the Mineralogical Record

Volume Twenty-nine, Number Five
September–October 1998
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THE MINERALOGICAL RECORD

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Articles

Columns

COVER: MIMETITE crystal group on matrix, 12 cm, from the Elura lead-zinc-silver mine, No. 1 Level, Cobar, New South Wales, Australia. Mined in 1988 by John Chapman, it is one of the three best specimens from the find. Collection of Marvin D. Rausch; photo by Jeff Scovil.

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notes from the EDITOR

BEHIND THE SCENES:
PUBLISHING THE SWEET HOME ISSUE

The first thing that readers probably noticed about the previous issue on the Sweet Home mine was the peel-off temporary cover. The story behind that goes back over 20 years, to the Colorado-I and Tsumeb issues, our very first special issues. When we published those, a sharp-eyed postal inspector advised us that we were violating Postal Service regulations for the mailing of second-class periodicals. The problem was that we were (and are) not allowed to have any word or lettering on the front cover that is larger or "more prominent" than the actual name of the magazine. Since the words "Colorado" and "Tsumeb" were larger than "Mineralogical Record," the Postal Service threatened to reclassify such issues in the future as "books" and charge the Book Rate for postage. That amounted to about $700 more in those days.

The interpretation and enforcement of the regulations was admittedly made problematical by our special issues, which are clearly issues of a periodical, and just as clearly designed to look and sell like books, independent of their nature as periodicals.

Most recently we got called on the carpet again for the *Boléo* issue, and this time it sounded like they were getting serious about demanding compliance from us. By now the difference in postage between our usual special second class periodical rate and the standard book rate had risen to over $6,000!

I decided that was too much money to risk, and got together with our printing people in Maryland. The cheapest method we could come up with, that would still allow us total artistic freedom while meeting regulations, was the temporary peel-off cover; $600 down the drain, but I guess we should be happy that *some* workable solution was found. I remember a while back we tried putting "DO NOT BEND" on the cover sheets, to perhaps encourage letter carriers to handle our valuable issues more carefully. We were quickly advised that doing so violated *another* regulation, and there was no way to get around that one. The reason behind such a prohibition still totally eludes me.

Annoying as they were, postal regulations were *not* the biggest headache involved in publishing the Sweet Home issue. The biggest challenge was simply the color *red*. Reds are, for some reason, the most difficult colors to get right in color printing. And in this case, *red* is what it was all about for the Sweet Home mine! Had the rhodochrosites *not* been found in that stunningly deep cherry-red color, they would not have achieved the fame and the selling prices that they enjoy today, and there probably would never have been a Sweet Home issue at all. So we were obliged to do everything scientifically possible to obtain maximum color fidelity for the rhodochrosite photos.

Seeing the best rhodochrosites in Bryan Lees' office at the *Collector's Edge* and at mineral shows was sufficient to cause complete editorial despair over the task of reproducing that color in print. There are limits to what normal printing inks can do, and the raspberry-red to cherry-red glow of Sweet Home rhodochrosite was beyond those limits. However, I figured we might be able to come pretty close if *every stage* of the process went perfectly, and if we did a little creative fiddling with the inks.

The first step was to obtain color transparencies that came as close as possible to correct color. The best photos could then be used as guides for the other photos, while retaining the natural color variability of the many specimens. Decades of experience on the part of professional photographers Harold and Eric Van Pelt, Jeff Scovil, and others yielded some truly superb transparencies.

The next step was "color separation," whereby the four printing negatives (one for each ink color: magenta, cyan, yellow and black) are produced from the transparencies, utilizing a computerized scanning and adjustment process. This process is still as much an art as a science, and there is no substitute for many years of experience. We have benefitted by having had the *same* color separation technician, Lois Sorenson, doing our demanding and unusual work for us since 1980. Lois works for Hollis Digital Imaging Systems in Tucson, which was known as Hollis Phototechnics when we first started using them 18 years ago. During that time she has gained countless hours of experience in color-separating mineral photos, punctuated by countless subtle correction demands from the editor, learning exactly how minerals should look and how to fix them when they go astray. When I handed over the huge pile of hard-won photography to her, I told her to imagine the color of a red raspberry Popsicle just beginning to melt, and then get to work. The resulting separations were proofed by making laminated plastic proofing prints called "match prints," which have proven over the years to very accurately show what will result when real printing inks are used. These were examined and a portion sent back to be refined and reworked until they were as good as they could possibly get.

At this point I decided to investigate the possibility of improving the printed results through a change in printing ink. The usual "red" ink (referred to as "process red" for use in the four-color printing process) is actually a pinkish, purplish red ink called "magenta." When combined with process yellow it makes a fire-engine red. With pigments, as with minerals, there are many different "reds," each one reflecting a different mixture of wavelengths (only laser light is a pure, single-wavelength color). Perhaps an ink could be found with a reflection spectrum closer to that of Sweet Home rhodochrosite, at least as far as the human eye could tell. Examining the thick swatch book from the ink manufacturer, Pantone Inc., I came across two inks that are deeper and richer than process magenta; these are *rhodamine red* (promising name for printing rhodochrosite photos!), and *rubine red*. The latter seemed the closest to Sweet Home rhodochrosite red.

I then called our printing representative, Tony Kohn, at Cadmus Journal Services in Maryland and explained my idea about substituting rubine red for process magenta in order to get a richer, snappier rhodochrosite-red. He thought the idea sounded interesting, but said he would have to meet first with his "ink people" to see if such a switch was actually feasible. The next day he called back, saying that it did indeed look possible. In fact, a couple of the oldest pressmen remembered using rubine red in just that way many years ago, and they were confident it would work. To be sure, they offered to take a few sample color separations and run some real press proofs using rubine red, which could be compared against the match prints. They also wanted to see the original transparencies, to get a feeling for what might have been lost in the color separation process.

The press proofs came, and were sent to Bryan Lees in Golden, Colorado. Holding them up next to actual specimens such as the "Snow Cone" (the cover specimen), he happily pronounced them to be *extremely* close to the correct color, if not dead on, and we all finally began to breathe a little easier!

Back at the printer, the ink density on the approved proofs was carefully measured and recorded. This was done so that printing quality could be maintained "form-to-form," meaning that consistency would be maintained throughout the large printing job despite the numerous shift changes that would occur, with new pressmen coming on duty every eight hours.

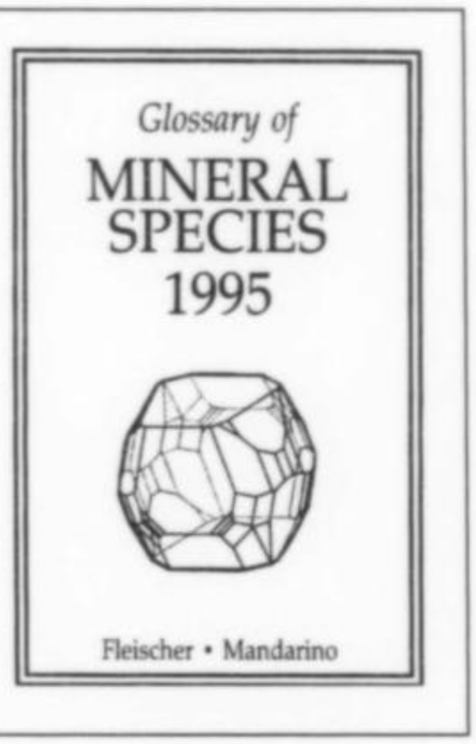
All of our readers saw the final result when they opened their July–August issue. Decades of experience on the part of everyone involved yielded a product which, for color accuracy on a tough subject, is the very best that modern technology can produce. We are all very happy (and relieved) that it came out so well, at a level of fidelity which we initially thought would be impossible; I want to thank everyone who worked so hard and so skillfully on it.

Obviously, such an issue demanded a hardcover edition. We had no trouble deciding to prepare 500 copies in a beautiful dark red "bonded leather" (a 100%-leather sheet made by reconstituting real leather and embossing the grain back into it), with gold stamping and dark red endpapers. We had custom dies made for the fancy title lettering and for the old-style Colorado coat of arms. At $49 it is a real bargain.

For his Sweet Home Rhodo investors and a handful of special friends, however, Bryan Lees wanted 20 copies prepared in extremely high-quality calfskin bindings, for which cost was no object. (I mention this only for the historical record, since copies are not for sale.) This was a job for Skip Carpenter of Green Dragon Bindery in Shrewsbury, Massachusetts. Skip has for many years been the principal binder for the Record Library, when valuable old antiquarian books need new leather bindings prepared in the old European style. He has quite a collection of old tooling dies used to put on all the gold designs and embossing; these dies are not generally available anymore, so bookbinders like Skip must actually build their own collections of antique dies to give their bindings the proper, authentic old look. Many years ago, Skip made a copy for the Record Library of all of his dies on black leather sheets. These we photocopy and paste up into binding mock-ups, showing exactly how we want our bindings designed. This was what we also did for Bryan's 20 copies. The fine leather and hand-tooling ended up costing over $350 per book, but they are mighty pretty, and are also extraordinary collector's items.

The Sweet Home issue is, at 192 pages, one of our biggest issues ever. And it certainly holds the all-time record for color illustrations: 192 photos and 29 other figures in color! Needless to say, we could not have published that issue without significant financial assistance from good friends of the Mineralogical Record (who were acknowledged in the Foreword); to be specific, it required an extra $60,000 above the cost of a regular issue of the magazine! That's a gift of nearly $10 to every subscriber! I know that sometimes readers are inclined to grouse a bit over the cost of a subscription. But we put every dollar to work producing the magazine, and in many cases must add significant additional dollars from outside sources, as in the case of the Sweet Home issue. It is our goal to give our readers more than they pay for, a fact which we hope will ease the pain of writing that next subscription check.

Books for Collectors



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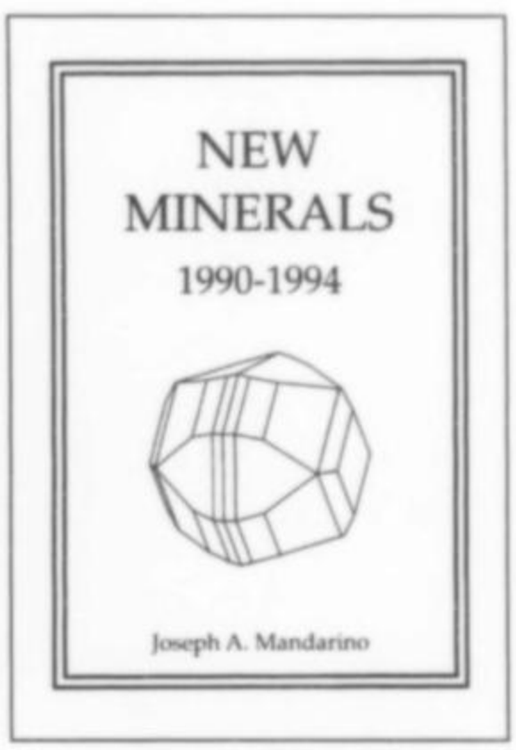

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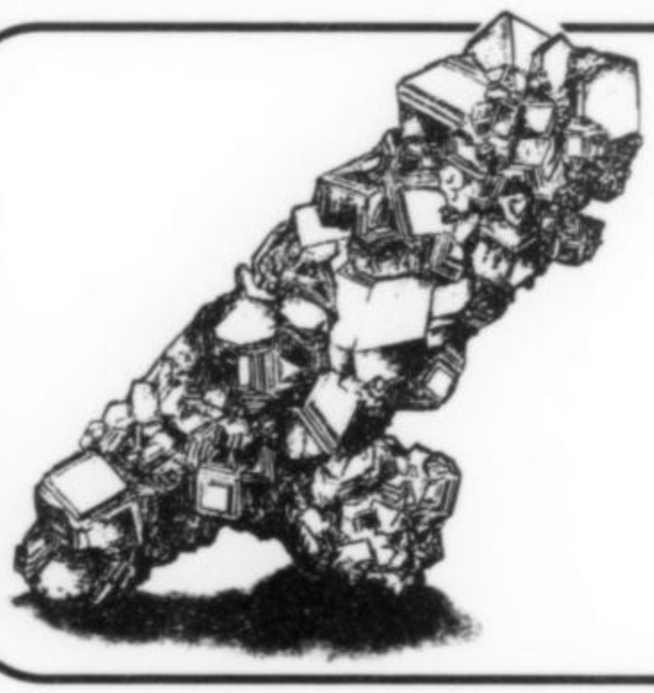

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The Castle Dome district is one of the oldest and longest-lived mining district in Arizona. The Hull and Puzzler mines have produced attractive combinations of barite, cerussite, fluorite, unusual green vanadinite, yellow wulfenite and green mimetite.

INTRODUCTION

The Castle Dome mining district is located in southwestern Arizona, in the northwestern part of Yuma County. It is a relatively easy drive north out of Yuma on U.S. Route 95, and east on Castle Dome Mine Road across the Castle Dome Plains. The district lies in the Castle Dome and Middle Mountains, a linear geographic feature that parallels the northwesterly trend of the basin and range mountains of southern Arizona and northern Sonora. They are rugged and blocky, with steep rock spires and domed towers. Spilling out from boxlike canyons across the rock pediments are *bajadas* surrounded by alluvial plains.

The origin of the name "Castle Dome" used throughout the area is believed to be a corruption of "Capitol Dome," a high, dome-like peak nearby which was named by American soldiers at old Fort Yuma in the 1880's. Early Spanish explorers called the same peak *Cabeza de Gigante*, "Giant's Head." But portions of the area also resemble the stockades and turrets of medieval castles.

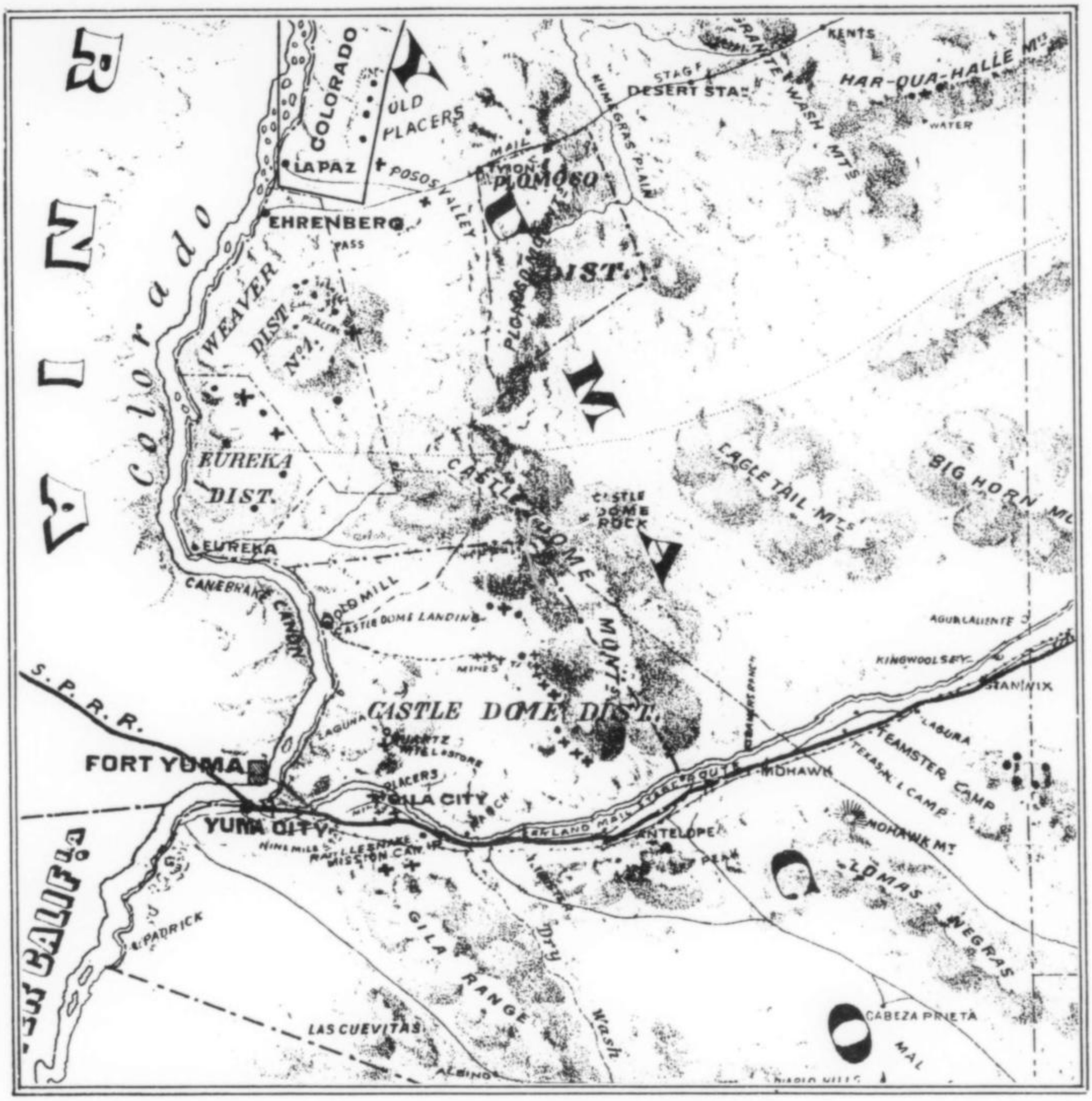


Figure 1. **Castle Dome district (+ = mines) as shown on an 1878 map of Arizona "prepared specially for R. J. Hinton's *Hand Book of Arizona*," San Francisco. The famous Red Cloud mine is nearby in the Eureka district, later renamed the Silver district. Courtesy Arizona Historical Society.**

LOCATION

The 7½-minute *Castle Dome Peak* quadrangle, Arizona, locates the Castle Dome district at T4S, R17W to R19W. The district lies within the Kofa National Wildlife Refuge and north of the U.S. Army's Yuma Proving Ground. The mines are clustered and scattered along a southeast-northwest trend covering about a four-square-mile area. Castle Dome Mine Road terminates in the central part of the district, near the Castle Dome mine itself. Other mines in the district can be reached by dirt roads or jeep trails, or on foot from the wash bottoms.

Elevations vary from about 1,300 feet in the low-lying areas to 1,600 feet along the ridges. Castle Dome Peak rises to an elevation of 3,788 feet. Vegetation is desert scrub. The area lies within the Lower Colorado Valley vegetation zone of the Sonoran Desert. As one might expect, temperatures are severe in the summer, commonly over 100°F for long periods of time. Because of the extensive network of arroyos and the wide-spreading bajadas, flooding in the low-lying areas is common during the summer rainy season.

HISTORY

The Castle Dome mining district is among the oldest and most continuously worked mine groups in Arizona. William P. Blake, an early Arizona mineralogist and president of the Castle Dome Mining and Smelting Company, wrote about the early history of the mine in an 1880 company report:

1880

The mineral veins of the Castle Dome District were rediscovered in the year 1863. They may truly be said to have been "re-discovered" for it is evident that the veins were opened and worked at a remote period, probably by the first Spanish padres, who made their way northward from Mexico into this country. Traces of ancient excavations on many of the veins were very plainly to be seen by prospectors in 1863, and there were, and still remain, heaps of débris consisting of the vein-stone with small fragments of ore. The metal had been taken from many of the veins by these ancient miners down to a depth of from six to fifteen feet, following the vein sometimes for fifty to one hundred feet or more. The excavations appeared to have been made with long bars, and to have followed the best outcrops of metal. These old workings thus were sure guides to good metal-bearing ground a short distance below the surface. Well-worn trails leading from the mines to the banks of the Gila, only some eighteen miles distant, and the ruins there of some rude smelting furnaces, go to show that the ores mined at Castle Dome were packed on the backs of Indians to the Gila and that they were there reduced to metal, possibly being used to mix with, and to flux the more refractory but richer ores of silver from districts further east. The explorations of the veins made since 1863 have obliterated the traces of the old workings for the greater part, but they can still be seen in several places. That they are ancient is abundantly shown by the growth of the peculiar slowgrowing hard-wood trees of that region, such as the palo verde and iron wood, which were found growing in the old pits and on the piles of refuse thrown out.

Castle Dome.

Figure 2. **Castle Dome Peak, as pictured in J. Ross Browne's *A Tour Through Arizona* (1864).**

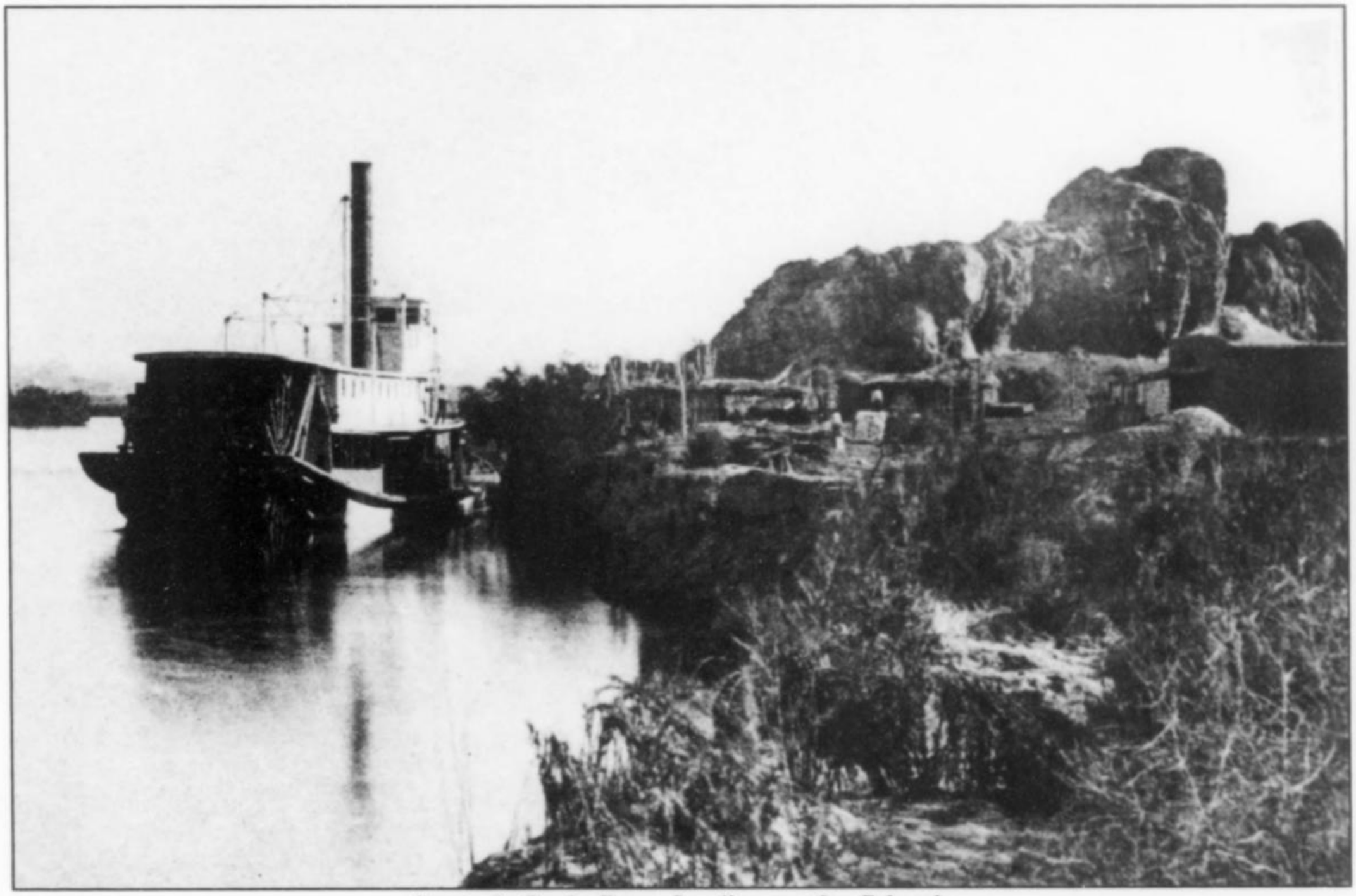


Figure 3. **Castle Dome Landing on the Colorado River, 1877. Courtesy Sharlot Hall Museum.**

Exactly who did the earlier work and when is not clear. It was in 1863, however, that two miners named Conner and Snively came upon galena ore that they assumed was pure silver. While there was indeed silver in the ore, it only amounted to about 30 ounces per ton. The ore was hand-sorted and sacked, then hauled by wagon to Castle Dome Landing on the Colorado River. River boats took the ore to clipper ships in the Gulf of California, where it was shipped to the Selby smelter in San Francisco.

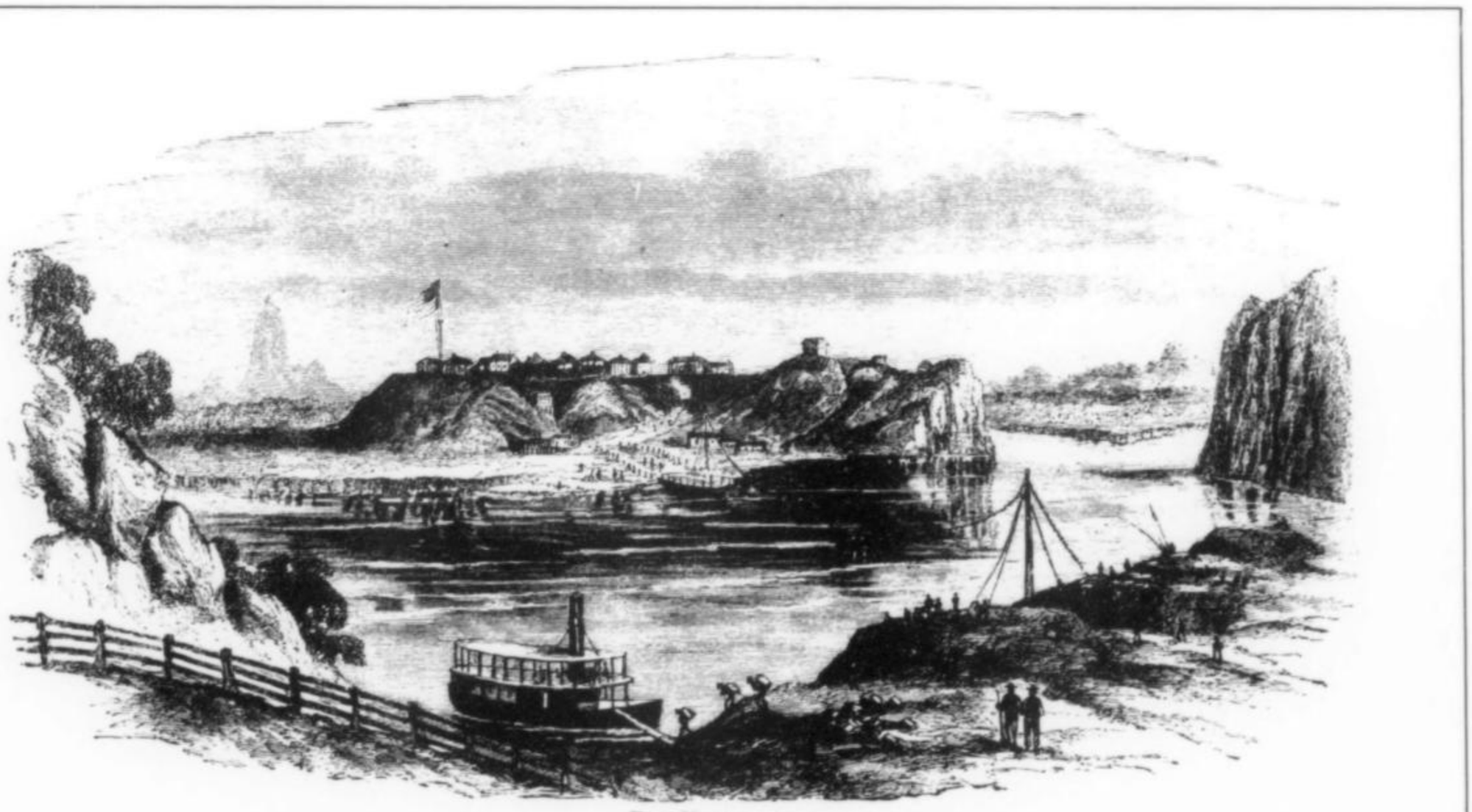
In 1864, just a year after the first claims were staked, J. Ross Browne traveled through the area and reported on what he saw:

> New and rich silver veins had been discovered a short distance above Fort Yuma on the Colorado, which were attracting considerable attention. In the vicinity of Castle Dome, twenty-five miles from the river and thirty miles from the Fort, the veins prospected were numerous and extensive, and the ores of a very promising character. I saw some of them myself, and am satisfied they contain a great abundance of lead. No assays had been made that I heard of, but gentlemen who owned in them assured me there was silver in them as well as lead, whether much or little remained to be seen. Very little work has yet been done in the Castle Dome district, although some hundreds of claims have been prospected, and extensions run upon the most promising.

In 1868, production records note 60% lead and $40 per ton silver, with an overall ore value of $90 per ton. It was also noted that costs to mine and sack the ore were $12 per ton, $15 to haul it, and $18 to ship it to San Francisco. Investors were doubling their investment. In 1875, a smelter was built in Yuma which handled the Castle Dome ore until the following year. In 1876, the Southern Pacific Railroad across Arizona made transport of the ore to San Francisco more economical. The Yuma smelter shut down, and ore was once again sent to the Selby smelter.

Hardy Adventurer

Figure 4. **J. Ross Browne's sketch of a "hardy adventurer" in western Arizona, pictured in his *A Tour Through Arizona* (1864).**



Fort Yuma.

Figure 5. **J. Ross Browne's view of Fort Yuma on the Colorado River in 1864, a few miles downriver from the site of Castle Dome Landing; from his *A Tour Through Arizona*.**

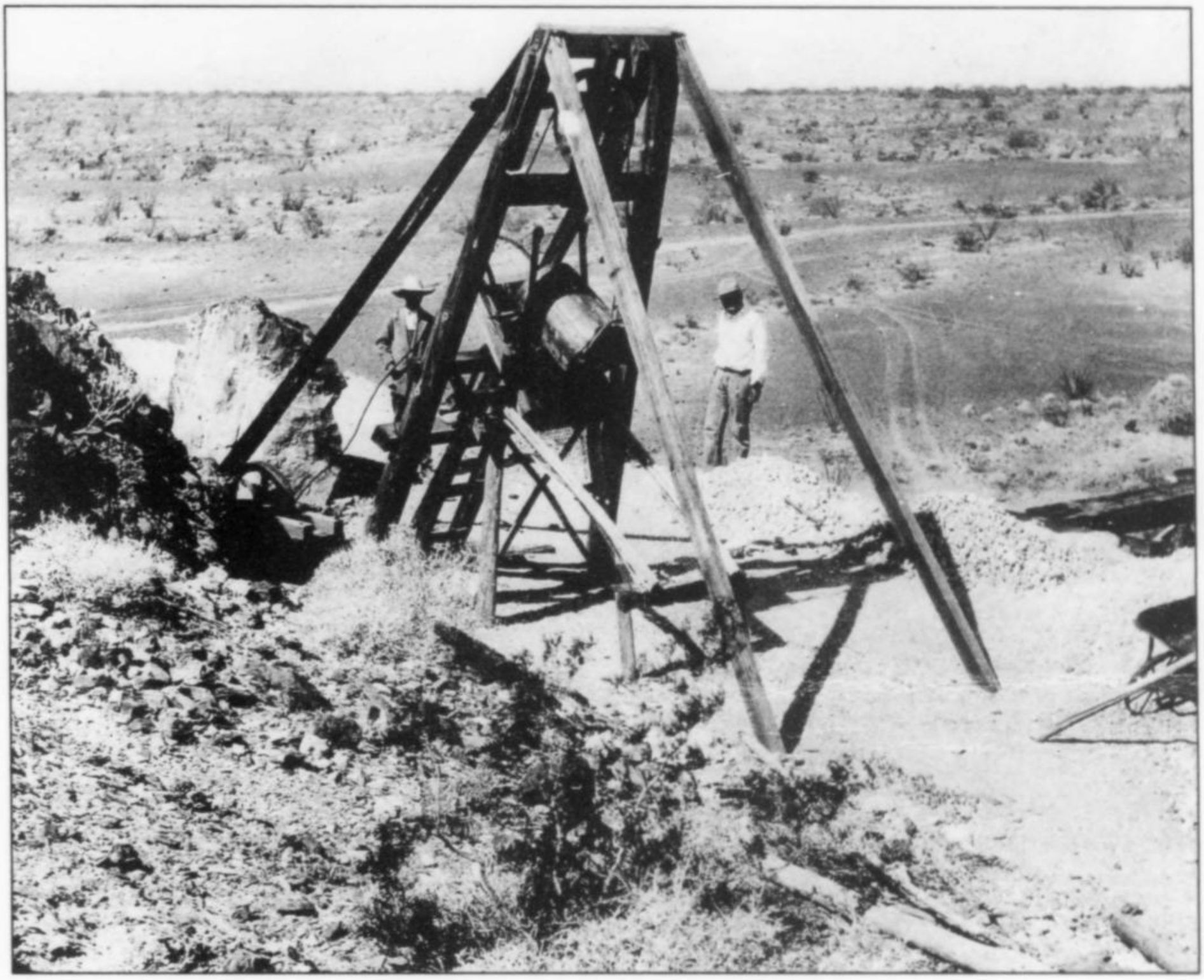


Figure 6. **Collar of the Morada shaft, Colorado Group, in 1919. Courtesy Arizona Geological Survey.**

The Buckeye Vein Group, which includes the Castle Dome mine, was patented in 1876, with much of the work done before 1890. Ore shoots were stoped to the 250-foot level from inclined shafts. The Hull (Rialto) Mine Group saw its greatest production from the years prior to 1900, with about 20,000 tons of ore recovered from stopes to the 200-foot level.

Ownership and production changed hands several times over the next few decades. In the late 1870's, the Castle Dome Mining and Smelting Company was organized; they shipped ore to Melrose, California for processing until 1883. From 1890 to 1896, ownership was in the hands of Gondolfo and Sanguinetti, who resumed ore shipment to Selby.

The majority of the later work in this century came from reworking old fills and dumps, with some underground mining in the old mines. All together, lead and silver ore totaled about 119,000 tons, containing 10,500 tons of lead, 478,000 ounces of silver, 38 tons of zinc, and some copper and gold byproducts. During 1902–1904, 1908–1909, and in 1913, a considerable amount of fluorite was sent to Riverside Portland Cement in southeastern California. From 1916 to 1918 the mines were worked for potash recovery.

It was not until the 1940's that the mines at Castle Dome began producing again. At that time, most claims were owned by Mrs. Eliza De Luce and leased by brothers George and Kenneth Holmes. They had a payroll of 20 people. Mining included underground work in six shafts, identifying reserves of 40,000 tons of ore. They had also produced 2 million pounds of lead and 27,000 ounces of silver from concentrates realized from dump ore and stope fill. Development included an additional 600-foot shaft and a diamond drilling project to explore for deeper deposits and parallel veins.

The idea was to ship 200 tons of ore a day to a mill on the Gila River 25 miles distant. But times were tough, as shown by a series of memos and letters between the brothers and ASARCO in El Paso, seeking payment on a shipment worth about $830 for 30,277 pounds of lead from the mines in late 1942. The Holmes brothers listed the following expenses for operating the mine: $0.75 per hour to muckers, $0.80 to miners, $0.85 to timbermen, all with time and a half for overtime; $2.50/ton to draw and hoist ore, $1.25/ton to haul from mines to mill, $0.75/ton for milling, and $2.50/ton to recover 30% lead from concentrates during smelting. Not only were costs to run greater than expected, but road conditions were ruining their trucks, and the price of lead was not high enough to allow much of a profit. The operation shut down again in 1944 after producing 3 million pounds of lead.

In the 1950's, the U.S. government recovered low-grade manganese ore from the andesite volcanics in the area, which produced 400 tons of 26%–30% manganese. Various concerns operated the mines sporadically from 1978 to 1982. Copper production from the Castle Dome mines was minimal, mostly at the Copper Glance mine. In the 1970's about 150 tons of ore produced 9 tons of copper, 1,465 ounces of silver, and minor gold and lead.

