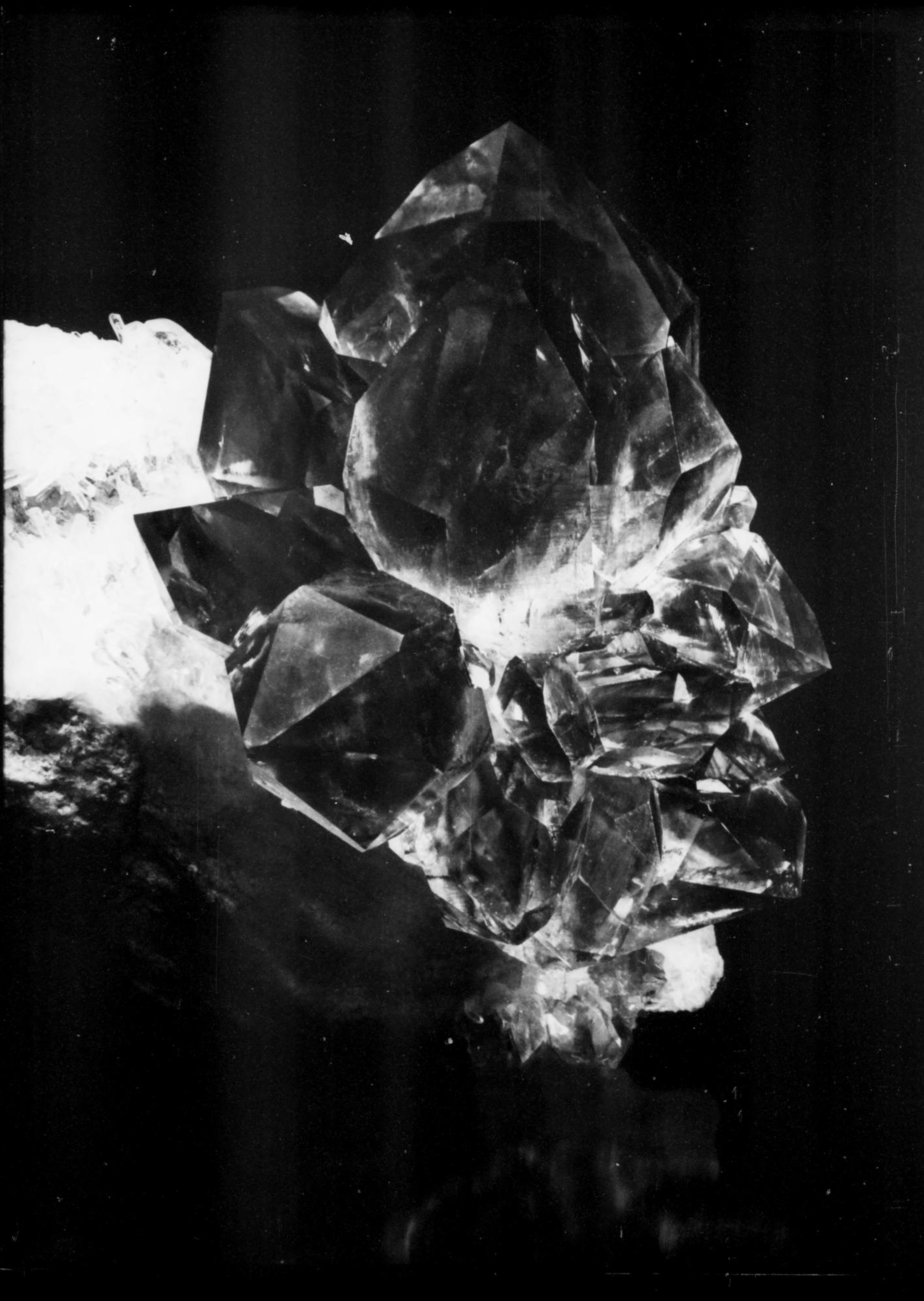

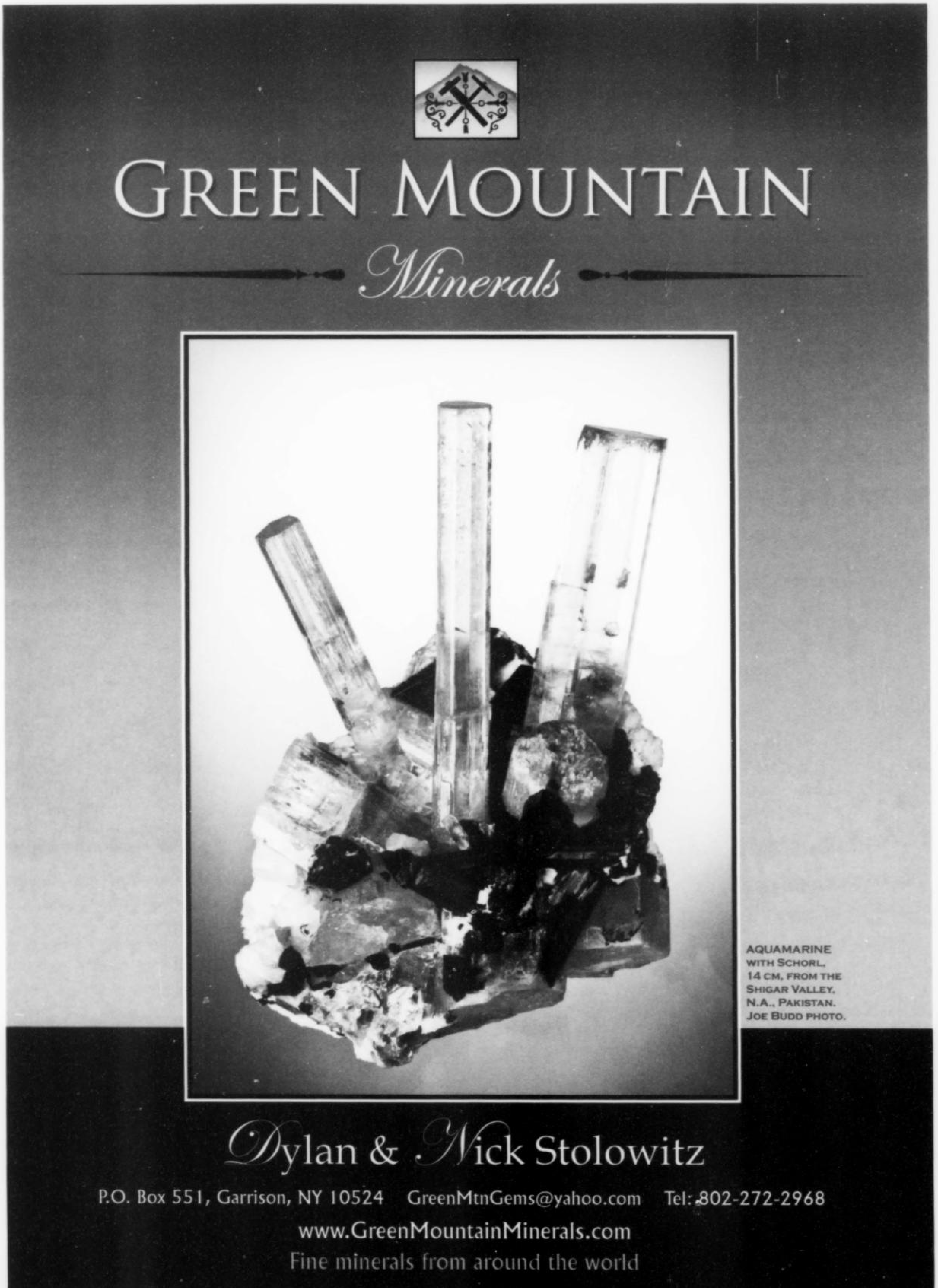
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The Heidelberger Mineralien-Comptoir, founded by one of Germany's early popularizers of mineral collecting, supplied collectors and institutions worldwide with mineral specimens for over 125 years. Though little remembered today, it was one of Europe's most important 19th-century mineral dealerships.

Introduction

The Heidelberger Mineralien-Comptoir was one of the earliest mineral dealerships in Europe, tracing its roots back to 1804 when a 25-year-old tax inspector (*Steuerassessor*) named Karl von Leonhard began occasionally dealing in minerals. Leonhard eventually became a prominent name among the mineralogists of Europe, having founded an important professional journal (which still exists) and published numerous books and articles. His mineral business grew in importance as well, and in time he passed on the management of the dealership to a succession of eager young men. The business ultimately operated for over 125 years, and during its heyday it was one of the leading such enterprises in the world, with a stock of over 40,000 specimens.

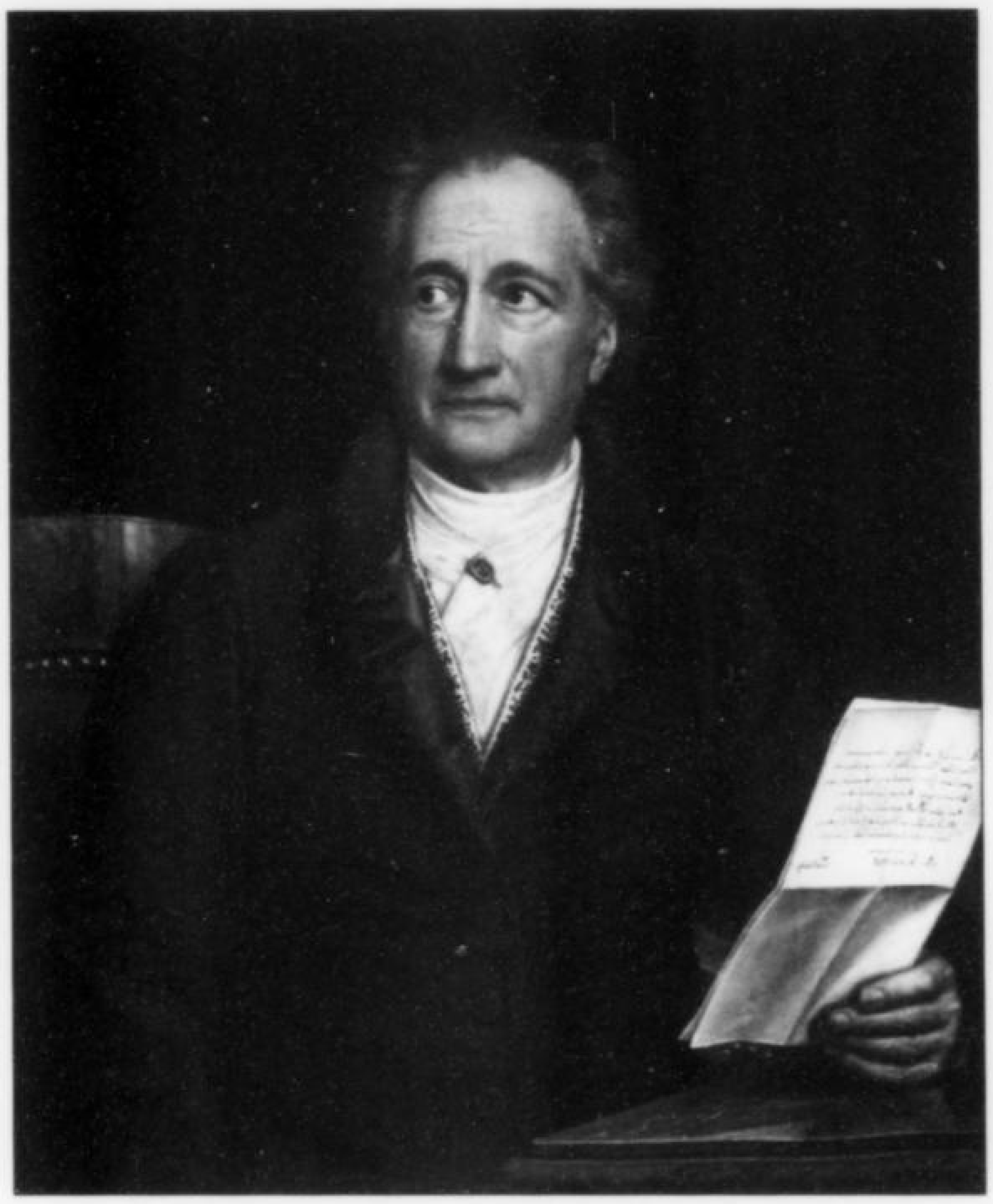
Karl von Leonhard

Karl Cäsar von Leonhard was born in Rumpenheim bei Hanau, Germany on September 12, 1779, and attended the University of Marburg in 1797, then moved on to the University of Göttingen in 1798. There he acquired an interest in minerals from his mineralogy professor, Johann Friedrich Blumenbach (1752–1840). He had planned to go on to study mineralogy under Abraham Werner in Freiberg, but an early marriage brought financial responsibilities that forced him to leave school and take a job as an assessor in the Bureau of Land Taxes in Hanau. Nevertheless he carried on a correspondence with Werner and other professors in Freiberg, and studied mineralogy on his own in his spare time.

In 1803 Leonhard began making frequent mineral collecting trips throughout Thuringia and Saxony. He probably accumulated more specimens than he ultimately needed, and so was inspired to begin selling some of them on the side; in 1804 he established a part-time mineral business (Kirchheimer, 1969). During the next few years he toured the Austrian Alps, meeting Friedrich Mohs in Vienna and Baron Karl von Moll in Munich.

In 1806 Leonard, in collaboration with Ernst K. F. Merz and Johann Heinrich Kopp, published *Systematisch tabellarische Übersicht und Charakteristik der Mineralien* ("Systematic tabulated overview of the properties of minerals"), and in 1807 he founded a magazine specifically for mineralogists and mineral collectors, called *Taschenbuch für die gesammte Mineralogie* ("Notebook for the whole of mineralogy"). The journal soon became popular and gained the support of miner-

Karl Cäsar von Leonhard (1779–1862), founder of the Heidelberger Mineralien-Comptoir.



Johann Wolfgang von Goethe (1749–1832), famous German writer and polymath; he was also a mineral collector and customer/supplier of the Heidelberger Mineralien-Comptoir. Portrait by Joseph Karl Stieler (1829).

alogists across Europe, making Leonhard's name widely known. (In 1830 the name of the journal was changed to *Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefakenkunde*; it remains a prestigious mineralogical journal today.)

From 1805 to 1809 Leonhard published his three-volume *Handbuch einer allgemeinen topographischen Mineralogie*, one of his major works. From 1811 to 1822 he also served as editor of the journal *Allgemeines Repertorium der Mineralogie*. He held various other jobs from 1809 to 1818, when he returned to Heidelberg to accept the position of Professor of Mineralogy at the University of Heidelberg, where he remained for the rest of his life.

Leonhard had an extensive practical knowledge of the physical properties of minerals and fossils, but because of his abbreviated education his lectures completely neglected the chemical and mathematical aspects of mineralogy. He is said to have used "barbaric terminology in his lectures and gesticulated endlessly" (Burke, 1973).

In 1817 Leonhard, with his friends J. K. Kopp and K. L. Gärtner, published *Propädeutik der Mineralogie* ("Introduction to Mineralogy"), a valuable and instructive compendium of all sorts of information useful to the mineralogist and mineral collector. His *Charakteristik der Felsarten* (1823) was the most comprehensive work on petrology to appear in the early 19th century, but, being based solely on visual examination, it was arbitrary and largely unsatisfactory by modern standards.

After operating his part-time mineral business intermittently for 20 years without help, Leonhard finally turned proprietorship over to a young mineralogist, Friedrich Moldenhauer, in 1824. But Leonhard continued to be involved in the business, probably as owner and certainly as advisor.

Johann Wolfgang von Goethe (1749–1832) was one of the Leonhard's customers, specimen suppliers and regular correspondents (beginning in 1807); Goethe wrote a friendly letter to Leonhard on February 3, 1826, saying: "How much my cabinet owes overall to your sympathetic consideration." Apparently Goethe also acted as an intermediary for Leonhard in specimen trades. On February 25, 1826, Goethe remarked: "I know quite well that bartering, particularly in this subject [minerals], has difficulties, because each party values his supply probably more highly than the other one." And on September 3, 1826, Goethe wrote: "You will receive by the next post a small packing case of minerals . . . ."

In 1833 Leonhard turned his attention again toward popularizing mineralogy and geology, with the publication of his *Geologie, oder Naturgeschichte der Erde* ("Geology, or a Natural History of the Earth"). His personal bibliography lists numerous other works, including 30 articles in scientific journals.

Leonhard built a huge personal mineral collection of 8,000-10,000 specimens (acquired by the University of Göttingen after his death on January 23, 1862). The mineral *leonhardite* was named in his honor by Johann Reinhard Blum (1802–1883) in 1843, but it was later discredited as H_2O-poor laumontite.

Friedrich Moldenhauer

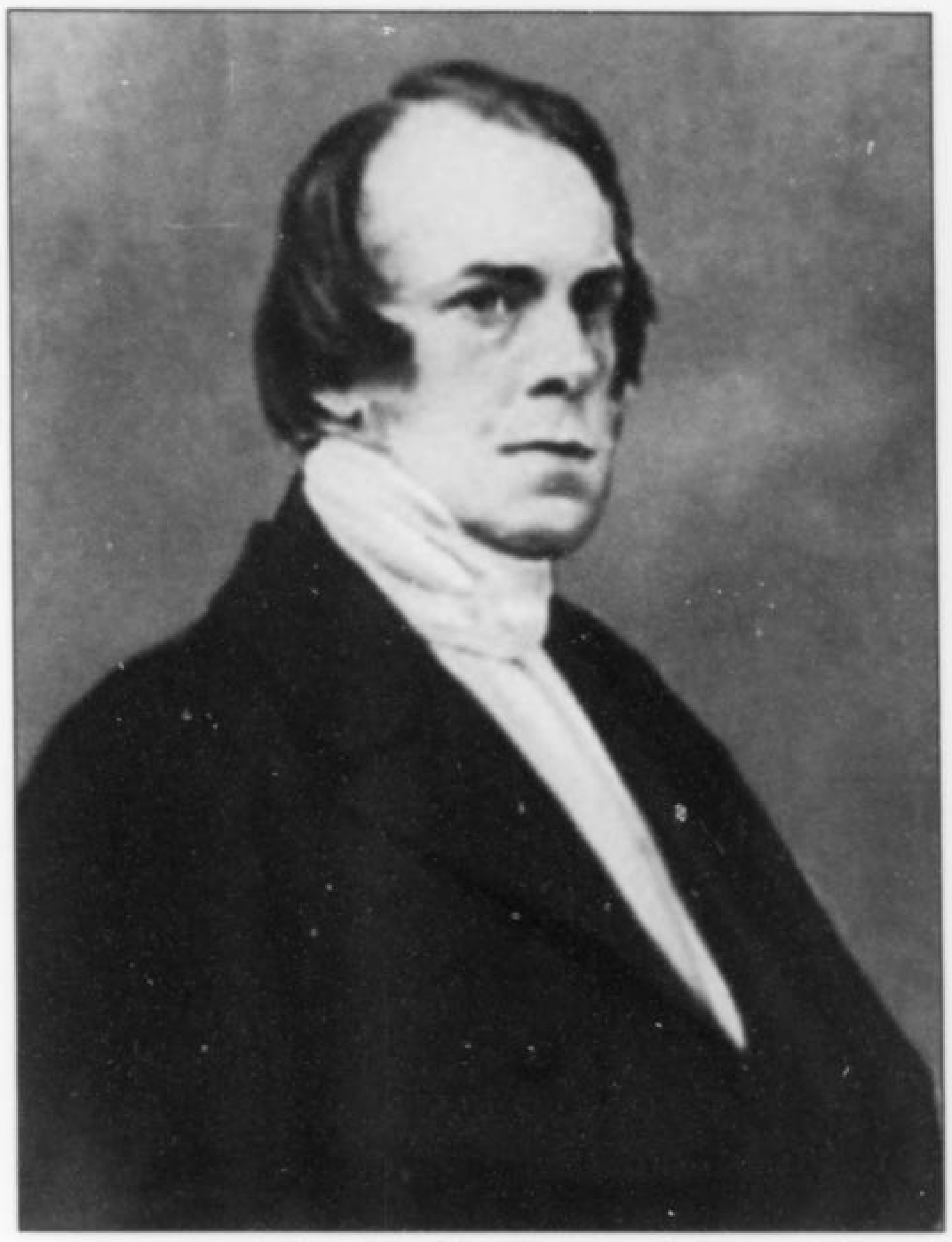
Karl Friedrich August Moldenhauer, Leonhard's initial successor in the mineral business, was born January 25, 1797 in Gernrode, in the Harz Mountains. He began training to be a pharmacist in Nordhausen in 1812, received his apprenticeship certificate in 1815, and worked as an assistant pharmacist in Ostheim, Frankfurt-am-Main and Mainz until 1818. In the spring of 1819 he transferred to the Heidelberg pharmaceutical laboratory of Henking and Mais, leaving in 1821 to study pharmacy at the University of Heidelberg, beginning with courses in the natural sciences and mathematics.

Leonhard was surely his mineralogy instructor, and that is most likely how they met.

In 1823, while still a student in Heidelberg, Moldenhauer was hired to travel to Leiden and arrange the mineral collection there at the Rijksmuseum van Natuurlijke Historie. Perhaps Leonhard recommended him for the job; or perhaps it was Moldenhauer's successful completion of the work that brought him to the attention of Leonhard. In any case, it was excellent experience for any potential mineral dealer. Following Moldenhauer's return to Heidelberg in 1824 he was invited to take over the day-to-day operation of Leonhard's mineral specimen business. The business had never been formally named, and Leonhard seems to have wanted to keep a low profile for himself, so rather than use Leonhard's name they decided to call it the *Heidelberger Mineralien-Comptoir**.

Moldenhauer lost no time in getting started as a mineral dealer; he was able to purchase the collection of precious stones belonging to the widow of Friedrich August Treutler (1766–1819), Royal Saxon Court councilor and Inspector of the Royal natural history cabinet in Dresden. Moldenhauer then sold the collection to King Willem I of the Netherlands in 1825. That same year he published a 40-page catalog of a collection of 982 specimens for sale by the "Mineralien-Comptoir von Friedrich Moldenhauer in Heidelberg," located at Kettengasse No. 566.

Despite the demands of his new mineral business, Moldenhauer continued his studies at the University, and in 1826 was awarded a doctorate in mineralogy, chemistry and pharmacy. In 1827 he spent time furthering his studies in Berlin and Clausthal, in an effort to gain an appointment at the University of Heidelberg as a lecturer in physics. He was unsuccessful in that bid, however, and left Heidelberg permanently in 1828 to take a succession of positions in Munich, Marburg, Göttingen and finally (in 1835) as instructor in the natural sciences at the Realschule in Darmstadt and then (from 1836 to 1857) as mineralogy and chemistry Professor at the vocational school in Darmstadt. In 1838 Moldenhauer published a mineralogy textbook: *Grundriss der Mineralogie*. He died on March 27, 1866 in Darmstadt.



Heinrich Georg Bronn (1800–1862), one of the leading 19th century paleontologists, was co-editor of *Neues Jahrbuch für Mineralogie* with Karl von Leonhard, and also helped Leonard with the Heidelberger Mineralien-Comptoir.

Heinrich Bronn

Moldenhauer having left in 1828, Leonhard sought to keep the Heidelberger Mineralien-Comptoir going with the help of his friend, Heinrich Georg Bronn (1800–1862), his co-editor of *Neues Jahrbuch für Mineralogie*. Bronn was also Professor of zoology and paleontology at the University of Heidelberg, and was the translator for the first German edition of Darwin's *Origin of Species*. He wrote company catalogs of shells, plants and rocks in 1827 and 1828, but seems to have had little interest in mineralogy *per se*. His major work, *Letkaea Geognostica* (1834–1838), ranks as one of the foundations of German stratigraphic petrology, and the company offered sets of rocks keyed to it.

