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Articles

Departments

COVER: WULFENITE group, 6 cm, from the Stefanie mine at Bleiberg, Carinthia, Austria. Photo by Werner Lieber. For a detailed review of this locality see the article by Niedermayr in this issue, beginning on p. 355.

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notes from the EDITOR

FOR STAMP COLLECTORS

This coming year the U.S. Postal Service will have a temporary postal station set up at the Tucson Gem and Mineral Show (February 12–15, 1987). On such special occasions a special cancellation is applied to all mail passing through the temporary station during the course of the event. Europeans have been commemorating mineral shows with special postmarks for years (see, for example, the Bad Ems show postmarks shown in vol. 15, no. 6, p. 339), but only rarely have American mineral shows done the same.

Your editor, it so happens, was called upon to design the Tucson Show postmark. I was told by the Postal Service that the temporary station must be given a name and that, with only a few stipulations, I could name it anything I chose. So, after giving it some thought, I decided to depict a specimen of Red Cloud mine wulfenite (drawn rather loosely from Bob Lane's superb, recently found specimen shown in vol. 16, no. 6, p. 498), and to give the name "Red Cloud Station" to the temporary office. The finished design is shown below.

Many people who might wish to have mail emblazoned with this cancellation may not be able to visit the show personally. For them the Post Office has a special service. Simply insert your mail, properly addressed, stamped and sealed, into a larger envelope and mail it to: U.S. Postal Service, Director of Marketing, Attn. Gem and Mineral Show Special Cancellation, Tucson, AZ 85726, so that it arrives in plenty of time before the show. That mail will then be postmarked and sent back on its way during the show.

It would be most appropriate, of course, to use the mineral stamps which came out a few years ago for postage. If you don't have any left, most stamp dealers can supply you with sheets at a surprisingly modest mark-up over face value. Just be sure to have at least 22¢ worth on each first-class envelope under 1 ounce, or 44¢ per half ounce on airmail going outside the U.S.

As with the well-known "First Day Covers," it is permissible for anyone to have specially designed envelopes printed up for the occasion, with an appropriate illustration (called a "cachet") on the left half of the envelope. Some people supply these to the Post Office in bulk, have them cancelled, and then sell them as collectors' items. I don't know if anyone is planning to do this for the Tucson Show, but it's a possibility.

NEW GLOSSARY COMING!

The fifth edition of Fleischer's *Glossary of Mineral Species* is currently in production and we hope to have it available in time for the Tucson Show in February. It will include well over 900 important changes and additions!

It will also have a heavy-duty Lexotone cover, unlike the previous editions which had ordinary paper covers. Lexotone is a very tough, flexible material and should stand up much better to the heavy use which collectors typically give their Glossaries. I've seen people bring their tattered Glossary up to our Show table and buy a new copy of the *same* edition to replace the worn out one. Well, much as we like to sell extra books, we thought we should try to make the new edition strong enough to stand at least a fighting chance.

The new edition will have the same spiral binding (technically called a "wire-o" binding), but we will also have unbound, unpunched copies available for people who wish to insert the Glossary in their own ring binder, or have it specially bound in some other way.

A minor change but one important to book dealers is that the year of publication (1987) will not be a formal part of the title this time. Some dealers reported confusion among buyers who, as early as 1984, began assuming that the *Glossary of Mineral Species 1983* was not the most current edition. The cover will simply state "Fifth Edition" instead.

We have been discussing the idea of making the Glossary available on floppy disc for home computers. This might be set up for accessing via a commercial filing program such as dBase-III (which the purchaser would have to obtain elsewhere), or it could conceivably have its own search and retrieve programs built in (at greater expense of course). If people who might be interested in such a thing will write in and state the maximum price they would be willing to pay, it will help us assess the market for this product.

We have always tried to keep the price as low as possible on the Glossary, so that it could achieve maximum distribution among mineral collectors and mineralogists who need it. The new edition will be priced at $13 which, we think, is still a bargain.

GOLDSCHMIDT ATLAS and MINERALS IN CHINA SOLD OUT

Some books remain available longer than others; and some are sold out before you can say "Edward Salisbury Dana." Our notice in the July-August issue announcing the availability of 47 copies of *Minerals in China* brought an instantaneous flood of anxious orders. All of our copies were sold in less time than it took for the magazine to reach all U.S. subscribers. The reprint edition of Goldschmidt's *Atlas der Krystallformen* lasted a little longer since we were able to order more copies than our initial 60 from the publisher, but that item too was sold out, before the following issue of the magazine reached subscribers. We regret not being able to fill all orders received, but these books were published in strictly limited editions and we just couldn't get any more copies.

FOREIGN RATE INCREASE

The Board of Directors of the Mineralogical Record Inc. recently elected to raise the subscription rate for non-U.S. subscribers by $3, in view of the significant extra postage cost (which is actually closer to $4). Since the founding of the magazine in 1970, the foreign and domestic subscription prices have been identical. This has meant that, in effect, American subscribers have been subsidizing the foreign circulation to some extent. The Directors felt that this was not equitable and decided to bring the subscription prices more in line with respective costs.

(Continued on p. 374)

famous mineral localities:

Bleiberg

Carinthia, Austria

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Bleiberg is among the most famous of European localities. It has been an important source of lead ore for more than 2000 years; and it is the type locality for wulfenite, hydrozincite and ilsemannite.

INTRODUCTION

Bleiberg (the name means "Lead Mountain") stands prominently among the classic mineral localities of Europe. Wulfenite is, of course, the most famous Bleiberg species, first described by Franz Xavier von Wulfen in 1785. Von Wulfen's elegant book, *Abhandlung von Kärnthnerischen Bleyspate* [Treatise on Carinthian Wulfenite], contains 21 hand-colored engravings of wulfenite specimens and is surely the most extravagantly produced description of a new mineral species in history. Today the work is a rare and expensive collector's item, as intensely coveted as the many fine wulfenite specimens themselves which grace museums and private collections around the world.

Bleiberg is located in southern Austria, in the province of Kärnten (Carinthia), just a few kilometers north of the ternary border point between Austria, Italy and Yugoslavia. A country road proceeds due west from the main highway at the town of Villach for about 12 km to Bleiberg, in the low foothills of the Austrian Alps.

HISTORY

Ancient lead figurines discovered in burials at Frög, near Villach, suggest that lead mining in Carinthia goes back at least to the sixth and eighth centuries B.C. The artifacts, depicting birds, riders and a wagon, are fashioned from very pure lead which is free of silver. The absence of silver is a characteristic of local ores in the so-called Drauzug trend of lead-zinc occurrences (Gailtaler Alps and Karawanken). Other excavations in the ancient Celtic-Roman town of Magdalensberg, northeast of Klagenfurt, have revealed a variety of lead pipes, clamps and weights.

The road from Villach to Bad Bleiberg skirts the southern slopes of Bleiberg Mountain, across which are scattered many small but conspicuous mine dumps amid the open forest. These are the result of mining operations which flourished in the late Middle Ages.

The earliest written record of lead mining in the Bleiberg area dates to 1333, when Bishop Werntho of Bamberg granted mining rights to one Heinrich Putigler on "dem Pleyberg pey Villach." The bishops of Bamberg never carried on mining themselves, but did grant mining rights to individual operators. These rights extended only to a shallow depth, however, and therefore did not permit the extensive development of underground workings.

Mining at Bleiberg reached a zenith around the year 1480. Theophrast Bombast of Hohenheim, better known as Paracelsus, wrote as follows in his *Chronica und Ursprung des Landts Kerndten* (1603):

* This article was originally published in German as a booklet entitled *Der Bergbau und die Mineralien von "Bleiberg-Kreuth" in Kärnten, Österreich* (1985); published by Doris Bode Verlag and reproduced here in English with permission and with some changes in the illustrations.

Figure 1. **An early engraving depicting Bleiberg, by Markus Pernhart (1863).**

> There are many mines in this region, more than in others.
> At Bleiberg a wonderful ore supplies lead not only to Germany but also to Pannonia, Turkey and Italy. The mountain opens like a treasure chest; who could wish for more wealth?

In 1759 the Austrian Empress Maria Theresia purchased, for one million gulden, the Carinthian properties of the Bambergers. These lands included the Bleiberg district, and in succeeding years the Austrian government became increasingly involved in Bleiberg mining. By the end of the 1700s the state had become the principal operator in the area. The Kaiser-Leopold tunnel, opened in 1790, provided deep drainage for nearly all of the workings in the western part of the district.

On December 11, 1867, the Bleiberger Bergwerks-Union was founded and, just a year later, the new concern acquired all local mining properties from the government. Additional consolidation followed, making possible an increase in overall efficiency and a broad revision of smelting procedures. Ground was broken for the Rudolf shaft in 1869. When joined with the Kaiser-Leopold tunnel in 1876, this shaft served most of the major Bleiberg workings as well as the Kreuth mines to the west. In 1894 the Franz-Joseph tunnel was started and became the principal haulage route in the district. At the Philadelphia Exposition of 1876 the Bleiberger Bergwerks-Union exhibited a selection of Bleiberg mineral specimens and lead products (Jugoviz, 1876), including wulfenite, smithsonite, heteromorphite and others.

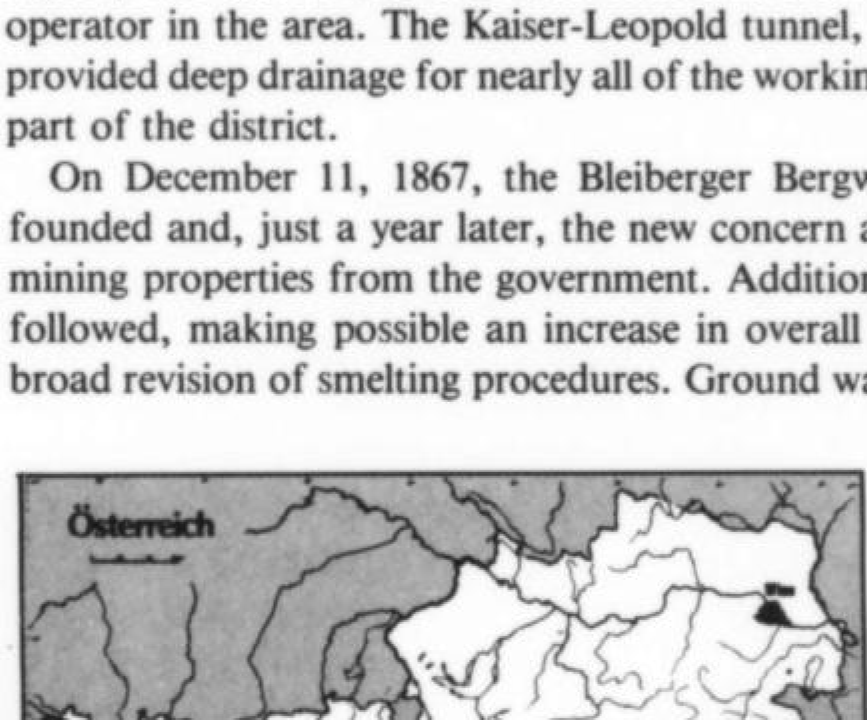

Figure 2. **Location map.**

Initially only galena was used as a source of metal. It was not until the latter half of the nineteenth century that zinc was obtained from sphalerite.

The raw blocks of ore were hand-sorted, broken, and sieved in pails of water to prepare a concentrate for smelting. This work was often done by women and children. According to the statistics of the Imperial Ministry of Agriculture in 1886, for instance, 1513 men, 485 women, 137 youths and 21 children were employed in the Carinthian lead mines.

By 1902 the entire Carinthian lead industry had come under control of the Bleiberger Bergwerks-Union. Operations were further modernized, and Bleiberg became the second mine in Europe to utilize electric haulage underground.

Due to the worldwide economic depression of 1929 mining operations in the district were, for a time, suspended. Following World War II emphasis was placed on exploration. Milling and chemical operations were improved, leading to increased production. In 1966, a new shaft and hoisting machinery were installed; a little later the central mill (including flotation) was modernized and enlarged. This made it possible to process material from the old dumps. During the 1960s exploratory workings disclosed large-scale

Figure 3. **An early engraving depicting some mining facilities at Federaun in the Bleiberg district, by Markus Pernhart (1863).**

Figure 4. **Even today some historical structures remain preserved in Bleiberg, such as this Miner's Hall or *Gewerkehaus* known as the Mühlbacher House. (Photo: Natural History Museum of Vienna.)**

Figure 5. **Massive iron doors of the old Miner's Hall; note crossed hammers inset at top. (Photo: Natural History Museum of Vienna.)**

mineralization in the Kreuth district to the west, where no ore had been thought to exist. This assured continuance of mining there for many years. The Antoni hoisting shaft and an enlarged milling facility were constructed as a result of those findings.

Nowadays the ore is processed by milling and flotation which yield a concentrate for further treatment. This is carried out at installations belonging to the same company at Gailitz near Arnoldstein south of Bleiberg.

In the lead mill, lead is recovered from the concentrate in the so-called "Bleiberger round hearth furnace." The zinc ore is first roasted in a special furnace, the "Wirbelschichtofen." The nearly three-fold higher sulfur content of the sphalerite makes possible the

Figure 6. **Mining continues today at Bleiberg, with modern mining equipment and electric lights. The miners shown here are drilling in the Rothinggang workings. Photo by V. Kabath.**

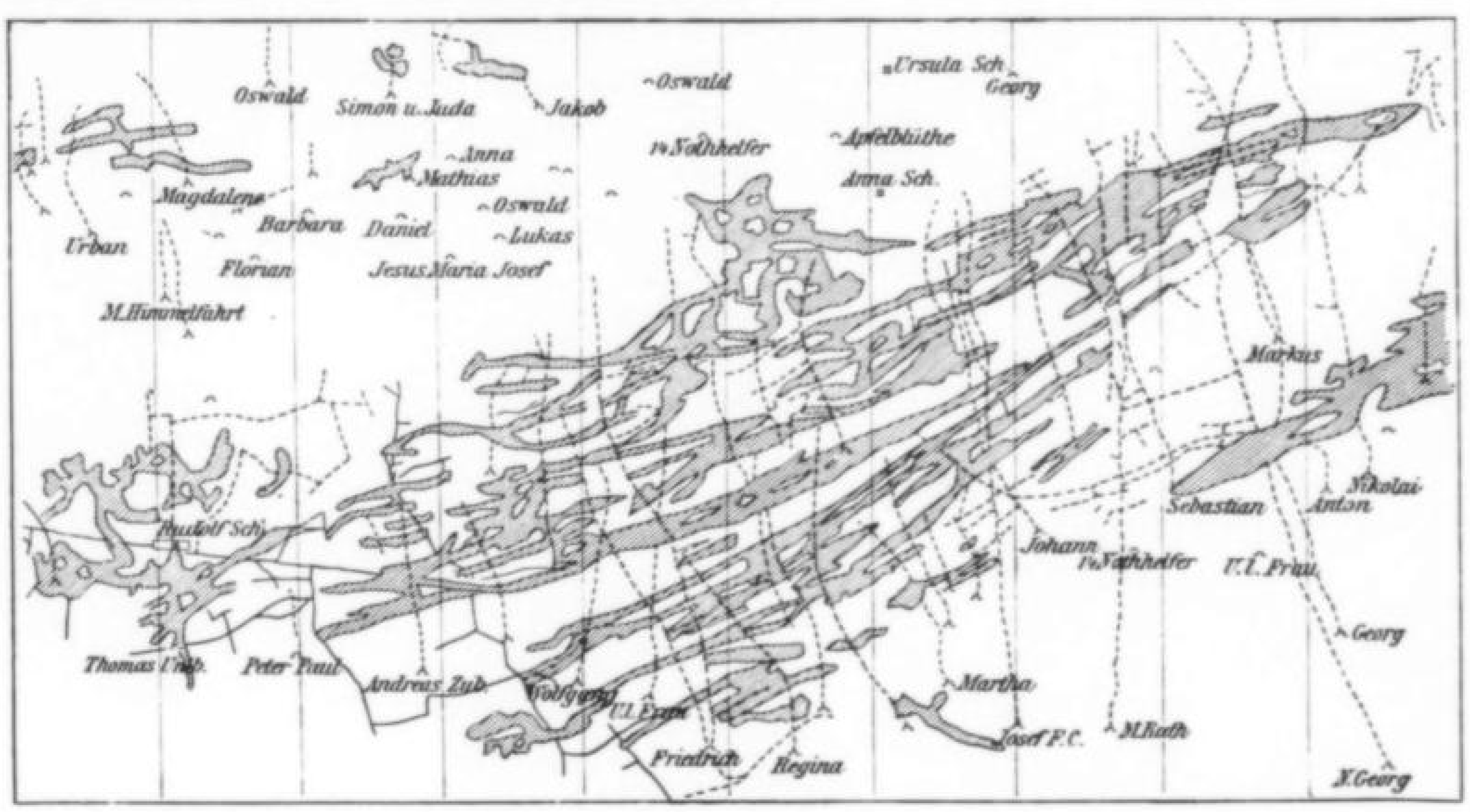

Figure 7. **Detail from a district map by Posepny (1873) showing various mines in the Bleiberg area.**

economic production of sulfuric acid from the roast gases.

Production of zinc metal is by an electrochemical procedure. In addition to metallic lead and zinc, the facilities also produce white lead, red lead, "superphosphate" and zinc sulfate.

In 1951 a heavy flow of thermal water was encountered in the Rudolf mine which quickly flooded the lower 200 meters of the workings. More than a year was required to reclaim this part of the mine, but by 1966 a health resort based on the hot mineral waters had been erected and was drawing visitors; the attraction became known as Bad Bleiberg ("Bleiberg Baths").

For many years now the high valley of Bad Bleiberg has been a popular spot, not only among hot springs enthusiasts but among mineral collectors and mineralogists who comb the old dumps and seek out the old miners in search of specimens. Thus far approximately 50 species have been identified at Bleiberg, three of which (wulfenite, hydrozincite and ilsemannite) were new to science.

GEOLOGY

Regionally the Bleiberg deposits belong to the Drauzug, a series of mineralized Triassic sedimentary rocks. At the base of the sequence are red sandstones and conglomerates of the Gröden formation, followed upward by gray sandstones, shales, graywackes and gypsum beds of the Werfen formation, and dark limestones and dolomites of the Anis formation. This latter unit is gypsiferous in places, where it is known at "Alpine Muschelkalk." These in turn are overlain by the middle Triassic Wetterstein limestone and dolomite complex; ore mineralization was long thought to be confined to the upper 120 meters of this unit. Only later was it realized that the overlying Raibler beds (also known as the Cardita formation), especially the dolomitic horizons, also carried relatively large orebodies. In fact, stratigraphic domains even higher in the sequence have also occasionally been found to be mineralized.

In the uppermost beds of the Wetterstein complex (the so-called

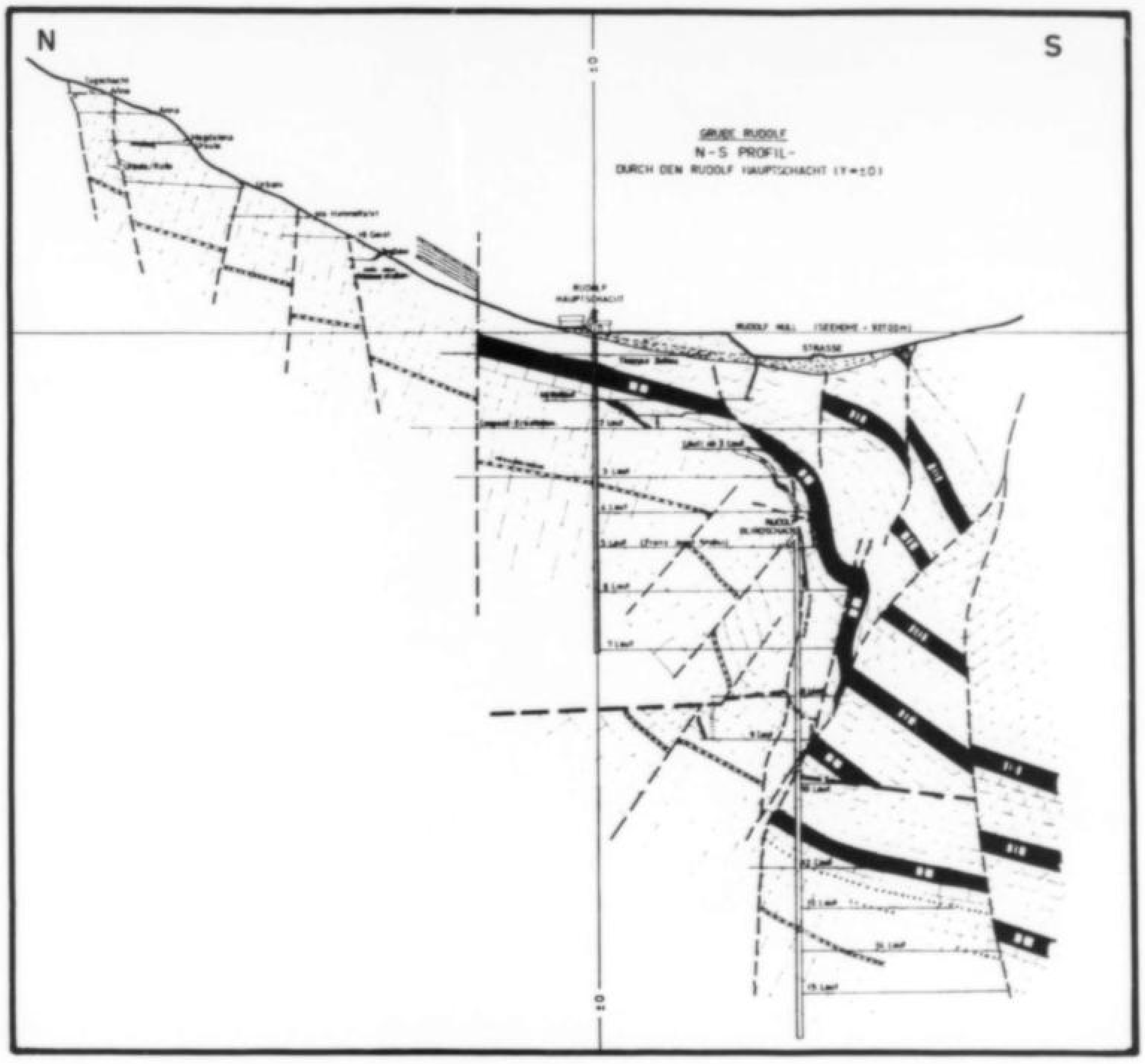

Figure 8. **A north-south through the Rudolf mine showing complex tectonic displacements of the ore horizons (Kostelka, 1972).**

"Bleiberger Sonderfazies") stratibound ore deposits appear principally along particular horizons which the early miners called "noble" beds. These contained stockworks and mineralized cavities. In part, at least, the stratigraphic relationships of the deposits were understood by Frederick Mohs who (in 1807) wrote:

> I do not believe it is possible to misconstrue the stratibound nature of these deposits. I assume that several successive sets of beds are to be characterized as true orebodies. The fossils in these beds indicate simultaneous deposition. They lie betwen barren beds, and with these form the thick series upon which the hope for successful mining is based. I further note that these thick beds, with enclosed ore horizons, are cut by nearly vertical, parallel fissures along which segments are offset, resulting in the present distribution of ore . . . . But there are also veins filled with galena. To explain their formation I note that they are emplaced above, below and within the actual ore horizons themselves. The veins were filled from these ore horizons and can invariably be traced to a connection with these beds unless subsequent tectonism has obscured the relationship.

Unfortunately Moh's astute observations remained unknown, and one of Austria's foremost mining geologists, F. Posepny, advocated in 1873 an epigenetic origin for Bleiberg ores. Consequently the Bleiberg deposits were long regarded as epigenetic, and the ore-forming solutions as a product of Alpine tectonism. Only since the 1950s has it finally been recognized that ore formation actually took place during and shortly after deposition of the Triassic sediments.

The argillaceous Raibler beds overlying the Wetterstein complex are prominent throughout the Drauzug and beyond, and mark a change in the regional conditions of deposition. These rocks are in part very rich in fossils; the well-known *Lumachelle,* which F. X. von Wulfen so beatifully described in his memoir of 1793, is from this horizon. The *Lumachelle,* conspicuous by the play of colors seen in its shell fragments,* was found in the St. Oswald tunnel near Bleiberg. Large blocks of *Lumachelle*-rich rock were quarried for ornamental use, much to the dismay of von Wulfen.

The sequence of beds at Bleiberg has been divided into three general units: the Drobratsch unit to the south, the Rubland unit to the north, and the Bleiberg unit between them. These three units are tectonically distinct and also show differences in facies development. Ore mineralization is limited to the Bleiberg and Rubland units.

In the Bleiberg area, rocks of the Bleiberg unit plunge steeply to the south, passing under the Dobratsch unit, and have been heavily faulted into stockworks. The intense fracturing and faulting hinders the search for ore and causes problems in rock mechanics and water control.

With few exceptions, the lead-zinc deposits in calcareous rocks of the eastern Alps show distinct similarities. Deposits of the "Bleiberg type" include not only the Bleiberg-Kreuth district but also a large number of other occurrences in the Drauzug itself and the southern Alps in general. Included among these is another of Europe's famous wulfenite occurrences, the mines at Mezica in Slovenia. Small, comparable deposits also extend into the northern Alps of Tyrol and Bavaria. In all cases the mineralization is Middle Triassic in age, connected and associated with massive, essentially pure calcareous rocks. The absence of any ore minerals other than galena and sphalerite is typical.

Discussions regarding the origin of these deposits have at times been carried on with some vehemence. Today it is generally agreed that mineralization was syngenetic with sedimentation – that is, metals were supplied during and shortly after deposition of the carbonate rocks at relatively low temperatures. Though some ques-

* The shell fragments in Bleiberg *Lumachelle* come primarily from a certain ammonite (*Carnites floridus*); the aggregate resembles the "ammolite" or "korite" specimens from Lethbridge, Alberta, Canada, which are currently common on the market.

tions remain unanswered, it is believed that metaliferous solutions rose through deep broken zones during the Triassic and may have been influenced by deep-lying saline deposits. In general, "Bleiberger type" lead-zinc deposits are probably analogous to Mississippi Valley-type ores.

Alteration or redeposition of the primary ores (in some cases as veins) took place at a much later date. This includes the formation of the many oxide-zone minerals so treasured by collectors. These have been found primarily along deep zones of dislocation on the lower levels; the Presse lens in the Rudolf shaft, for example, was found at a depth of 400 meters (1300 feet) below the surface.

A rather large variety of minerals, some occurring in the range of habits and crystal forms, is found at Bleiberg. For more details the reader is referred to the studies of Schroll (1953, 1984), Meixner (1957) and Kanaki (1972) which, taken together, furnish a comprehensive and detailed picture of Bleiberg mineralization.

Secondary mineralogy is to a large extent dependent on the character of the primary ore, which is not uniform at Bleiberg. Lead dominates in the eastern part of the district and zinc in the west. Corresponding differences exist in the distribution of oxidation products.

Among the primary syngenetic sedimentary minerals, galena, sphalerite, wurtzite, gypsum and anhydrite are most prominent, but fluorite, quartz, pyrite, marcasite, dolomite and calcite are important as well. Schroll (1953) classifies the baritic lead-zinc ores in the eastern part as "Bleiberg type" and the western fluorite zinc-lead ores as "Kreuth type." Pyrite, marcasite and carbonates are uniformly distributed throughout the district. Gypsum (pink to white), anhydrite (pale blue to gray masses) and idiomorphic micro-crystals of quartz are taken to indicate a saline environment.

Syndiagenetic minerals, those crystallized or recrystallized shortly after sedimentation, include many of the above-mentioned species but in a great variety of habits and assemblages; only a few of these can be mentioned here. Galena forms as rather large octahedrons, but sphalerite crystals are small (rarely reaching 1 cm) and most common as dense crusts of 1–2 mm crystals. Wurtzite, even in the scale habit, is rarely preserved unaltered to sphalerite. Calcite shows a wealth of crystal forms and habits. The "cannon spar" so characteristic of Bleiberg calcite is generally a rather late product. Small, attractive crystals of celestite, quartz and barite are early recrystallizations of syngenetic minerals, as are some pyrite and marcasite.

The younger oxidation products are far more varied than their syngenetic and syndiagenetic predecessors, and are distributed rather unevenly throughout the district. The best known occurrences are mostly located in the eastern part, and include the Franz Josef, Rudolf and Stefanie workings. Toward the west secondary minerals become less abundant due to the increasing depth of the ore and also to the increasing predominance of zinc over lead in the ore.

Important oxidation-zone minerals include wulfenite, hemimorphite, cerussite, vanadinite, descloizite, hydrozincite, greenockite, barite and many others. Molybdenite, ilsemannite and jordisite are very rare.

MINERALS

Anglesite $PbSO_4$

The lead sulfate, anglesite, is much less abundant that cerussite and in the earlier workings was found only sporadically in the eastern part of the district. Besides {211} dipyramids, mostly colored lead-gray by encrustation with tiny galena crystals, it was also found as platy crystals with {001} dominant.

Anhydrite $CaSO_4$

Anhydrite occurs at Bleiberg as pale blue to grey, dense to coarse-grained masses, often also with galena and sphalerite. It is unknown as free crystals in open spaces.

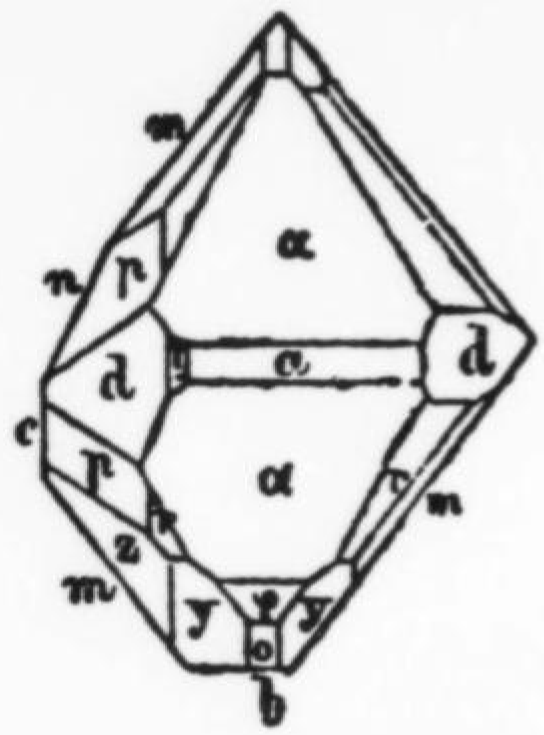

Figure 9. **Bleiberg anglesite; crystal drawing from Goldschmidt (1913).**

Aragonite $CaCO_3$

Aragonite occurs as thin needles over calcite on which are emplaced tiny kernels of sphalerite. It is rare in this deposit and has probably often been confused with strontianite. Aragonite is an essential component of shell scales in the Bleiberg "Muschelmarmor" or shell marble.

Barite $BaSO_4$

The white, hemispherical, 1.5-cm barite aggregates, mostly implanted on galena and sphalerite, are well known at Bleiberg. Coatings of barite parallel to beds or fissures are also common. Needle-like crystals are rare. Thick, tabular, brown crystals several centimeters in dimension are also known.

Barytoanglesite $(Ca,Pb)SO_4$

According to the X-ray examination by Kanaki (1972) the so-called "barytoanglesites" of Bleiberg are actually submicroscopic mixtures of anglesite and barite.

Bianchite $(Zn,Fe^{+2})(SO_4)\cdot 6H_2O$

Bianchite is rare at Bleiberg. It occurs as thin cleft fillings in clay slates, together with melanterite and rozenite.

Calcite $CaCO_3$

Calcite in large crystals up to 10 cm is a very common mineral at Bleiberg and appears in several habits. Scalenohedral, rhombohedral and thick prismatic crystals have been observed which belong to different generations. Several twin laws are also present; these include "butterfly" twins on (101). Clear, milky white, grey and rarely orange calcites also occur.

White to colorless, often pearly, rhombohedral crystals and coatings of plumbian calcite ("plumbocalcite") occur with galena and calcite on limestone. According to Kanaki (1972), some plumbian calcite may instead be a very fine-grained intergrowth of cerussite and calcite. Rhombohedral, partly white, partly brownish crystals with brilliant luster have been shown by X-ray analysis to be true plumbian calcites.

Celestite $SrSO_4$

Celestite occurs at Bleiberg as prismatic crystals elongated parallel to the *a* axis and tabular {001} crystals up to 1 cm, usually pale blue and sometimes transparent. These occur with calcite, fluorite, anhydrite and gypsum, rarely also with coarse galena; the mineral is generally rare at Bleiberg.