Gold, in combination with silver, was a byproduct recovered from the Castle Dome ores. Gold had been known in the area as far back as the 1860's, but the only records are from 1884, when it was

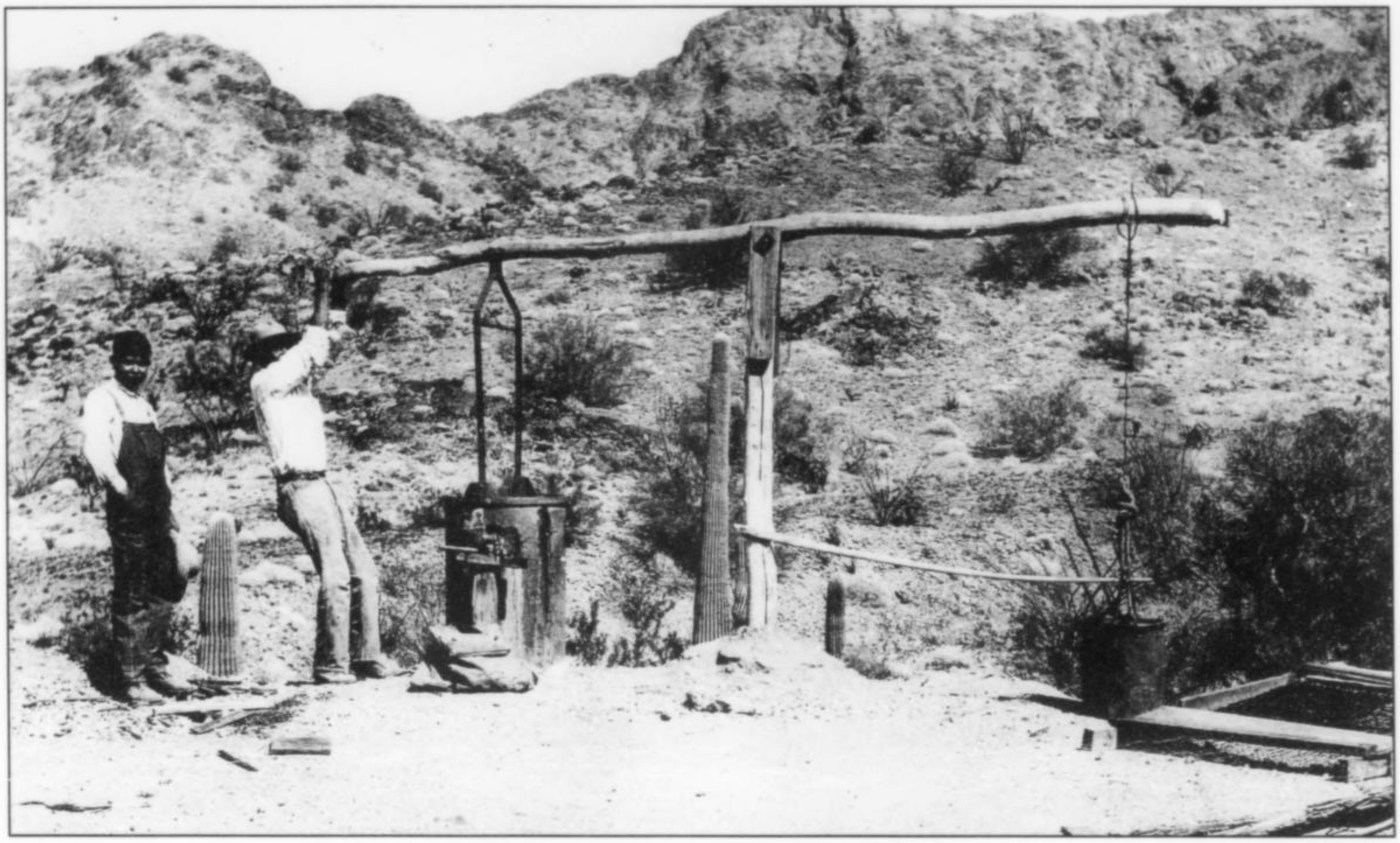


Figure 7. **A primitive Mexican-style concentrator in use at Castle Dome in 1919; it could process 50 pounds of ore in 10 minutes. Courtesy Arizona Geological Survey.**

noted that gold had been recovered from placers by Mexican dry washers. The placer deposits in gravels at or near bedrock in gulches are thought to have come from gold-bearing veins near the Buckeye mine. Serious mining for gold and silver did not begin until about 1912; a total of 2,380 tons of ore was mined, containing 2,150 ounces of gold and 19,000 ounces of silver. The total ore production of the Castle Dome district up to 1912 amounts to more than $2 million in lead, silver, gold, zinc and copper.

Mining in the district was accomplished in open cuts, and by stoping of veins reached by numerous shallow shafts. The area produced from 1863 until the mid-1980's, with some minor "weekend prospecting" going on to the present time. Roughly 120,000 tons of ore came from the district, containing 10% lead, 5 ounces per ton silver, placer and lode gold, and minor copper and zinc. Fluorite was, apparently, the only significant industrial mineral recovered from the Castle Dome district.

COLLECTING HISTORY

Though the Castle Dome district has an extensive history of mining and a significant suite of secondary minerals, good mineral specimens have never been plentiful. They were as rare on the specimen market 40 years ago as they are today (Scott J. Williams, personal communication). However, this is not due to collectors being unaware of the district or indifferent to it. Quite the contrary, specimen collectors have been scouring the dumps and underground workings for more than 50 years. The more likely reason, with few exceptions, is that significant quantities of specimen-grade material just don't occur in the Castle Dome orebodies.

The earliest recorded specimen from the Castle Dome district is in the University of Arizona collection in Tucson. It is labeled "*Anglesite with galena, cerussite and [fluorite], Castle Dome, Arizona.*" Professor William P. Blake, who taught at the University from 1895 to 1905, donated the piece. He published well over a dozen professional works on the geology and mineralogy of the Arizona Territory and had a special interest in the Castle Dome mining district. Several of his publications dealt with the district, and he was president of the Castle Dome Mining and Smelting Company for a period in the late 1870's and early 1880's. It isn't known if Blake personally collected the piece now in the University of Arizona collection but, given his involvement in the district, it is a strong possibility, especially since he states (1881a) that he personally collected specimens there in the spring of 1880 and 1881. There is no further indication of specimen recovery until the late 1940's.

1950–1970

The earliest known efforts at specimen recovery involved Billy Theison and her first husband, Darrell Casey. The Caseys lived in a small house nestled in a narrow valley just east of the Puzzler mine from 1949 to 1969 (Billy Theison, personal communication). Darrell was a civilian employee at the nearby Yuma Army Proving Ground. Billy loved minerals and had a passion for exploring. She scoured mine dumps and, where possible, searched the underground workings in her pursuit of minerals. They maintained a small shop by their house where she sold some of the things she had found.

Many collectors that visited the district in this period developed close friendships with Billy and received their introduction to the mines from her. The minerals they collected consisted primarily of vanadinite from the Puzzler and Silver Cross mines, wulfenite from the Puzzler and Hull (Rialto) mines, cerussite from the Hull mine, and fluorite from the Hull, Señora and some of the smaller unnamed workings.

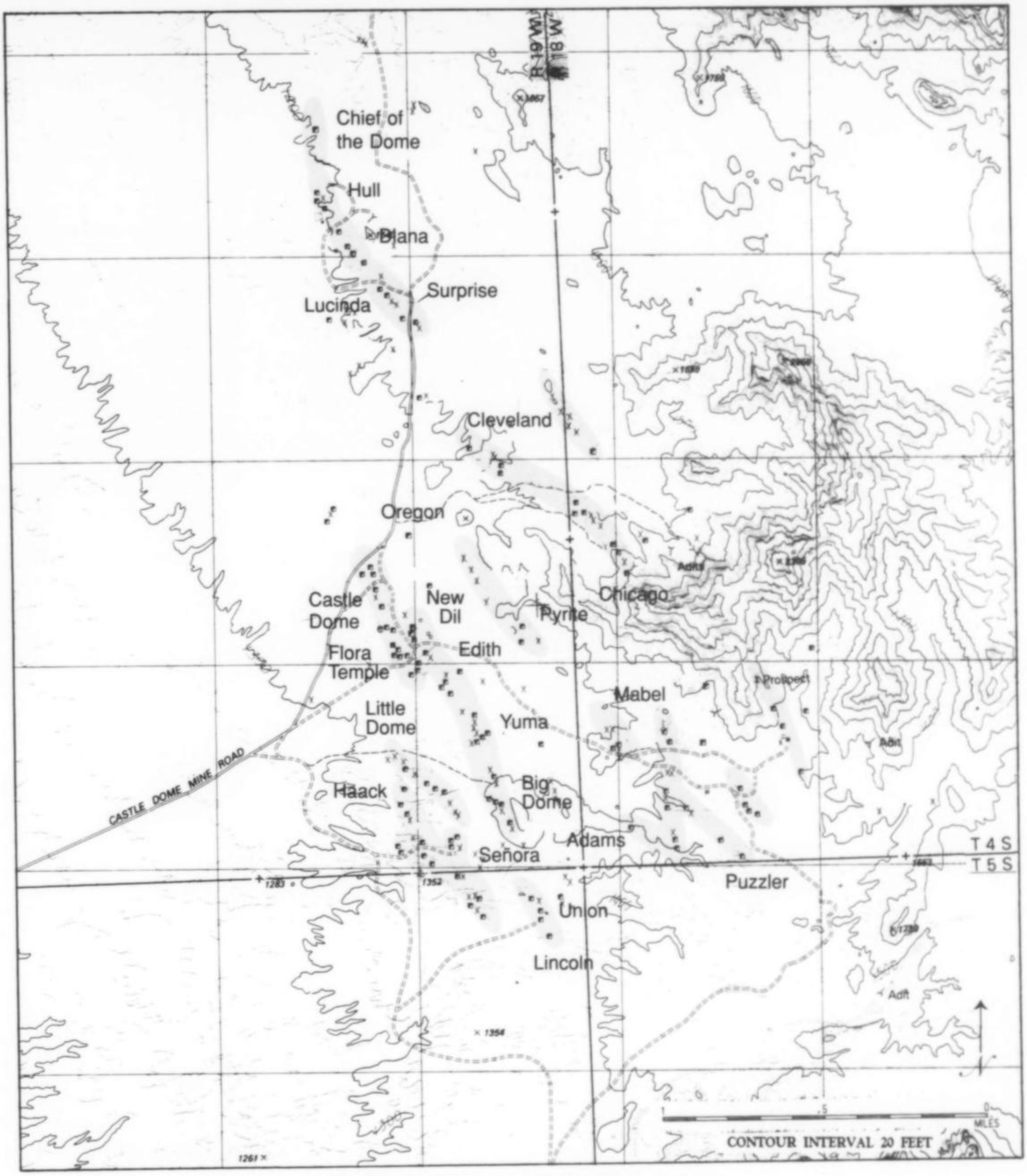


Figure 8. **Location map showing major veins, mines and mine groups in the Castle Dome district. Adapted from the *Castle Dome Peak* 7.5-minute quadrangle, 1990.**

The late William Sanborn collected the district extensively in the 1950's and 1960's and was one of the more successful collectors of this period. Much of his collecting was done with Billy. They did extremely well at the Puzzler mine, collecting many flats of greenish brown vanadinite to 6 mm on black manganese-stained calcite matrix (Billy Theison and Gene Tribbey, personal communication). They also collected a few flats of yellow wulfenite occurring as clusters of crystals to about 6 mm. Specimens from the Puzzler dating to this period probably came from Bill and Billy. Bill is also reported to have done well collecting yellow wulfenite on fluorite and cerussite at the Hull mine.

Bob Pedersen is a field collector living in Tucson with over 35 years of experience collecting the Castle Dome mines. Most of his time in the district has been spent at the Hull mine. In addition to the wulfenite and cerussite specimens typical of the mine, Bob found specimens of wulfenite with unusual green mimetite in the late 1960's. The occurrence was on the 260-foot level and was very limited, producing only a few pieces. The mimetite occurs as

bright, translucent, yellow-green balls to 3 mm with gemmy, lemon-yellow, "window pane" wulfenite crystals to about 5 mm. Most are thumbnail size, although Bob did get one piece about 8 cm across which is still in his collection.

1970–1985

Around 1970, Bill Sanborn showed Jack Crowley through the district, taking him to many of his favorite collecting areas (Jack Crowley, personal communication). Jack reports that Bill lamented while on these trips about the deteriorating condition of many of the mines. Some of his favorites had become inaccessible due to dangerous conditions. Jack continues to collect the area today whenever possible. He feels his best finds have been wulfenite from the Hull mine, vanadinite from the Puzzler mine and some interesting *diagonally* zoned fluorite from some small workings in the eastern part of the district. The fluorites form bright 2.5-cm cubes that are zoned green and purple.

From the mid-1970's through the mid-1980's the high price for silver generated a renewed commercial interest in the mines, the Hull mine in particular. While collecting was still possible in some smaller outlying properties, for the most part the main ones were off-limits. Peter Megaw, Kurt Gilliam and Stan Esbenshade collected good quality cubic fluorite crystals to 2.5 cm from some small shafts in the southern end of the district around 1980–1982. The fluorite has an attractive blue-green color with good clarity and luster; many crystals occurred on matrix. Some of the better pieces from their find are today in the collection of the Arizona-Sonora Desert Museum in Tucson.

1985 to the Present

As might be expected, when mining operations ceased in the mid-1980's field collectors descended on the district *en masse*. In addition to those already mentioned, these included Ray Grant, Graham Sutton, Fred DeVito, Ron Gibbs, Malcolm Alder, Ken Algier, Mitchell Dale, Paul Bakerman, George Stevens, George Godas, Dick Morris and Mark Hay. Many of these collectors made significant finds.

Today most of the mines of the Castle Dome district are inaccessible. Shafts that once provided entry are impassible, their timbers and ladders have collapsed, leaving only intimidating black holes, inaccessible to anyone other than technical rock climbers. The mines that are the heaviest collected today are the Hull and the Puzzler, largely because they remain accessible. Additional collecting is possible in the numerous shallow shafts and prospects that pepper the district.

Collecting in the district over the last 10 years is related below through the personal experiences of one of the authors (MH). Mark, along with friends Dick Morris and George Godas, has spent much time collecting in the district, primarily at the Hull and Puzzler mines and some of the shallow unnamed prospects in the southern part of the district.

Hull Mine

Our first trip to the Hull mine was in 1987. George Godas, Dick Morris and I were digging a seam of cerussite that Ray Grant had discovered a few years earlier. The seam was in the face of a short dead-end drift on about the 250-foot level of a large, inclined tunnel that had been driven in the 1970's. It was producing euhedral cerussite crystals in the 6–12 mm range, though a few reach 2 cm. The cerussite occurred as waxy, dipyramidal sixlings on a fine-grained, greenish gray volcanic matrix with occasional bright orange, small (<1.5 mm) pseudocubic wulfenites and cemented fragments of barite and fluorite. Over the next year or so, about a dozen flats of specimens ranging in size from thumbnail to cabinet were collected. An excellent small cabinet specimen from this find is in Les Presmyk's collection (Gilbert, Arizona). Additional good pieces can be found in the Arizona-Sonora Desert Museum and the Tucson Gem & Mineral Society collection. This seam was probably the most prolific producer of good quality specimens found in the Hull mine in recent years.

The new tunnel mentioned above bottoms out at about the 300-foot level, where it breaks into an old stope. The stope is largely backfilled with muck and is extremely dangerous. We never had the courage to venture far into it. In the right rib of the tunnel, just before the old stope, is a large crack that runs perpendicular back into the rock and up. It twists out of sight and appears to be totally barren of minerals. However, several thick, yellow, tabular wulfenite crystals to about 1.2 cm were found buried in the loose sand in the floor of the crack. These are nice, but they always occurred as singles, no groups and never on matrix. On one trip Dick dug an unusual cerussite crystal out of the crack. The cerussite is odd in that it is not the usual dipyramidal sixling; instead this one is a heavy, thick, reticulated group about 3.8 cm long. It's the only one of this type we ever found at the Hull. We tried to dig the crack back to the mother lode that was certainly just out of sight but the rock was extremely hard. We began by working the crack but, after a couple of hours and no noticeable progress, we moved off in search of easier digs!

In 1989 and 1990 George, Dick and I dug in an area on the 100-foot level where the new tunnel intersects one of the old shafts. When the mine was operating in the 1970's the shaft was retimbered and used as a fire escape route. George had discovered a way to crawl under the wooden flooring near the shaft where there was a rich galena seam in the vein. Occasionally a vug could be found with bright orange, pseudocubic wulfenites to 6 mm; they strongly resemble Los Lamentos wulfenite in both form and color. Wolfgang Mueller collected a few wulfenite crystals to 1.2 cm several years before, from the shaft wall just below this area. The wulfenite sometimes occurs on euhedral galena crystals coated with a fine-grained, sugary cerussite and sometimes accompanied by pale blue-green, transparent cubes of fluorite. All in all, the specimens are very attractive.

George and Wolfgang entered the lower workings by way of the fire escape shaft in the summer of 1990. They found strong showings of wulfenite, cerussite and fluorite but again with difficult digging conditions. The most interesting pieces they collected are several thumbnail-size specimens showing small lemon-yellow wulfenite crystals with bright yellow-green mimetite balls. They were probably found very close to where Bob Pedersen found his 25 years earlier. George said conditions were very difficult but, with work, he thought there was a reasonable chance of collecting more pieces with the wulfenite/green mimetite combination. However, shortly after their trip the fire escape shaft burned and all of the timbers and ladders destroyed.

Puzzler Mine

Some of the most exciting and satisfying mining trips I've ever had were at the Puzzler mine. Dick Morris, George Godas and I first went there in July 1987. At the time the place was a total mystery. We had only seen a single specimen and had not found any Arizona field collectors who had been there; most had never even heard of it. Like many mines in the Castle Dome district, it wasn't identified on the topographic maps. However, we were fortunate enough to find a claim map at the Arizona Department of Mineral Resources that located the Puzzler claim. By comparing the water drainage patterns on the claim map with those shown on the topo maps we were able to narrow it down to just a few mines.

We split up and it was George who actually found the mine first, tipped off by vanadinite on the dump rock. There was a weathered

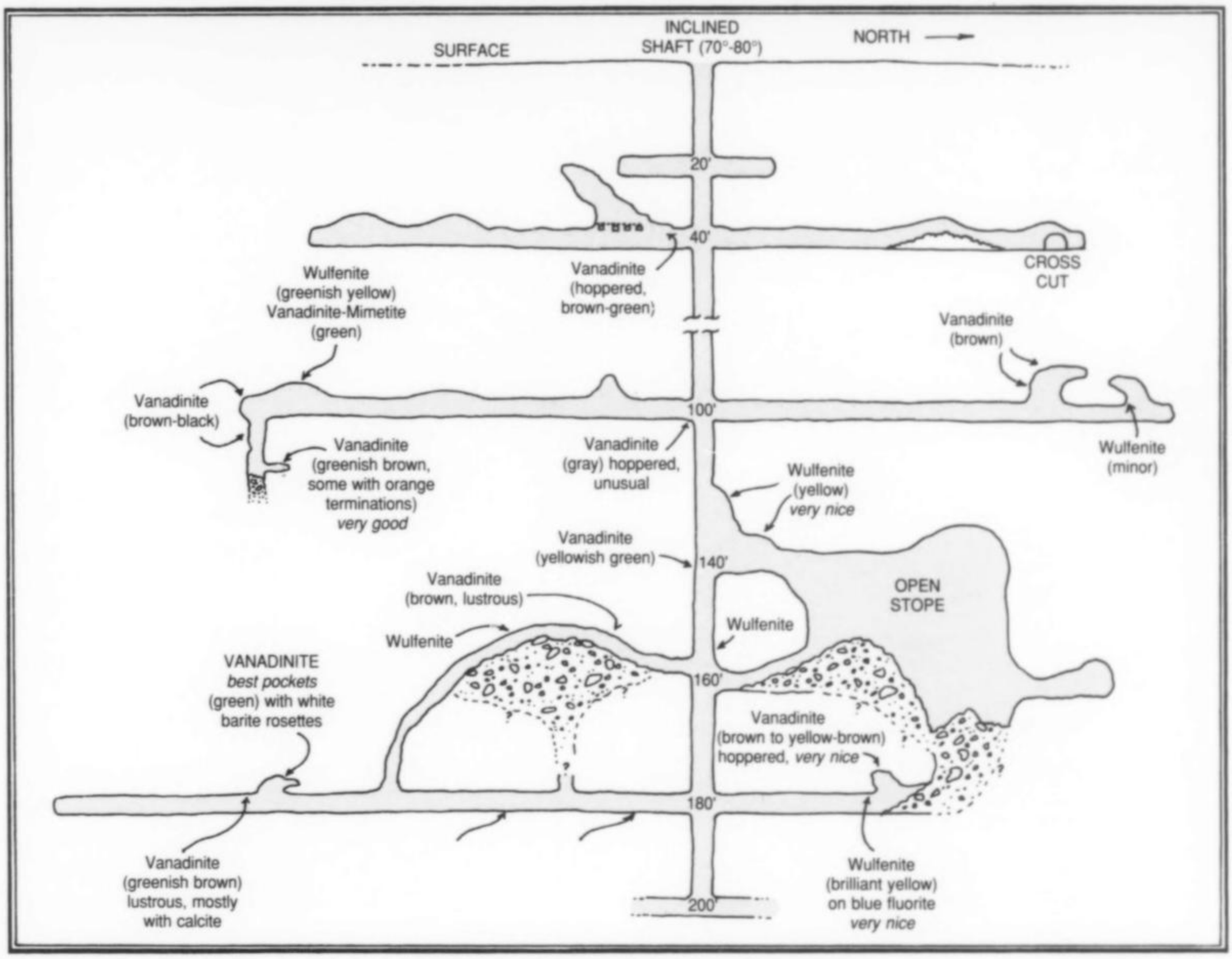


Figure 9. **Workings in the Puzzler mine as of 1988, showing specific sites where vanadinite and wulfenite have been found.**

old flat-bed mine car chained in place straddling the shaft. By pushing the car to the side there was just enough room to squeeze our heads through and look down inside. It was a vertical shaft, obviously quite old but the timber looked in reasonably good shape. A weathered wooden ladder disappeared down into the darkness. This definitely predated Federal MSHA safety regulations. The ladder looked like railroad tracks going to the horizon, except these went straight down as far as the eye could see.

Going in the first time was quite a thrill. We had to go in backwards, squeeze past the mine car, then with our butts hanging out over the shaft, find the ladder with our feet. There was a strong sense of relief when that first rung was located! To be "safe" we tied off a rope and threw it down beside the ladder. How we were going to grab the rope in the split second it would take for the ladder to fail was a mystery but we all felt better having it there.

Conditions underground suggested that it had been many years since anyone had been in the place. There were newspapers dating to the 1960's, and *Saturday Evening Post* magazines from the 1930's. But the strange thing was the tools. Gads, chisels and pry bars lay about like the diggers might have just gone out for lunch and would be returning any minute! It was peculiar but it gave us a strong connection to those that had been there before. We didn't know who they were or when they had been there but we knew very well what had motivated them.

Everywhere we looked were glittering tiny yellow-brown crystals! The amount was truly astonishing. The shaft was sunk right down the vein, and its walls glistened with vanadinite. The many cracks and fissures in the walls sparkled with thousands of tiny prisms. Needless to say, we went nuts! We filled our flats in record time and headed out to the truck for more. At the surface we inspected our treasure and discovered that all that glittered was not glorious. When examined in the full light of day, we found our flats to be filled with the ugliest vanadinite we'd ever seen, *seriously* ugly. (It's an experience common to underground collectors—in a dirty black hole a simple mine light has a remarkable ability to make an ugly rock look wonderful.) Even with this early setback, though, the potential was obvious: the Puzzler was ripe for a choice pocket.

Over the next two years we put in many hundreds of hours of hard work. Our efforts produced small finds of yellow wulfenite plus cerussite and anglesite as microspecimens. Fluorite was common, occurring mostly as unconsolidated breccia fragments within the vein structure, but collector-grade specimens were extremely scarce. It was the vanadinite, however, in various forms and colors, that gave us our best finds—several hundred flats' worth—mainly from three large pockets.

The first pocket was hit by Dick and myself on New Year's Day 1988. It was on the 180-foot level, midway down the south tunnel.

Figure 10. **The Puzzler mine area. Photo by Ron Gibbs.**

We were following a highly fractured seam into the ceiling when it opened into a pocket about 45 cm tall, 60 cm long and up to 10 cm wide. We have always referred to this as the "Green Pocket" because of the jade-green color of the crystals. We were stunned; their appearance was strongly suggestive of pyromorphite. If so, they were the finest we had ever seen from Arizona. We subsequently gave a sample for analysis to Chuck Lewis at Arizona State University, and he confirmed it to be vanadinite.

The Green Pocket produced about 10 flats of material. Specimens range in size from thumbnail to about 18 cm, most occurring as dense crusts of vanadinite crystals on matrix. The crystals have brilliant luster and curved, barrel-shaped sides. Individual crystals reach a maximum size of about 5 mm, but they often appear larger due to a propensity to occur in subparallel groups.

An unusual aspect of vanadinite from this pocket, both in terms of other pockets from this mine and other Arizona occurrences in general, is their tendency to form stacks of crystals which rise off the matrix in curving subparallel growths. Some are as much as 2.5 cm tall. The curve to these stacks is always convex upward with smaller crystals on the bottom and larger on top. These are very similar in habit to some of the curved pyromorphite crystal groups from Kellogg, Idaho.

Many of the pieces recovered from the Green Pocket occur with barite in delicate white, tabular crystals and rosettes of crystals to 6 mm. Four years later, in 1992, George collected some wonderful barite crystals from the floor near the Green Pocket. His barites are also white but are up to 5 cm on a side and are lightly dusted with small (1 mm), bright orange-yellow vanadinite crystals. George recovered about a dozen high-quality specimens from his pocket.

The second vanadinite pocket also occurred on the 180-foot level, but at the other end of the mine, north of the shaft. Here the tunnel ends in a pile of rubble where it intersects the bottom of a large stope. In the tunnel ceiling just before its end, Dick and I opened a large pocket of hoppered caramel-brown vanadinite. The crystals have excellent luster and measure up to 1.2 cm, on plates as large as 40 cm across. These specimens are particularly appealing because of an epitaxial growth of small vanadinite crystals perched at the ends of the larger crystals on some of the specimens. The smaller crystals are attached at the point formed by the intersection of adjacent prism faces and the *c*-face termination of the larger crystals. This pocket produced the largest crystals and the largest specimens we ever obtained from the Puzzler mine. Overall, about six flats were recovered.

The third pocket we refer to as the "Winze Pocket" because we found it at the bottom of a short underground shaft (a winze) at the south end of the 100-foot level. The winze is only about 15 feet deep and, like the main shaft, was sunk right on the vein. The Winze Pocket was not really a pocket but a long seam that was loaded with vanadinite crystals. We never worked the seam to its end. It seemed content to produce specimens as long as we continued to work. This was the most prolific zone for good specimens we found in the Puzzler.

The seam extended both north and south from the winze. However, the best vanadinite was to the north. Dick and I worked

it for several months in the late spring and summer of 1998, hand-digging a new tunnel for 3 to 4 meters along the seam. Crystals are simple hexagonal prisms with flat *c*-face terminations. They attain a maximum length of about 6 mm. The best crystals are dark greenish brown with rich orange terminations and a brilliant, adamantine luster. The matrix is totally coated with small, bright yellow-green crystals that contrast nicely with the larger dark crystals. Other pockets commonly yielded a half dozen to a dozen flats of nice pieces, but the Winze Pocket produced 60–80 flats. The winze has since become almost totally filled with muck; the seam is still there and could produce more good specimens but it will require a lot of work to get to it.

Unnamed Prospects

Our most recent efforts in the Castle Dome district have focused on a search for a good fluorite locality. Dick and I had been searching Arizona for a fluorite dig for several years. The Castle Dome area is known to be especially rich in fluorite and was an obvious target. Finding a Castle Dome mine with good fluorite potential is easy; the challenge is finding one that is accessible.

In November 1995 Dick and I located a strong northwest-southeast trending vein in the southern part of the district with a tremendous showing of fluorite. We walked it for over a mile and found small location pits every few hundred feet, each with a tiny dump littered with fluorite fragments. We continued to trace the vein south and came on the workings of the Señora mine. The dumps of the Señora were totally covered in lavender, pink and colorless fluorite, some with terminated cubic faces to 2.5 cm. Clearly an *enormous* amount of fluorite was present underground. But, as is often the case in this district, the only access was via the vertical, untimbered shafts. For us, at least, that rendered them inaccessible. A short distance south of the Señora the vein appears to pinch out and no more workings are seen.

This was clearly an exceptionally rich area and we continued our search, checking smaller veins to the east and west. We soon located a small prospect shaft on a parallel vein about 60 meters to the east of the Señora vein. The shaft was about 12 meters deep and its dump was covered with rocks composed of breccia fragments cemented together with fluorite. In the cracks and holes between pieces we found razor sharp fluorite cubes to almost 2.5 cm.

The shaft was untimbered and almost vertical but it was relatively shallow so we were able to get into it using simple rope ladders. The biggest hindrance was a thick carpet of cholla cactus spines covering the floor of the shaft. We shoveled as many as possible into the corner and covered them in rock but we still spent time after each trip picking cholla needles out of our hands and knees (and other places).

Climbing down the shaft we saw that the walls were absolutely loaded with fluorite and barite; there were several pockets exposed and waiting to be collected. It appeared that this prospect had been completely overlooked by other collectors! The pockets were lined with large, dark blue-green fluorite cubes in places intergrown with milky, thick, tabular barite crystals. Both the barite and the fluorite in the exposed pockets were heavily fractured and most cleaved or broke when we tried to collect them, but we were still able to get some nice single crystals. Dick and I visited this little shaft many times over the next few months, each time returning with six or eight flats of specimens.

We found several pockets by digging in the walls of the shaft. The largest probably measured about 45 cm long by 25 cm high by 10 cm wide. In many cases the pockets were filled with silt and clay. In these pockets, the fluorite crystals had become detached and were floating in the silty fill material. Their bases were broken where they had come loose from the wall rocks but their edges and faces were surprisingly undamaged. Unfortunately, all of the crystals in these pockets were coated in a thick layer of caliche and, thought the color was good, they lacked good luster. However, we found a few pockets that were not filled with dirt. In these pockets the fluorite crystals were clean and had excellent luster. The crystals always occurred as extremely sharp cubes with absolutely no crystallographic variations. They are up to 6 cm across and range in color from a pale, watery green to a rich, deep blue-green. Many of the smaller crystals were obtained on matrix but, of the larger ones (those greater than 2.5 cm across) only a few came out on matrix.

In addition to the fluorite, barite and rarely galena also occur in the mine. The barite is found as large, thick, tabular, milky crystals often totally filling the pocket. In these instances, the barite crystals rendered the pockets virtually worthless. The barites were so tightly packed they just broke up when collected. We recovered crystal fragments up to 10 cm long and over 6 mm thick but only rarely would even one end be terminated. The fluorite crystals lining these pockets were usually ruined as well, due to damage resulting from contacting the barite. The galena, on the other hand, while not particularly aesthetic, was interesting and always a thrill to find. They occur as cuboctahedrons up to 5 cm across, usually as individuals nestled down in among the fluorites. In all cases, the surface of the galena crystals has altered to a fine-grained, sugary coating of anglesite and cerussite.

We revisited the little shaft in the spring of 1997 and were disappointed to find that it had been filled with muck to within 5 feet of ground surface, apparently by collectors digging fluorite and barite in the vein material around the collar of the shaft.

Figure 11. **Ore chutes at the Haack group of mines. Photo by Kevin Franklin.**

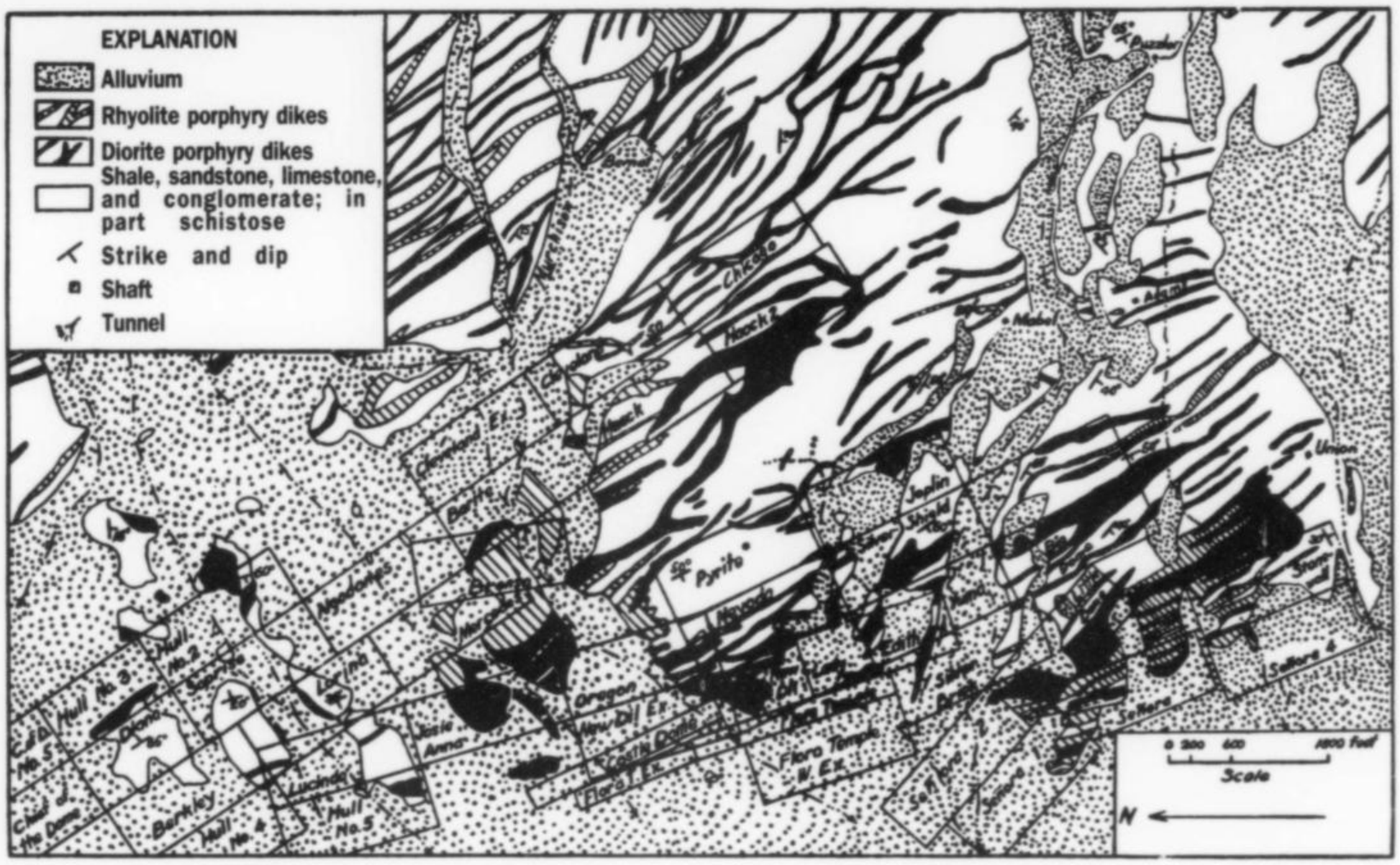


Figure 12. **Geologic map of the Castle Dome district showing dikes, alluvial cover and claims as of 1930 (Wilson, 1933).**

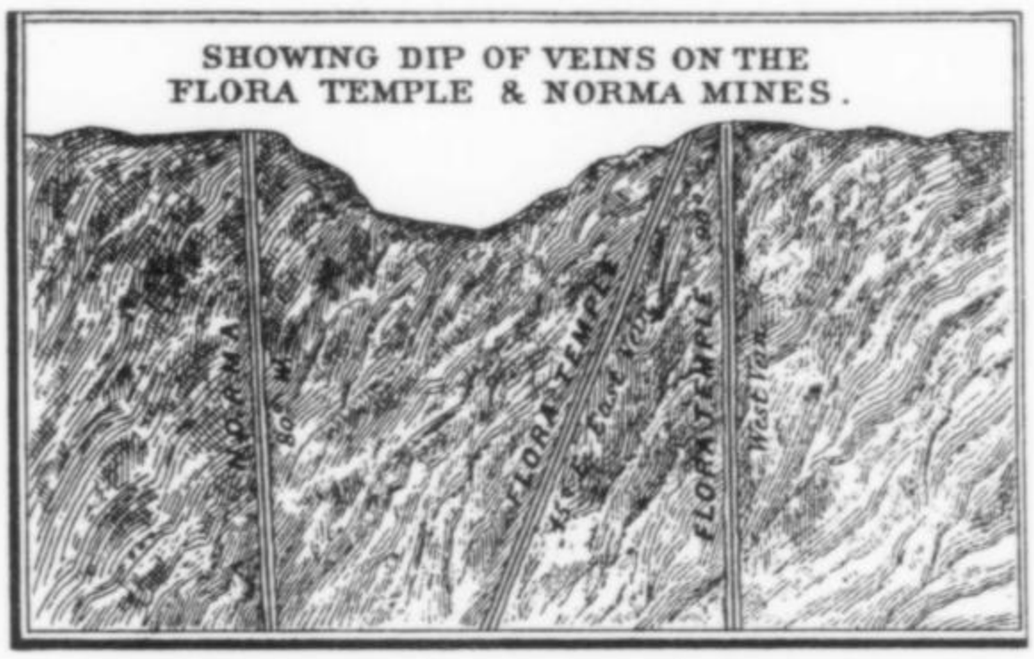


Figure 13. **Sketch (vertical section) showing veins at the Norma and Flora Temple mines (Blake, 1880).**

GEOLOGY

Geological investigations in the Castle Dome district have been going on for more than a century (see Wilson, 1933, 1951; Gutmann, 1981, 1982; etc.). William P. Blake compiled reports that date back to the late 1870's. He notes, as geologists continue to do at present, some unmistakable geologic features. The northern part of the Castle Dome Mountains is a thick sequence of Cretaceous to Quaternary volcanics in excess of 2,000 feet in thickness. They are mainly extrusive rhyolite, andesite, tuff and obsidian, with the oldest cut by quartz porphyry dikes. The oldest extrusive rocks are capped by a Quaternary basalt flow several hundred feet thick.