In an ad in the *Magazin für Pharmacie* for February 1828 the Heidelberger Mineralien-Comptoir (Leonhard still declined to attach his own name to any advertisements) offered a number of "Collections of Minerals, Fossils and Crystal Models," including (1) an oryktognostic collection of 650 mineral specimens organized according to Leonhard's *Handbuch der Mineralogie*, (2) a gemstone collection of 50 pieces, (3) a geognostic collection of 600 specimens, (4) a pharmaceutical collection of minerals, (5) a collection of 700 minerals of economic value, (6) a fossil collection, and (7) a collection of 123 crystal models. The ad pointed out that

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*Comptoir (or komptoir), literally a "countertop" as in a store, office or bank, is a word that Germans and Austrians borrowed from the French; in the 19th century it was used as a term for a dealership, especially a mineral dealership. The German-language equivalents were *Kontor, Niederlage* or *Handlung*. Examples include the *Tiroler Mineralien-Comptoir* of Johann Alpenberg (1806–1873), the *Bayerisches* [Bavarian] *Petrefacten und Mineralien Comptoir* of Friedrich Kohl (1839–1907), and the *Österr-Ungar* [Austro-Hungarian] *Mineralien Comptoir* of Julius Böhm (ca. 1850–1925), among many others. Of course the French and Swiss dealers also used the term, e.g. the *Comptoir Central d'Histoire Naturelle* operated by the Boubée family in Paris, the *Comptoir Géologique de Paris* of Emanuel Dagincourt, and the *Comptoir Minéralogique et Géologique de Genéve* of Henri Minod. In 1841, however, a three-language catalog of the Heidelberger Mineralien-Comptoir offered a rather free translation in the English section, rendering the company name as the "Heidelberg Mineralogical Institute."

MINERALIEN-COMPTOIR
ZU
HEIDELBERG.

Verzeichnifs
vorräthiger einfacher Mineralien.

COMPTOIR DE MINÉRAUX
A
HEIDELBERG.

Catalogue de Minéraux.

1831.

Diesem Verzeichnisse sichtlich nicht gemengter Mineralien liegen unsere, mehr als 40,000 Exemplare betragende Vorräthe zum Grunde. Der Raum gestattete keine ausführlichen Angaben, was Krystall-Gestalten, begleitende Substanzen, Art des Vorkommens, Fundstätten u. s. w. betrifft. Unsere Versendungslisten, oder die jedem einzelnen Handstücke beizulegenden Etiquetten aber werden stets die genauesten Bezeichnungen liefern. — Die Preise wechseln nach dem Verschiedenartigen des Formats und nach dem mehr oder weniger Ausgezeichneten der Exemplare.

Unsere Vorräthe von Fels-Arten sind nicht minder bedeutend und mannichfach, so dafs wir jede Bestellung zu befriedigen vermögen. Dasselbe gilt in Absicht der Petrefakten, von welchen besondere Cataloge zu haben sind.

Geordnete Oryktognistische Sammlungen nach LEONHARD's Handbuch, Edelstein-Sammlungen, geognostische Samm-

Title page of the 1831 catalog of the Heidelberger Mineralien-Comptoir, noting the company's stock of over 40,000 specimens (Mineralogical Record Library).

"Every specimen comes with a label (available in French, German or English) giving the species name and the locality."

Leonhard and Bronn continued to operate the business for several years following the departure of Moldenhauer. Even though Leonhard meticulously kept his name out of advertisements, everyone knew it was his company. At the September 12, 1834 meeting of the Congres Scientifique de France, the moderator, Mr. Desvaux, brought to the attention of the attendees: ". . . the catalog of the *Comptoir Mineralogique et Geologique* very recently founded in Paris, like that which the Baron Mr. Leonhard directs in Heidelberg."

By this time many European museums with collections dating to the early 1800s had acquired mineral specimens through the Heidelberg Mineralien-Comptoir. The website of the Museum of Geology at the University of Tartu in Estonia, for example, states that "The first professor and head of the Cabinet of Mineralogy was O. M. von Engelhardt (1820–1841). In Engelhardt's time the acquisition of geological collections became more regular. The collections grew mainly thanks to donations . . . and less from purchases made from *Heidelberg Mineralien-Comptoir*, H. H. Hess, A. H. Scheerer and A. Kämmerer."

Im
Mineralien-Comptoir
Sandgasse Nro. 4.
sind Mineralien und Konchylien in einzelnen Stücken sowie in geordneten Sammlungen zu beziehen. Unsere kleine Mineraliensammlung zu 100 Stück mit gedruckten Etiquetten zu fl. 8. 45 oder 5 Thlr. sind besonders für Geschenke zu empfehlen.

Heidelberger Mineralien-Comptoir.
J. Lommel.

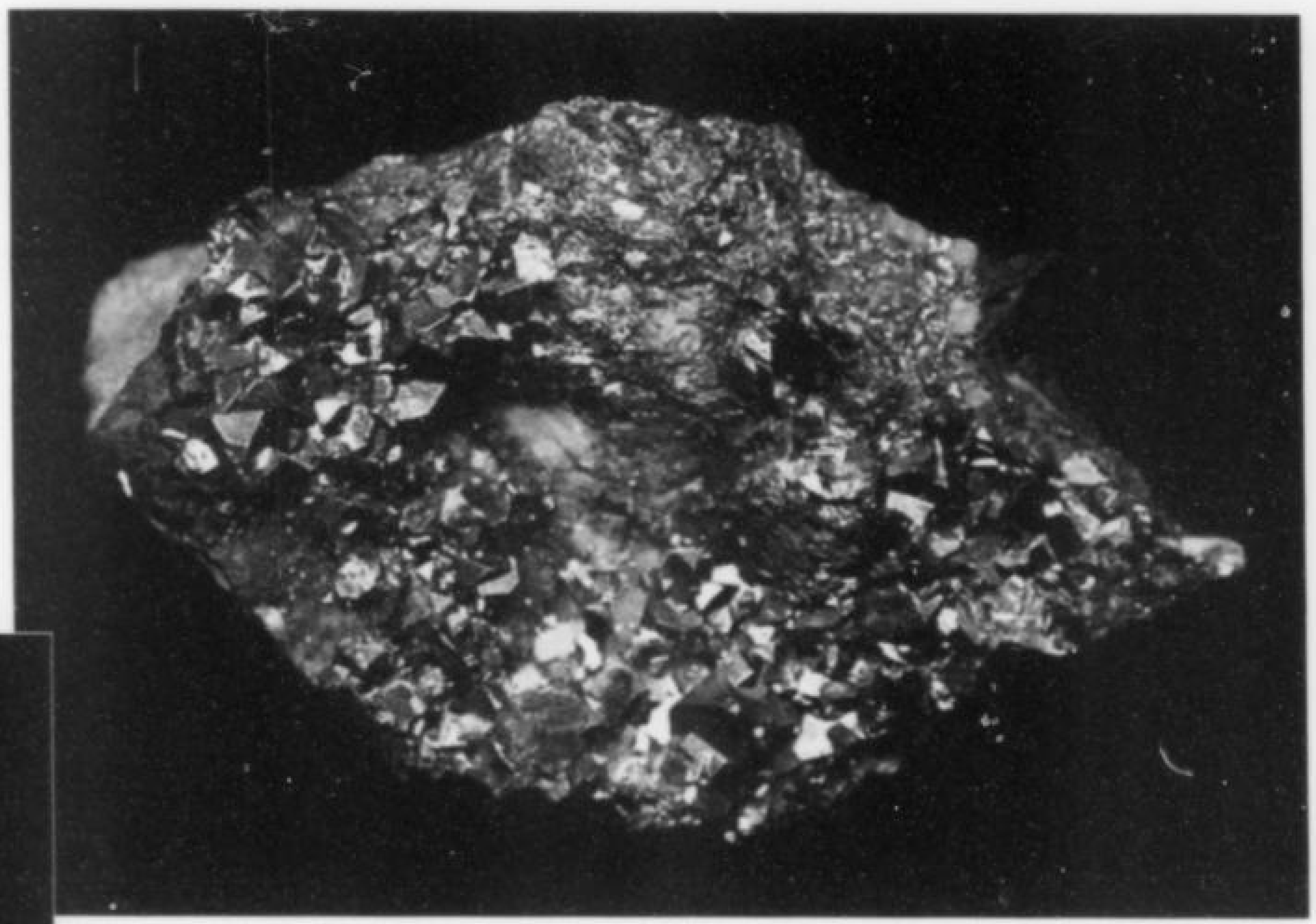
Advertisement for J. Lommel's Heidelberger Mineralien-Comptoir published in the 1860 edition of *Guide to Heidelberg and its Environs*.

In 1834, the Heidelberger-Mineralien Comptoir sold what would become the type specimen for variscite to August Breithaupt. The Museum der Natur in Gotha, Germany purchased from the Heidelberger Mineralien-Comptoir a collection of 1,000 fossils in 1835.

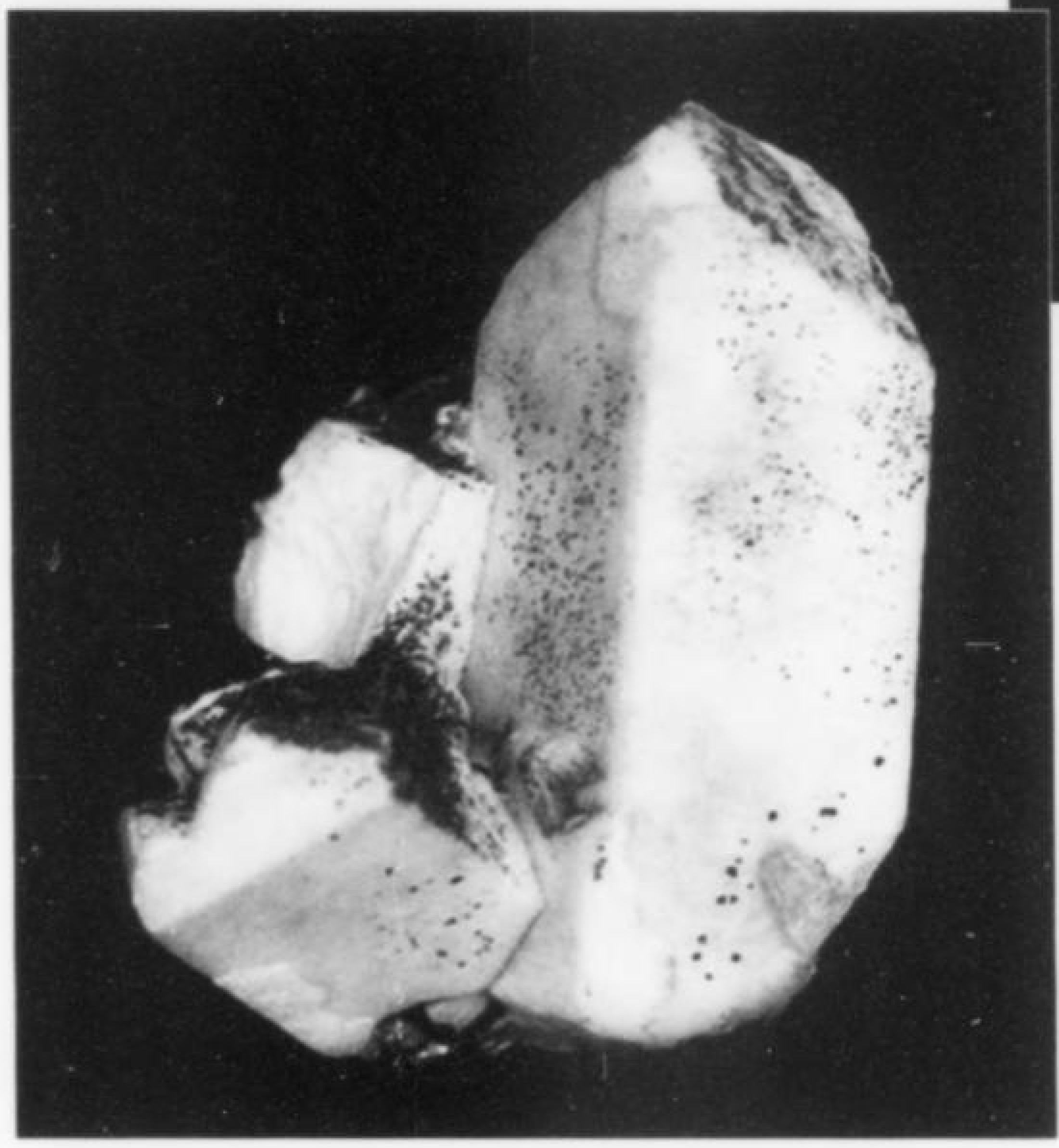
J. Lommel

In the meantime, Leonard had made the acquaintance of another young mineralogist, named J. Lommel. In 1841 Lommel had completed a 320-page 10-year index to Leonhard and Bronn's journal, *Jahrbuch für Mineralogie*, covering the years 1830–1839; it was published in Stuttgart by E. Schweizerbart. This may have been the catalyst for bringing Lommel into the Heidelberger Mineralien-Comptoir at some point and setting him up as proprietor.

According to the Heidelberg City Directories, Lommel was living on the Schiffgasse in 1840, 1842 and 1844, and he had moved to a new address, Sandgasse No. 4 by 1846. He was listed there as "J. Lommel, Mineralogist," and the records note that "his mineral cabinet is there." By 1853 he had formally taken over management of the Heidelberger Mineralien-Comptoir. In that year Karl von Leonhard's son, Gustav von Leonhard (who eventually took over from his father as editor of *Neues Jahrbuch für Mineralogie*), published an article about orthite. Apparently Gustav and Lommel had been field-collecting partners. In the article he writes: "Quite a long time



Galena, 7.5 cm, from Bad Ems, Nassau, Germany. Heidelberger Mineralien-Comptoir specimen now in the collection of the Natural History Museum of Luxembourg.



Orthoclase, 3 cm, from Baveno, Piemonte, Italy. Heidelberger Mineralien-Comptoir specimen now in the collection of the Natural History Museum of Luxembourg.

ago I and J. Lommel, the Managing Director of the Heidelberger Mineralien-Comptoirs, made an excursion to the Birkenaue Valley, having become aware of a peculiar mineral which is found there. We looked in vain for better examples."

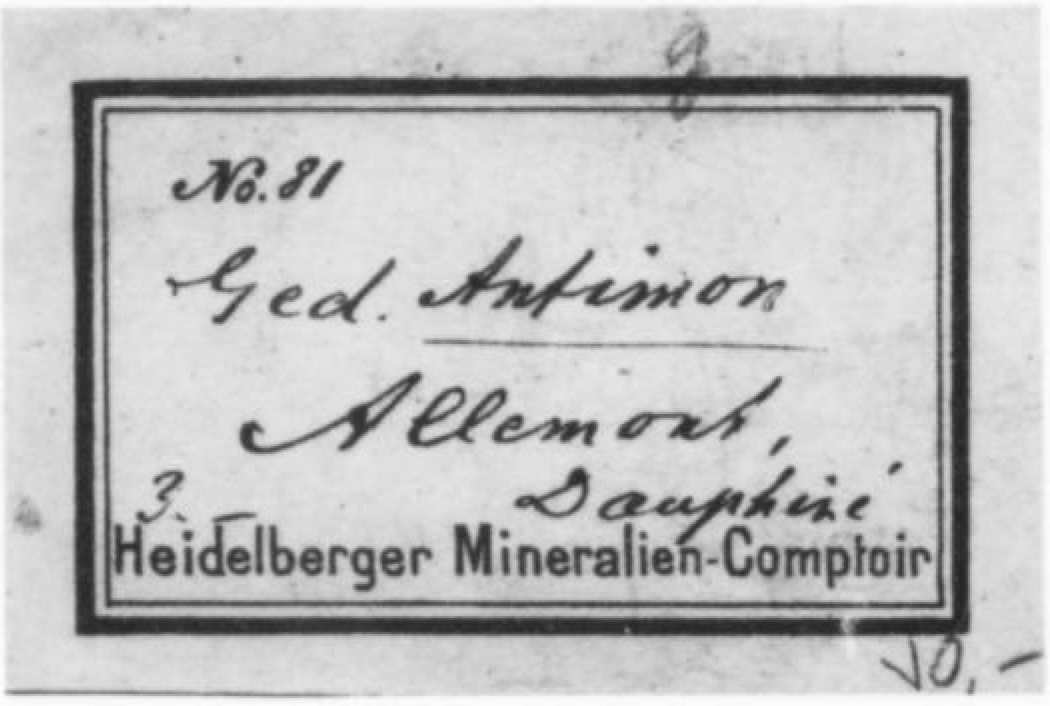
In 1858, Bronn noted in a discussion of bituminous fossils from Carinthia that large and complete collections of the fossils were available from Heidelberg Mineralien-Comptoir, thanks to "the efforts of Mr. Lommel." Lommel is listed as a "mineralogist" in the 1859 *Verhandlungen des naturhistorisch-medizinischen Vereins zu Heidelberg*.

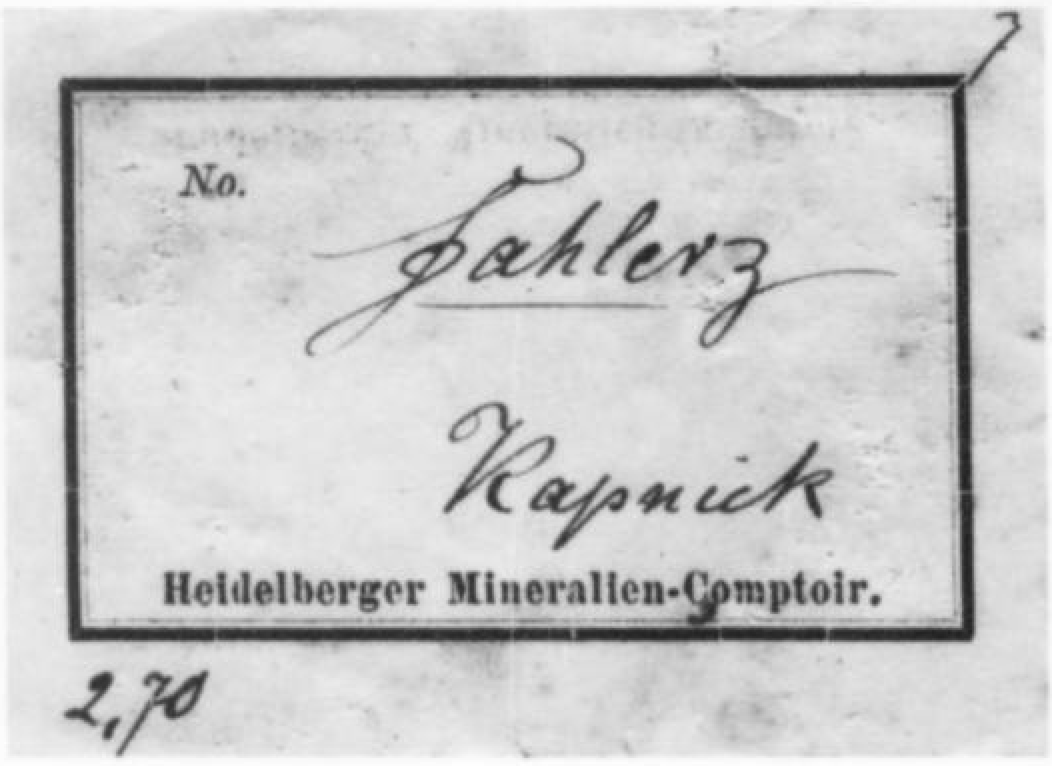
In the 1860 edition of *Führer durch Heidelberg & Umgebungen* ("Guide to Heidelberg and its Environs") there is an ad for the Heidelberger Mineralien-Comptoir of J. Lommel at Sandgasse No. 4, offering minerals and shells by the piece or in collections; their "small mineral collection" of 100 labeled specimens was deemed especially appropriate as a gift for someone. In the following year Lommel came out with an eight-page catalog of specimens under his own authorship (previous catalogs had been composed anonymously, no doubt by Leonhard), in French, German and English, entitled *Verzeichniss von Versteinerungen herausgegeben vom Heidelberger Mineralien-Comptoir.*

Professor Julius von Haast wrote in 1881 about acquiring specimens from Lommel for the Canterbury Museum collection in New Zealand: "In 1862, at my suggestion, the Provincial Council voted £100 for the purchase of type collections in mineralogy, lithology, palæontology, and conchology, which were obtained from the Mineralien Comptoir in Heidelberg, Germany, under very favourable conditions. It contained 2,613 well-selected specimens, many of them of permanent value."

William J. Hamilton, Secretary of the Geological Society of London, wrote in 1860 that "The institution [Heideberger Mineralien Comptoir] is also under the superintendence of the principal geologists and mineralogists of Heidelberg, as Leonhard, Blum and Brown [Bronn]," suggesting that they all advised Lommel as necessary in the assembling and labeling of the collections he sold.

In 1867 the company issued a 30-page catalog, written by J. Lommel, entitled *Collection of 1,000 Specimens of Rocks and Fossils.* It was the "fifth edition," and Lommel's last publication. He died on October 12, 1868. His brief obituary notice in *Neues Jahrbuch* identifies him as the *besitzer* ("owner") of the Heidelberger-Mineralien Comptoir; probably he had inherited formal ownership following Leonhard's death in 1862 (and Bronn's death that same year).





L. and Daniel Blatz

The company continued under new management after the death of Lommel. The Heidelberger Mineralien-Comptoir under L. Blatz, "formerly under J. Lommel," located at Burgweg 7, is listed under mineral dealers in 1871–1873 issues of *Neues Jahrbuch für Mineralogie* (by then under the editorship of Leonhard's son Gustav and Hanns Bruno Geinitz). Paul Groth (in his 1878 description of the mineral collection of Kaiser Wilhelm University in Strassburg), referred to Daniel Blatz as the proprietor of the company. In 1879 the university in St. Petersburg obtained a collection of diorite specimens from "Dr. Blatz in Heidelberg." The Heidelberger Mineralien-Comptoir, under the management of Daniel Blatz, is referred to by Victor Goldschmidt in 1900 and 1905 (in *Zeitschrift für Kristallographie* in 1900, and in *Tschermak's mineralogische und petrographische Mitteilungen* in 1905); the American mineral dealer Lazard Cahn bought specimens from Daniel Blatz in 1906, and the Senckenberg Naturalists Society listed "Dr. L. Blatz" as a source of mineral specimens that same year. Other sources refer to Daniel Blatz's dealership as late as 1909. Julius Ruska commented in a 1937 memoir how grateful he was to Daniel Blatz, who years earlier had carried on Lommel's mineral dealership in Heidelberg.

Friedrich Rodrian

Goldschmidt and Thomson (1920) refer to the Heidelberger Mineralien-Comptoir under the management of Friedrich Rodrian in volume 5 of the *American Mineralogist*, so Rodrian appears to have taken over from the Blatz brothers at some time between 1909 and 1920. Rodrian is cited as the source of a specimen of Tsumeb phosgenite.

Early advertisements indicate that as of 1905 Friedrich Rodrian had been in business with his brother Dr. Alfred Rodrian in Heidelberg as proprietors of the C. Desaga company—chemical suppliers and purveyors of laboratory apparatus. (Founder Peter Desaga was the first manufacturer of the Bunsen burner.) They operated their own glass-blowing studio for manufacturing laboratory apparatus on demand. Apparently Friedrich had an inclination toward mineralogy, and took over the mineral business from Blatz.

Rodrian eventually moved to Hamburg, taking the business with him but necessarily no longer calling it the "Heidelberger" mineral dealership. The Hamburg City Directories for 1930, 1932 and 1933 list "Friedrich Rodrian-Schenk, Mineralien-Niederlage, hmb33, Heidhörn." Nothing is known of him or the mineral business after that time.

Acknowledgments

My thanks to Lawrence H. Conklin and Si Frazier for reviewing the manuscript and making helpful suggestions.