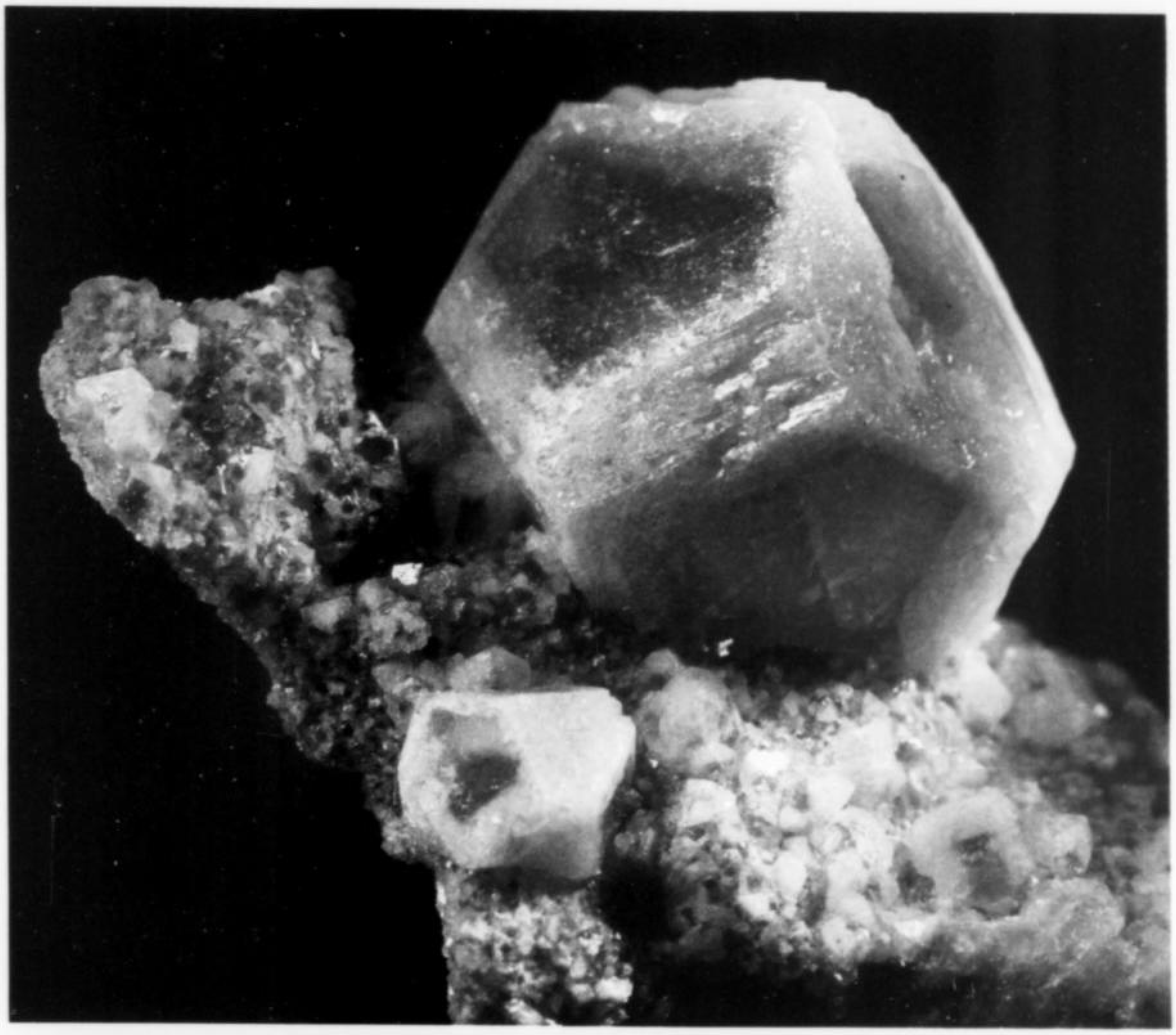

Figure 10. **Calcite crystal, 5.5 cm. W. Knobloch collection; photo by R. Bode.**

Figure 11. (below) **Calcite crystal, 1 cm. W. Knobloch collection; photo by R. Bode.**

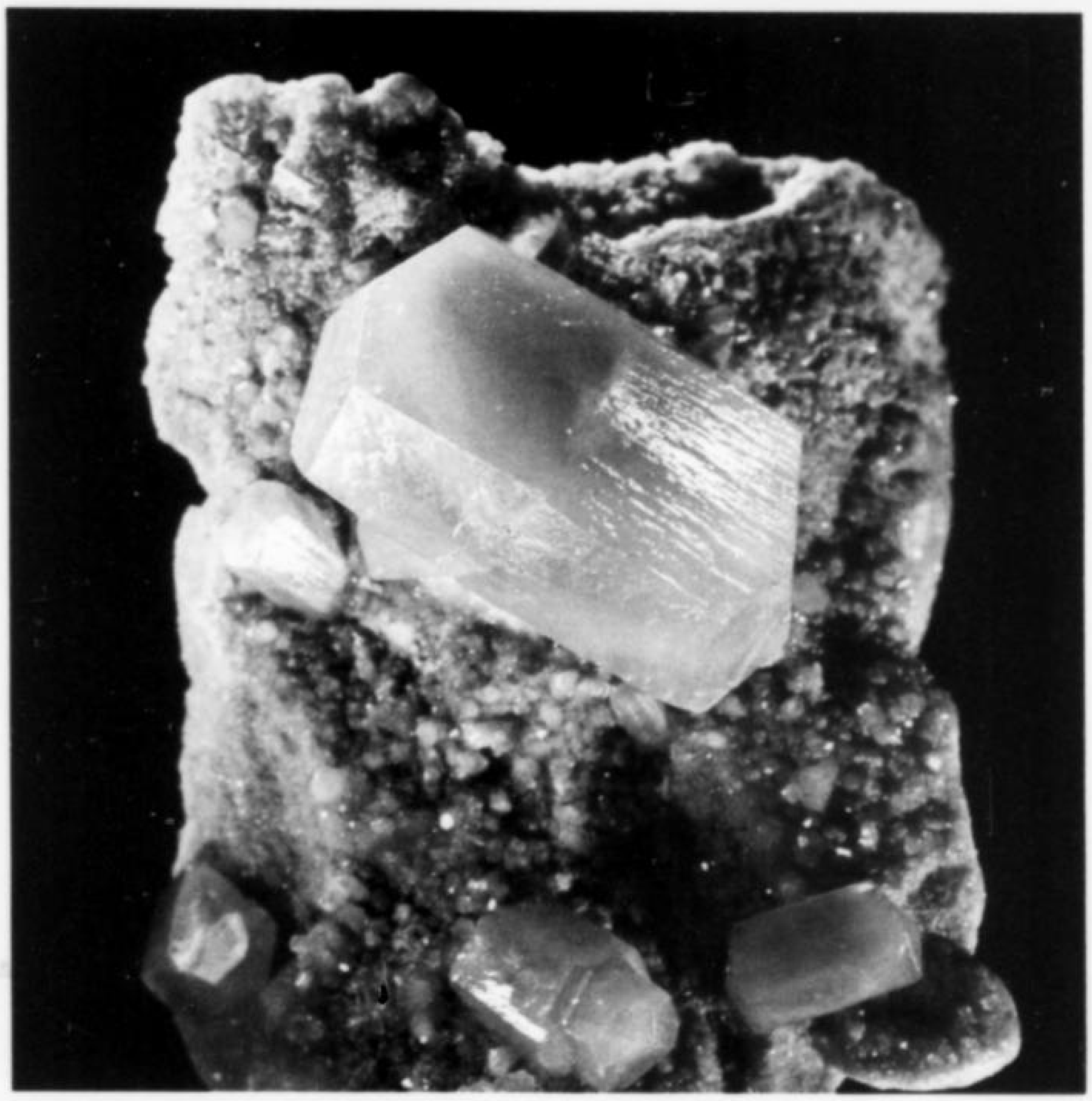

Figure 12. **Calcite crystals to 3.7 cm, on matrix. Natural History Museum of Vienna collection; photo by R. Bode.**

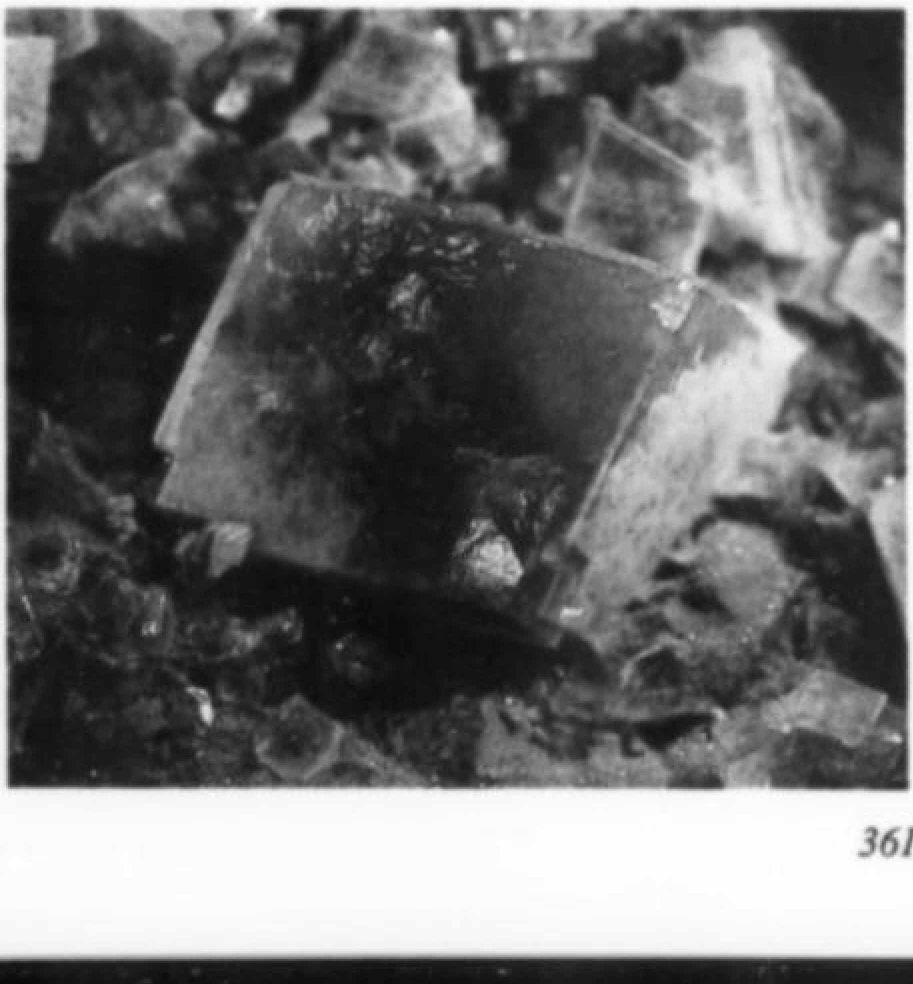

Figure 13. **Plumbian calcite crystal, 2.2 cm. Natural History Museum of Vienna collection; photo by R. Bode.**

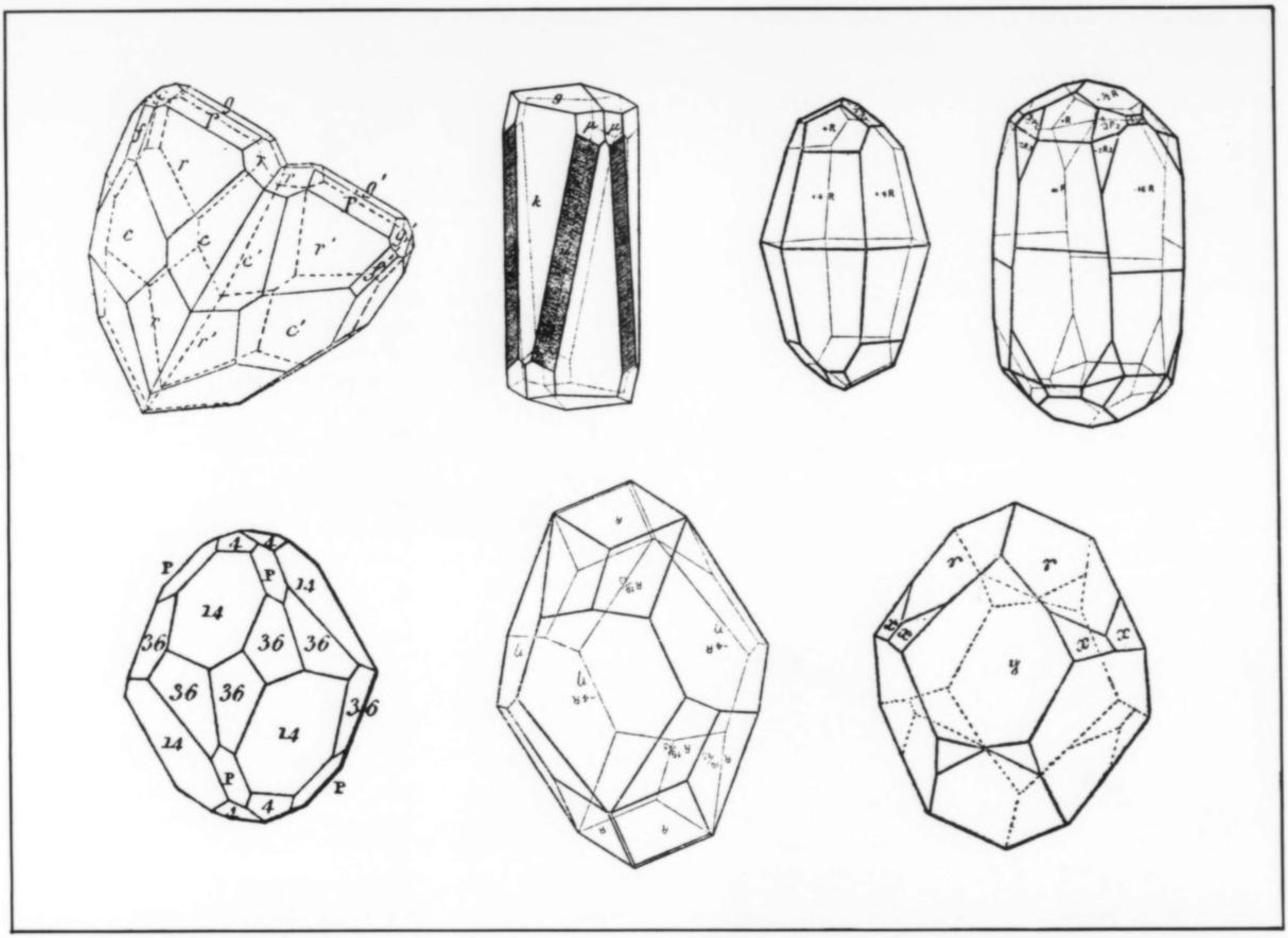

Figure 14. **Bleiberg calcite; crystal drawings from Goldschmidt (1913).**

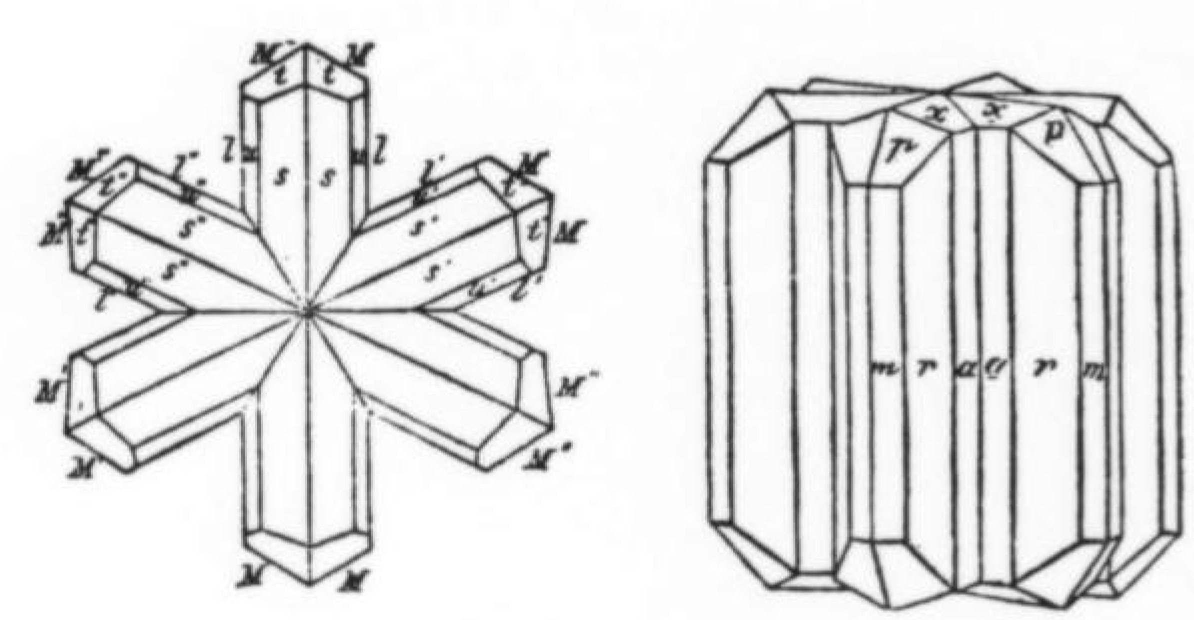

Figure 15. **Bleiberg cerussite twins; crystal drawings from Goldschmidt (1913).**

Figure 16. **Colorless cerussite crystal, 7 mm tall. Natural History Museum of Vienna collection; photo by R. Bode.**

Cerussite $PbCO_3$

Along with wulfenite, cerussite is the most common and most interesting mineral in the oxidation zone of the Bleiberg deposit. The crystals are often water-clear, transparent, but in part gray or turbid due to inclusion of ultrafine galena. The average dimension of the crystals is 2–6 mm, but crystals up to 2 cm, including cyclic twins, have also been described.

Chalcophanite $(Zn,Fe^{+2},Mn^{+2})Mn_3^{+4}O_7 \cdot 3H_2O$

The chalcophanite occurrence at Bleiberg has not been confirmed. "Thin reddish brown to steel-gray crusts with hemimorphite crystals over hydrozincite" have been described by Meixner (1957), and crystals surrounding todorokite were mentioned by Kanaki (1972).

Descloizite $PbZn(VO_4)(OH)$

Descloizite appears as an incrustation of dark brown crystals in clefts of the Wetterstein limestone and is rarely also associated with wulfenite. It is known from the Franz Josef and Stefanie mines, on the dumps below the Rauchfang wall, and along the Sonnblick path above the Legaten wall.

Dolomite $CaMg(CO_3)_2$

In spite of the prevalence of dolomite rock, distinct crystals of dolomite with the typical curved, saddle-shaped, aggregates have only rarely been observed.

Fluorite CaF_2

Coarse fluorite is, in part, rather abundant, especially in the western part of the district. Fluorite forms dense, colorless crusts of cubic crystals from 1 mm to, exceptionally, 20 mm on an edge.

Figure 17. **Galena crystals to 1 cm on calcite. Natural History Museum of Vienna collection; photo by R. Bode.**

Galena PbS

Galena, along with sphalerite, is the principal ore mineral in the district. It occurs as vein fillings, on bedding planes and as well-formed crystals. Octahedrons up to 3 cm have been observed. This galena is practically free of silver. "Pipe ores" (*Röhrenerze*), like the columnar galena from Raibl (with sphalerite and calcite), have also been found.

Goethite α-$Fe^{+3}O(OH)$

Goethite, in ocherous, red-brown and earthy masses and incrustations, is a common oxidation product of pyrite, marcasite and iron-rich sphalerite.

Goslarite $ZnSO_4 \cdot 7H_2O$

White efflorescences of acicular goslarite crystals, probably of recent formation, have been collected.

Greenockite CdS

Greenockite usually occurs as greenish yellow, thin crusts on galena, sphalerite and the country rocks (limestone and slates). It commonly forms near pale yellow sphalerite that is thought to be cadmium-rich.

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

Groutite has been found at Bleiberg as reniform, black incrustations (Kanaki, 1972) with goethite, lepidocrocite and pyrolusite.

Gypsum $CaSO_4 \cdot 2H_2O$

Acicular gypsum, in part of recent formation, is not rare in the district. Fairly coarse nests of gypsum crystals in limestone and gypsum crusts on anhydrite are also found. In the deeper parts of the Bleiberg sequence it also occurs between beds of limestone or dolomite, and has a reddish color due to the inclusion of submicroscopic hematite platelets.

Hemimorphite $Zn_4Si_2O_7(OH)_2 \cdot H_2O$

Tabular crystals of hemimorphite form dense incrustations on the country rocks, and on other minerals (especially galena and barite). Hemimorphite also occurs as a sinter-like formation and as stalactites. Hemimorphite crystals may reach 2 cm in size and are mostly colorless but also yellow, murky, gray or brown. It is a mineral of the oxidation zone at Bleiberg and is more common than smithsonite.

Hydrozincite $Zn_5(CO_3)_2(OH)_6$

Soft, chalk-white incrustations of hydrozincite are found on other oxidation products and on galena. Hydrozincite also occurs as a component of stalagmites and associated sinter. It was first recognized, from Bleiberg, as a new species by Smithson in 1803.

Ilsemannite $Mo_3O_8 \cdot nH_2O$(?)

Ilsemannite was recognized at Bleiberg by Hofer (1871) and described as a new mineral species. It is an oxidation product of jordisite, is dark blue in color, water soluble, and occurs in earthy masses.

Jordisite MoS_2

Jordisite, a black, amorphous, molybdenum sulfide, is present in clefts in the Wetterstein limestone and also in the Carnic and Norian schists. It is, however, a rare mineral.

Leadhillite $Pb_4(SO_4)(CO_3)_2(OH)_2$

The occurrence of leadhillite at Bleiberg has previously been the subject of some doubt. However, leadhillite in tabular crystals with pearly luster from the area of the Stefanie mine has been identified on several specimens and confirmed by X-ray analysis.

Lepidocrocite γ-$Fe^{+3}O(OH)$

Lepidocrocite occurs with goethite as brown, earthy masses and crusts; it cannot be distinguished from goethite macroscopically.

Loseyite $(Mn,Zn)_7(CO_3)_2(OH)_{10}$

Recently formed white crusts on timbers in the Max mine were initially thought to be hydrozincite. X-ray analysis showed that the specimens are loseyite with some admixed hydrozincite (Kanaki 1972).

Marcasite FeS_2

Marcasite frequently occurs with pyrite, especially in bread loaf-sized nodules and in pyritized fossils in the Cardita shales. It also forms in small crystals of various habits, including the acicular "spear pyrite" and multiple twins on (101).

Melanterite $Fe^{+2}SO_4 \cdot 7H_2O$

Melanterite occurs rarely at Bleiberg as fibrous, pale green aggregates in fissures in slate.

Figure 18. **Wulfenite crystals to 2.5 cm. Natural History Museum of Vienna collection; photo by R. Bode.**

Figure 19. **Wulfenite crystals to 8 mm. W. Knobloch collection; photo by R. Bode.**

Figure 20. **Wulfenite crystal, 9 mm. Natural History Museum of Vienna collection; photo by R. Bode.**

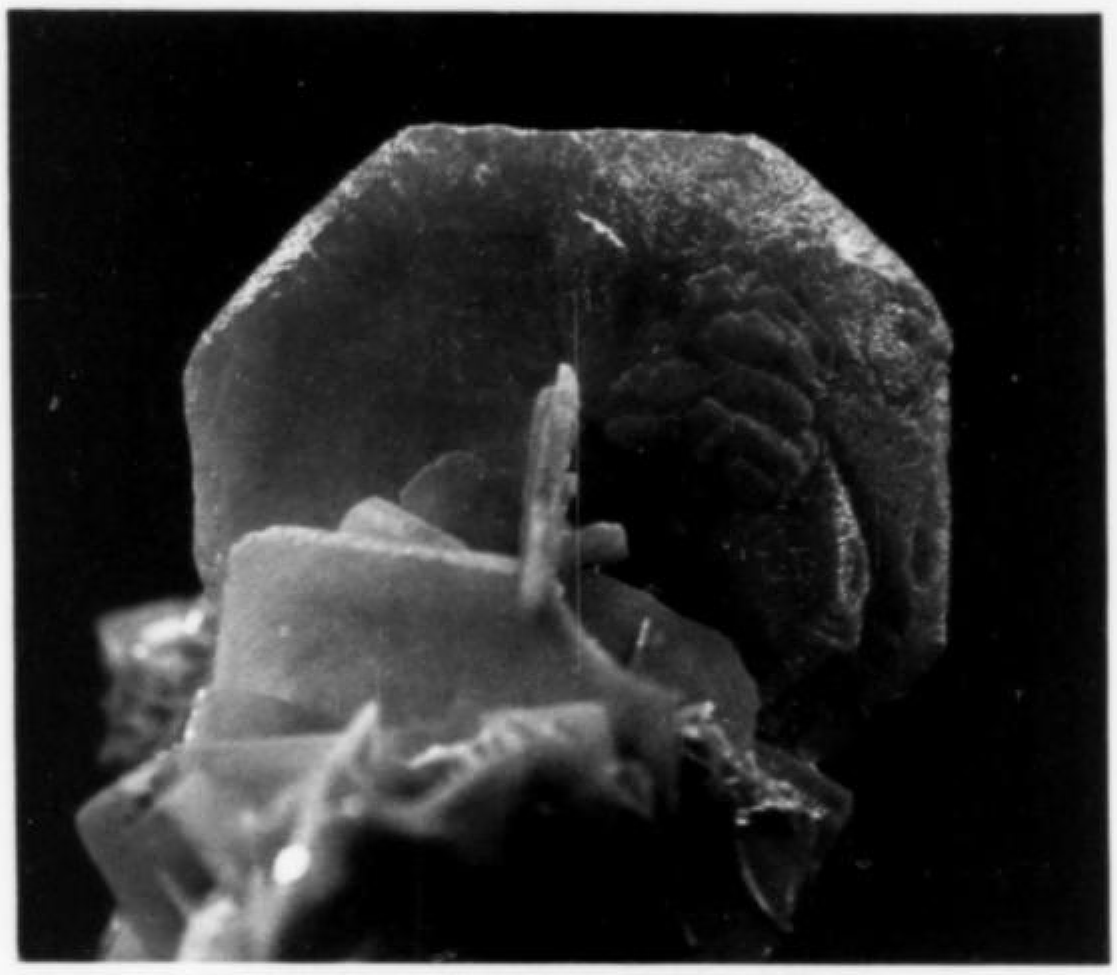

Figure 21. Wulfenite crystal, 2.5 cm, from the Stefanie mine, Bleiberg, collected in 1984. Natural History Museum of Vienna collection; photo by R. Bode.

Figure 22. (top right) Wulfenite crystals to 2 mm, colored dark and turbid by inclusions of galena. Natural History Museum of Vienna collection and photo.

Figure 23. Wulfenite crystals to 5 mm. Natural History Museum of Vienna collection; photo by R. Bode.

Figure 24. Wulfenite crystals to 1.5 cm. W. Knobloch collection; photo by R. Bode.

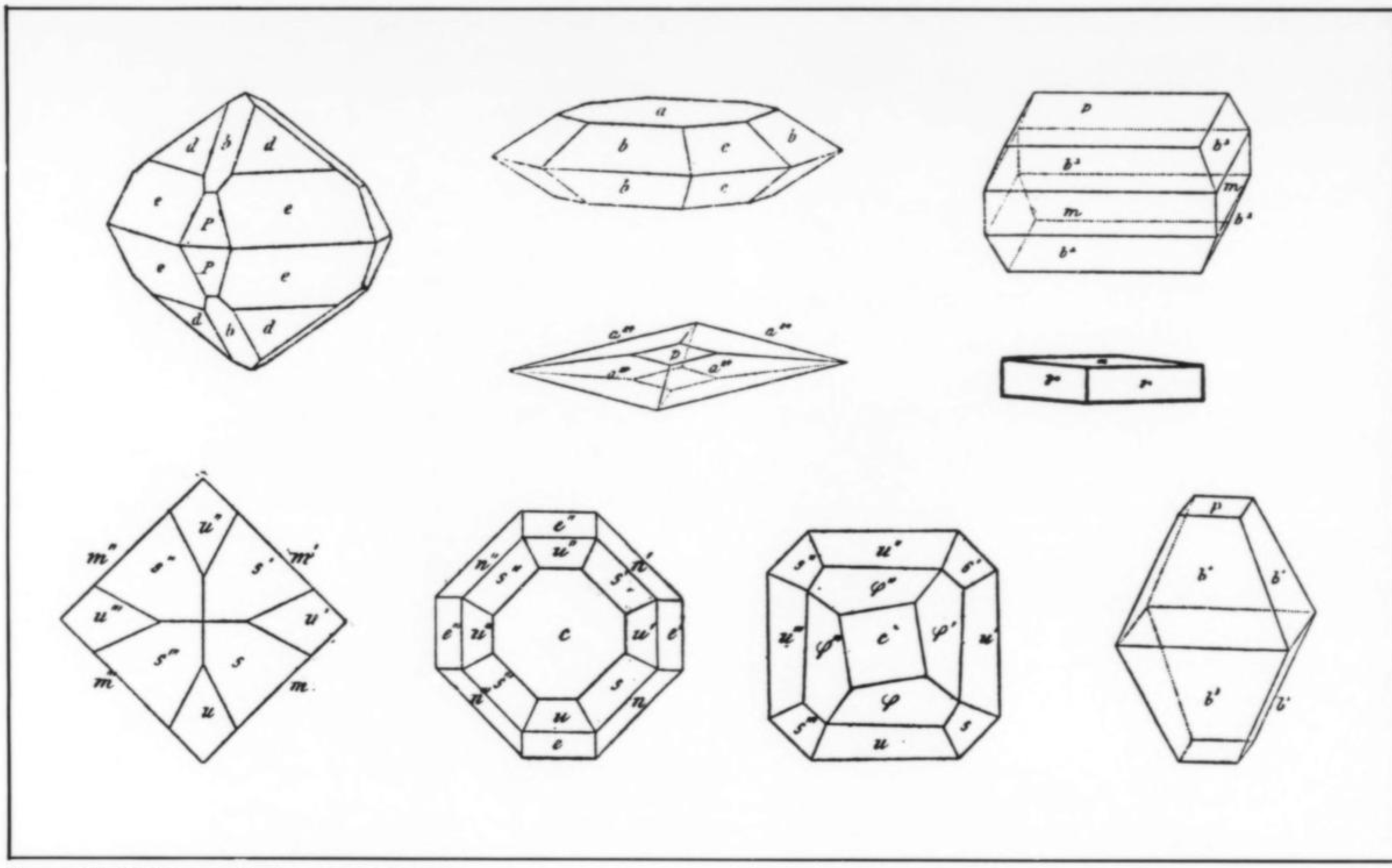

Figure 25. **Bleiberg wulfenite; crystal drawings from Goldschmidt (1923).**

Figure 26. **Franz Xavier von Wulfen (1728–1805) was born in Belgrade, Yugoslavia. He became a priest and studied philosophy and mathematics in Vienna, and theology in Graz. Throughout his life he maintained an active interest in the natural sciences, and wrote a famous monograph on Bleiberg wulfenite in 1785. The mineral was subsequently named in his honor, as was also a rare flower from Carinthia (*Wulfenia*).**

Xavier Wulfens

Abhandlung

vom

kärnthnerischen Bleyspate.

Wien,

Figure 27. **Title page of Wulfen's 1785 monograph on wulfenite from Bleiberg.**

Molybdenite MoS_2

The occurrence of molybdenite at Bleiberg is similar to that of jordisite and probably formed from it. It has been found very rarely as tiny tabular crystals.

Palygorskite $(Mg,Al)_2Si_4O_{10}(OH)\cdot 4H_2O$

White, fibrous to coarse tabular aggregates of palygorskite have been found in clefts in the dolomitic Cardita beds and in the Wetterstein dolomite. The mineral is seldom associated with ore.

Psilomelane (= massive, unidentified Mn oxides)

Dark brown to black crusts of psilomelane on hemimorphite crystals from the 11th level of the Stefanie mine have been confirmed by X-ray analysis. It is rare at Bleiberg.

Pyrite FeS_2

Pyrite is rarer than marcasite, with which it often occurs in these deposits. Mostly it forms tiny millimeter-sized cubic crystals and granular aggregates.

Pyrolusite MnO_2

Pyrolusite (along with groutite and goethite) has been identified in limonitic crusts.

Quartz SiO_2

Microscopic, holohedral quartz crystals occur embedded in the Wetterstein limestone. In vugs they rarely attain dimensions of 2 mm to 1 cm. Crystals of rhombohedral as well as dihexagonal habit have been noted. It is rare in the ore zones.

Rozenite $Fe^{+2}SO_4 \cdot 4H_2O$

Rozenite occurs rarely with melanterite and bianchite in crevices in slaty rocks.

Smithsonite $ZnCO_3$

Smithsonite occurs as botryoidal to reniform, colorless to brownish crusts of rudely formed crystals. It is rarer than the associated hemimorphite.

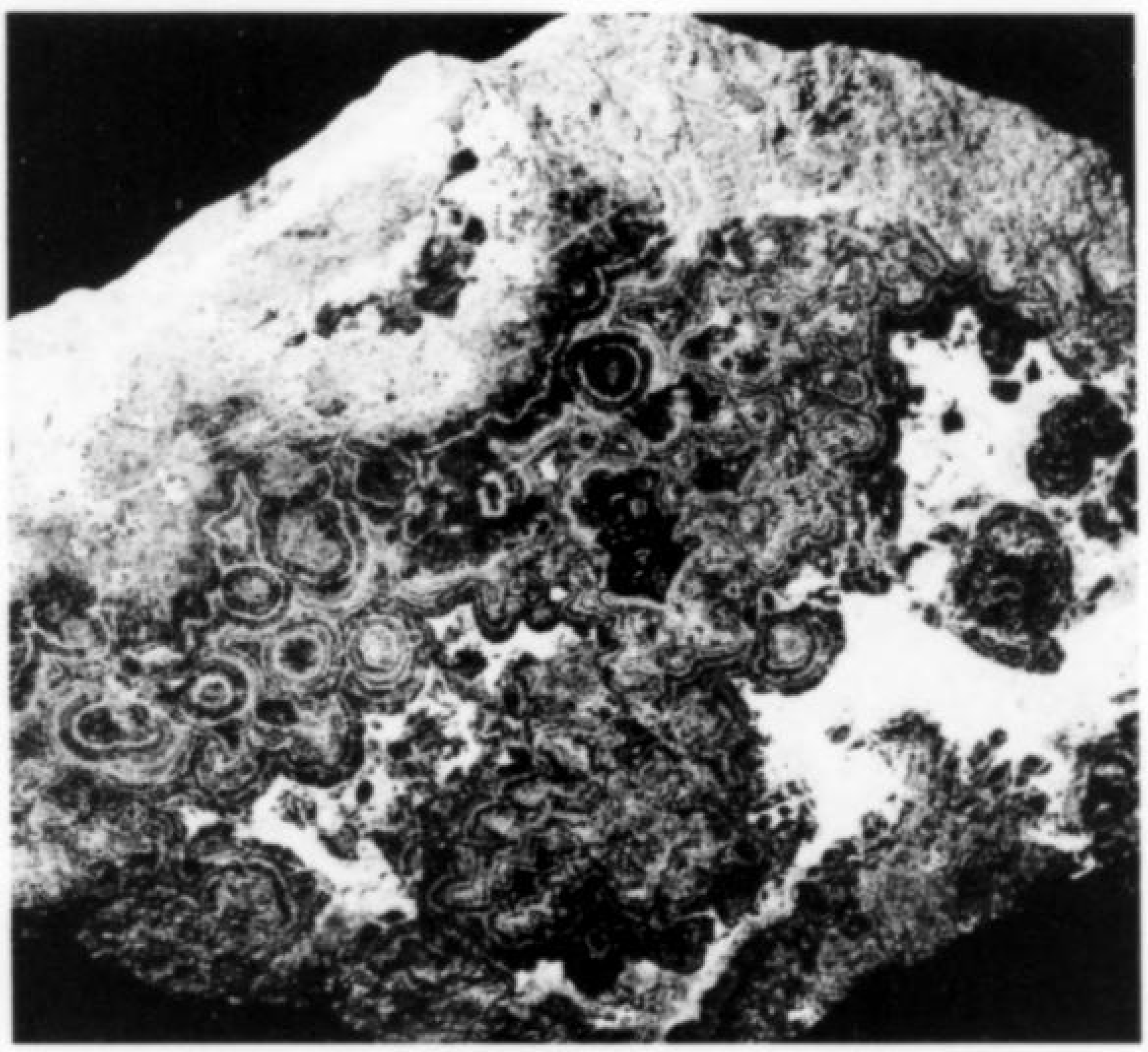

Figure 28. **Sphalerite-rich ore known as *Schalenblende,* about 15 cm across. Werner Lieber photo.**

Sphalerite (Zn,Fe)S

Sphalerite, along with galena, is the principal ore mineral in the Bleiberg deposits and is more abundant than the latter, especially in the western part of the district. Sphalerite forms dense layers often parallel to the bedding. The variety *Schalenblende* can be found as fine-grained crusts with a 1-mm to 1-cm crystal size. The color is light gray, orange, red, brown and black.