In the southern part of the mountains, the rocks are metamorphosed sedimentary and intrusive igneous rocks. Schist and gneiss of Mesozoic age also occur in fault contact with Cretaceous sedimentary rocks (shale, cherty limestone, arkosic sandstone, conglomerate) and metamorphic quartzite and slate. The sedimentary rocks are dissected extensively by a diorite and rhyolite dike swarm. The rhyolite is younger than the diorite, which is believed to be older than the extrusive volcanics. Finally, on the eroded Mesozoic rocks and Cretaceous sediments there is a series of extrusive rocks which consist of andesite, rhyolite flows and tuff.

The alluvial plains surrounding the Castle Dome Mountains consist of a thin veneer of sediments overlying a Cretaceous (maybe Tertiary in some areas) basaltic cap. The alluvium fans out in *bajadas* from the canyon mouths to the west over the Castle Dome Plains.

The structure of the mountains is dominated by a series of northwest-trending faults occurring along the northern and northeastern part of the range, and in the extreme southern end. The faults are near vertical and tilt the volcanic units 7° to the east. These faults have been intruded locally by Laramide-age granite, syenite, diorite and quartz porphyry. The majority of the mineralization in the Castle Dome district occurs within these dikes.

The deposits are believed to have formed as a result of hydrothermal deposition from a very deep magma source. The nature of the mineralization suggests deposition occurred in the mesothermal zone, meaning the deposit formed about 4,000 feet below the land surface at the time of deposition. Ore deposits consist of argentiferrous galena replacements along fissure veins through most of the district, and placer gold and gold-bearing veins in the area around the Buckeye mine.

MINES

Hull Group

The most important mines and workings in the district (Wilson, 1933) fall into eight general groups, beginning on the north with the Hull (Rialto) group, situated along the Hull vein which strikes N30°W and dips 65° to 75°NE. Northernmost in the group is the Chief of Dome, followed southward by the Hull mine (two shafts), the Diana (five shafts) and the Surprise (four shafts). Underground

Figure 14. **Flora Temple mine and mill ca. 1930, Castle Dome Peak in the background behind the headframe. Courtesy Arizona Geological Survey.**

workings have exploited the vein for more than 2,000 feet in stopes up to 18 feet wide extending to a depth of up to 275 feet.

Cleveland-Chicago Group

The Cleveland-Chicago vein runs roughly parallel to the Hull vein, apparently beginning south of the Diana shafts at the Lucinda mine and extending southeasterly. The Algodones mine is next along the extended trace of the vein, followed by the Cleveland mine (two shafts) and on to the Chicago mine (several shafts). The vein is clearly traceable between the Cleveland and Chicago shafts for at least 1,400 feet, where it strikes S30°E and dips about 80°W. A considerable portion of the vein above the 100-foot level has been stoped.

Buckeye Vein

Claims along the Buckeye vein begin just northeast of the middle of the Flora Temple vein, with the old Castle Dome claim (at least seven shafts, patented in 1876) and follow the trace of the vein for about a mile southeast. After the Castle Dome shafts come the New Dil, Lady Edith, Yuma (three shafts) and Big Dome (four shafts) mines. The vein here dips about 70°W. The New Dil and Lady Edith sections of the vein were stoped out continuously for a distance of more than 1,000 feet, and to a depth of 250 feet.

Little Dome Vein

South of the Flora Temple vein is the Little Dome vein, which adjoins the Señora vein on the north end and extends along strike through four shafts to the southeast. The vein strikes S45° to 55°E and dips 85°SW. Stopes 4 to 7 feet wide follow the vein for a length of 125 feet and to a depth of 20 to 60 feet.

Señora Vein

The Señora mine (at least three shafts) begins at its northern juncture with the Little Dome vein and traces southward, curving toward the east and ending at the Union and Lincoln mines. The Señora vein strikes N20° to 40°W and dips 50° to 70°E. The vein has been stoped out to a width of up to 5 feet, and to a depth of 300 feet. Below the 250-foot level the vein pinches to only a few inches in thickness. The southernmost two shafts are connected underground by stopes.

Mabel-Adams Groups

South of the Chicago mine about half a mile are the Mabel claims (five shafts), and adjacent due south from there are the Adams claims (at least four shafts, of which the Puzzler is by far the most important). Most of the stoping in the Mabel mine took place south of the shafts toward the Adams claims, on an 11-inch streak of galena that feathered out with depth; workings extend down to 380 feet. In the area of the Puzzler mine the vein strikes S23°E and dips 70°NE; in places the stoping is 7 or 8 feet wide. Very little drifting has been done on the other shafts in the Adams group.

Flora Temple Vein

The Flora Temple mine has the distinction of being the second claim ever patented in Arizona (in 1871). At least 11 shafts along two semi-parallel veins are connected underground by a series of stopes. For many years the Flora Temple was the most important producer in the district, and its workings are probably the most extensive. The veins have been stoped out to a width of up to 10 feet and a depth of 225 feet for most of the 2,000-foot length of the claim. The veins strike N18°W and dip 45° to 55°E.

Colorado Vein

Claims known as the Lincoln or Colorado Group were located about 5 miles southeast of the Union mine at the extreme southern end of the district (Crampton, 1919). The vein here strikes northerly and dips about 45°W; it measured 1 to 3 feet thick in most

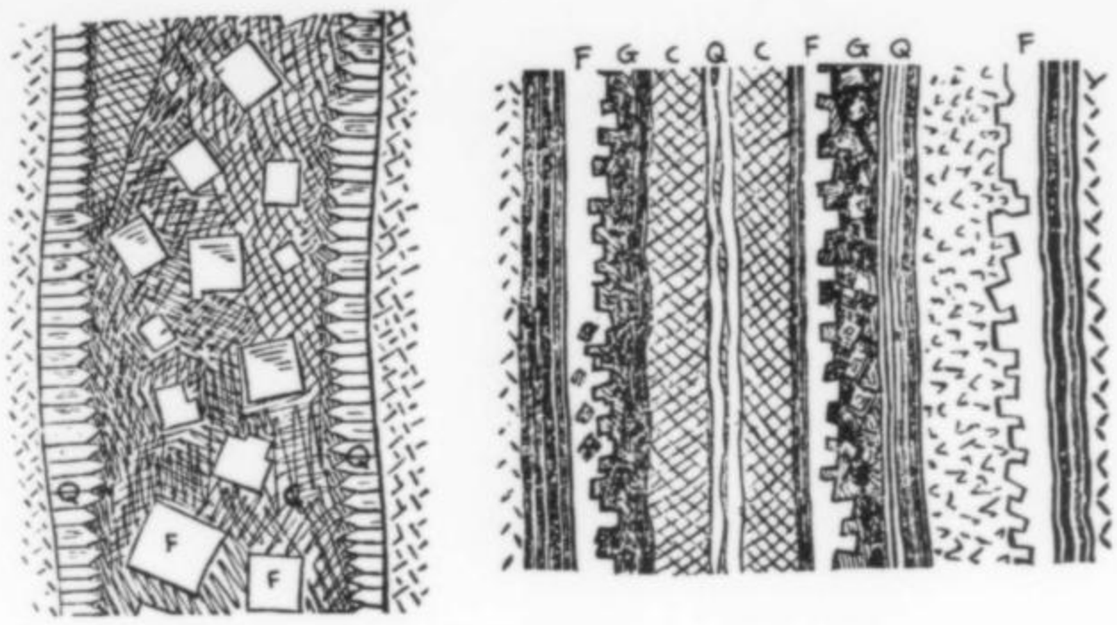


Figure 15. **Sketches showing typical vein structures containing fluorite crystals and crystal crusts (F), quartz (Q), calcite/dolomite (C) and galena (G) (Blake, 1880).**

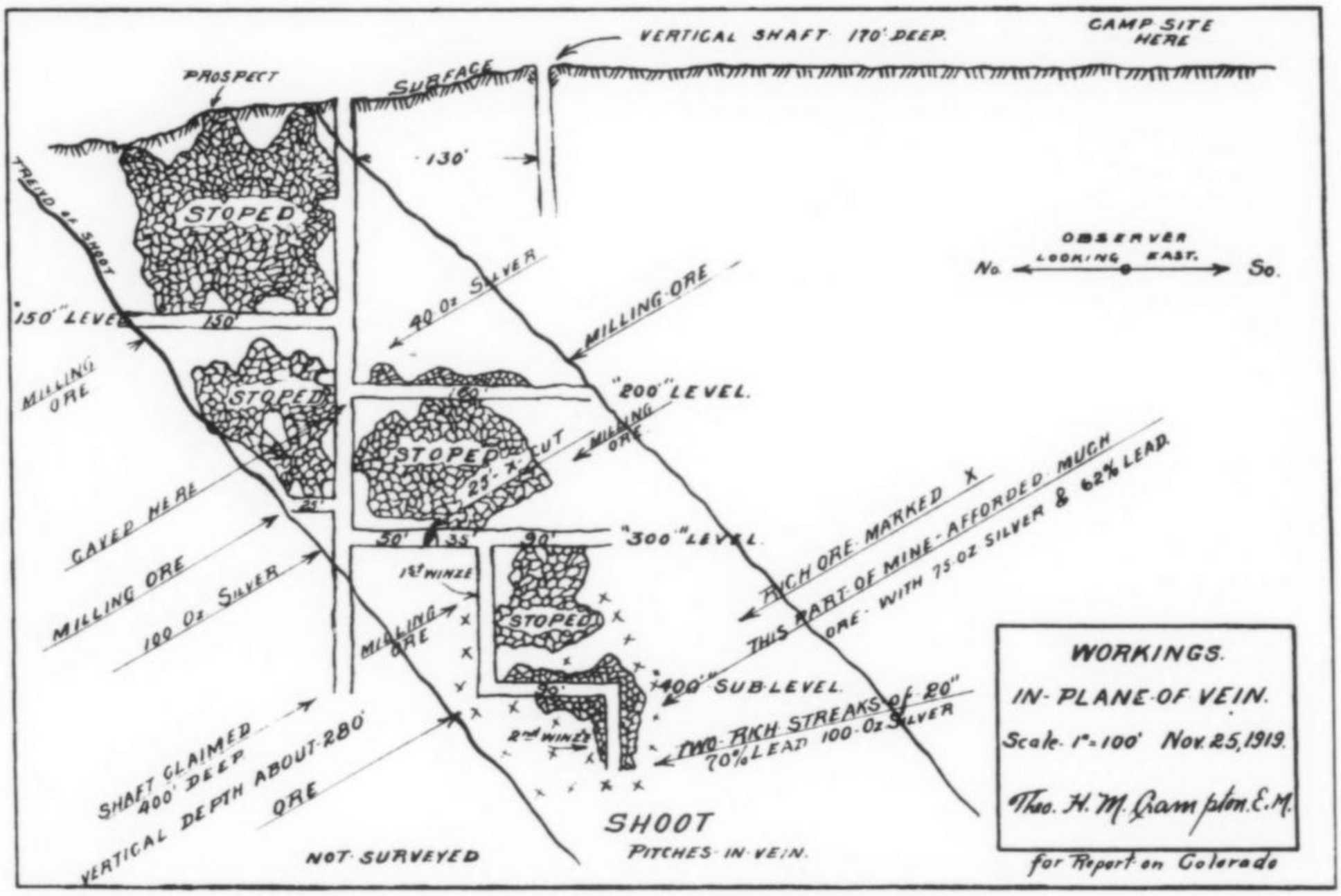


Figure 16. **Workings on the Colorado vein (Crampton, 1919).**

places, occasionally widening to 8 feet. The high-grade argentiferous galena and cerussite were accompanied by calcite, a small amount of barite, and economic quantities of fluorite sometimes shipped as ore. These claims were all owned by Althee Modesti, a Yuma merchant; the Colorado was worked single-handedly on a lease by Juan Laguna from 1898 to 1904, using only hand tools. Johnson (1911) states that "at the lowest level reached in the mine some very rich [silver] chloride ore was cut."

MINERALOGY

The most important mineral deposits of the Castle Dome district are the veins of argentiferous galena emplaced along several major fissures. The principal gangue minerals are fluorite and calcite with quartz, aragonite and late-stage barite. There is little copper in the district. Collectible secondary minerals are primarily the product of alteration of the galena, first to anglesite, cerussite and minium, and then to the more attractive vanadinite, mimetite and wulfenite. A little zinc is represented by smithsonite and hydrozincite lining vugs and watercourses. Perhaps the most unusual collector-quality species (for Arizona), aside from the green vanadinite, is the attractive, pale green fluorite found as crystals lining fissures and often with associated vanadinite and wulfenite.

Anglesite $PbSO_4$

Anglesite was first reported from the district by J. G. Brush (1873), who chemically analyzed a compact variety, and later by Foshag (1919) and Wilson (1933). Foshag described "very showy specimens" of 1-cm yellow wulfenite crystals scattered over etched crystals of anglesite as superficial alteration layers surrounding cores of galena. At the Señora claim cubical pseudomorphs of black anglesite after galena crystals were found, sometimes coated by a film of rusty-red minium. At the Flora Temple claim anglesite/cerussite-coated alluvial nuggets of galena in gravel were traced to their source veins. Some anglesite has a "woody" appearance. Small crystals 3 to 6 mm in size have also been collected at the Puzzler mine.

Aragonite $CaCO_3$

Anthony *et al.* (1995) report aragonite in the district in channels

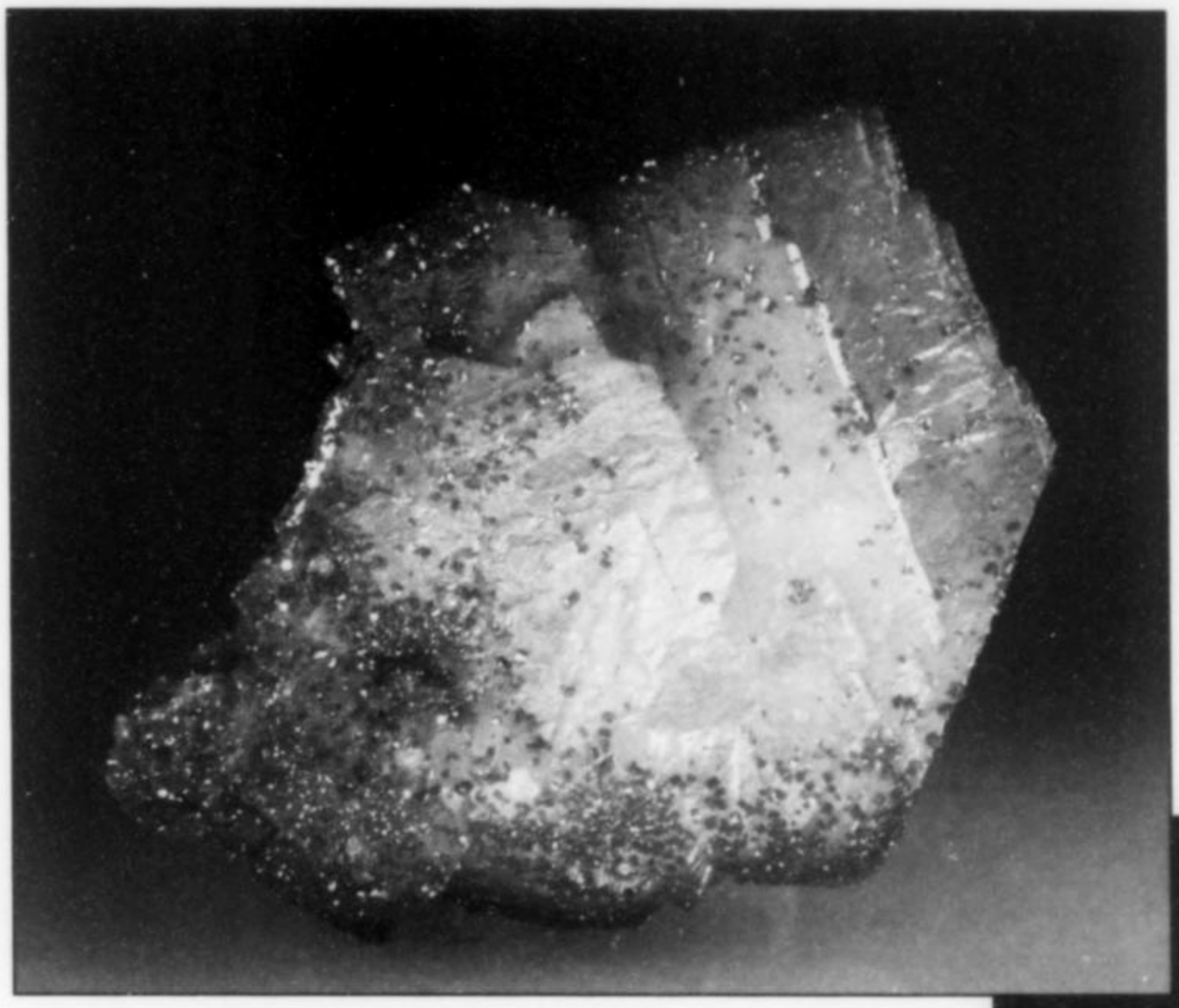
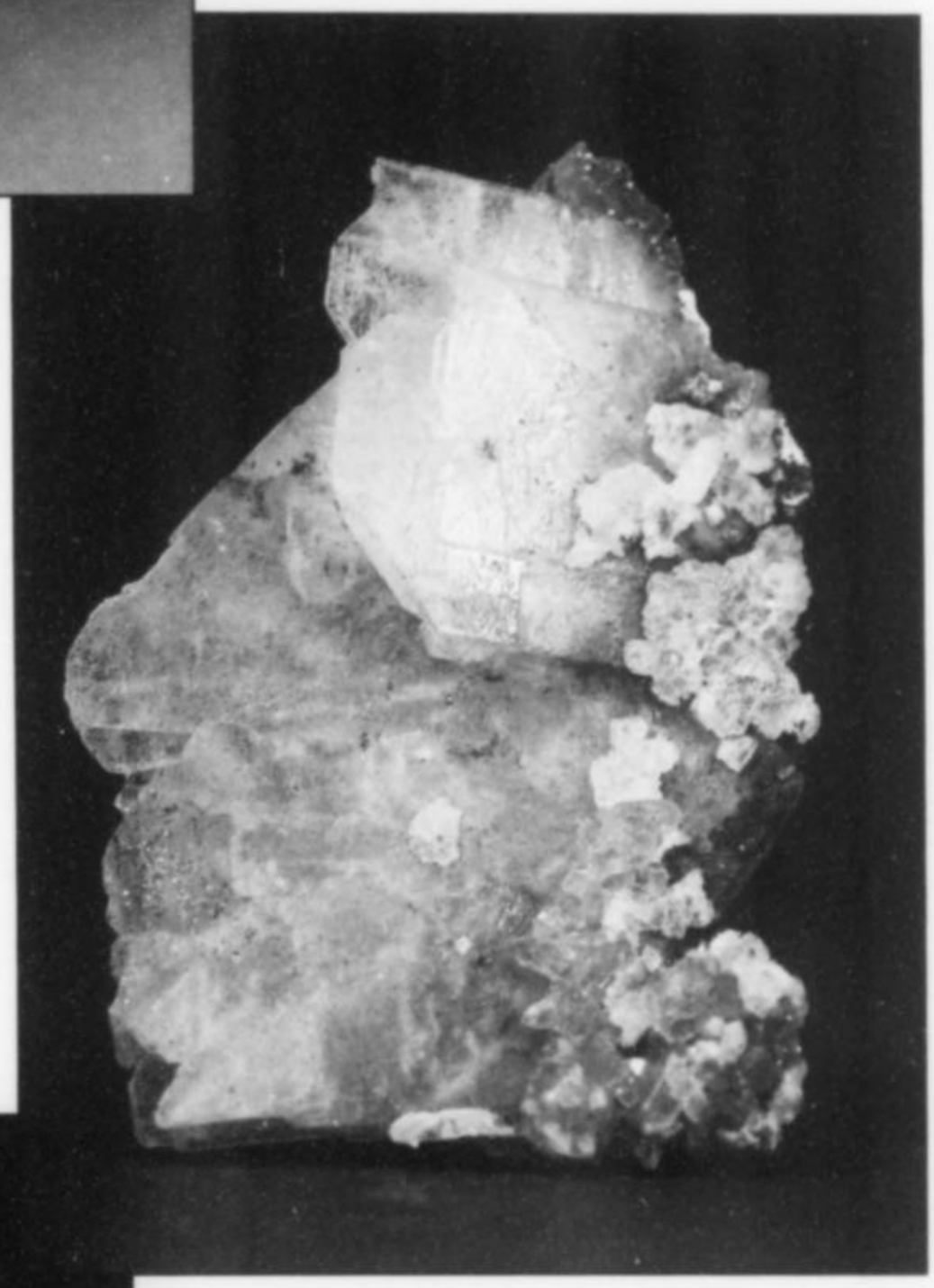


Figure 17. **Tiny vanadinite crystals sprinkled over a 6.8-cm white barite crystal, from the Puzzler mine, 180-foot level. Mark Hay specimen; Wendell Wilson photo.**

Figure 18. **White barite crystal plates, 5.8 cm, from the Puzzler mine. Arizona-Sonora Desert Museum specimen #8479; photo by Jeanne S. Broome.**



and vugs associated with smithsonite, hydrozincite, wulfenite, vanadinite and mimetite.

Barite $BaSO_4$

Foshag (1919) reported barite from the district as platy masses and also rarely as large, clear crystals in open cavities. Wilson (1933) notes it as a common gangue mineral in the argentiferous galena-fluorite veins, as massive vein fillings and as groups of bladed crystals. At the Señora claim, at least, the barite is clearly later than the fluorite; at the Little Dome claim veinlets of crystalline barite cut across crystalline fluorite and calcite.

Cerussite $PbCO_3$

Wilson (1933) reported cerussite as a common constituent of ore, forming alteration layers around nodules of galena. Anthony *et al.* (1995) mentioned sixling twins from the Hull mine. These are solid pseudohexagonal dipyramids up to 1 cm each or more, sometimes in connected groups and clusters. Associations include minium, litharge, anglesite and other secondary lead minerals. Some nice microcrystals have also been collected at the Puzzler mine.

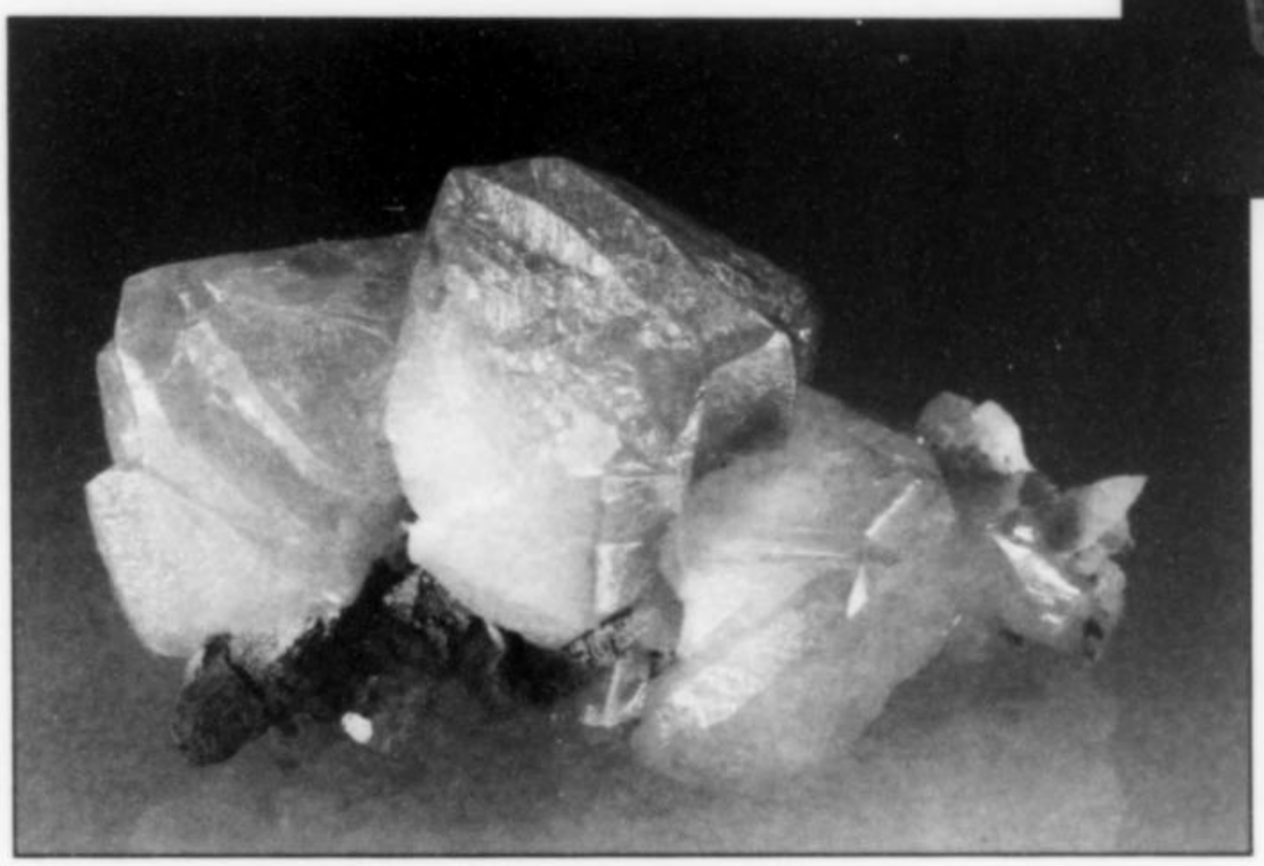


Figure 19. **Cerussite crystal cluster, 3.3 cm, from the Hull mine. Dick Morris collection; photo by Wendell Wilson.**

Figure 20. **Cerussite crystal cluster, 4.2 cm, from the Hull mine. Dick Morris collection; photo by Wendell Wilson.**

Figure 22. **Fluorite crystal group, 2.2 cm, on matrix, from an undisclosed mine in the Castle Dome district. Peter Megaw collection; photo by Wendell Wilson.**

Figure 21. **Cerussite crystal cluster, 3.0 cm, from the Hull mine. Dick Morris collection; photo by Wendell Wilson.**

Chalcocite Cu_2S

One specimen in the Smithsonian Institution (#65493), labeled as originating in the Castle Dome district, contains chalcocite with malachite. This may, however, be from the Thumb Butte district, 6 miles south of Castle Dome, where veins of chalcocite and malachite were mined from 1918 to 1929 (Wilson, 1933). The principal mine of the group was the Copper Glance.

Descloizite $Pb(Zn,Cu)(VO_4)(OH)$

Guild (1910) reported Castle Dome as being a "well-known" locality for descloizite on wulfenite, vanadinite and calcite.

Fluorite CaF_2

Fluorite is a common gangue mineral in the argentiferous galena veins of the district. Foshag (1919) reported it in green masses and commonly as green crystals which, if exposed to sunlight, take on a pale pink hue. Crystals of blue to purple color are also known. Ladoo (1923) described a photosensitive black fluorite from the Hull mine which changes to a pale gray or pink color on exposure to sunlight. At the Señora mine Wilson (1933) reported pale green, purple and rose-colored crystals from "less than an inch up to several inches in diameter." At the Adams claims greenish fluorite crystals to an inch in diameter were found. Cubic crystals to 3 inches on an edge, with multiple phantoms, have been collected at the Hull mine; some are sprinkled or coated with small wulfenite crystals.

Freieslebenite $AgPbSbS_3$

Anthony *et al.* (1995) report that a small amount of freieslebenite was mined from one of the claims in the district and was shipped with other argentiferous ores.

Galena PbS

Galena, much of it argentiferous, was the principal ore mineral of the galena-fluorite veins in the district, including the Flora Temple, Señora, Little Dome, Hull, Lincoln and Adams properties. Masses and crude cubic crystals were once quite common, as well as cubical pseudomorphs of black anglesite after galena. In places nearly solid vein fillings of galena up to 8 feet thick were mined (Blake, 1880). Some remarkable cubic crystals up to 4 cm on an edge and coated with white drusy anglesite-cerussite have been collected from a shaft at the southern end of the Señora vein.

Figure 23. **Green fluorite crystal cluster, 6.3 cm, from the Hull mine. Mark Hay collection; photo by Wendell Wilson.**

Figure 24. **Fluorite crystals, including a twin (right), zoned green and purple, from an unnamed shaft just east of the Señora shaft. Dick Morris collection; photo by Wendell Wilson.**

Figure 25. **Purple fluorite crystal group, 4.5 cm, from an unnamed shaft at the south end of the Castle Dome district. Jack Crowley collection; photo by Wendell Wilson.**

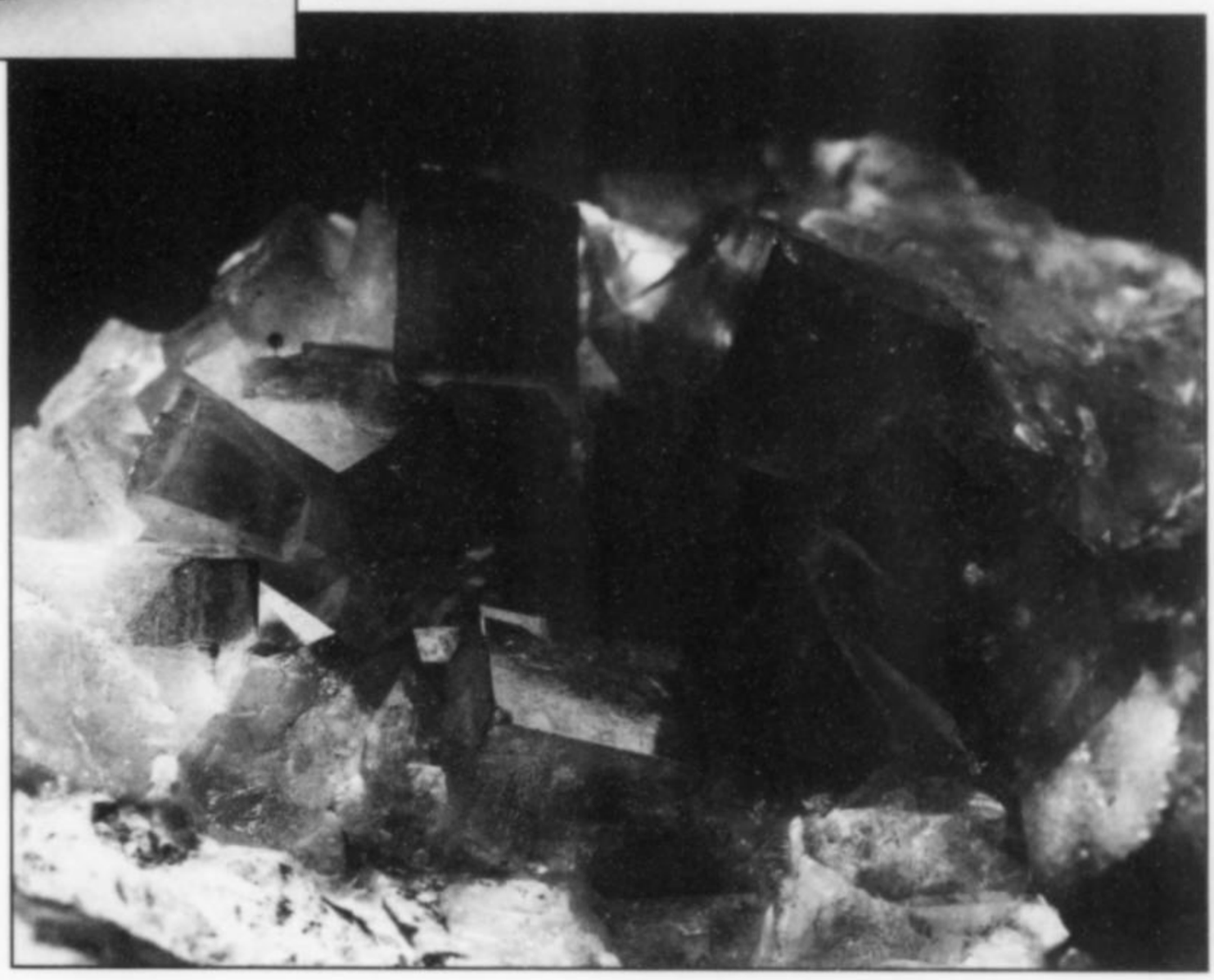


Figure 26. **Vanadinite crystals to 4 mm, green and orange, from the Puzzler mine. Mark Hay collection; photo by Wendell Wilson.**

Figure 27. **Vanadinite crystals to 5 mm, green and orange-brown, from the Puzzler mine. W. Milici collection; photo by Wendell Wilson.**

Figure 28. **Vanadinite crystal cluster, 3.4 cm, orange and green, from the Puzzler mine. Dick Morris collection; photo by Wendell Wilson.**

Gold Au

Gold-bearing veins were found in the eastern portion of the Castle Dome Mountains. Only the Big Eye vein, about 4 miles south-southeast of Castle Dome Peak, had any production; it operated from 1912 to 1917, yielding about $33,000 in gold. Including local placers plus a few byproduct ounces from the Copper Glance mine, 6,556 ounces of gold were recovered from the district (Wilson, 1933), half of that by dry-washing from 1884–1908. The lead-silver veins in the district have not yielded any gold.

Gypsum $CaSO_4 \cdot 2H_2O$

Massive and crystalline gypsum is commonly found in the upper portions of lead-silver veins in the district (Wilson, 1933).

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

Hydrozincite with minor gypsum is found in the upper portions of all veins, especially on the Señora claim, mainly in solution channels. Other associated minerals in these channels include calcite, cerussite, smithsonite, wulfenite, vanadinite and mimetite (Wilson, 1933). The hydrozincite is fluorescent (Flagg, 1958).

Mimetite $Pb_5(AsO_4)_3Cl$

Mimetite occurs in vugs and solution channels in association primarily with wulfenite. Yellow crystals of wulfenite at the Hull mine have been found on botryoidal, dull-green to yellow-green mimetite (see Fig. 33). Blake (1881a) noted vanadiferous mimetite, as "crusts of small aggregated crystals of a light brown to straw-yellow color and waxlike luster."

Minium Pb_3O_4

Minium, a powdery red lead oxide, occurs commonly in the district where galena is altering to anglesite and cerussite (Wilson, 1933).

Torbernite $Cu(UO_2)_2(PO_4)_2 \cdot 8–12H_2O$

A specimen of torbernite (#6162) labeled as coming from the Castle Dome Mountains is in the University of Arizona mineral collection. This is probably from the Castle Dome *copper* mine near Inspiration, where metatorbernite has been reported (Petersen, 1947).

Vanadinite $Pb_5(VO_4)_3Cl$

Vanadinite is a fairly common alteration product of galena in the district, especially in solution channels and vugs where it is locally abundant. Associations include wulfenite, mimetite, cerussite, smithsonite, hydrozincite and anglesite.