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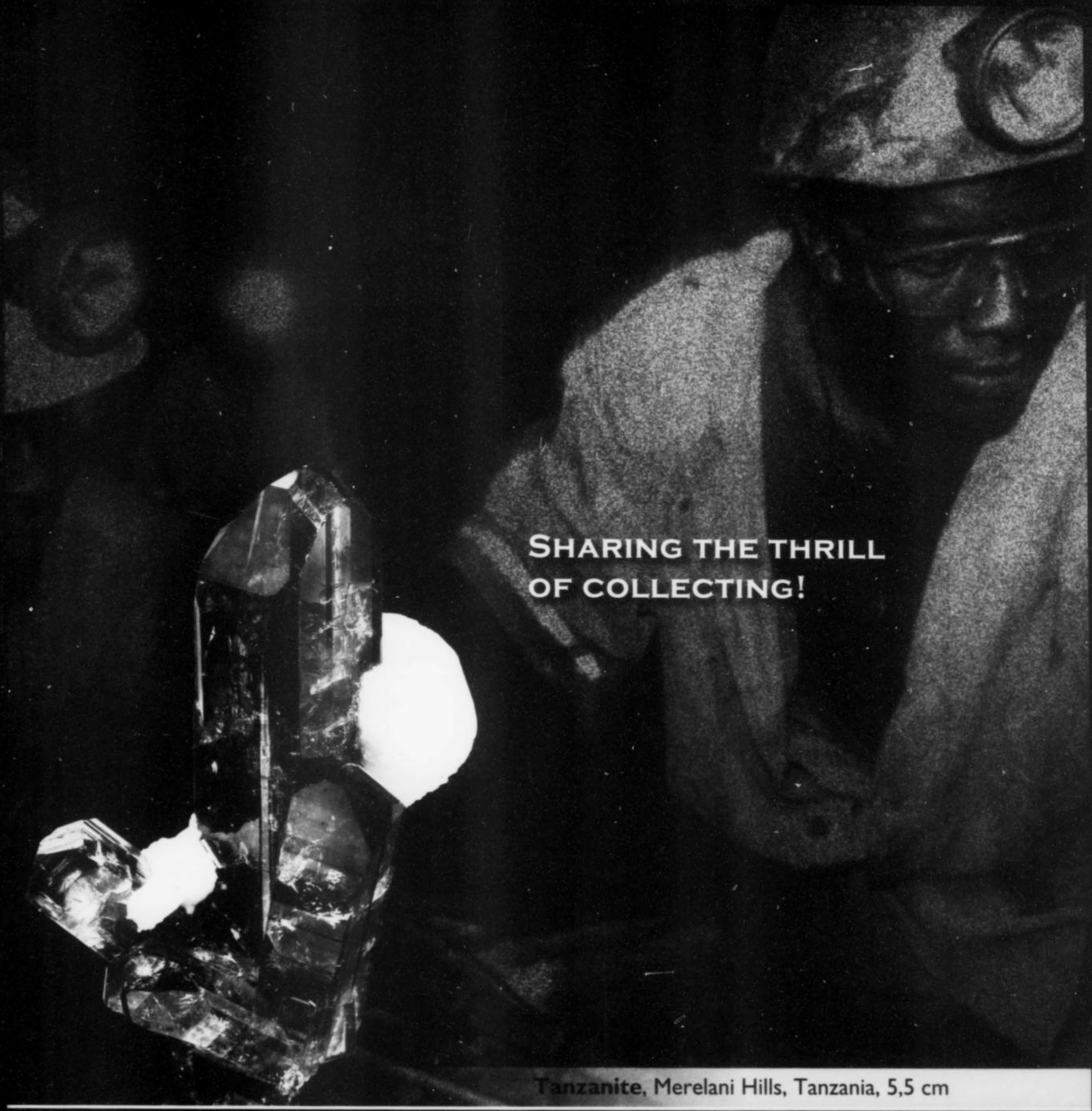

Tanzanite, Merelani Hills, Tanzania, 5,5 cm

Photo: M. Sickinger

CUBIC MAGNETITE CRYSTALS

from Balmat, New York

Steven C. Chamberlain[1]
George W. Robinson[2]
Marian Lupulescu[3]
Timothy C. Morgan[4]
John T. Johnson[5]
William M. deLorraine[6]

In 1991 a sphalerite mining operation near Balmat, New York, encountered an altered area containing cubic to tetrahexahedral magnetite crystals in halite-filled veins. The large, lustrous, morphologically unique magnetite crystals rank among the finest known examples of the species.

INTRODUCTION

In 1991, the Zinc Corporation of America's mining operation to recover sphalerite from the stratabound Fowler orebody near Balmat in St. Lawrence County, New York, encountered an altered area of unusual mineralogy. Magnetite crystals were found there in two modes: (1) lining halite-filled veins along with anhydrite, sphalerite, and calcite, and (2) frozen in a matrix of halite and talc together with pods of zoned massive sulfides. The magnetite crystals have unusual morphology and may well rank among the finest examples of the species yet found. Thousands of fine crystals and crystal clusters were recovered before mining progressed through the zone.

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LOCATION

The Balmat mines are located in northern New York State, about 26 miles southeast of Ogdensburg on the Canadian border. Other well-known mineral localities in the area include DeKalb (diopside), Antwerp (millerite), Gouverneur (tourmaline), Rossie (galena) and Pierrepont (black uvite).

At the time the magnetite specimens were collected (1991–1992), access to mining operations in the Fowler orebody was gained by a vertical shaft at the No. 4 mine on Sylvia Lake Road, just north of Sylvia Lake in the town of Fowler. The Zinc Corporation of America also operated the adjacent No. 3 mine at Balmat, the Hyatt mine at Talcville, and the Pierrepont mine on Crary Road in the town of Pierrepont, all in St. Lawrence County. All four mines exploit stratabound sphalerite deposits in Precambrian metasediments.

HISTORY

Zinc mining in northern New York began in 1915 when the Northern Ore Company began production at the Edwards mine at the northeastern end of the Balmat-Edwards marble belt (see Johnson, 1998, for a historical review). After a brief period of ownership by the New York Zinc Company, the property was bought by the St. Joe Lead Company in 1926. St. Joe continued the Edwards operation and began exploration in Balmat about 13 kilometers to the southwest on an outcropping of zinc ore that had been described as early as 1838 by Ebenezer Emmons in a New York Geological

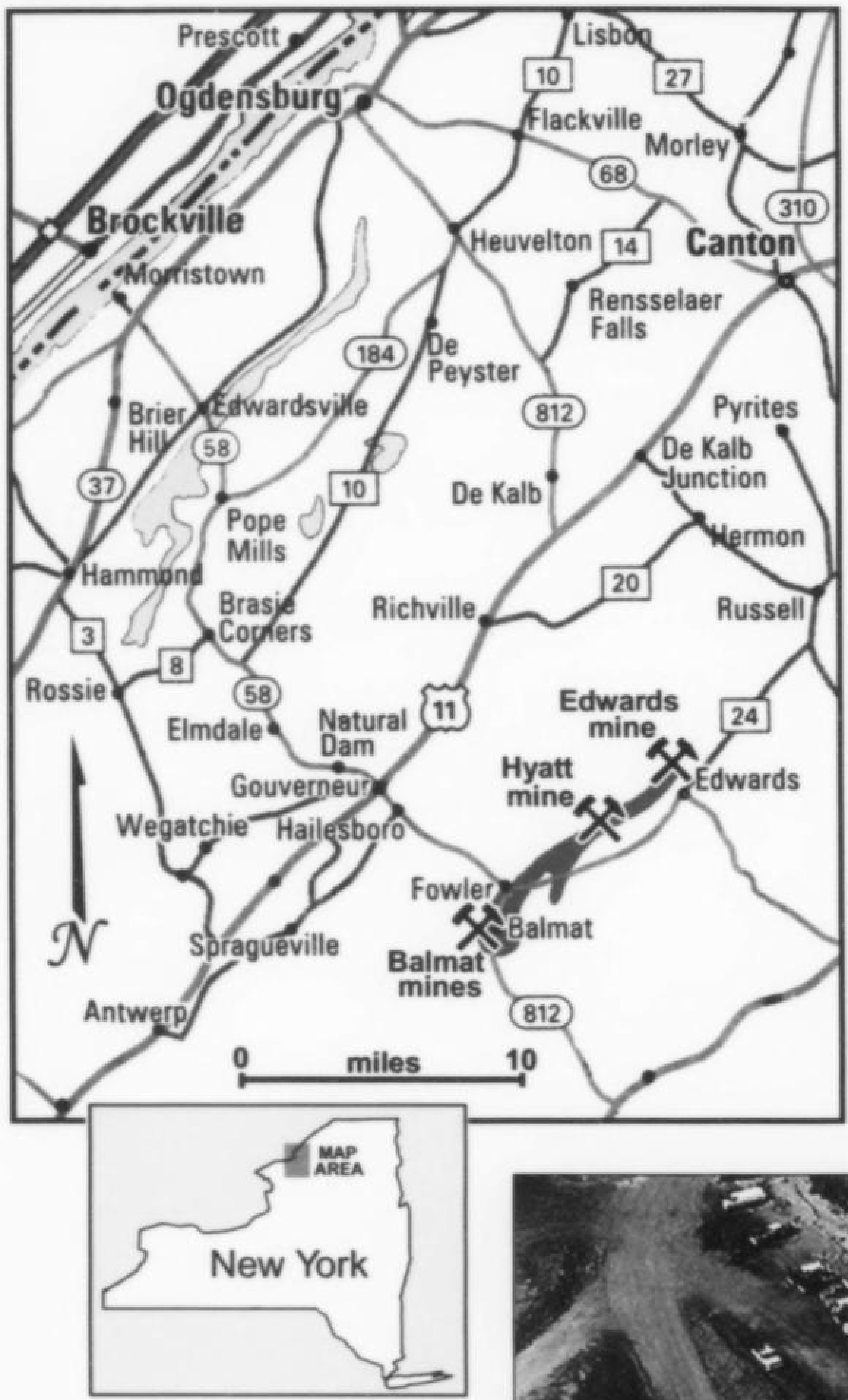

Figure 1. **Map showing the location of the Balmat mines and nearby ZCA mines in St. Lawrence County, New York. The red area is the Grenville marble (locally known as the Balmat, Edwards, and Pierrepont marbles).**

Survey report. This effort led to the discovery of a very large deposit consisting of the Main, Hanging Wall, and Streeter orebodies, all of which were accessed by the No. 2 mine shaft.

Subsequent exploration met with continuing success: the Loomis and Gleason orebodies were discovered in 1948 and the Fowler and Upper Fowler orebodies in 1966. Additional smaller satellite bodies were also encountered during this time. Exploration of the Pierrepont marble belt, 45 kilometers northeast of Balmat, led to the discovery of the very high-grade Grange and Crary orebodies at the Pierrepont mine in 1979. Ownership was transferred to the Fluor Corporation in 1981 and finally, in 1987, to the present owner, the Zinc Corporation of America, a subsidiary of Horsehead Industries. The Balmat, Edwards, Pierrepont, and small Hyatt mines have produced over 36 million tons of zinc ore at a grade of 9.5 percent zinc—truly a world-class district.

The Magnetite Zone

A small but crystallographically unique occurrence of magnetite crystals was encountered in the Fowler orebody in 1991. The occurrence was in an alteration zone that had affected the primary sulfide minerals, sphalerite and pyrite, to produce an unusual suite of mineral associations.

The magnetite and associated minerals occur in a zone of hydrothermal alteration in the F-24 stope in the Fowler orebody, just below the 2,500-foot top mining sublevel. The coordinate location is 44° 16′ 21″ N, 75° 24′ 11″ W and 688 meters below the surface. Several years of mining in this stope had given little indication that there was a significant zone of unusual mineralization to be encountered.

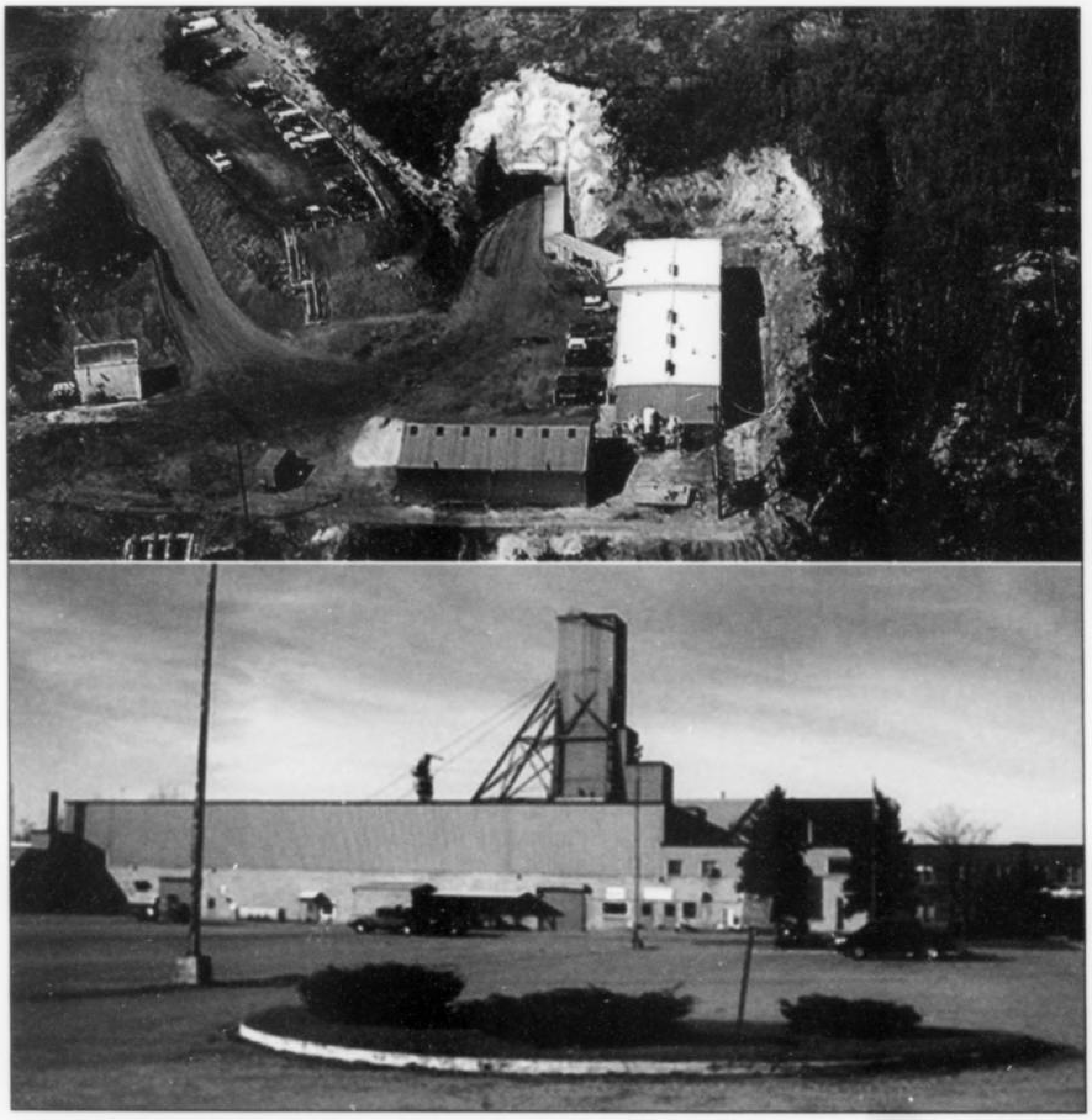

Figure 2. **Headframe and processing plant of the Balmat mine.**

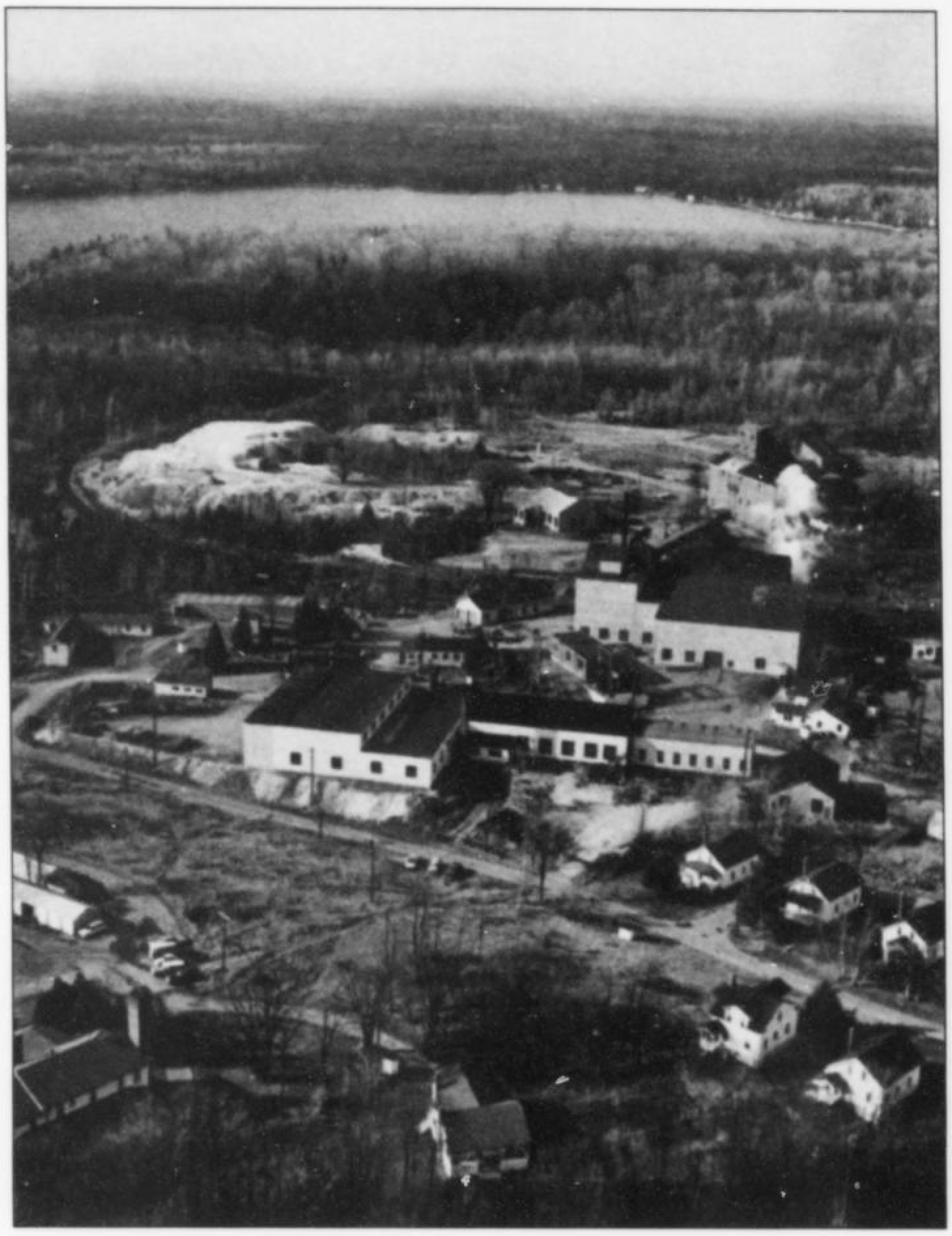

Figure 3. **The Balmat mine processing facilities in 1963 (from the 100th Anniversary Annual Report of the St. Joseph Lead Company).**

The initial entrance into the alteration zone was a drift through massive sphalerite with disseminated pyrite. The first sign of anything unusual was the partial alteration of the pyrite grains to magnetite. Farther along, layers with heavily disseminated magnetite were interlayered with typical sphalerite. Still farther along, this was supplanted by intense alteration and a change in the ore texture: most of the original sphalerite and pyrite were replaced with ore having a "birds-eye" texture made up of small cores of magnetite and sphalerite ringed by concentric bands of fleshy pink secondary sphalerite, hematite and magnetite.

Late in the summer of 1991, veins filled with very coarse-grained (up to several centimeters) halite, anhydrite and lesser amounts of calcite and lined with small magnetite and sphalerite crystals were encountered. In the first pass, drifting about 35 meters along strike exposed the bottom of the alteration zone, and small magnetite crystals were recovered. Subsequent shrink mining exposed the top of the alteration zone where the most abundant and largest magnetite crystals were recovered beginning on May 29, 1992.

Because the ore was only slowly mucked, collecting continued throughout the summer and into the fall. Some of us visited the site together on October 2. Shortly thereafter, mining in the drift resumed, and all traces of the occurrence were removed. A second, smaller alteration zone was encountered nearby at a lower elevation in 1994 and a few more specimens were recovered.

Many people helped recover and preserve specimens during the year-long period that the unusual mineralization was exposed, including Charlie Bowman, Chuck Bowman, Dave Bowman, Bill deLorraine, John Johnson, Gary Stacey, and David Nace. Through the efforts of these people, thousands of specimens were collected, thus insuring the status of this occurrence as an important locality for magnetite.

GEOLOGY

Regional Geology

The zinc deposits of the Balmat-Edwards district are hosted by a sequence of Precambrian metasedimentary rocks of the Grenville Series. The geology of the Balmat district is complex and involves multiple episodes of structural deformation. For a more detailed discussion see Brown and Engel (1956) and deLorraine (1979).

Locally the geologic column is characterized by mostly clean, siliceous dolomitic marbles, but with major occurrences of anhydrite and talc-tremolite schist. The sphalerite-pyrite ore is thought to have accumulated as massive sheets and lenses in a sedimentary environment as sulfides precipitated out of metalliferous thermal brines which vented to the sea floor via fault channels. These thermal vents may have resembled the so-called "black smokers" now found along the mid-oceanic ridges, except that they formed in a shallow, carbonate shelf environment. The stratigraphic sequence hosting the sulfide ores was subsequently buried and subjected to high-grade metamorphism approximately 1.1 billion years ago. Over time the ore and host rocks were complexly folded and sheared.

After the region had been uplifted to nearly its present elevation, post-metamorphic hydrothermal fluids permeated small portions

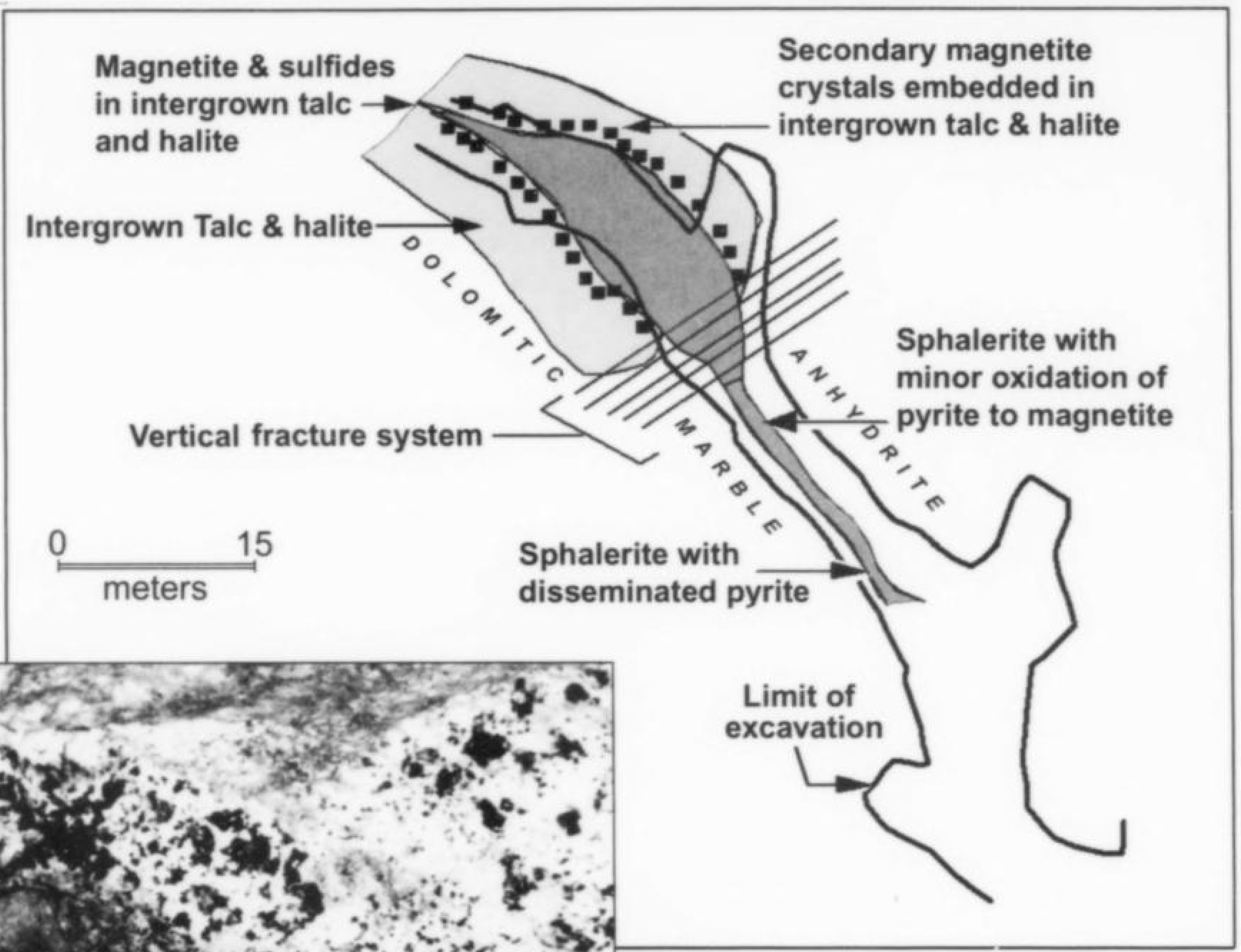

Figure 4. **Scale drawing of the limits of excavation in the region of the cubic magnetite occurrence and the local fracture system there.**

Figure 5. **Cubes of magnetite in a fine-grained matrix of halite and talc. John Johnson photo.**

of several of the orebodies along fractures, causing alteration in some areas. In 1936, J. S. Brown, a geologist for the St. Joe Lead Company, described "supergene sphalerite, galena, and willemite" in the No. 2 mine at Balmat. This alteration zone was composed of a pervasive red earthy hematite, pyrite grains rimmed with magnetite, and secondary replacement minerals along with high-grade primary sphalerite. The term "birds-eye" ore was used to describe the textural characteristics of the altered ore. Brown described a zone extending from the surface to the 700-foot level. Other geologists were later able to trace the zone down to a depth of 2,000 feet.