Strontianite $SrCO_3$

Sheaf-like aggregates of thin intergrown strontianite needles up to 1 cm have been found. Formerly, it has sometimes been regarded as aragonite; later it was X-ray identified as strontiantite. The mineral is rare, and occurs mostly implanted on calcite.

Sulfur S

Sulfur is a recent product at Bleiberg. It forms as small, bright yellow, sometimes soft plastic hemispherical aggregates. It occurs with greenockite.

Todorokite $(Mn^{+2},Ca,Mg)Mn_3^{+4}O_7 \cdot H_2O$

Manganese oxides occur in minor amounts with goethite and lepidocrocite. Black, botryoidal to reniform crusts have been shown to be todorokite by X-ray analysis (Kanaki, 1972).

Vanadinite $Pb_5(VO_4)_3Cl$

Small, prismatic, yellow, brown and red-brown crystals of vanadinite with cerussite and calcite have been found on porous Wetterstein limestone. The find was made at the Altstefanie dump in Kadutschen, east of Bleiberg.

Wulfenite $PbMoO_4$

Wulfenite is a typical oxidation zone mineral in many mines of the Bleiberg district. The Abbot Franz Xavier von Wulfen described the "kärntnerischen Bleyspate" from Bleiberg in 1785.* Sixty years later the geologist and mineralogist Wilhelm Karl von Haidinger, director of the Imperial Geological Survey in Vienna, named the mineral wulfenite in honor of its discoverer. Up until this time the mineral had been known under a variety of terms including *gelber Bleispath* ("yellow lead spar"), *Gelbbleirz* ("yellow

Table 1. **Minerals of the Bleiberg-Kreuth district.**

Principal Ores	*Carbonates*
Galena	Aragonite
Sphalerite	Calciostrontianite
	Calcite
Principal Secondary Minerals	Dolomite
Cerussite	Loseyite
Hemimorphite	Smithsonite
Hydrozincite	Strontianite
Wulfenite	*Sulfates*
	Anglesite
Other Species Present	Anhydrite
Elements	Barite
Sulfur	Bianchite
Sulfides	Celestite
Greenockite	Epsomite
Jordisite	Gypsum
Marcasite	Goslarite
Molybdenite	Leadhillite
Pyrite	Melanterite
Wurtzite	Rozenite
Halides	*Oxides and Hydroxides*
Fluorite	Chalcophanite (?)
Silicates	Goethite
Palygorskite	Groutite
Quartz	Ilsemannite
Vanadates, Molybdates	Lepidocrocite
Descloizite	Manganomelane
Ferrimolybdite	"Psilomelane"
Vanadinite	Pyrolusite
	Todorokite
	Woodruffite

* In the literature, attention is sometimes drawn to the fact that Ignaz von Born (1772) described a mineral he called *plumbum spatosum flavor rubrum pellucidum* from the Annaberg mine in southern Austria several years before Wulfen's monograph. Some authorities therefore believe that Annaberg should have priority as the type locality for wulfenite. However, it should be remembered that Haidinger clearly named the mineral in honor of Wulfen's work at Bleiberg. Furthermore, Born also refers to *plumbum spatosum flavescens effervescens, Carinthiae* in his 1772 paper, the description of which coincides with Bleiberg wulfenite. Consequently, Bleiberg should stand as the type locality.

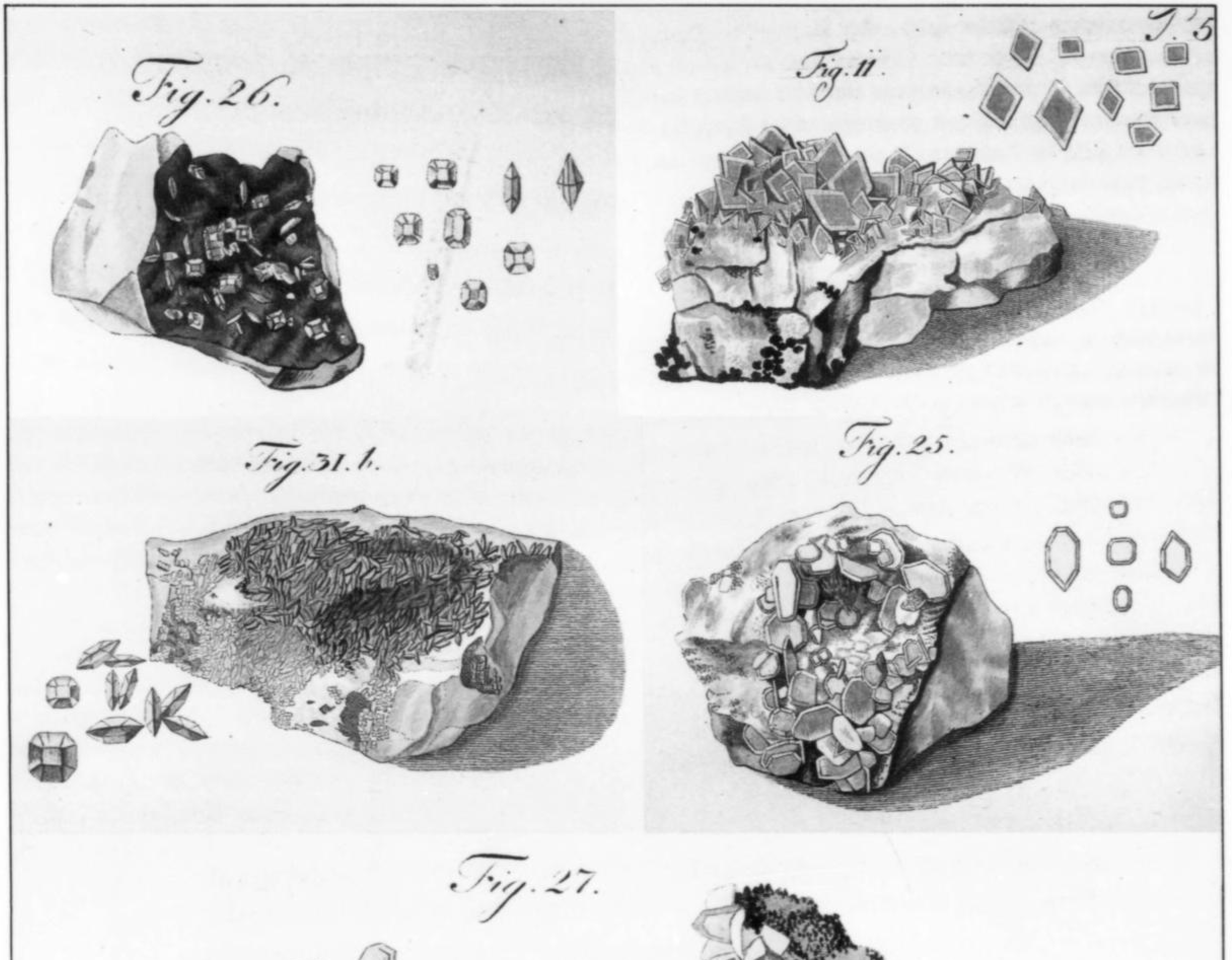

Figure 32. **Wulfenite illustrations from Wulfen (1785); taken from a copy loaned to the *Mineralogical Record* by Wayne Leicht.**

lead ore"), and *pyramidaler Blei-Baryt*. The most common habit is a simple combination of {001} and {110}. For a detailed discussion of Bleiberg wulfenite the reader is referred to Kanaki (1972), who distinguishes nine distinct habits.

In recent years crystals up to 2.5 cm have been found in the Stefanie mine in the eastern part of the district; these are the largest wulfenites found at any Austrian locality. In addition to the great variety of habits among Bleiberg wulfenites, their variety of colors is also notable, as recognized by Wulfen. Colorless, green, lemon or honey-yellow, ocherous, orange, red, gray and black wulfenites are known. The color of the latter is due to microscopic galena inclusions; these black wulfenites tend to be pyramidal and resemble the wulfenites from Příbram, Czechoslovakia.

Wulfenite is most unevenly distributed in the district; in the eastern lead-rich area it is common, whereas in the west it is rare. At times in the past wulfenite has been found in the Stefanie and Franz Josef mines in great amount and in large masses. It was mined for its molybdenum content when economic condition permitted.

Wurtzite (Zn,Fe)S

Wurtzite is rare at Bleiberg but occurs in the *Schalenblende* sphalerite ore, and is often altered to sphalerite.

CONCLUSIONS

Compared to other lead-zinc mines of the world, the mining at Bleiberg-Kreuth is a relatively small operation. Nevertheless is supplies Austria with lead and zinc. It may also be that the mining will yield more interesting specimens for collectors in the future. This ancient and famous locality is by no means extinct.

ACKNOWLEDGMENTS

My thanks to Adolf Pabst for kindly preparing the English translation. Thanks also to Werner Lieber, Wayne Leicht and Friedrich H. Vcik for providing additional illustrations.

Figure 33. **The American smelter at Kreuth.**

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Brochantite and Other Minerals from the Paoli, Oklahoma, Area

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INTRODUCTION

The first and only documented occurrence of well-crystallized brochantite in Oklahoma was discovered in 1981 in northern Garvin County near the community of Paoli. The outcrop containing the brochantite is located along the extreme eastern edge of the NE ¼ of Sec. 24, T4N, R1W, about 3 kilometers south-southeast of Paoli. In the vicinity are numerous other exposures of copper-bearing sandstones, but none has produced specimen-quality brochantite.

The deposit was mined for brochantite by the author in 1981 and has been worked intermittently since that time. Almost all of the brochantite was removed by trenching during the initial mining period.

The brochantite deposit and most of the other deposits described in this report are on private property owned by various area farmers and ranchers. The deposits are generally not open to collecting, although special permission can sometimes be obtained from the landowners. Several of the deposits outcrop on county road rights-of-way southeast and east of Paoli.

HISTORY

Early settlers in Oklahoma noticed greenish and bluish stains in the sandstone outcrops east and southeast of Paoli, and several small open-pit mines were opened for short periods. Merritt (1940) reported that a few tons of copper ore were shipped from the Teepee Queen Copper Company mine in Sec. 18, T4N, R1E, but no data on the quantity of copper produced is given.

At least two other small pits were dug in the area, but no records of their production are known.

In 1971, Teton Exploration Drilling Company, Inc., along with Wolf Ridge Minerals Company, acquired mineral leases for a prospect located in section 7 (Shockey, Renfro and Peterson, 1974). An open pit was dug and core samples obtained. Analyses of mineralization showed up to 4.1% copper and 239 ounces of silver per ton in core samples of one foot in length.

Analyses of the copper deposits in the region (Shead, 1929) indicated a copper content of up to 23%.

A similar deposit several kilometers southwest of Byars along the Garvin-McClain County line was mined for silver in 1897 and 1898 (Merritt, 1940). These efforts apparently were unprofitable.

The Byars deposits was reworked in 1913 through 1916, producing more than 8,000 ounces of silver during that period. Dunlop (1916) describes the deposit (known as the Criswell mine) as follows:

> The ore deposits lie on the side of a canyon running north and south, and there is evidence that there was prospecting here before the present owner of the property purchased it.
>
> The ore shipped in 1914, amounting to 190 tons, was obtained from an open cut eight feet deep and was hand-sorted before shipment. This ore, which is a light-grey decomposed sandstone containing silver chloride and a small quantity of copper, has averaged about 33 to 37 ounces of silver a ton. The production from this mine is notable for the reason that it is the only mine in the Central States in which silver is the predominant value in the ore.

There has been no active metallic ore mining in the Paoli or Byars areas in recent years.

GEOLOGY

The host rocks for the copper and silver mineralization in the Paoli district are sandstones and a few shales belonging to the Garber and Wellington formations of Permian age (Dott, 1927), and are typical of the "red bed" formations of the southwestern United States. The rocks are frequently cross-bedded and fractured and are difficult to trace for extended distances at the surface (Merritt, 1940).

Malachite cements the sandstone in some outcrops while barite is the dominant cementing agent in others. The sandstone frequently contains abundant hematite and shows manganese oxide staining.

MINERALS

Brochantite $Cu_4(SO_4)(OH)_6$

Brochantite occurs as druses of small (less than 1 mm) stubby emerald-green crystals only at the deposit in the NE ¼ of section 24.

The brochantite was restricted to an intermittent vein varying in width from 25 to 50 cm and roughly 7 meters in length. The thickness of the brochantite layer at any given point was only a few millimeters, although several thin beds extended over a vertical distance of several centimeters.

Crystals were most abundant at a contact between an overhanging sandstone bed and a clay layer below. A few crystals of brochantite were found coating chalcocite nodules embedded within the clay layer.

The overhanging sandstone layer, which varied from 50 cm to 1

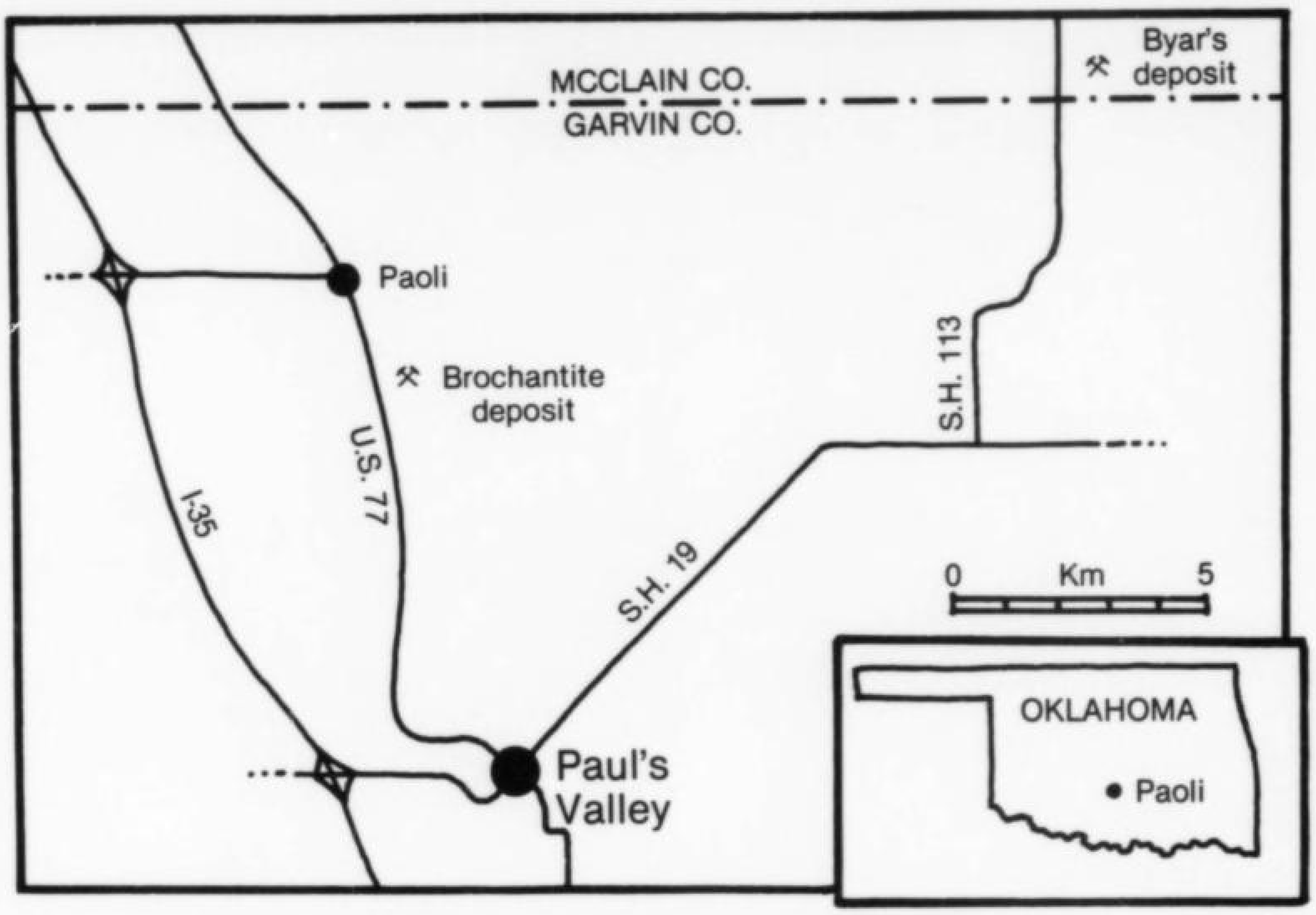
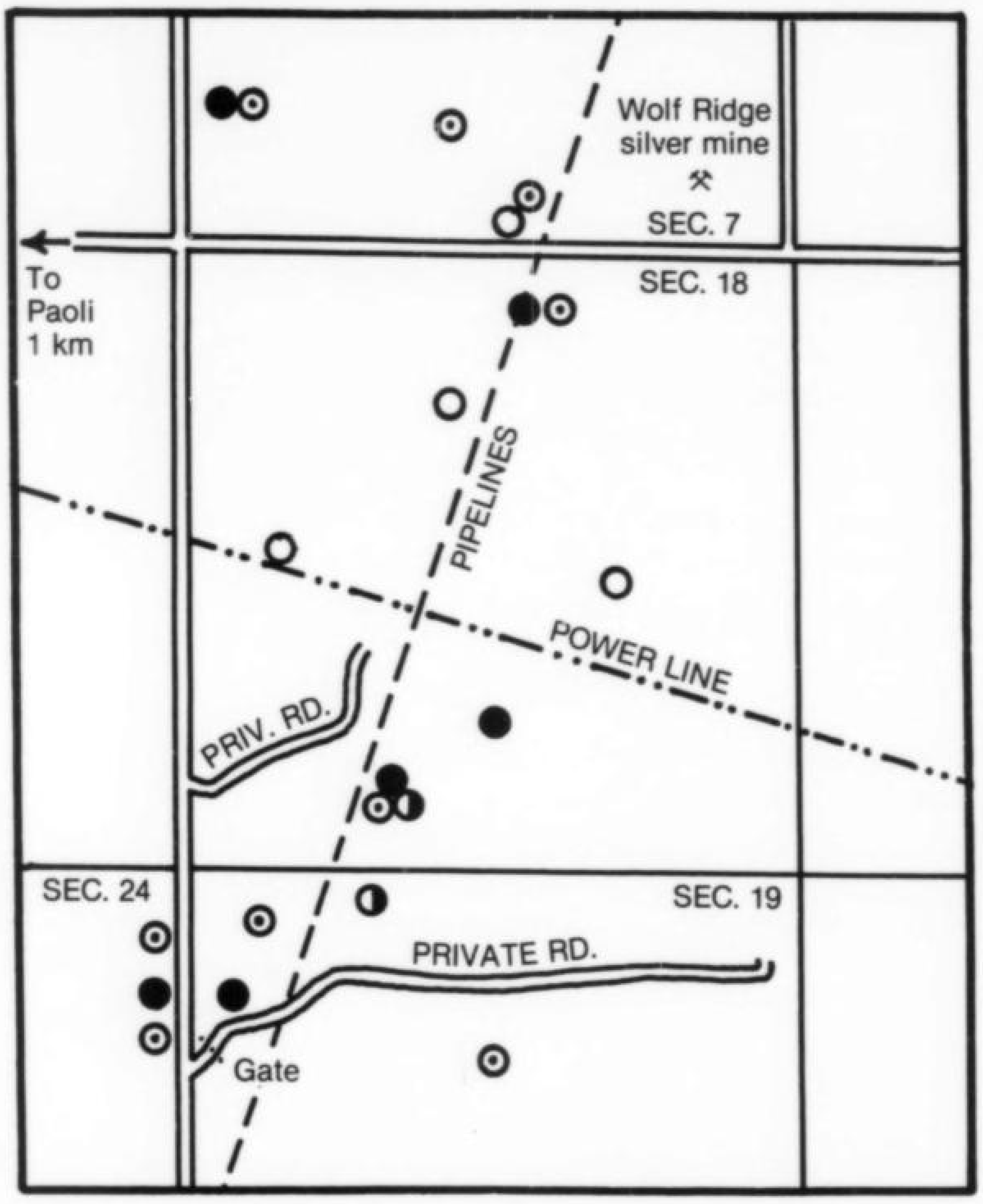


Figure 1. **Location map.**

Figure 2. **Section 18 and surrounding area showing the location of important outcrops. Solid circles = major copper mineral outcrops; open circles = minor copper mineral outcrops; half-black circles = significant iron mineral outcrops; and dotted circled = significant barite outcrops.**



meter in thickness, contained numerous nodules of iron-bearing and copper-bearing minerals, increasing in frequency with depth. Near the bottom of the sandstone bed were long, thin stringers of a dark material primarily composed of chalcocite, with some cuprite. The brochantite was intimately associated with the chalcocite-bearing nodules and stringers.

Matrix coverage by the brochantite ranges from less than 10% on specimens obtained from the edge of the occurrence to greater than 90% on specimens from the center of the deposit. Matrix specimens of up to 15 by 45 cm have been removed.

The crystals of brochantite are occasionally intergrown to form a lustrous botryoidal surface.

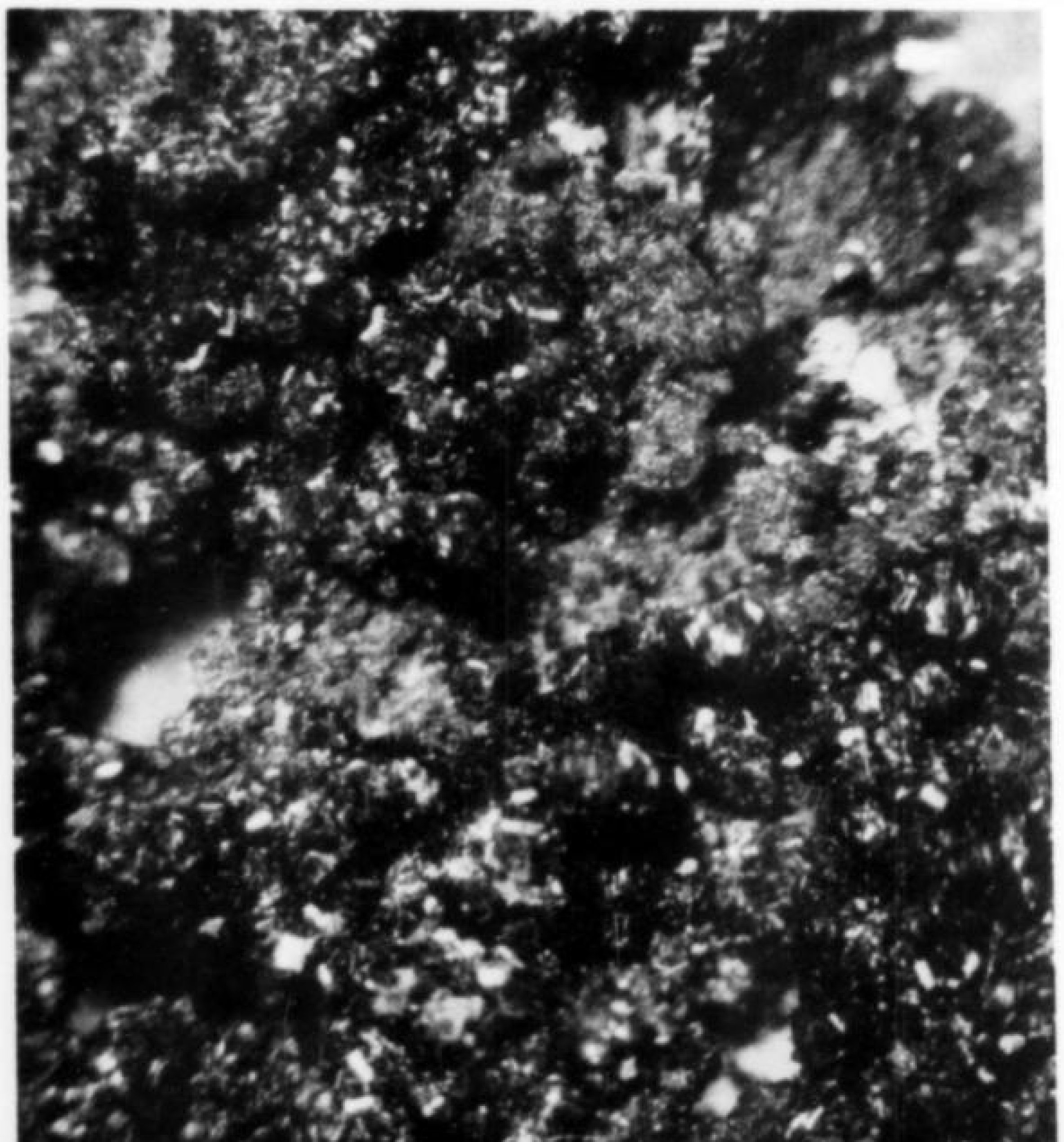


Figure 3. **Brochantite crystals from Paoli; the largest are about 1 mm in size.**

Malachite $Cu_2(CO_3)(OH)_2$

Malachite is widespread in the Paoli district as alterations of chalcocite nodules and as cement and intergrowths with sandstone.

Malachite from the region near the brochantite occurrence tends to be earthy with very little enclosed sand. In other areas it is found predominantly as cement and as a surface alteration of chalcocite nodules up to 10 cm in diameter. Sometimes the malachite cements sandstone concretions.

A sand-malachite shell resembling the copper "skulls" of Michigan in size and shape was found in section 7. The skull, approximately 5 by 10 by 15 cm in size, includes a slightly altered core of chalcocite and sand.

Figure 4. **A view of a typical area roadcut, with the Washita River valley in the background. Brochantite was found in the slope at right.**

Figure 5. **Scanning electron micrograph of brochantite crystals measuring about 0.1 mm each. Note irregular terminations.**

Azurite $Cu_3(CO_3)_2(OH)_2$

Azurite is comparatively rare in the district, occurring sparsely as films or thin intermittent layers with malachite and sand.

Chalcanthite $CuSO_4 \cdot 5H_2O$

A thin layer of crudely crystallized chalcanthite was found associated with brochantite on the exposed portion of the outcrop. The occurrence was restricted to a portion of the sandstone ledge shielded from contact with rainwater.

A similar chalcanthite occurrence is found beneath a sandstone ledge a few hundred meters east of the Byars silver-copper deposit.

Chrysocolla $(Cu,Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$

Chrysocolla, light blue to bluish white in color, occurred sparingly along tiny fracture surfaces in the sandstone, associated with the richest portion of the brochantite deposit. It is probably an alteration product of the brochantite.

Barite $BaSO_4$

Barite is widespread in the area and assumes many forms.

In sections 18 and 19 southeast of Paoli, large barite-claystone concretions cover the floors of several gullies. The barite is crystalline, assumes several pale tints, but does not form distinct crystals. These concretions range up to 25 cm in diameter.

Almost pure barite balls of a radiating crystal structure occur in scattered locations throughout the Paoli district. Known locally as "raisin rocks," these barite nodules are most concentrated where removed from enclosing clay by weathering. The nodules range from a few millimeters to several centimeters in diameter. A few exhibit yellow to orange fluorescence in concentric bands under shortwave ultraviolet radiation.

Elsewhere barite is a cementing agent of the sandstone, and occasionally forms the well-known "rose rocks" consisting of rounded, intergrown plates with much included sand, in the rough shape of a flower. The Paoli "roses" are poorly formed and paler in color than those found in Cleveland County to the north.

Bedded crystalline barite occurs in several layers embedded in clay a few kilometers north of Paoli in McClain County and at the Byars deposit. Barite also occurs at the Byars deposit as incomplete crystals or fibrous aggregates in claystone concretions and geodes.

Yellowish white parallel barite crystals to about 1 millimeter occur at the brochantite location in association with the contact between the sandstone and the clay beds.

Hematite α-Fe_2O_3

Hematite is common in the sandstone, sometimes to the extent that the hematite content is greater than the sand content. In section 18 near one of the pits is a large outcrop of black hematite-impregnated sandstone. A few specimens exhibit pseudomorphs, probably after pyrite, to several millimeters in size.

Hematite is also common at the Byars deposit as relatively pure, irregular fragments to several centimeters.

Silver minerals

Native silver was reported as the primary silver ore at the Wolf Ridge deposit (Shockey, Renfro and Peterson, 1974). The silver mineralization at Byars was reported to be silver chloride (Merritt, 1940).

The author found no visual evidence of silver mineralization at either locality.

Aragonite and **calcite** $CaCO_3$

Aragonite and calcite coat the interiors of claystone geodes at the Byars deposit. The geodes range in size to 6 cm; the aragonite and calcite crystals seldom exceed 2 mm in maximum dimension.

Goethite $\alpha\text{-}Fe^{+3}O(OH)$

Goethite (visual identification) occurs as thin, acicular blades to several millimeters in a few of the claystone geodes from the Byars deposit. The crystals are black with dark brownish red translucent edges.

Cuprite Cu_2O

Cuprite (visual identification) occurs as very small (less than 0.2 mm), brilliant, red, irregular crystals associated with barite and brochantite. It has also been found sparingly as the acicular variety (chalcotrichite), associated with malachite and disseminated within the chalcocite at one locality.

Pyrite FeS_2

Crystals of pyrite partially altered to "limonite" occur in the sandstone at the brochantite locality. The crystals are cuboctahedral in form and range in size to 3 mm.

Unknowns

Microscopic examination of several of the brochantite specimens reveals a brilliant blue crystallized material associated with cuprite, brochantite and chalcocite; crystals are generally about 0.1 mm in maximum dimension. Also, a bluish green fibrous material was found on a few brochantite specimens. These may be copper sulfates.

ACKNOWLEDGMENTS

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(Continued from p. 354)

The Directors also voted to establish a higher rate for libraries, companies and institutions, in keeping with the standard practice of most scholarly journals.

TENNIS TOURNAMENT & PARTY

Don't forget, the *Fifth Annual Mineralogical Record Tennis Tournament* will be held again in conjunction with the coming Tucson Show. Contact Gale Thomssen (P.O. Box 1656, Carson City, NV 89702; 702-883-2598) for more information. No registrations will be accepted after January 30, 1987. The matches will be held from 9 a.m. to 5 p.m., February 9 and 10, 1987, at the Sheraton Pueblo Inn in Tucson. Categories include men's and women's singles, men's doubles, and mixed doubles.

The *Annual Special Friends Party* will be held at the Sheraton Pueblo Inn on February 10 (Tuesday) from 6-8 p.m. Everyone who considers himself a "special friend" of the *Mineralogical Record* is invited. This includes authors, advertisers, donors, volunteers, photographers, directors, associate editors, and even subscribers!

Curved Jamesonite Crystals from Romania

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INTRODUCTION

Studies concerning curved crystals of jamesonite found amid intergrown acicular jamesonite at the Baia-Mare district, Romania, have been published, both in Romania and in the U.S. Bideaux (1970), for example, described ring-like to cylindrical crystals from various locations including Baia Mare (given as Felsobanya, an outdated name).

Motiu *et al.* (1972) presented independent research on the same subject, a rich occurrence of curved jamesonite found at Herja and Baia Sprie, Romania. Motiu and Reffner (1974) provided further discussion, and Motiu (1976, 1981) considered possible growth mechanisms, and the implications of ring-shaped crystals regarding crystal symmetry.

For the current study 21 jamesonite specimens were selected from northern Romanian occurrences. Of these, 14 are from geodes and 7 are from relatively dense lode environments.

All of the geode samples examined proved to contain a rich assortment of curved jamesonite microcrystals, whereas the lode samples were totally lacking in curved crystals.

Separation of the free-growing (unimbedded) jamesonite microcrystals was accomplished by sifting the sample through a 0.175–0.315-mm mesh sieve. The resulting separate consisted of a large number of jamesonite rings and curved crystals accompanied by euhedral quartz crystals, sphalerite, tetrahedrite, dolomite, siderite, and minor pyrite, chalcopyrite, calcite, stibnite, gypsum and limonite.

Under a binocular microscope the jamesonite crystals were separated into different morphologies and isolated in sample cells of the type used by micropaleontologists. A population of several thousand such microcrystals was obtained, including rings in the 0.11–0.65 mm range which are visible to the unaided eye.

Crystal morphologies found include straight *acicular* crystals (the most common, comprising 98% of geodal jamesonite crystals), *transitional* crystals (straight on each end and bent in the middle), *elliptical* crystals, *ring* crystals (having rougly equant cross sections), *washer-shaped* or discoidal crystals (with a hole in the center), and *cylindrical* or tubular crystals. Of these, only the ring shape has been described previously. Our focus here will be the transitional and elliptical habits.