William P. Blake visited Castle Dome in April of 1880 and again in the spring of 1881. He published some of his observations on vanadinite from the district in two 1881 articles, one in the

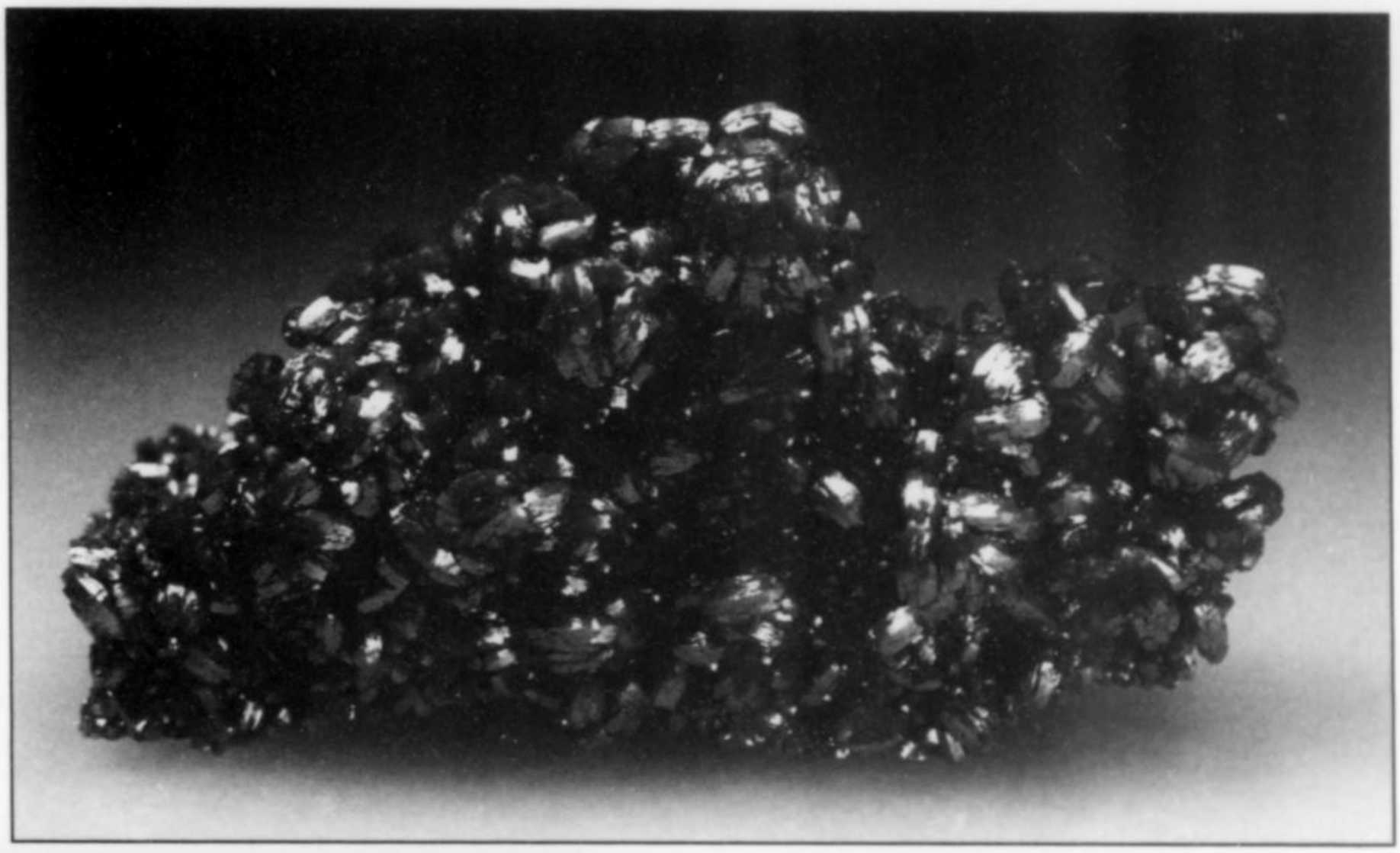


Figure 29. **Vanadinite crystal group, 5.5 cm, from the Puzzler mine, 1988. Mark Hay collection; photo by Wendell Wilson.**

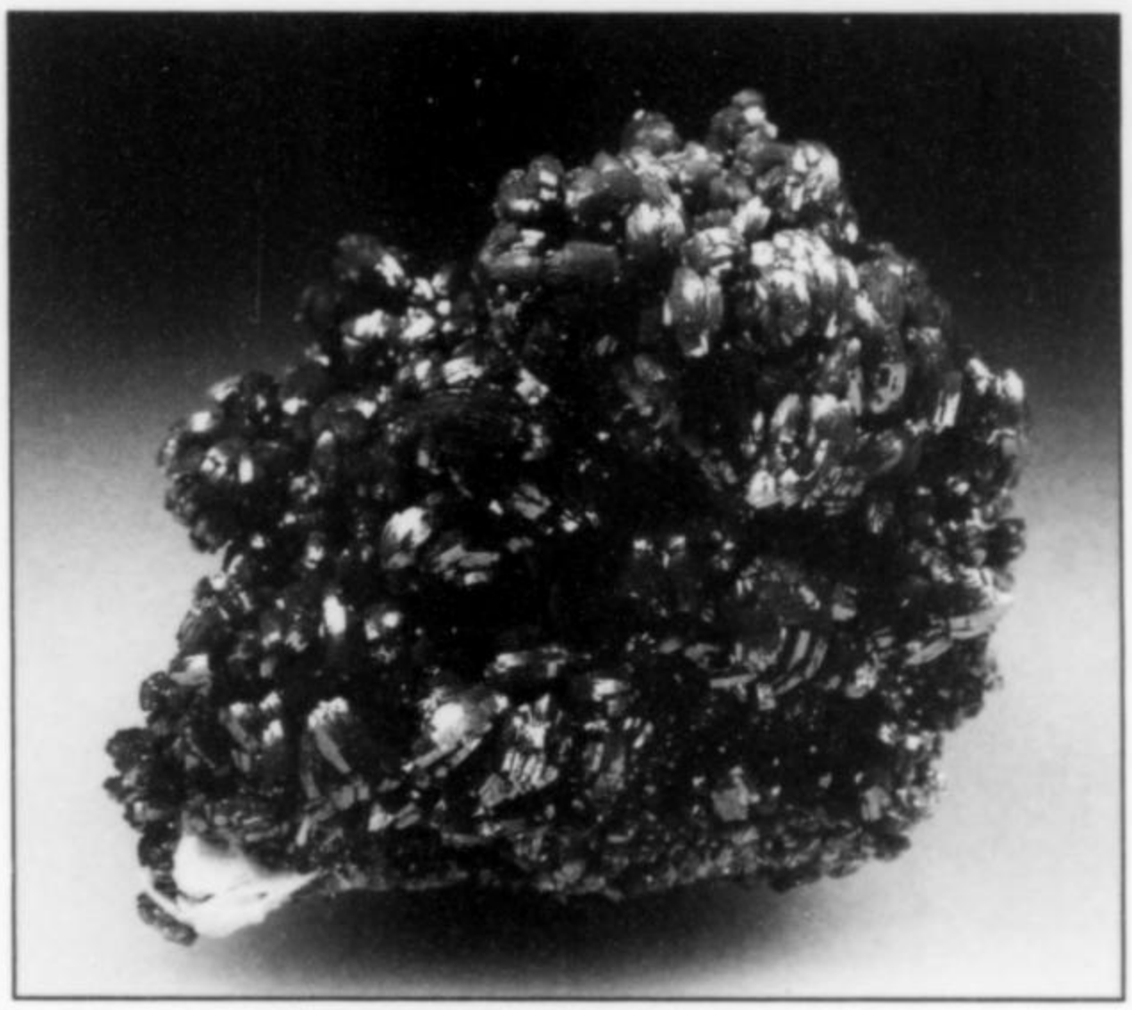


Figure 30. **Green vanadinite crystal group, 5 cm, from the Puzzler mine, 1988. Mark Hay collection; photo by Wendell Wilson.**

American Journal of Science (for scientists) and one in the *Mining and Scientific Press* (for mining men, quoted from below):

> Vanadinite, which occurs in considerable abundance in the claim known as the "Railroad" [=Diana mine], is a rare mineral, and has not hitherto been found in the United States, if we except some minute microscopic crystals mixed with wulfenite in the ores of the Wheatley mines, at Phoenixville, Pa.
>
> The vanadinite [at Castle Dome] occurs in groups of hexagonal prismatic crystals with curved sides, tapering at each end, and closely resembling pyromorphite in form and grouping. These crystals are rarely over one-sixteenth of an inch in diameter . . . in confused aggregations, forming crusts and filling cavities in the decomposing ores of lead, and also on fluor-spar. Some of the crystals are cavernous, presenting the appearance often seen in phosphate of lead [pyromorphite]. One side of a crust of crystals is often in distinct hexagonal crystals, and the other consists of an aggregation of minute crystals grouped in arborescent forms, and differing in color from the larger crystals. The larger crystals are generally light brown in color, with a bronzy luster. The smaller crystals are lighter, and are of various shades of orange-yellow, becoming in places nearly white with a silvery satin-like luster. The yellowish brown crystals have a wax-like appearance and luster.

Blake notes that simple chemical tests indicate a range of compositions, from vanadinite to vanadiferous mimetite.

The lustrous, green to orange vanadinite crystal groups from the Puzzler mine are among the best occurrences in the state and are very distinctive because of their color. The only similar specimens are those from the Ramsey mine.

Wilson (1933) reports vanadinite and wulfenite in vugs in the Puzzler mine. Small yellow to brown crystals have been found at the Hull mine.

The best vanadinite taken out in modern times was found in the Puzzler mine in 1988 by Mark Hay, Dick Morris and George Godas, and reported by Wilson (1989). Hundreds of attractive specimens of dull-green vanadinite clusters and crystals were recovered from a pocket on the 180-foot level. These specimens were at first assumed to be pyromorphite because of their color, but analyses provided by Chuck Lewis at Arizona State University and Dr. Terry Wallace at the University of Arizona confirmed their identity as vanadinite. Some crystals are green on one end, progressing to a reddish brown on the other end. All are simple hexagonal prisms with flat pinacoid terminations, but some crystals and clusters are distorted into a barrel-shaped habit.

Other occurrences in the Puzzler mine include the following:

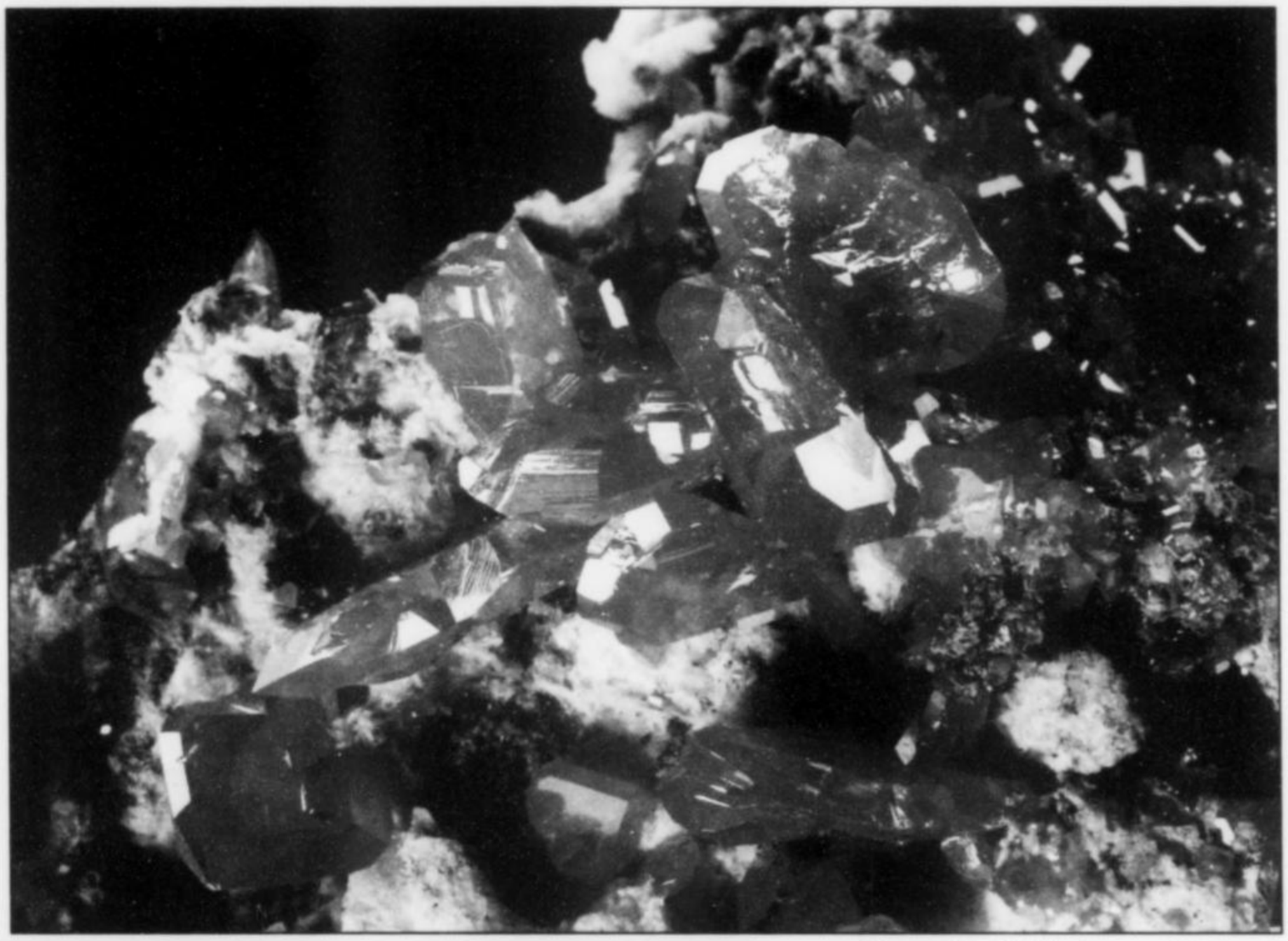


Figure 31. **Wulfenite crystal group, 2.5 cm across, from the Puzzler mine. Mark Hay collection; photo by Wendell Wilson.**

Figure 32. **Wulfenite crystal group, 3 cm, from the Hull mine. W. Milici collection; photo by Wendell Wilson.**

Figure 33. **Wulfenite crystals with green botryoidal mimetite, 3 cm, from the Hull mine. George Godas collection; photo by Wendell Wilson.**

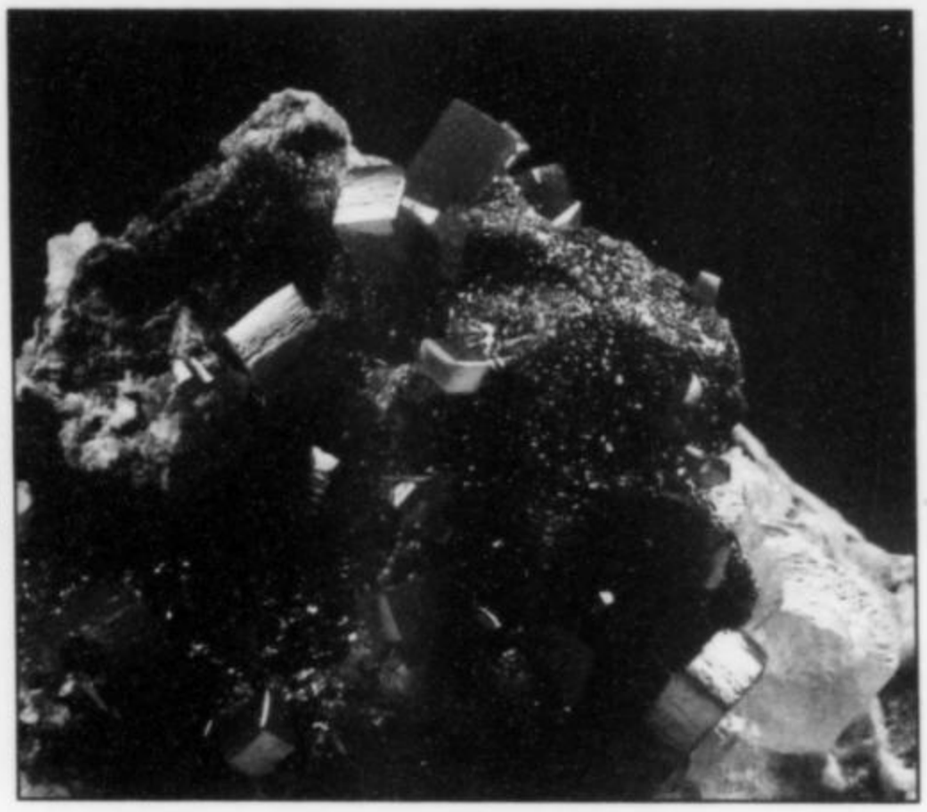
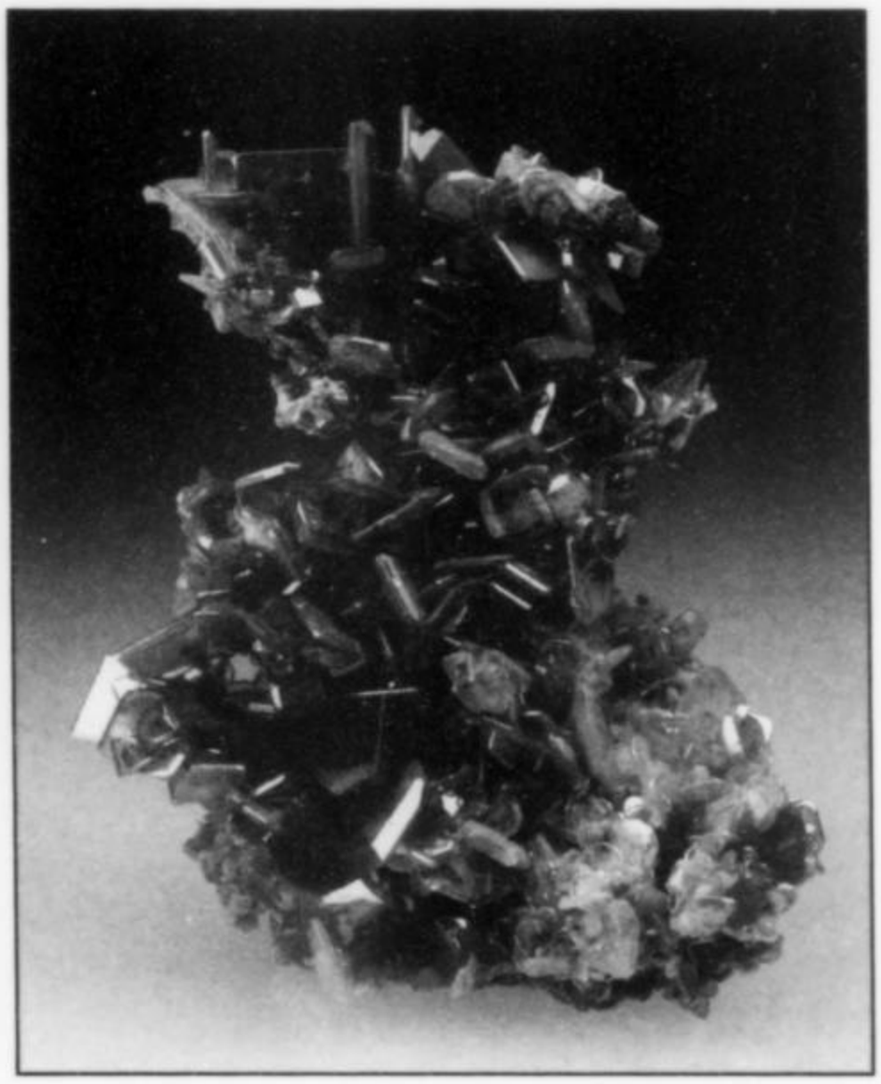


Figure 34. **Wulfenite crystals (pseudocubic) to 5 mm, with cerussite druse on galena, from the Hull mine. Mark Hay collection; photo by Wendell Wilson.**



40-foot level: Brown-green hoppered vanadinite crystals to 5 mm.

100-foot level: Drusy green vanadinite coating greenish yellow wulfenite crystals. Also brown to black vanadinite crystals to 5 mm; very good, blocky, greenish brown vanadinite crystals to 5 mm having good luster and, in some cases, orange termination zones; unusual hoppered gray vanadinite crystals to 5 mm; and blocky brown vanadinite crystals to 6 mm.

140-foot level: Blocky yellowish green vanadinite crystals to 6 mm.

160-foot level: Brilliant drusy brown vanadinite.

180-foot level: Brilliant orange vanadinite crystals to 3 mm; brilliant orange-brown vanadinite crystals to 3 mm on calcite; bright, greenish brown vanadinite crystals to 5 mm with calcite; curved green vanadinite crystals to 6 mm on white barite rosettes.

Willemite Zn_2SiO_4

Willemite has been identified on Castle Dome specimens in the collection of the Arizona-Sonora Desert Museum.

Witherite $BaCO_3$

Nevius (1912) reported witherite as a constituent of the gangue in lead ores from the De Luce (=Castle Dome) mine.

Wulfenite $PbMoO_4$

Wulfenite was first noted at Castle Dome by Blake (1881a). In describing vanadinite from the Railroad (Diana) claim, he remarked:

> The wulfenite crystals in association are extremely brilliant and light yellow in color, presenting a beautiful appearance upon a background of green fluor-spar or white crystalline carbonate of lead [cerussite].

Wulfenite has also been found in several other mines in the Castle Dome district (Foshag, 1919). The Smithsonian Institution has specimens of wulfenite in small, blocky yellow crystals on barite and dark purple fluorite from "Howe's mine, Castle Dome district." Fine, tabular yellow crystals to over 1 cm have been found as clusters on green mimetite from the Hull mine. Blocky orange crystals to 5 mm have been found on cubical black pseudomorphs of anglesite after galena with fluorite from the same mine. In some vugs and solution channels wulfenite is found associated with hydrozincite, smithsonite, vanadinite, calcite, quartz and aragonite (Wilson, 1933). Wulfenite is also known from the Señora mine (Blake, 1881a and b) with considerable amounts of vanadinite. Greenish fluorite crystals form the matrix for wulfenite in some cases, making for attractive and unusual specimens. Fine yellow crystals to 5 mm are also known from the Danny Boy (or Dandy Boy) mine, in the Arizona-Sonora Desert Museum collection.

In the Puzzler mine, greenish yellow wulfenite crystals to 3 mm have been found on the 100-foot level, clusters of bright yellow crystals to 6 mm have been found on the 130-foot level, and very good, brilliant yellow wulfenite on blue fluorite has been found on the 180-foot level.

CONCLUSION

The Castle Dome district still has the potential to produce good mineral specimens in the future. It is an area which challenges the skills and energies of even the most experienced and determined field collectors, but for those willing to put in the time and labor (and risk the hazards inherent in entering abandoned mines), the ground will grudgingly yield specimens. There is still exploration work to be done, but generally only the most dangerous and least accessible workings remain unexamined. It is not a promising or safe place for inexperienced or ill-equipped collectors, or those unfamiliar with the safety precautions necessary in the desert.

ACKNOWLEDGMENTS

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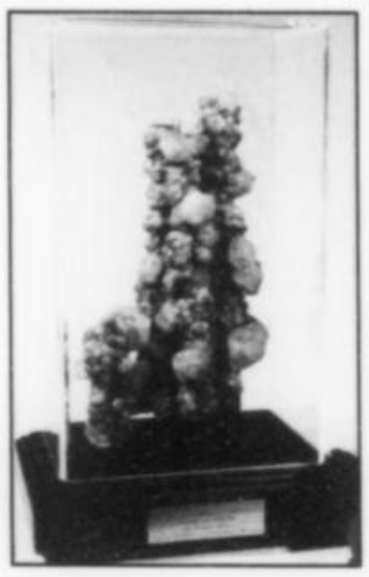

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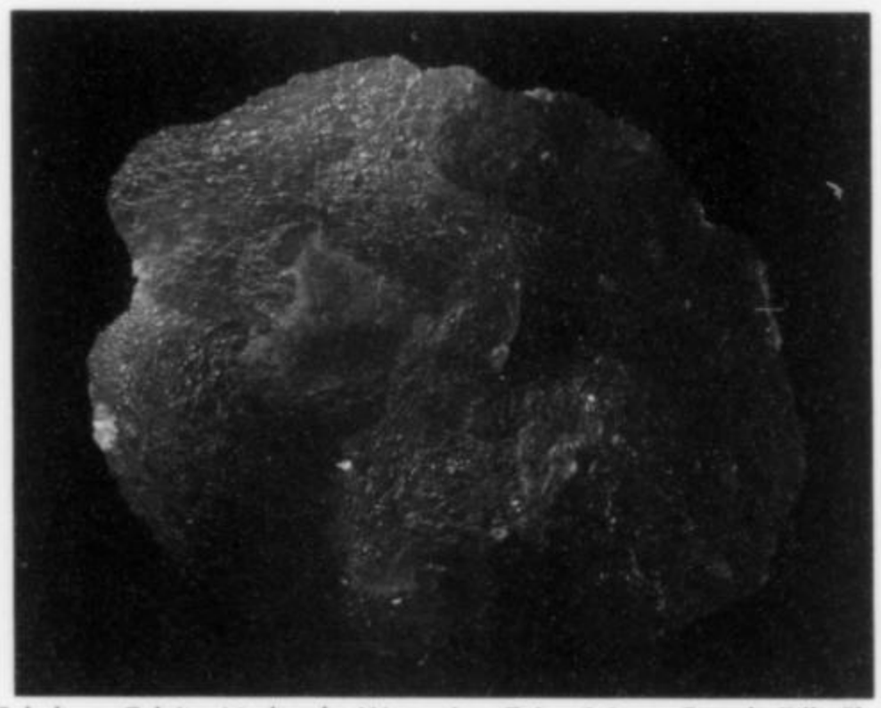

Cobaltoan Calcite, Mashamba West mine, Zaire, 3.8 cm; Pamela Zilly Photo

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MICROMINERALS FROM THE BUSHVELD COMPLEX SOUTH AFRICA

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The Bushveld Complex is not only a fascinating geological feature, but also the source of numerous interesting micromineral species including carminite, scorodite, crocoite, linarite, julgoldite, anatase and munirite.

INTRODUCTION

The Bushveld Complex of South Africa is world-famous for several reasons. It contains the largest deposits of platinum and chromium in the world and is the largest layered complex on Earth (Anhaeusser and Maske, 1986). The main rock-types are ultramafic to mafic, but granites, granophyres and felsites, containing economic tin deposits, fluorite and pegmatite minerals are also present (Cairncross and Dixon, 1995). There are also economic deposits of metamorphic minerals, such as andalusite, that formed by thermal metamorphism during the intrusion of the Complex. A large quarrying industry in the area produces granite, norite and gabbronorite for building stone and tombstones. In addition to these economic deposits, there are base-metal (galena/sphalerite), gold, silver and other more exotic mineral deposits (e.g., cobalt and molybdenum) that originated from hydrothermal fluids associated with the intrusion. It is this last group of deposits which provide an interesting and attractive array of micromounts, most of which have been collected from dumps located at abandoned, worked-out

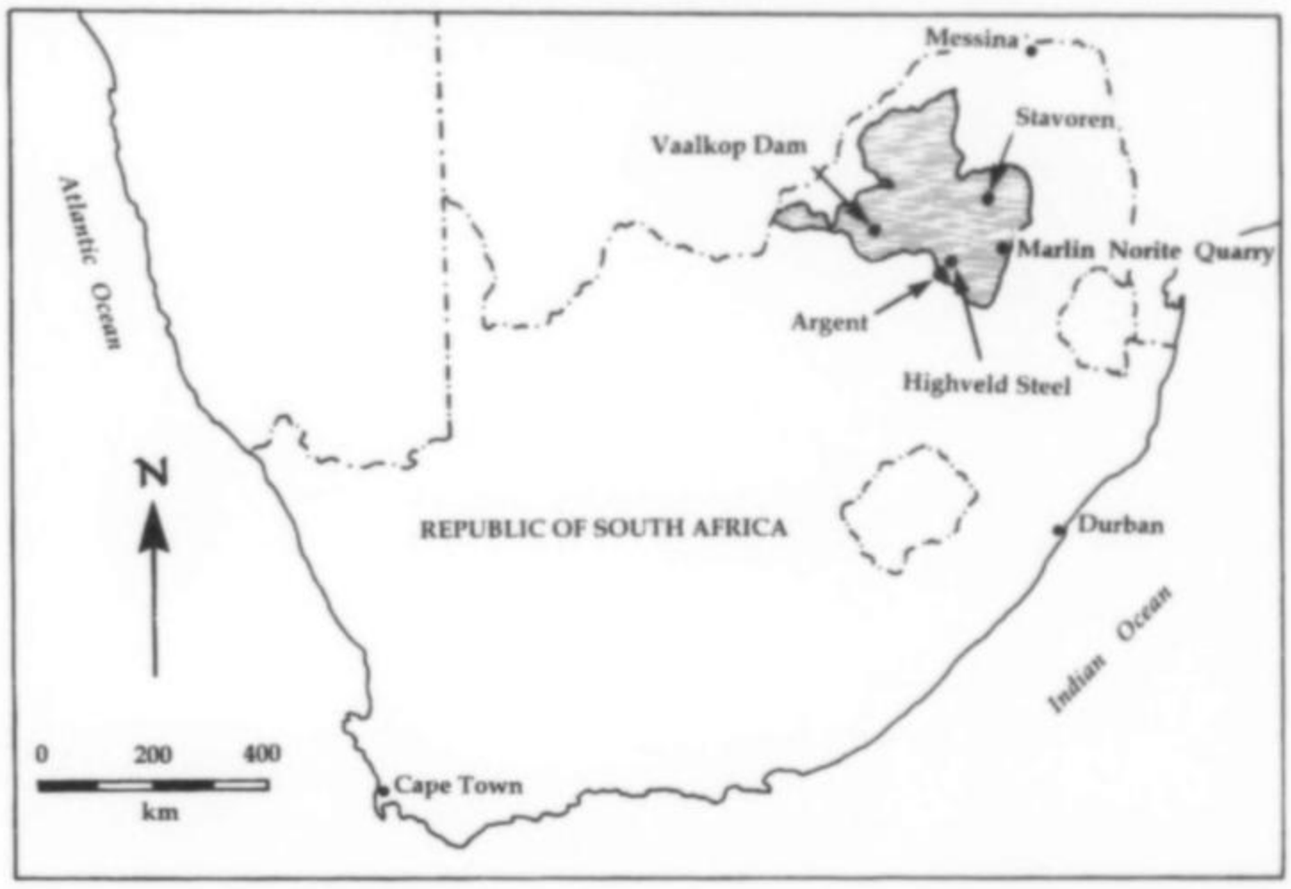

Figure 1. **The Bushveld Complex (shaded area), showing the localities from which the minerals featured in this article were collected.**

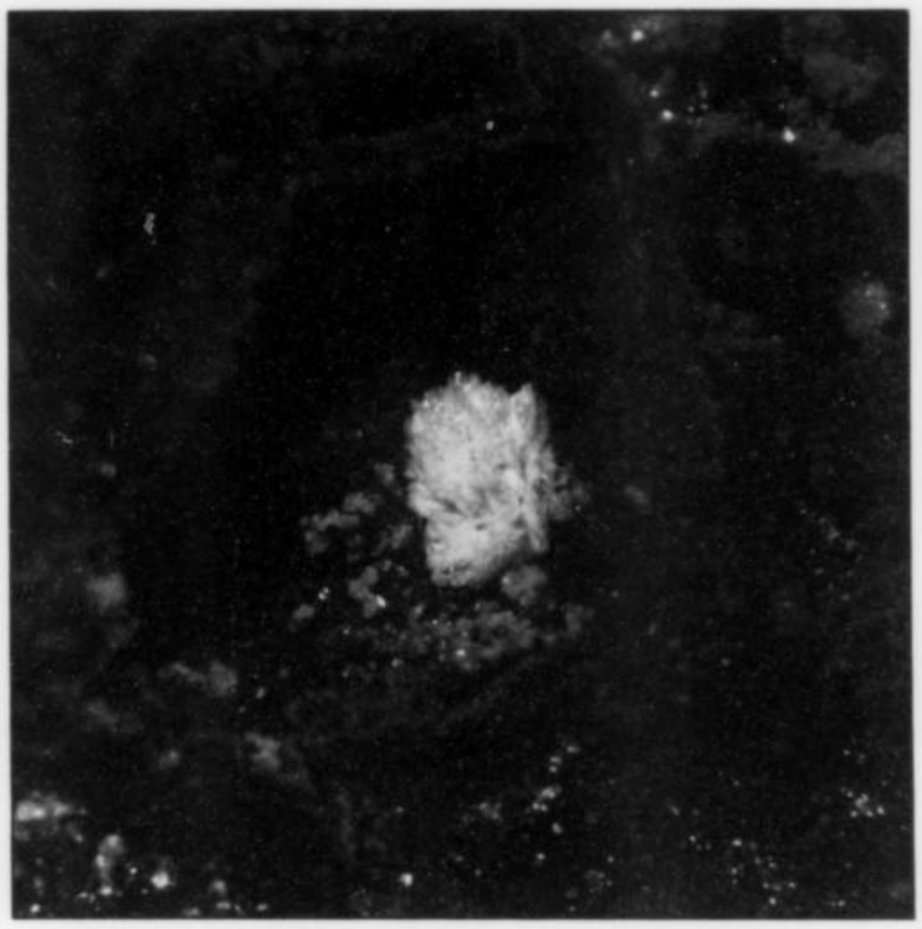

Figure 2. **Scorodite and beudantite in a 3-mm cavity lined by carminite, from Stavoren. Windisch specimen ST/5; Cairncross photo.**

Figure 5. **Bundles of extremely acicular crystals of olivenite to 2.2 mm, from Stavoren. Windisch specimen ST/82; Cairncross photo.**

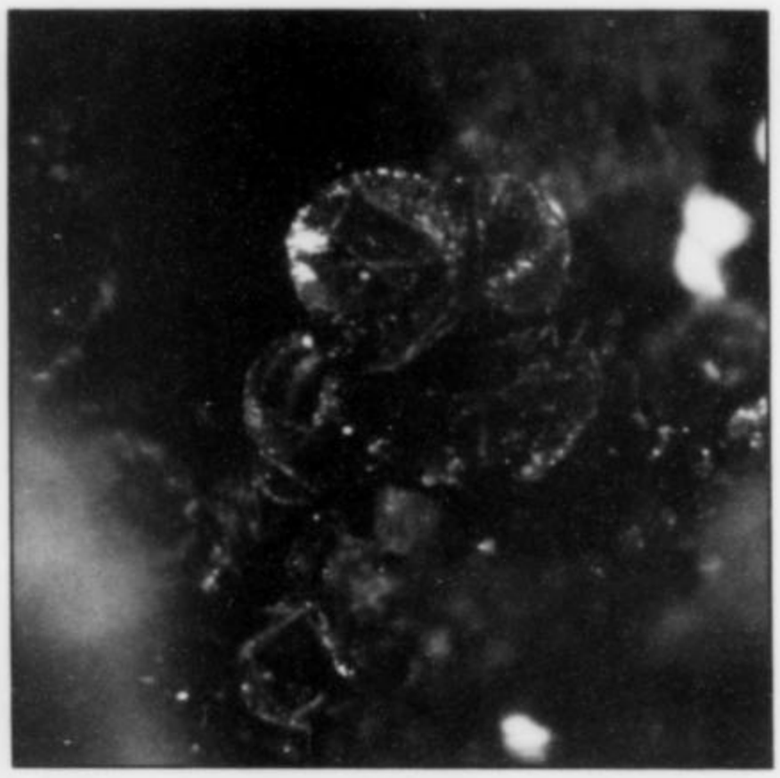

Figure 3. **Beudantite (olive-green platelets) and scorodite in a 2.5-mm cavity, from Stavoren. Windisch specimen ST/106; Cairncross photo.**

Figure 4. (below) **Microstalactite of scorodite in the front of a 5-mm cavity containing spherical aggregates of scorodite. Stavoren. Windisch specimen ST/109; Cairncross photo.**

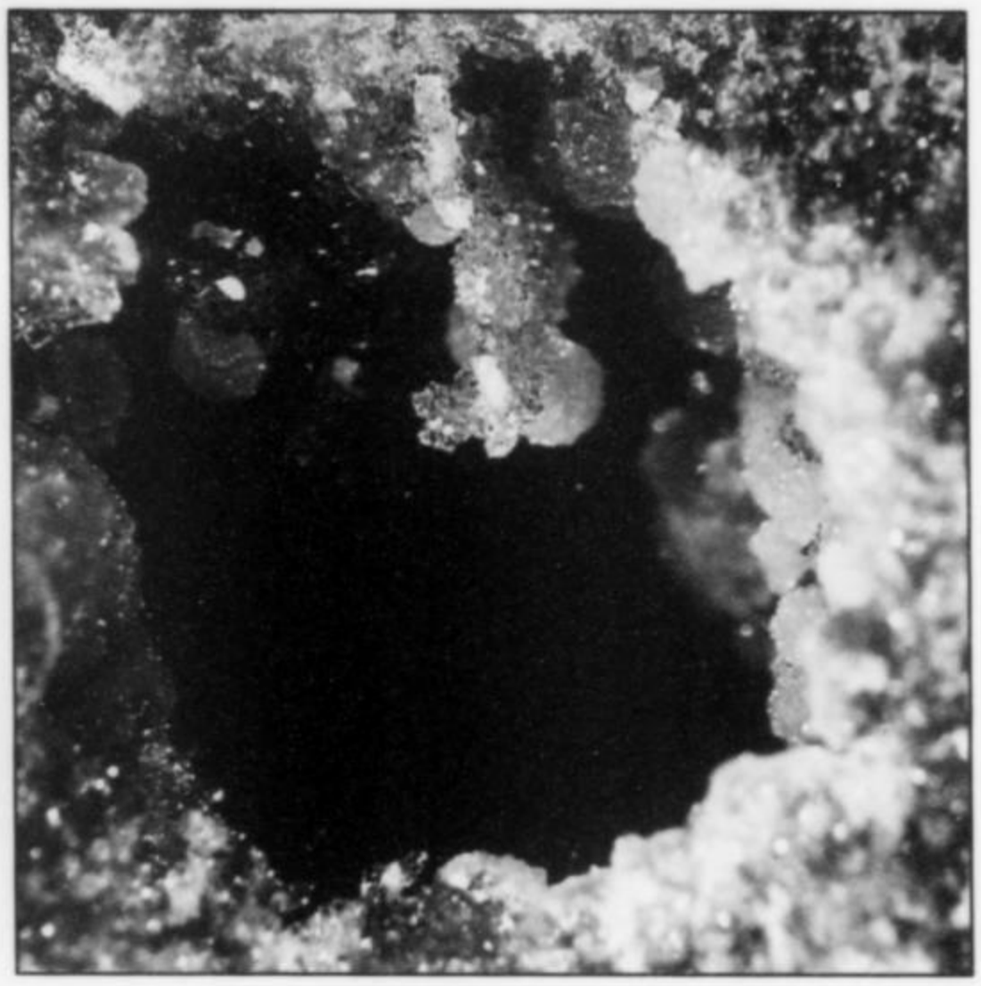

Figure 6. **Brochantite from Stavoren. Field of view is 2.5 mm. Windisch specimen ST/72; Cairncross photo.**

mines (e.g., Reeks, 1996). The microminerals featured here come from a cross-section of the Bushveld deposits—Stavoren and Argent are polymetallic hydrothermal deposits; the Marlin Norite quarry is self-explanatory; Vaalkop dam is located in the granites of the Complex, and the Highveld Steel sample is a slag mineral.