Generally such oxidation penetrates only to shallow depths, the degree of alteration decreasing with depth. Thus, it was a complete surprise when mining operations encountered a small (approximately 30 by 100 meters) alteration zone deep in the Fowler orebody nearly 700 meters (2,275 feet) beneath the surface. There had been no other evidence of alteration encountered either above or below the 1,450-meter plunge-length of the Fowler orebody.

Fowler Orebody

The Fowler orebody is composed of massive sphalerite and pyrite of varying proportions, and minor galena. The orebody extends from the 1,300-foot level, plunging northward down to the 3,100-foot level of the No. 4 mine. Like all the orebodies in the Balmat-Edwards district, it has been affected by multiple phases of folding and shearing at a high metamorphic grade. Under these conditions, sulfides were very mobile and were forced into gash veins, extension fractures, and other structural sites in the hinges of major folds. The orebody occurs in the axial region of an isoclinal fold, the limbs of which are separated by a thrust fault. Conformable ore in the upper and lower limbs of the fold was remobilized into and along the shear zone by plastic flow during the metamorphic event.

The alteration zone hosting the magnetite crystals is located in the "cross-cutting" ore horizon of the Fowler orebody that occurs along a ductile fault. Here the ore was exposed to upper amphibolite-facies metamorphism reaching temperatures of 650° to 700°C. Most of the sulfides in the cross-cutting ore zone were further subjected to recurrent deformation and strain partitioning resulting in an ore that is locally layered with alternating pyrite-rich and sphalerite-rich bands. As much as 85% of the cross-cutting ore has *durchbewegung* texture from the incorporation of numerous rounded, lenticular inclusions of wall rock. By contrast, as much as 15% of the cross-cutting ore consists of enclaves of pure sulfide that had developed a much coarser texture during recrystallization. The cubic magnetite occurrence appears to have been in an alteration zone affecting one of these massive sulfide enclaves.

Along the periphery of the altered area there was partial to complete replacement of the pyrite in the ore by magnetite. Nearer the center there was an intensely altered area where the original ore appears to have been replaced by birds-eye ore consisting of very fine-grained pink sphalerite and hematite interlayered with magnetite and surrounding dark cores of magnetite and sphalerite. Cubic magnetite crystals were found lining halite-filled veins, sometimes mixed with sphalerite crystals and frozen in a greenish gray matrix of fine-grained talc and halite. The entire main alteration zone occupied an area of approximately 10 × 16 × 16 meters at the structural top of the ore shoot. Within this zone, secondary sphalerite was relatively depleted in iron compared to the typical sphalerite outside the alteration zone and pyrite was virtually absent. Some relict banding similar to that of the original sulfide ore was observed, particularly in the more magnetite-rich layers which preferentially replaced the original pyrite-rich layers. Grains, lenses, and masses of chalcopyrite up to a meter across were encountered in the center of the intensely altered zone. Some of these displayed spectacular bornite rims and contained minor amounts of galena as well as betekhtinite and other copper sulfides. Breccias along the east side of the alteration zone contained subangular, partially altered fragments of sphalerite in a matrix of earthy hematite and talc.

Except for a smaller alteration zone with more cubic magnetite encountered nearby but at lower depth, no other similar alteration zones have been encountered in the district. Birds-eye ore was encountered in the No. 2 mine, but large chalcopyrite pods with other sulfides are thus far unique to this one alteration zone in the orebodies.

MAGNETITE

Associations

Cubic crystals of magnetite and the associated minerals listed in Table 1 were found in three different environments: (1) in halite-filled veins with associated talc-halite; (2) in the sulfide pods; and (3) in assemblages that appear to have formed after mining while the broken ore sat in a sodium chloride brine formed by washing the ore pile with tap water. All species reported have been confirmed by X-ray diffraction, electron microprobe analysis or both. Magnetite crystals occur frozen in a matrix of microscopically intergrown halite and talc, lining the walls of halite-filled veins, and as isolated crystals in the halite core of halite-filled veins.

Crystal Sizes

The largest single magnetite crystal we have observed is a tetrahexahedron with minor cube faces measuring 3.3 cm on edge. Several other crystals we measured reach 2.7 cm on edge. Crystals to 1 or 2 cm on edge were common in the occurrence.

Specimens include single crystals, both as "floaters" and in matrix, miniature and cabinet-sized groups with and without matrix, double-sided slabs of crystals, and sections of halite-filled vein wall covered with crystals. Hollmann (1992) reported the recovery of slabs of crystals up to 15 by 20 cm with crystals on both sides.

Morphology

Three crystal forms in several combinations have been identified: the cube {100}; the octahedron {111}; and the tetrahexahedron {015}. Eight distinctive habits have been recognized: six of these are equant crystals, one is tabular, and one is pseudoprismatic. The two most common habits are (1) cubes with minor octahedral faces and (2) the combination of cube and tetrahexahedron in nearly equal development. Tetrahexahedrons with minor cube faces and tetrahexahedrons with both minor cube and octahedron faces are less common. The combination of nearly equal development of the tetrahexahedron and the octahedron is also uncommon, and some of these crystals show a peculiar growth distortion wherein one octahedron face is much larger than the other seven. Tabular crystals with both cube and tetrahexahedron faces are rare. Elongated crystals with cube faces and minor octahedron modifications have been observed only in microscopic crystals recovered by dissolving halite from the cores of halite-filled veins. In hand specimens, the cube faces are typically splendent and the octahedral faces are slightly less so. Tetrahexahedron faces can be splendent, striated,

Figure 6. **Halite from the center of a halite-filled vein on cubic magnetite crystals. The luster of the magnetite facing the halite is splendent; the reverse of the specimen has magnetite crystals that faced the halite/talc, which are dull. 9 cm wide. Steve Chamberlain photo.**

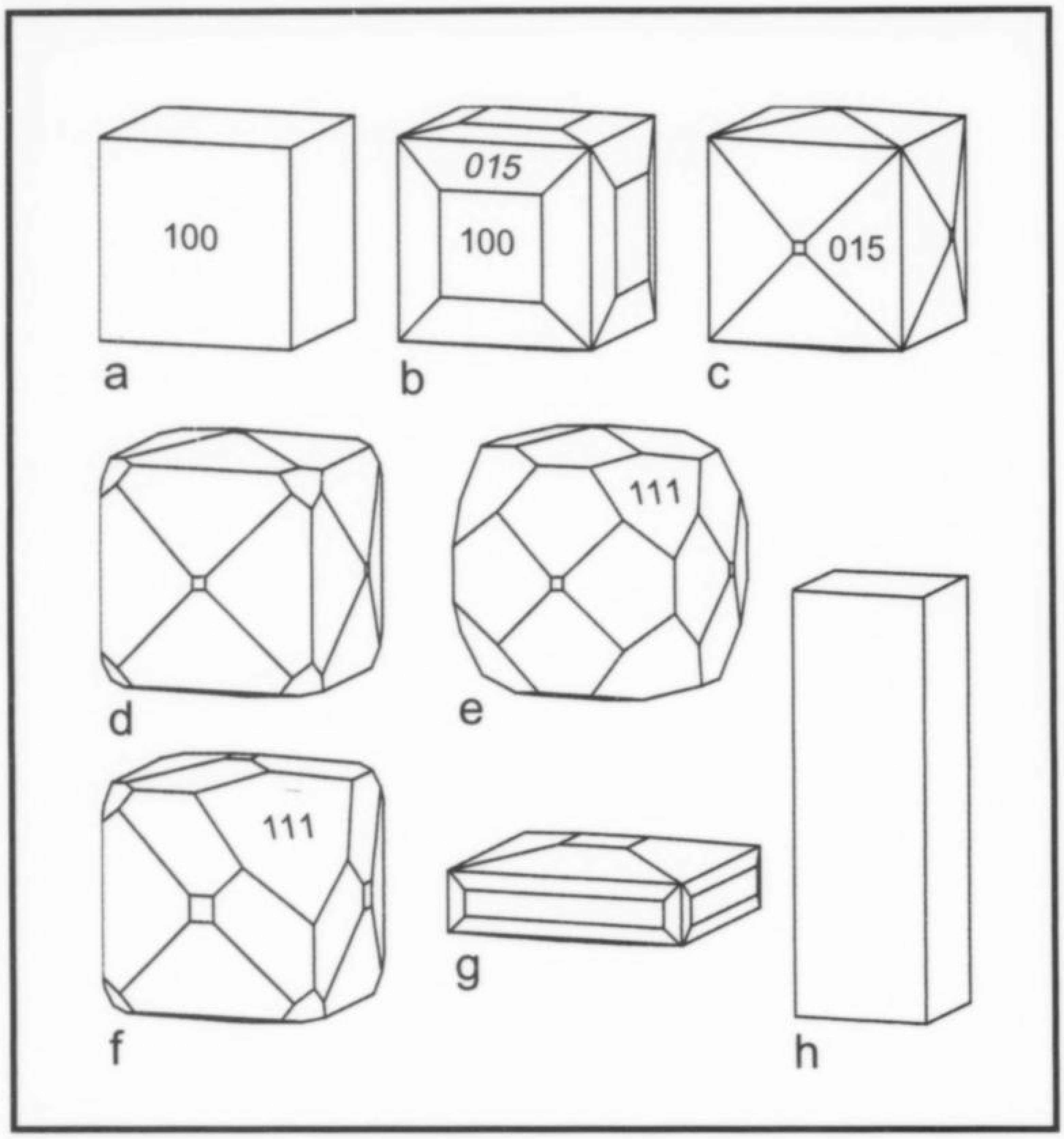

Figure 7. **Crystal drawings of the observed habits of magnetite crystals. (a) Cube. (b) Equal development of the cube and tetrahexahedron. (c) Tetrahexahedron with minor cube. (d) Tetrahexahedron with minor cube and octahedron. (e) Tetrahexahedron with octahedral faces and minor cube faces. (f) Tetrahexahedron with minor cube and asymmetrical development of octahedral faces such that typically one of 8 is enlarged. (g) Tabular crystal with tetrahexahedron and cube. (h) Elongation of the cube by growth distortion.**

pitted, or velvety. Magnetite crystals that formed isolated in the halite in the cores of halite-filled veins typically have splendent luster on the faces of all three crystal forms. Some floater crystals from the halite-filled veins consist of larger cubes covered with many smaller cubes.

Some magnetite crystals with prominent cube faces show growth distortion which gives them a diamond-shaped rather than a square outline. Other cube faces show bowed edges made up of multiple linear segments.

Because magnetite crystals of cubic and tetrahexahedral habit are so rare worldwide, we investigated their crystal habits at this locality in more detail (Chamberlain and Robinson 1993; Morgan, *et al.* 2006). One such study was aimed at characterizing the distribution of crystal habits. The eight crystal drawings shown comprise the set of observed magnetite crystal habits, made up of varying degrees of the development of just three forms: the cube, the tetrahexahedron, and the octahedron. We examined and characterized all the crystallized magnetite specimens in the collection of the New York State Museum (NYSM), which includes the recently acquired Kenneth Hollmann collection (329 specimens) and the Steven C. Chamberlain collection (164 specimens). We also examined 225 microscopic single crystals that Hollmann had found frozen in halite; these are preserved in a number of vials now in the New York State Museum. Cubes and cubes with tetrahexahedron modifications are by far the two most common habits. All three samples no doubt emphasized the rarer habits because they were preferentially sought.

We did find one crystal habit in microscopic crystals that was not present in hand specimens. Rarely, microscopic magnetite crystals were found to be elongated cubes of pseudo-prismatic rather than equant habit. No large specimens of such elongated magnetite crystals are known from this occurrence.

SEM Examination

Another study involved the careful examination of microscopic magnetite crystals with scanning electron microscopy. At the outset, we thought perhaps that microscopic crystals might show crystal forms not present in larger crystals because they disappeared as the crystals grew larger. However, scanning electron micrographs revealed only the same three forms already found on large specimens. We also carefully examined the surfaces of the three forms and found that many of them are smooth and planar even when viewed with the scanning electron microscope. Octahedron faces occasionally show triangular growth hillocks. Tetrahexahedron faces, although sometimes smooth, more often show a variety of very interesting microscopic textures that lead to striations and frosted surfaces when such specimens are viewed with the naked eye. Cube faces sometimes show four-sided growth pits with edges parallel to the cube-octahedron edge and with inward-sloping octahedron faces. The edges of cubes are sometimes not straight lines but are composed of a number of off-set straight-line segments which, taken together, present a bowed appearance. Such growth distortion is more rarely seen in macroscopic crystals.

Unexpected, and not particularly rare, are microscopic cube crystals with a myriad of odd growth features on the cube faces. Large, four-sided pits have hemispherical voids on their bottom surfaces, where cube faces should be. Grooves are sometimes at crystallographic orientations, with octahedron faces forming their walls; others are curved with walls that look more like erosional surfaces. The bottoms of these valleys also have hemispherical voids. The cube edges have an eroded appearance with semi-spherical voids. The impression is that the crystal is made of styrofoam inside with six solid plates forming the cube faces that don't quite meet at the edges and are partially eroded away.

Figure 8. (right) **Magnetite crystals with equal development of the cube and tetrahexahedron, 2.4 cm tall. This specimen has no points of attachment and was freed from solid halite. Steve Chamberlain photo.**

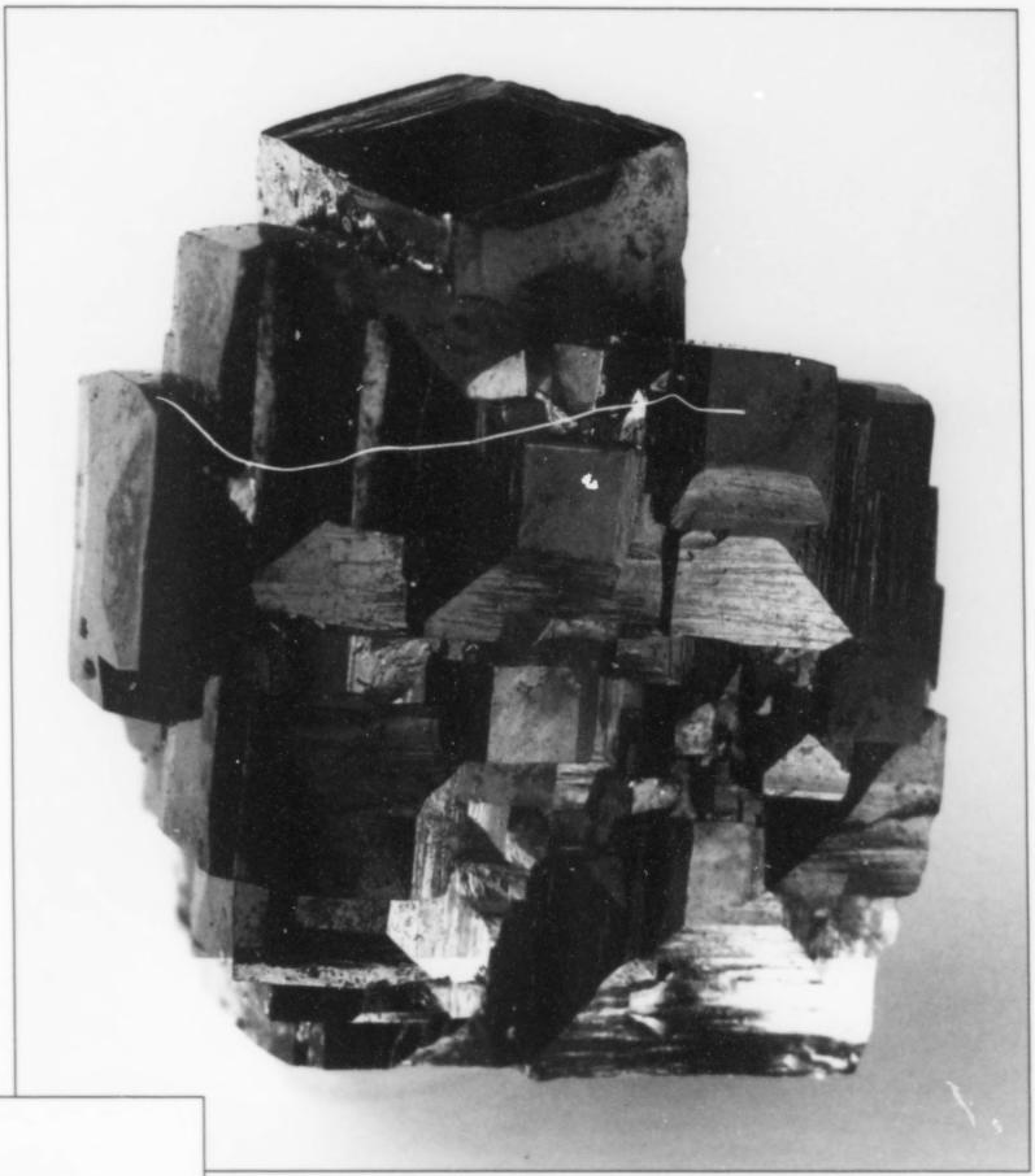

Figure 9. (below right) **Tetrahexahedral magnetite crystals with octahedral and minor cube faces; 3 cm wide. This specimen was removed from halite/talc. Steve Chamberlain photo.**

Figure 10. (below) **Tetrahexahedral magnetite crystals with minor cube faces, 4 cm tall. This specimen was embedded in halite/talc. Steve Chamberlain photo.**

Figure 11. **Tetrahexahedral magnetite crystals with minor cube faces, 4.5 cm wide. Note the growth distortion on the left-hand crystal, which makes it appear rhombohedral. This specimen was embedded in halite/talc. Steve Chamberlain photo.**

Figure 12. **Tetrahexahedral magnetite crystals with minor cube faces, 7.5 cm wide. This specimen was removed from halite/talc matrix. Steve Chamberlain photo.**

DISCUSSION

Crystallography of magnetite

Describing the habit of magnetite, Hintze (1933) noted that "usually the octahedron prevails, more rarely the rhombic dodecahedron predominates . . . still more rarely {100} is found alone or with prevailing development" (translation of p. 34). Perusal of Goldschmidt's *Atlas der Krystallformen* (1918) shows few localities for the cubic habit: Gulsen, Steyermark, Austria; Arendal, Norway; the O'Neil mine in Orange County, New York; Eisenach, Germany; Mossgrufva, Nordmark, Sweden; and Split Rock, Essex County, New York. There are a few other localities such as the Sunset Crater volcano in northern Arizona (Hanson *et al.*, 2008) but only at Balmat does magnetite occur as cubes in such size and profusion. Interestingly, one of the most common occurrences of cubic magnetite is biogenic (Violante *et al.*, 2003; Vali *et al.*, 2004). The presence of cubic magnetite as evidence of life became a hot topic during the analysis and interpretation of the Martian meteorite (Thomas-Keprta *et al.*, 2000).

Magnetite crystals with tetrahexahedron faces are even rarer. Again, a perusal of Goldschmidt (1918) shows only three localities where the crystals show minor tetrahexahedraon faces: Nordmark, Sweden; Wildkreuzjoch, Pfitschtal, Italy; and Rotenkopf, Zillertal, Austria. We are aware of no other localities for magnetite crystals

Figure 13. **Cubes of magnetite covered with tiny secondary cubes of magnetite, 3.4 cm wide. This specimen was recovered from halite/talc matrix and has no points of attachment. Steve Chamberlain photo.**

Figure 14. **Tetrahexahedral magnetite crystals with minor cube faces and asymmetrical development of one of 8 octahedral faces, 9 cm wide. The specimen was embedded in halite/talc. Steve Chamberlain photo.**

with a predominantly tetrahexahedral habit. In that regard the crystals from Balmat, New York, appear to be unique.

Analysis of the chemistry and mineral phases in the Balmat cubic magnetite was published by Clark and Evans (1997). They found that, unlike octahedral habit magnetite from other localities that may typically contain Ca, Cr and Ti as impurities, Balmat cubic magnetite crystals contain Zn in the range 0.05 to 0.09 *apfu* (atoms per formula unit) in the formula $Zn_xFe_{3-x}O_4$. Additional analysis using Mössbauer spectroscopy showed that some of this zinc is contained in a separate zinc ferrite ($ZnFe_2O_4$) phase, so that the actual amount of zinc in the magnetite phase was between 0.02 and 0.03 *apfu* in the preceding formula. They suggested that the presence of an impurity such as Zn, which favors the tetrahedral site in the spinel structure (occupied by Fe^{2+} in magnetite), leads to the suppression of the predominantly octahedral habit typical of most magnetite crystals and the expression of the cube instead. These same authors note that Mn seems to play a similar role in other cubic magnetites.

Our SEM examination of the tetrahexahedron faces of Balmat magnetite, which are even less commonly found than cube faces, further suggests that even under circumstances that permit their development, there is serious competition from other forms leading to the rich variety of textures on the surface of tetrahexahedron faces. It's not easy to be a tetrahexahedron in a magnetite crystal.

Origin

The discovery of a zinc ferrite phase distinct from a zinc-rich magnetite phase in the magnetite crystals from this deposit places some restrictions on the temperature of formation. Mason's original conclusions that there was complete miscibility in the Fe_3O_4-$ZnFe_2O_4$ system (Mason, 1947) were subsequently revised by the analysis of magnetite-franklinite-pyrophanite intergrowths from Sterling Hill, New Jersey (Valentino *et al.*, 1990). These authors concluded that a miscibility gap exists below 500°C. The clear presence of a zinc ferrite ($ZnFe_2O_4$) phase thereby establishes an upper limit on the temperature of formation of 500°C. This eliminates the possibility that the magnetite, halite, and associated minerals formed from a halite melt (since halite only liquefies above 800°C) and favors the conclusion that crystallization occurred from a sodium chloride brine. This assumption is further endorsed by Hill and Darling (1997), who analyzed the fluid inclusions in sphalerite taken from vugs in the Balmat-Edwards district and found that the mineralizing fluids were possibly brines with approximately 20 weight percent $CaCl_2$ and 10 weight percent NaCl; these brines reached elevated temperatures and had the characteristics of the "shield-type" brines described from elsewhere in the Canadian Shield. Examination of fluid inclusions during the present study further substantiates this theory. Daughter crystals of halite were found in fluid inclusions of colorless sphalerite associated with the cubic magnetite. Anhydrite, talc, and sphalerite daughter crystals were observed in fluid inclusions in the cubic magnetite itself. This upper limit of 500°C is also consistent with magnetite formation after the maximum regional metamorphism at 650° to 700°C.

Petrographic examination of the sulfide pods shows that the chalcopyrite formed by replacement of sheared pyrite, but similar pods of pyrite in the Balmat orebodies that might represent precursors are absent. The chalcopyrite pods are usually, but not always, enveloped by a rind of bornite that clearly replaces the chalcopyrite, and the bornite is commonly replaced by chalcocite in both monoclinic and hexagonal polymorphs, the latter of which suggests a minimum temperature of formation of 105°C. The successive alteration of chalcopyrite to bornite to chalcocite also indicates a progressive leaching of iron from the pods.