TRANSITIONAL HABIT

Crystals of transitional habit consist of two straight, acicular sections joined by a curved section. The curved section is a portion of a circle; the amount of a full circle present determines the shape. If exactly half of a circle (180°) is present, the straight sections will extend in parallel fashion. If less than half is present the "arms" will

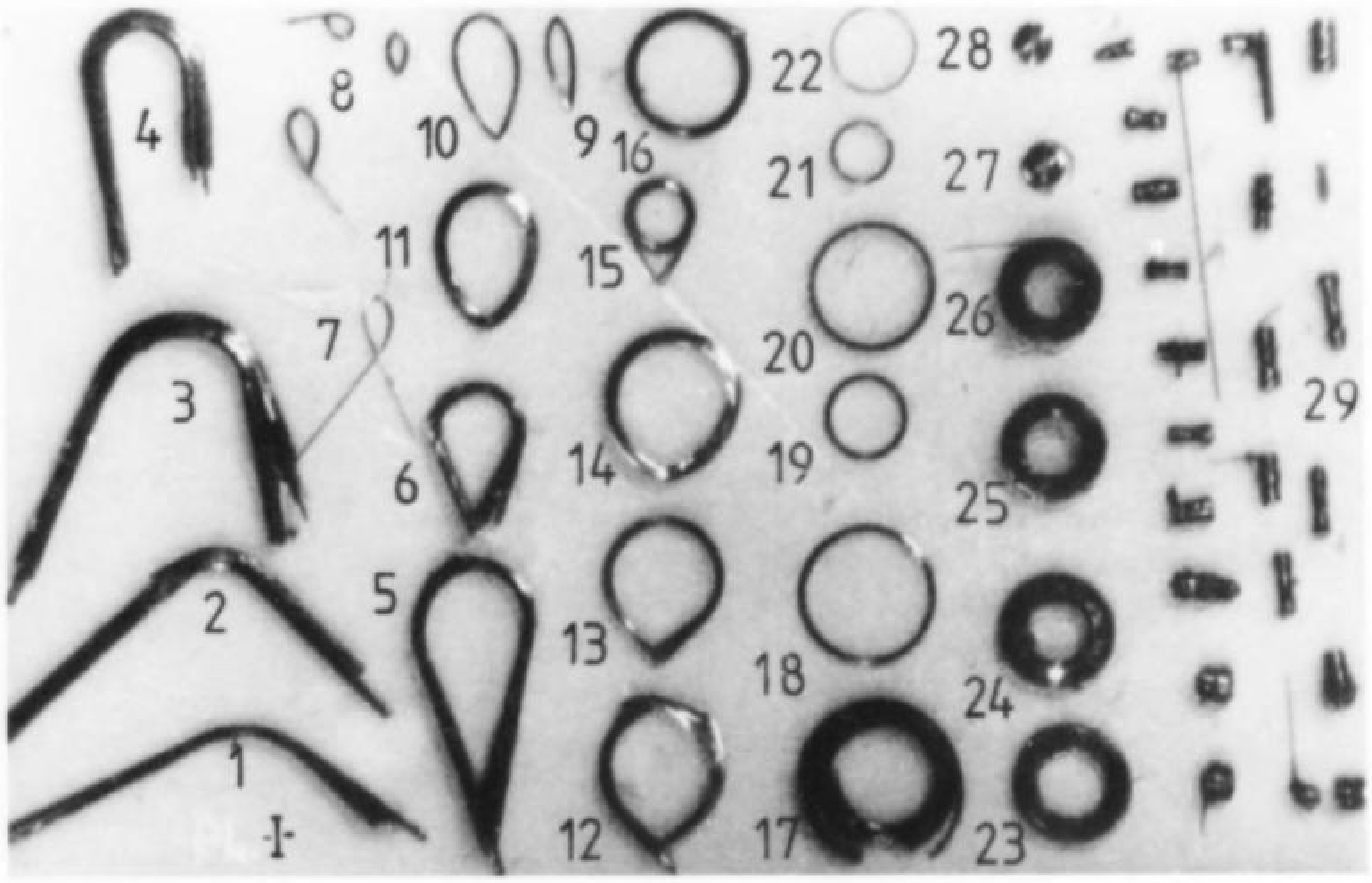

Figure 1. **Jamesonite crystals from Baia Mare, Romania. (1, 2, 3): Transitional type, divergent. (4): Transitional type, parallel. (5, 6, 7, 12, 13): Transitional type, closed into tear-drop shape. (8, 10, 11, 14): Elliptical type, one end acute. (9): Elliptical type, both ends acute. (15): Multiple termination-ring combination. (16): Elliptical type approaching circular. (17, 18, 19, 20, 21, 22): Ring type. (23, 24, 25, 26, 27, 28): Washer type. (29): Cylindrical type. (43X)**

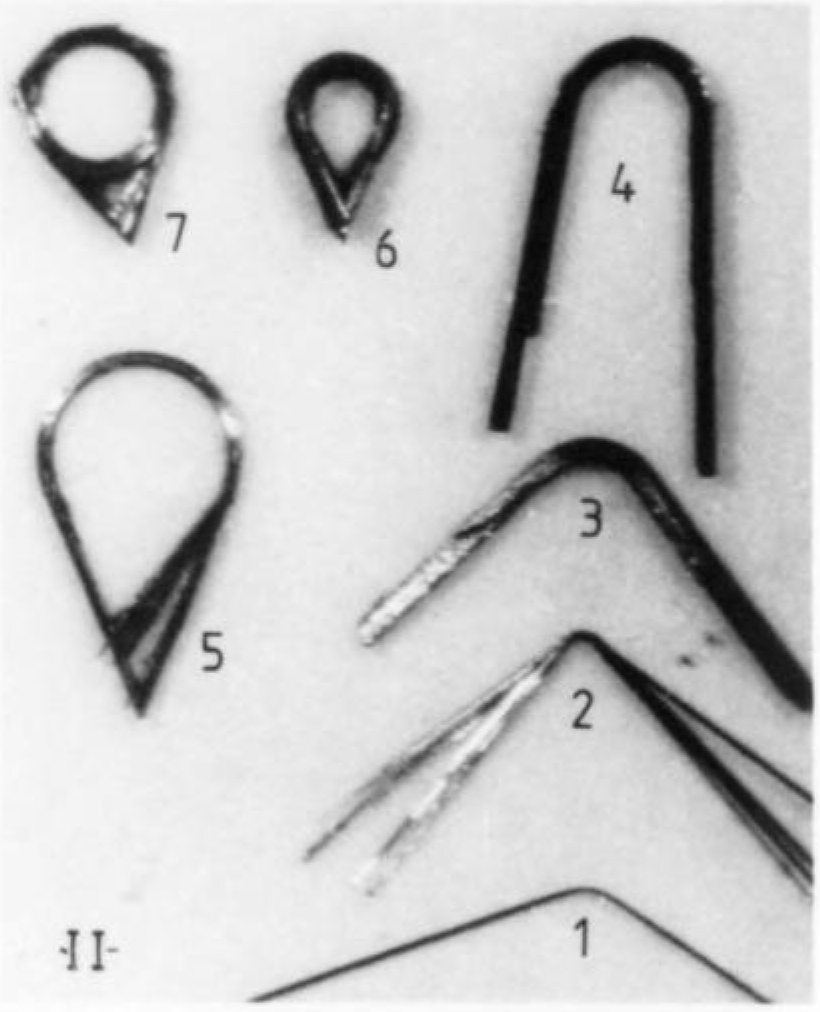

Figure 2. **Jamesonite crystals from Baia Mare, Romania. (1, 2, 3, 4): Transitional type, divergent, some with multiple terminations at varying angles. (5, 6): Transitional type, closed into tear-drop shape, with multiple terminations at varying angles. (7): Combination Ring type and Transitional type, with multiple terminations at varying angles. (44X)**

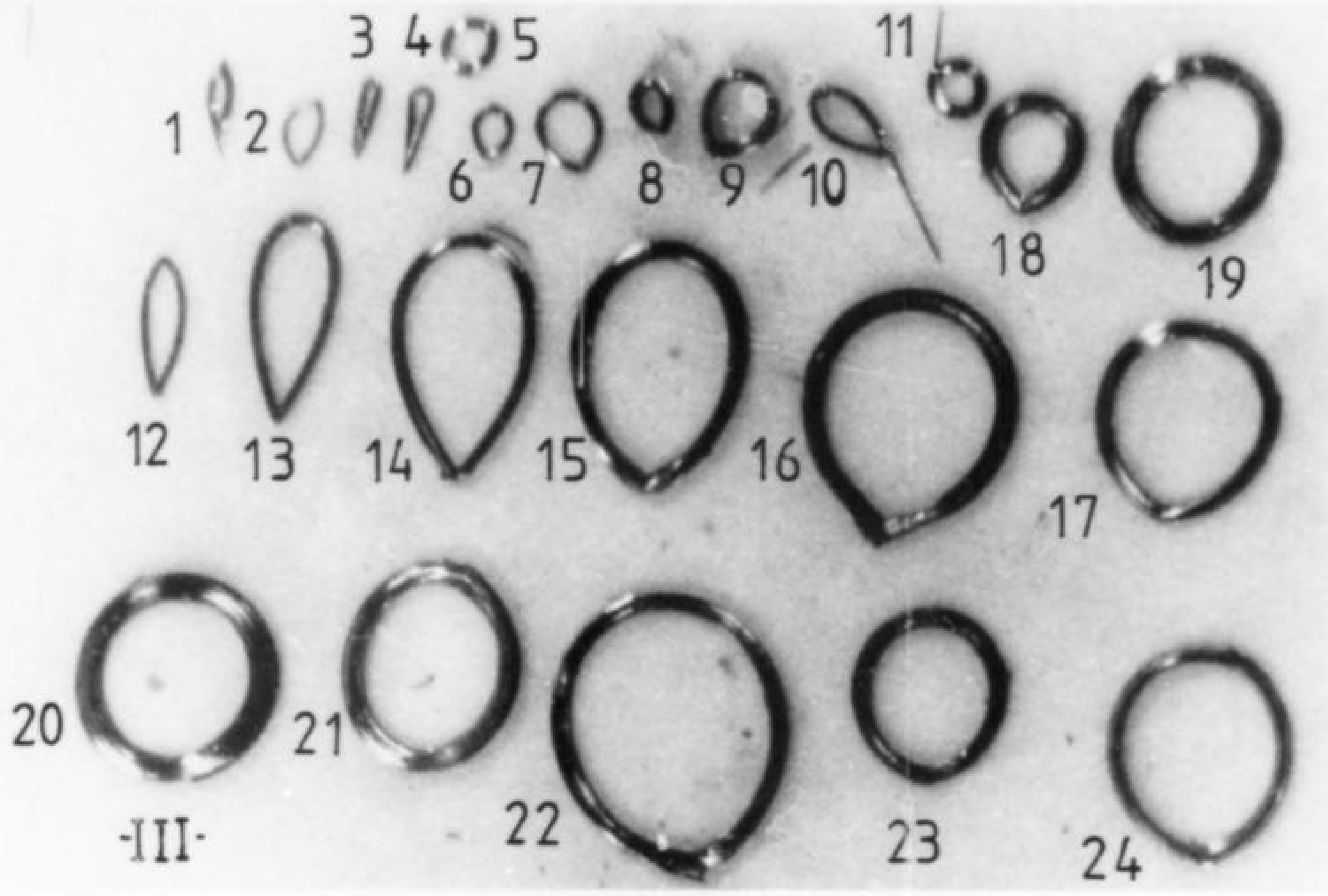

Figure 3. **Jamesonite crystals from Baia Mare, Romania. (1, 2, 12): Elliptical type, both ends acute. (3, 4): Transitional type, very acute. (5–11, 13–18): Elliptical type, one end acute. (19–24): Elliptical type, approaching perfect ellipses. (44X)**

diverge, and if more than half is present the "arms" will meet to form a tear-drop shape. As the portion of a circle approaches 100% (360°), the tear-drop becomes progressively less acute, and the straight sections shorter.

Judging from our sample, virtually all gradations appear to be possible. In fact, some crystals show a separation into multiple subparallel terminations meeting or diverging at a variety of angles.

ELLIPTICAL HABIT

Crystals of elliptical habit have no straight sections, and form a closed loop. The loop may come to a point at one or both ends, or may be rounded on both ends. Though some examples may appear close to a perfectly rounded ellipse, one end is almost always slightly more acute than the other. The crystals having both ends pointed or acute are very rare and usually small. As with the transitional habit, all gradations of shape leading up to a perfect ellipse and from these to a perfect circle appear possible.

GENETIC MODELS

The authors are not of one mind regarding the possible mechanisms which may have led to the development of these curved crystals. One of us (VG) prefers a purely mechanical process, whereas the other (AM) favors a skin-tension model.

Evidence for the mechanical model includes observations of crystals which appear to have been bent around euhedral crystals of quartz, calcite, dolomite and uncurved jamesonite. Furthermore, euhedral quartz microcrystals were found invariably to accompany curved jamesonite crystals, and where quartz was absent no curved jamesonite could be found.

The mechanical model supposes that the flow of solutions in the cavity caused some thin, floating crystals to catch on an impediment and bend. Flow rate and changes therein, would determine the degree of curvature. Continued crystallization would preserve the shape.

Whatever the cause, the ring crystals were very likely under some tension. If broken at one point, a very thin ring will open slightly as if by relaxation of the tension.

The skin-tension model relies on conditions present in fluidized beds where geodes form. Unequal step-spiral growth results in a curved crystal (Motiu and Reffner, 1974).

CONCLUSIONS

The unusual phenomenon of curved and ring-shaped crystals of jamesonite, pyrite, rutile and other minerals remains to be explained. Any theory will have to account for the peculiar variety of shapes exhibited by the Romanian occurrences. The mechanism, when definitely determined, might conceivably have some industrial application.

The occurrence of curved crystals worldwide is as yet poorly described, but the Baia Mare area appears to be the richest source known at present.

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Natrolite Arches from Simmon's Bay, Australia

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Extraordinary curved arrays of lath-shape natrolite crystals from Simmon's Bay, near Flinders, Victoria, Australia, were sent to one of us by Jon Mommers of Sunshine, Victoria, Australia.

These and other zeolites are found in vugs in the Older Basalt in outcrops in the sea cliffs facing Bass Strait. The zeolites in the area appear to have been formed by remobilization of mineral solutions in older basaltic flows in response to heat from subsequent ones (Coulsell, 1980). All the zeolites found are soda-rich and deficient in silica. In order of abundance, they are chabazite (most abundant), analcime, natrolite, thomsonite and gmelinite. Phillipsite is uncommon, while offretite and levyne are extremely rare.

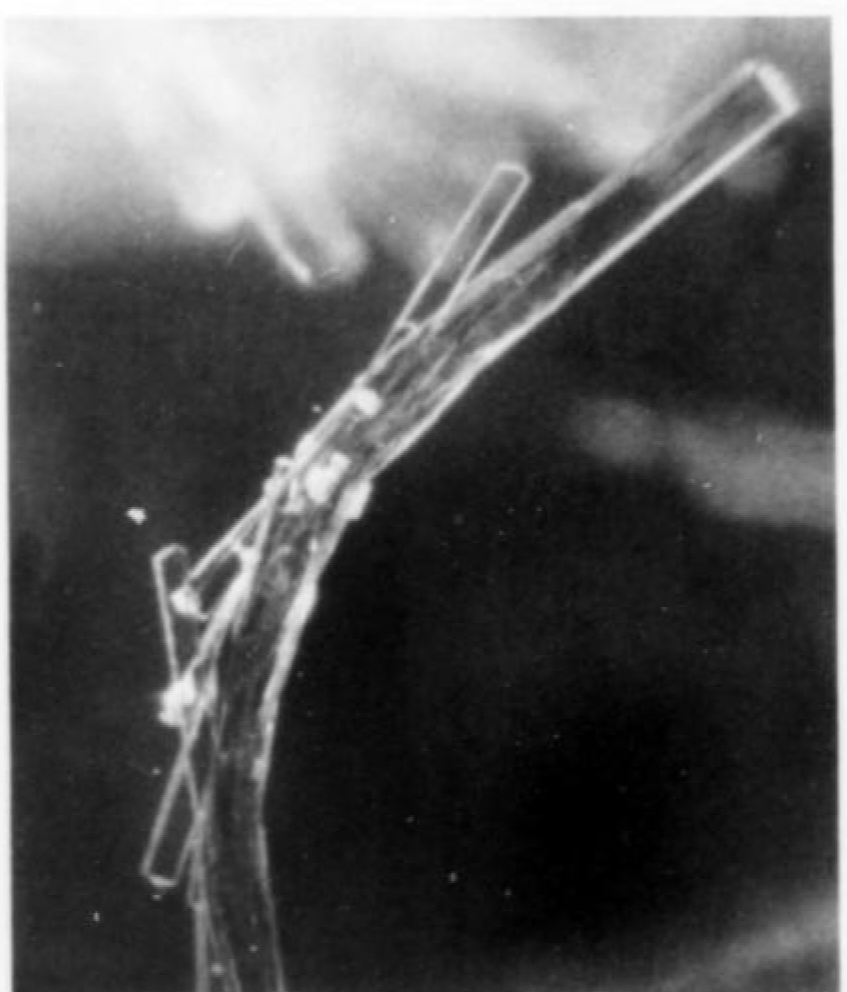

Figure 1. **Bow shaped, colorless, transparent group of curved natrolite crystals, length 1.2 mm.**

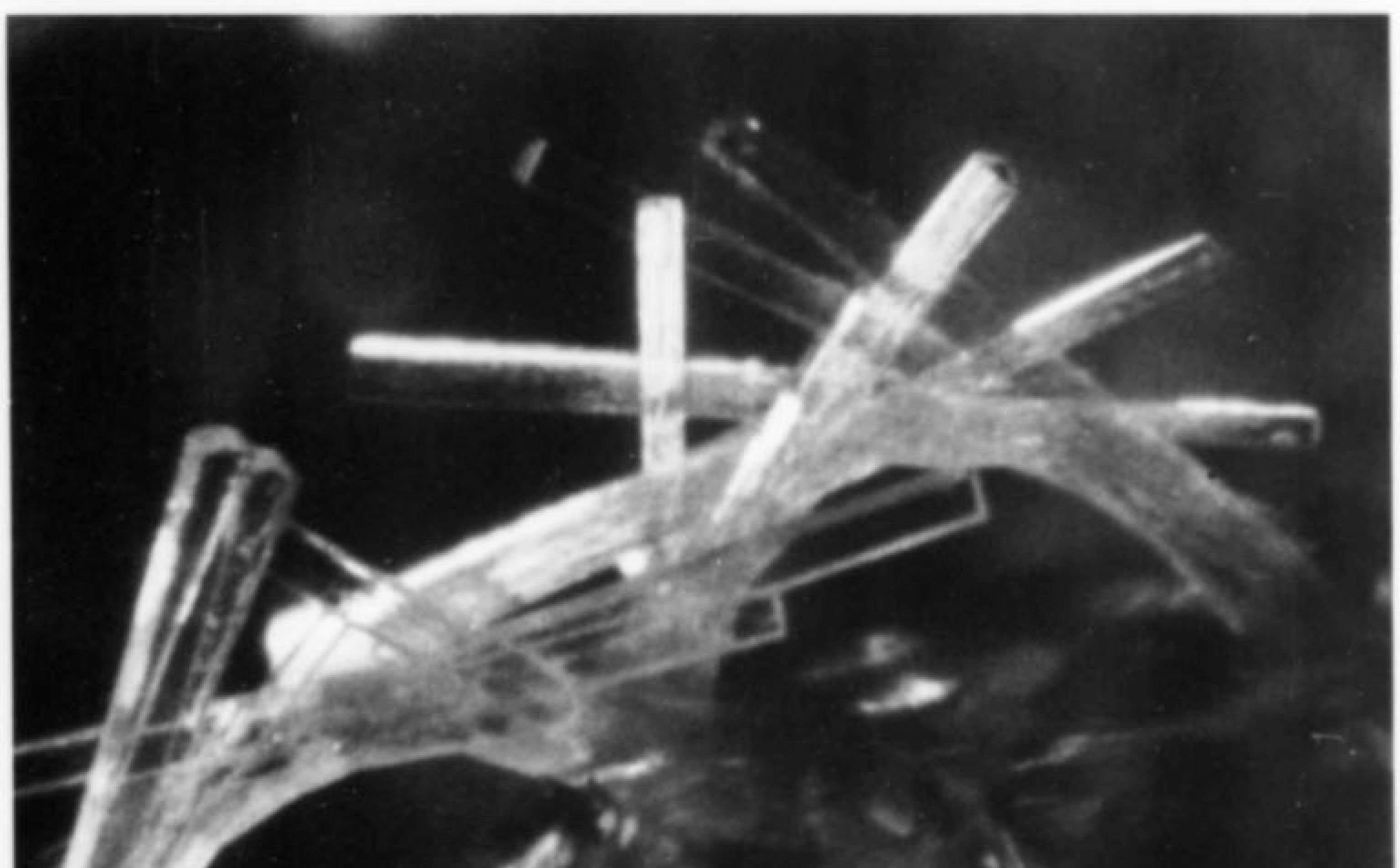

Figure 2. **Two complete arches of lathlike natrolite crystals on analcime. Field of view 2.3 mm.**

The curved arrays of natrolite occur on analcime, and vary from bow-shape groups (Fig. 1) through fish-hook groups to complete arches (Fig. 2 and 3). The crystals were identified as natrolite on the basis of morphology, association with analcime, optics and a semi-quantitative microprobe analysis.

Speculation as to the origin of these groups was aided by the occasional appearance with the arches of extremely thin, whisker-like crystals such as those shown in Figure 4. These also were identified as natrolite on the basis of their optics and chemical analysis. As shown in Figures 4–6, the whisker crystals are either straight or curved, and their rate of curvature is very like that of the curved arrays of larger crystals.

It is proposed that these extremely thin, smoothly curved crystals of natrolite are indeed whisker crystals of that mineral. Whisker crystals may be defined as close to crystallographically perfect crystals with extremely high aspect (length to width) ratios. They occur naturally, and can also be grown in the laboratory. When first formed, they may be a centimeter or so long and so thin as to be invisible under a high power light microscope.

Some naturally occurring minerals which form whiskers are pyrite, cuprite and native silver (all isometric and normally forming equant crystals), millerite, boulangerite and rutile (all of which may form rings) and such normally acicular minerals as fibroferrite and

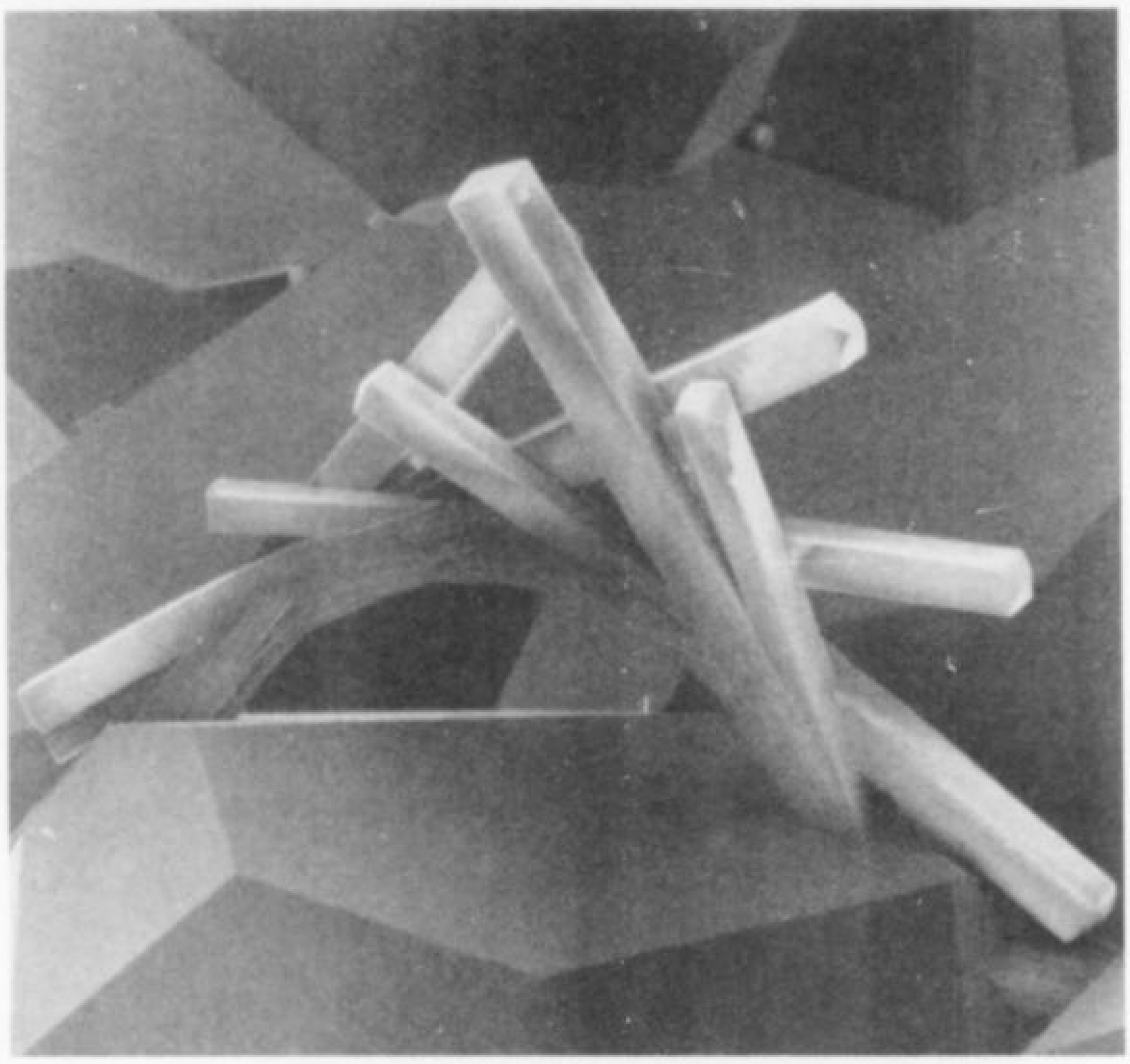

Figure 3. **SEM photo of natrolite arch, 0.9 mm across, on natrolite.**

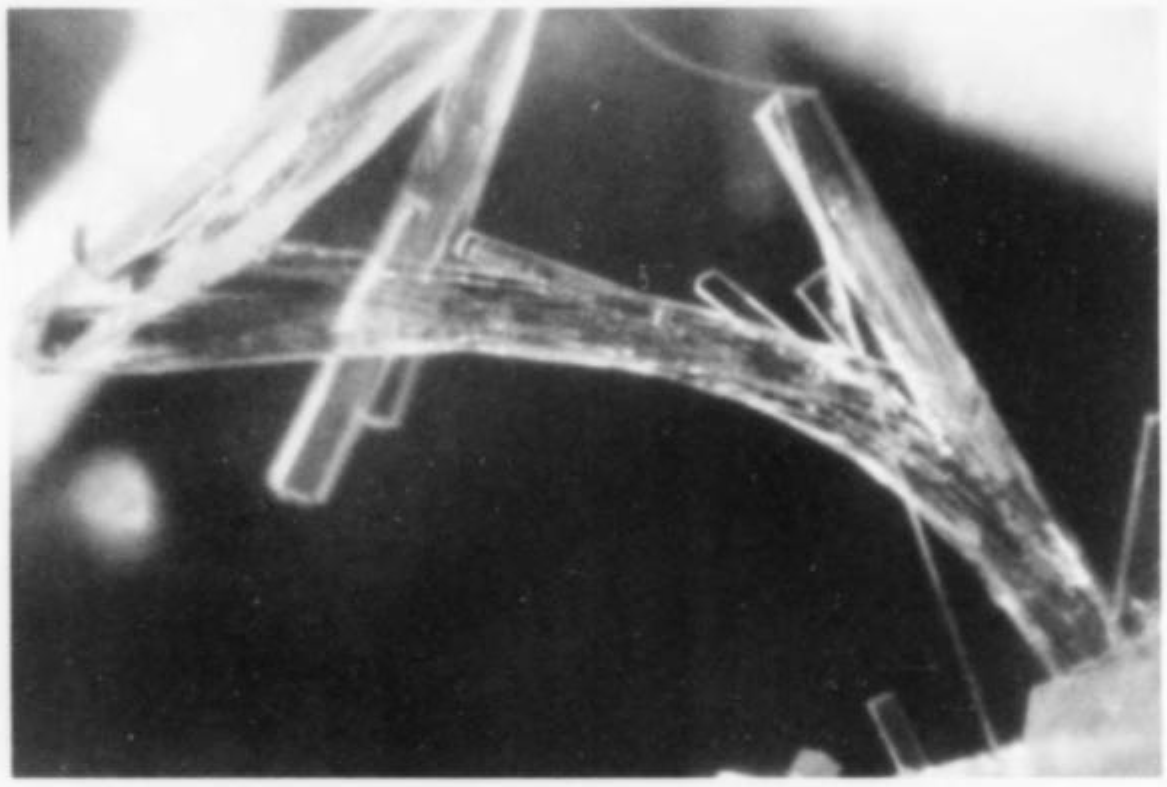

Figure 4. **Two whisker crystals of natrolite, one straight and one curved, associated with a partial arch of natrolite laths. Field of view, 2.7 mm.**

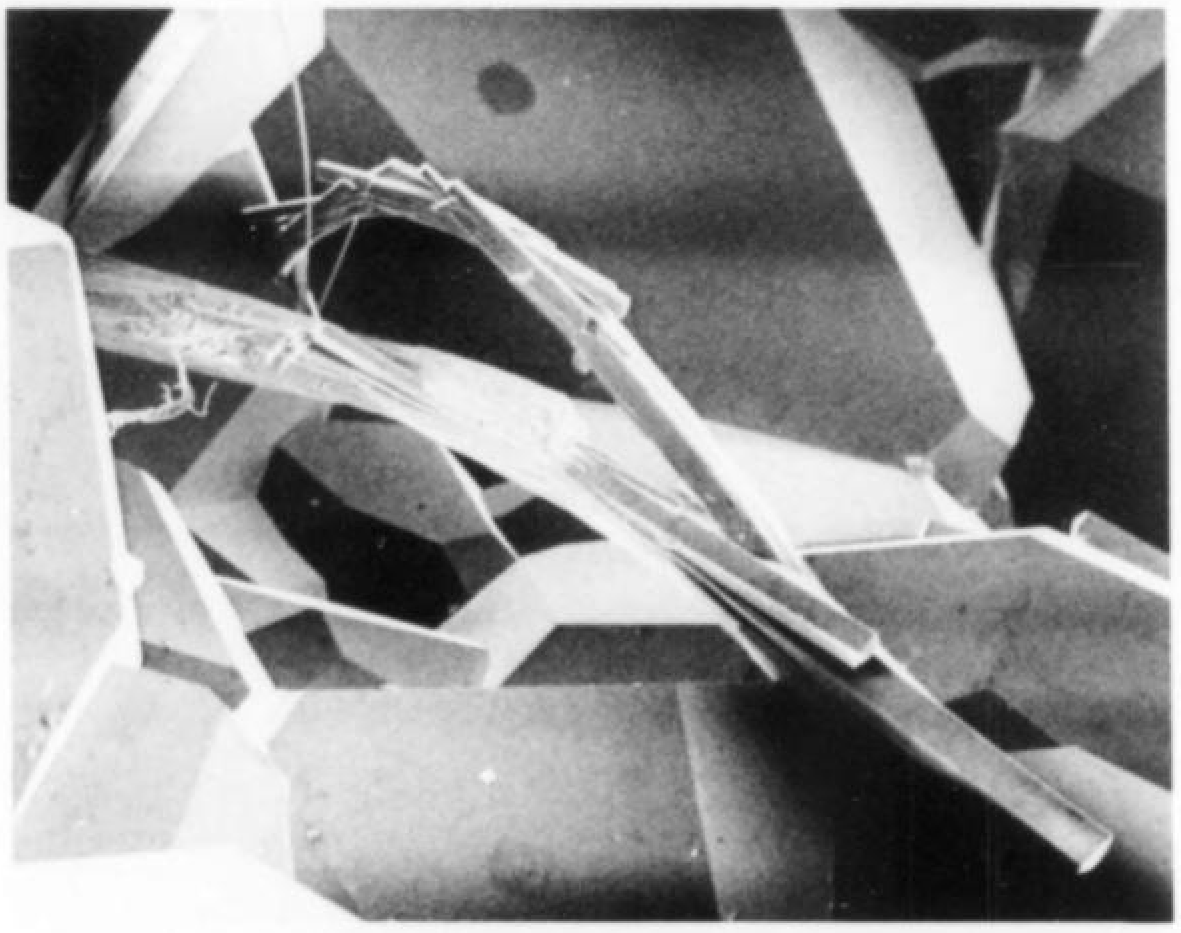

Figure 5. **SEM photo showing (a) natrolite arches of lathlike crystals and (b) whisker crystals of natrolite with approximately the same rate of curvature. Field of view, 2.2 mm.**

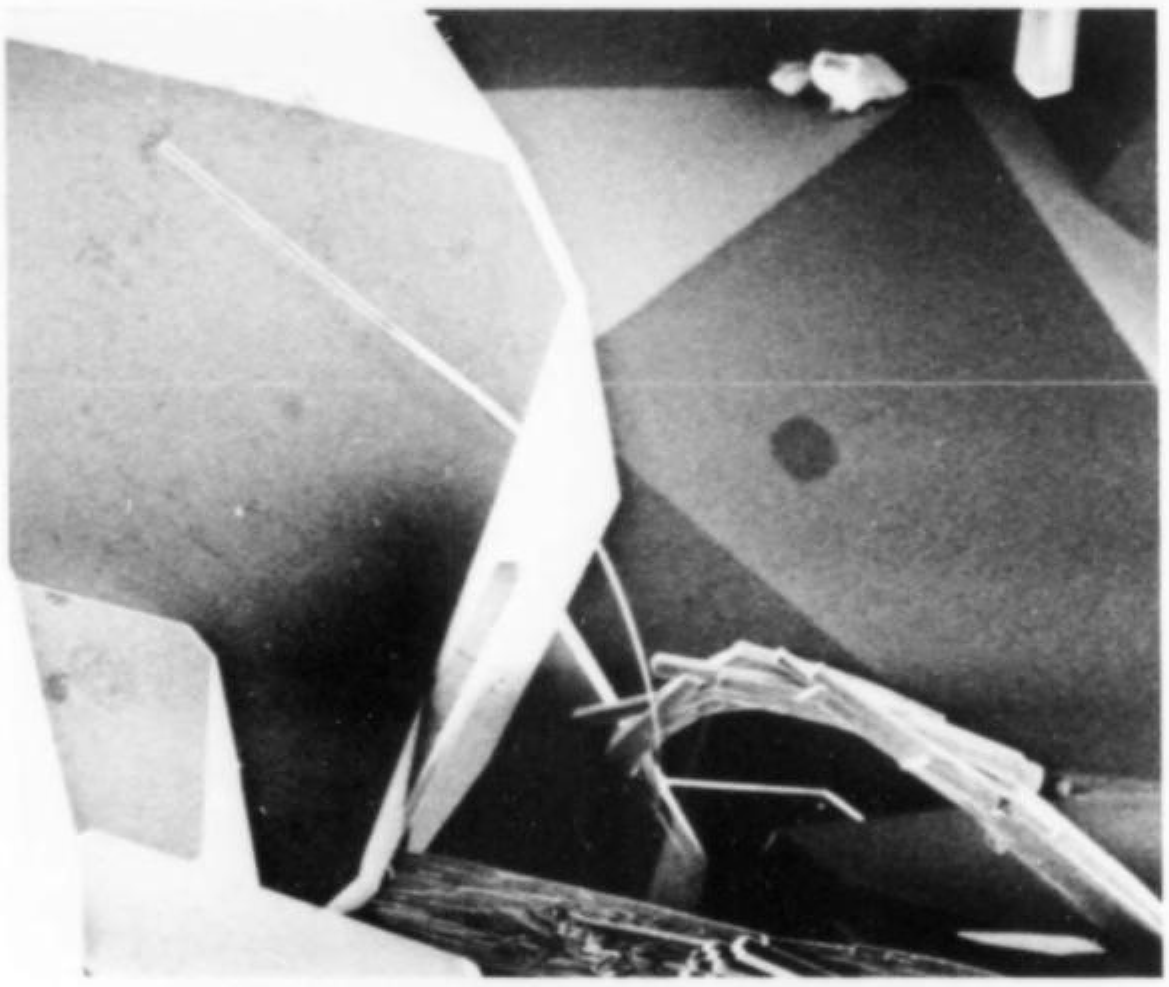

Figure 6. **Different view of the specimen in Figure 5. Note the thickening of the straight portion of the whisker crystal. Field of view, 1.6 mm.**

chrysotile asbestos. Many compounds can be synthesized in the laboratory as whiskers. Among them are sodium chloride (halite), potassium bromide, sulfur, a variety of metal sulfates and many of the elemental metals. Organic compounds such as quinone, hydroquinone and resorcinol will form whiskers. In fact, it seems to be impossible to crystallize some of these materials in any other form.