STAVOREN

The abandoned Stavoren tin workings are located 20 km north of Marble Hall in the Northern Province. Geologically, the deposit occurs in the Rashoop Granophyre Suite of the Bushveld Complex. The rock is composed of coarse-grained, intergrown quartz and potassium feldspar, with minor plagioclase feldspar and hornblende, the latter usually altered to chlorite and epidote (von Gruenewaldt, 1968). Stavoren was predominantly a tin mine, similar to some of the other tin deposits in the Bushveld Complex, but also contained tungsten, rare-earth-element minerals, lead, copper, fluorine, molybdenum and bismuth. In fact, scheelite was the second-most important ore mineral after cassiterite (Steyn,

Figure 7. **Prismatic, 1.8-mm crocoite crystal associated with pale green, hexagonal pyromorphite. Argent. Windisch specimen ARG/18; Cairncross photo.**

Figure 8. (below) **Twinned chalcopyrite crystal, 9 mm, surrounded by tabular hydroxyapophyllite, from the Marlin Norite quarry. Cairncross specimen and photo.**

Figure 9. (right) **Sprays of linarite on a matrix of slag material, from Argent. Field of view is 5.5 mm. Windisch specimen ARG/SL/8; Cairncross photo.**

Figure 11. **Julgoldite-(Fe^{2+}) from the Marlin Norite quarry, the first reported occurrence of this mineral from South Africa. Field of view is 2.8 mm. Windisch specimen JS/3; Cairncross photo.**

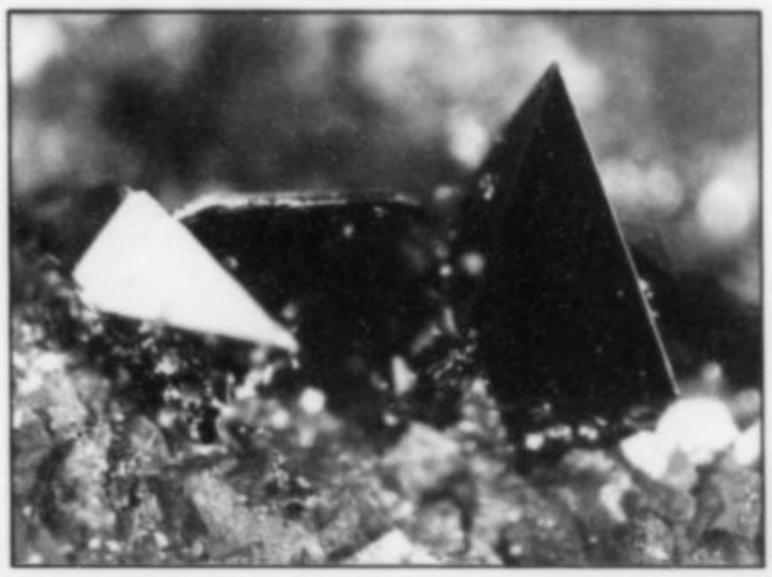

Figure 10. **Anatase on iron-stained calcite from Vaalkop Dam. Platy specularite hematite is also present. Field of view is 3.6 mm. Windisch specimen VK/79; Cairncross photo.**

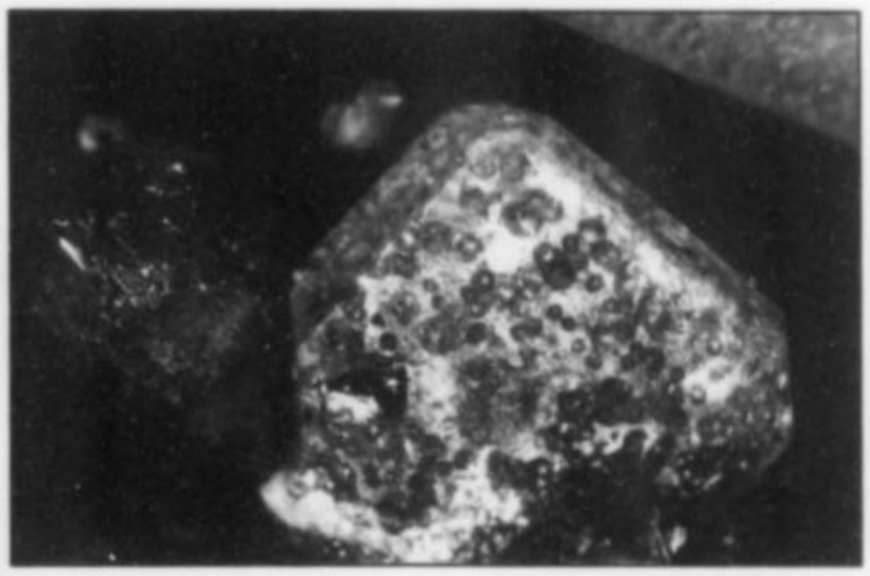

Figure 13. **Tabular, 4-mm hydroxyapophyllite crystal displaying unusual circular pit marks on the main crystal faces. Alongside is a quartz crystal stained red by inclusions of hematite and goethite, from the Marlin Norite quarry. Cairncross specimen and photo.**

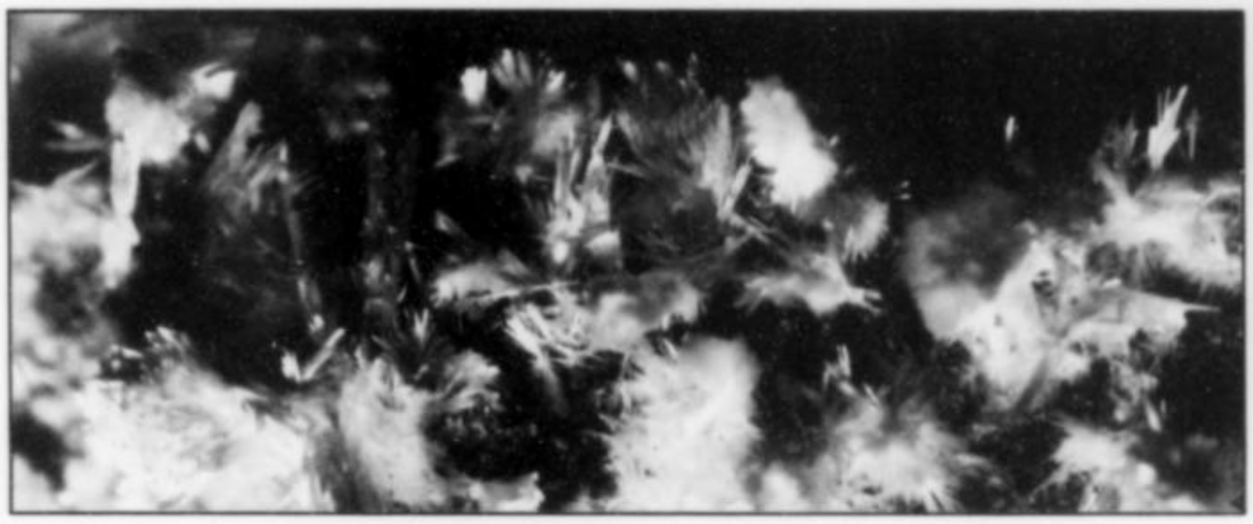

Figure 12. **Sprays of munirite crystals in a cavity from slag material from the Highveld Steel and Vanadium Corporation processing plant. Field of view is 7.2 mm. Windisch specimen M28/1; Cairncross photo.**

1962). Cairncross and Dixon (1995) list 57 reported species from the deposit.

A few of the most attractive micromineral species are those shown here. **Carminite, beudantite, scorodite** and **olivenite** have been collected off the old dumps. These four species are rare from South Africa, and Stavoren is the premier locality in South Africa for them. The site is still regularly visited by the members of the South African Micromount Society. Other species such as **azurite** and **brochantite** are also present.

Stavoren is the only locality in South Africa where **beaudantite** is found. The mineral occurs as single, 2–3 mm, yellow-green crystals and groups of crystals. The color and crystal habit resemble those of beaudantite specimens from Tsumeb, although the Stavoren crystals are smaller. The association with the other arsenates produces striking assemblages when viewed under the microscope.

Carminite is found as gemmy-red crystals up to 2 mm, associated with the other arsenates. It can be associated with scorodite, a relationship that is observed at other localities (for example, at Mapimi, Durango, Mexico). Carminite and beaudantite is also a well-known association from Tsumeb, Namibia.

Olivenite is the most common copper arsenate and many specimens have been collected from the Hillside quarry at Stavoren. Crystals are olive-green and occur as radiating sprays composed of acicular crystals {001}. Most are scattered in small cavities less than 1 cm diameter, but vugs up to 10 cm are known. It also forms fibrous, botryoidal crusts and hemispheres.

Although **scorodite** has been reported from the Kuils River tin deposits in the Western Cape Province and from the Bokseputs pegmatite in the Northern Cape Province, the specimens from Stavoren are the most well-known to South African micromounters and justifiably so. Crystals are either short prismatic or pyramidal and invariably occur in radiating groups. It was a common mineral in the oxide zone, and was presumed to have formed from the alteration of arsenopyrite; some crystals are perched on weathered arsenopyrite (Wagner, 1921). Scorodite was once found in such abundance that a plant was erected on-site to recover arsenious oxide.

The South African Micromount Society has an annual collecting trip to Stavoren. These have been held since the early 1980's; the specimens shown here were collected during one of six trips to the site. Surface material at the so-called Hillside site has diminished considerably over the years, but digging still produces excellent material.

ARGENT

Argent is arguably the most well-known micromount locality in South Africa. It is one of a series of lead-zinc-silver deposits formed by medium to low-temperature hydrothermal fluids associated with the Bushveld Complex. The name "Argent" refers to a small railway siding located about 100 km east of Johannesburg.

Several mineralized veins cut across gabbro, granophyres and felsites. The gangue minerals in the veins are quartz and siderite and the primary ore minerals were argentiferous galena, associated with zinc (sphalerite), copper (chalcopyrite) and minor antimony mineralization. Four mines extracted the ores, but only two, the Boschpoort mine and the Transvaal mine are of importance to collectors. Eighty-three minerals are recorded from this locality but the list of species steadily grows because a dedicated group of researchers, the "Argent Study Group," continues to discover new, unreported minerals from this prolific locality. The main area of collecting is in the old exploration trench that was dug to determine the strike direction of the orebody that cropped out on the farm Boschpoort. The best material comes from within the vein itself (which dips vertically). Some of the material that was excavated from the trench and dumped nearby is also a fruitful source of specimens. The slag dump covers several hectares and still contains an enormous amount of material.

Two of the most colorful Argent minerals, pictured here, are crocoite and linarite. **Crocoite** has been collected for many years from the dumps. Bright-orange, sometimes gemmy prisms up to 5 mm are found in cavities and on weathered quartzite and shale. Associated minerals include **pyromorphite** (shown here), **cerussite, vanadinite** and **goethite**.

Linarite was a species only rarely found with the primary ore. However, on slag material that was dumped on the site, linarite is relatively common, forming, as shown here, stellate groups of brilliant blue crystals.

MARLIN NORITE QUARRY

The Marlin Norite quarry is one of several quarries that extract Bushveld Complex gabbro, norite and gabbronorite for use by the construction industry and also by the tombstone market. Because the rock quarried has to be virtually blemish-free and must possess a very consistent color and texture, secondary minerals are very rarely found in Bushveld quarries. The exception is the Marlin Norite quarry, where minor faulting has, in places, disrupted the rock. Distinct, narrow bands (less than 15 cm wide) of white, leached rock extend vertically and cut across the norite. Very rarely, these veins widen out to form spherical, nodular-like cavities 30–40 cm in diameter. From these vugs and fissures associated with the veins, secondary minerals such as euhedral **chalcopyrite**, extremely tabular **hydroxyapophyllite, prehnite** and **quartz** have been collected. One of us (WW) noticed microscopic, unusual, dark-green, acicular crystals on one specimen. Enough material was present to send to the laboratories of the Council for Geoscience (Geological Survey) in Pretoria for quantitative analysis, and as a result the mineral has been positively identified as **julgoldite-(Fe^{2+})**, the first reported occurrence for this species in South Africa. Interestingly, the mineral is associated here with apophyllite, as at Långban, Sweden.

VAALKOP DAM

Vaalkop ("pale hill") Dam is situated approximately 90 km northwest of Pretoria. In order to prevent erosion by rain, the earth wall has been covered by a packed layer of Bushveld granite boulders, blasted and excavated from a quarry about 2 km from the dam. On the advice of a fellow micromounter, one of us (WW) visited the site. A Water Affairs Department official soon appeared and suspiciously asked what was going on. On being told that small crystals were being sought in the granite boulders, the official gave directions to the quarry from which the rock had been removed. All of the minerals described here came from a very small section of the quarry.

Several boulders of this granite were seen to have small miarolitic cavities, and pieces were collected, split at home and examined. Apart from attractive iron-stained rhombohedral **calcite**, silver platelets of **hematite**, and perfectly euhedral, tarnished cubic **pyrite** crystals, some of the best specimens of **anatase** from South Africa were discovered. In one specimen, the anatase is imbedded and attached to clear, hexagonal **quartz** crystals, producing the microscopic equivalent of the famous, macroscopic Norwegian specimens. The anatase is very dark blue to black and exhibits very sharp dipyramidal forms.

HIGHVELD STEEL AND VANADIUM CORPORATION

It is perhaps fitting that the final species featured here comes not from one of the geological formations of the Bushveld Complex, but from the smelter that processes some of the ore. The Highveld

Steel and Vanadium Corporation operates a large processing plant located on the periphery of the Bushveld Complex, west of Witbank. From the slag heaps, **munirite**, $NaV^{5+}O_3 \cdot (2-x)H_2O$, has been discovered, as a slag mineral. The crystals closely resemble those described from the type-locality in Pakistan. They occur as radiating, fibrous aggregates of pearly, cream-white crystals. So, apart from the beautiful, "primary" minerals, secondary species are being discovered from the residual processed ore.

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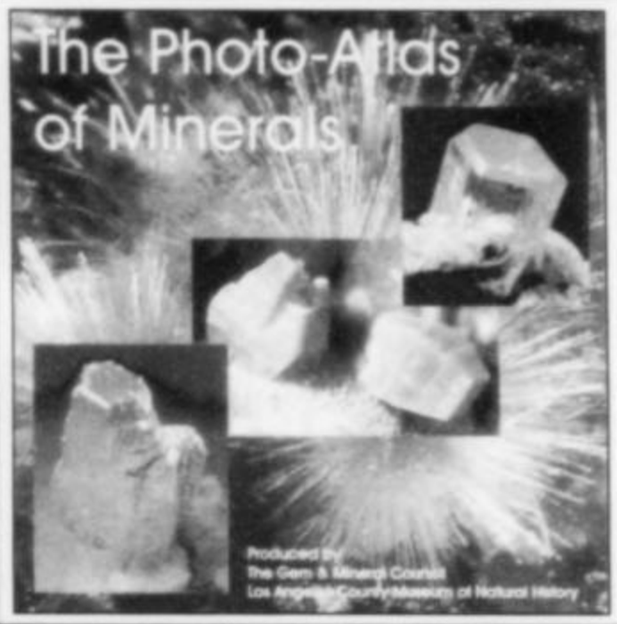

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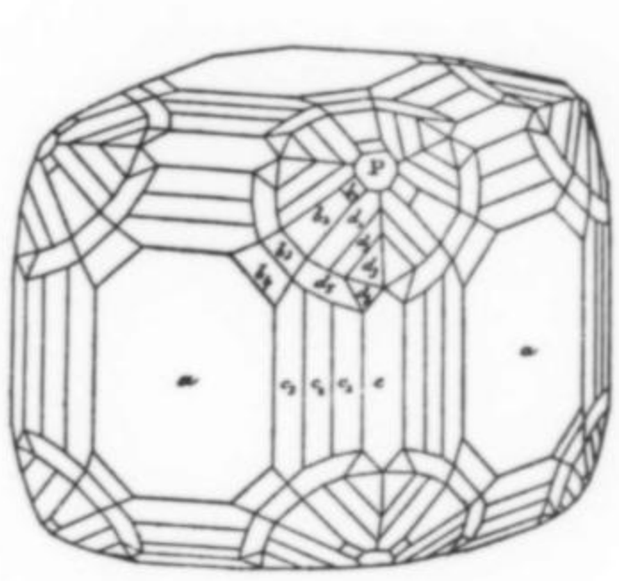

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Berezanskite

Hexagonal

$KLi_3Ti_2Si_{12}O_{30}$

Locality: Dara-i-Pioz glacial moraine, junction of Alaiskiy, Turkestanskiy, and Zeravshanskiy ridges of South Tien-Shan, Garm region, Tajikistan (Tadzhikistan).

Occurrence: From the late hydrothermal stages of a pegmatite. Associated minerals are: quartz, aegirine, microcline, cesium-kupletskite, hyalotekite, polylithionite, tadzhikite-(Y), dusmatovite, zektzerite, and stillwellite-(Ce).

General appearance: Granular aggregates (up to 3 x 2 mm) of individual crystals 0.05 to 0.6 mm.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* white. *Streak:* white. *Luminescence:* bluish-white in short wave ultraviolet radiation. *Hardness:* 2½ to 3. *Tenacity:* brittle. *Cleavage:* {001} perfect. *Fracture:* uneven. *Density:* 2.66 g/cm^3 (meas.), 2.67 g/cm^3 (calc.). ***Crystallography:*** Hexagonal, P6/mcc (?), a 9.903, c 14.276 Å, V 1212.4 Å^3, Z 2, c:a = 1.4416. Morphology: no forms were identified. Twinning: none mentioned. ***X-ray powder diffraction data:*** 7.15 (40), 4.29 (50), 4.07 (85), 3.57 (80), 3.16 (100), 2.895 (95), 2.742 (30). ***Optical data:*** Uniaxial (–), ω 1.635, ε 1.630, nonpleochroic. ***Chemical analytical data:*** Means of seven sets of electron microprobe data: Li_2O 4.50, Na_2O 0.18, K_2O 4.70, FeO 0.16, BaO 0.11, Al_2O_3 0.09, SiO_2 73.64, TiO_2 15.86, Nb_2O_5 0.56, Total 99.80 wt.%. Empirical formula: $(K_{0.98}Na_{0.06}Ba_{0.01})_{\Sigma 1.05}(Li_{2.95}Al_{0.02})_{\Sigma 2.97}(Ti_{1.94}Nb_{0.04}Fe_{0.02})_{\Sigma 2.00}Si_{11.99}O_{30.00}$. ***Relationship to other species:*** A member of the osumilite group; the titanium-dominant analogue of brannockite.

Name: For Anatolyi Vladimirovich Berezansky (1948–), Russian geologist who carried out geological mapping in the Central Asia part of the former Soviet Union. ***Comments:*** IMA No. 96-041. Dimitriy I. Belakovskiy of the Fersman Mineralogical Museum, Moscow, Russia, is gratefully acknowledged for his assistance in translating parts of the original paper.

PAUTOV, L. A., and AGAKHANOV, A. A. (1997) Berezanskite $KLi_3Ti_2Si_{12}O_{30}$—a new mineral. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(4)**, 75–80.

Changchengite

Cubic

IrBiS

Locality: At a branch of the Luanhe River, about 200 km NE of Beijing, Peoples's Republic of China.

Occurrence: In chromite orebodies in dunite and in placer deposits. Associated minerals are: iridium (given as "osmiridium"), ferrian platinum, "iridisite," laurite, sperrylite, cooperite, irarsite, shuangfengite, mayingite, chromite, and gold.

General appearance: Massive aggregates 0.02 to 0.2 mm and veinlets 0.1 to 0.2 mm wide and 1.0 mm long.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* steel black. *Streak:* black. *Hardness:* VHN_{20} 165 kg/mm^2, Mohs 3½. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* none. *Density:* could not be determined, 12.27 g/cm^3 (calc.) (see comments). ***Crystallography:*** Cubic, $P2_13$, a 6.164 Å, V 234.2 Å^3, Z 4. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 2.75 (70), 2.51 (60), 1.860 (100), 1.090 (50), 1.027 (50). ***Optical data:*** In reflected light: bright white with a yellowish tint, isotropic. R: (46.2 %) 470nm, (47.2 %) 550nm, (47.6 %) 590nm, (47.4 %) 650nm. ***Chemical analytical data:*** Means of seven sets of electron microprobe data: Cu 0.3, Ir 41.2, Pt 2.8, Bi 47.2, Te 0.4, S 7.2, Total 99.1 wt.%. Empirical formula: $(Ir_{0.94}Pt_{0.06}Cu_{0.02})_{\Sigma 1.02}Bi_{0.99}(S_{0.98}Te_{0.01})_{\Sigma 0.99}$. ***Relationship to other species:*** The tellurium-dominant analogue of mayingite, IrBiTe, but with a different space group.

Name: For the locality which is near the Great Wall (Changcheng in Chinese). ***Comments:*** IMA No. 95-047. The calculated density is given as 11.96 g/cm^3 in the paper.

YU, Z. (1997) Changchengite—a new iridium bismuthide-sulfide. *Acta Mineralogica Sinica* **71(4)**, 336–339.

Chromphyllite

Monoclinic

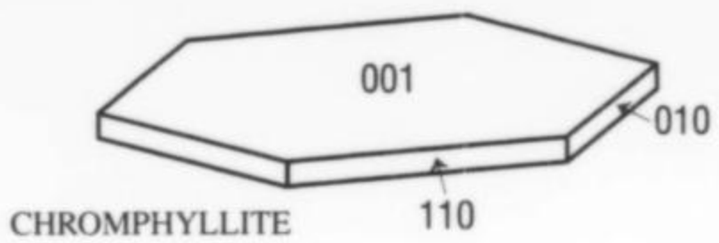
$KCr_2[AlSi_3O_{10}](OH,F)_2$

Locality: Near Pereval marble quarry, Slyudyanka, southern Lake Baikal region, Russia.

Occurrence: In chromium- and vanadium-bearing calcareous-siliceous sediments. Associated minerals are: calcite, plagioclase series, K-feldspar, diopside, tremolite, barite, "apatite," zircon, pyrite, chalcopyrite, pyrrhotite, malachite, muscovite, biotite-phlogopite, uvarovite, chromian dravite, chromite-zincochromite, eskolaite, rutile, titanite, and anatase.

General appearance: Pseudo-hexagonal platy crystals (0.3 to 0.4 mm).

Physical, chemical and crystallographic properties: *Luster:* vitre-



CHROMPHYLLITE

ous. *Diaphaneity:* transparent. *Color:* emerald green. *Streak:* light green. *Luminescence:* not mentioned. *Hardness:* VHN_{20-30} 129 kg/mm², Mohs about 3½. *Tenacity:* sectile. *Cleavage:* {001} perfect. *Fracture:* not given. *Density:* 2.88 g/cm³ (meas.), 3.04 g/cm³ (calc.). ***Crystallography:*** Monoclinic, C2/c, a 5.32, b 9.07, c 20.50 Å, β 95.6°, V 986 Å³, Z 4, a:b:c = 0.5865:1:2.2602. Morphology: forms, {001}, {110}, {010}. Twinning: none observed. ***X-ray powder diffraction data:*** 9.94 (6), 4.52 (8), 2.86 (5), 2.60 (10), 2.40 (6), 2.15 (6), 1.982 (5), 1.648 (5), 1.519 (10). ***Optical data:*** Biaxial (-), α 1.619, β 1.669, γ 1.673, 2V(meas.) 31°, 2V(calc.) 31°; dispersion r > v, strong to moderate; pleochroism distinct to strong, X = blue-green, Y = emerald green, Z = brownish-green; X ∧ c ≃ 6°, Y ≃ a, Z = b. ***Chemical analytical data:*** Means of twelve sets of electron microprobe data: Na_2O 0.27, K_2O 8.58, MgO 1.60, CaO 0.04, FeO 0.12, BaO 4.83, Al_2O_3 14.11, V_2O_3 2.08, Cr_2O_3 23.99, SiO_2 40.24, H_2O 3.32, F 1.28, sum 100.46, less O = F 0.54, Total 99.92 wt.% (given as 99.97 wt.%). Empirical formula: $(K_{0.82}Ba_{0.14}Na_{0.04})_{\Sigma 1.00}(Cr_{1.43}Al_{0.26}Mg_{0.18}V_{0.13})_{\Sigma 2.00}[Al_{1.01}Si_{3.03}O_{10.00}][(OH)_{1.66}F_{0.30}O_{0.04}]_{\Sigma 2.00}$. ***Relationship to other species:*** The chromium-dominant analogue of muscovite.

Name: For the composition and relationship to the mica group. ***Comments:*** IMA No. 95-052. The calculated density given by the authors is 2.86 g/cm³ which is considerably lower than the value of 3.04 g/cm³ calculated here from their data. The crystal drawing given here is based on the data given in the paper. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

REZNITSKY, L. Z., SKLYAROV, E. V., USHCHAPOVSKAYA, Z. F., NARTOVA, N. V., EVSYUNIN, V. G., KASHAEV, A. A., and SUVAROVA, L. F. (1997) Chromphyllite $KCr_2[AlSi_3O_{10}](OH,F)_2$—a new dioctahedral mica. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(2)**, 110–119.

Damiaoite

Cubic

$PtIn_2$

Locality: Near the village of Damiao and the Yixun River, about 270 km N of Beijing, Peoples's Republic of China.

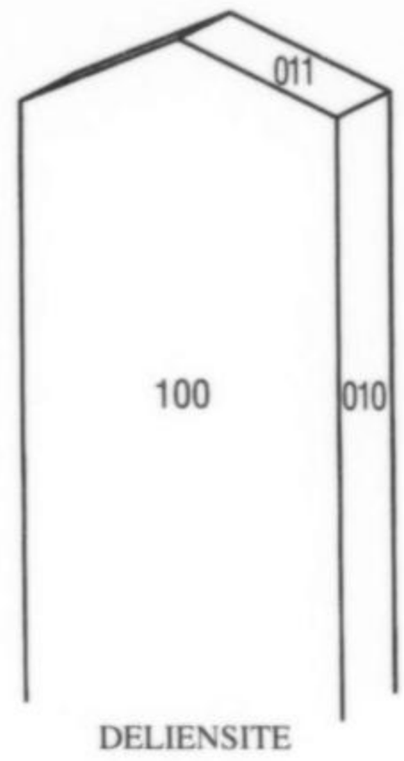
Occurrence: In a cobalt-copper-platinum bearing vein in garnet-amphibole pyroxenite. Associated minerals are: moncheite, sperrylite, cooperite, chalcopyrite, and yixunite.

General appearance: Globules 1.0 to 2.0 mm in diameter.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* bright white. *Streak:* black. *Hardness:* VHN_{50} 485 kg/mm², Mohs 5. *Tenacity:* not given. *Cleavage:* none. *Fracture:* not given. *Density:* could not be determined, 10.95 g/cm³ (calc.). ***Crystallography:*** Cubic, Fm3m, a 6.364 Å, V 257.75 Å³, Z 4. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 2.25 (100), 1.92 (60), 1.59 (60), 1.299 (80), 1.125 (60), 1.006 (70). ***Optical data:*** In reflected light: bright white with a yellowish tint, isotropic. R: (49.3 %) 470nm, (60.6 %) 550nm, (68.5 %) 590nm, (80.1 %) 650nm. ***Chemical analytical data:*** Means of nine sets of electron microprobe data: Pt 45.6, In 53.5, Total 99.1 wt.%. Empirical formula: $Pt_{1.00}In_{2.00}$. ***Relationship to other species:*** The natural analogue of $PtIn_2$.

Name: For the locality. ***Comments:*** IMA No. 95-041.

YU, Z. (1997) Damiaoite—a new native indium and platinum alloy. *Acta Mineralogica Sinica* **71(4)**, 328–331.



DELIENSITE

Deliensite

Orthorhombic

$Fe^{2+}(UO_2)_2(SO_4)_2(OH)_2 \cdot 3H_2O$

Locality: Mas D'Alary, Lodève, Hérault, France.

Occurrence: In the oxidation zone of a uranium deposit. Associated minerals are: uraninite, gypsum, and pyrite.

General appearance: Spherical aggregates (up to 4 mm in diameter) of crystals averaging 0.35 mm x 0.06 to 0.15 mm.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent to translucent. *Color:* pale yellow to greyish white. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* 2. *Tenacity:* weak. *Cleavage:* {100} perfect. *Fracture:* not given. *Density:* 3.268 g/cm³ (meas.), 3.29 g/cm³ (calc.). ***Crystallography:*** Orthorhombic, Pnnm or Pnn2, a 15.908, b 16.274, c 6.903 Å, V 1787 Å³, Z 4, a:b:c = 0.9775:1:0.4242. Morphology: forms, {100}, {010}, and {011}. Twinning: on {010}. ***X-ray powder diffraction data:*** 7.95 (81), 5.90 (100), 3.94 (71), 3.45 (67), 3.165 (50), 2.893 (41), 2.596 (70). ***Optical data:*** Biaxial (-), α 1.432(calc.), β 1.470, γ 1.492, 2V(meas.) 73°; dispersion r > v, weak; nonpleochroic; orientation, X = a, Y = b, Z = c. ***Chemical analytical data:*** Means of twenty sets of electron microprobe data: FeO 7.42, UO_3 67.63, SO_3 17.37, H_2O 8.63, Total 101.05 wt.%. Empirical formula: $Fe_{0.90}(UO_2)_{2.07}(SO_4)_{1.90}(OH)_{2.14} \cdot 3.12H_2O$. ***Relationship to other species:*** None apparent.

Name: For Dr. Michel Deliens (1939–), Royal Belgian Institute of Natural Sciences, Brussels, in recognition of his research on uranium-bearing minerals (25 new species). ***Comments:*** IMA No. 96-013. The calculated density given here is slightly different from that given by the authors.

VOCHTEN, R., BLATHON, N., and PEETERS, O. (1997) Deliensite, $Fe^{2+}(UO_2)_2(SO_4)_2(OH)_2 \cdot 3H_2O$, a new ferrous uranyl sulfate hydroxyl hydrate from Mas D'Alary, Lodève, Hérault, France. *Canadian Mineralogist* **35**, 1021–1025.

Ferroaluminoceladonite

Monoclinic

$K_2Fe^{2+}_2Al_2Si_8O_{20}(OH)_4$

Locality: Hokonui Hills, Southland, New Zealand (Grid reference E45 649657).

Occurrence: In an altered crystal-vitric tuff. Associated minerals are: ferroceladonite, heulandite, "chlorite," mixed-layer chlorite-berthierine, mixed-layer chlorite-corrensite, titanite, pyrite, quartz, albite, prehnite, siderite, plagioclase (ranging from "labradorite" to "oligoclase"), augite, magnetite, "hornblende," biotite, and glass.

General appearance: Submicrometer grains ranging in size from a few unit cells to 300 nanometers thick intergrown with ferroceladonite and other minerals.

Physical, chemical and crystallographic properties: *Luster:* earthy. *Diaphaneity:* translucent in thin section. *Color:* dark blue green (bright blue green in thin section). *Streak:* paler green. *Luminescence:* not mentioned. *Hardness:* estimated to be 2 to 2½ by analogy with other mica group minerals. *Tenacity:* not mentioned. *Cleavage:* {001} perfect. *Fracture:* earthy in aggregates. *Density:* could not be measured, 2.93 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, C2/m, a 5.270, b 9.106, c 10.125 Å, β 100.27°, V 478.1 Å^3, Z 1, a:b:c = 0.5787:1:1.1119. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 3.65 (52), 3.358 (86), 3.321 (100), 3.090 (60), 2.671 (48), 2.584 (50). ***Optical data:*** The fine grained nature of the material prevented full optical characterization. The aggregate index of refraction is 1.625; pleochroism X = pale green, Z = blue green; orientation, length slow, Z parallel to the cleavage. ***Chemical analytical data:*** Twelve analyses were carried out, but the data are not given. Instead, the numbers of atoms per formula unit are given and are represented by the subscripts in the empirical formula given here for the means of the twelve sets of data. Weight percentages of the constituents given in the empirical formula have been calculated here and are: K_2O 10.67, MgO 3.11, MnO 0.50, FeO 9.88, Al_2O_3 10.22, Fe_2O_3 4.54, SiO_2 56.42, TiO_2 0.38, H_2O 4.27, Total 100.02 wt.%. Empirical formula: $K_{1.91}(Fe^{2+}_{1.16}Mg_{0.65}Mn_{0.06})_{\Sigma 1.87}(Al_{1.61}Fe^{3+}_{0.48})_{\Sigma 2.09}(Si_{7.92}Al_{0.08})_{\Sigma 8.00}O_{20.00}(OH)_{4.00}$. ***Relationship to other species:*** It is the Fe^{3+}-dominant analogue of ferroceladonite.

Name: For the relationship to ferroceladonite. ***Comments:*** IMA No. 95-019. The value of Z is given erroneously as 2 in the paper. It should be noted that this mineral and the related mineral, ferroceladonite, are very finely intergrown and that some of the data given for these species are composite values. The mineral is the 1*M* polytype.

LI, G., PEACOR, D. R., COOMBS, D. S., and KAWACHI, Y. (1997) Solid solution in the celadonite family: The new minerals ferroceladonite, $K_2Fe^{2+}_2Fe^{3+}_2Si_8O_{20}(OH)_4$, and ferroaluminoceladonite, $K_2Fe^{2+}_2Al_2Si_8O_{20}(OH)_4$. *American Mineralogist* **82**, 503–511.

Ferroceladonite

Monoclinic

$K_2Fe^{2+}_2Fe^{3+}_2Si_8O_{20}(OH)_4$

Locality: Hokonui Hills, Southland, New Zealand (Grid reference E45 649657).

Occurrence: In an altered crystal-vitric tuff. Associated minerals are: ferroaluminoceladonite, heulandite, "chlorite," mixed-layer chlorite-berthierine, mixed-layer chlorite-corrensite, titanite, pyrite, quartz, albite, prehnite, siderite, plagioclase (ranging from "labradorite" to "oligoclase"), augite, magnetite, "hornblende," biotite, and glass.

General appearance: Submicrometer grains ranging in size from a few unit cells to 300 nanometers thick intergrown with ferroaluminoceladonite and other minerals.

Physical, chemical and crystallographic properties: *Luster:* earthy. *Diaphaneity:* translucent in thin section. *Color:* dark blue green (bright blue green in thin section). *Streak:* paler green. *Luminescence:* not mentioned. *Hardness:* estimated to be 2 to 2½ by analogy with other mica group minerals. *Tenacity:* not mentioned. *Cleavage:* {001} perfect. *Fracture:* earthy in aggregates. *Density:* could not be measured, 3.05 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, C2/m, a 5.270, b 9.106, c 10.125 Å, β 100.27°, V 478.1 Å^3, Z 1, a:b:c = 0.5787:1:1.1119. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 3.65 (52), 3.358 (86), 3.321 (100), 3.090 (60), 2.671 (48), 2.584 (50). ***Optical data:*** The fine grained nature of the material prevented full optical characterization. The aggregate index of refraction is 1.640; pleochroism X = pale green, Z = blue green; orientation, length slow, Z parallel to the cleavage. ***Chemical analytical data:*** Twelve analyses were carried out, but the data are not given. Instead, the numbers of atoms per formula unit are given and are represented by the subscripts in the empirical formula given here for the means of the twelve sets of data. Weight percentages of the constituents given in the empirical formula have been calculated here and are: K_2O 10.37, MgO 2.53, MnO 0.57, FeO 10.41, Al_2O_3 3.84, Fe_2O_3 13.57, SiO_2 54.26, TiO_2 0.36, H_2O 4.11, Total 100.02 wt.%. Empirical formula: $K_{1.93}(Fe^{2+}_{1.27}Mg_{0.55}Mn_{0.07})_{\Sigma 1.89}(Fe^{3+}_{1.49}Al_{0.58})_{\Sigma 2.07}(Si_{7.92}Al_{0.08})_{\Sigma 8.00}O_{20.00}(OH)_{4.00}$. ***Relationship to other species:*** It is the Fe^{2+}-dominant analogue of celadonite.

Name: For the relationship to celadonite. ***Comments:*** IMA No. 95-018. The value of Z is given erroneously as 2 in the paper. It should be noted that this mineral and the related mineral, ferroaluminoceladonite, are very finely intergrown and that some of the data given for these species are composite values. The mineral is the 1*M* polytype.

LI, G., PEACOR, D. R., COOMBS, D. S., and KAWACHI, Y. (1997) Solid solution in the celadonite family: The new minerals ferroceladonite, $K_2Fe^{2+}_2Fe^{3+}_2Si_8O_{20}(OH)_4$, and ferroaluminoceladonite, $K_2Fe^{2+}_2Al_2Si_8O_{20}(OH)_4$. *American Mineralogist* **82**, 503–511.

Fluorcaphite

Hexagonal

$Ca(Sr,Na,Ca)(Ca,Sr,Ce)_3(PO_4)_3F$

Locality: Mount Koashva, southeast part of the Khibina alkaline massif, Kola Peninsula, Russia.