It is clear that the copper chlorides and sulfates formed as post-mining secondary minerals. Water from mining operations promoted reactions between halite and chalcocite in the muck pile, resulting in the formation of the observed chlorides and other post-mining minerals. The nonmetallic minerals in the alteration zone are present in the adjacent metasediments from which they were very likely derived. These include halite, calcite, talc, and anhydrite.

CONCLUSIONS

The magnetite occurrence at Balmat, New York, is noteworthy because it produced crystallized magnetite specimens of exceptional quality and beauty; because the association of magnetite and halite is unusual, perhaps unique; and because of the unusual geochemistry of the environment which produced a magnetite with zinc as an impurity that may have been influential in producing the unusual cubic and tetrahexahedral morphology. A unique set of geological circumstances led to a unique mineral assemblage.

ACKNOWLEDGMENT

We thank the Zinc Corporation of America for permitting access to their property and making specimens available for research, and Dr. Jeremy Gilbert and Gregory Rommel for their assistance with the scanning electron microscopy. We appreciate the assistance of Michael Hawkins in making the collections of the New York State Museum available for detailed study. We acknowledge the late Kenneth Hollmann for having assembled an outstandingly comprehensive collection of specimens from this occurrence. A longer version of this paper was published in *Rocks and Minerals* (2008, pages 224–239). All mineral specimens shown are now in the collection of the New York State Museum.

***Table 1.* Minerals associated with cubic magnetite at Balmat, New York**

Anhydrite	$CaSO_4$
Arsenopyrite	FeAsS
Atacamite	$Cu_2Cl(OH)_3$
Betekhtinite	$Cu_{10}(Pb,Fe)S_6$
Bornite	Cu_5FeS_4
Bottallackite	$Cu_2Cl(OH)_3$
Calcite	$CaCO_3$
Celestine	$SrSO_4$
Chalcocite	Cu_2S
Chalcopyrite	$CuFeS_2$
Digenite	Cu_9S_5
Galena	PbS
Gordaite	$NaZn_4(SO_4)(OH)_6Cl\cdot 6H_2O$
Halite	NaCl
Hematite	Fe_2O_3
Malachite	$Cu_2(CO_3)(OH)_2$
Nantokite	CuCl
Namuwite	$(Zn,Cu)_4SO_4(OH)_6\cdot 4H_2O$
Paratacamite	$Cu_2Cl(OH)_3$
Pyrite	FeS_2
Silver	Ag
Sphalerite	ZnS
Talc	$Mg_3Si_4O_{10}(OH)_2$

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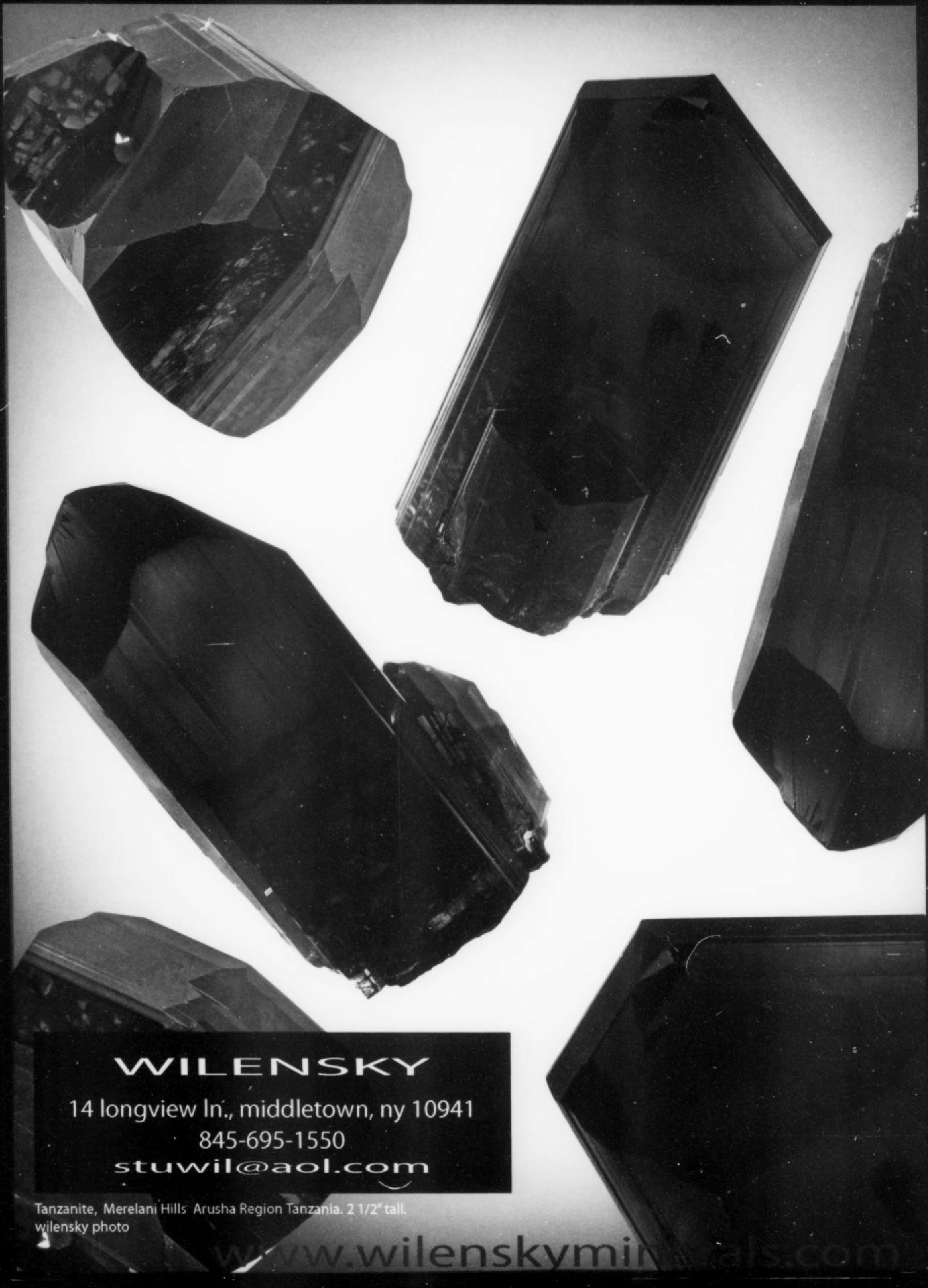

Tanzanite, Merelani Hills Arusha Region Tanzania. 2 1/2" tall.
wilensky photo


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What's New

Sainte-Marie-aux-Mines Show 2010

by Bill (and Will, and Carl) Larson

[*June 24–27*]

Bill Larson, proprietor of Pala International *and* The Collector *shop in Fallbrook, California, visited the Sainte-Marie-aux-Mines show again this year and filed this day-by-day report for us, giving an idea of what the show is like from the viewpoint of a visiting dealer (and collector). He, along with his sons Will and Carl, had a good time as always, even aside from the intense concentration on minerals. (For illustration, Jeff Scovil has provided some photos he took of specimens at the show, not necessarily referred to in Bill's report.)*

It was mid-May when I received a text from Mark Kaufman, our traveling partner to Ste-Marie-aux-Mines for the past several years; it read simply: "Have you checked the cost of flights into Europe lately?" He usually books our flights so we can be on the same carrier. I realized that the cloud of volcanic ash from the ongoing eruption in Iceland was going to make travel this year to our favorite mineral and gem show expensive! I checked and, sure enough, prices were 50% higher and the connections were not good. However, since I had 500,000 miles accumulated on United Airlines, I reserved three tickets for the Larson clan. Off to Europe we went. Mark went on a separate flight and had a connection through Canada, which caused him no small consternation. But we all arrived safely in Frankfurt on Tuesday morning, June 22—Mark was a bit late since his plane had spent time waiting on the tarmac in Toronto. We ate a bratwurst and got our Volkswagen semi-van (an icebox on wheels) from Avis. I was "elected" to be the driver of last resort since we planned to go to Idar-Oberstein for a brief sojourn while Mark returned to California before the rest of us.

Tuesday

The drive to Ste-Marie was pretty easy, since there was little to no traffic and by now all of us knew the roads. We arrived at the show by noon. We had been emailing and texting various friends for days, but none of our Euro dealer friends could name a new find or a fine collection that was going to be offered. When we arrived we did see that the same phenomenon that has plagued U.S. shows had come to Europe: dealers opening earlier and earlier. In previous years there had been no one set up yet in the theater on Tuesday, but this time it was almost completely set up and half of the dealers were already open for business; it turned out that some selling had started on Sunday!

As we entered the theater, we saw that Gilles Eminger had a beautiful cavansite in his hand that he had just purchased, so we knew we were late. We passed Jordi Fabre's set-up, but he was not in; he was out hunting. At his stand we did notice some nice specimens of malachite and azurite on quartz, one of which is large, perhaps 10 cm, from a new find in M'Cessi near Alnif, Morocco. He also had a few small specimens of cerussite on drusy velvet malachite from Bou Beker, Morocco—also new, and very cute.

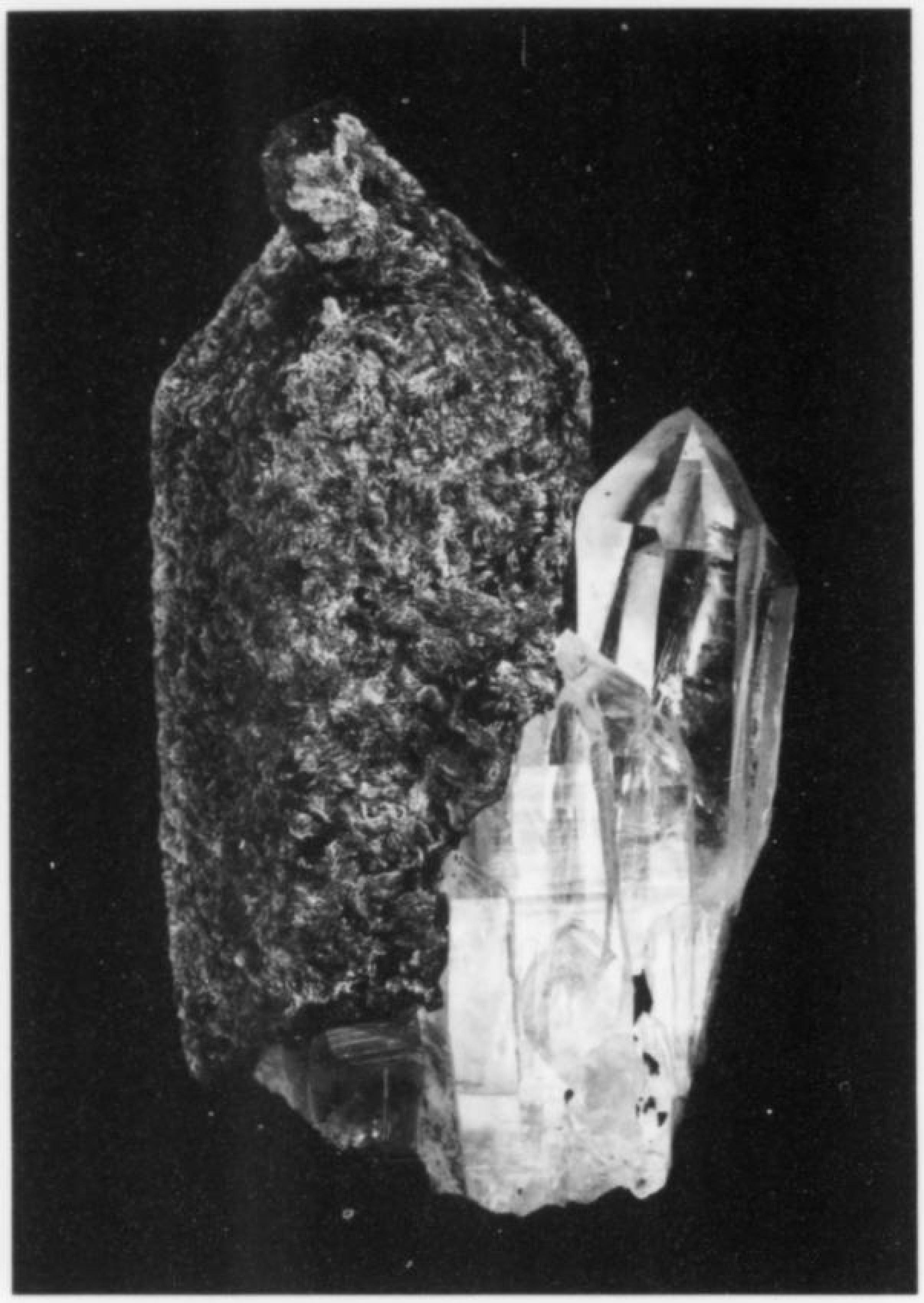


Figure 1. **Malachite after azurite with quartz, 9.6 cm, from M'Cessi near Alnif, Morocco. Jordi Fabre specimen; Jeff Scovil photo.**

Next door was *Superb Minerals* sans K. C. Pandey, but his efficient staff had a good-looking booth in his absence. We saw a beautiful large specimen of gem calcite on a stalactitic quartz matrix. The people in charge at the booth explained that the specimen has a simple repair and the price reflects this. So we negotiated a bit, the staff reminding us that we had not purchased from *Superb Minerals* in a while; we were tempted with some fine small pieces, including a lovely fluorite "ball" from Jalgaon. A deal was struck, and our first purchase was made.

We were especially anxious to get to our good friend Christophe Gobin, since we had brought a special bottle of Añejo Tequila from San Diego's "El Agave," that we planned to open in his booth on our last day in Ste-Marie—Party! This cheered Christophe up a lot, but he told us "I have been everywhere I usually go, my brother has traveled as well, and we have nothing new to show you." In fact, his brother Brice, sadly, did not even come to the show. We looked at his specimens, which included many cute, small, new things and a potentially exceptional blue Namibian jeremejevite which needed trimming, but most of the finer examples we recognized from before. He was not kidding when he said "fine minerals are hard to get!"

We moved on to visit the booth of our "partner in crime" at the Westward Look and TGMS shows in Tucson: Alain Martaud. He is the finest example I know of a person who always strives to do his best for all, and his lovely wife Caroline was also there, helping him set up. He had told me in advance about a few specimens he had obtained from visiting French and German collectors. One particularly fine piece is an old Prince of Wales Island, Alaska epidote with a quartz Japan-law twin perched on the main crystal. This piece will need some cleaning and trimming, but we bought it: with the euro being down to 1.23 to the dollar, we (and all the other U.S. dealers and collectors here) can afford to bring specimens back to America. Alain also showed me another fine Moroccan erythrite to add to the ones I had bought from him during a quick trip to Paris just a month before (I do love France!). Alas, he said, this would be the last piece from his source; the pocket, found the year before, was exhausted and no more specimens were available. He showed me a flat of fine Kaokoveld dioptase, but he was also honest enough to tell me that the specimens belong to Stephan Stolte, so we reserved the best five pieces to talk with Stephan about later. Paul Stahl, German collector extraordinaire, was also visiting dealers, shopping as intensely as we were, and probably getting a few fine things before we could see them. First days at shows can be crazy.

We moved up onto the stage of the theater, and there was Marcus Budil's booth. He was in a great mood since the booth was almost completely set up, he was ready for business, and the German national team was doing very well in the World Cup. While Marcus was feeling proud for his team, the French dealers were so upset with their national team that they were rooting for other teams. Like Gobin, Marcus remarked that there was "almost nothing new," even though he had many fine things on display.

The Watzl brothers then came over from their booth next door. My son Will had previously seen, via the Internet, three fine small Chinese specimens that they had reserved for him. The booth was not completely set up yet, but I spotted a fine small miniature of French rose-colored fluorite on matrix that Alain thought highly of, even though it is repaired. The Watzls have great taste, and we were excited by many of their fine minerals; we promised to come back the next day and select a few more specimens.

In the back behind a curtain was the booth of Ennio Prato; he always has good things for many collectors, so we spoke through this curtain and he said quietly, "legrandite." He then brought out a bright yellow crystal cluster; it was beautiful and priced right, so we bought it. We were very excited to have had such an upbeat beginning, and it was only mid-afternoon.

Next to Ennio was Andreas Weerth, who always has great Pakistan/Afghanistan minerals. But he had just started to set up, so we promised to see him later. He had visited Peshawar just recently, which was interesting news because most people have stayed far away since the Continental Hotel bombing there earlier this year.

We left the stage to visit the many other fine dealers in the theater who were in various stages of set-up, or busy with customers. Marcus Grossmann was set up, for the most part; he brought out from under his showcases two lovely old German cabinet specimens, a fluorite and a barite, each of museum quality. Next door the French-Madagascar dealer Laurent Thomas had not even started to set up, and just looking at him getting flustered with all he still had to do made us tired. We said hello, but we also realized that jet lag was beginning to set in on all of us, even Carl and Will, who are both only in their twenties! So for me and Mark it was truly slow-mo. We walked to the car and headed for the apartment we had rented (thanks to Eric Asselborn) in the fir tree forest.

First, however, we made the obligatory stop at the local supermarket to get melons, juices, a "runny" brie, and sausages. When we arrived at the apartment we immediately felt at home, having stayed there each June for the past several years. After a small but enjoyable dinner we all turned in early, knowing that we would have to get up early tomorrow.

Wednesday

We were all up by 7 a.m. on Wednesday morning. Alain had to put the finishing touches on his booth, so he and Caroline left first, but we were soon behind them. This was a bit early for non-show dealers to be allowed in, but I had two VIP badges (courtesy of show promoter Michel Schwab) and hoped for the best. I let the boys and Mark off at the front entrance gate, then went to park the car. The small lots close to the show are normally full by that time, but I was lucky, and got the last open spot in the second small lot.

I walked to one of the back entrances. Security there was set up much better than it had been on Tuesday, but my VIP pass gained me entrance along with the show dealers. I saw several other early-bird Americans, including Scott Wershky and Herb and Moni Obodda, already looking around. I received a text from Will that they were being held back at the gate, so I walked over there to see what could be done. As I approached the gate from behind the security guys, I pointed to my group and uttered the magic words "Michel Schwab" while waving my VIP pass in the air; entry was granted.

Most of the Ste-Marie show is held outdoors, so we swarmed down the street looking at the various dealers lining the main road. As in the theater on Tuesday, most of the dealers were already largely set up. Wolfgang Wendel of *Wendel Minerals* always has a selection of good minerals here; today he showed me a superb 14-cm slice of liddicoatite with typical triangular patterns of various colors. On a parallel street we visited *Mikon Mineralien* where we harassed Matthias Rheinländer and he harassed us, but he is a long-time friend, and sells great gemological and mineralogical equipment (which I buy for my suppliers in Asia, especially Burma). He also tends to have lots of rare species and occasionally fine cut haüynes.

Moving on, we passed by the theater because Mark wanted to visit the foreign (non-French) dealer area early. More than a hundred dealers there were setting their goods out on tables. Mark specializes in faceting rare species, so he wanted to look for small or broken gemmy pieces of various rare minerals. He has been coming to Ste-Marie long enough that many dealers save these especially for him. He also had received an order for fine Ethiopian opals, so he needed to visit the gem show about a kilometer away in order to get an early selection.

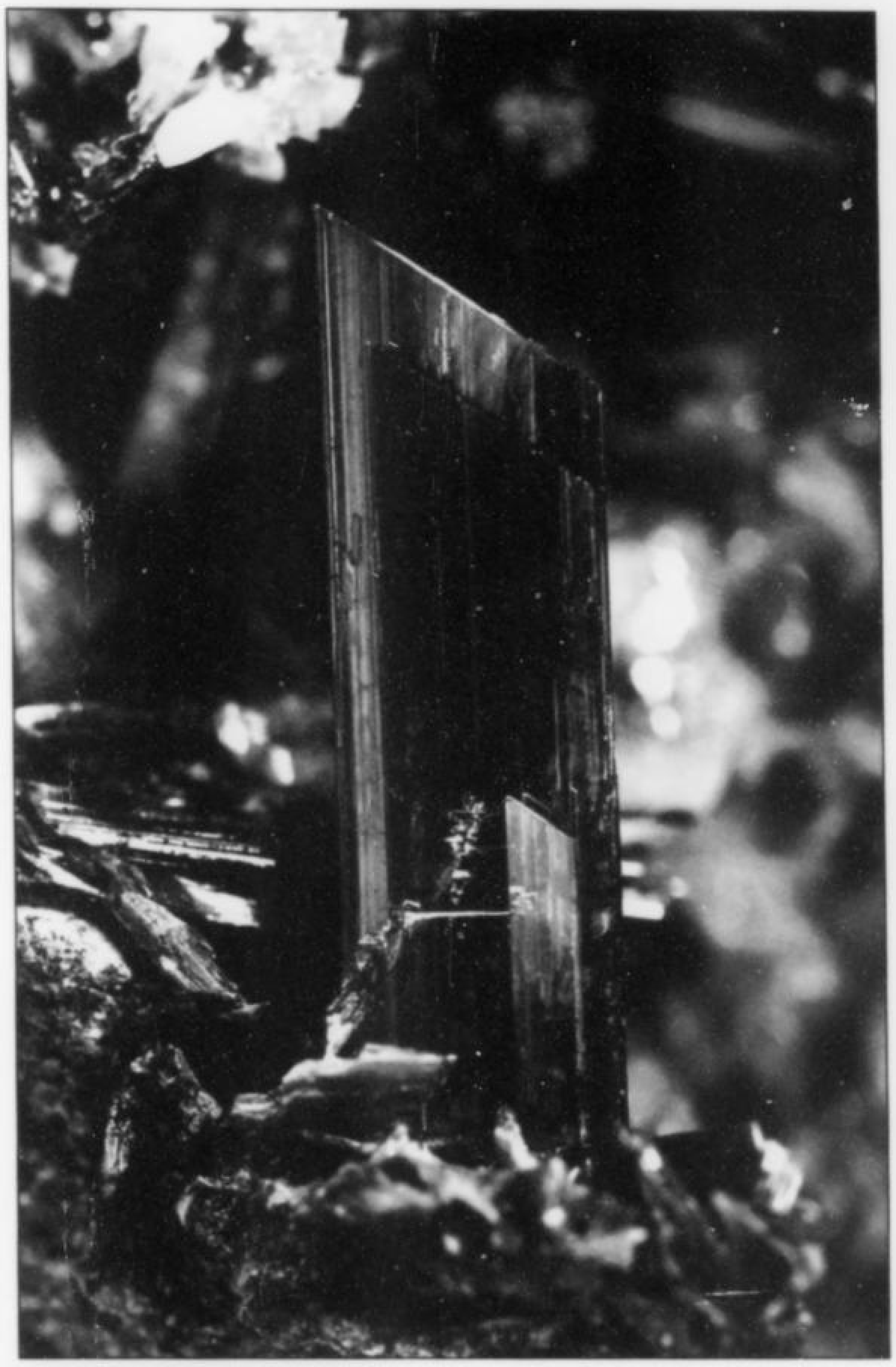


Figure 2. Erythrite crystal, 1.2 cm, from Shaft 2, Bou Azzer district, Morocco. Spirifer specimen; Jeff Scovil photo.