Whisker crystals can be grown from the vapor phase, from solution or from the solid state. There are several mechanisms by which such whisker crystals form. Excellent descriptions of these and of the growth and properties of whisker crystals are found in books by Strickland-Constable (1968) and Doremus *et al.* (1958).

Once formed, whisker crystals can stop growing or thicken by lateral growth. Such thickening is shown in the photograph of hydroquinone whiskers in Figure 7. As can be seen, the original whiskers are curved. As they thicken by lateral accretion, lattice strain in the crystal is increased, and the crystals straighten. Indeed, if constrained, the lattice strain becomes so great that the weak intermolecular forces binding the hydroquinone crystal together are overcome and the crystal snaps (Gordon, 1957).

It is proposed that the curved arrays of natrolite shown here were formed by lateral accretion to and thickening of curved natrolite whiskers. As thickening occurred, lattice strain, at least in whiskers attached to the vug walls at both ends, became greater until the natrolite began to grow or accrete as tangential, straight laths of the mineral. Other curved whiskers formed curved arrays of straight laths as in Figure 1 or underwent straightening as did the thicker end of the whisker crystal shown in Figure 6.

Observations corroborating the above proposal are the following. The laths are arranged tangentially to smooth curves such as those of the whisker crystals. As shown in Figure 3, all laths in a single curve or arch lie in the plane of the arch, i.e., the same prism face of each natrolite crystal in the group is always in the same plane as the curve. This would be the case if (a) the orientation of the laths is controlled by and the same as the crystallographic orientation of the original whisker and (b) the original whisker were bent

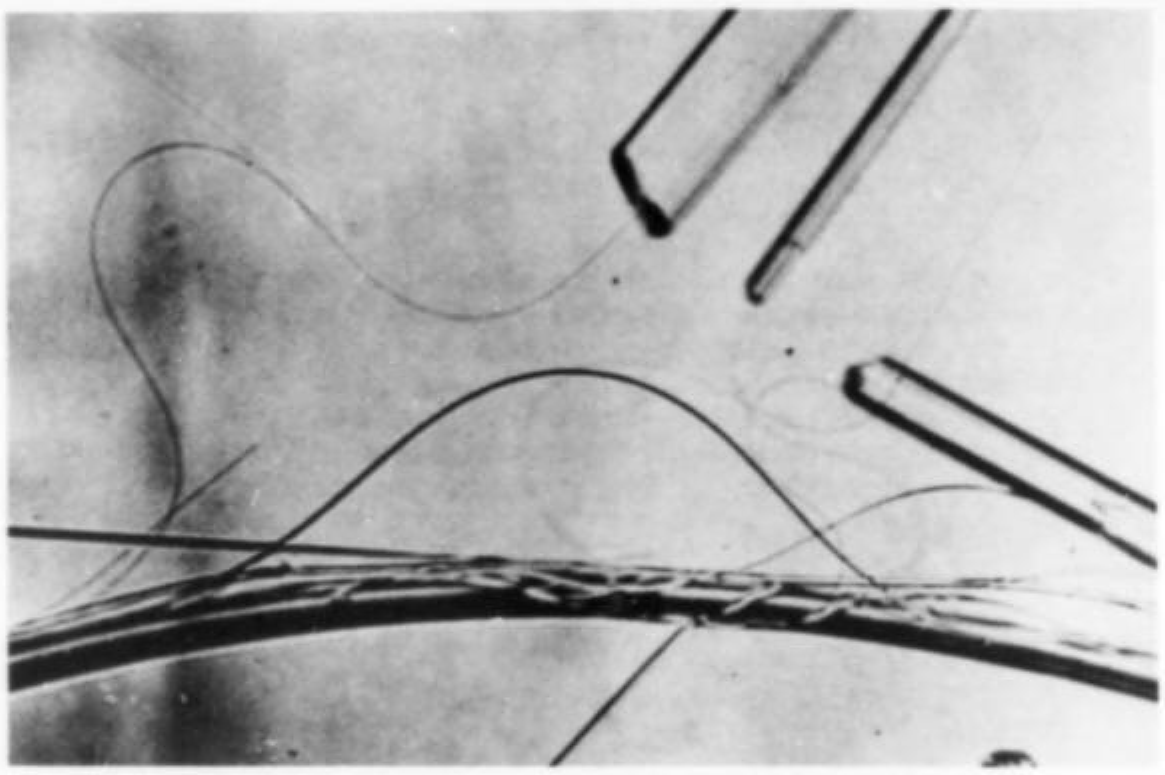

Figure 7. **Straight crystals of hydroquinone growing as sheaths on curved whisker crystals of the same substance. Length of largest crystal 0.8 mm.**

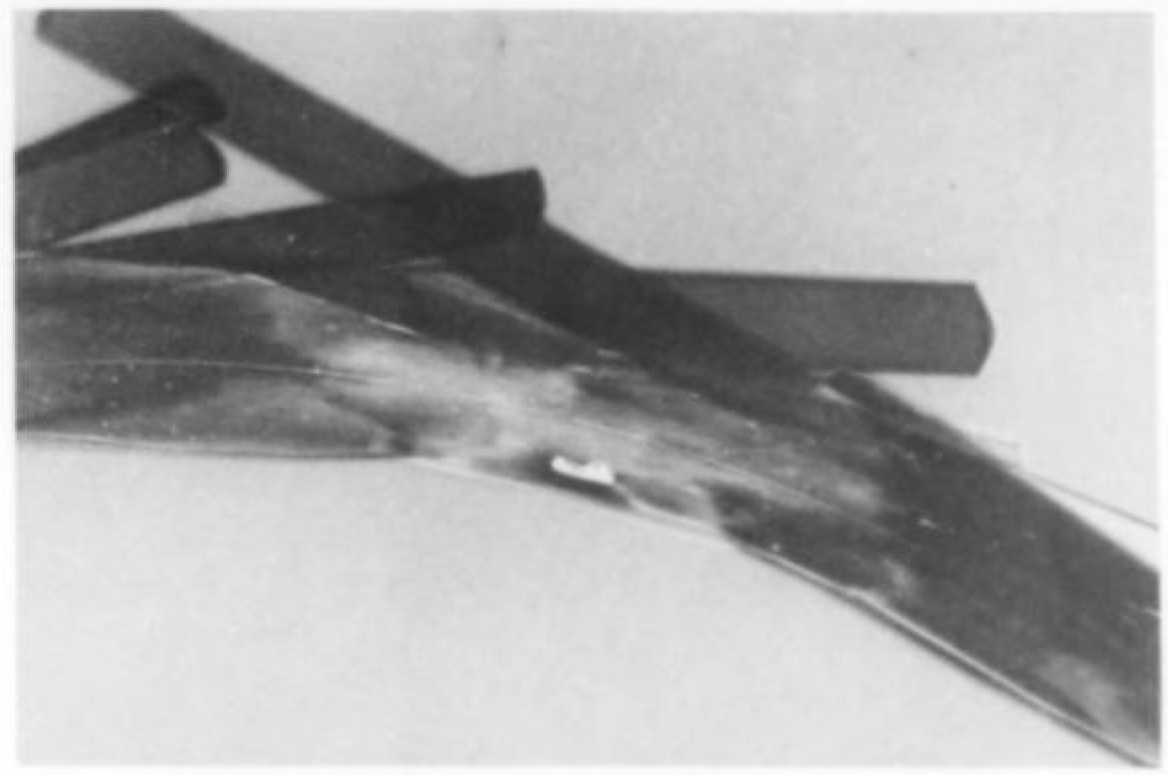

Figure 8. **Portion of a curved array of natrolite crystals photographed using transmitted light and crossed polarizers. The thin, smoothly curved bright line is the original whisker crystal of natrolite. The straight, tangential laths are uniformly colored, while the mottled appearance of the arch itself indicates lattice strain in that portion of the large natrolite crystals. Field of view, 0.25 mm.**

or curved in the manner causing the least mechanical strain (parallel to a prism face, rather than on a diagonal). Examination of a crystal arch under polarized light shows that the portion of a crystal lath nearest to or in the smoothly curving part of the arch is highly strained, while the portion of a lath which is straight and well away from the arch shows no strain. And finally, the curved array shown in Figure 8, photographed using polarized light, shows a thin, smoothly curved line down its center, a line which is believed to show the position of the original whisker crystal. Optical examination of thin sections of laths mounted vertically shows that the central line is composed of material with optical indices close to those of the surrounding natrolite. The slight differences in index are probably caused by the diverging optical orientation of the surrounding, tangential natrolite crystals from the whisker core.

It is proposed that these curved arrays of natrolite crystals were formed by the following sequence of events: (1) growth of curved whisker crystals of natrolite, (2) lateral thickening of the crystals with a consequent increase in crystallographic strain until (3) the crystals continued to grow as straight, tangential laths.

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Arsenopyrite from the Kilpatrick mine, Madoc, Ontario

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The village of Madoc, Hastings County, Ontario, is well known to collectors for the beautiful green fluorite once produced in the mines about the area. Though the few remaining dumps are now largely barren of collectible material, the country rock at these mines is still a source of finely crystallized microminerals. One such occurrence is the Kilpatrick (Detomac) mine, situated to the southwest of the village off of Seymore Street. It is described by Melanson and Robinson (1982). The productive rock, largely covered by brush and the encroaching swamp, consists of large blocks of marble. The most promising of these are white, granular, nearly pure calcite with only a faint banding of salt and pepper-like inclusions of arsenopyrite, phlogopite and tourmaline.

The best collecting approach is to sample a large assortment of likely looking blocks and take them home for further work. Etching them in hydrochloric acid then exposes the resistant minerals. With luck, numerous samples of euhedral, textbook crystals will be revealed.

The following list does not include any of the ore minerals (for which see Melanson and Robinson) but is representative of those species abundant within the country rock.

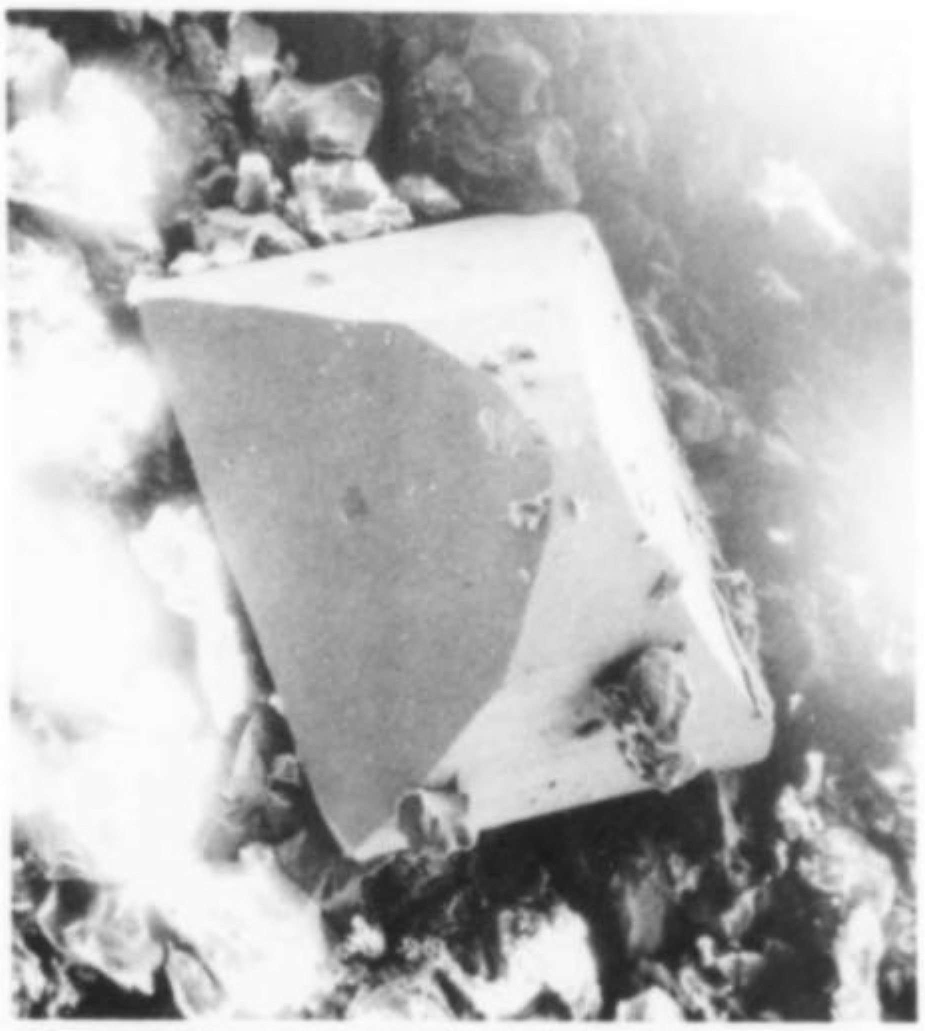


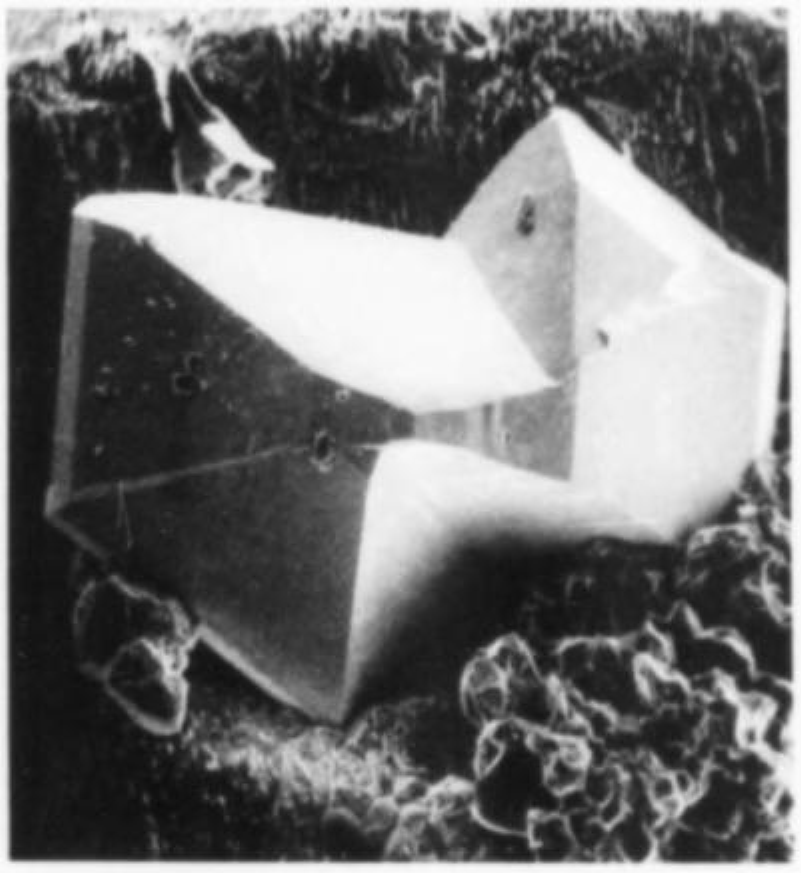
***Figure 1.* Single crystal of arsenopyrite from the Kilpatrick mine (0.5 mm).**

Arsenopyrite FeAsS

Arsenopyrite occurs as single or twinned, isolated crystals within the marble. These are usually of simple form but commonly exhibit complex habits due to twinning. The crystals range up to 3 or 4 mm and have a bright mirror-like surface.

The basic crystal habit is as shown in Figure 1, with very few modifications. The diversity of form comes rather from the ease with which arsenopyrite twins. From any single block of marble the crystal habits tend to be similar, but the variety from block to block is quite marked. The habit shown in Figure 2 might be referred to as a "bowtie." It is a penetration twin composed of two crystals. A related habit is shown in Figure 3 (from Deloro, Ontario). Repeated twinning of this type produces disk-like sixlings such as the one in Figure 4 which are quite common in some samples.

***Figure 2.* Penetration twin of arsenopyrite from the Kilpatrick mine (0.9 mm).**



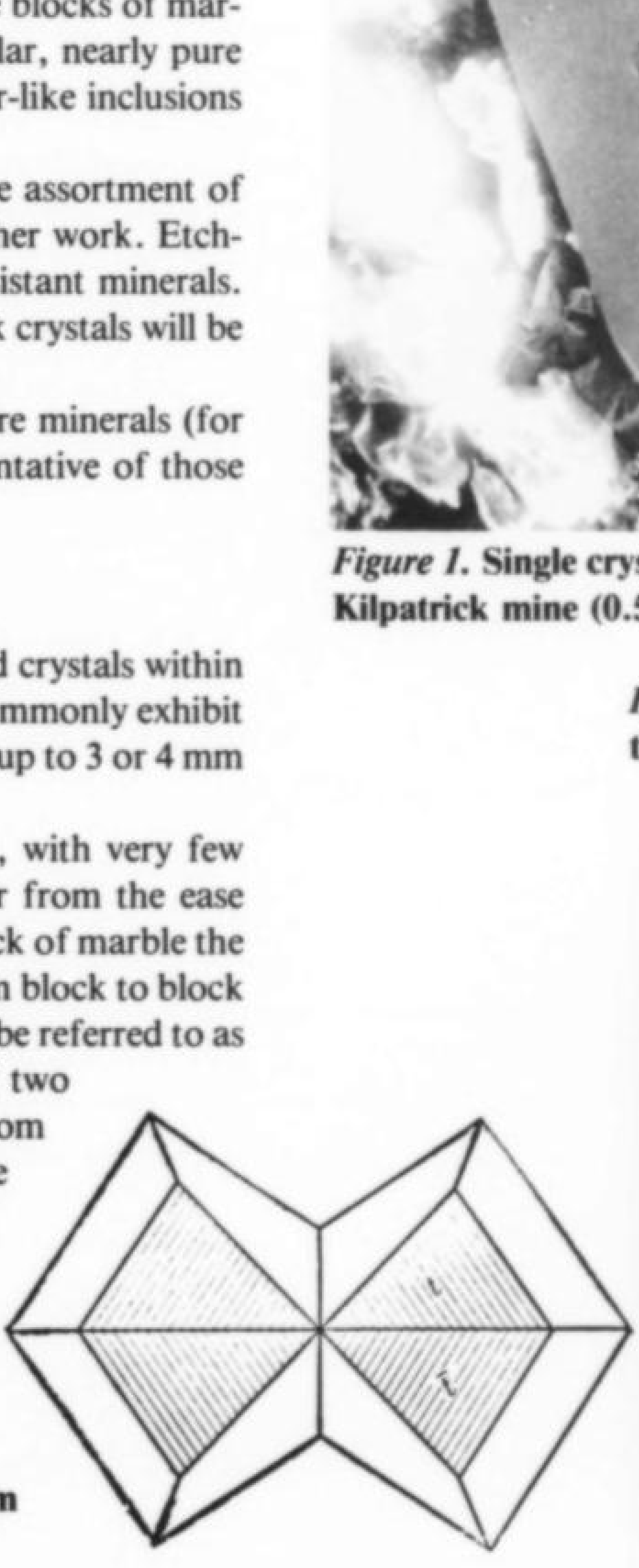


***Figure 3.* "Bowtie" twin of arsenopyrite from Deloro, Ontario (Palache *et al.*, 1944).**

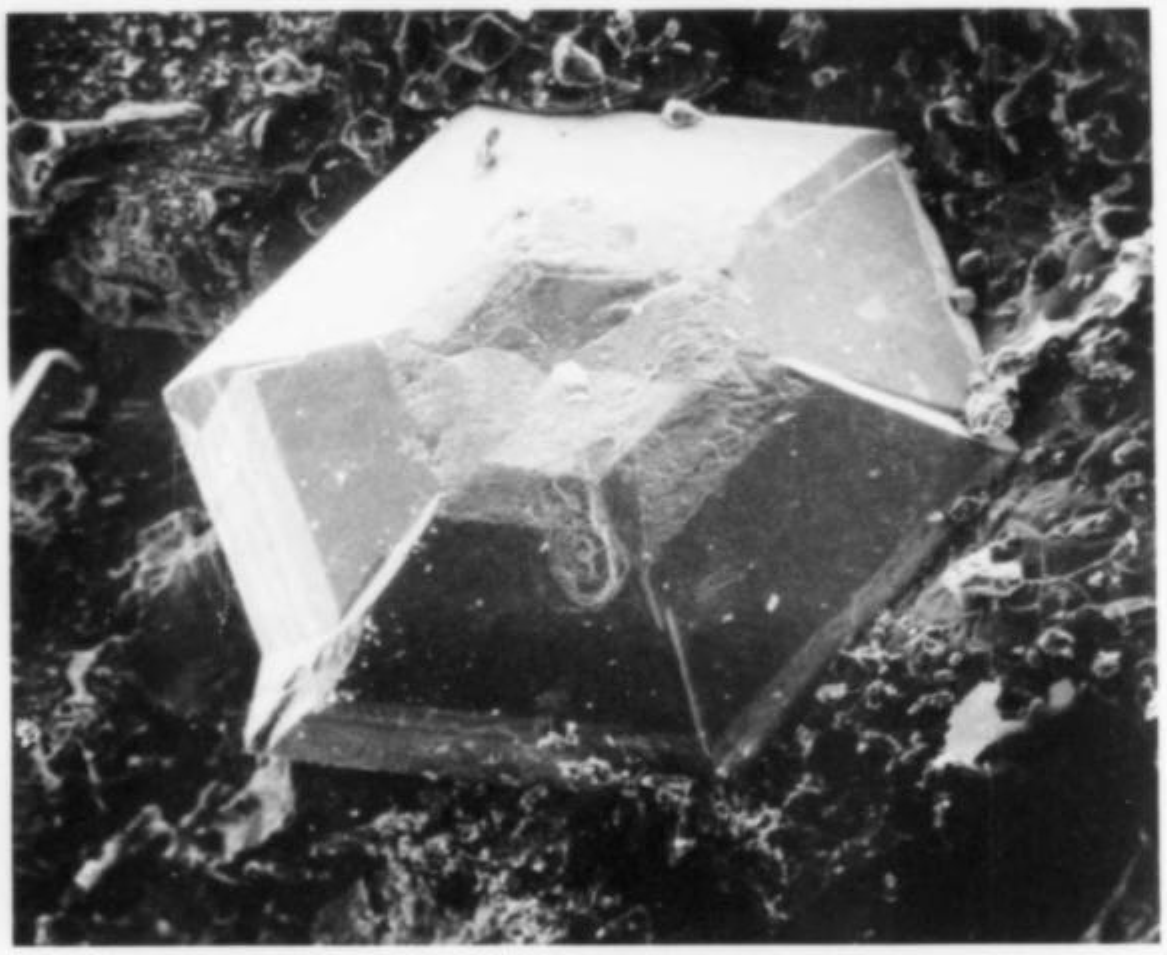


Figure 4. **Cyclic arsenopyrite twin from the Kilpatrick mine (0.7 mm).**

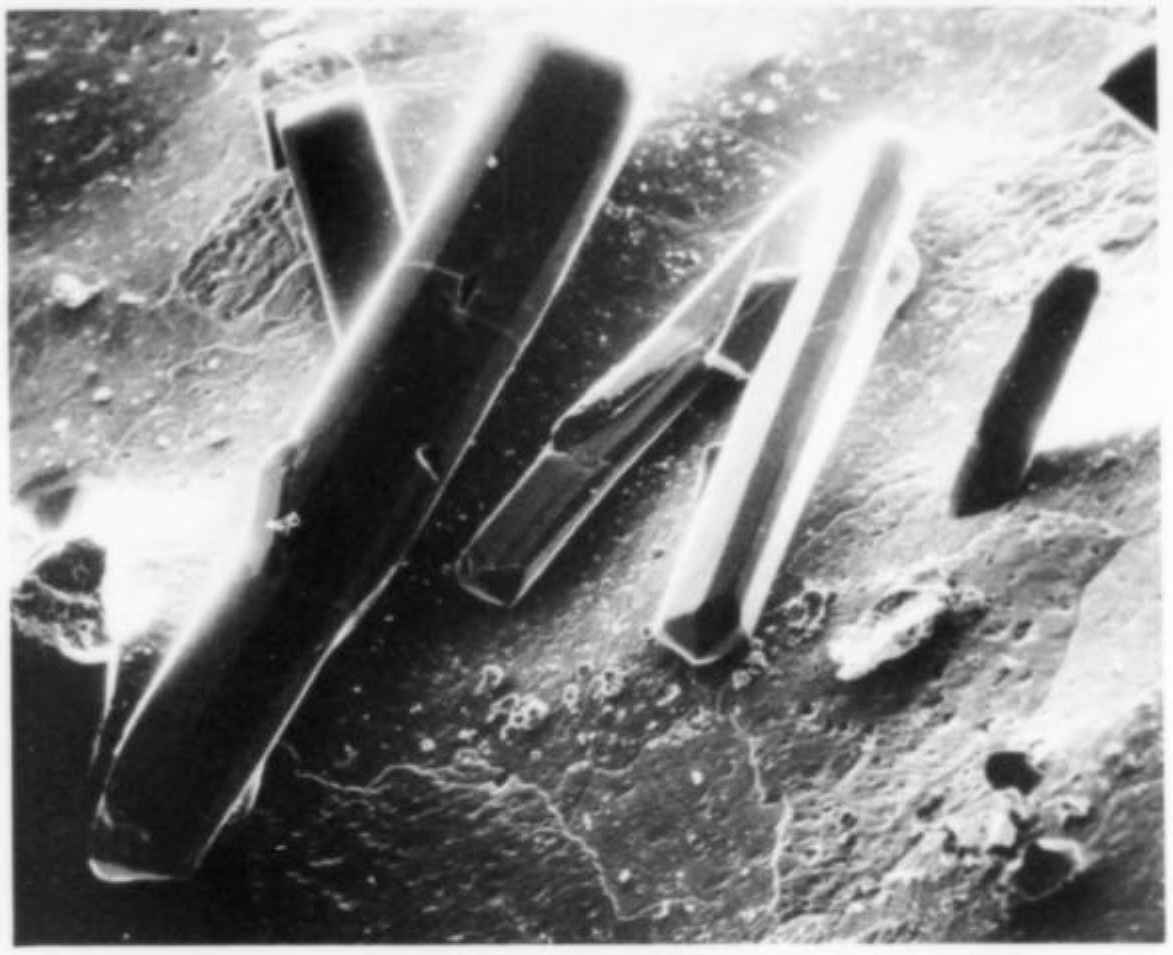


Figure 6. **Lathlike tourmaline crystals to 0.8 mm, from the Kilpatrick mine.**

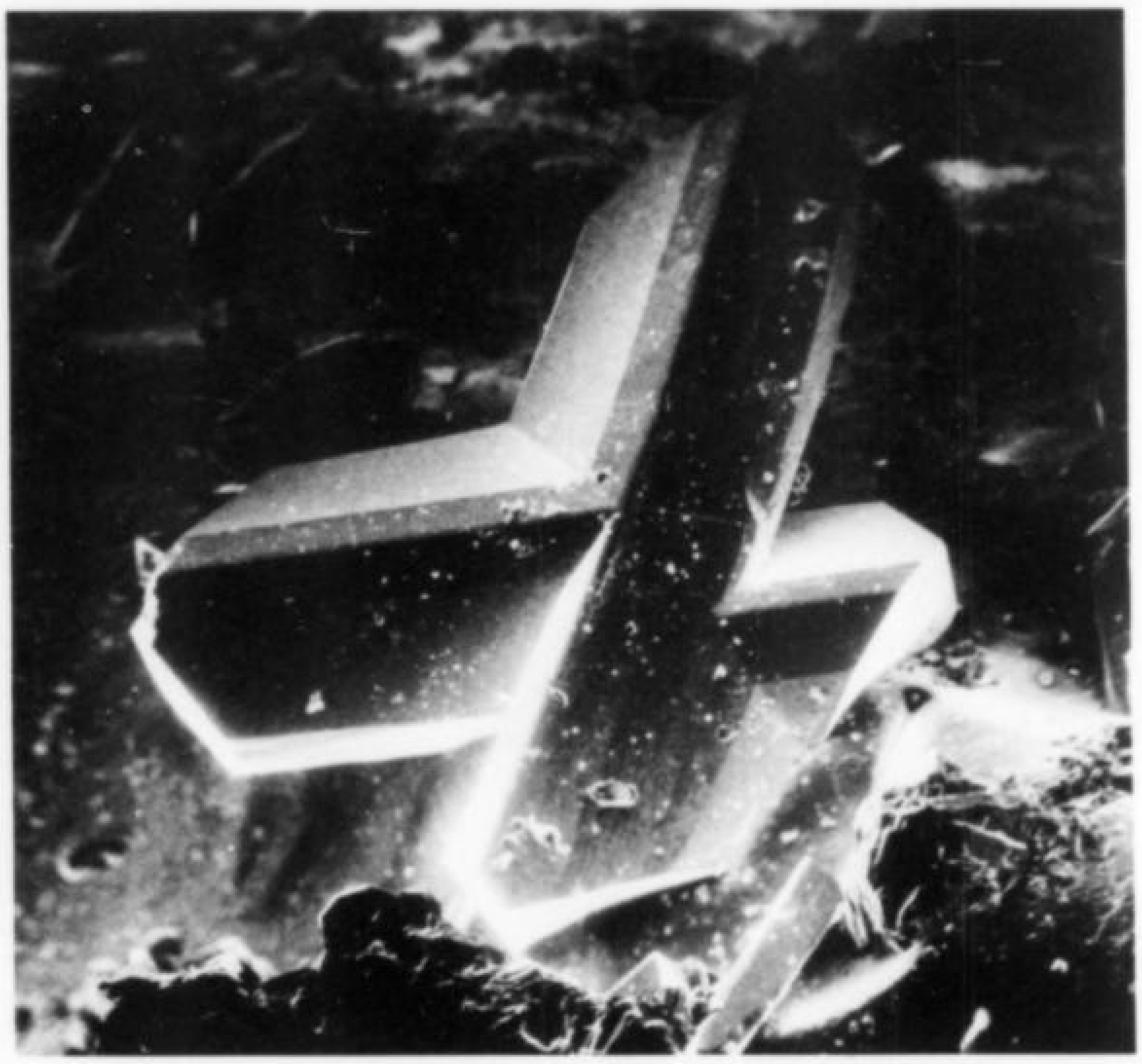


Figure 5. **Offset penetration twin of arsenopyrite from the Kilpatrick mine (1.6 mm).**

Cruciform penetrations are also common, but those shown in Figure 5 are of particular interest. They have been found thus far in only one fist-sized piece of marble, but every crystal in the sample exhibits the peculiar misalignment of the crossing twin.

An assortment of geniculated twins also occur. The most attractive of these are the ones that produce chevron-like pairs.

Microcline $KAlSi_3O_8$

Gray, well formed simple crystals of microcline may occasionally be etched from some of the darker marbles. These range to 3 or 4 mm. The dark color is reportedly due to included hydrocarbons.

Phlogopite $KMg_3Si_3AlO_{10}(F,OH)_2$

Doubly terminated, rough, hexagonally bounded crystals of phlogopite to about 5 mm in length may be etched from both the light and dark marbles. They are an interesting association but are not particularly attractive in themselves.

Tourmaline

Pale amber tourmaline crystals (species unknown) in transparent prisms with shallow terminations are found with some of the arsenopyrite. Their occurrence is less common but where present they occur literally by the thousands, like yellow straw. They cannot be exposed except by acid removal of the enclosing calcite.