Occurrence: In hyperagpaitic pegmatites. Associated minerals are: alkali amphibole, lamprophyllite, labuntsovite, sphalerite, galena, fluorite, graphite, belovite-(Ce), wadeite, sazykinaite-(Y), and deloneite-(Ce).

General appearance: Subhedral prismatic crystals (up to 5 mm) and in clusters.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* pale yellow. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* 5. *Tenacity:* brittle. *Cleavage:* not observed. *Fracture:* subconchoidal. *Density:* 3.60 g/cm^3 (meas.), 3.57 g/cm^3 (calc.). ***Crystallography:*** Hexagonal, $P6_3$, a 9.485, c 7.000 Å, V 545.4 Å^3, Z 2, c:a = 0.7380. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 3.498 (45), 3.218 (20), 3.104 (22), 2.838 (100), 2.814 (48), 2.740 (53), 2.278 (20), 1.963 (21), 1.865 (31). ***Optical data:*** Uniaxial (-), ω 1.649, ε 1.637, nonpleochroic. ***Chemical analytical data:*** Means of seven sets of electron microprobe data: Na_2O 1.74, CaO 30.46, SrO 20.78, BaO 0.03, La_2O_3 2.61, Ce_2O_3 4.78, Pr_2O_3 0.34, Nd_2O_3 1.48, Sm_2O_3 0.14, Y_2O_3 not detected, SiO_2 0.57, P_2O_5 36.23, H_2O 0.52, F 2.17, sum 101.85, less O = F 0.91, Total 100.94 wt.%. Empirical formula: $(Ca_{3.15}Sr_{1.16}Na_{0.33}Ce_{0.17}La_{0.09}$-

$Nd_{0.05}Pr_{0.01})_{\Sigma 4.96}(P_{2.96}Si_{0.06})_{\Sigma 3.02}[F_{0.66}(OH)_{0.34}]_{\Sigma 1.00}$. ***Relationship to other species:*** Structurally related to fluorapatite.

Name: For the chemical composition *fluor Ca ph*osphate. ***Comments:*** IMA No. 96-022. The space group of this mineral, $P6_3$, differs from that of fluorapatite which is $P6_3/m$. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

KHOMYAKOV, A. P., KULIKOVA, I. M., and RASTSVETAEVA, R. K. (1997) Fluorcaphite Ca(Sr,Na,Ca)(Ca,Sr,Ce)$_3$(PO$_4$)$_3$F—a new mineral with the apatite structural motif. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(3)**, 87–97.

Fluorthalénite-(Y)

Monoclinic

$Y_3Si_3O_{10}F$

Locality: Ploskaya Mountain, Kola Peninsula, Russia.

Occurrence: In pegmatites. Associated minerals are: microcline (var., amazonite), albite, quartz, yttrian fluorite, keiviite-(Y), kuliokite-(Y), xenotime-(Y), hingganite-(Y), and bastnäsite-(Ce).

General appearance: Euhedral inclusions in yttrian fluorite and equant crystals in fractures in yttrian fluorite aggregates. The inclusions and crystals range from 0.2 to 1.0 mm.

Physical, chemical and crystallographic properties: *Luster:* adamantine. *Diaphaneity:* translucent. *Color:* colorless to white. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* 4 to 5. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* uneven. *Density:* 4.24 g/cm^3 (meas.), 4.25 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, $P2_1/n$, a 7.321, b 11.133, c 10.375 Å, β 97.17°, V 839.0 Å^3, Z 4, a:b:c = 0.6576:1:0.9319. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 5.60 (5), 3.81 (5), 3.12 (10), 2.828 (8), 2.253 (8), 2.187 (4), 2.131 (4), 1.724 (4). ***Optical data:*** Biaxial (-), α 1.719, β 1.739, γ 1.748, 2V(meas.) 73°, 2V(calc.) 67°; dispersion r < v, medium; nonpleochroic; orientation not given. ***Chemical analytical data:*** Means of sixteen sets of electron microprobe data: CaO 0.33, Gd_2O_3 0.24, Dy_2O_3 1.77, Ho_2O_3 0.22, Er_2O_3 2.91, Tm_2O_3 0.26, Yb_2O_3 2.40, Lu_2O_3 0.19, Y_2O_3 55.06, SiO_2 34.55, F 3.76, sum 101.69, less O = F 1.58, Total 100.11 wt.%. Empirical formula: $(Y_{2.62}Er_{0.08}Yb_{0.07}Dy_{0.05}Ca_{0.03}Gd_{0.01}Tm_{0.01}Ho_{0.01}Lu_{0.01})_{\Sigma 2.89}Si_{3.09}O_{9.94}F_{1.06}$. ***Relationship to other species:*** It is the fluorine-dominant analogue of thalénite-(Y).

Name: For the relationship with thalénite-(Y). ***Comments:*** IMA No. 94-022. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper. Note that "thalenite-(Y)" and "fluorthalenite-(Y)" should be written with an acute "e"; i.e., thalénite-(Y) and fluorthalénite-(Y), respectively.

VOLOSHIN, A, V. and PAKHOMOVSKII, YA. A. (1997) Fluorthalenite-(Y)—a new mineral from Kola Peninsula amazonite pegmatites. *Doklady Akademia Nauk* **354(1)**, 77–78.

Georgeericksenite

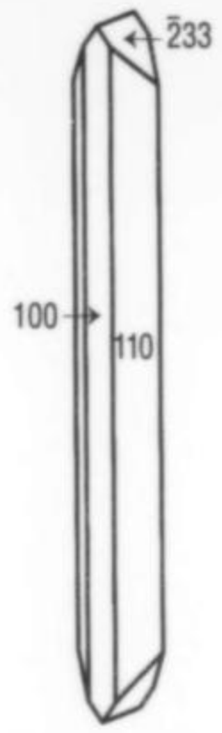
Monoclinic

$Na_6CaMg(IO_3)_6(CrO_4)_2 \cdot 12H_2O$

Locality: Oficina Chacabuco, Chile (Lat. 23°09′ S, Long. 69°37′ W).

Occurrence: Associated minerals are: halite, nitratine, niter, an undefined hydrated Ca-K-Ti-iodate-chromate-chloride, "plagioclase," and "clinopyroxene."

General appearance: As isolated and groups of micronodules (average size 0.2 mm) made up of randomly oriented crystals (average size 30 x 5 x 5 μm).



GEORGEERICKSENITE

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent to translucent. *Color:* pale yellow to bright lemon yellow. *Streak:* pale yellow. *Luminescence:* non-fluorescent. *Hardness:* 3 to 4, estimated. *Tenacity:* brittle. *Cleavage:* none observed. *Fracture:* unknown. *Density:* could not be determined, 3.22 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, C2/c, a 23.645, b 10.918, c 15.768 Å, β 114.42°, V 3707.3 Å^3, Z 4, a:b:c = 2.1657:1:1.4442. Morphology: forms, {100}, {110}, {$\bar{2}$33}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 10.69 (100), 6.36 (50), 5.65 (50), 3.590 (70), 3.121 (80), 3.051 (80). ***Optical data:*** Biaxial (+), α 1.647, β 1.674, γ 1.704, 2V could not be determined, 2V(calc.) 88.4°; dispersion not given; pleochroism slight, X = very pale yellow, Z = distinct yellow-green; Z ≈ c. ***Chemical analytical data:*** Satisfactory data could not be obtained by electron microprobe analysis because the mineral reacted with the electron beam. The ideal formula derived from the crystal structure analysis requires: Na_2O 10.98, MgO 2.38, CaO 3.31, SO_3 1.51, CrO_3 9.92, I_2O_5 59.13, H_2O 12.77, Total 100.00 wt.%. Empirical formula: $Na_{6.00}Ca_{1.00}Mg_{1.00}(IO_3)_{6.00}[(Cr_{0.84}S_{0.16})O_{4.00}]_{2.00}(H_2O)_{12.00}$. ***Relationship to other species:*** None apparent.

Name: For George E. Ericksen (1920–1996), a noted research economic geologist with the United States Geological Survey for fifty years. ***Comments:*** IMA No. 96-049. The crystal drawing in the paper is not in the standard orientation; it has been redrawn in the standard orientation for this abstract.

COOPER, M. A., HAWTHORNE, F. C., ROBERTS, A. C., GRICE, J. D., STIRLING, J. A. R., and MOFFATT, E. A. (1998) Georgeericksenite, $Na_6CaMg(IO_3)_6(CrO_4)_2(H_2O)_{12}$, a new mineral from Oficina Chacabuco, Chile: Description and crystal structure. *American Mineralogist* **83**, 390–399.

Grattarolaite

Hexagonal (trigonal)

$Fe^{3+}_3PO_7$

Locality: The Castelnuovo mine, Santa Barbara lignite area, Upper Arno River Valley, 30 km southeast of Florence, Italy.

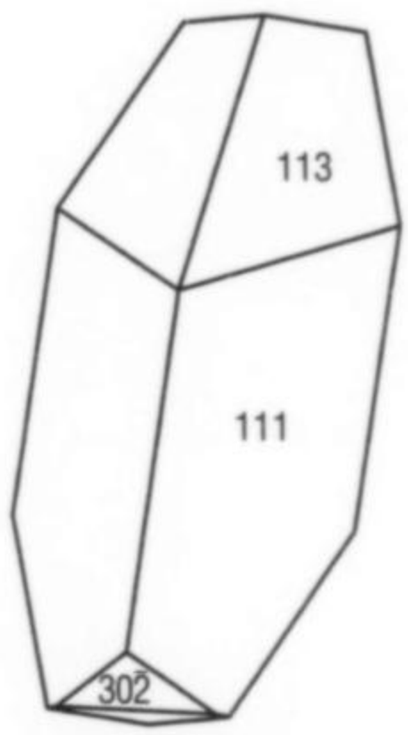
Occurrence: As nodules about 1 cm in diameter with cavities lined with aggregates up to 1 mm long. Associated minerals are rodolicoite and heterosite.

General appearance: Grattarolaite and rodolicoite occur as fine intergrowths of irregularly shaped crystallites less than 1000 Å.

Physical, chemical and crystallographic properties: *Luster:* greasy. *Diaphaneity:* opaque. *Color:* reddish-brown. *Streak:* brown. *Luminescence:* non-fluorescent. *Hardness:* could not be determined. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* not given. *Density:* could not be determined, 4.07 g/cm^3 (calc.). ***Crystallography:*** Hexagonal (trigonal), R3m, a 7.994, c 6.855 Å, V 379.4 Å^3, Z 3, c:a = 0.8575. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 3.08 (100), 2.437 (20), 2.077 (30), 1.622 (20), 1.437 (20). ***Optical data:*** Because of the very small size of the crystallites, no optical data could be determined. ***Chemical analytical data:*** Analytical data were obtained by transmission electron microscopy which gave: Fe_2O_3 76.91, P_2O_5 23.09, Total 100.00 wt.%. Empirical formula: $Fe^{3+}_{2.99}P_{1.01}O_{7.00}$. ***Relationship to other species:*** None apparent.

Name: For Giuseppe Grattarola (1905–1988), professor of mineralogy at the University of Florence. ***Comments:*** IMA No. 95-037. The nodules consist of 80 to 85% rodolicoite.

CIPRIANI, C., MELLINI, M., PRATESI, G., and VITI, C. (1997) Rodolicoite and grattarolaite, two new phosphate minerals from Santa Barbara Mine, Italy. *European Journal of Mineralogy* **9**, 1101–1106.



HECHTSBERGITE

Hechtsbergite

Monoclinic

$Bi_2O(OH)(VO_4)$

Locality: The Hechtsberg quarry near Hausach, Black Forest, Germany.

Occurrence: In cavities in gneiss. Associated minerals are: chrysocolla, bismutite, beyerite, namibite, mixite, eulytite, wittichenite, and tennantite.

General appearance: Euhedral crystals and aggregates (up to 0.2 mm).

Physical, chemical and crystallographic properties: *Luster:* adamantine. *Diaphaneity:* transparent to translucent. *Color:* brown. *Streak:* yellow. *Luminescence:* non-fluorescent. *Hardness:* VHN$_{15}$ 320 kg/mm^2, Mohs 4½. *Tenacity:* not mentioned. *Cleavage:* none observed. *Fracture:* conchoidal. *Density:* could not be determined, 6.96 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, P2$_1$/c, a 6.971, b 7.535, c 10.881 Å, β 107.00°, V 546.6 Å^3, Z 4, a:b:c = 0.9251:1:1.4441. Morphology: forms, {111} is dominant, also {112}, {113}, {10$\bar{1}$}, {10$\bar{2}$}, {30$\bar{2}$}. Twinning: none observed. ***X-ray powder diffraction data:*** 4.271 (41), 3.267 (100+), 3.150 (63), 2.734 (35), 2.549 (27), 2.133 (27), 2.036 (29). ***Optical data:*** Biaxial (+), α 2.26, β 2.27(calc.), γ 2.30, 2V(meas.) 50°; no distinct dispersion was observed; no pleochroism was observed; X = b, Z ∧ c ~ 35° (in obtuse angle β). ***Chemical analytical data:*** Means of twenty-two sets of electron microprobe data: Bi_2O_3 83.02, V_2O_5 15.18, As_2O_5 0.52, H_2O (1.59), Total (100.31) wt.%. The water content was calculated to give 6 oxygen atoms. Empirical formula: $Bi_{2.03}O_{1.07}(OH)_{1.01}(VO_4)_{0.95}(AsO_4)_{0.03}$. ***Relationship to other species:*** It is the vanadium-dominant analogue of atelestite and, probably, smrkovecite.

Name: For the locality. ***Comments:*** IMA No. 95-050. The calculated density is given in the paper as 6.87 g/cm^3 which is slightly lower than the value of 6.96 g/cm^3 calculated here. The value of one of the unit cell parameters (a) given in the paper's abstract is a typographic error (6.791 instead of 6.971 Å). Dr. Krause kindly made available the necessary data to produce the crystal drawing for this abstract.

KRAUSE, W., BERNHARDT, H.-J., BLAß, G. EFFENBERGER, H., and GRAF, H.-W. (1997) Hechtsbergite, $Bi_2O(OH)(VO_4)$, a new mineral from the Black Forest, Germany. *Neues Jahrbuch für Mineralogie, Monatshefte* **1997**, 271–287.

Hiärneite

Tetragonal

$(Ca,Mn^{2+},Na)_2(Zr,Mn^{3+})_5(Sb^{5+},Ti,Fe^{3+})_2O_{16}$

Locality: The Långban iron-manganese deposit, Långban, Filipstad district, Värmland, Sweden.

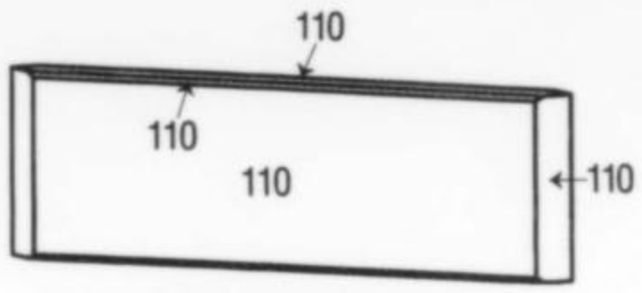
Occurrence: In a skarn assemblage. Associated minerals are: phlogopite, calcite, arsenatian fluorapatite, svabite, jacobsite, magnetoplumbite, titanian bindheimite, and pyrophanite.

General appearance: Single subhedral crystals of short prismatic habit (up to 200 µm long) and aggregates up 0.5 mm wide.

Physical, chemical and crystallographic properties: *Luster:* not stated, but presumably adamantine. *Diaphaneity:* translucent. *Color:* red. *Streak:* orange. *Hardness:* VHN$_{50}$ 1254 kg/mm^2, Mohs 7. *Tenacity:* brittle. *Cleavage:* not given. *Fracture:* not given. *Density:* could not be measured, 5.44 g/cm^3 (calc.). ***Crystallography:*** Tetragonal, I4$_1$/acd, a 15.265, c 10.102 Å, V 2354 Å^3, Z 8, c:a = 0.6618. Morphology: forms, none observed. Twinning: none observed. ***X-ray powder diffraction data:*** 3.45 (40), 3.38 (30), 2.92 (100), 2.539 (60), 2.168 (30), 1.792 (90), 1.534 (80), 1.520 (30), 1.2726 (30), 1.1636 (30). ***Optical data:*** Uniaxial (+), ω 2.12, ε′ 2.16, pleochroism weak in orange and yellow-orange. In reflected light: colorless to grey, weak anisotropism, bireflectance not mentioned, R_O & R_E: (13.1, 14.0 %) 460nm, (12.8, 13.5 %) 540nm, (12.8, 13.5 %) 580nm, (12.8, 13.4 %) 640nm. ***Chemical analytical data:*** Means of eight sets of electron microprobe data: Na_2O 0.54, MgO 0.09, CaO 9.11, MnO 4.51, Mn_2O_3 2.97, Fe_2O_3 0.75, TiO_2 4.88, ZrO_2 53.47, HfO_2 0.5, Sb_2O_5 22.94, Total 99.76 wt.%. Empirical formula: $(Ca_{1.57}Mn^{2+}_{0.61}Na_{0.17}Mg_{0.02})_{\Sigma 2.37}(Zr_{4.19}Mn^{3+}_{0.36}Hf_{0.02})_{\Sigma 4.57}(Sb_{1.37}Ti_{0.59}Fe^{3+}_{0.09})_{\Sigma 2.05}O_{16.00}$. ***Relationship to other species:*** It is the antimony-dominant analogue of calzirtite.

Name: For Urban Hiärne (1641–1724) a universal scholar and a pioneer in Swedish geology. The name is pronounced *year-neite*. ***Comments:*** IMA No. 96-040. Some of the physical properties given here are taken from the original proposal.

HOLTSTAM, D. (1997) Hiärneite, a new, Zr-Sb oxide mineral isostructural with calzirtite, from Långban, Sweden. *European Journal of Mineralogy* **9**, 843–848.

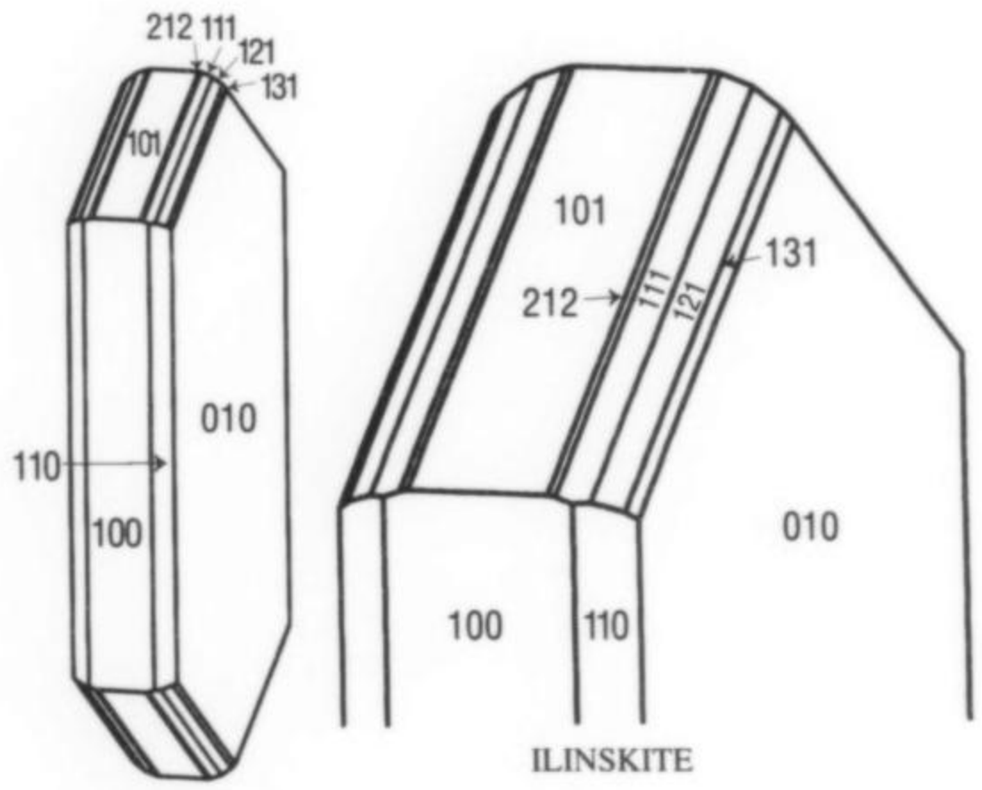


HORVÁTHITE-(Y)

Horváthite-(Y)

Addendum

The abstract of the description of horváthite-(Y) was published in the May–June, 1998 issue of this journal. At that time, not enough information on the morphology of horváthite-(Y) crystals was known to draw a crystal. Recently, Mr. László Horváth of Hudson, Quebec, kindly sent me information on his observations of the mineral. This and the data given in the original paper enabled the drawing given here to be produced. I am pleased to acknowledge the assistance of Mr. Horváth.



ILINSKITE

ILINSKITE

Ilinskite

Orthorhombic

$NaCu_5O_2(SeO_3)_2Cl_3$

Locality: On the South and North breaks of the Tolbachik Main Fracture eruption, Kamchatka, Russia.

Occurrence: From fumarolic exhalations. Associated minerals are: halite, moissanite, aluminium, $Cu_5O_2(SeO_3)_2Cl_2$ (IMA No. 96-015), gold, sofiite, cotunnite, tolbachite, melanothallite, chalcocyanite, and some unidentified species.

General appearance: Euhedral crystals, flattened on {010} and elongated on [001] (up to 0.35 mm long and 0.05 mm thick).

Physical, chemical and crystallographic properties: *Luster:* given as vitreous, but the indices of refraction indicate adamantine. *Diaphaneity:* transparent. *Color:* emerald green. *Streak:* light green. *Luminescence:* non-fluorescent. *Hardness:* $VHN_{1.5}$ 10 kg/mm^2. *Tenacity:* very brittle. *Cleavage:* {100} perfect. *Fracture:* not mentioned. *Density:* could not be measured, 4.08 g/cm^3 (calc.). ***Crystallography:*** Orthorhombic, Pbnm, a 10.482, b 17.732, c 6.432 Å, V 1195.6 Å^3, Z 4, a:b:c = 0.5911:1:0.3627. Morphology: forms, {010}, {100}, {110}, {170}, {140}, {130}, {250}, {120}, {450}, {210}, {310}, {101}, {111}, {121}, {131}, {141}, {021}, {212}, {221}. Twinning: none observed. ***X-ray powder diffraction data:*** 9.01 (10), 8.84 (60), 5.24 (100), 3.251 (40), 2.955 (27), 2.626 (25), 2.513 (12). ***Optical data:*** Biaxial (-), α 1.845, β 1.965, γ 1.975, 2V(meas.) 20°, 2V(calc.) 31°; dispersion not observed; pleochroism X = green, Y = yellowish, Z = green; orientation, X = a, Y = c, Z = b. ***Chemical analytical data:*** Means of nine sets of electron microprobe data: Na_2O 3.76, K_2O 0.94, CuO 53.54, SeO_2 31.27, Cl 13.93, sum 103.44, less O = Cl 3.15, Total 100.29 wt.%. Empirical formula: $(Na_{0.89}K_{0.15})_{\Sigma 1.04}Cu_{4.92}O_{1.95}(SeO_3)_{2.06}Cl_{2.87}$. ***Relationship to other species:*** None apparent.

Name: For G. A. Ilinskiy (1927–1996), St. Petersburg University. ***Comments:*** IMA No. 96-027. Details of the crystal structure are given in the paper. For simplicity, only the eight most well-developed forms are shown on the crystal drawing produced for this abstract. Because of the crowding of some of the {hkl} forms in the drawing, an enlarged drawing of the top of the crystal is shown and indexed also. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

VERGASOVA, L. P., SEMENOVA, T. F., SHUVALOV, R. R., FILATOV, S. K., and ANANYEV, V. V. (1997) Ilinskite $NaCu_5O_2(SeO_3)_2Cl_3$ a new mineral from volcanic exhalations. *Doklady Akademia Nauk* **353(5)**, 641–644.

Jedwabite

Hexagonal

$Fe_7(Ta,Nb)_3$

Locality: Nijniy-Tagil, near Solovjeva mountain (former Aurorinsky mine) (Lat. 59°52′ N, Long. 59°45′ E) and Baranchinsky massif near the Aktai River (former Baranchinsky mine (Lat. 59°39′ N, Long. 60°07′ E), Middle Urals, Russia.

Occurrence: In placer deposits. Associated minerals are: tantal-carbide and niobocarbide.

General appearance: Irregular polymineralic grains (up to 0.15 mm).

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* greyish-yellow. *Streak:* not given. *Hardness:* VHN_{50} 1050 kg/mm^2. *Tenacity:* brittle. *Cleavage:* not observed. *Fracture:* not observed. *Density:* could not be measured, 8.60 g/cm^3 (calc.). ***Crystallography:*** Hexagonal, $P6_3mmc$, $P6_3mc$, or P62c, a 4.81, c 7.87 Å, V 157 Å^3, Z 1, c:a = 1.6362. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 2.19 (7), 2.05 (10), 2.01 (6), 1.347 (8), 1.314 (4), 1.059 (5). ***Optical data:*** In reflected light: greyish white, negligible anisotropism and bireflectance, nonpleochroic. R: (55.4 %) 460nm, (60.8 %) 540nm, (62.4 %) 580nm, (62.4 %) 650nm. ***Chemical analytical data:*** Means of eleven sets of electron microprobe data: Ta 35.33, Nb 13.05, Fe 44.40, Mn 0.60, Sn 2.06, W 3.07, Si 1.54, Total 100.05 wt.%. Empirical formula: $(Fe_{6.46}Si_{0.44}Mn_{0.09})_{\Sigma 6.99}$-$(Ta_{1.59}Nb_{1.14}Sn_{0.14}W_{0.14})_{\Sigma 3.01}$. ***Relationship to other species:*** None apparent.

Name: For Jacques Jedwab, Professor of Mineralogy, Université Libre de Bruxelles, Brussels, Belgium. ***Comments:*** IMA No. 95-043. The calculated density given in the paper (8.91 g/cm^3) is significantly different from the value calculated here (8.60 g/cm^3). The name "jedvabite" given in the title of the paper is an error. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

NOVGORODOVA, M. I., GENERALOV, M. E., and TRUBKIN, N. V. (1997) Jedvabite (sic) $Fe_7(Ta,Nb)_3$—a new mineral in paragenesis with tantal- and niobocarbides from Pt-bearing placers. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(2)**, 100–104.

Juonniite — Orthorhombic

$CaMgSc(PO_4)_2(OH)\cdot 4H_2O$

Locality: Kovdor ultramafic alkaline complex, Kola Peninsula, Russia.

Occurrence: In calcite-dolomitic carbonatite veins. Associated minerals are: dolomite, magnesite, bobierrite, kovdorskite, manasseite, hydrotalcite, pyrite, strontian collinsite, rimkorolgite, and talc.

General appearance: Spherulites (up to 0.8 mm) composed of individual platy to elongated crystals 10 x 2 μm.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* greyish, brown to bright orange. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* VHN_{20} 330 kg/mm², Mohs 4 to 4½. *Tenacity:* brittle. *Cleavage:* none observed. *Fracture:* uneven. *Density:* 2.43 g/cm³ (meas.), 2.40 g/cm³ (calc.). ***Crystallography:*** Orthorhombic, Pbca, a 15.03, b 18.95, c 7.59 Å, V 2162 Å³, Z 8, a:b:c = 0.7931:1:0.4005. Morphology: no forms were identified. Twinning: none observed. ***X-ray powder diffraction data:*** 9.49 (100), 4.75 (17), 3.440 (31), 2.942 (27), 2.912 (44), 2.890 (35), 2.018 (15). ***Optical data:*** Biaxial (–), α 1.574, β 1.579, γ 1.582, 2V(meas.) 70.2°, 2V(calc.) 75°; dispersion not given; nonpleochroic; orientation not given. ***Chemical analytical data:*** Means of nine sets of electron microprobe data: MgO 12.08, CaO 12.33, MnO 1.28, FeO 1.07, SrO 0.53, BaO 1.58, Sc_2O_3 13.17, TiO_2 0.39, P_2O_5 36.16, H_2O (21.41), Total (100.00) wt.%. Water calculated by difference from 100.00 wt.%. Empirical formula: $(Ca_{0.86}Mn_{0.07}Ba_{0.04}Sr_{0.02})_{\Sigma 0.99}Mg_{1.00}(Sc_{0.75}Mg_{0.17}Fe_{0.06}Ti_{0.02})_{\Sigma 1.00}(PO_4)_{1.99}\cdot(OH)_{0.80}\cdot 4.24H_2O$. ***Relationship to other species:*** The scandium-dominant analogue of segelerite and overite.

Name: For the Juonni river near the locality. ***Comments:*** IMA No. 96-060.

LIFEROVICH, R. P., YAKOVENCHUK, V. N., PAKHOMOVSKY, Ya. A., BOGDANOVA, A. N., and BRITVIN, S. N. (1997) Juonniite, a new mineral of scandium from dolomitic carbonatites of the Kovdor massif. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(4)**, 80–88.

Koragoite — Monoclinic

$(Mn,Fe)_3(Nb,Ta,Ti)_3(Nb,Mn)_2(W,Ta)_2O_{20}$

Locality: The Khorog region, south-east Pamir, Tadzhikistan.

Occurrence: In granitic pegmatites. Associated minerals are: zircon, stibiocolumbite, pyrochlore, columbite, and ixiolite.

General appearance: Thin, platy crystals 1 to 3 mm long and 0.1 to 0.3 mm thick.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* red to brown-red. *Streak:* greyish-brown. *Hardness:* VHN_{40} 550 kg/mm², Mohs 4 to 5. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* uneven. *Density:* 4.70 g/cm³ (meas.), 6.22 g/cm³ (calc.). ***Crystallography:*** Monoclinic, $P2_1$, a 24.73, b 5.056, c 5.760 Å, β 103.50°, V 700.5 Å³, Z 2, a:b:c = 4.8912:1:1.1392. Morphology: forms, none mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 6.0 (5), 3.74 (8), 3.69 (8), 2.98 (10), 1.783 (5), 1.744 (6), 1.732 (7), 1.456 (5). ***Optical data:*** In reflected light: light grey, weak anisotropism, weak bireflectance, nonpleochroic. $R_{max.}$ & $R_{min.}$: (19.2, 18.0 %) 470nm, (18.5, 17.5 %) 546nm, (19.3, 18.5 %) 589nm, (16.5, 16.0 %) 650nm. ***Chemical analytical data:*** Means of three sets of electron microprobe data: MnO 19.97, FeO 0.69, TiO_2 0.49, Nb_2O_5 36.84, Ta_2O_5 9.46, WO_3 32.16, Total 99.61 wt.%. Empirical formula: $(Mn_{2.87}Fe_{0.13})_{\Sigma 3.00}(Nb_{2.53}Ta_{0.39}Ti_{0.08})_{\Sigma 3.00}(Nb_{1.12}Mn_{0.84})_{\Sigma 1.96}(W_{1.83}Ta_{0.17})_{\Sigma 2.00}O_{20.00}$. ***Relationship to other species:*** None apparent.

Name: For A. A. Korago (1942–1993), Russian geologist. ***Comments:*** IMA No. 94-049. The calculated density indicates that the measured density probably is incorrect. Note that the crystal structure has been determined. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

VOLOSHIN, A. V., PAKOMOVSKII, Ya. A., BAKHCHSARAITSEV, A. Yu., PUSHCHAROVSKY, D. Yu., and YAMNOVA, N. A. (1997) Koragoite—a new mineral in granitic pegmatites in south-east Pamir, Tadzhikistan. *Doklady Akademia Nauk* **353(4)**, 516–518. YAMNOVA, N. A., PUSHCHAROVSKY, D. Yu., and VOLOSHIN, A. V. (1995). Crystal structure of a new natural Mn, W-tantaloniobate. *Kristallografiya* **40(3)**, 469–475.

Kuzelite — Hexagonal (trigonal)

$Ca_4Al_2(OH)_{12}(SO_4)\cdot 6H_2O$

Locality: The Zeilberg quarry, Marolsweisach, northern Bavaria, Germany.

Occurrence: In carbonaceous xenoliths in a Tertiary basalt. Associated minerals are: ettringite, afwillite, natrolite, calcite, tobermorite, gyrolite, portlandite, and "apophyllite."

General appearance: Small (up to 10 μm) platy crystals of hexagonal shape.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* white. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* 1 to 2. *Tenacity:* not given. *Cleavage:* {001}excellent. *Fracture:* uneven. *Density:* 1.99 g/cm³ (meas.), 2.02 g/cm³ (calc.). ***Crystallography:*** Hexagonal (trigonal), $R\bar{3}$ or R3, a 5.76, c 53.66 Å, V 1541 Å³, Z 3, c:a = 9.3160. Morphology: no forms given, but {001} probably is present. Twinning: none mentioned. ***X-ray powder diffraction data:*** 8.972 (100), 4.476 (70), 2.362 (40), 2.190 (40), 2.071 (35). ***Optical data:*** Uniaxial (-), ω 1.504, ε 1.485, nonpleochroic. ***Chemical analytical data:*** Wet chemical and electron microprobe analyses gave the following data: Na_2O 0.0, CaO 34.5, Al_2O_3 19.6, SO_3 12.9, H_2O 33.45, Total 100.45 wt.%. Water by thermogravimetric analysis. Empirical formula: $Ca_{3.83}Al_{2.40}(SO_4)_{1.00}(OH)_{12.86}\cdot 5.14H_2O$. ***Relationship to other species:*** Related to hydrocalumite.

Name: For Prof. Hans Jürgen Kuzel of Erlangen, Germany, who first synthesized the compound. ***Comments:*** IMA No. 96-053.

PÖLLMANN, H., WITZKE, T., and KOHLER, H. (1997) Kuzelite, $[Ca_4Al_2(OH)_{12}][(SO_4)\cdot 6H_2O]$, a new mineral from Maroldsweisach/Bavaria, Germany. *Neues Jahrbuch für Mineralogie, Monatshefte* **1997**, 423–432.

Lesukite — Cubic

$Al_2(OH)_5Cl\cdot 2H_2O$

Locality: The Tolbachik Main Fracture eruption, Kamchatka, Russia.

Occurrence: The result of interaction of fumarole gases and volcanic rocks at 50°C. Associated minerals are various unidentified chlorides of Ca, Mg, Na, K, Al, and Fe.

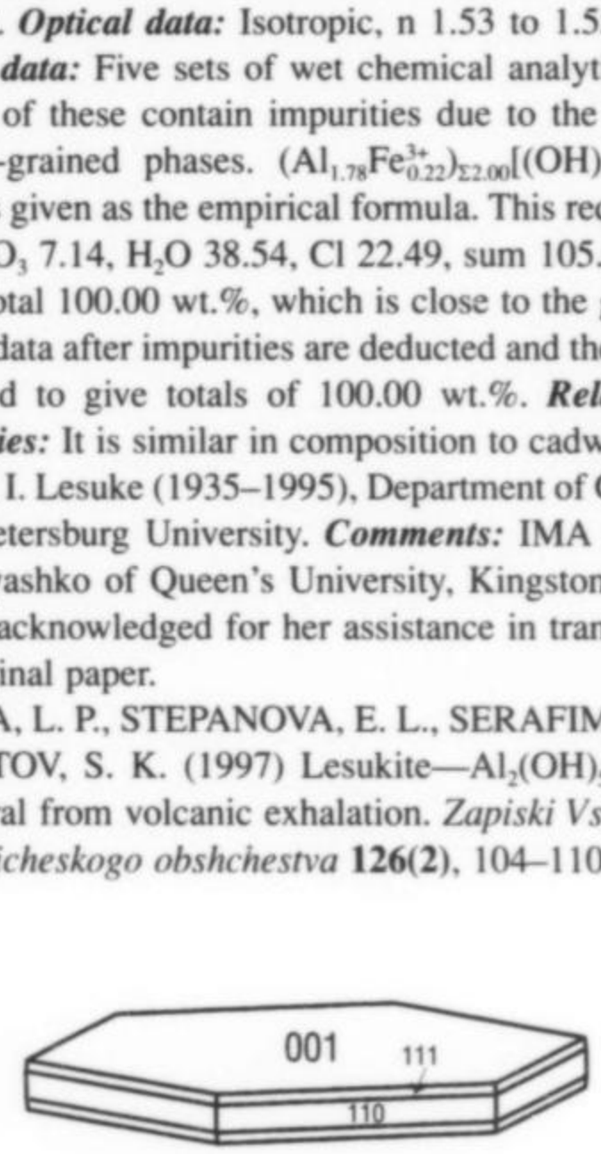
General appearance: Aggregates (up to 0.02 mm) of rectangular to square grains (up to 0.005 mm).