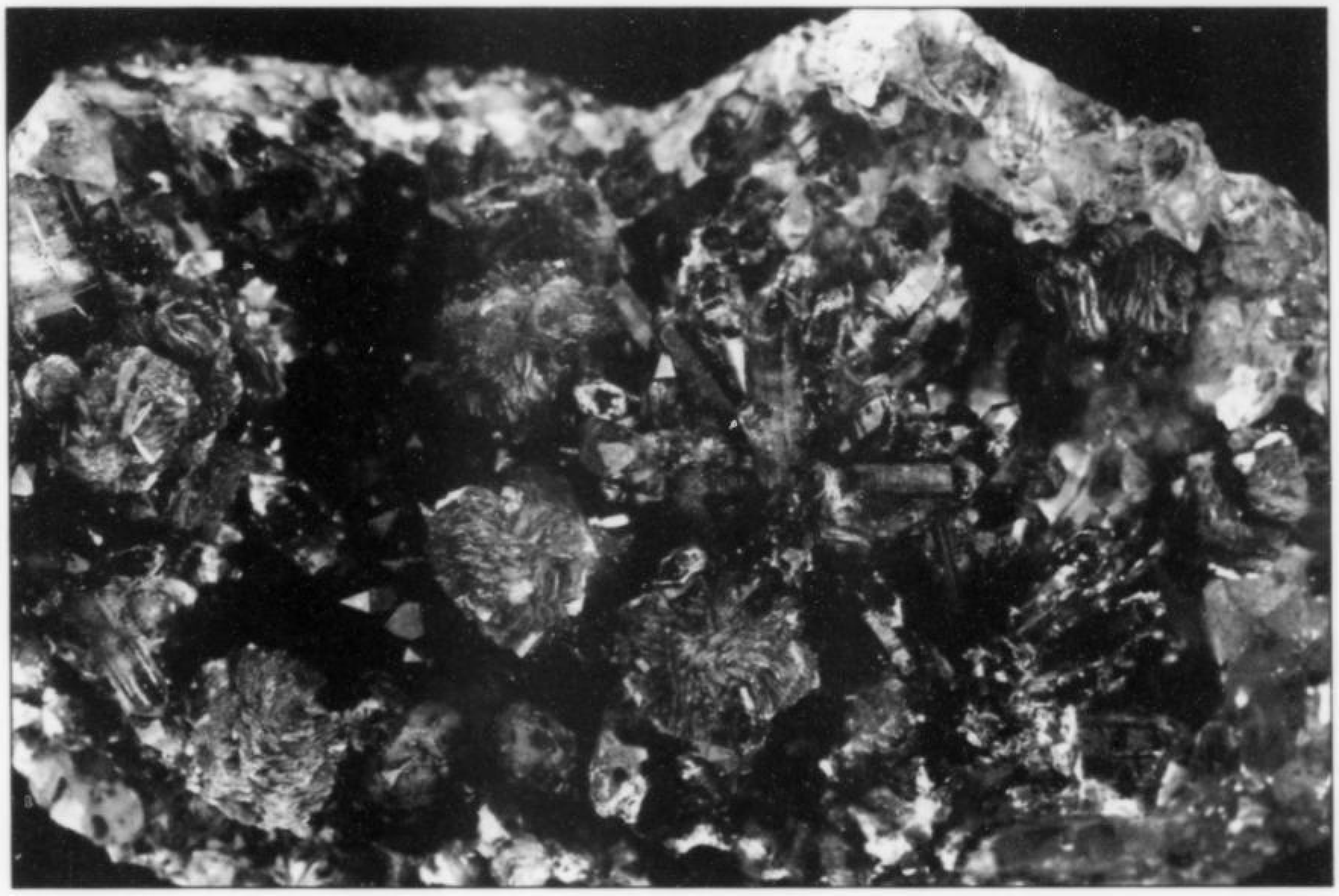


Figure 3. Roselite-beta with erythrite on quartz crystals, 7 cm, from the Agoudal quarry, Bou Azzer district, Morocco. Spirifer specimen; Jeff Scovil photo.

As we entered the first building, an Indian dealer was unwrapping a large lot of fine, uncleaned cavansites. He was quick to point out how well they would clean up and he was, of course, quite correct. He allowed us to select a half dozen that should clean very well indeed. He also agreed to accept US dollars, since the dollar is strong these days whereas last year it was "sorry, we only take euros."

We continued hunting there, along with many other dealers doing the same. Some pieces had been saved for various dealers, and others were brought up in bags from under the table; a good time was had by all. New mineral finds and the finer specimens do not last long, so there is always that element of competition and fever on the first morning of set-up. This proved to be an especially good area to buy minerals to sell via our website, *Palaminerals.com*, as we were able to select some fine miniature specimens at a quite reasonable price to offer in our Ste-Marie update.

We checked back in the Theater and it seemed quite busy. In the booth of Yevgeny Pljaskov we saw some fine new cuboctahedral fluorite groups on tan quartz from the Nikolaevskiy mine, Dalnegorsk, Russia, some to 7 cm across. We were also shown (by Werner Radl) some deep pink, etched corundum crystals with muscovite and scapolite, from a new find at Mawingu, Tanzania. By 1:00 p.m. we were finished, in more ways than one, and it was time to meet Mark, so I texted him and he was on his way to meet us for lunch at the Tavern du Mineur ("Miner's Café") across from the main entrance. After so many years the ladies in the café recognized us. And yes! we shall all four have the roast pork leg. We recognized almost everyone else in the restaurant, as they were all fellow collectors and dealers.

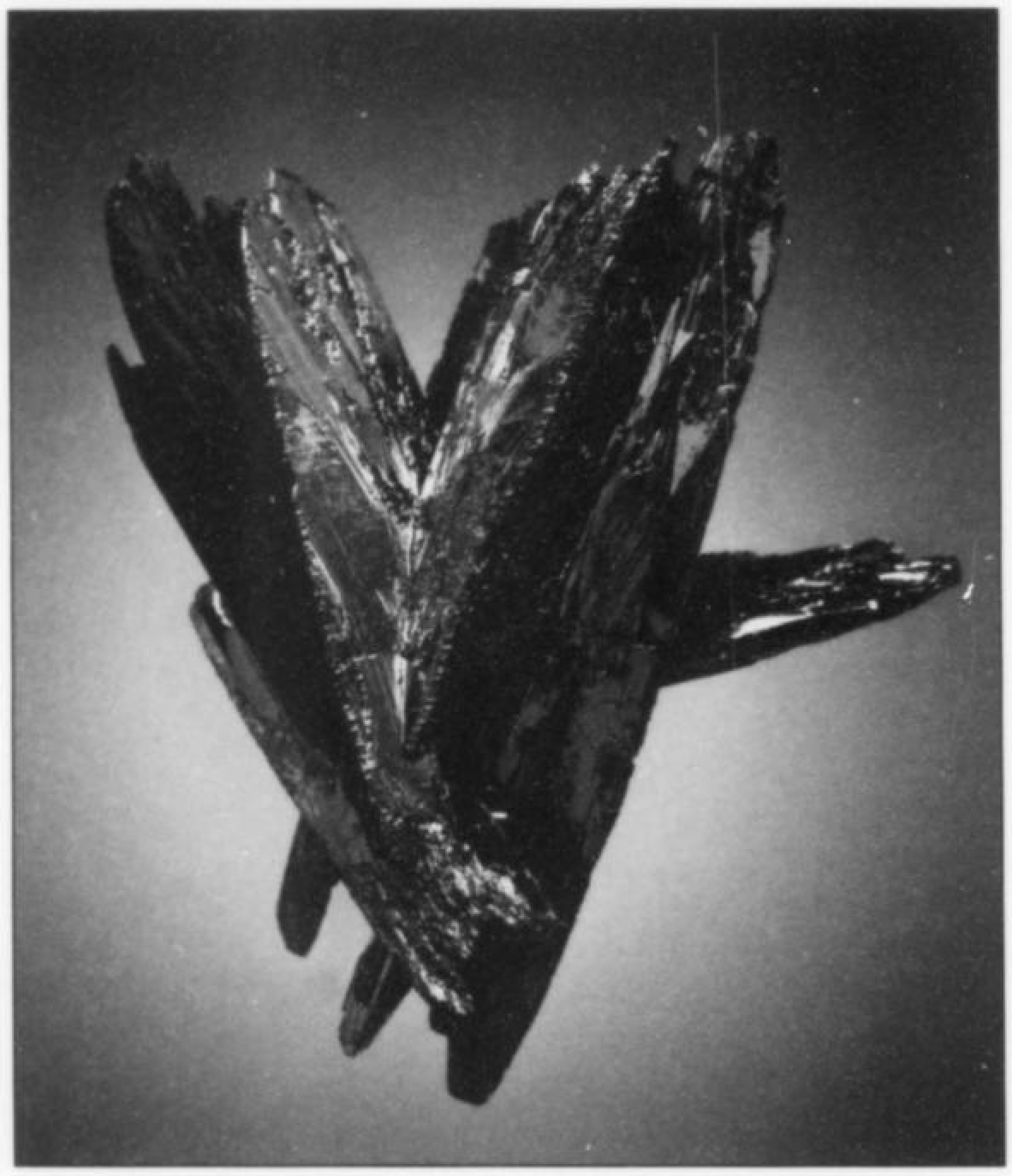


Figure 4. **Azurite crystal cluster, 4.4 cm, from Kerrouchen, Morocco. Spirifer specimen; Jeff Scovil photo.**

After lunch we returned to the theater, as Luis Burillo had told us to come back in the afternoon. He and his partner, the French *Minerama* dealership, had purchased a large new pocket of hübnerite, fluorite, and quartz from the Huanzala mine in Peru. I had already seen some photos from Gilles Emringer, so I was fairly excited to see the real things, even though I knew others had seen the best before me. We saw several French collectors who were already selecting hübnerites and had various piles which they were guarding and adding to. Will spotted a beautiful fluorite group in the bottom shelf of a glass case that, amazingly, was unsold. It was priced a bit high for resale, but as a fluorite collector himself, Will could justify its purchase. Luis was going in several directions at once, but was kind enough to give us an empty flat for our selections, and then he showed us flats from under the table to let us select a few fine things. Carl and Will were looking as fast as they could, as there was a kind of small, crowded feeding frenzy going on. We did get a nice new Peruvian coquimbite from a flat of new-found specimens similar to those described by Tom Moore in the last Tucson Show report. As we left, more people were keeping the feeding frenzy going.

We went down across the street to Gilles Emringer's booth. He is a long-time fluorite collector and is always upgrading, so we always think that his rejects may be our treasures. Since we do a lot of cleaning and trimming, it is always possible that we might be able to improve his old pieces! He showed us four flats he had told me about in advance, and we picked out about 15 fine examples, from miniatures to cabinet pieces. His booth was busy and we looked it over as well, but most of the cutest treasures had already been reserved. He also told me to come back tomorrow to see two "killers," but gave no description.

We walked down to the crossroads and into another area where we visited Patrick of *Miner K*, another friendly competitor with me in Burma. He reaffirmed that there has been little or no production from Burma recently and so he had nothing new to offer. Next door to him was our good friend Dr. George (Guanghua) Liu, a Germany-based dealer in Chinese minerals. He also had little new material, just some nice, typical specimens of fluorite and a few rhodochrosites from China.

Moving on, we came to the booth of *Prima Materia*, run by Hans Peter, a dealer in minerals and fine books. He had a nice small lot of Pala tourmalines with an old Krantz label, and he showed Will a group of reasonably priced Japanese minerals that Will could purchase and sell at the next Japan show in Ikebukuro. Just beyond Hans Peter, in an open-air booth under a tree, was Renee Daulon, a dealer from Paris I have known a long time, who offered me an espresso while Carl and Will looked over perhaps 40 flats of nice Chinese things. It was relaxing to be in the lovely outside air in the shade, drinking a coffee; this is the best of shows, is it not?

The boys made their selections, and after negotiating a bit we had another nice lot of minerals. We continued on and saw the rest of the area which, although full of mineral people and dealers, did not yield any further purchases; we were not lucky, or we were too late.

Thus our second day came to an end, and we rejoiced to learn from Marcus Grossmann that one of our two favorite restaurants, the Auberge an Zahnacker in Ribeauville, was open (some years during the Ste-Marie show it has been closed for vacation). We left the show at 5 p.m. and joined Christophe Keilmann, Marcus Budil and many other German dealers at their local hotel to watch the World Cup on a large-screen TV that Christophe had brought all the way from Munich! We all sat outside on the patio, enjoyed good beer and watched Germany defeat Ghana (with occasional changes of channel to see America defeat Algeria). Afterwards we drove to Ribeauville where the chef-owner of the restaurant, who knows us very well, greeted us. He introduced us to a French waiter who had spent time in America and whose English was better than ours. The food and wine in the Alsace region is epic: that's all there is to say. Our waiter was fun, helped us with specials, and generally made the whole evening great. As our evening came to an end, we asked our waiter for another reservation on Friday, since they are closed on Thursdays. Then we asked him "the question": What do you think of the French National soccer team? He looked downcast and only muttered "You are so mean," but with a twinkle in his eye! All that day at the show the French dealers had been grumbling or outright rooting for the French team to be defeated and end the pain! Wish granted!

Figure 5. **Purple corundum crystals to 2.2 cm, with green scapolite and muscovite, from Morogoro, Tanzania. Mawingu Gems specimen; Jeff Scovil photo.**

Thursday

On Thursday we arrived later than before, by which time the parking lot was far more filled and we ended up out at the distant end of the main parking lot, 2 kilometers from the show. After walking there we began in the theater, mostly just to look and listen. All the booths were by then fully set up and had many lovely minerals for sale. It was just a matter then of looking for whatever we or our customers needed.

Thursday was also our day for photograhy; Carl took the lead and photo-documented many people, minerals and booths. We visited *KARP* and were jokingly offered a breakfast beer. I declined, but did accept a coffee. Ivo Szegeny said that it had not been easy to get fine minerals from Russia, and the few great Russian things that he did get he had sold immediately in Russia to Russian collectors! We all contemplated the ever-changing world of mineral collecting. We left *KARP* and headed toward the front steps of the theater.

Gilles motioned us over and showed us two boxes, each containing a fabulous Romanian stibnite cluster, certainly among the finest I have ever been offered, but the price reflected their quality and their fragility made the purchase risky, so we thanked him and moved on. At another stand we saw large fluorite specimens from a find in Spain in early May of this year. The fluorite crystals range in color through a beautiful blue, teal and purple. I was shown a photo of a piece that was sold (for a very high price, rumor has it) to a Chinese mineral museum. The specimen is huge, with a nice, apparently undamaged, cubic crystal of fluorite on white matrix.

We got into the catacombs under the theater, where Jeff Scovil was set up for professional photography. Jeff and I shared information so we would not miss too many new things or fine specimens. He had several new finds that *Spirifer*, the Polish group with which Jeff had traveled to Madagascar and Morocco, had brought over to show him. All these new finds were from Morocco, including a few of the erythrites, some nice roselite from the Agoudal quarry, Bou Azzer district, some cute loose clusters of azurite from Kerouchen, and a few acanthites from Imiter.

After lunch we decided to visit the gem show. The small train was not working yet, so we walked a kilometer and worked off a tiny bit of the great cuisine we'd enjoyed so far. In the past few years the gem show has improved considerably. We went with Mark, as he had already scoped out the show and saved us a lot of time. We saw Dennis Gravier as we walked into the main building and were shown his offering of a large private collection of hundreds of gem species, but only to be sold as a collection. It was interesting, but more for a museum than for a dealer. We were mostly interested in visiting the *Opalinda Company*, as they have submitted an article to *Gems and Gemology* on the Wello opal locality in Ethiopia, so we wanted to see what they had. They gave us an appointment for the following day and we continued to look around this show. I saw Nicolas Flurot, who sells fine gemstones and rare books. He had an interesting lot of books among which I found an old 18th-century French mineralogy by Lavoisier.

Outside the main building of the gem show, we visited some individual tents. An Australian dealership I've been friendly with for a long time, *Cody Opals*, had brought a fabulous collection of Black Lightning Ridge Australian opals to this show for the first time; it was quite impressive for Ste-Marie. Cody had just visited us in Fallbrook only weeks before, so this was a nice surprise. As we left his booth we realized it was late and we had made a reservation at our other favorite restaurant: Auberge la Meuniere. As we entered, the owner, Francesca Dumoulin, said, "Oh it's you!" and gave us all hugs! We were escorted out to the patio, in the gentle air, with a view of the sunset, the mountains and the nearby castle. Francesca opened a chilled bottle of the local pinot noir and we all toasted her; it does not get any better than this!

Friday

Friday was our last day at the show, as we were going to Idar-Oberstein the next day. This was the day to view the special exhibit, a tribute to the La Gardette mines, with superb specimens from many French collectors shown off in a circle of glass cases at the center of the theater's stage, many rivaling anything in the best museum collections. It was also the day to pay the bills and pack our specimens. We spent the rest of the day mostly talking with dealers about what they hoped to get for the Munich show or, for those who come to the Denver show, what they hoped to bring. Daniel Trinchillo showed up, and all of us had fun laughing

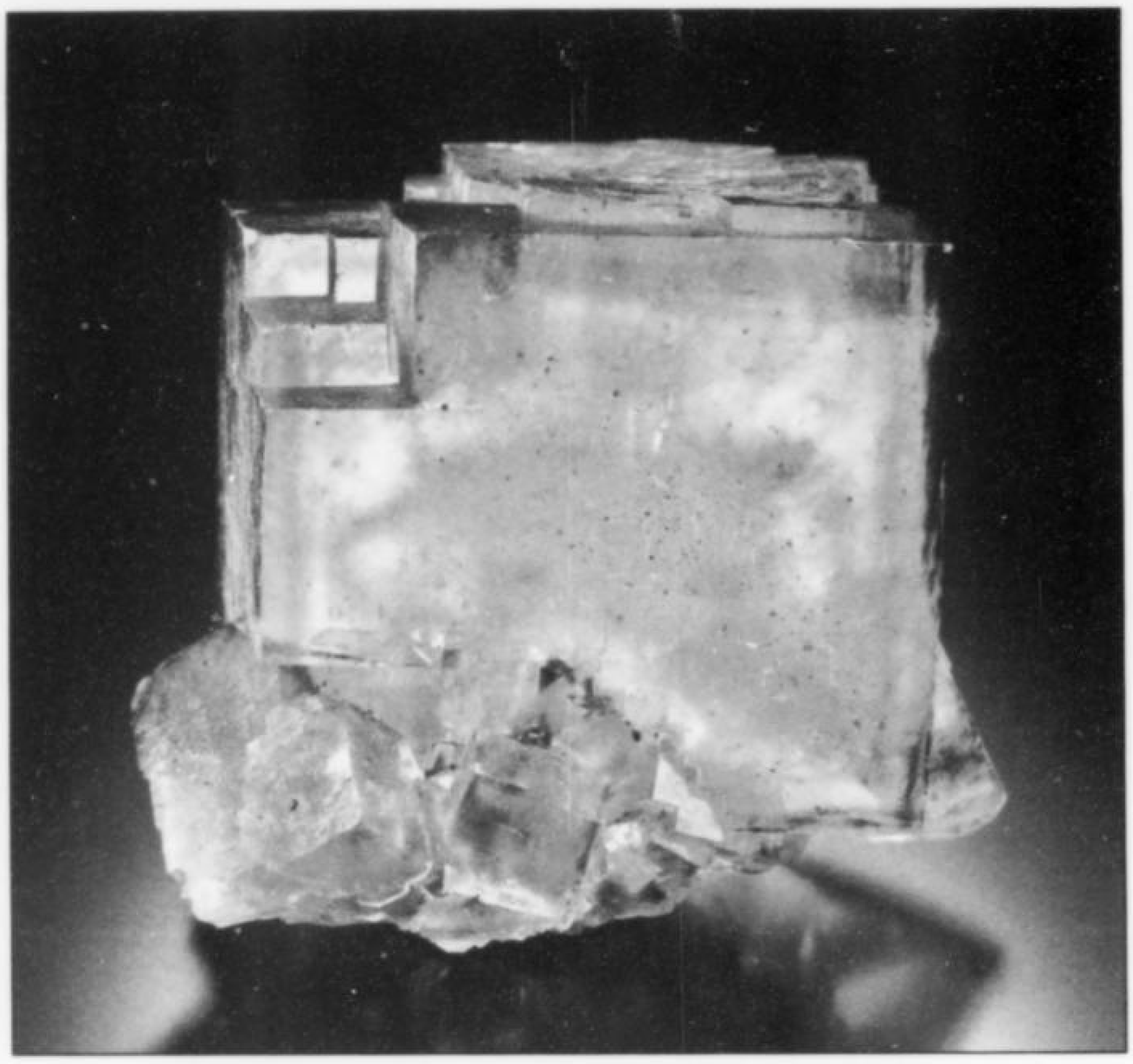


Figure 6. **Fluorite crystal, 5.2 cm, from the Hamada mine, Jorf, Morocco. Spirifer specimen; Jeff Scovil photo.**

at his late arrival while enjoying his good company. We met up later with Federico Pezzotta and Federico Barlocher and made an agreement to see their minerals in their car, as it was parked in the far lot near ours.

Since this was our last day, it was time for "El Agave" in Christophe Gobin's booth. We got many cups from the concession stand and handed out superb tequila to many, amid toasts and later expressions of *adieu*. We then set out to see the Federico minerals, and noticed that both Federicos still had cups in hand as we started the "long journey" to our cars to see their goodies. We were all in a great mood and did purchase a few fine things.

That night we returned to Auberge an Zahnacker, where our waiter from Wednesday had not forgotten us. He told us as we walked into the outside dining area, "I knew you were coming so I tried to get the night off but, alas, no," and then showed us into our reserved seats with the same twinkle. This was the night we always come to Ste-Marie for. The chef came out and recommended a wine and his specials for the evening. We added to his selection and the dinner was epic. Our waiter was awesome; later he did not want to leave, even though the restaurant was closing, but the owner-chef came out, released him, and sat down at our table with a special wine he opened with flair. Saying "you cannot buy this one," he poured and told us about his vacation, scuba diving in the Philippines. It truly does not get better than this.

Saturday

We began the day with a wine tasting, arranged by Francesca from Auberge la Meuniere. Then it was straight to Idar and visits to a few dealers. We checked in at the Park Hotel and then drove to the Mosel Valley for some sightseeing. We shopped at a local antiques and flea market, buying some German soccer paraphernalia so we could later dress as hooligans German-style as we watched the game with all the hotel guests, chefs, and staff; Germany defeated England! Loud horns were heard throughout the rest of the evening!

As I write this, Mark Kaufman has already reserved his flight for next year's Ste.-Marie-aux-Mines show—and you should too.

Springfield Show 2010

by Joe Polityka

[*August 13–15*]

The weather was beautiful when we left our home in Macungie, Pennsylvania on Wednesday. It was Springfield Show week, and this year I decided to leave a day earlier so I would be well-rested for the customary Thursday pre-show preview of dealers' stocks. This year my wife and daughter (along with our Chihuahua, Butterbean) were going to Springfield, and our car was loaded with luggage. Last year it was just me and the puppy, so we had traveled light; this year I had to make room for multiple changes of clothing and enough shoes to open a shoe store. Overall, though, it was a fun trip with lots of laughs, and featuring a pleasant surprise. Surprise? Yes, after arriving in Springfield my wife and daughter discovered (while they were having lunch at the Marriott) that the "Dream Team"—the winners of the basketball gold medal at the 1992 Summer Olympics—was in town to be inducted into the Basketball Hall of Fame. Magic Johnson, Larry Bird, Charles Barkley, Karl Malone, John Stockton, Chris Mullen, *et al.* were in attendance, along with two members of the 1960 gold medal team, Jerry West and Oscar Robertson. The Springfield City Hall was adorned with a huge red carpet and the town was loaded with tourists from around the country. How this event affected attendance at the mineral and gem show is anyone's guess, but I imagine that some basketball fans might have drifted into the show during their spare time.

This year at the show I discovered some exciting new things, and was also able to examine several recycled collections. At the booth of *Donald K. Olson and Associates* (he can be emailed at donaldkolson@netscape.net) I saw more specimens from the Ernie Schlichter collection such as were offered at last year's show and at other shows around the country recently. Most of the specimens were from the northeastern United States, including classics from such localities as Bristol, Connecticut; Acushnet, Massachusetts; and Maine. One-of-a-kind specimens, mostly miniatures mounted in large Perky boxes, from the Saums collection were also available from Don.

Mike Walter of *Geologic Desires* (his website is www.geologicdesires.com) offered some exciting new specimens from finds made over the past several years at the Roncari (Tilcon) quarry, East Granby, Connecticut. It seems a local collector has been working a seam at the quarry and has dug out beautiful specimens of **calcite, quartz and prehnite.** Most specimens are quartz-calcite combinations in miniature to large-cabinet sizes, with small-cabinet sizes being the norm. On some specimens, **quartz epimorphs after anhydrite** form attractive finger-shaped aggregates 3 to 6 cm long (one stalactiform specimen is almost 20 cm long). On some of these specimens, quartz crystals to 2.5 cm show inclusions of hematite; on others the quartz crystals have hematite coatings and inclusions on selected faces, making for very attractive, reddish orange crystals. Mike's single specimen of **prehnite** from the Roncari quarry is an extracted pocket about 20 cm in diameter sporting lime-green fingers and aggregates of prehnite with associated quartz and calcite: a very nice specimen.