COLLECTING STATUS

While the collecting status of most mines in the Madoc area is not good, there are numerous exposures of marbles in the area that would justify investigation for arsenopyrite and related microminerals. Arsenopyrite is easily collected at the Ackerman mine several miles west along Highway 7 toward Marmora; and the Canada Talc property (a working mine) also produces some tourmaline and other interesting species.

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Cuprocassiterite Discredited as Mushistonite; And an Unnamed Tin Mineral from the Etta Mine

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CUPROCASSITERITE

Cuprocassiterite was originally described by Ulke (1893) from the Etta mine, near Keystone, Pennington County, South Dakota. It was described as a malachite-green mineral with dull luster, found with cassiterite and quartz, and having the composition: Sn = 62, Cu = 13, and H_2O = 6 weight %, with traces of Fe and Si. It was thus correctly considered to be a copper-tin-hydroxide mineral.

In the same year, Headden published a description of similar material from both the Etta and the Peerless mines in South Dakota. The physical description is similar, except that Headden noted in some samples a reticulated network of thin seams of white to colorless material. Headden's analyses of the two cuprocassiterite samples yielded, for Etta mine and Peerless mine material respectively: CuO = 12.53 and 21.34; Fe_2O_3 = 8.94 and 13.98; SnO_2 = 64.33 and 54.40; H_2O = 13.87 and 9.68; (ZnO + CdO) not given and 0.60; totals = 99.67 and 100.00 weight %.

Additional comments on cuprocassiterite were made by Ziegler (1914a, 1914b) who considered the mineral to be a mixture of pseudomalachite and stannite.

Our examination of a number of samples from the Etta mine has resulted in the observation that all of the samples known to us are mixtures. There are two green minerals which fit Ulke's description. One of these is pseudomalachite. The other, a phosphate-free Cu-Fe-Sn-OH mineral, is the mineral known previously as cuprocassiterite. The X-ray powder pattern of this mineral matches that of mushistonite, $(Cu,Fe,Zn)Sn(OH)_6$ (Marshukova *et al.,* 1984), a mineral from the Mushiston deposit, in Tadzhikstan, U.S.S.R. Microprobe analysis of this mineral (NMNH # 92059) indicates that it is grossly inhomogeneous at the microprobe level, but that it is a Cu-Sn-dominant mineral and, combined with the X-ray data, shows that cuprocassiterite is mushistonite, a member of the schoenfliesite group.

Under most conditions the rules of priority would prevail, and the name cuprocassiterite has priority by over 90 years. However, our study of numerous samples indicates that the material from South Dakota is not of sufficient quality that we could provide a full characterization. Therefore, we have decided to discredit the name cuprocassiterite in favor of the better characterized mushistonite. This nomenclature proposal and mineral discreditation was approved by the Commission on New Minerals and Mineral Names, I.M.A.

Most extant samples have come from the dumps, but some were collected (by WLR) from a spodumene-rich zone near the core of the pegmatite, in 1952. This occurrence, at the boundary of the quartz core, is the only *in situ* occurrence we have observed. It can still be found on the dumps of the Etta mine in small amounts.

UNNAMED MINERAL

Headden (1893) reported that cuprocassiterite (now mushistonite) occurred as a replacement of stannite, and we have confirmed this, although we have not studied the stannite in detail. Headden also reported numerous fine veinlets, in a reticulated texture, which are in some instances filled with a pale green mineral with vitreous luster. We have examined this green mineral and report here its characteristics. The veinlet fillings are compact, transparent, and have no apparent cleavage. The X-ray powder diffraction pattern of this mineral resembles that of cassiterite in the spacing of the strongest lines, but all diffractions are very weak and diffuse, precluding precise measurement. Microprobe analysis was performed using as standards: cuprite (Cu), SnO_2 (Sn), synthetic Sb_2O_3 (Sb), and hornblende (Si,Al,Ca,Fe). The resultant analysis yielded SiO_2 = 2.7, Al_2O_3 = 0.3, CaO = 0.4, FeO (total iron calculated as FeO) = 9.0, SnO_2 = 58.2, CuO = 10.1, Sb_2O_5 = 11.2, with H_2O = 9.1 (by difference), sum = 100.0 weight %. A possible formula, calculated on the basis of Sn = 3 atoms, yields: $(Cu_{0.99}Fe_{0.97}Ca_{0.05})_{\Sigma 2.01}Sn_3$ $(Sb_{0.54}Si_{0.35}Al_{0.05})_{\Sigma 0.94}(OH)_{6.98}O_{6.64}$. This could be idealized as $CuFeSn_3(Sb,Si)O_7(OH)_7$, or $CuFe(Sn,Sb,Si)_4O_7(OH)_7$. We know of no such mineral, but prefer not to propose this as a species until the identities of other cassiterite-like minerals, such as varlamoffite, are clearly defined.

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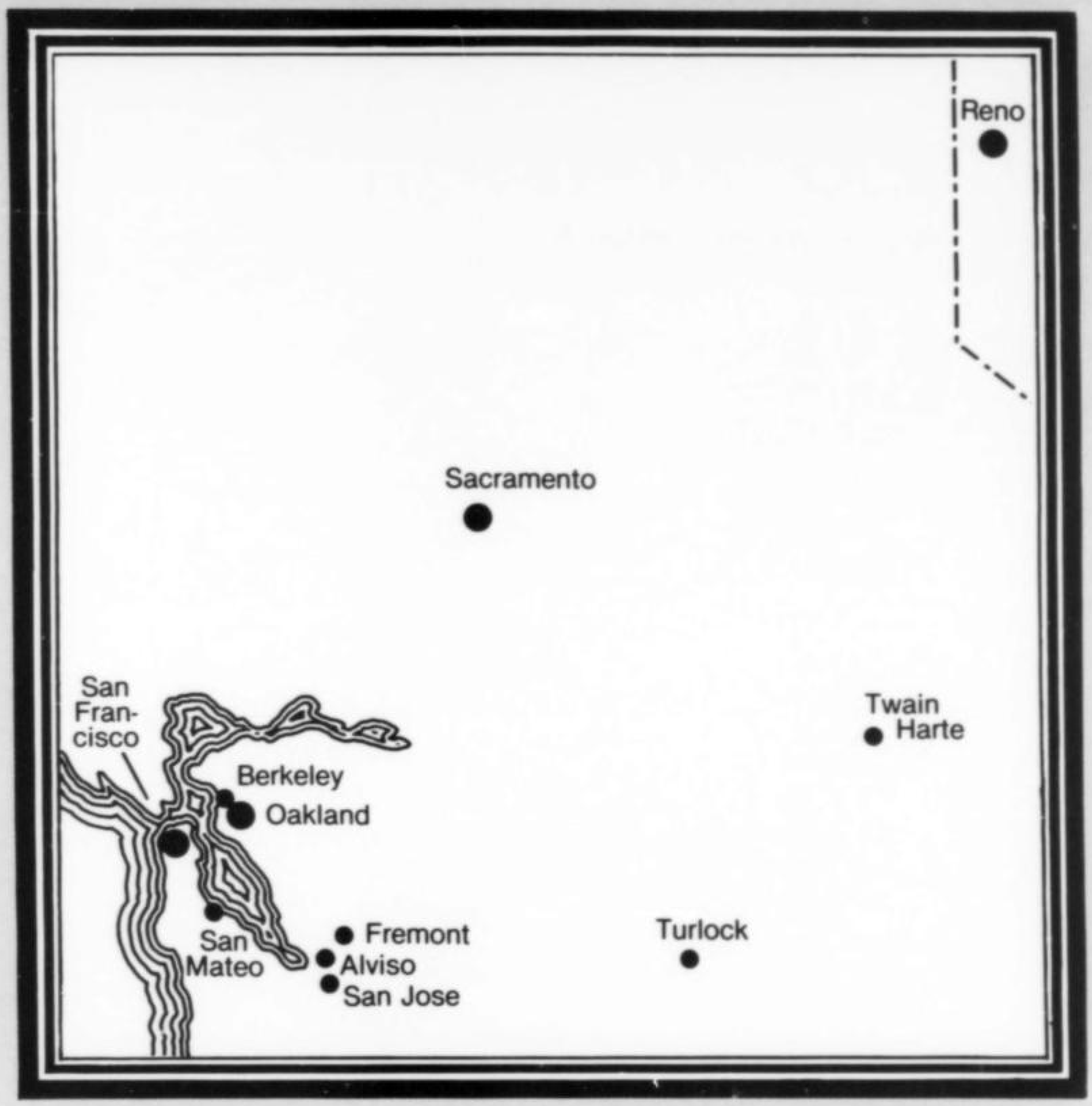

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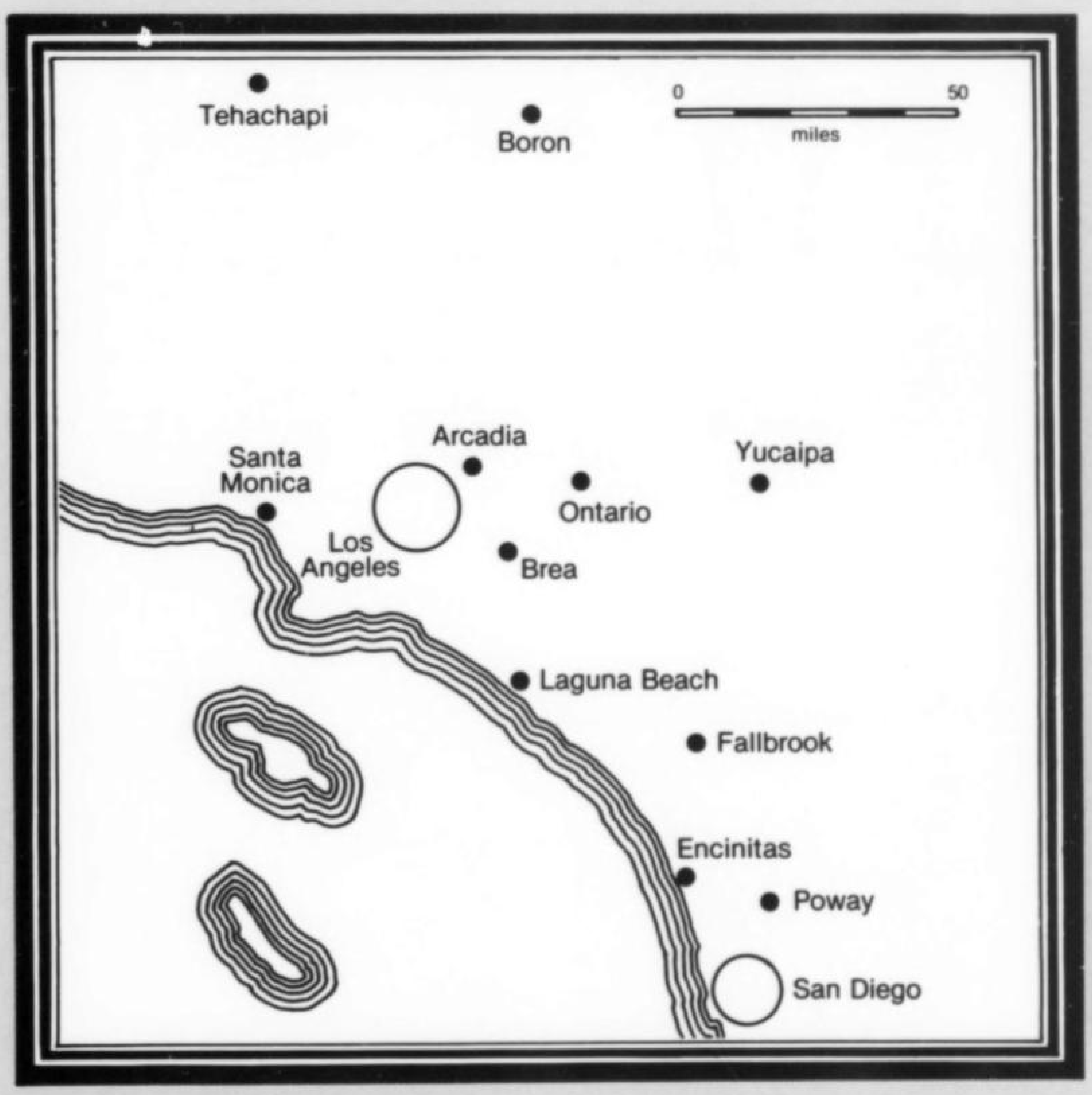

Notes from Germany

by Thomas P. Moore

ST-MARIE-AUX-MINES SHOW, 1986

The province of Alsace runs north-south parallel to the Rhine, buttressing France on the east, and things German seep capillary-action westward across the border at least as far as the ragged edge where the broad Rhine valley meets the first risings of the forested Vosges. On our way to the St-Marie-aux-Mines show this year we drove south through the Rheinpfalz forests from our home in Kaiserslautern, Germany, crossing the border at Wissembourg, then continuing due south down the valley. The highway, bypassing Strasbourg, offers only a far glimpse of the spire of the great red sandstone cathedral, a high Gothic fantasy of the twelfth century. We, as Americans who often feel that we've lived rather too long in Germany, welcome the casual onset of French grunginess: sooty profiles of villages; weathered gravestonelike mileage markers that lean by intersections even along this main route; gas stations, new car lots, furniture outlets, and other places of mass business that never seem, actually, as busy or businesslike as their likes on the opposite side of the mirror-imaging river. Mixing cultural signals still, however, are language (bilingual road signs), cuisine (e.g., the excellent sauerkraut and smoked-pork *choucroute,* advertised by tourist and indigenous-clientele inns alike), and, in the little wine towns along the *Route de Vin* to the west and against the hills, a certain compulsively prettified look, with overtones of potted geraniums – Germanic tidiness, as if small squads of *Putzfrauen* frequently slip across the river to sweep, scour, disinfect and decorate the gabled housefronts lining these brown village squares. One reads in such signs an ancient cultural ambivalence or, if one prefers modern history, the fading memory-tokens of the fact that Alsace was merged in the Second Reich during the period between the Prussian conquest of 1870/71 and the great French reconquest, reannexation and sweet revenge of 1918.

My wife Lynn, friend Gary, and I headed for the old mining town of St-Marie-aux-Mines, in that part of the Vosges where rich little silver mines worked in centuries past, for this July's edition of one of France's top mineral bourses. We had perfect weather: a temperate temperature (good for the show's "outside" part), nearly cloudless sky and tepidly bright summer light over the placid, plotted Vosges landscape. We hit the road climbing into the hills covered with small farm fields, meadows with grazing cows, tamed sociable woods with signs to mark the hiking trails. As I downshifted to negotiate a hairpin turn, it occurred to me as appropriate (given all the cultural scrambling and mulching) that this note from France will initiate my projected series of "Notes From Germany"; the absent-mindedness of the thing is of a piece with the laid-back, picnicky atmosphers of the St-Marie show itself. My companions agreed to step, if necessary, into the breach of my Frenchlessness with their vague bits of vaguely practicable vocabulary. But Lynn's ten years of attending countless mineral shows with me have created in her, along with (to be sure) a certain mild interest, a firm immunity to any deeper infection; Gary for his part came along to take pictures, and for the ride and fine weather, and perhaps for the anthropological kick of seeing so many mineral groupies in one place just being themselves.

We had to creep through the middle of St-Marie, where crowds of Saturday Market Day shoppers wove shuttles through the narrow streets, crossing between fresh egg- and cabbage-vendor stalls. At last we arrived, somehow accidentless, on the far end of town where the show was. Safely parked and regrouped, we first had to choose between entrances to the "inside" and "outside" parts of the show; there's a big difference. The friendly "outside" courtyard was attractive and uncrowded, although there was already a brisk action of smalltime capitalism around the open trunks of the tailgaters and at the beer-and-limo concession. But, for reasons mainly of greed, I opted for going first inside the blocky *lyceé* and *gymnastique* guilding, where major dealers from all ends of Europe were crammed together in the usual packed aisles and highrise

Figure 1. **Entrance to the St-Marie-aux-Mines show hall (photos by Gary Kissick).**

display stands. Just inside the front entrance there was a wide stand piled with back issues (alas, for me unreadable) of *Monde et Mineraux.* Neighboring it and fronting the main show hall was a display case where (typically) no labels were present to identify the specimens or their owners. Inside the case: a gemmy blue Brazilian topaz crystal 20 cm high, a huge matrix group of Colorado rhodochrosite of richest rose-red, and numerous other nice items.

Just inside the main hall, and with sudden alarms and palpitations of sundry inner organs, I spotted what indeed proved to be the finest single piece at the show: a thumbnail of powellite from Nasik, India. It is a gemmy deep orange pyramid, sharp, clean and

Figure 2. **Portion of the show building.**

undamaged, garlanded with white stilbite crystals and priced (I note, coming to a realization of the humility of my position) at 11,000 francs, or about $1620. The dealer, Michel Jouty (2 Rue Paccard, 74401 Chamonix), also had five other powellites, including three miniatures, all likewise priced understandably steeply, as well as a fine miniature of Erzgebirge wire silver, and about a dozen oily-greenish trapezohedral floater crystals of grossular from the old vesuvianite locality in Yakutsk, Siberia. As excitedly I explicated all these, Lynn grinned in a familiar way, and Gary regarded me just as we would a particularly cute and well-trained performing seal.

But, sensitized as I am to old "classics," I reminded them that bargains in these may often be encountered at St-Marie. At other dealers' stands I soon saw a fine small cabinet specimen of Cornwall bornite with crystals to 1.2 cm; a very nice matrix miniature of black arborescent Romanian hessite; and a sharp pale violet anhydrite crystal, one termination complete and the other struggling valiantly for expression, from the Simplon Tunnel. "My" classic sleeper, though, turned out to be a vivid red-black, brightly lustered pyrargyrite group from Freiberg, the major crystal two centimeters high, for only about $20. It is of considerable advantage to be (like me) a thumbnail collector living in Europe, because specimens of this size class tend often to be underpriced and wanly appreciated; the large cabinet pieces, often obese with excess matrix, are still most popular here.

Further, at St-Marie the best chances for sleepers of any size are found, as one would expect, among French minerals. I recall a previous visit during which I picked up, at bargain prices, excellent meta-autunite and metatorbernite thumbnails from the Loire uranium district, and once a superb siderite/quartz from Allevard, this one in deep cover among a "beginner's collection" of instructive shards in a plastic tray (I paid, of course, the full $5 for the tray, kept the siderite, and gave the rest of the rocks to a deserving and well-delighted 11-year-old). However, this year there were to be no serendipities of that order. One dealer did have a spread of decent though not remarkable rounded clusters of crude apple-green prehnite crystals from Iseré; there was a bit of micromount anatase; there were brown ferroaxinites that served only to confirm one strahler's glum report that nothing so far this year had come from the Alpine clefts of Dauphiné. And one knows better than to look very seriously for the fine proustites, tetrahedrites, bournonites, etc., said by Dana to have come from St-Marie itself long ago. A placard outside offered a tour of an old mine nearby, but according to Lieber and Leyerzapf (in "German Silver" in the *Record*'s recent Silver Issue), the silver mines here ceased large-scale operations in the seventeenth century. I felt and still feel pinched by guilt that in four trips to the St-Marie Bourse I have not yet found time to visit the Mineralogical Museum just down the street, where, presumably, such antique apocryphal proustites *et al.* may be viewed.

M. Daulon (97889857 Couzbevoie, 5 km. from Paris near La Defense) had a pretty impressive selection of Panasqueira, Portugal, material, in thumbnail through small cabinet sizes. Daulon, who said he deals *only* in Panasqueira minerals, assured me that (as I've heard elsewhere) the specimen pipelines from the locality are very tight though the mine continues to be productive; and here to prove the latter contention were perhaps 50 excellent thumbnails of fluorapatite in all shades of green and all stages of clarity from gemmy to mint milky, and arsenopyrite and siderite, and sharp black ferberite groups to 7 cm across. There was, I noticed, a fairly generous sprinkling of good Panasqueira specimens elsewhere in the hall too; we can be happy that this wonderful locality is apparently still prolific.

Figure 3. **Dealers' booths inside the show.**

Of worldwide contemporary localities, well, Peruvian and Elba pyrites were plentiful; Brazilian gem material was fairly scarce (but with honorable mention to a few small, beautiful deep green elbaites on cleavelandite matrix from Virgem da Lapa); Afghan and Pakistani gem pegmatites were well represented; big, gorgeous calcites and sphalerites from the Elmwood mine, Tennessee, continued in myriads their European incursion although, a U.S. friend writes me, they are oddly hard to come by in America. And Moroccan localities, especially the Touissit mine, are productive enough to jade the most generous-spirited browser. As at all major German shows for the past few years, one here learns hardly to glance at the magnificent vanadinite at a given stand, since at the next there will almost certainly be a still more magnificent one. From Touissit there continues to come, in abundance, large anglesites in all gemmy shades from orange to pale yellow through colorless; orange and yellow wulfenite in complexly modified plates; and (less abundantly) fishtail cerussites and noble, indigo-fresh clusters of bladed azurite.

lapidary materials, and of colorfully wonderfully vulgar beaker-grown blooms (many-tinted alums, better-chalcanthites-through-chemistry, gaudily iridescent hopper-cube bismuth groups). Giving onto the courtyard were two ugly concrete buildings, metamorphosed this year, it seems, from the blue-and-white striped tents of former years (or did the tentstuffs only cover these gray beams? I can't remember). In a quick tour of one of these, among the thickets of ferny pink and orange coral, I discovered a few mediocre specimens of Correzé pyromorphite (pale ghosts of late 1970s glories), and, all in a little row of little white cotton-lined boxes, about ten malachite-coated dodecahedrons of Chessy cuprite, the largest one only about 1 cm across, and all much overpriced. But, happily, the well-remembered bug dealership is still in its same corner: Gary for one enjoys (if that is the word) inspecting the 8-cm-wide green diaphonous moths and great winged Wright Brothers cockroaches set out on pinboards. This "outside" show is indeed a bit of a self-parodic affair – friendly, beery and winey, bug- and pyritized-ammonite-infested, and only commercial in one circumscribed, well-patrolled part of its soul.

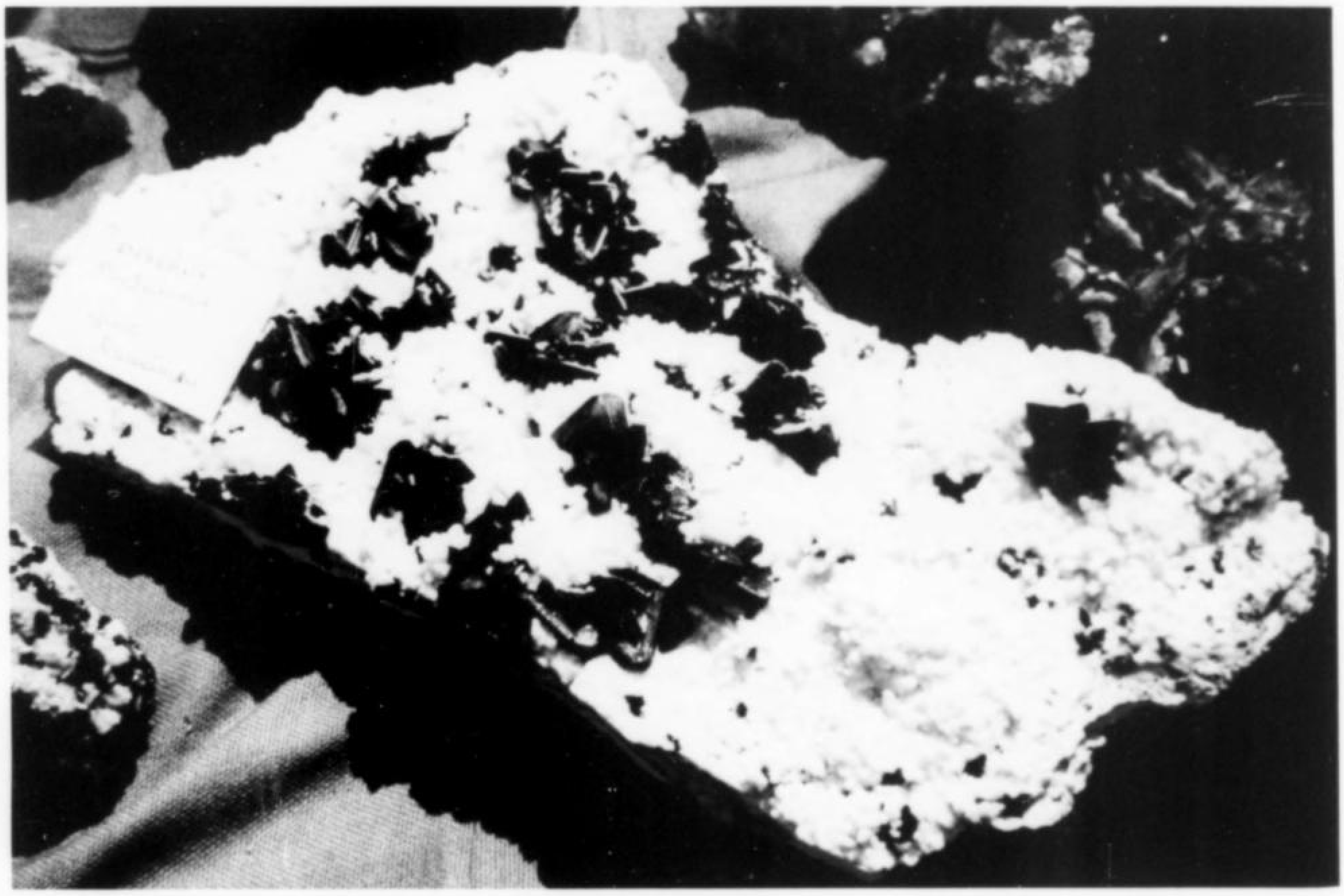

Figure 4. **Tetrahedrite crystals with calcite and rhodochrosite, 60 cm across, from Cavnik, Romania. Helmut Törk specimen.**

The offerings of Francois Lietard (Au Bois, Ruisey, 42410 Pélussin) served to characterize the pleasantly miscellaneous manner of representation of current localities in the show at large. Here were smoky brown-green, well-terminated, thin epidote prisms without matrix, said to be from the Khyber Pass, Afghanistan; Rokana mine, Zambia, libethenites in curved crystals to 2 cm on matrix; gem aquamarines and sherry-brown-topazes, many on matrix, from Pakistan; superb Moroccan anglesites, wulfenites, etc.; and five miniatures and one wonderfully vivid thumbnail of emerald-green metatorbernite from Zaire. Of famous contemporary specimen sources, only the greatest, Tsumeb, offered anything really new at this show (though otherwise Tsumeb material, one grieves to say, is hardly more available than, say, St-Marie ruby silvers). Saving a second and closer look at the new find for later that day (and later in this report), I adjourned with my restive companions to the outside part of the show.

It was in a courtyard blocked off from an alleylike street by old, leaning houses: a humbler domain altogether than "inside," with rows of spindly tables whose loads consisted largely of dubious specimens mostly sold by the flat, and of fossils of course, and of

It was outside, however, that I discovered this show's chief Trepća ambassador: the Stri Trg mine at Trepća, Bosnia, Yugoslavia, being, with Panasqueira, one of the two best current European localities, hence always worth monitoring. But for Trepća the news on the whole was sad. The Austrian dealer, who had fine, large cabinet specimens of galena, sphalerite, rhodochrosite and characteristic mixtures of these (and one small piece with a crude bournonite nestled among drusy pyrite), reported that a Yugoslav miner can be imprisoned for at least three months if caught selling minerals from the mine, and that dealers caught trying to leave Yugoslavia with specimens can have the specimens and sometimes their cars impounded by government authorities. Collectors would be well advised to buy good Trepća pieces, formerly so common on the market, but which now, for these reasons, are growing rapidly rarer.

Outside, finally, I found two recent Norwegian localities well spoken for at the table of Helmut Törk (Steingarten, Baaderstrasse 32, 8000 München 5). Törk sold me one of his sharp red-brown floater crystals of zircon from the Alta Fjörd, above the Arctic Circle in Norway, and interested me in several reasonably priced, very good thumbnails of anatase on quartz from the short-lived locality at Matskorhae, Ullensvang. The latter display narrow blue-black bipyramids, quite sharp though not of the brightest luster, to 2 cm, tightly clustered on shapely quartz crystal groups. However, the reigning monarch of Törk's table, to which I immediately directed Gary with his camera, was an immense tetrahedrite from Cavnik (Kapnik), Romania. It is a flat plate fully 60 cm (two feet) long and 30 cm wide, covered with drusy calcite and very pale pink rhodochrosite; nestling individually or in sharp finny groups among the carbonate foam are perhaps 50 bright black metallic tetrahedrites, uniformly 2.5 cm on an edge, some showing blue iridescences on the tetrahedron faces. For reasons I wish I knew but do not, considerable numbers of good tetrahedrites of this type from the fast-fading Transylvanian localities have been showing up lately on the European market – but I'd be surprised ever to see a better one than this, which Törk had priced at about $1000. (See Fig. 4.)

After our meals of grilled *Schweinshaxen* ("pigs' shanks" in plainest English, called on the sign of course by some unplain French name), we agreed that I was to be allowed one last foray "inside" to pick up a specimen and a scoop from the dealer – Daniel Bossu (2 Rue de Mars Latour, 54000 Nancy, France) – who had the only interesting new find in evidence at this show, namely: sturmanite labeled as having come from Tsumeb. A spread of about 60 glowing yellow thumbnails, miniatures and small cabinet pieces was available. The crystals closely resemble the now familiar ones from the find a few years ago at Kuruman, South Africa: hexagonal prisms with basal pinacoids slightly bevelled by the pyramid; and they come in sharp groups without matrix, or singles standing straight up from, or leaning at fetching angles to, or sprinkled haphazardly flat over, dark brown sparkling matrixes that look like microcrystalline descloizite. Individual sturmanites reach 3 cm long in the groups, with one loose orangish one reaching 5 cm; some are concentrically color-zoned, with milky pale interiors surfacing on the pinacoids and pyramids while remaining visible through a thin, gemmy, bright yellow layer that covers the prisms. Bossu, a close-mouthed sort, somewhat grudgingly claimed that the lot represents about 80% of the total contents of two pockets discovered one month ago at Tsumeb. These are fully the equals of the smaller previous pieces from Kuruman, and were priced fairly reasonably at $30–$150. [Ed. note: It's conceivable that these actually *are* old Kuruman pieces which have somehow acquired an erroneous locality along the way. Mineral dealer Julius Zweibel visited Tsumeb right after the show and heard nothing there of such a discovery.]

The late afternoon found us, three among a tourist herd, "doing" Riquewihr, a pleasant wine town that's worth the stop, despite all the herding, for its Alsatian pastry, its wine of course, and its old city gate in an old city wall, still complete. To get back to the border crossing at Wissembourg, Gary recommended a "short cut" that turns out in fact to be a much-rutted dirt road through cornfields, a road of a mind on a whim to turn into a goat trail. But Gary *did* know what he was recommending when he led us to a favorite hotel restaurant at Wissembourg: the meal was excellent, incongruously seafood-centered, and concluded with a fine *fromage* plate. There at the table I unwrapped my new specimens, the better to study, recritique and fondle them without further delay. Great waddings of tissue and gray corrugated toilet paper began building up among the glassware, labels astrew on the linen, beside the soup bowls; pyrargyrite with the paté. You see, I won't be visiting another show until the German fall season engages its clutch at Heidelberg, Frankfurt, Stuttgart and Munich, with their very different and much headier atmospheres. Reports on some of these will follow in due course.

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An Author's Guide to Writing Locality Articles *for the Mineralogical Record*

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Locality articles are a mainstay of the* Mineralogical Record, *and yet very few authors, professional or otherwise, specialize in writing them. This guide is aimed at smoothing the writing process.

INTRODUCTION

Locality articles, in which the total mineralogy of a deposit is described and considered, are a major component of the *Mineralogical Record*. We like to present a broad picture, including geology, history, ore genesis, economics and so on, with particular emphasis on the mineral assemblage and collector aspects.

Because there is already a body of literature on most major localities, a significant portion of each locality article is usually review, and we encourage a thorough bibliography. Ideally, we would like each locality article to be the *definitive* review of that locality, such that no one will ever feel inclined to attempt a better one unless major new discoveries are made. This means that a reader will find pulled together in one place a key to all aspects of the deposit, and a guide to the previous literature for further study. Through this approach the volumes of the *Mineralogical Record,* as they accumulate on the shelf year after year, retain their reference value indefinitely.

Considering the importance of receiving good locality articles to publish, we thought an author's guide might prove helpful. Authors of widely varying experience will probably be reading this, and those who are old hands at writing and researching will most likely find some statements to be patently obvious. I hope they will find at least a few items of value as well. By the same token, beginning authors may wish to tackle localities of very limited complexity, and may not have use at first for all of the suggestions given here. I, of course, must try to hit all the bases nonetheless, and hope readers will forgive any excesses they perceive.

The only potentially counterproductive aspect of a guide such as this is that some beginning authors may feel intimidated or overawed by the idea of writing a locality article once they see what can be involved. There is no need for this, however. The editorial staff stands ready and happy to assist in any way. The main thing an author needs is simply the fortitude to begin.

CHOOSING A LOCALITY

Most authors have no trouble deciding what they would like to write about. However, they may wonder what the *Mineralogical Record* would like (and would not like) to publish.

Our primary consideration is what we call "collector significance." In other words, are museums and mineral collectors at all likely to (a) own specimens from the locality, (b) be able to buy or self-collect such specimens, or (c) wish very much that they could get such specimens (even if they can't)? The *Mineralogical Record* is a specimen-oriented publication. The mere existence of fine specimens makes our readers want to know more.

Another consideration, however, is pure mineralogical curiosity. Some localities are so interesting in terms of underlying phenomena that our readers may want to learn about them despite a shortage of specimens. Such subjects are comparatively rare, however, and ideas for such projects should first be cleared with the editor. The same holds true for localities having a fascinating and colorful history but a shortage of specimens or noteworthy mineralogy.

For many years the *Mineralogical Record* has published articles in the "famous mineral localities" series, and we are always happy to receive papers in that category. Articles on lesser known localities are wanted as well, provided they pass the "collector significance" requirement, and especially if they are of more than just local interest.