Physical, chemical and crystallographic properties: *Luster:* not given, but probably vitreous. *Diaphaneity:* transparent. *Color:*

yellow-orange, yellow-brown. *Streak:* yellow-orange, yellow-brown. *Luminescence:* not given. *Hardness:* could not be measured. *Tenacity:* could not be determined. *Cleavage:* not given. *Fracture:* not given. *Density:* could not be measured, 1.87 g/cm^3 (calc.). ***Crystallography:*** Cubic, Im3m, a 19.878 Å, V 7854 Å^3, Z 36. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 8.11 (70), 7.03 (50), 4.47 (60), 3.23 (70), 2.706 (100), 2.446 (80), 1.957 (70). ***Optical data:*** Isotropic, n 1.53 to 1.55. ***Chemical analytical data:*** Five sets of wet chemical analytical data are given. All of these contain impurities due to the presence of other fine-grained phases. $(Al_{1.78}Fe^{3+}_{0.22})_{\Sigma 2.00}[(OH)_{4.44}Cl_{1.56}]_{\Sigma 6.00}\cdot 3.04H_2O$ is given as the empirical formula. This requires: Al_2O_3 36.90, Fe_2O_3 7.14, H_2O 38.54, Cl 22.49, sum 105.07, less O = Cl 5.07, Total 100.00 wt.%, which is close to the given sets of analytical data after impurities are deducted and the remainders recalculated to give totals of 100.00 wt.%. ***Relationship to other species:*** It is similar in composition to cadwaladerite.

Name: For G. I. Lesuke (1935–1995), Department of Crystallography, St. Petersburg University. ***Comments:*** IMA No. 96-004. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

VERGASOVA, L. P., STEPANOVA, E. L., SERAFIMOVA, E. K., and FILATOV, S. K. (1997) Lesukite—$Al_2(OH)_5Cl\cdot 2H_2O$—a new mineral from volcanic exhalation. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(2)**, 104–110.



LUKECHANGITE-(CE)

Lukechangite-(Ce) — Hexagonal

$Na_3Ce_2(CO_3)_4F$

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

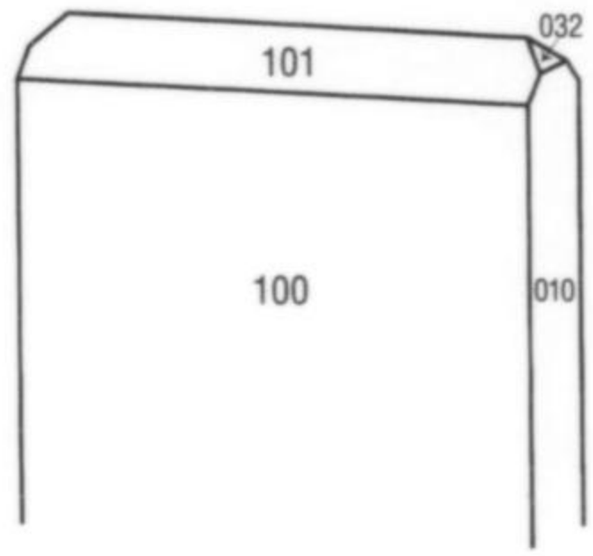
Occurrence: In a large pegmatite dike in nepheline syenite. Associated minerals are: microcline, analcime, sodalite, aegirine, sérandite, eudialyte, catapleiite, fluorite, petersenite-(Ce), siderite, astrophyllite, and albite. Horváthite-(Y) and two unidentified minerals were found in a different section of the same pegmatite.

General appearance: Tabular crystals (0.5 to 1.0 mm) and short prismatic to barrel-shaped crystals 0.5 to 1.0 mm.

Physical, chemical and crystallographic properties: *Luster:* vitreous, somewhat pearly on {001}. *Diaphaneity:* transparent to translucent. *Color:* colorless to pale beige. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* ≈ 4½. *Tenacity:* brittle. *Cleavage:* {001} perfect. *Fracture:* uneven to conchoidal. *Density:* could not be determined, but the mineral sinks in methylene iodide so the density is greater than 3.3 g/cm^3; 3.97 g/cm^3 (calc.). ***Crystallography:*** Hexagonal, $P6_3/mmc$, a 5.068, c 22.87 Å, V 509 Å^3, Z 2, c:a = 4.1526. Morphology: forms, {001}, {110}, {111}, and at least one more bipyramid (see comments). Twinning: none observed. ***X-ray powder diffraction data:*** 5.71 (50), 4.31 (100), 3.804 (50), 3.169 (70), 2.877 (60), 2.534 (70), 2.192 (90B), 1.978 (70), 1.658 (50). ***Optical data:*** Uniaxial (–), ω 1.728, ε 1.542, nonpleochroic. ***Chemical analytical data:*** Means of five sets of electron microprobe data: Na_2O 14.94, CaO 0.10, SrO 0.12, La_2O_3 16.36, Ce_2O_3 29.48, Pr_2O_3 1.95, Nd_2O_3 5.88, CO_2 (28.40), F 3.58, sum 100.81, less O = F 1.51, Total 99.30 wt.%. CO_2 was calculated by stoichiometry from the crystal structure analysis. Empirical formula: $(Na_{2.96}Ca_{0.01}Sr_{0.01})_{\Sigma 2.98}(Ce_{1.10}La_{0.62}Nd_{0.21}Pr_{0.07})_{\Sigma 2.00}(CO_3)_{3.96}F_{1.16}$. ***Relationship to other species:*** It is structurally related to huanghoite-(Ce) and cordylite-(Ce).

Name: For Prof. Luke L. Y. Chang (1934–), University of Maryland, for his contributions to the study of carbonate group minerals. ***Comments:*** IMA No. 96-033. The calculated density given in the paper is 4.02 g/cm^3. The specimens were collected by Steve and Janet Cares. No figures are given in the paper, but the crystal drawings produced for this abstract are based on the data and descriptions given by the authors. Mr. László Horváth approved the drawing of the prismatic crystal as being representative of the crystals he has seen. He also suggested that the second bipyramid mentioned by the authors might be {112}. His assistance is gratefully acknowledged.

GRICE, J. D. and CHAO, G. Y. (1997) Lukechangite-(Ce), a new rare-earth-fluorocarbonate mineral from Mont Saint-Hilaire, Quebec. *American Mineralogist* **82**, 1255–1260.



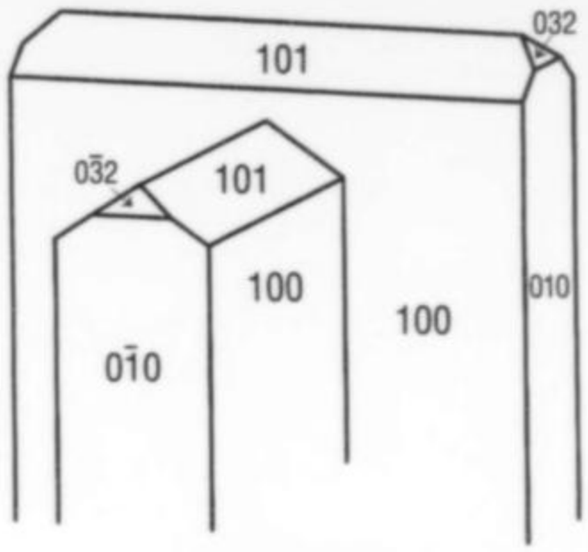
MUTINAITE

Mutinaite — Orthorhombic

$Na_3Ca_4(Si_{85}Al_{11})O_{192}\cdot 60H_2O$

Locality: Mt. Adamson, Northern Victoria Land, Antarctica (Lat. 73°56′21″ S, Long. 162°57′30″ E, 3,900 m above sea level).

Occurrence: In cavities in dolerite. Associated minerals are: mordenite, heulandite, erionite, phillipsite, stilbite, chabazite, lévyne, epistilbite, tschernichite, boggsite, gottardiite, ferrierite,



MUTINAITE

terranovaite, cowlesite, Fe-rich smectite, quartz, cristobalite, opal, "apophyllite," gypsum, and calcite.

General appearance: Subspherical aggregates (up to 1.8 mm in diameter) of radiating lath-like fibers or as aggregates (up to 0.6 mm across) of tabular crystals (up to 200 x 80 x 60 μm).

Physical, chemical and crystallographic properties: *Luster:* silky to vitreous. *Diaphaneity:* transparent. *Color:* colorless to pale milky-white. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* could not be determined. *Tenacity:* brittle. *Cleavage:* {100} good. *Fracture:* irregular. *Density:* 2.14 g/cm^3 (meas.), 2.14 g/cm^3 (calc.). ***Crystallography:*** Orthorhombic, Pnma, a 20.223, b 20.052, c 13.491 Å, V 5471 Å^3, Z 1, a:b:c = 1.0085:1:0.6728. Morphology: forms, {100}, {010}, {101}, and {032}. Twinning: none observed, but see comments below. ***X-ray powder diffraction data:*** 11.20 (84), 9.98 (35), 3.85 (100), 3.75 (98), 3.67 (27), 3.00 (32). ***Optical data:*** Biaxial (–), α 1.485, β 1.487, γ 1.488, 2V could not be measured, 2V(calc.) 70°; dispersion not observed; nonpleochroic; orientation, X = b, Y = a, Z = c. ***Chemical analytical data:*** Means of twenty-two sets of electron microprobe data: Na_2O 1.21, K_2O 0.07, MgO 0.12, CaO 3.00, Al_2O_3 8.08, Fe_2O_3 trace, SiO_2 72.22, H_2O 15.30, Total 100.00 wt.%. Empirical formula: $(Ca_{3.78}Mg_{0.21})_{\Sigma 3.99}$-$(Na_{2.76}K_{0.10})_{\Sigma 2.86}(Si_{84.91}Al_{11.20})_{\Sigma 96.11}\cdot 59.98H_2O$. ***Relationship to other species:*** A member of the zeolite group.

Name: For Mutina, the ancient Latin name of Modena, Italy, the site of many years of zeolite research. ***Comments:*** IMA No. 96-025. Although it is stated that no twinning was observed, the crystal drawing in the paper appears to represent a twin. I asked the authors about this and they replied that they could not determine any angles to define a rational twinning law. They prefer to interpret the SEM image and the resulting crystal drawing as an example of epitaxy. The authors' crystal drawing is not in the standard orientation, so it has been redrawn for this abstract. In addition, a single crystal in the standard orientation is included here.

GALLI, E., VEZZALINI, G., QUARTIERI, S., ALBERTI, A., and FRANZINI. M. (1997) Mutinaite, a new zeolite from Antarctica: The natural counterpart of ZSM-5. *Zeolites* **19**, 318–322. VEZZALINI, G., QUARTIERI, S., GALLI, E., ALBERTI, A., CRUCIANI, G., and KVICK, Å. (1997). Crystal structure of the zeolite mutinaite, the natural analog of ZSM-5. *Zeolites* **19**, 323–325.

Niobocarbide — Cubic

(Nb,Ta)C

Locality: Nijnetagilsky, near Solovjeva mountain (former Aurorinsky mine) (Lat. 59°52′ N, Long. 59°45′ E) and Baranchinsky massif near the Actai River (former Baranchinsky mine (Lat. 59°39′ N, Long. 60°07′ E), Middle Urals, Russia.

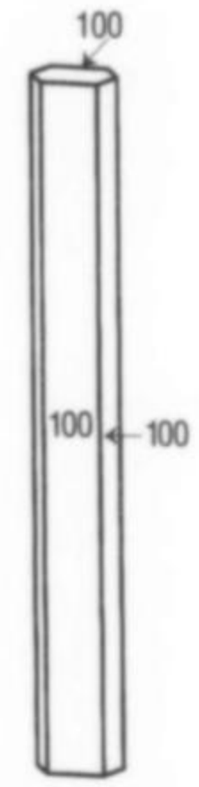
Occurrence: In placer concentrates. Associated minerals are: tantalcarbide, gold, iron, nickel, Fe-Ta-Nb alloys, Fe-Sn alloys, microlite, Mn-Ta-Nb oxides, "apatite," magnetite, dolomite, zircon, wüstite, serpentine, and graphite.

General appearance: Octahedral crystals (up to 0.05 mm) as inclusions in tantalcarbide.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* bronze-yellow. *Streak:* not mentioned. *Hardness:* VHN$_{50}$ 1800 kg/mm^2. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* conchoidal. *Density:* could not be measured, 10.25 g/cm^3 (calc.). ***Crystallography:*** Cubic, Fm3m, a 4.45 Å, V 88.1 Å^3, Z 4. Morphology: the only form observed is {111}. Twinning: none observed. ***X-ray powder diffraction data:*** 2.56 (10), 2.22 (9), 1.574 (8), 1.343 (8), 1.289 (7), 1.115 (3). ***Optical data:*** In reflected light: yellowish- to rose cream, isotropic. R: (31.8 %) 460nm, (38.5 %) 540nm, (45.1 %) 580nm, (51.5 %) 660nm. ***Chemical analytical data:*** Means of twenty-one sets of electron microprobe data: Nb 43.00, Ta 45.16, W 2.49, C 8.85, Total 99.50 wt.%. Empirical formula: $(Nb_{0.63}Ta_{0.34}W_{0.02})_{\Sigma 0.99}C_{1.01}$. The carbon content was calculated to give a total of two atoms per formula unit. ***Relationship to other species:*** The niobium-dominant analogue of tantalcarbide (see comments).

Name: For the chemical composition. ***Comments:*** IMA No. 95-035. The mineral tantalcarbide has been redefined and validated by this study. Elena Valyashko of Queen's University, Kingston. Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

NOVGORODOVA, M. I., GENERALOV, M. E., and TRUBKIN, N. V. (1997) The new TaC-NbC isomorphic series and niobocarbide—a new mineral from platinum placers of the Urals. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(1)**, 76–95.



NORMANDITE

Normandite — Monoclinic

NaCa(Mn^{2+},Fe^{2+})(Ti,Nb,Zr)Si$_2$O$_7$OF

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

Occurrence: In miarolitic cavities in nepheline syenite. Associated minerals are: albite, kupletskite, natrolite, donnayite-(Y), nepheline, microcline, aegirine, catapleiite, eudialyte, cancrinite, villiaumite, and rinkite.

General appearance: Euhedral prismatic crystals up to 10 mm long and as groups of subparallel acicular crystals or fibers.

Physical, chemical and crystallographic properties: *Luster:* vitre-

ous (probably approaching adamantine). *Diaphaneity:* transparent to translucent. *Color:* orange to orange-brown, also yellow. *Streak:* white to very pale yellow. *Luminescence:* non-fluorescent. *Hardness:* 5 to 6. *Tenacity:* brittle. *Cleavage:* {100} and {001} distinct. *Fracture:* conchoidal. *Density:* 3.50 g/cm^3 (meas.), 3.48 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, $P2_1/a$, a 10.828, b 9.790, c 7.054 Å, ß 108.20°, V 709.9 Å^3, Z 4, a:b:c = 1.1060:1:0.7205. Morphology: forms, {100}, {110}, and {001}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.942 (20), 3.234 (30), 2.859 (100), 2.807 (70), 1.762 (20), 1.741 (20), 1.727 (20), 1.688 (20), 1.627 (20). ***Optical data:*** Biaxial (-), α 1.743, β 1.785, γ 1.810, 2V(meas.) (on two crystals) 72° and 84°, 2V(calc.) 74°; dispersion r > v, moderate; pleochroism pronounced, X = pale yellow, Y = yellow, Z = brownish red to deep red; X ∧ c = 15° (in obtuse angle β), Y = b. ***Chemical analytical data:*** Means of five sets of electron microprobe data: Na_2O 9.26, K_2O 0.01, CaO 15.38, MnO 9.31, FeO 6.13, SiO_2 31.92, TiO_2 17.51, ZrO_2 2.62, Nb_2O_5 3.89, F 5.11, sum 101.14, less O = F 2.15, Total 98.99 wt.%. Empirical formula: $Na_{1.12}Ca_{1.03}(Mn_{0.49}Fe_{0.32})_{\Sigma 0.81}(Ti_{0.82}Nb_{0.11}Zr_{0.08})_{\Sigma 1.01}Si_{2.00}O_{7.00}O_{0.99}F_{1.01}$. ***Relationship to other species:*** The Ti-analogue of låvenite.

Name: For Mr. Charles Normand (1963–), of Montreal, who discovered the mineral. ***Comments:*** IMA No. 90-021. The crystal drawing which appears here is based on the data and SEM image given in the paper.

CHAO, G. and GAULT, R. A. (1997) Normandite, the Ti-analogue of låvenite from Mont Saint-Hilaire, Quebec. *Canadian Mineralogist* **35**, 1035–1039.

Rhodarsenide

Orthorhombic

$(Rh,Pd)_2As$

Locality: In platinum group mineral placers of the Srebrnica river, near Veluce, Central Serbia, Yugoslavia.

Occurrence: Associated minerals are: Pt-Fe alloys, Ru-Os-Ir alloys, hollingworthite, irarsite, and sperrylite.

General appearance: Irregular inclusions in Pt-Fe alloys and Ru-Os-Ir alloys between 10 x 70 and 80 x 100 µm.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* megascopic color unknown. *Streak:* not given. *Hardness:* VHN_{25} 515 kg/mm^2. *Tenacity:* not given. *Cleavage:* not given. *Fracture:* not given. *Density:* could not be determined, 11.27 g/cm^3 (calc.). ***Crystallography:*** Orthorhombic, space group unknown, a 5.866, b 3.893, c 7.302 Å, V 166.7 Å^3, Z 4, a:b:c = 1.5068:1:1.8757. Morphology: no forms given. Twinning: none mentioned. ***X-ray powder diffraction data:*** 2.426 (7), 2.348 (4), 2.237 (10), 2.067 (8), 1.935 (6), 1.860 (5). ***Optical data:*** In reflected light: brownish with a pale green tinge, moderate to distinct anisotropism, bireflectance not stated, pleochroism weak in air but distinct in oil. $R_{max.}$ & $R_{min.}$: (46.3, 45.5 %) 470nm, (48.4, 47.6 %) 546nm, (49.5, 48.2 %) 589nm, (51.2, 49.8 %) 650nm. ***Chemical analytical data:*** Six sets of electron microprobe data are given; one of these is: Cu 0.08, Rh 60.81, Pd 12.65, Pt 0.49, Sb 0.09, As 26.04, Total 100.16 wt.%. Empirical formula: $(Rh_{1.67}Pd_{0.34}Pt_{0.01})_{\Sigma 2.02}As_{0.98}$. ***Relationship to other species:*** None apparent.

Name: For the composition. ***Comments:*** IMA No. 96-030.

TARKIAN, M., KRSTIĆ, S., KLASKA, K.-H., and LIEßMANN, W. (1997) Rhodarsenide, $(Rh,Pd)_2As$, a new mineral. *European Journal of Mineralogy* **9**, 1321–1325.

Rodolicoite

Hexagonal (trigonal)

$Fe^{3+}PO_4$

Locality: The Castelnuovo mine, Santa Barbara lignite area, Upper Arno River Valley, 30 km southeast of Florence, Italy.

Occurrence: As nodules about 1 cm in diameter with cavities lined with aggregates up to 1 mm long. Associated minerals are: grattarolaite and heterosite.

General appearance: Rodolicoite and grattarolaite occur as fine intergrowths of irregularly shaped crystallites less than 1000 Å.

Physical, chemical and crystallographic properties: *Luster:* greasy. *Diaphaneity:* opaque. *Color:* reddish-brown. *Streak:* brown. *Luminescence:* non-fluorescent. *Hardness:* could not be determined. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* not given. *Density:* could not be determined, 3.07 g/cm^3 (calc.). ***Crystallography:*** Hexagonal (trigonal), R 3_121, a 5.048, c 11.215 Å, V 247.5 Å^3, Z 3, c:a = 2.2217. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 4.38 (25), 3.45 (100), 2.362 (20), 2.190 (15), 1.877 (20), 1.426 (15). ***Optical data:*** Because of the very small size of the crystallites, no optical data could be determined. ***Chemical analytical data:*** Analytical data were obtained by transmission electron microscopy which gave: Fe_2O_3 54.93, P_2O_5 45.07, Total 100.00 wt.%. Empirical formula: $Fe^{3+}_{1.05}P_{0.97}O_{4.00}$. ***Relationship to other species:*** A polymorph of heterosite.

Name: For Francesco Rodolico (1905–1988), professor of mineralogy at the University of Florence. ***Comments:*** IMA No. 95-038. The nodules consist of 80 to 85% rodolicoite.

CIPRIANI, C., MELLINI, M., PRATESI, G., and VITI, C. (1997) Rodolicoite and grattarolaite, two new phosphate minerals from Santa Barbara Mine, Italy. *European Journal of Mineralogy* **9**, 1101–1106.

Saddlebackite

Hexagonal

$Pb_2Bi_2Te_2S_3$

Locality: Boddington, near Mount Saddleback approximately 100 km southeast of Perth, Western Australia, Australia (Lat. 32°44′ S, Long. 116°22′ E).

Occurrence: In a lateritic orebody in a greenstone belt. Associated minerals are: quartz, gold, galena, aleksite, tsumoite, altaite, chalcopyrite, an unidentified cadmium sulfide, a lead-bismuth-tellurium-sulfur phase (in a ratio of 1:4:4:3), actinolite, "chlorite," muscovite, pyrrhotite, and pyrite.

General appearance: In lamellar aggregates (up to 2 mm) intergrown with aleksite, galena, tsumoite, altaite, and gold.

Physical, chemical and crystallographic properties: *Luster:* metallic to splendent. *Diaphaneity:* opaque. *Color:* grey to black. *Streak:* blackish. *Hardness:* VHN_{20} 42 kg/mm^2. *Tenacity:* sectile; cleavage flakes are inelastic but flexible. *Cleavage:* {001} perfect. *Fracture:* uneven. *Density:* could not be determined, 7.61 g/cm^3 (calc.). ***Crystallography:*** Hexagonal, space group unknown, a 4.230, c 33.40 Å, V 518.0 Å^3, Z 2, c:a = 7.9031. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.35 (40), 3.06 (100), 2.22 (25), 2.115 (50), 1.311 (25), 1.213 (25). ***Optical data:*** In reflected light: greyish-white, faint anisotropism from grey to yellowish-brownish grey, very weak bireflectance, nonpleochroic. R_O & R_E: (40.4, 39.3 %) 470nm, (42.1, 40.8 %) 546nm, (41.3, 40.8 %) 589nm, (41.9, 40.9 %) 650nm. ***Chemical analytical data:*** Means of eight sets of electron microprobe data: Pb 35.10, Bi 34.40, Te 23.12, S 7.94, Total 100.56 wt.%.

Empirical formula: $Pb_{2.00}Bi_{1.94}Te_{2.14}S_{2.92}$. ***Relationship to other species:*** Chemically similar to aleksite and has an affinity with tetradymite group minerals.

Name: For the locality. ***Comments:*** IMA No. 94-051. Before analytical work, the total amount of the mineral in the holotype specimen was a few hundred milligrams.

CLARKE, R. M. (1997) Saddlebackite, $Pb_2Bi_2Te_2S_3$, a new mineral species from the Boddington gold deposit, Western Australia. *Australian Journal of Mineralogy* **3**, 119–124.

Sudovikovite

Hexagonal (trigonal)

$PtSe_2$

Locality: Southern Karelia, 30 km north of Kizhy Island, Russia.

Occurrence: In metasomatites. Associated minerals are: clausthalite, guanajuatite, insizwaite, padmaite, bohdanowiczite, sobolevskite, froodite, polarite, hematite, bismuth, gold, roscoelite, chromian phengite, dolomite, quartz, and two new phases.

General appearance: Irregular grains (10 to 180 μm) in clausthalite.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* white-yellow. *Streak:* not given. *Hardness:* VHN_{20} 87 kg/mm². *Tenacity:* not given. *Cleavage:* not given. *Fracture:* not given. *Density:* 9.7 g/cm³ (meas.), 9.63 g/cm³ (calc.). ***Crystallography:*** Hexagonal (trigonal), $P\bar{3}m1$, a 3.730, c 5.024 Å, V 60.5 Å³, Z 1, c:a = 1.3469. Morphology: no forms were observed. Twinning: none observed. ***X-ray powder diffraction data:*** 5.04 (3), 2.715 (10), 1.983 (5), 1.859 (5), 1.747 (3), 1.360 (4). ***Optical data:*** In reflected light: white, moderate to strong anisotropism, strong bireflectance, pleochroic from light yellow to light lilac. $R_{max.}$ & $R_{min.}$: (48.4, 35.1 %) 470nm, (48.3, 35.1 %) 546nm, (49.1, 35.3 %) 589nm, (50.8, 36.5 %) 650nm. ***Chemical analytical data:*** Means of twelve sets of electron microprobe data: Pt 53.38, Pd 2.52, Se 43.70, Total 99.60 wt.%. Empirical formula: $(Pt_{0.96}Pd_{0.08})_{\Sigma 1.04}Se_{1.95}$. ***Relationship to other species:*** None apparent.

Name: For N. G. Sudovikov (1903–1966), noted Russian petrologist. ***Comments:*** IMA No. 95-009. Some of the data given here are taken from the original proposal. Elena Valyashko of Queen's University, Kingston, Ontario, is gratefully acknowledged for her assistance in translating parts of the original paper.

POLEKHOVSKII, YU. S., TARASOVA, I. P., NESTEROV, A. R., PAKHHOMOVSKII, YA. A., and BAKHCHARAITSEV, A. YU. (1997) Sudovikovite $PtSe_2$—a new platinum selenide from South Karelia metasomatites. *Doklady Akademia Nauk* **354(1)**, 82–85.

Ternesite

Orthorhombic

$Ca_5(SiO_4)_2SO_4$

Locality: The Ettringer Bellerberg, near Mayen, Eifel, Germany.

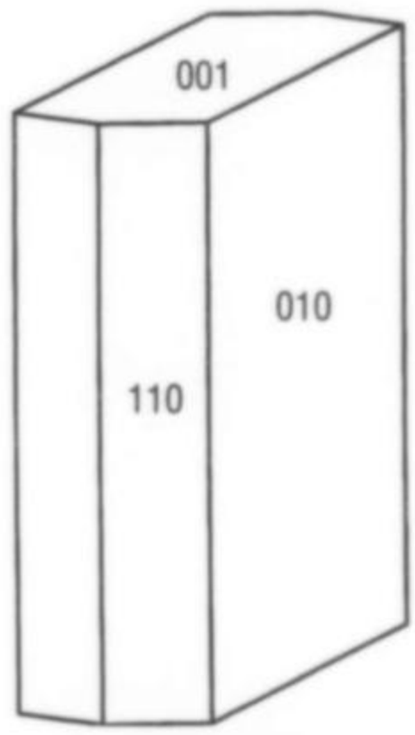
Occurrence: In calcium-rich xenoliths in leucite tephrite lava. Associated minerals are: "ellestadite" (not differentiated as fluorellestadite or hydroxylellestadite), a mineral in the solid solution between ettringite and thaumasite, mayenite, tobermorite, "calcio-olivine" (presumably, calcian forsterite), larnite, portlandite, magnetite, and hematite.

General appearance: Aggregates of radially arranged prismatic crystals (elongated along [100]) (up to 0.2 mm long and about 0.05 mm in diameter).

Physical, chemical and crystallographic properties: *Luster:* not given but presumably vitreous. *Diaphaneity:* not given but presumably transparent. *Color:* bright blue in aggregates, colorless in single crystals. *Streak:* not given. *Luminescence:* non-fluorescent. *Hardness:* 4½ to 5. *Tenacity:* not given. *Cleavage:* none. *Fracture:* not given. *Density:* 2.94 g/cm³ (meas.), 2.98 g/cm³ (calc.). ***Crystallography:*** Orthorhombic, Pnma, a 6.863, b 15.387, c 10.181 Å, V 1075.1 Å³, Z 4, a:b:c = 0.4460:1:0.6617. Morphology: no forms were identified. Twinning: none mentioned. ***X-ray powder diffraction data:*** No table of data is given, but the strongest lines are stated to be: 3.198 (42), 2.853 (63), 2.830 (100), 2.565 (55), 1.892 (39). ***Optical data:*** Biaxial (-), α 1.630, β 1.637, γ 1.640, 2V(meas.) 63.5°, 2V(calc.) 66°; dispersion not given; presumably nonpleochroic; orientation, X = a, Y = c, Z = b. ***Chemical analytical data:*** Means of seven sets of electron microprobe data: CaO 58.90, SiO_2 25.22, SO_3 16.34, Total 100.46 wt.%. Empirical formula: $Ca_{5.04}(SiO_4)_{2.01}(SO_4)_{0.98}$. ***Relationship to other species:*** None apparent.

Name: For Mr. B. Ternes of Mayen, Germany, who found the mineral and provided specimens for the study. ***Comments:*** IMA No. 95-015. Details of the crystal structure are given in the paper.

IRRAN, E., TILLMANNS, E., and HENTSCHEL, G. (1997) Ternesite, $Ca_5(SiO_4)_2SO_4$, a new mineral from the Ettringer Bellerberg/Eifel, Germany. *Mineralogy and Petrology* **60**, 121–132.



TERRANOVAITE

Terranovaite

Orthorhombic

$(Na,Ca)_8(Si_{68}Al_{12})O_{160}\cdot 29H_2O$

Locality: The southwest crest, just below the summit of Mt. Adamson, Northern Victoria Land, Antarctica (Lat. 73°56′ S, Long. 162°56′ E).

Occurrence: In cavities in dolerites. Other minerals found in the cavities are: Fe-rich smectite, quartz, cristobalite, "apophyllite," gypsum, calcite, mordenite, heulandite, erionite, phillipsite, stilbite, lévyne, epistilbite, tschernichite, boggsite, gottardiite, ferrierite, and cowlesite.

General appearance: Small globular masses and a single crystal 0.7 x 0.6 x 0.2 mm.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* colorless to bluish. *Streak:* white. *Luminescence:* non-fluorescent. *Hardness:* could not be determined. *Tenacity:* brittle. *Cleavage:* {010} perfect and {001} parting. *Fracture:* irregular. *Density:* 2.13 g/cm³ (meas.), 1.98 g/cm³ (calc.). ***Crystallography:*** Orthorhombic, Cmcm, a 9.747, b 23.880, c 20.068 Å, V 4671 Å³, Z 1, a:b:c =

0.4082:1:0.8404. Morphology: forms, {010}, {001}, and {110}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 11.94 (40), 10.16 (65), 9.04 (33), 8.23 (29), 7.69 (29), 3.79 (100), 3.61 (40). ***Optical data:*** Biaxial (+), α 1.476, β 1.478, γ 1.483, 2V(meas.) 65°, 2V(calc.) 65°; dispersion not mentioned; nonpleochroic; orientation, X = c, Y = a, Z = b. ***Chemical analytical data:*** Means of ten sets of electron microprobe data: Na_2O 2.33, K_2O 0.20, MgO 0.14, CaO 3.72, SrO tr., BaO tr., Al_2O_3 11.25, Fe_2O_3 tr., SiO_2 73.02, H_2O (9.34), Total (100.00) wt.%. Water calculated by difference. Empirical formula: $(Na_{4.19}Ca_{3.70}K_{0.24}Mg_{0.19})_{\Sigma 8.22}(Si_{67.77}Al_{12.30})_{\Sigma 80.07}O_{160.00}\cdot 28.90H_2O$. ***Relationship to other species:*** A member of the zeolite group.

Name: For the Italian Antarctic Station at Terranova Bay, Antarctica. ***Comments:*** IMA No. 95-026. The authors point out that in order to get a calculated density equal to the measured density, the water content must be about 15.50 wt.%. The crystal drawing for this abstract was produced from the data and photograph given in the paper. The drawing was sent to the authors and Prof. Franzini stated that it is a correct representation of the mineral.

GALLI, E., QUARTIERI, S., VEZZALINI, G., ALBERTI, A., and FRANZINI, M. (1997) Terranovaite from Antarctica: A new 'pentasil' zeolite. *American Mineralogist* **82**, 423–429.

Utahite

Triclinic

$Cu_5Zn_3(Te^{6+}O_4)_4(OH)_8\cdot 7H_2O$

Locality: The Centennial Eureka mine, 1 mile southwest of Eureka, Tintic District, Juab County, Utah, U.S.A. (Lat. 39°56′38″ N, Long. 112°07′18″ W).

Occurrence: A secondary mineral. Associated minerals are: quartz, cesbronite, and two undefined secondary Cu-Zn-Te minerals.

General appearance: Aggregates of tightly bound prismatic crystals (up to 0.3 mm long) with a length-to-width ratio of about 20:1.

Physical, chemical and crystallographic properties: *Luster:* given as vitreous to pearly, but the indices of refraction indicate adamantine. *Diaphaneity:* translucent. *Color:* pale blue to deeper blue-green. *Streak:* pale blue. *Luminescence:* non-fluorescent. *Hardness:* estimated to be 4 to 5. *Tenacity:* brittle. *Cleavage:* none observed. *Fracture:* uneven. *Density:* could not be determined, 5.33 g/cm³ (calc.). ***Crystallography:*** Triclinic, P1 or $P\bar{1}$, a 8.794, b 9.996, c 5.660 Å, α 104.10°, β 90.07°, γ 96.34°, V 479.4 Å³, Z 1, a:b:c = 0.8798:1:0.5662. Morphology: forms, {010} and {001}. Twinning: none observed. ***X-ray powder diffraction data:*** 9.638 (100), 8.736 (50), 4.841 (100), 2.747 (60), 2.600 (45). ***Optical data:*** Reflectance studies yielded poor results because of strong internal reflections. Indices of refraction calculated relative to SiC are 1.84 to 1.90 and relative to cubic zirconia are 1.83 to 1.88 at 590 nm. ***Chemical analytical data:*** Means of six sets of electron microprobe data: CuO 25.76, ZnO 15.81, TeO_3 45.47, H_2O (12.96), Total (100.00) wt.%. Water was calculated by difference. Empirical formula: $Cu_{4.98}Zn_{2.99}(Te^{6+}O_4)_{3.99}(OH)_{7.96}\cdot 7.09H_2O$. ***Relationship to other species:*** None apparent.

Name: For the state in which it was found. ***Comments:*** IMA No. 95-039.

ROBERTS, A. C., STIRLING, J. A. R., CRIDDLE, A. C., JENSEN, M. C., MOFFATT, E. A., and WILSON, W. E. (1997) Utahite, a new mineral and associated copper tellurates from the Centennial Eureka mine, Tintic District, Juab County, Utah. *Mineralogical Record* **28**, 175–179.

Velikite

Tetragonal

Cu_2HgSnS_4

Locality: Khaidarkan, about 60 km South of Fergana, Kirghizstan (Lat. 39°58′ N, Long. 71°15′ E).

Occurrence: In veins cutting carboniferous black schists and limestones in a mercury deposit. Associated minerals are: fluorite, quartz, cinnabar, metacinnabar, mercurian sphalerite, aktashite, livingstonite, and native antimony.

General appearance: Isolated grains and tetragonal-scalenohedral crystals (up to 1 mm, usually 0.2 to 0.4 mm).

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* dark grey. *Streak:* grey. *Hardness:* VHN_{30} 270 kg/mm², Mohs 4. *Tenacity:* brittle. *Cleavage:* none. *Fracture:* uneven. *Density:* 5.45 g/cm³ (meas.), 5.42 g/cm³ (calc.). ***Crystallography:*** Tetragonal, $I\bar{4}2m$, a 5.560, c 10.905 Å, V 337.1 Å³, Z 2, c:a = 1.9613. Morphology: the habit is given as tetragonal-scalenohedral but no forms are identified. Twinning: none. ***X-ray powder diffraction data:*** 3.17 (10), 1.958 (2.5), 1.941 (8), 1.671 (4), 1.646 (3.5), 1.264 (2.5). ***Optical data:*** In reflected light: greenish-grey to light grey with greenish-brownish tint, moderate anisotropism, insignificant bireflectance, weak pleochroism. $R_{max.}$: (26.0 %) 470nm, (26.3 %) 546nm, (25.6 %) 589nm, (24.8 %) 650nm. ***Chemical analytical data:*** Two sets of electron microprobe data are given: Cu 23.26, 22.69; Ag 0.19, –; Hg 29.99, 31.92; Cd 0.16, –; Zn 2.54, 2.03; Fe 0.01, 0.02; Mn 0.02, 0.02; Pb 0.10, –; Sn 19.90, 20.74; Ge 0.61, –; As 0.37, –; Sb 0.21, –; Te 0.05, –; S 23.08, 23.03; Se 0.10, –; Total 100.59, 100.41 wt.%. Empirical formulae: $Cu_{2.00}Ag_{0.01}(Hg_{0.82}Zn_{0.21}Cd_{0.01})_{\Sigma 1.04}(Sn_{0.92}Ge_{0.05}As_{0.03}Sb_{0.01})_{\Sigma 1.01}S_{3.94}Se_{0.01}$ and $Cu_{1.98}(Hg_{0.88}Zn_{0.17})_{\Sigma 1.05}Sn_{0.97}S_{3.99}$. ***Relationship to other species:*** A member of the stannite group.

Name: For A. C. Velikyi (1913–1970), a well-known investigator of the ore deposits of Central Asia. ***Comments:*** IMA No. 96-052. Other data for the second analyzed sample are: a 5.542, c 10.908 Å, V 335.0 Å³, c:a = 1.9682, density (meas.) 5.59 g/cm³, density (calc.) 5.53 g/cm³. Dimitriy I. Belakovskiy of the Fersman Mineralogical Museum, Moscow, Russia, is gratefully acknowledged for his assistance in translating parts of the original paper.