Mike also had a large selection of **phlogopite twins** which were found in the Grenville Marbles of West Pierrepont, Saint Lawrence County, New York. The twins (in thumbnail to cabinet sizes) are translucent and reddish brown and reach 7 cm in size. The background information was written up by Dr. Steven Chamberlain; his report can be found, along with some photos, at www.geologicdesires.com/private%20viewing.htm.

Transplanted Tucson resident Isaias Casanova of *IC Minerals* (icminerals@earthlink.net) was handling the large and choice Marty Zinn thumbnail collection. All specimens I saw were mounted in traditional Perky boxes and are mostly high-quality pieces from classic East Coast and European localities. I saw thumbnails from Franklin, New Jersey and from Maine, Germany, Switzerland and other desirable places; **hematite roses** from the Alps and **pyromorphite** from Germany and Pennsylvania come to mind especially. You will have to rummage through Isaias's inventory to find that special specimen you have been seeking, as most of the specimens are one-of-a-kind.

Tony Nikischer of *Excalibur Mineral Corporation* (tony@excaliburmineral.com) co-authored the official description of a new mineral: **eurekadumpite** from the Centennial Eureka Mine, Juab County, Utah, and had specimens for sale. This new species occurs as microscopic, turquoise-blue spherules and rosettes sparsely scattered on matrix; the balls and rosettes are comprised of densely stacked, radiating platy crystals with pearly luster. The formula for eurekadumpite (IMA approval number is #2009-072) is $(Cu,Zn)_{16}(TeO_3)_2(AsO_4)_3Cl(OH)_{18}\cdot 7H_2O$, and the mineral is monoclinic. It was being offered by Nikischer for the first time and was a very popular item with collectors.

Tony was also offering **picropharmacolite with realgar** from the White Caps mine, Manhattan, Nye County, Nevada. Specimens in this exceptional lot consist of picropharmacolite in tiny, white, spiky spheres of acicular crystals to several millimeters, well scattered on matrix, typically over a pale orange-red druse of realgar and occasionally with transparent and colorless **gypsum,** yellow **sulfur** and/or white globular **pharmacolite.** The specimens have been SEM/EDS verified and come in matrix sizes from 3 to 10 cm in diameter. For the lover of minerals from below sea level, Tony had **colemanite** crystals from the Boraxo pit, Death Valley, Inyo County, California in short-prismatic, spear-shaped crystals in radiating and upstanding groups. The crystals are transparent to translucent and have a subtle, pleasant, grayish white color. The specimens range in size from thumbnails to cabinet pieces 10 cm wide.

R. Scott Wershky of *Miner's Lunchbox* (see his website at www.minerslunchbox.com) showed me a flat of specimens from the Skorpion mine, Rosh Pinah, Namibia, including miniature to small-cabinet specimens of **tarbuttite** in pale green crystal aggregates to about 2 cm in length. Also in the flat were specimens of **hemimorphite** crystals on pale green, opaque **fluorapatite**, the latter pseudomorphically replacing **tarbuttite**, an unusual combination. Finally, the flat contained several specimens of pale blue **smithsonite** closely resembling specimens from the Kelly mine, Magdalena, New Mexico. Scott also had a half dozen or so **gold nuggets** which were found about three months ago in the vicinity of the American River east of Sacramento, California. The rounded, worn nuggets (which weigh up to 4 ounces) were found by several prospectors using metal detectors. And, as usual, Scott had many fine gold specimens from localities around California, Nevada and elsewhere in the American West.

Intrepid traveler Alfredo Petrov (alfredo@mindat.org), who seems to have visited every time zone on earth, had some interesting **phosphophyllite psuedomorphs after marine fossils.** The fossils are Cretaceous marine pelecypods, perhaps clams, but genus and species not identified, now replaced by microcrystalline phosphophyllite. In one, the shell is replaced by phosphophyllite and the interior by metavivianite (the analysis, according to Alfredo, was done by Dr. Anthony Kampf at the Natural History Museum of Los Angeles County). Several other specimens are just shell-shaped cavities partially filled by acicular phosphophyllite crystals to 2.5 cm long. These specimens are from the Machacamarca mining district, near Potosí, Bolivia.

Wayne and Dona Leicht of *Kristalle* (www.kristalle.com) have also recently been traveling, judging by the spectacular photos posted on their website on a link called "Rambling with Dona." Photos and articles about their recent trip to Asia and Australia make the wanderer in all of us want to make reservations for the next flight out of town. Generally speaking, the Leichts were offering exceptional Tsumeb specimens from the Grosch and Moller collections and cerussite from the Eileen Kokinos collection, both of these collections dating back to the 1960s.

Dudley Blauwet of *Mountain Minerals International* (mtnmin@q.com) had his usual inventory of gem minerals and faceted stones from Pakistan and Viet Nam. Exceptional **red spinel** crystals in white marble matrix from Luc Yen, Yenbai Provence, Viet Nam average about 2 cm in diameter and have sharp, highly lustrous faces. Specimens were available from thumbnail to small-cabinet sizes.

In a recent "what's new" posting on the *Mineralogical Record* website (www.mineralogicalrecord.com), Tom Moore mentioned mineral specimens from the El Mochito mine near San Pedro Sula, Santa Bárbara Department, Honduras. At the booth of Walter Kellogg's *M & W Minerals* (www.mwminerals.com) I had the chance to examine some of these specimens in person. The most spectacular piece is a combination specimen of **sphalerite, quartz, andradite and hedenbergite** over 25 cm in diameter. The major sphalerite crystals are over 5 cm: this is a spectacular museum piece. According to Walter, the specimen was recovered from the 2210 level of the El Mochito mine on May 8, 2001.

High-end mineral dealers Rob Lavinsky of *The Arkenstone*

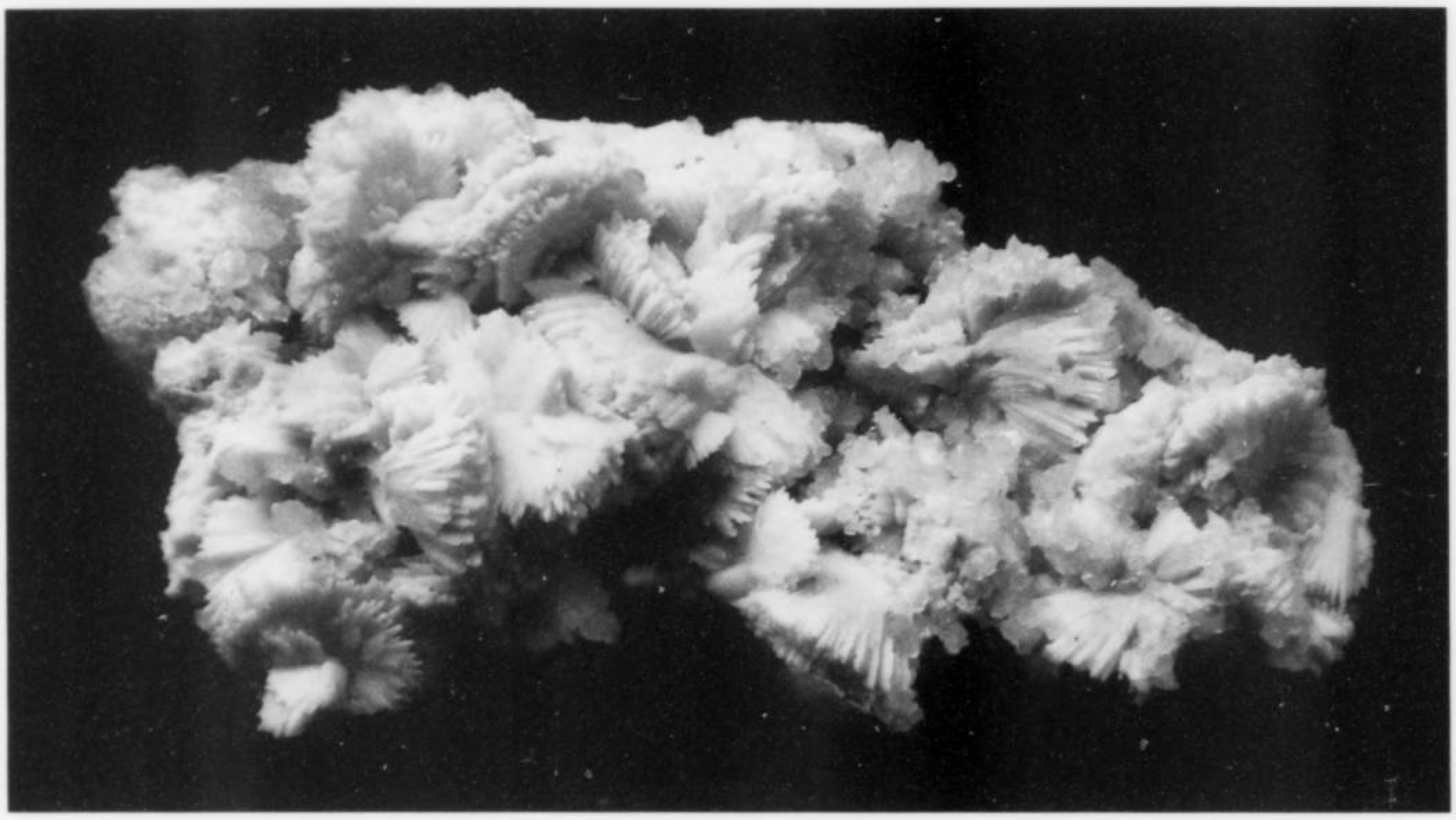


Figure 7. **Fluorapatite pseudomorphs after tarbuttite, 9.3 cm, from the Skorpion mine, Namibia. Scott Werschky/John Veevaert specimen; John Veevaert photo.**

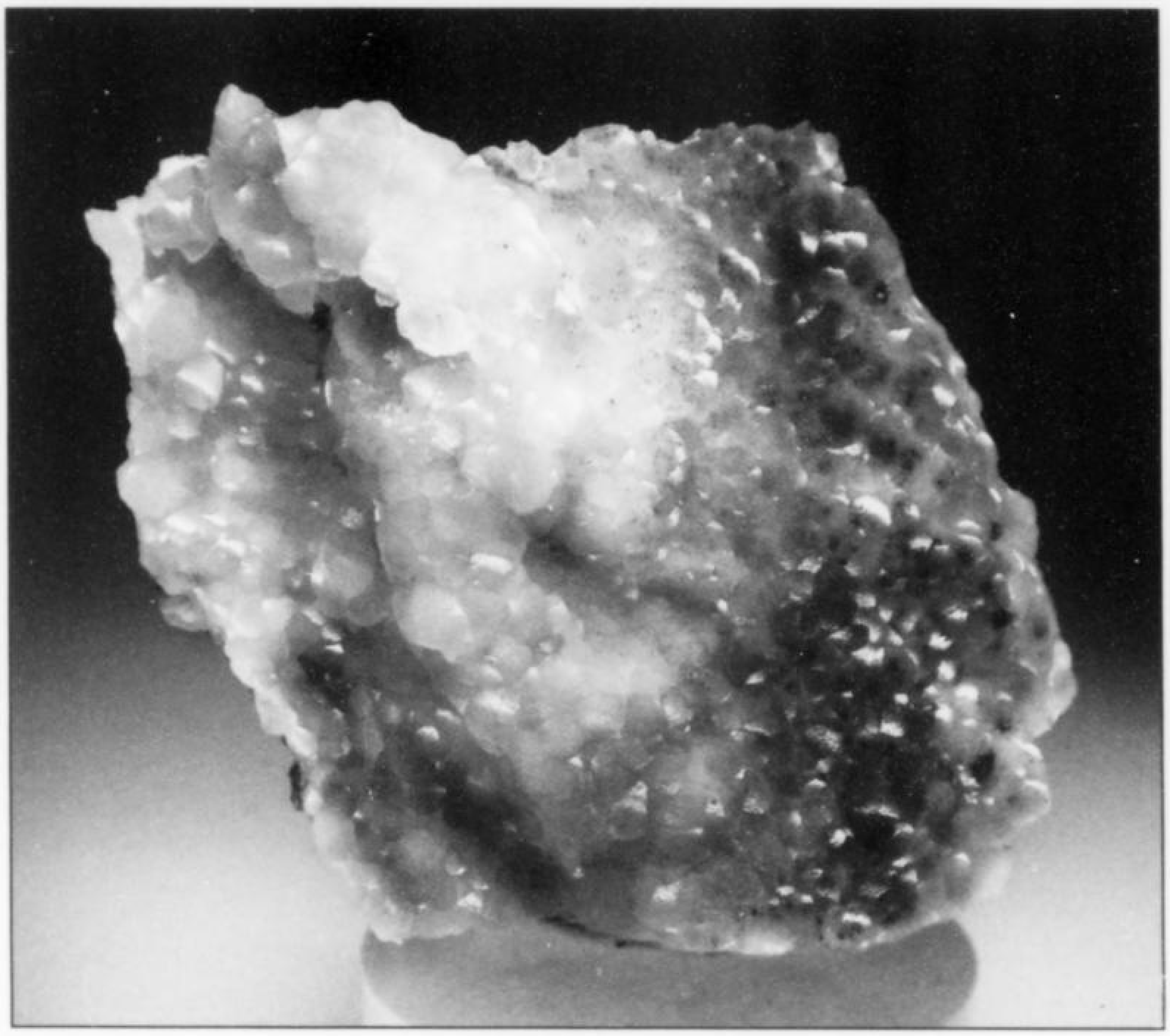


Figure 8. **Smithsonite, 6 cm, from the Skorpion mine, Namibia. Scott Werschky/John Veevaert specimen; John Veevaert photo.**

(rob@irocks.com); Bryan Lees and Steve Behling of *Collectors Edge Minerals, Inc.* (steve@collectorsedge.com); Dylan Stolowitz of *Green Mountain Minerals* (greenmountaingems@yahoo.com); Leonard Himes of *Minerals America* (minamer@aol.com); Bill Larson of *Pala International* (bill@palagems.com); and Dan and Diana Weinrich of *Weinrich Minerals* (danweinrich@charter.net) had their customary selections of museum-quality specimens but also had side tables loaded with discounted items, some up to 50 percent off the ticketed price. There were bargains galore, but you had to take the time to examine each of these dealers' stocks.

A pleasant surprise in the retail dealer category was Dave Bunk (www.davebunkminerals.com). Dave has been the man behind the scenes who sets up the special exhibits every year at the Springfield show; this year, in addition, Dave had a booth in which he offered one-of-a-kind display specimens, many from classic localities.

In the "old collections" category, Ted Johnson of Yankee Mineral and Gem Company was offering a few hundred specimens from England and Scotland. These included leadhillite from Leadhills, Scotland in miniature sizes with crystals to 1 cm, and other one-of-a-kind classics such as liroconite from Cornwall. Ted can be reached at yankeeminerals@comcast.net.

In the wholesale area, *Luis Menezes Minerals* (lmenezesminerals@uol.com.br) was offering **quartz pseudomorphs after anhydrite with calcite** in small-cabinet to large-cabinet sizes from Saltinho, Rio Grande do Sul, Brazil. At first glance the 3-mm-thick , pale pink fans seem quite delicate, but on closer examination it becomes

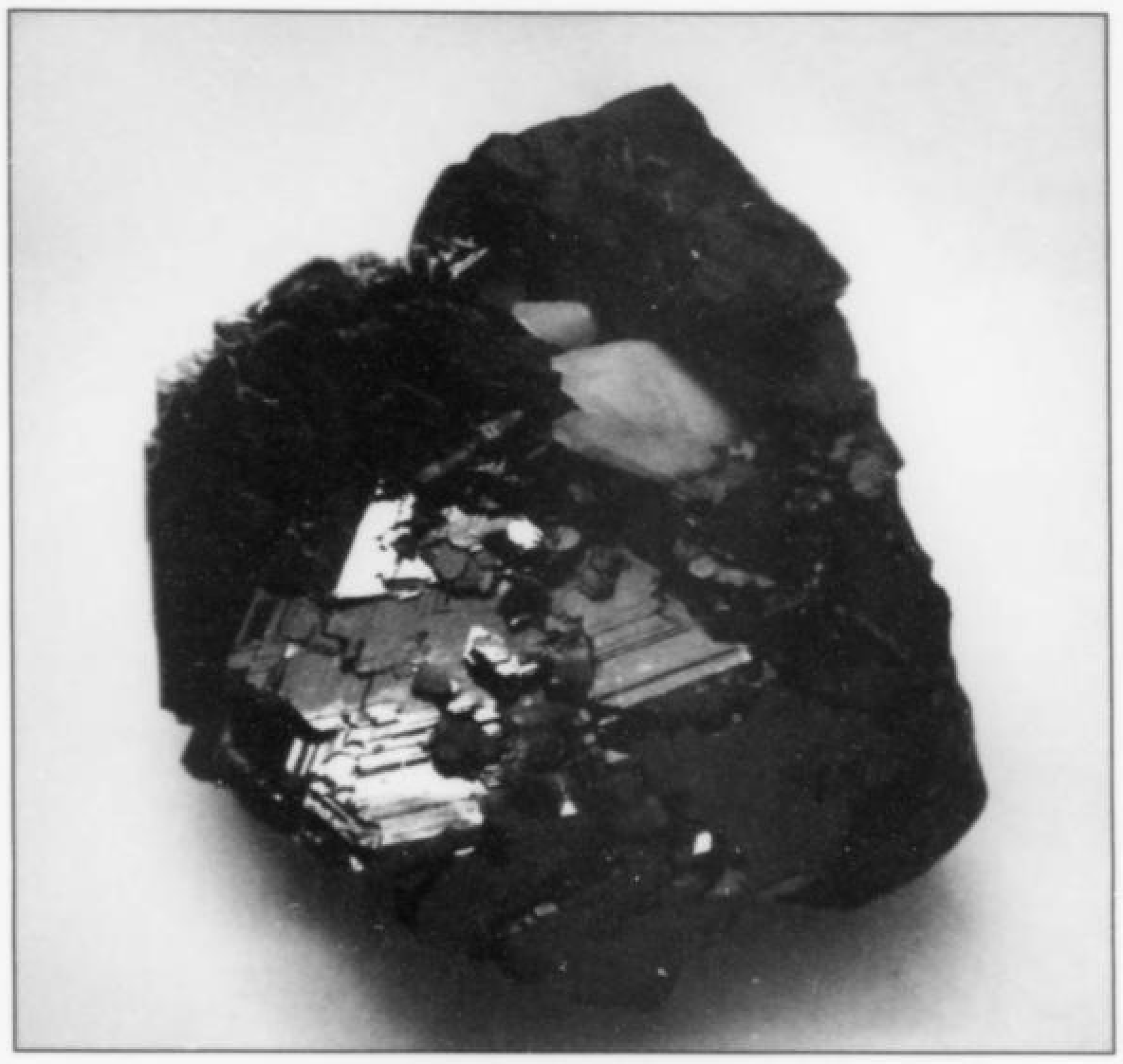


Figure 9. **Sphalerite crystals with galena and calcite, 9 cm, from the El Mochito mine, Santa Bárbara Department, Honduras. Walt Kellogg/ John Veevaert specimen; John Veevaert photo.**

Figure 10. **Rhodochrosite crystals to several millimeters from the Foote mine, Kings Mountain, North Carolina. Ted Johnson (Yankee Minerals & Gems)/John Veevaert specimen; John Veevaert photo.**

Figure 11. **Fairfieldite crystals with fluorapatite, 7.5 cm, from the Foote mine, Kings Mountain, North Carolina. Ted Johnson (Yankee Minerals & Gems)/John Veevaert specimen; John Veevaert photo.**

apparent that the quartz gives structure and strength to the pseudomorphs, so that the specimens show little or no damage. The fans reach 3 to 5 cm long and are about 2.5 cm wide. In the mica group, Luis had beautiful, dark bown to almost black **muscovite roses on albite** from the Xanda mine, Virgem da Lapa, Minas Gerais, Brazil. Individual roses reach 5 cm in width and sit attractively, with good color contrast, on white albite. Finally, Luis had matrix specimens in miniature to small-cabinet sizes showing brown, gemmy **eosphorite** crystals to 1 cm on **microcline.** An added bonus were olive-green hemispherical clusters (to 4 mm) of **greifensteinite** microcrystals scattered on matrix. Luis assured me that the greifenstienite has been verified through analysis.

During our conversation Luis showed me a copy of a book he is marketing (published in 2010) entitled *Minerals & Precious Stones of Brazil*, authored by Carlos Cornejo and Andrea Bartorelli. This thick book (700 plus pages) is filled with information that covers the entire mining history of Brazil from pre-European times to the present. There are hundreds of photos, drawings, maps and descriptions of the common and not so common minerals found in Brazil, along with biographies of the scientists who put Brazil on the mineralogical map. I found the $120.00 price tag to be a bit steep, so my wife and daughter (thankfully) bought me a copy for my birthday. See the review of this fine book in the September–October 2010 issue.

In case you think that the show is just about selling specimens of minerals and gems, I must inform you that *The Mineralogical Record, Rocks & Minerals* and *Lithographie, LLC* each occupied booths at the show. Not only could you get past issues of these magazines, you could also purchase books on every mineralogical topic imaginable.

Lehigh Minerals of Bountiful, Utah (www.lehighminerals.com) had some new specimens of arborescent copper from the 6950 level, Bingham Canyon Mine, Oquirrh Mountain, Salt Lake Country, Utah. The specimens are mostly thumbnails and miniatures and feature aggregates of copper crystals sitting on quartzite matrix. The copper crystals are reminiscent in shape of the leaves of cedar or arborvitae trees and are quite attractive. These specimens were saved from the crusher about a year ago and are considered to be the best native copper specimens found at the mine in the last 30 years.

Kevin Downey of Well-Arranged Molecules (www.wellarranged-molecules.com) had his usual selection of choice minerals from China but also had a hundred or so specimens from the late John Marshall's collection, with good representation of classic European localities. Two highlights were botryoidal malachite from Schwaz, Tyrol, Austria, generously coating a 5 × 7-cm matrix, and meta-torbernite crystals to 1 cm on a 4 × 5-cm matrix from the antique locality of Slavkov (German name: Schlaggenwald), Bohemia, Czech Republic. Kevin has many choice, affordable specimens, so I suggest you browse his website.

Of course, no Springfield show would be complete without mention of the year's guest exhibitor. In 2010 it was Bill Larson, of Pala International, Fallbrook, California. To the seasoned collector, Bill needs no introduction, but I must say he is a world-renowned expert in the mineral and gem field and that he has travelled the globe to find the best minerals and gems available. As is the custom at the show, about 50 cases were filled with gems, minerals and mining memorabilia from the Larson collection. As an East Coast native I was drawn to the case which contained a 5-cm golden beryl (heliodor) from the extinct Slocum Quarry, East Hampton, Middlesex County, Connecticut; a 4 × 8-cm transparent green and pink elbaite from Newry, Maine; and a 4-cm grossular on diopside with grossular crystals to 1.2 cm sitting atop an opaque diopside crystal from Eden Mills, Vermont (this grossular specimen has been photographed many times and is probably the best small specimen ever found at the quarry). Other cases contained fabulous gem crystals of topaz, beryl, spinel and zircon from Burma; amazing polished slabs of azurite-malachite from Morenci, Arizona with alternating concentric circles of blue and green; topaz and spessartine from the Little Three Mine in Ramona, California; and, of course, gem-quality elbaite from the Himalaya Mine, Mesa Grande, California and blue-cap elbaite from Bill's 1972 find at the Tourmaline Queen Mine, Pala District, San Diego County, California. The piece de resistance, in my opinion, was the famous crystallized "Christmas tree" gold from Spanish Dry Diggings, El Dorado County, California which was sold at the Dohrmann Action in 1886. According to the display card in the case, this triangular specimen was acquired from Ed McDole and weighs 2.75 ounces; I estimate that it measures about 5 cm. Other cases contained top-quality specimens from Elba, Italy; Chessy, France; Bisbee, Arizona; the copper country of Michigan; Mexico and Russia. One 7-cm colorless fluorite crystal from Dalnegorsk, Russia is so transparent that you can see the matrix right through the center of the crystal. Another case contained top-quality amethyst from eastern United States localities, including crystals from Hopkinton, Rhode Island and Delaware County, Pennsylvania. Needless to say, I visited the display of the Larson collection whenever I was anywhere near it during this productive and beautiful long weekend. Thanks, Mr. Larson, for taking the time and making the effort to bring your fabulous collection for us to see. Next year the guest exhibiter, according to the show program, will be Mr. Scott Rudolph.