LENGTH

Length should be roughly commensurate with significance, but not to the exclusion of interesting information. Authors are often unduly concerned about this, and we simply suggest they keep on writing as long as it makes interesting reading. It's always best to write too much and have the editor cut it down somewhat than to short-change the subject. As a rule, 4 to 4½ typed, double-spaced pages will yield one solid magazine page of text (excluding figures). We've published manuscripts ranging from 4 to nearly 100 typed pages.

THE LITERATURE SEARCH

The first order of business in a locality study is the literature search, in which all important previous references to the locality, its minerals and its history are tracked down. This is usually an awkward period involving a certain amount of disorientation and wasted motion while one is building up a perspective on the subject; but it pays to be thorough in order to avoid unnecessary work and post-publication embarrassment. One never truly knows what one is getting into until the literature search has been completed.

Detailed notes must be kept regarding the source of each bit of data gleaned, so that properly referenced citations can be inserted in the resulting text, and a detailed bibliography included at the end. Furthermore it must be clear to the reader of your article which data represent your own *original* research and which have come from the published or privately communicated work of others.

As to the plan of the search itself, this will vary depending on the subject. The following suggestions are geared primarily toward researching North American localities via English-language books and journals; for foreign localities it may be necessary to seek out analogous foreign-language publications which are too numerous to list here (but see, for example, Spencer, 1948).

Checking the indexes to *American Mineralogist, Canadian Mineralogist, Mineralogical Magazine,* the *Mineralogical Record* (Groben, 1985), *Mineralogical Abstracts, Chemical Abstracts, Economic Geology, Engineering and Mining Journal,* the various U.S.G.S. Bulletins, Professional Papers, Memoirs, and so on (McKelvey, 1964, 1972) may turn up some references. An important source of information, though hardly comprehensive, is the *Bibliography of North American Geology* series published as bulletins of the U.S. Geological Survey. These, begun by J. M. Nickles, cover the years 1785–1918, 1919–1928, 1929–1939, 1940–1949, 1950–1959, and continue in annual volumes from 1960 through 1970. Beginning in 1933, the Geological Society of America published annual volumes of the *Bibliography and Index of Geology Exclusive of North America;* in 1969 this series took over for the U.S.G.S.'s North American index and became worldwide under the new title *Bibliography and Index of Geology.* Also worth checking is the *Annotated Bibliography of Economic Geology,* which was issued in 38 semi-annual volumes from 1928 to 1965 by the Economic Geology Publishing Company.

A great deal of information on the history, geology and mineralogy of mines and mineral deposits appeared in early mining engineering journals, which are generally not covered by the major geological bibliographies. However, Crane's (1909) *Index of Mining Engineering Literature* partially fills that gap.

State geological survey publications (if the locality is in the U.S.) are often very useful; for a bibliographical review of U.S. state publications see Smith and Cook (1979), and also an update to that article scheduled for publication soon. Most states and some foreign countries have published their own geological bibliographies; however, a few are not indexed and are therefore difficult to use. Journals such as *Rocks & Minerals, Lapidary Journal, Rock and Gem, Gems and Minerals, the Mineralogist* and *the Mineral Collector* contain a wealth of non-technical data but are unfortunately not comprehensively indexed. Gem locality references may be located through Gill's Index (1978) or Sinkankas (1959, 1976, 1981), the latter, especially, containing many mineral references. Each reference will generally contain its own bibliography, and each of those entries should be checked as well.

Much effort can be saved if a bibliography for the locality has already been prepared by someone else. Especially valuable are the works by John Drew Ridge (1958, 1968, 1976, 1981, 1984).

Mineralogy texts, especially *Dana's System* (in its numerous editions) and *Hintze's Handbuch,* commonly carry abundant bibliographic detail. The famous *Atlas der Krystallformen* of Victor Goldschmidt (1913–1923) gives a reference and usually a locality for roughly 23,000 crystal drawings. Economic geology textbooks are also usually well referenced and indexed.

For historical references there is only one comprehensive bibliography and it is unfortunately unpublished: *A Bibliography of Books on Mining History* by Arthur E. Smith, Jr. It contains well over 3,000 entries, and all publications listed are in English. The Mineralogical Record is considering publishing it, but in the meantime authors may contact Smith directly (9118 Concho St., Houston, TX 77036).

For references on American localities published prior to 1850, the book by Hazen and Hazen (1980) is indispensable.

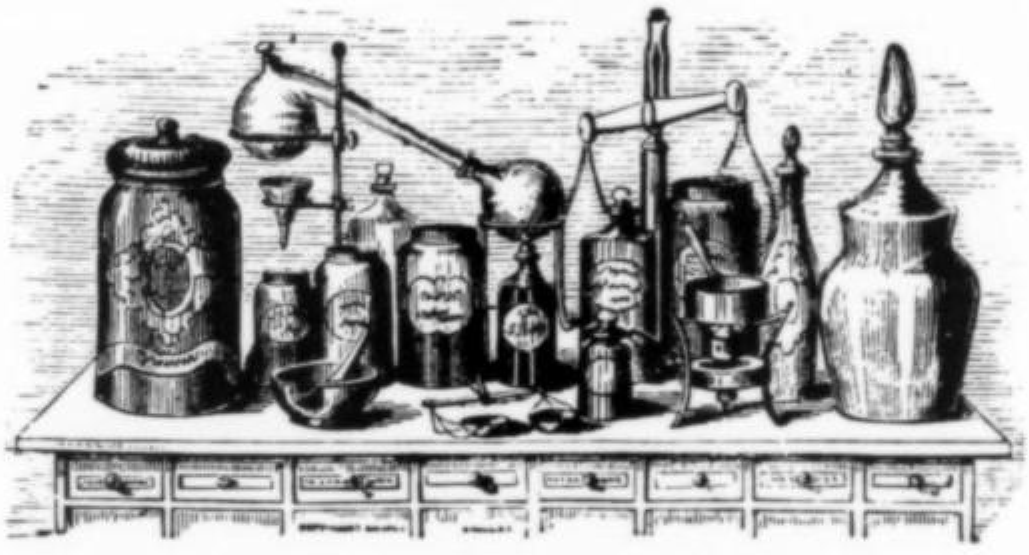
It is not uncommon to find that a graduate student somewhere once wrote an unpublished Master's thesis or PhD dissertation on your chosen locality. These can be a real boon to research when found. The student will invariably have done a fairly thorough literature search, and may also have carried out field work, sampling and analyses. Fortunately, there is a service (in the U.S. at least) to help you locate dissertations on particular topics. University Microfilms (telephone 800-521-3044) has on file over 900,000 dissertations going back to 1861 and covering virtually all American universities and colleges except Stanford and M.I.T. They will be happy to do a computer search on the locality name for you, and send you the resulting computer print-out in a week or two. If you are associated with a university or corporation there is no charge; otherwise a flat fee of $20, regardless of the number of titles found, will apply. Once you have the information you can order the appropriate microfilm or try to obtain loan copies of the dissertations from libraries or even from the original authors.

As references are tracked back into the 1800s, two problems become increasingly common: language and availability. Roger Bacon (1214–1294) wrote that "the first responsibility of the scholar is to learn languages," and there is no doubt that a working knowledge of German, Italian, French, Spanish, Russian, etc., would be a great advantage to the mineralogical researcher. Most of us, however, are lucky if we can stumble through even one foreign language. Foreign publications can nevertheless yield valuable maps, figures and tables which need little or no translation, so they should not be by-passed. In important cases it may be necessary to pay for a translation.

As to availability of rare reference works, that can sometimes be an insurmountable problem, even with the kind assistance of the Interlibrary Loan Service. Diligent work with a local librarian will sometimes locate a rare title in another library, even the Library of Congress, from which photocopies can then be obtained. If the work is foreign, especially British, it might prove worthwhile to contact Michael O'Donoghue at the British Library, Science Reference Section, 9 Kean Street, London WC2B 4AT, England, or the science reference librarian at the British Museum (Natural History), Cromwell Road, London SW7 5BD England. Some institutions have available a computerized search service, and may charge a fee.

The systematic study of the literature of mineralogy can be an occupation in itself. And, in fact, there is a very useful and detailed book on searching the literature by Richard Pearl (1951), which I recommend highly despite its being 35 years old. Another good one, though rare, is by Brian Mason (1953); it covers books and journals worldwide.

If all else fails, the researcher can quiz friends and colleagues, or track down an expert on the area and give him a phone call. Even the editor of the *Mineralogical Record* can sometimes help.



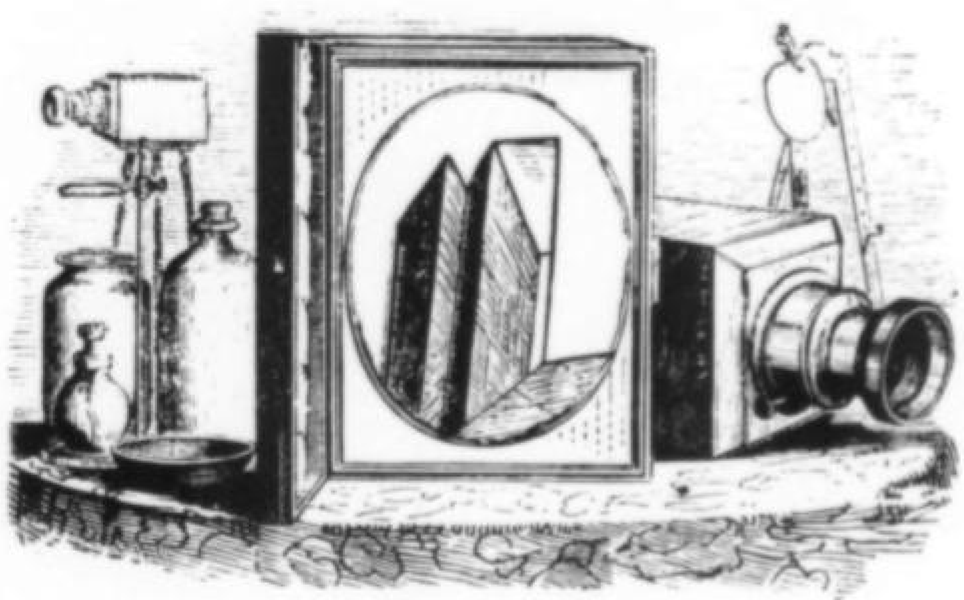
ORIGINAL RESEARCH

The degree to which original research enters into a locality article is highly variable. In some cases none is necessary at all, whereas in other cases it is essential. Some localities have been much written about over the decades (and even over the centuries), but mostly in short notes and news releases scattered to the four winds. The author who goes to the work of rooting these all out, organizing, evaluating, comparing and analyzing them, and who then brings it all together as never before has performed a major service. Important conclusions about the deposit may become evident simply through the process of bringing previously dispersed data together. So an author should not always feel required to produce new field work or laboratory analyses.

In most cases, however, it is a fairly simple matter to gather some original data together for inclusion in the article. Interviews with reliable collectors who have first-person experience at the mine can help to outline a collecting history. Examination of many specimens can yield conclusions on common habits and assemblages. Mineral exposures and veins remaining in place can be mapped or diagrammed. Museums and private collections can be scanned for exceptional specimens to describe.

A thorough study of a locality should ideally include an exhaustive listing of the mineral species present, and for some localities this may require some laboratory work. Sometimes the personnel at major museums and universities can be enlisted to perform the analyses at no charge, or a commercial analytical service can be employed for a fee. If not, and if the author does not have personal training and access to simple diagnostic equipment, the only alternative may be to search for a co-author who does. The same holds true for more detailed descriptive mineralogy such as goniometric measurements, X-ray crystallographic studies and electron microprobe analyses. These are valuable when they can be obtained, but are not necessarily essential. In any case, it should always be stated in the text how, and by whom, the various identifications and analyses were carried out.

Having done all this work, the author is, in the end, entitled (but not obliged) to make some deductions and conclusions of his own. He is in the best position to do so relative to previous authors who had less data to consider. The only warning to give here is that the author should be careful not to overstep the bounds of his expertise and background, or he may embarrass himself.



PHOTOS AND FIGURES

Specimen Photos

Like Oscar Wilde, we at the *Mineralogical Record* and our faithful readers have the simplest of tastes: we are easily satisfied with the best. Normally, this is not a problem for authors, except when it comes to specimen photos. Not only must the specimen itself be of top quality, but the technical and esthetic aspects of the photo must also meet a high standard.

We demand top quality specimens for illustrations because (1) such pieces best show mineralogical features such as habit, forms, associations, colors, etc., (2) they represent a standard of quality for the locality against which collectors and curators can compare their own specimens, and (3) they provide maximum esthetic pleasure for the reader. A European subscriber once complained to me that the *Record* works too hard to show the best; instead, he said, we should show specimens of the quality which collectors can reasonably expect to be able to dig up at the locality or purchase from dealers for a nominal sum. Otherwise, the reader will become discouraged. My response is that the purpose of the *Mineralogical Record* is not to foster satisfaction with one's personal collection, but to provide *information*. Once one knows what the best looks like it is a simple matter to visualize the mediocre; the reverse, however, is not possible. And in any case personal satisfaction must come from within; the joy of gaining new knowledge is all that we can expect to offer the reader.

Therefore, the first task is simply to locate the best, or at least particularly fine, specimens. At this point I should mention that, as a service to authors, the editorial staff of the *Mineralogical Record* can sometimes arrange for some or all of the necessary specimens and photos. An author with a good text, lacking only photos, will not be rejected out of hand. In fact, in some cases we actually *prefer* to be allowed to prepare the photography ourselves, to assure that our standards are met.

Those authors wishing to provide at least some of the necessary specimen photography themselves should canvas the private and public collections available to them, then borrow the specimens or visit the owner for a photo session. If necessary the author must arrange for an experienced mineral photographer to help him out. With luck some photos already on file might be found, and custom work can be kept to a minimum. For cover photos, we must have 4 x 5-inch large-format transparencies because cover-size enlargements require the extra detail afforded by large-format photography. For the article itself, however, 35-mm color slides will do fine, for color work, and 5 x 7 or 8 x 10 black and white (B&W) glossy prints will suffice for the rest. Polaroid 4 x 5 prints and other odd sizes of B&W are permissible as well. We can convert color transparencies to B&W prints but the result will not be as sharp as if the photo had been shot originally on B&W film. Remember that color printing is very expensive, so we will probably want to publish *only* the colorful specimens in color.

Once a mass of specimen photography has been gathered, the author may choose to send it all to the editor for a final selection. Editors prefer to do it that way . . . it is always better to receive too much rather than not enough.

As to the details of what constitutes a technically satisfactory photo, space does not permit a discussion within the scope of the present article. However, a companion article designed to serve as a guide for photographers has been prepared and will be published soon.

Hand-drawn art depicting mineral specimens is also commonly used in the *Mineralogical Record*. But we generally restrict these to historical illustrations from the days before photography came into common use.

Locality Photos

In addition to specimen photos, at least one good photo of the locality itself is beneficial to an article. It gives the reader a visual frame of reference for the history, geology and so forth. Sometimes the most efficient course is simply to hike out to the locality, camera in hand (loaded with B&W film), and shoot away. Try for a panorama of the general area and also close ups of the important mine entrances, workings, buildings and outcrops. Pick a time of day when the sun is at a sufficient angle to cast shadows and show relief.

Antique or historical photos are almost always interesting and worthwhile when they can be found. Check with local museums, libraries and especially state and county historical societies. If they have photos, they will generally be happy to make you a copy print for a few dollars, and will usually waive reproduction fees when you point out to them that the Mineralogical Record is a nonprofit organization. Private collectors of mining memorabilia are also a good source. Repositories of more than local significance include the Amon Carter Museum (Fort Worth, TX), the Denver Public Library Western History Department (Denver, CO), and the Library of Congress (Washington, DC). The U.S. Geological Survey Photo Library (MS 914, Box 25046, Federal Center, Denver, CO 80225) maintains an enormous collection of photo negatives from U.S.G.S. publications going back many decades, and will have prints made at a modest fee.

Photos lifted directly from early mining journals generally do not reproduce well due to the primitive half-tone printing. However, from 1850 to 1890 the standard type of illustration was the high-quality engraving. These can be made to reproduce extremely well, provided that a professional lab can shoot the copy, or that the original print can be provided with the article. In those rare cases where a fine painting or other full-color artwork is available, we can sometimes use that too if a color slide is provided.

Crystal Drawings

Crystal drawings are commonly included in locality articles. These can usually be taken directly from other journals and books and reproduced without written permission as long as proper credit is given and the original orientation maintained. Creating crystal drawings, drafted in the old way from raw crystallographic data, is a dying art and we are always pleased to see such illustrations. If not rigorously drafted according to the requirements of orthographic or clinographic projections they should be labeled as "sketches" rather than "crystal drawings." If computer-drafted they should be so labeled.

Maps and Diagrams

Maps are quite naturally of importance to a locality article. At least a simple location map should be provided, showing sufficient detail for a reader to go out and actually find the locality. A common question from authors who are writing about a currently producing new occurrence is: "Do I have to pinpoint the locality?" Whereas it is true that doing so may result in some unwanted visitors, failing to do so will introduce a "lost locality" into the literature, and that is something we cannot allow. We all have a long-term responsibility to the science. So, yes, you must pinpoint the locality. If, on the other hand, the location of the mine or mines in question is already well described in previous literature, your map need not be quite so detailed as to show every pertinent cow-path and windmill.

Location maps should include a scale bar in kilometers, a north arrow, and perhaps a small inset map showing the main map area in relation to the state or country.

A geologic map is in some cases a useful illustration, but should exclude most extraneous detail not germane to the mineral occurrence itself. A map of the above-ground and underground workings, at least in the important mineralized areas, is usually an extremely valuable illustration and will endear the author to future generations of grateful field collectors and field-oriented mineralogists.

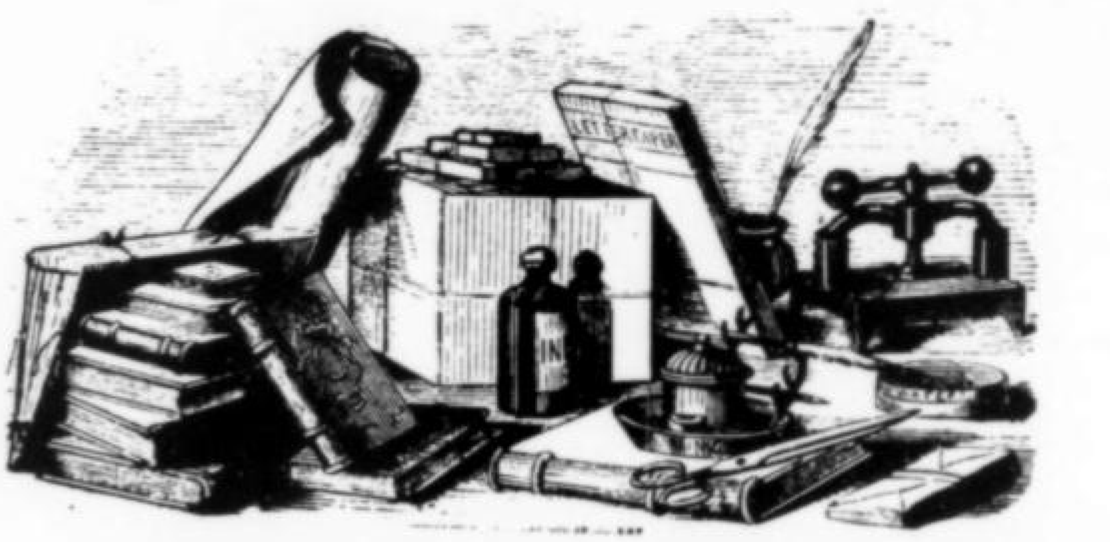
Paragenetic diagrams which illustrate, by a sort of horizontal bar graph, the relative times and durations of crystallization for different species in the assemblage are commonly included. These must be built up from a great many careful observations of overlapping relationships seen on hand specimens, micromounts and polished or thin sections. Such a diagram should not be drawn without a sizeable amount of data to back it up.

Eh-pH diagrams, purporting to show the evolution of the crystallochemical environment in terms of solution acidity and electrical potential, have fallen into disfavor in recent years. This is mainly because they lack credibility. The natural system is always far more complex in its variables than the diagram's equations allow; and, in addition, there may have been numerous sub-environments and micro-environments in the deposit which each evolved differently (i.e., a lack of equilibrium).

All of the various types of maps and diagrams may be submitted as careful sketches and the *Mineralogical Record* staff will prepare the final copies, if the author cannot. Photocopies of published maps with locations marked are easily redrafted. Diagrams and maps may be submitted in any size and will be resized as necessary for publication.

LANGUAGE

Some authors, particularly those for whom English is a second language, may feel insecure about their skill at technical writing. They should not be concerned. It is the editor's job to correct any deficiencies in grammar and style. A clear presentation of the facts is all that is necessary; the editor can polish the prose. Authors who wish to be meticulous, however, should consult a good style manual as necessary (e.g., *The Chicago Manual of Style, The New York Times Manual of Style and Usage, [U.S.] Government Printing Office Style Manual, Suggestions to Authors of the U.S. Geological Survey,* etc.).



STRUCTURE

Locality articles in the *Mineralogical Record* are all organized along similar lines. Each major section, however, is flexible and can contain a range of different types of data presented in different ways. This flexibility is necessary because every locality is unique in its own way; overall complexity and relative complexity of the different aspects vary widely from one locality to the next. Hence overall length of articles, and relative lengths of the various sections and subsections, will vary accordingly.

The Lead

The "lead" is a brief statement about the most significant and interesting aspects of the locality. It is not an abstract or an introduction but more of a "teaser," almost an advertisement, designed to convince the reader that the article is worth his time to read. Questions the reader wants answered here include: Is this a *type* locality? Is it still producing fine specimens? Are the specimens mineralogically interesting or esthetically superior? Has the locality been productive over a long span of years? In short, does the subject of the article have "collector significance" in some way? Clearly the editor thinks so or he would not have accepted it for publication. But the editor is obliged to read everything that comes across his desk; the subscriber tends to be more selective and sometimes needs convincing. In any case it is quite permissible to allow the editor to prepare the lead. (Formal "Abstract" or "Summary" sections are not used.)

The Introduction

The "Introduction" typically contains basic information on location and access, collecting restrictions, perhaps a more detailed review of the significance of the locality, and in some cases a pertinent note on what caused the author to become interested in the locality in the first place. The purpose is to give the reader some initial perspective which will aid him in evaluating the information which follows. Introductions are the hardest to write, from a prose standpoint, because they are slightly more conversational in tone than following sections.

The History Section

The "History" section *can* be one of the most interesting and even entertaining parts of the article. Readers lacking mineralogical expertise will commonly read this section in detail and merely skim the rest. Mineral collectors love a colorful history because it lends flavor and background to their specimens, and provides a context for the deposit and its exploitation. Naturally, however, some localities are vastly more endowed with interesting history than others; nevertheless, each usually has at least a few points worth reporting.

The initial discovery is important to describe, and the succession of major owners and lessees, leading up to the current property holder, is worth listing or summarizing. Significant developments in mining techniques used, the sequential exploitation of various portions of the deposit (and corresponding production of specimens), and a brief review of the economic success or failure is typically included. The history of mineralogical researches on mineral specimens from the deposit sometimes makes good reading as well. Of particular interest to our readers is the collecting history, since this is an aspect unlikely to be covered in any other journal. Details regarding at least the more significant specimen discoveries made over the years are much appreciated and are important to have recorded in the literature. As mentioned earlier, the collecting history is an area in which even amateur authors can sometimes make a valuable, original contribution. Interesting notes and asides on local culture, mining life and the like fit here as well, and lend human interest.*

The Geology Section

A review of the regional and local geology gives critical information necessary to a full understanding of the deposit. Uncommon jargon should be avoided or defined, and complexities unrelated to mineralization should be downplayed. There is no need, for example, to launch into a detailed petrologic/stratigraphic discussion of the country rocks except insofar as it is pertinent to ore genesis. Structures controlling ore deposition are important, but others are less so. Ages of faulting, intrusions and mineralization are worth noting.

The details of the size, shape and extent of the orebody or mineralization zone must be included; the closer one gets, geologically, to the minerals, the more pertinent the information becomes. Gross trends in mineralization, assemblages, textures and zoning may be noted here. Theories on the origin of the deposit should be reviewed, including the most up-to-date work. Factors controlling the form and location of the mineralization, oxidation and enrichment, manner of emplacement, source and nature of the ore-forming or

*One of our associate editors reviewing this guide wrote: "I greatly regret that much 'professional' writing has either lost these touches, or that the vital juices have been lost in editorial digestion, resulting in the issuing of the dried, homogeneous excreta."

mineral-forming solutions, physical and chemical conditions of deposition, deposition and alteration sequences . . . all these things should be considered for inclusion. In some cases a classification of the deposit and a brief discussion of related deposits is also appropriate.

The Mine Workings Section

This is an optional section reserved for localities with complex or extensive workings. If the description is sufficiently brief it can be inserted within the history or introduction sections instead.

Descriptions of workings typically will include notes on the precise location of significant veins, discoveries or localized occurrences. However, safety aspects should not be ignored; dangerous areas should be identified, particularly if they contain tempting exposures of minerals.

Some articles are written to cover entire districts or mine groups. Every effort should be made to name and locate important mines, and to be as specific as possible in referring to their individual mineralogies. Potential areas of confusion, such as the merging or renaming of mines, should be clarified as much as possible.

The Minerals Section

In this section all of the species found at the locality (or at least those having some degree of "collector significance") are discussed individually, usually in alphabetical order. Pertinent facts include rarity at the locality, environment, specific occurrences, crystal size range (metric units please), luster, habits, common crystal forms, colors, transparency, fluorescence, cleavage (if diagnostic), twinning, typical associations, uncommon assemblages and growth sequences. Chemical and crystallographic analyses can be summarized, with emphasis given to those that differ substantially from previously published data. Previous mineralogical studies should be referenced meticulously. Particular attention should be paid to species for which this is the type locality or one of the few known occurrences in the world.

This is another area where amateur authors can make important contributions: the description of specimens. It is likely that mineral collectors, on the average, actually see and handle far more specimens than do professional mineralogists. Therefore they are in a better position to make generalized descriptions provided they have sufficient command of the appropriate terminology and that they do not overstep their expertise in coming to conclusions.

Some discussion of collector aspects is appropriate here, including information on the appearance and disposition of the finest known specimens, current market availability, important discoveries and the habits that characterized them, and so on. Particular note should be made of any museums or private collections where comprehensive locality suites are kept.

As a matter of format, each species discussion should be headed by the species name and (on the same line) formula, using Fleischer's *Glossary of Mineral Species* as the formula reference. The discussion should then begin on the next line, using complete sentences.

Some localities are the focus of on-going investigations for new mineral species. Privileged information from other researchers should not be included in a locality article without their written permission. Unpublished new mineral names should not be used prior to their acceptance by the International Mineralogical Association's Commission on New Minerals and Mineral Names. We further discourage the use of provisional names for minerals under study (e.g., "Mineral Z"), and prefer instead descriptive terms (e.g., "the unnamed manganese phosphate"). Varietal names should usually be avoided as well. For an interesting review of the process of characterizing and naming new mineral species see Dunn (1977).

Tables of various sorts are commonly included in the Minerals section, depending on the kinds of data to be presented. Every locality article should have a list summarizing all of the species known to occur there, including those not deemed significant enough to discuss in the text. Minerals from the surrounding country rock may be omitted if not relevant to the deposit.

The Discussion

It is sometimes most convenient to present all information before attempting to discuss speculations and theories or draw salient technical conclusions. If so a "Discussion" section can be inserted following the "Minerals" section. Usually the topics of a "Discussion" section are ore genesis, paragenesis, unsolved problems, explanations for conflicting data, and so on.

The Conclusions

The "Conclusions" section in *Mineralogical Record* locality articles is usually reserved for comments on the prospects for future field discoveries, specimen production and locality accessibility. Comparisons with other important localities, from a collector standpoint, are also sometimes made.

The Acknowledgments

It is considered proper form in American publications to make note of the people who gave assistance during the preparation of the article. People who provided unpublished analytical, mineralogical, geological or historical data should be acknowledged unless they prefer not to be, and their institution or affiliation given. Mine personnel or landowners who provided cooperation and access during field work deserve equal recognition. Professional colleagues or acquaintances with whom you discussed puzzling or difficult aspects of the deposit and who offered useful insights, particularly if they reviewed the manuscript, might also be thanked. Library personnel who gave assistance above and beyond the call of duty might appreciate being mentioned. The owners of specimens pictured or studied and the photographers who donated their work are sometimes thanked even though their names have appeared in the figure captions. And, of course, if the work was financially supported by a grant the grantor should be acknowledged.

The Literature Listing

Several options are available with regard to the listing of pertinent literature at the end of the article. The list can be titled "References" if each and every entry has been referred to somewhere in the text. If the list is more comprehensive, including all references cited in the text *plus* many more that were not cited, it should be entitled "Bibliography." These are the two most common choices. In very rare cases, the list might be entitled "Sources" (perhaps for a solely historical text), or "Suggested Reading" for a short article of very wide scope). These latter two apply only when rigorous citations in the text are not used; since we prefer rigorous citations, we rarely use these formats.

The literature list should follow our usual format (see any recent issue for examples). In particular, all journal titles should be spelled out in full, with page numbers given. Author names should be all in capital letters. Book titles and journal titles should be underlined.

The Figure Captions List

The final part of any article is the figure caption list. Each caption should include full data, such as source for maps and diagrams, meaning of symbols, etc. Specimen photo captions should include (1) species name, (2) color (if a B&W photo), (3) crystal size (metric units please), (4) specimen owner, (5) photographer, and any other pertinent data on the location or the mineralogical aspects. Photos provided by historical archives, libraries, private collections and the like should be so identified. Maps, diagrams and crystal drawings taken directly from a previous source should be noted as: (from Jones, 1985). Those that have been redrawn should be noted as: (after Jones, 1985) or (modified from Jones, 1985).

Incidentally, we discourage routine parenthetical text references to every figure. Each figure is usually placed adjacent to the appropriate text. But in many cases figures must be deleted or regrouped by the editor (especially when color printing is involved), and therefore renumbered. Fewer text references to correct means less chance for error.

COMMENTS

Every author brings his own strengths and weaknesses to an article. Those areas where he is strong are the easiest for him to write about. By the nature of locality articles and their wide-ranging scope, however, there will invariably be sections where he is weak, and these will be more difficult. For first-time authors almost *every* section may seem difficult. There is a common fear among new authors that their article will be published unreviewed, and their mistakes and weaknesses held up to ridicule by the more experienced readers. Let me assure you that such is not the way at the *Mineralogical Record.* Because our reputation rides on each article as well, we work doubly hard to find qualified reviewers, to identify and help correct any technical problems, and to provide whatever assistance is necessary in the gathering of information and illustrations. In fact, I don't know of any other journal which offers the range and depth of author support that we do. Our goal is to see that every article, regardless of any shortcomings it may have had when first received, is a fully realized and professionally sound document when published. The editorial staff works closely with the author on any suggested improvements or additions to be sure they meet with his approval.

A great many readers of the *Mineralogical Record* could produce valuable contributions to the mineralogical literature, but have thus far refrained from doing so. It is my hope that this guide will eliminate some barriers of uncertainty, and give potential authors the impetus to write about what they know and love.

Table 1. Locality Article Check-list

- I. Article Structure (text)
  - A. The Lead (optional)
  - B. Introduction
  - C. History
  - D. Geology
  - E. Mine Workings (optional)
  - F. Minerals
  - G. Discussion (optional)
  - H. Conclusions
  - I. Acknowledgments
  - J. References (or Bibliography)
  - K. Figure Captions
  - L. Tables
- II. Illustrations
  - A. Specimens
    1. Color photos
    2. B&W photos
    3. Crystal drawings
    4. Artwork (historial)
  - B. Locality scenes
    1. Site photos (recent or historical) (above-ground or underground)
    2. Site artwork (recent or historical) (above-ground or underground)
  - C. Maps and Diagrams
    1. Location map(s)
    2. District map (showing mines)
    3. Plan of mine workings
    4. Geology (various)
    5. Paragenesis, Eh-pH, etc.

ACKNOWLEDGMENTS

My thanks to the editorial board of the *Mineralogical Record,* as well as to Carl Francis, Tom Gressman, Marie Huizing, Terry Huizing, Anthony Kampf, Gloria Ludlum, Don Olson, John Sinkankas, Art Smith, John Sampson White, and L. V. and W. E. Wilson for reading the manuscript and providing many helpful comments. The concept of such a guide was first suggested by Don Olson (while in the throes of preparing his first article for the *Mineralogical Record*).