Figure 12. **Fluorite, 8.5 cm, from Huanzala, Peru. William Larson collection; Jeff Scovil photo.**

On the way home, we continued my food theme from last year, stopping at Nardellis in Naugatuck, Connecticut, an Italian salumeria (deli), established in 1922, which was recently featured on the Travel Channel's episode of the "Greatest Places to Pig Out." In New England this store's specialty sandwich is called a grinder; in other parts of the United States it might be called a torpedo, submarine, hoagie, bomber, hero, po'boy, wedge, or zeppelin. The sandwich is quite delicious, not only because of the fresh bread and cold cuts but because of the unique chopped vegetable topping marinated in an Italian vinaigrette. Warning! You have to eat it carefully lest everything slide into your plate from inside of the roll. Honestly, this lunch stop was a welcome end to a great weekend, during which I met old friends, saw fantastic minerals, saw some legendary basketball players enter the Basketball Hall of Fame and spent time with my family. Local newspaper reports state that the induction ceremony might be held permanently at the same time each year, which gives you another reason to visit Springfield, Massachusetts in August 2011!

Arkenstone Grand Opening

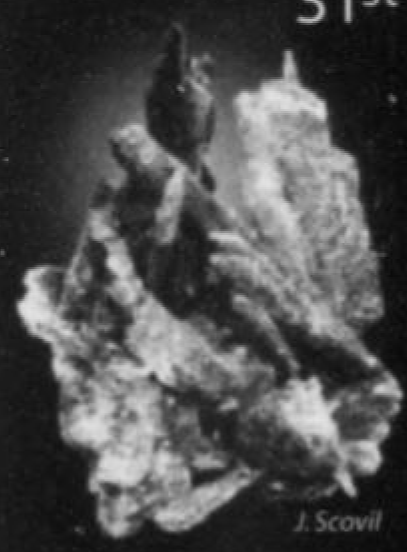
by Wendell E. Wilson

It was a weekend of wonderful minerals in Dallas. On August 29 Rob Lavinsky held a one-man-show and Grand Opening for his newly remodeled Arkenstone facility in Richardson, Texas, just outside Dallas. About 200 people were in attendance for the event, which culminated in a dinner and speaker program at a local hotel; this was followed on Sunday by an open-house at the home of Jim and Gail Spann, where their extensive, award-winning collection was on display in an array of showcases throughout the house. "Field trips" to visit other collections in the Dallas area were also possible by appointment.

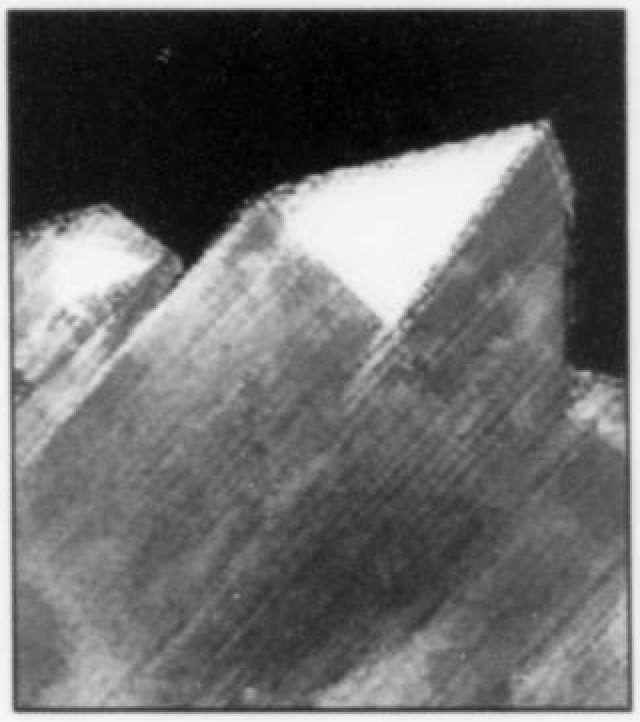
But Rob's new facility was the focal point of the event. The main Arkenstone showroom (designed by Kevin Brown) begins with an array of 31 cabinets, each with seven to 12 drawers and most of them topped by glass display cases. Proceeding around a corner, one enters an area with 12 tall glass display cases on three walls; facing these is an imposing 28-foot line of seven security vaults where the most valuable specimens are usually stored. Over 460 shelf-feet of exhibit space are available in the whole gallery.

The nearly-10,000-square-foot complex also includes meeting rooms, other (smaller) display rooms with 15 more tall glass cases, and a room just for specimen photography, plus other workrooms, offices, preparation rooms and storage rooms.

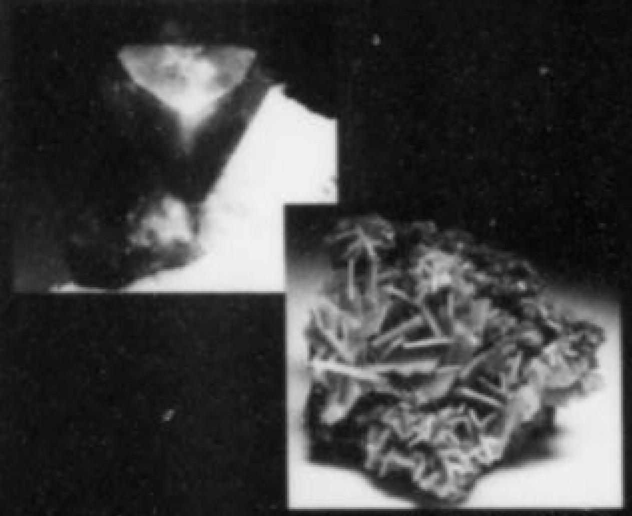
Rob was pleased with the turnout and plans to repeat the event next year.



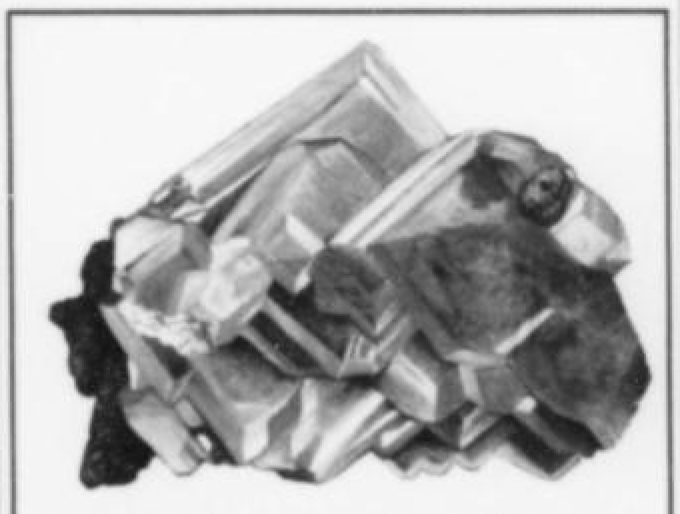
Malachite ps. Linarite
Hansonburg, NM



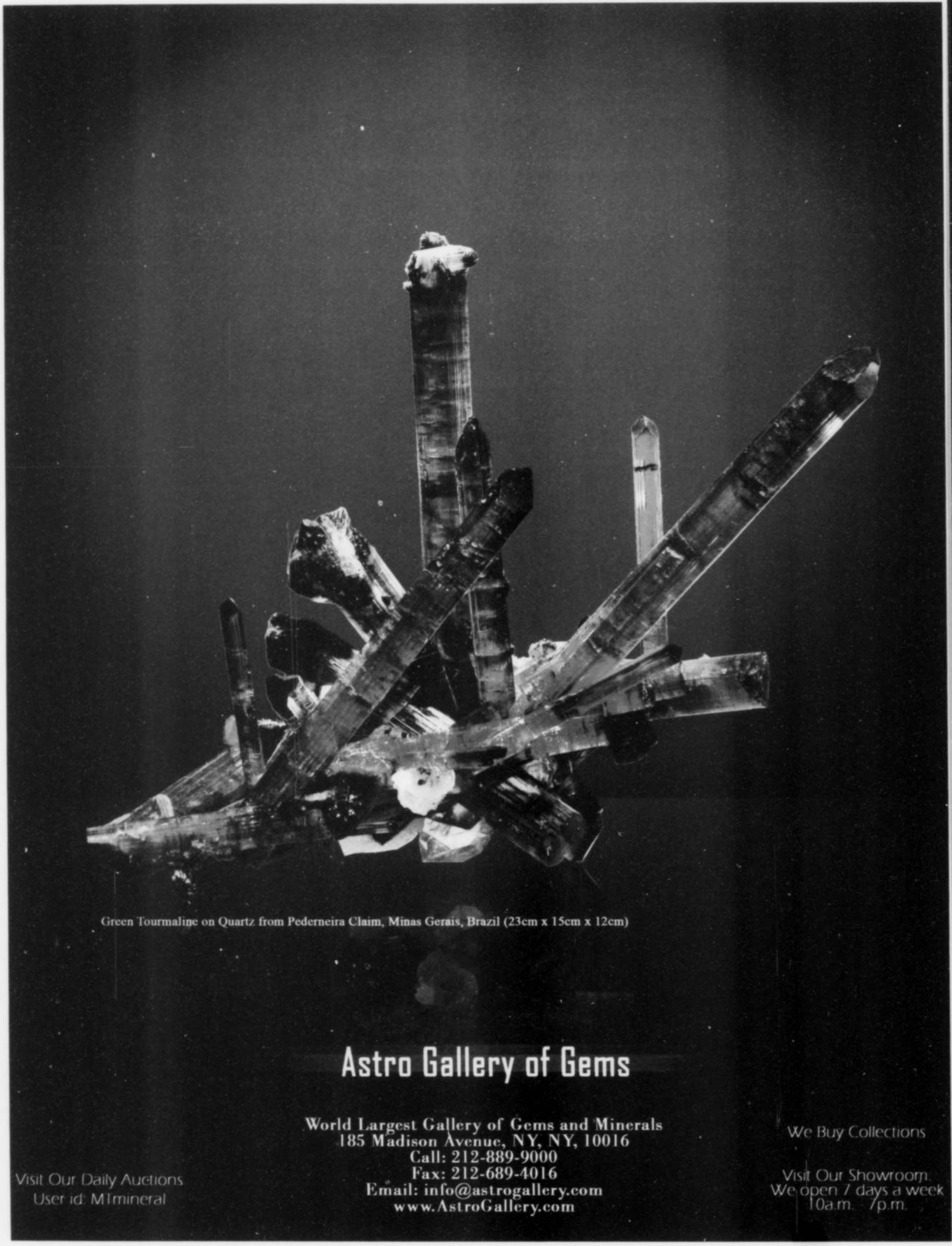
Benitoite - California



Wulfenite - Arizona



Wulfenite, Old Yuma Mine © 2005 Wendell E. Wilson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Recommendations Regarding the Handling and Sale of Your Collection

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Every year we hear horror stories of fine mineral collections mishandled, thrown away or sold for pennies by heirs. Unless a collector sells his collection himself before dying, it will someday pass on to another person who will be required to deal with its disposition, even though he or she may know little or nothing about minerals. Here's how to prepare instructions for an executor:

INTRODUCTION

Needless to say, our lives will end someday and our mineral specimens will pass to others to enjoy. As is often said, we are merely their temporary custodians. If the ultimate liquidation of your mineral collection is to be carried out in closest accord with your wishes and with the greatest price realized, there is truly no substitute for doing the job yourself *before* you die or become incapacitated. We can try to cover every contingency (at least logically) in a document such as the one proposed here, but you never know exactly what will happen when your collection passes into an executor's hands. Trying to abide by your instructions could be a nightmare for an inexperienced executor, and also a tremendous amount of work. **Therefore, our primary recommendation here is that you liquidate your collection yourself, while you are still able, rather than leave it to an executor.**

That said, if you elect *not* to sell, distribute or donate your collection yourself, there are two important things that must be done in preparation for the day when your collection will pass to your executor, and you are no longer around to advise. It is every collector's responsibility, to his family, to his heirs and to future generations of collectors, that he take these two duties seriously.

The first requirement is fairly obvious: to record and keep up-to-date a catalog—or at least a list—of all the specimens in the collection, keying the catalog entries unambiguously to the actual specimens. The key can be a painted-on catalog number, or it might be a digital snapshot, a paper label, or some combination of these. The most important information to retain is the locality; additional information of various kinds (purchase price, source, previous owners, exact size, etc.) is also nice to have, but the locality is of paramount importance. This work can be tedious for collectors who are not detail-oriented, but it is critical if the specimens are to retain their full value. If your collection is large and you don't have the time to catalog it properly, it might be wise to hire a temporary curator (e.g. a college student who is a mineral collector) to prepare a catalog/inventory.

The second requirement (unless the collection is to be donated to an institution) is the preparation of a document that will help guide your executor in handling and selling your collection. This is a much easier task than the cataloging of a large collection, and there is little excuse for not taking care of it. In fact, you could complete the job today, right now. To make it easy, we have prepared a template for such a document (shown below), which can be modified to fit your particular collection and wishes. It covers all of the significant information that your executor will need.

Aside from details about the collection itself, your executor will want to know who to turn to in the dealer community. You can discuss (in the document) which dealers you have done business with over the years and found to be trustworthy. You might also mention other dealers who are known to purchase collections like yours (even though you may not have done business with them personally), and who might be invited to make an offer.

Even if you are bequeathing all or part of your collection to a museum, your executor will need some critical information from this document, including the seemingly obvious, such as *where* you actually keep your collection. Is it in a safe deposit box? In a cabinet in the basement? Is some of it on loan somewhere? And where do you keep your catalog? In a drawer or cabinet? As a computer file? How can the file be accessed in your computer? You might even specify how large your collection is, so your executor can be sure he has successfully rounded it all up from its various hiding places.

If you plan to bequeath all or some of your specimens to a museum, it would be wise to first consult with the curator to make sure that the museum needs and wants the specimens. Or you could sell off the best things in the collection, which will usually account for the vast majority of the collection's value and which will be the easiest to dispose of, and then donate the remainder to a school for teaching purposes. Bear in mind that tax advantages may apply if you donate specimens to a non-profit institution *before* you die, rather than leaving them for your executor to handle.

If you wish the collection to be sold at auction, you should select the auction house yourself and contact them in advance. They will explain their fee structure to you, and the timetable for the auction. Instruct your executor to provide them with the appraisal you obtained.

You may recommend that the collection be offered to a dealer to be sold "on consignment," with payments made as the pieces are sold. The "consignment fee" will be such that you will receive a price somewhere between retail and wholesale, but not until the specimens have sold … and some may take a long time to sell.

It might be possible for you to negotiate terms in advance with a dealer of your choice.

Whatever your wishes are, this document should be updated periodically, and copies kept in several obvious, sure-to-be-found places (with your spouse, your attorney, your will, your future executors, in a safety deposit box, in a drawer in your mineral cabinet, etc.).

INSTRUCTIONS
regarding the
Handling and Sale of My Mineral Collection

Your name: ______________________

Date: ______________________

(1) APPROXIMATE VALUE: I would estimate very roughly that my mineral collection is currently worth between $ ____ and $ ____ retail. [You could also specify the total purchase price, but as some famous collections have shown, the purchase price may or may not equal the current value.]

(2) FRAGILITY: Mineral specimens are delicate and fragile, and can lose a great deal of their value (sometimes over 90%) as a result of even the tiniest bruises, chips, scratches, cracks and other seemingly minor damage. Just picking one up in the wrong way can cause damage. Therefore it is important that they be handled and packed for shipment by someone with the proper experience. Please do not attempt to do this yourself. I recommend that you ask the following person to do this, and pay him for his time: ____

(3) BEAUTY: Looks can be deceiving. Beauty is not the only factor in value. Some very plain-looking specimens can be very rare and valuable, so please treat all of my specimens with equal respect.

(4) LABELS and CATALOG: It is very important that any paper labels or catalog numbers (and the corresponding catalog) be kept with each specimen and not mixed up or thrown away. These labels and catalog numbers record critical information about the specimens. If that information is lost, the value of the specimens may be significantly reduced.

(5) My catalog may be found here:____

(6) My collection is stored here: ____

(7) GETTING AN APPRAISAL: Only an expert in the kinds of minerals I have collected will be able to formally advise you as to their current value. An appraisal can give several different values for any particular specimen, and it is important for you to understand the difference. There are three main valuations: (a) The highest value is the "value for insurance purposes." It is highest because I may have waited years to get a good price when buying a specimen, but the insured value should cover the cost of *immediate* replacement, in a time frame too short to allow extensive bargain hunting. The next highest value is (b) the "retail value." This is the average price that a dealer might charge his customer for such a specimen. The lowest valuation is (c) the "wholesale price," which is the price a dealer might be willing to pay you for the specimen, knowing that he needs to make a profit when he resells it later. A specimen appraised at $150 for insurance purposes might be worth $100 retail and only $25 to $60 wholesale. "Auction value" is kind of a wild card. If an auction house agrees to handle the collection, the selling price can range from below wholesale to above retail . . . you never know.

I recommend that you contact the following dealer(s) and arrange for an appraisal: (a) ____ (b) ____

You will have to pay an appraisal fee (find out in advance how much that will cost). You should receive a written document from them, detailing the appraisal, their qualifications, and which kinds of appraisals they are giving. Be sure that they include the wholesale valuation, as that is what you are liable to receive in the end. It must be stipulated that the appraiser cannot purchase the collection himself (thus avoiding a conflict of interest).

(8) SELLING THE COLLECTION WHOLESALE:
I recommend that, after obtaining the appraisal, you contact the following dealer and offer the collection to him at the appraised wholesale value: (a) ____

You may have to negotiate the price a bit, but do not come down to less than ___% of the appraised wholesale value. If he will not take it, then offer it to the following dealer: (b) ____

Third choice would be the following dealer: (c) ____

If none of those three will pay at least ___% of the appraised wholesale value, then make the best deal you can. IMPORTANT: Do not let the buyer purchase only the best specimens. The collection should be sold only as a unit, unless no dealer can be found who will agree to purchase it all. [NOTE: If you are recommending selling the whole collection to another collector, rather than a dealer, the offering price should still be less than the retail value.]

(9) SELLING THE COLLECTION ON CONSIGNMENT:
I recommend that you ask the following dealer to sell the collection on consignment, and return any unsold specimens to you in 12 months: (a) ____

After that time, any unsold specimens should be offered at a below-wholesale price to the following dealer: (b) ____ or donated to the following institution: (c) ____.

(10) SELLING THE COLLECTION AT AUCTION:
I recommend that you contact the following auction house: _____

I recommend that you [DO/DO NOT] place a reserve on the specimens. The reserve, if any, should be set at ___% of the appraised retail value or expected auction price. Any specimens that do not meet the reserve will be returned to you to sell in some other way, and you will be charged the auction fee regardless of whether or not it meets the reserve and sells.

(11) SPECIMEN BEQUESTS: I ask that you give the following specimens to the person(s) or institution(s) indicated, at no charge [see appended list].

(12) KEEPSAKE SPECIMENS: I suggest that you keep the following specimen(s) as a keepsake in my memory, perhaps as a decorator specimen [see appended list].

ACKNOWLEDGMENTS
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The Vug
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e-mail: Justin@the-vug.com

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THE MUSEUM DIRECTORY

Colburn Earth Science Museum

Curator: Phillip M. Potter
Tel: (828) 254-7162
Fax: (828) 257-4505
Website: www.colburnmuseum.org
Pack Place Education, Arts & Science Center
2 South Pack Square
Asheville, NC 28801
Hours: 10–5 Tues.–Sat. 1–5 Sun. Closed Mondays and holidays
Specialties: North Carolina and worldwide minerals and gems
Accessible to persons with disabilities

Montana Tech Mineral Museum

Curator: Dr. Richard Berg
Tel: 406-496-4172
E-mail: dberg@mtech.edu
Assistant Curator: John Foley
Tel: 406-496-4414
E-mail: jfoley@mtech.edu
Website: http://www.mbmg.mtech.edu/museum/museum.asp
Montana Bureau of Mines and Geology
Montana Tech of U. of Montana
1300 W. Park St.
Butte, MT 59701
Hours: Memorial Day to Labor Day: 9–5 daily
Rest of year: M–F 9–4
Specialties: Butte and Montana minerals, worldwide classics

Additional listings welcome!

Send vital information, as shown, to the editor. There is a modest annual fee (lower than our regular advertising rates).

The Gillespie Museum of Minerals, Stetson University

Curator: Dr. Bruce Bradford
Tel: (386) 822-7331
E-mail: bbradford@stetson.edu
Associate Director: Dr. Karen Cole
Tel: (386) 822-7330
E-mail: kcole@stetson.edu
234 East Michigan Avenue
DeLand, FL 32730
[mailing: 421 N. Woodland Blvd., Unit 8403]
Hours: 10:00 AM–4:00 PM, Monday-Friday (closed during university holidays)
Specialties: Worldwide, comprehensive mineral collection; Florida minerals, rocks and fossils; historic fluorescent collection.

Colorado School of Mines

Museum Director: Bruce Geller
Tel: (303) 273-3823
E-mail: bgeller@mines.edu
Website: www.mines.edu/academic/geology/museum
Golden, Colorado 80401
Hours: 9–4 M–Sat., 1–4 Sun. (closed on school holidays & Sundays in the summer)
Specialties: Worldwide minerals; Colorado mining & minerals

A. E. Seaman Mineral Museum

Website: www.museum.mtu.edu
Curator & Professor of Mineralogy: Dr. George W. Robinson
E-mail: robinson@mtu.edu
Tel: 906-487-2572; Fax: 906-487-3027
Electrical Energy Resources Center
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931-1295
Summer Hrs (July-Sept.): M–F: 9–4:30, S–S: 12–5
Winter Hrs (Oct–June): M–F: 9–4:30
Specialty: Michigan minerals, Lake Superior region & Midwest U.S. minerals

Houston Museum of Natural Science

Curator (mineralogy): Joel Bartsch
Tel: (713) 639-4673
Fax: (713) 523-4125
1 Herman Circle Drive
Houston, Texas 77030
Hours: 9–6 M–Sat., 12–6 Sun.
Specialty: Finest or near-finest known specimens

Natural History Museum of Los Angeles County

Fax: (213) 749-4107
Website: http://www.nhm.org/site/research-collections/mineral-sciences
Curator (Mineral Sciences): Dr. Anthony R. Kampf
Tel: (213) 763-3328
E-mail: akampf@nhm.org
Collections Manager: Alyssa R. Morgan
Tel: (213) 763-3327
E-mail: amorgan@nhm.org
900 Exposition Blvd.
Los Angeles, CA 90007
Hours: 9:30–5:00 Daily
Specialties: Calif. & worldwide minerals, gold, gem crystals, colored gemstones, micromounts
Support organization: The Gem and Mineral Council

California State Mining and Mineral Museum

Curator: Darci Moore
Tel. (209) 742-7625
Fax: (209) 966-3597
Website: www.parks.ca.gov
Mailing: P.O. Box 1192
Mariposa, CA 95338
Hours: May 1–Sept. 30, open daily 10–6
Oct. 1–April 30, open 10–4, closed Tuesdays
Closed Christmas and Thanksgiving
Specialties: California & worldwide minerals, gold, gems, and mining

Museums listed alphabetically by city

THE MUSEUM DIRECTORY

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Curator: Dr. Sharon Fitzgerald
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E-mail: slfitz@udel.edu
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E-mail: rdolbier@unr.edu
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Fax: (505) 835-6333
Associate Curator: Robert Eveleth
Tel: (505) 835-5325
E-mail: beveleth@gis.nmt.edu
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Tel: (520) 883-3033
E-mail: adomitrovic@desertmuseum.org
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E-mail: minerals@nmnh.si.edu
Collection Managers: Paul Pohwat and Russell Feather
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