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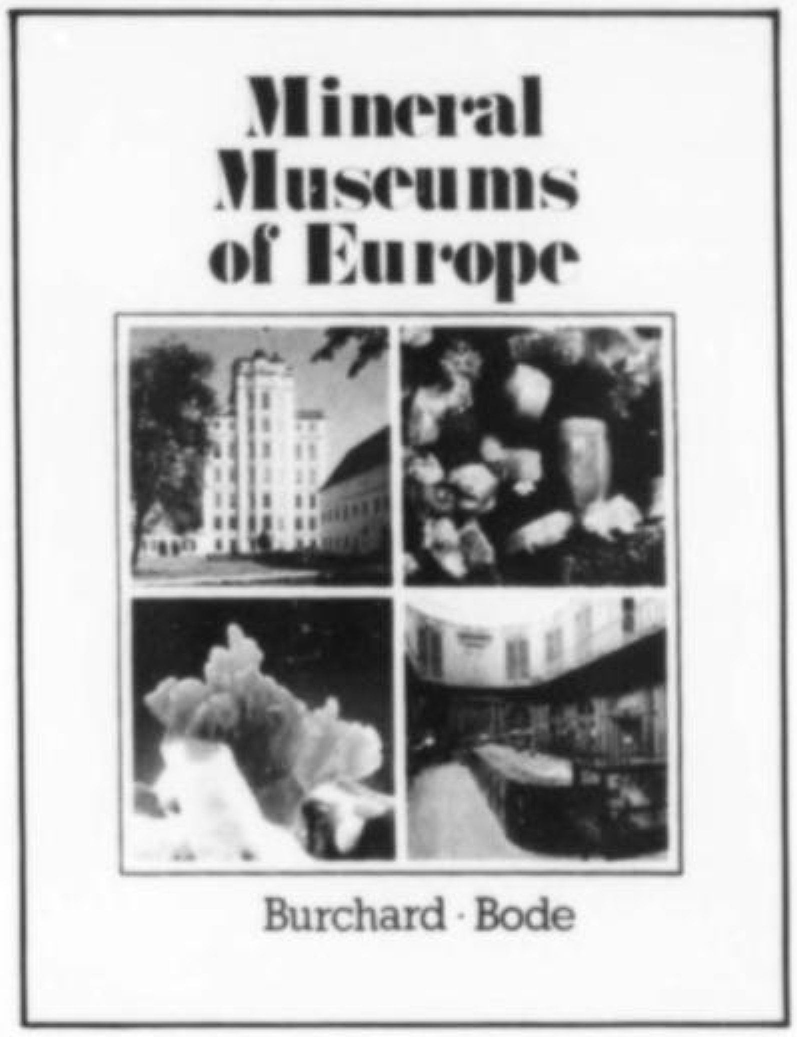

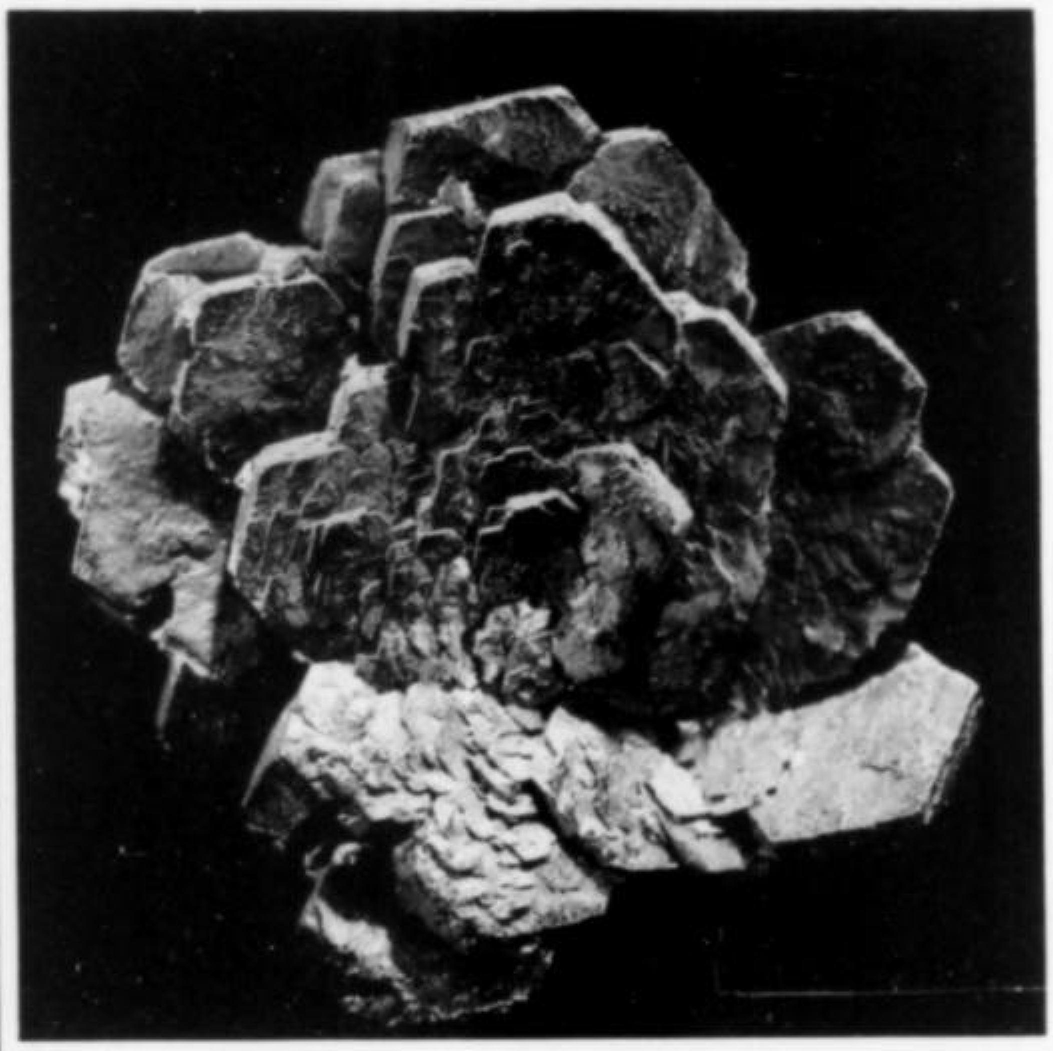

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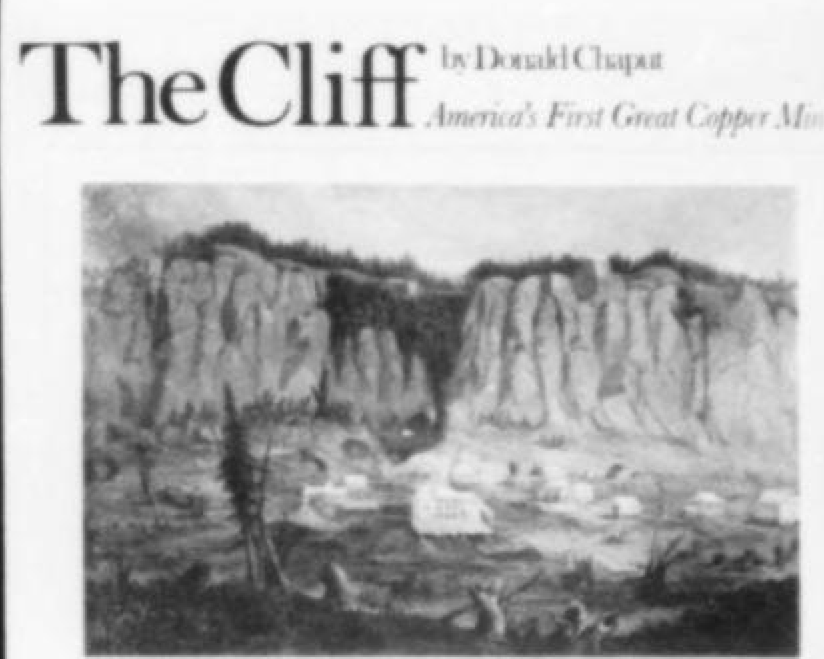

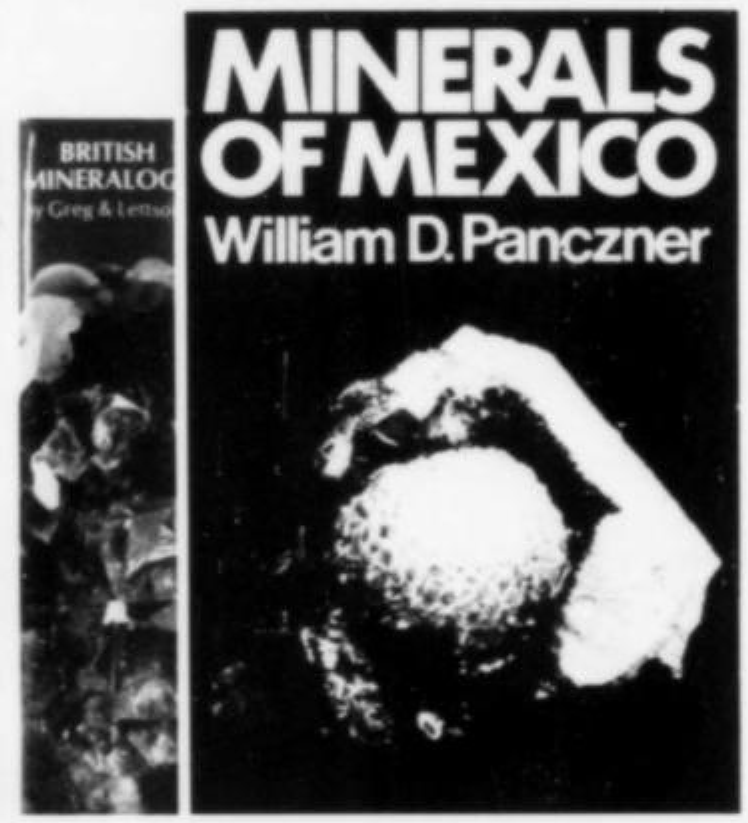

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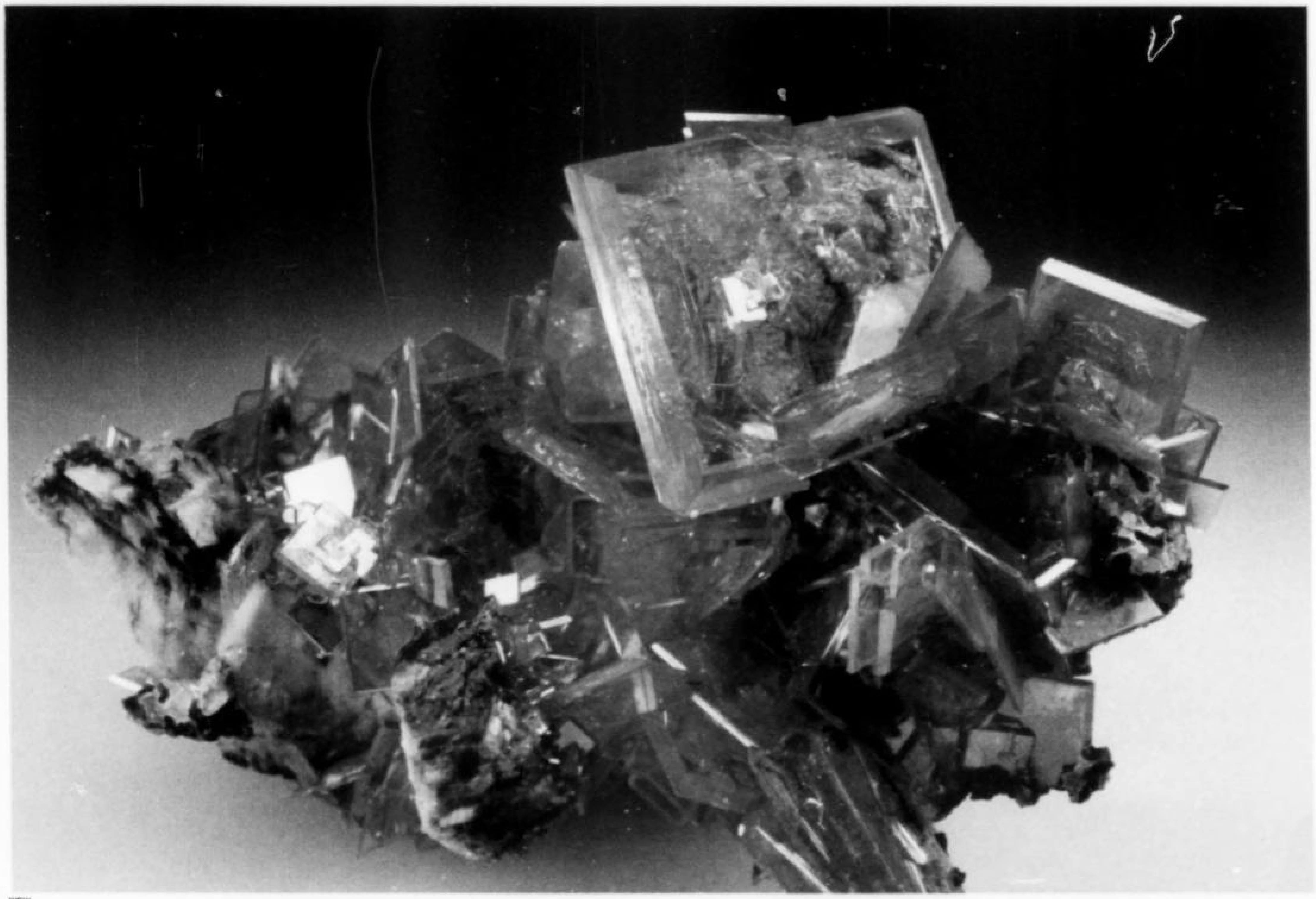
What's New in Minerals?

by Wendell E. Wilson



WEW

Figure 1. **Superb, undamaged small cabinet specimen of wulfenite on barite recently collected by George Godas at the Rowley mine. The large crystal is 2.8 cm diagonally.**

ROWLEY MINE

The Rowley mine in Maricopa County, Arizona, has long been famous as an important wulfenite locality (see the article by Wilson and Miller in vol. 5, no. 1, p. 10–30). The accessible workings are not very extensive, and over the years collectors have moved a great deal of rock in search of wulfenite. Back in the 1960s all the shafts and inclines were well timbered and all areas above the water table were open. Prior to 1970, however, the Jobes inclined shaft (which passes through the major stoped area) was somehow set afire and all the timbering there burned out. Then, just in the last few years, all of the boxwork timbering was systematically removed from the main incline (some say by the owner). Collectors have nevertheless continued to work the mine for specimens.

An extremely fine pocket of wulfenite was recently opened at the Rowley mine by George Godas.* According to George, the find was made in a side stope just above the main crosscut and roughly midway between the two inclined shafts. The pocket-seam yielded fourteen flats of good specimens including a truly superb small cabinet piece with a razor-sharp 2.8-cm main crystal perched on a nest of smaller ones (Fig. 1). This is one of the two or three finest specimens of Rowley wulfenite I have ever seen. Also from the same find is an excellent plate of barite crystals with wulfenites perched across it (Fig. 2), which is a typical combination for the mine. Wulfenite near the top of the pocket tended to occur in thinner, cleaner crystals whereas thicker crystals soiled by pulverulent red hematite were found lower down. Associations included yellow to pale orange and pale green botryoidal mimetite; small, white tufts of willemite; white to hematite-stained barite crystals; and tiny (1 mm), gemmy quartz crystals perched on barite.

George and Dick Morris found a couple of flats of green pyromorphite crystals, generally 1–2 mm but some up to 3 mm and associated with wulfenite (these were identified by George Robinson at the National Museums of Canada).

George has also found some very good (for the mine) vanadinite in the workings extending north from the Jobes shaft. The crystals are somewhat hoppered and red-brown in color with a dull luster; the best specimen is a cabinet piece about 11 cm across and com-

*George is one of Arizona's most successful field collectors. Readers may recall a number of his self-collected pieces illustrated in the articles on the Old Yuma mine (vol. 14, no. 2, p. 97, 100, 101, 104) and the J. C. Holmes claim (vol. 17, no. 2, p. 112). He has also done exceptionally well recently at the Red Cloud and Grand Reef mines. His personal collection of about 100 superb Arizona pieces is entirely self-collected.

Figure 2. **Wulfenite crystals to 1.2 cm on edge, on barite crystals, recently collected by George Godas at the Rowley mine.**

pletely covered on one side with vanadinite. This is the same place where in previous years other collectors have found interesting specimens of vanadinite in rectangular shells or molds around now-gone wulfenite. (Such specimens are termed "perimorphs.")

Garth Bricker is a collector from southern California who has often ventured across the state line to collect at Arizona localities such as the Red Cloud and Rowley mines. Following publication of the 1974 article Garth visited Rowley several times and came up with a variety of interesting microminerals including boleite crystals to 0.1 mm, numerous diaboleite crystals to 1 mm, caledonite crystals in various stages of replacement by diaboleite (identified at the Smithsonian), atacamite and a microcrystal of native gold in contact with a caledonite crystal. These were all found in the area marked "Chrysocolla Stope" on the map in the 1974 article.

We report these finds here as a matter of scientific documentation, but we do *not* recommend that collectors continue to visit the Rowley mine. Very large expanses of fractured, unsupported hanging wall now extend over much of the open workings and present an extreme hazard to future collecting. I would not be surprised to hear, sometime in the next few years, that this mine has suffered a sudden and catastrophic collapse.

The bad condition of the Rowley mine is particularly sad in view of the fact that the deposit is far from exhausted. The volumes of vein material just below the current water table probably hold a significant reserve of fine specimens which might be tapped if the water level falls. In the 1950s *Mineralogical Record* president Richard Thomssen was on the site when core drilling was being undertaken by Charles Rowley to check out deep portions (>150 meters) of the vein. Thomssen reports that the same secondary suite (wulfenite, mimetite, vanadinite, cerussite) was found at depth, suggesting that significant wulfenite mineralization continues down-dip along the fault zone, and that the early water table at the time of secondary alteration was much lower than at present.

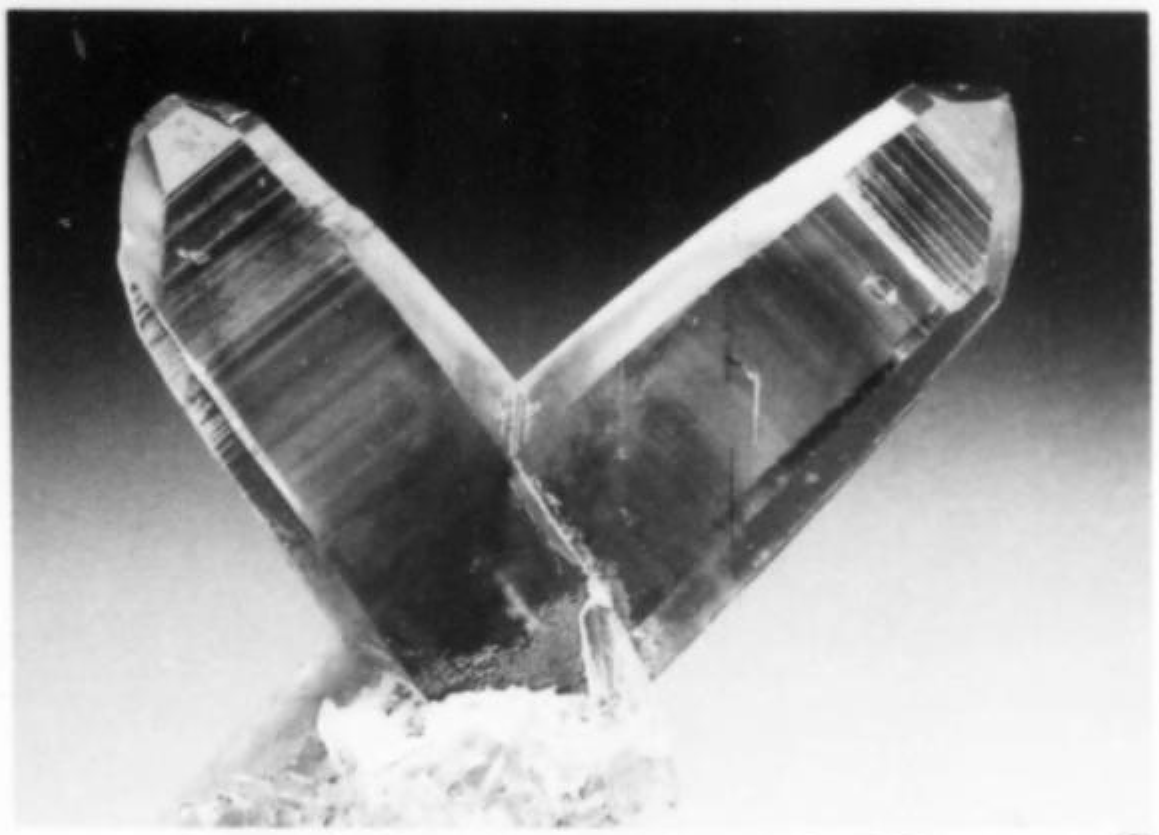


Figure 3. **Japan-law amethyst twin, 2.8 cm across, from Guerrero, Mexico. Steve Green specimen.**

AMETHYST TWIN

For some unknown reason, Japan-law twins of amethyst are scarcer than *Archaeopteryx* teeth. Steve Green (*New Deal Minerals*) came across a beauty recently (Fig. 3) in a flat of average material from the well known amethyst occurrence at Guerrero, Mexico. Miners at Guerrero routinely discard small crystals, so it is particularly fortunate that this one was preserved. The crystals are flattened in the common plane as most Japan-law twins are (contrary to the usual habit for Guerrero amethyst), a feature which helps to verify that this is indeed a twin and not an accidental configuration. (See the article on Japan-law quartz twinning by Cook in vol. 10, no. 3, p. 137–146.)

BRAZILIAN TOURMALINE

Mike Ridding (*Silverhorn*) reports a new (May 1986) discovery of tourmaline at Lavra da Pederneira, Municipio de Agua Boa, Minas Gerais, Brazil. The locality is very near the famous Cruzeiro mine (see vol. 11, p. 363–367), which is also currently producing specimens. Pederneira crystals, like those shown in the photo at right, are blue-gray in color with deep red terminations and lower cores, and occur on albite-lepidolite matrix. Approximately ten of the recently found pieces are considered "very fine."

Mike also reports that about 100 kg of bright orange-colored beryl were found late last year near Coronel Murta in Minas Gerais. Complete crystals were not recovered, but the large (to more than 1.2 kg), hexagonal fragments with pale green rims are interesting nonetheless. Most are unfortunately destined to be used for carving.

Figure 4. **Tourmaline crystal group, 10 x 10 cm, pale blue-gray with red terminations and cores, from Lavra da Pederneira. Mike Ridding specimen and photo.**

History of a Traprock Silver

Richard Hauck
8 Rowe Place
Bloomfield, New Jersey 07003

On Christmas Day of 1948 I received as a gift my first book on minerals: George L. English's *Getting Acquainted with Minerals* (1934). On page 196 of this book is pictured a wire silver specimen from Paterson, New Jersey. Over the years that tantalizing illustration motivated many a trip to the Paterson quarries in search of elusive silver and other traprock minerals.

I was never successful in finding any native silver at Paterson, despite those many collecting trips. However, a fortunate series of events approximately 30 years later resulted in my actually being able to acquire the original silver specimen pictured by English.

The first lead came from California mineral dealer Rock Currier, who had at one time worked for a chemical company in New Jersey. His lodgings in the town of Montclair were located within a block of mineral collector Allen Crunden's residence. The Crunden Collection was ostensibly a secret collection known only to very few people. I had heard of this great and mysterious collection, but had never been able to locate it. (Rock later pointed out to me that this "secret collection" was prominently listed in the "Visiting rockhounds welcome" column of *Rocks and Minerals* magazine!)

Following up on Rock's lead I found that the entire collection was being offered for sale by Crunden's heirs, and I was lucky enough to be able to outbid the other collectors who knew of it, and acquire the collection. The Paterson silver was there.

John Kolic of Franklin recalled that the person credited with finding the silver, Charles Hansen, was the son of Florence Hansen, then the manager of the Franklin Mineral Museum. Charles was deceased, but, when I spoke with his mother she remembered who his collecting partner had been that day when the silver was found.

The collecting partner was Lester Jochem, a retired high school principal from Pompton Lakes, New Jersey. From Jochem I obtained Hansen's mineral catalog (which listed the collecting trip and noted the discovery of the silver specimen), and also Lochem's first-person description of the find:

> On March 10, 1930, late in the afternoon and evening, I visited the Prospect Park quarry and found good specimens of bornite. I told my friend, Charles Hansen, and he was interested so we visited the quarry on the following day. I suggested that he break up a piece of bornite and basalt which was the size and shape of a large watermelon. When he broke it open he found a cavity [about 4 by 5 inches] from which he obtained a specimen of calcite crystals and [heavily tarnished] wire which we assumed to be native copper since it was associated with bornite. I scratched the wire near the base to see the true color of the metal (these scratches can be seen in early pictures). The specimen was found [at the quarry wall, about due west of the quarry office and] about one-third of the way up from the quarry floor.

Shortly after finding the specimen, Hansen showed it to Mr. John Grenzig of Brooklyn, N.Y., a mineral dealer, and traded it to him for $15 in quartz crystals. Charles told me that there were several other pieces of wire silver [from the same pocket], much smaller, but he could not find them later and thought they might have been accidentally thrown out.

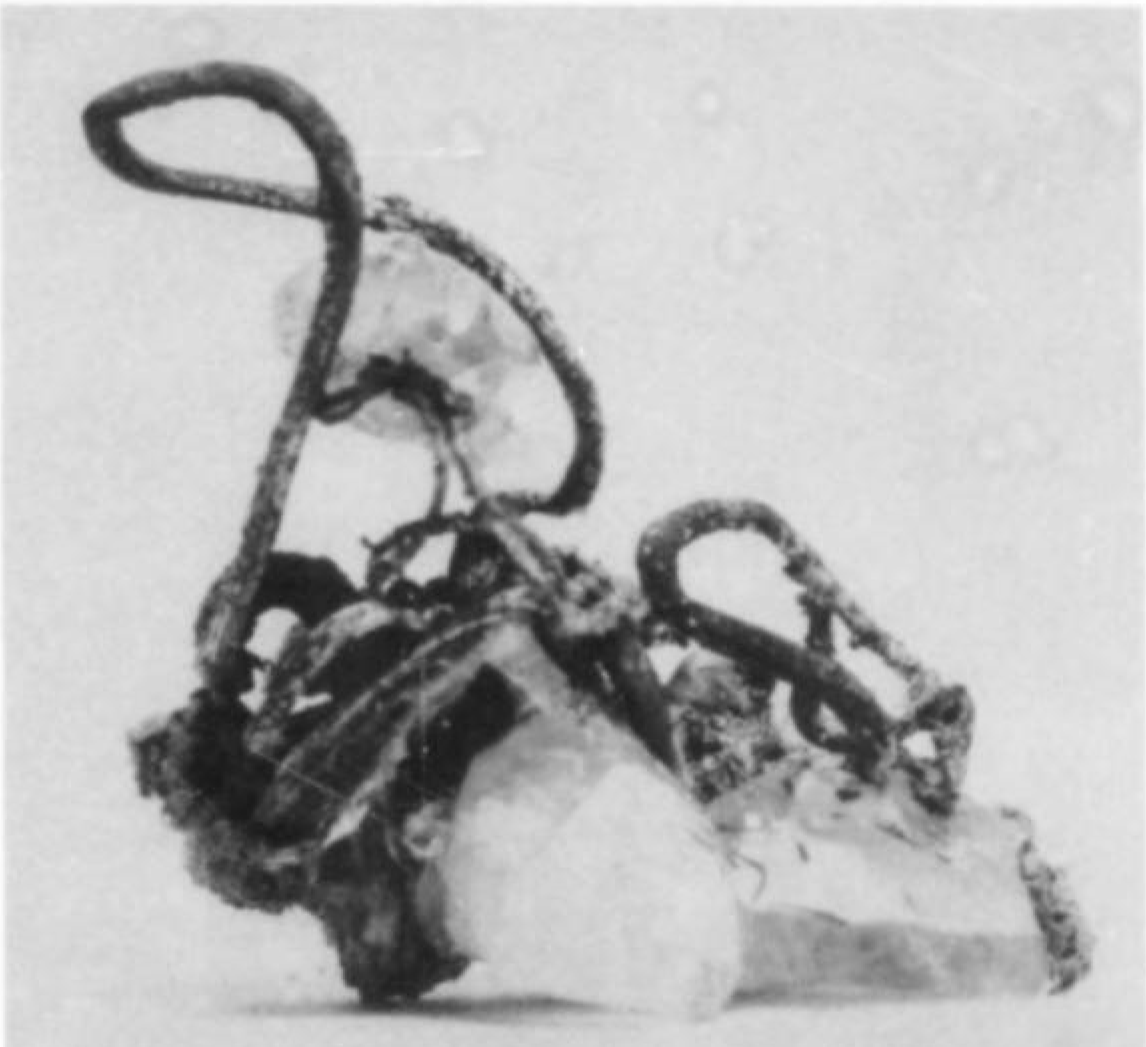


Figure 1. **John Grenzig's original photo of the Prospect Park quarry wire silver, 5.9 cm across, now in the Hauck collection.**

John Grenzig was an electrician by trade and a part-time mineral dealer who recognized the importance of Hansen's silver specimen. He had photos taken which were subsequently published in English's book and also in J. G. Manchester's *Minerals of New*

York City and It's Environs (1931). Hansen's copy of Manchester's book (which I also obtained from Jochem) has a handwritten note next to the photo briefly describing the find. Manchester comments in the text (p. 53):

> The Prospect Park quarry has become of much interest to collectors because a large variety of minerals have been found . . . . Most interesting of all, however, is the discovery of native silver in the form of stout wire threads . . . . The specimen here illustrated is no doubt the finest native silver yet found in the metropolitan area.

William Casperson, in his *Minerals of New Jersey* (1952), also mentions the discovery:

> The bornite find covered an area about the size of the body of a five-ton truck and consisted of solid metallic ore with chalcopyrite and chalcocite. An interesting find of native silver was made within this bornite mass. This find was made by a young man, Charles Hansen, who took the specimens to John A. Grenzig of Brooklyn, a well-known collector and dealer. Mr. Grenzig recognized the silver and secured for himself the finest of the specimens. The young man kept one specimen for himself, another specimen came to the Paterson Museum and is now on exhibit, and one specimen remained with the quarry owner, Mr. Abe Vandermede.

I have since acquired several pieces of bornite from around the original pocket. Whereas no wire silver is visible, small veinlets of silver radiate outward from the pocket surfaces.

In conclusion, several points about all this are worth noting. The Paterson wire silver is in my collection today only because a number of people and events interacted in a fortunate way. If Charles Hansen hadn't visited the quarry that day in 1930; if Grenzig hadn't recognized the significance of the specimens; if Crunden hadn't pressured Grenzig for many years to sell him the specimen; if Rock Currier hadn't shared his old contact; if I had been outbid by a better funded collector at the Crunden auction; if John Kolic hadn't remembered who Hansen's mother was; and if she hadn't remembered who his collecting partner had been that day . . . . All these ifs demonstrate the improbability of major specimens being preserved, along with their history, and made available for acquisition by a particular collector. I hope, in any case, that my efforts in researching the provenance of this piece will assure future owners and skeptics that wire silver is indeed known from the traprock of New Jersey.

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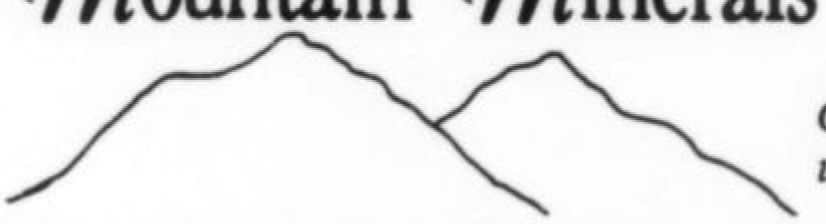

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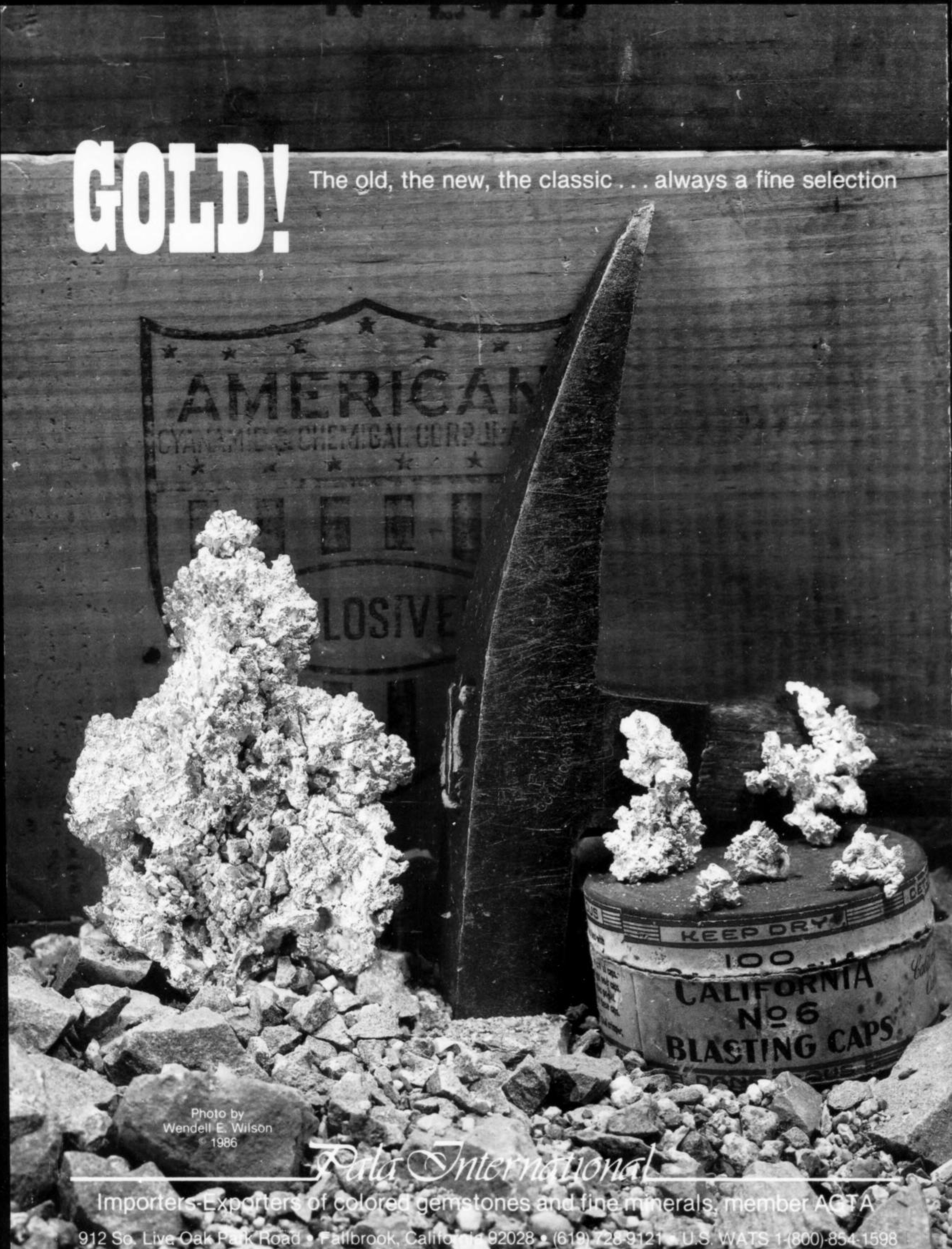
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