GRUZDEV, V. S., VOLGIN, V. Y., SPIRIDONOV, E. M., EVSTIGNEEVA, T. L., KABALOV, Y. K., SOROKIN, V. I., OSADCHYI, E. G., CHVILEVA, T. N., and CHERNIZOVA, N. M. (1997) Velikite Cu_2HgSnS_4 (mercurian member of the stannite group)—a new mineral. *Zapiski Vserossiyskogo mineralogicheskogo obshchestva* **126(4)**, 71–75.

Yixunite

Cubic

Pt_3In

Locality: Near the village of Damiao and the Yixun River, about 270 km N of Beijing, Peoples's Republic of China.

Occurrence: In a cobalt-copper-platinum bearing vein in garnet-amphibole pyroxenite. Associated minerals are: moncheite, sperrylite, malanite, cooperite, chalcopyrite, and damiaoite.

General appearance: Globules 1.0 to 2.0 mm in diameter.

Physical, chemical and crystallographic properties: *Luster:* metallic. *Diaphaneity:* opaque. *Color:* bright white. *Streak:* black. *Hardness:* VHN_{50} 634 kg/mm², Mohs 6. *Tenacity:* not given. *Cleavage:* none. *Fracture:* not given. *Density:* could not be determined, 18.32 g/cm³ (calc.) (see comments). ***Crystallography:*** Cubic, Pm3m, a 3.988 Å, V 63.43 Å³, Z 1. Morphology: no forms were observed. Twinning: none mentioned. ***X-ray***

powder diffraction data: 2.30 (100), 1.99 (60), 1.41 (40), 1.203 (80), 1.151 (40), 0.997 (20). ***Optical data:*** In reflected light: bright white with a yellowish tint, isotropic. R: (56.1 %) 470nm, (62.5 %) 550nm, (65.7 %) 590nm, (71.3 %) 650nm. ***Chemical analytical data:*** Means of eight sets of electron microprobe data: Pt 82.9, In 16.3, Total 99.2 wt.%. Empirical formula: $Pt_{3.00}In_{1.00}$. ***Relationship to other species:*** Chemically similar to damiaoite, $PtIn_2$.

Name: For the locality. ***Comments:*** IMA No. 95-042. The calculated density is given as 18.21 g/cm³ in the paper. This mineral was described and named in 1974 and 1978 without approval of the Commission on New Minerals and Mineral Names of the International Mineralogical Association. The description abstracted here differs significantly from those published earlier.

YU, Z. (1997) Yixunite—an ordered new native indium and platinum alloy. *Acta Mineralogica Sinica* **71(4)**, 333–335.

Yvonite

Triclinic

$Cu(AsO_3OH)\cdot 2H_2O$

Locality: The Salsigne mine on the south hillside of Montagne Noire, 15 km north of Carcassone, Aude, France.

Occurrence: Associated minerals are: geminite, lindackerite, arsenopyrite, bismuth, chalcopyrite, and pushcharovskite (approved but not yet published).

General appearance: Aggregates or radiated spherules (up to 1 mm in diameter) consisting of individual crystals (up to 0.3 x 0.15 x 0.06 mm).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* turquoise blue. *Streak:* blue. *Luminescence:* non-fluorescent. *Hardness:* ~ 3½ to 4. *Tenacity:* brittle. *Cleavage:* {100} perfect, {010} poor. *Fracture:* irregular. *Density:* 3.20 g/cm³ (meas.), 3.22 g/cm³ (calc.). ***Crystallography:*** Triclinic, $P\bar{1}$, a 7.632, b 11.168, c 6.020 Å, α 89.32°, β 86.55°, γ 74.43°, V 493.4 Å³, Z 4, a:b:c = 0.6834:1:0.5390. Morphology: forms, {010}, {100}, {001}, {hkl}. Twinning: very rare multiple lamellae, composition plane (010), twin axis perpendicular to (010). ***X-ray powder diffraction data:*** 7.35 (100), 5.239 (50), 4.440 (60), 3.936 (60), 3.302 (40), 3.008 (50), 2.840 (35). ***Optical data:*** Biaxial (–), α 1.615, β 1.660, γ 1.700, 2V(meas.) 82°, 2V(calc.) 84°; dispersion r > v, medium; pleochroism weak, X = light blue to colorless, Y = light blue, Z = blue; orientation on (010) X ∧ c = 42° and Z perpendicular to (010), on (100) Z′ ∧ [001] = 0 to 2.5° and X′ ∧ c = 3 to 5.5°. ***Chemical analytical data:*** Means of eight sets of electron microprobe data: CuO 33.3, Al_2O_3 0.4, As_2O_5 47.8, H_2O 19.0, Total 100.5 wt.%. Water by TGA. Empirical formula: $Cu_{0.99}Al_{0.02}H_{0.93}(AsO_4)_{0.99}\cdot 2.04H_2O$. ***Relationship to other species:*** Structurally related to geminite, $Cu(AsO_3OH)\cdot H_2O$, and fluckite, $CuMn^{2+}(AsO_3OH)_2\cdot 2H_2O$.

Name: For Prof. Klaus Yvon (1943–), Professor of Crystallography, University of Geneva. ***Comments:*** IMA No. 95-012. The mineral was found by M. G. Favreau.

SARP, H. and ČERNÝ, R. (1998) Description and crystal structure of yvonite, $Cu(AsO_3OH)2H_2O$. *American Mineralogist* **83**, 383–389.

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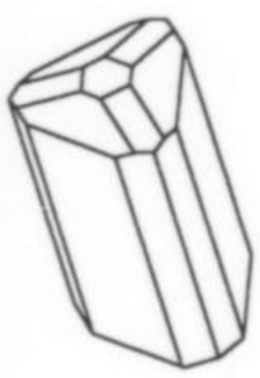

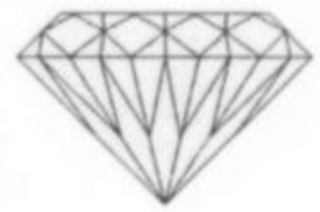

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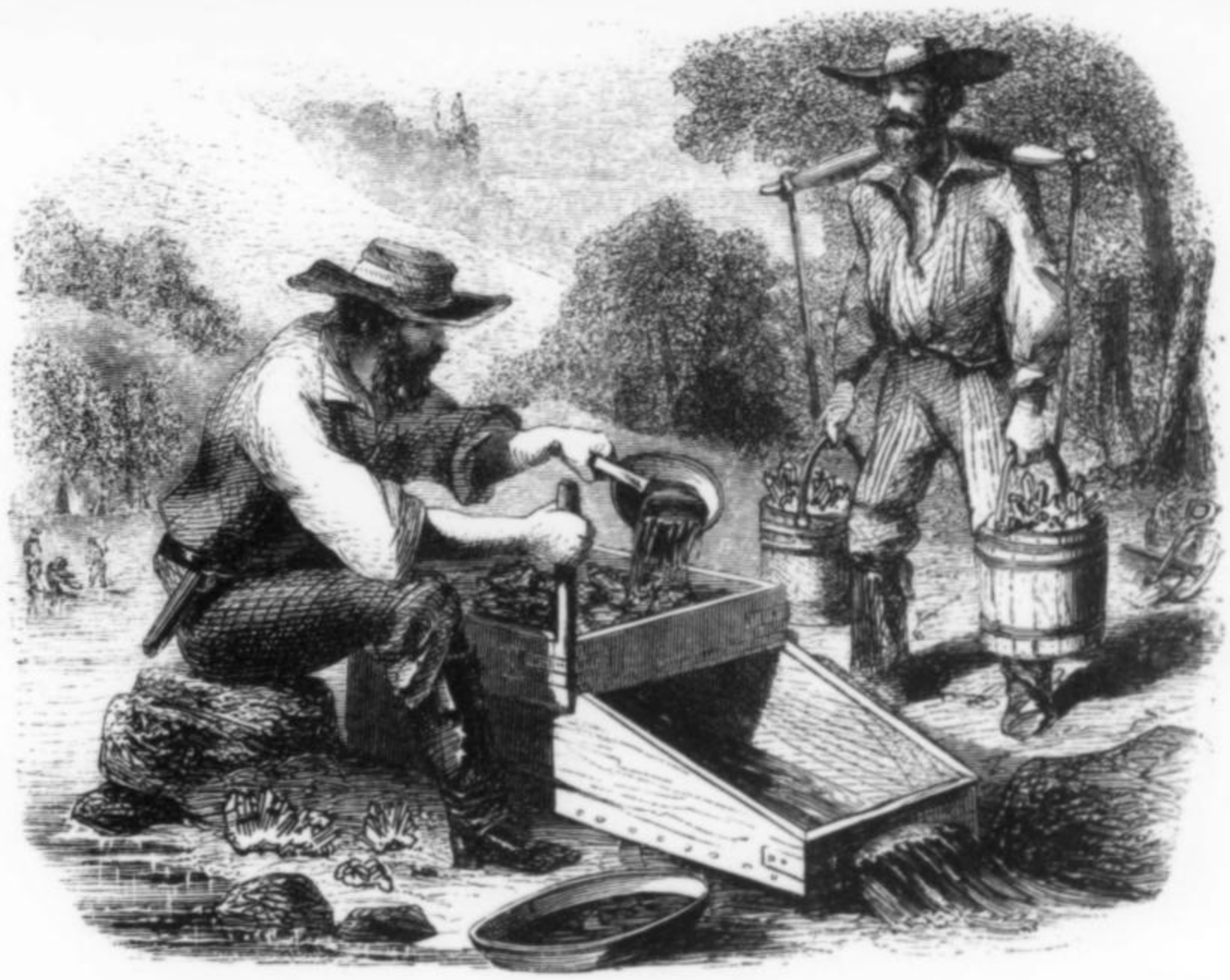

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A New Mineral . . . Almost:

1,5-Dinitronaphthalene from the Boarezzo mine, Varese, Italy

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About a year ago Mr. F. Cassani, a mineral collector from Varese (Italy), sent to one of us (P.O.) a specimen from the Boarezzo mine bearing elegant minute pink crystals to be identified. The Boarezzo mine is related to a small deposit of galena and silver-rich tetrahedrite embedded in a quartz-porphyric intrusive Paleozoic rock, locally named "Granofiro della Val Ganna." The mine was worked only from 1937 to 1939 and is now completely inactive, but for some hammer-and-chisel work by Italian mineral collectors. In fact, the locality is well known for small silver specimens and for some rare sulfides such as jalpaite, proustite and pearceite (P. Orlandi, 1994). Moreover, many interesting copper and lead alteration minerals, such as susannite, caledonite, linarite, langite and shultenite (P.O., to be published) have been observed.

The pink prismatic crystals did not resemble any of the numerous known species from the mine. They had been found in a small cavity on millimeter-size transparent quartz crystals, as a spray aggregate about 3 mm in diameter, consisting of sharp, elongated, vitreous, transparent crystals (Fig. 1). A preliminary X-ray powder pattern recorded on a Gandolfi camera did not reveal the identity of the mineral. Single crystal patterns were then collected with Weissenberg and Buerger cameras. However, even after these investigations, no known mineral could be matched with the findings. A chemical EDS analysis by scanning electron microscopy on a crystal fragment disclosed the presence of carbon, oxygen and nitrogen, revealing that the material was an organic compound. Finally, by extending the search to synthetic organic compounds, a match was found between the cell parameters and the X-ray powder pattern data of the crystals and the corresponding recorded data concerning the synthetic phase *1,5-dinitronaphthalene*.

This compound cannot be accepted unquestioningly as a mineral. Possible hypotheses regarding a natural origin in the mine appeared unconvincing. In fact, one could guess that the compound was present in tar, possibly used by miners to protect timbers from water. Alternatively, the puzzling presence could in some way be related to transport from an adjacent bituminous rock (or to a joke by a malicious mineral collector).

To be sure of the identification a specimen of the crystals was sent from P.O. to A.P., for further analysis (Orlandi, 1994) by Hnmr spectroscopy. The spectrum of the crystals in chloroform is identi-

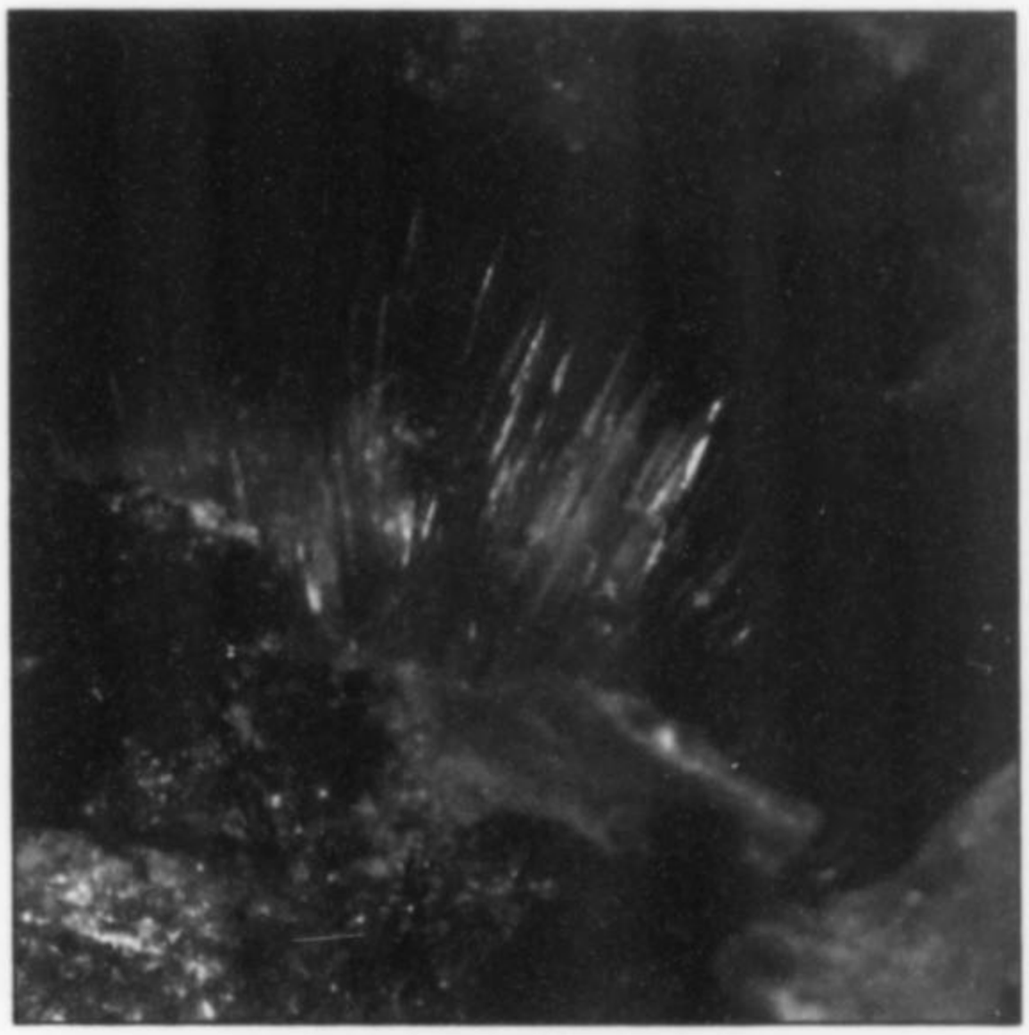

Figure 1. **1,5-dinitronaphthalene: spray-aggregate about 3 mm in diameter consisting of needle-shaped, pink, vitreous, transparent crystals.**

cal to that of an authentic sample of 1,5-dinitronaphthalene (on a Varian UNITY 400MHz equipped with a +1 SPARC station, in $CDCl_3$, chloroform as internal standard: δ 8.79, H_2 and H_6,d,J_{2-3}= J_{6-7} = 8.8Hz; 8.31,H_4 and H_8,J_{4-3} = J_{8-7} = 7.6Hz; 7.83,H_3 and H_7,dd; see also P. R. Wells, 1963). Moreover, A.P. learned from literature that 1,5-dinitronaphthalene is a common explosive, whose microscopic identification had been recently investigated with particular attention to optical properties (McCrone *et al.*, 1994).

At this point, it appeared reasonable that the crystals could have originated from the blast of an explosive during mining. To collect all possible information on the practices adopted in mining during the last two years of work, P.O. asked mineral collectors of the Varese club to contact some of the old miners. One of them eliminated the possibility that the compound could derive from tar, since during mining it had never been required to protect the timbering in the stope. P.O. also determined that there are no reported occurrences of bituminous rocks, which could possibly release the compound, at the contact or in proximity of the "Garofiro" around the mine. With regard to the explosive used in mining, we were unable to acquire direct information from the mine operators or other people involved in the mine works, in order to establish the composition of explosives used. However, nitrated naphthalenes are contained in some varieties of the commonly used *cheddite*. Thus, the most plausible hypothesis for the origin of the crystals is that they were formed in a fracture of the rock from gases containing unburned and volatilized explosive resulting from a blast. At least that is the conclusion stemming from our work (as "detectives" more than as researchers); we are not sure that we have characterized a new mineral species, but we nevertheless enjoyed our investigation.

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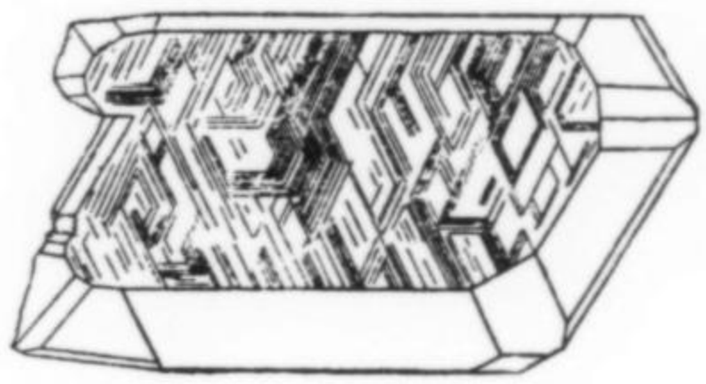

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Any relationship to other minerals

Crystal system, space group. Unit cell parameters. Color; luster; diaphaneity. Optical properties. Strongest lines in the X-ray powder diffraction pattern. IMA No.

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$(Bi,Pb)_2Fe(O,OH)_3PO_4$

Chemically related to paulkerrite

Monoclinic: C2/m. a 12.278, b 3.815, c 6.899 Å, β 111.14°. Black to dark brown; vitreous to adamantine; opaque to translucent. Biaxial (–), α 2.06, β 2.15(calc), γ 2.19, 2V(meas.) 70°. 5.726 (54), 3.372 (77), 3.322 (37), 3.217 (46), 3.011 (100), 2.863 (34), 2.750 (62). IMA No. 97-001.

$Ca_2B_2SiO_7$

The boron-dominant analogue of gehlenite (melilite group)

Tetragonal: $P42_1m$. a 7.116, c 4.815 Å. Creamy-white; earthy; earthy. Probably uniaxial (–), n 1.67. 3.479 (40), 2.862 (55), 2.654 (100), 2.231 (15), 2.129 (20), 1.920 (35), 1.644 (20). IMA No. 97-002.

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

The Ti-dominant analogue of nenadkevichite

Monoclinic: C2/m. a 14.39, b 13.900, c 7.825 Å, β 117.6°. Colorless; vitreous; transparent to translucent. Biaxial (+), α 1.667, β 1.677, γ 1.802, 2V(meas.) 32°, 2V(calc.) 33°. 6.94 (61), 6.39 (43B), 3.186 (100), 3.100 (96), 2.600 (28), 2.586 (28), 2.489 (24). IMA No. 97-003.

$AgSbS_2$

A polymorph of miargyrite

Cubic: Fm3m. a 5.650. Greyish black; metallic; opaque. In reflected light: grey. R: (34.5 %) 470 nm, (33.8 %) 546 nm, (32.8 %) 589 nm, (28.7 %) 650 nm. 3.26 (9), 2.83 (10), 1.998 (8), 1.703 (6), 1.630 (5), 1.296 (2), 1.263 (3). IMA No. 97-004.

$(UO_2)H(AsO_3)$

Tetragonal: space group unknown. a 11.00, c 15.96 Å. Yellow; dull; translucent. Uniaxial (–), ω 1.84, ε 1.75. 5.58 (8), 4.95 (10), 4.40 (6), 3.33 (8), 3.03 (6), 2.91 (5). IMA No. 97-005.

$Na_3SrCeMnSi_6O_{17}$

The Mn^{2+}-dominant analogue of nordite-(Ce)

Orthorhombic: Pcca. a 14.449, b 5.187, c 19.849 Å. Colorless, pale-brownish, brown; vitreous; transparent. Biaxial (–), α 1.623, β 1.636, γ 1.642, 2V(meas.) 60°, 2V(calc.) 68°. 7.22 (38), 4.215 (100), 3.326 (67), 2.965 (83), 2.875 (55), 2.597 (54), 2.443 (35). IMA No. 97-007.

$Na_3SrCeFeSi_6O_{17}$

The Fe^{2+}-dominant analogue of nordite-(Ce)

Orthorhombic: Pcca. a 14.460, b 5.187, c 19.848 Å. Colorless or light coffee-color; vitreous; transparent. Biaxial (–), α 1.623, β 1.636, γ 1.642, 2V(meas.) 60°, 2V(calc.) 68°. 7.22 (41), 4.216 (100), 3.325 (67), 2.964 (73), 2.879 (62), 2.595 (46), 2.444 (31). IMA No. 97-008.

$CaCu_6[(AsO_4)_2(AsO_3OH)(OH)_6] \cdot 3H_2O$

The calcium- and arsenate-dominant member of the mixite group

Hexagonal: $P6_3/m$. a 13.571, c 5.880 Å. Pale green; vitreous; transparent. Uniaxial (+), ω 1.688, ε 1.765. 11.64 (100), 4.431 (41), 3.387 (17), 3.254 (22), 2.9347 (42), 2.6932 (29), 2.5624 (30). IMA No. 97-009.

$Pb_4As_2S_7$

Orthorhombic: Pba2 or Pbam. a 15.179, b 38.117, c 4.0428 Å. Silvery lead grey; metallic; opaque. In reflected light: white with a greenish tint, distinct anisotropism (dark grey to greenish grey, weak bireflectance, weak pleochroism. R_{min} & R_{max}: (33.8, 34.0 %) 470 nm, (31.8, 31.9 %) 546 nm, (31.2, 31.3 %) 589 nm, (30.4, 30.4 %) 650 nm. 4.462 (40), 3.699 (37), 3.392 (100), 2.817 (45), 2.735 (31), 2.156 (25), 2.150 (22). IMA No. 97-010.

$Ca(Al,Fe^{2+},Mg,Mn)_2(AsO_4)_2(OH)_2$

Monoclinic: C2. a 8.9252, b 6.1427, c 7.352 Å, β 115.25°. Light brownish to brownish pink, orange-brown; vitreous; transparent. Biaxial (sign unknown), n 1.76 parallel to fibre, n 1.70 perpendicular to fibre. 4.914 (58), 3.376 (65), 3.164 (100), 3.084 (61), 2.945 (72), 2.687 (53), 2.522 (84). IMA No. 97-012.

$Ca_8Mg(SiO_4)_4Cl_2$

Cubic: $Fd\bar{3}$. a 15.0850 Å. Orange brown to amber; vitreous; transparent. Isotropic, n 1.676. 2.901 (40), 2.666 (100), 2.549 (30), 1.9637 (30), 1.8845 (30), 1.7774 (30), 1.5400 (50), 1.4585 (30). IMA No. 97-013.

$Mg_2Al_3B_2O_9(OH)$

Chemically and structurally related to sinhalite

Monoclinic: $P2_1/c$. a 7.49, b 4.33, c 9.85 Å, β 110.7°. Colorless; vitreous; transparent. Biaxial (-), α 1.691, β 1.713, γ 1.730, 2V(meas.) 80.0°, 2V(calc.) 82°. 3.21 (40), 2.61 (40), 2.14 (100), 2.102 (60), 1.625 (100), 1.607 (40), 1.399 (40). IMA No. 97-014.

$(Na,Ca)_5Ca(Ti,Nb)_5Si_{12}O_{34}(OH,F)_8 \cdot 5H_2O$

A Ca-dominant polymorph of zorite

Orthorhombic: C222. a 7.024, b 23.155, c 6.953 Å. Pale brown, brown, orange-yellow; vitreous; transparent to translucent. Biaxial (+), α 1.599, β 1.610, γ 1.696, 2V(meas.) 38°, 2V(calc.) 41°. 11.564 (100), 6.932 (90), 5.258 (40), 4.446 (40), 3.052 (75), 2.977 (70), 2.582 (40). IMA No. 97-015.

Sb_2O_4 ($Sb^{3+}Sb^{5+}O_4$, β-phase)

A monoclinic polymorph of cervantite

Monoclinic: C2/c. a 12.061, b 4.836, c 5.383 Å, β 104.60°. Colorless; vitreous; transparent. Biaxial (sign unknown), α′ 1.72, γ′ 2.10. 3.244 (VS), 2.920 (M), 2.877 (S), 1.619 (M). IMA No. 97-017.

$K(Ca,Mn,Na)_2(K_{2-x}h_x)_2Zn_3Si_{12}O_{30}$

A member of the osumilite group

Hexagonal: P6/mcc. a 10.505, c 14.185 Å. Colorless, white; vitreous; transparent to translucent. Uniaxial (+), ω 1.561, ε 1.562. 7.11 (35), 3.830 (100), 3.345 (60), 3.304 (40), 2.940 (50), 2.795 (85), 2.627 (35). IMA No. 97-018.

$Zn_4Al_2(OH)_{12}(CO_3) \cdot 3H_2O$

The zinc-dominant member of the manasseite group

Hexagonal: $P6_3/mmc$. a 3.0725, c 15.1135 Å. White; vitreous; transparent. Optical properties could not be measured. 7.51 (vs), 3.794 (m), 2.511 (mw), 2.175 (mw), 1.830 (mw), 1.542 (ms), 1.539 (ms). IMA No. 97-019.

$HgBi_2S_4$

Monoclinic: C2/m. a 14.164, b 4.053, c 13.967 Å, β 118.28°. Grey-black; metallic; opaque. In reflected light: creamy-white, distinct anisotropism, low bireflectance, nonpleochroic. R_1 & R_2: (35.7, 37.8 %) 470 nm, (35.4, 37.5 %) 546 nm, (34.9, 37.0 %) 589 nm, (33.9, 35.8 %) 650 nm. 3.86 (m), 3.55 (m), 3.05 (S), 2.914 (mS), 2.865 (mS), 2.644 (m), 1.913 (m), 1.805 (m). IMA No. 97-021.

$(Cd,Ca,Mn)KCu_5(AsO_4)_4[As(OH)_2O_2](H_2O)_2$

The cadmium-dominant analogue of 97-023

Monoclinic: $P2_1/m$. a 9.8102, b 10.0424, c 9.9788 Å, β 101.686°. Electric blue; vitreous; transparent. Biaxial (–), α 1.720, β 1.749, γ 1.757, 2V(meas.) 50°, 2V(calc.) 55°. 9.64 (100), 4.46 (40), 3.145 (50), 3.048 (40), 2.698 (40). IMA No. 97-022.

$(Ca,Cd,Mn)KCu_5(AsO_4)_4[As(OH)_2O_2](H_2O)_2$

The calcium-dominant analogue of 97-022

Monoclinic: $P2_1/m$. a 9.8102, b 10.0424, c 9.9788 Å, β 101.686°. Electric blue; vitreous; transparent. Biaxial (–), α 1.713, β 1.743, γ 1.749, 2V(meas.) 50°, 2V(calc.) 48°. 9.64 (100), 4.46 (40), 3.145 (50), 3.048 (40), 2.698 (40). IMA No. 97-023.

$Cu_4Cd(SO_4)_2(OH)_6 \cdot 4H_2O$

The cadmium-dominant analogue of campigliaite

Monoclinic: $P2_1/m$. a 5.543, b 21.995, c 6.079 Å, β 92.04°. Bluish-green; vitreous; transparent. Biaxial (–), α 1.619, β 1.642, γ 1.661, 2V(meas.) 66°, 2V(calc.) 83°. 11.02 (90), 5.496 (100), 5.322 (25), 4.079 (50), 3.437 (30), 3.243 (40), 2.470 (30). IMA No. 97-024.

$UO_2CO_3 \cdot H_2O$

Hexagonal: space group unknown. a 15.79, c 23.93 Å. Canary yellow; silky; translucent. Uniaxial (+), ω 1.588, ε 1.612. 7.86 (47), 6.91 (55), 6.56 (77), 4.76 (40), 4.34 (36), 3.39 (33), 3.056 (100). IMA No. 97-025.

$Ca_{19}(Al,Mg,Fe,Ti)_{13}(B,Al,\square)_5Si_{18}O_{68}(O,OH,F)_{10}$

The boron-dominant analogue of vesuvianite

Tetragonal: P4/nnc. a 15.752, c 11.717 Å. Dark green; vitreous; translucent. Uniaxial (+), ω 1.721, ε 1.725. 2.776 (100), 2.617 (61), 2.592 (43), 2.491 (61), 2.121 (20), 1.660 (26), 1.640 (23). IMA No. 97-026.

$Ca(Co,Fe,Ni)_2(AsO_4)_2(OH,H_2O)_2$

The cobalt-dominant analogue of lotharmeyerite

Monoclinic: C2/m. a 9.024, b 6.230, c 7.421 Å, β 115.15°. Brown; vitreous; translucent. Biaxial (+), α 1.78, β 1.79, γ 1.85(calc.), 2V(meas.) 48°. 4.955 (38), 3.398 (85), 3.188 (28), 3.115 (33), 2.972 (100), 2.709 (28), 2.545 (34). IMA No. 97-027.

$Rh_{17}S_{15}$

The rhodium- and sulfur-dominant analogue of palladseite

Cubic: $Pm\bar{3}m$, $P\bar{4}3m$ or P432. a 10.024 Å. Color unknown; metallic; opaque. In reflected light: grey with slight bluish tint, isotropic. R: (38.6 %) 480 nm, (39.0 %) 540 nm, (39.1 %) 580 nm, (38.8 %) 660 nm. 3.33 (2), 3.17 (7), 3.02 (9), 2.68 (5), 2.24 (9), 1.931 (8), 1.774 (10). IMA No. 97-029.

$Rh_{12}As_7$

Hexagonal: $P6_3/m$. a 9.31, c 3.64 Å. Color unknown; metallic; opaque. In reflected light: brownish-grey, weak anisotropism from grey to brownish-grey, weak bireflectance, nonpleochroic. $R_{min.}$ & $R_{max.}$: (44.5, 47.8 %) 480 nm, (44.7, 48.3 %) 540 nm, (46.4, 49.2 %) 580 nm, (48.6, 51.3 %) 660 nm. 2.33 (4), 2.03 (2), 1.852 (9), 1.767 (6), 1.755 (10), 1.549 (8). IMA No. 97-030.

$(Ca,Cu)_4Fe_6[(As,Si)O_4]_4(OH)_8 \cdot 18H_2O$

The Fe^{2+}-dominant analogue of wallkilldellite

Hexagonal: $P6_3/mmc$, $P6_3mc$ or P62c. a 6.548, c 23.21 Å. Brown-yellow; vitreous to resinous; translucent. Uniaxial (–), ω 1.750, ε could not be determined. 11.6 (100), 5.670 (80), 3.275 (70), 2.850 (10), 2.760 (15), 2.547 (10), 1.641 (25). IMA No. 97-032.

$ZnFe_2^{3+}(AsO_4)_2(OH)_2$

Monoclinic: $P2_1/n$. a 6.629, b 7.616, c 7.379 Å, β 91.79°. Dark green; adamantine; translucent. Biaxial (sign unknown), n 1.94, mineral reacts with liquids of n > 1.9. 3.385 (100), 3.315 (78), 2.939 (47), 2.839 (28), 2.381 (29), 2.331 (29), 1.652 (32), 1.621 (34). IMA No. 97-034.

$(K,Na)Ca_2Fe^{2+}Fe_2^{3+}[Si_5Al_3O_{22}](OH)_2$

A member of the amphibole group

Monoclinic: C2/m. a 9.94, b 18.08, c 5.38 Å, β 105.5°. Black; vitreous; transparent. Biaxial (–), α 1.696, β not determined, γ 1.715, 2V(meas.) 45°. 8.44 (90), 3.405 (25), 3.285 (30), 3.145 (100), 2.823 (26), 2.722 (52), 2.606 (27), 2.579 (25). IMA No. 97-035.

$Ca(Ce,REE)_2(CO_3)_4 \cdot H_2O$

Triclinic: $P\bar{1}$. a 6.397, b 6.389, c 12.383 Å, α 96.58°, β 100.85°, γ 100.46°. Colorless to white; vitreous; translucent. Biaxial (–), α 1.635, β 1.725, γ 1.750, 2V(calc.) 53°. 5.901 (59), 5.049 (72), 4.695 (37), 4.468 (36), 4.006 (110), 3.899 (45), 3.125 (39), 3.0051 (448). IMA No. 97-036.

$Na_2CaCu_2^{2+}(P_2O_7)_2(H_2O)_{10}$

Orthorhombic: Fdd2. a 11.938, b 32.854, c 11.017 Å. Blue-green; vitreous; transparent. Biaxial (+), α 1.508, β 1.511, γ 1.517, 2V(meas.) 76.2°, 2V(calc.) 71°. 8.23 (30), 6.52 (100), 4.05 (40), 3.255 (40), 2.924 (40), 2.807 (25), 2.614 (20). IMA No. 97-037.

$Na_2Zn(SO_4)_2 \cdot 4H_2O$

The zinc-dominant analogue of blödite

Monoclinic: $P2_1/a$. a 11.077, b 8.249, c 5.532 Å, β 100.18°. Colorless; vitreous; transparent. Biaxial (–), α 1.507, β 1.512, γ 1.516 (all for synthetic material). 4.550 (58), 4.245 (32), 3.325 (25), 3.289 (100), 3.262 (35), 3.245 (25), 2.631 (27). IMA No. 97-041.

$Pb_9Sb_{10}S_{24}$

Triclinic: P1. a 24.789, b 8.26, c 21.787 Å, α 90.53°, β 99.58°, γ 94.78°. Black; metallic; opaque. In reflected light: black, low anisotropism, low bireflectance, nonpleochroic. R_1 & R_2: (38.95, 37.64 %) 470 nm, (42.35, 38.26 %) 546 nm, (41.67, 37.63 %) 589 nm, (37.43, 36.53 %) 650 nm. 3.47 (vs), 3.35 (ms), 3.24 (ms), 2.986 (s), 2.947 (s), 2.229 (ms). IMA No. 97-042.

$PbSnS_3$

Orthorhombic: Pnma. a 8.8213, b 3.7725, c 14.0053 Å. Greyish black; metallic; opaque. In reflected light: white, weak anisotropism, weak bireflectance, nonpleochroic. R_1 & R_2: (33.9, 36.0 %) 470 nm, (31.3, 32.9 %) 546 nm, (30.0, 31.4 %) 589 nm, (28.8, 29.9 %) 650 nm. 4.128 (100), 3.730 (30), 3.1085 (28), 2.8081 (51), 2.7421 (41), 2.6692 (51), 1.9335 (54). IMA No. 97-043.

$(Mg,Fe)SiO_3$

A member of the ilmenite group

Hexagonal (trigonal): $R\bar{3}$. a 4.78, c 13.6 Å. Colorless; vitreous; transparent. Uniaxial, no other data could be determined. 3.509 (61), 2.616 (100), 2.366 (52), 2.097 (45), 1.755 (45), 1.636 (65), 1.366 (50). IMA No. 97-044.

Na_2LiAlF_6

Monoclinic: $P2_1$ or $P2_1/m$. a 7.5006, b 7.474, c 7.503 Å, β 90.847°. Pale buff-cream; somewhat greasy; transparent to translucent. Almost isotropic (biref. = 0.0009), biaxial n 1.359, 2V(meas.) up to 27°. 4.33 (100), 2.65 (60), 2.25 (70), 2.18 (50), 2.158 (40), 1.877 (90). IMA No. 97-045.

$(Na,Y)(Y,REE)(HCO_3)(OH)_2 \cdot 5H_2O$

Monoclinic: P2 (pseudo-tetragonal). a 4.566, b 13.018, c 4.566 Å, β 90.15°. White to yellow; vitreous; translucent to transparent. Uniaxial (–), ω 1.540, ε 1.40, 2V(meas.) 0-5°. 12.97 (10), 6.52 (3), 4.57 (3), 4.32 (5), 3.223 (3), 3.133 (5), 2.016 (4). IMA No. 97-047.

$NaCa_2Mg_2(VO_4)_3$

The magnesium-dominant analogue of palenzonaite

Cubic: $Ia\bar{3}d$. a 12.427 Å. Red; adamantine; transparent. Isotropic, n 1.94. 3.108 (44), 2.779 (100), 2.652 (20), 2.535 (39), 1.723 (26), 1.662 (40). IMA No. 97-048.

$KFe^{3+}_3(H_2PO_4)_6(HPO_4)_2 \cdot 4H_2O$

Monoclinic: C2/c. a 16.95, b 9.59, c 17.57 Å, β 90.85°. White; vitreous; translucent. Biaxial (–), α 1.557, β 1.598, γ 1.602, 2V(meas.) 32°, 2V(calc.) 34°. 8.83 (10), 7.60 (4), 3.75 (10), 3.30 (4), 3.23 (5), 3.11 (4), 3.02 (9). IMA No. 97-049.

$BaMn_9[(V,As)O_4]_6(OH)_2$

Cubic: $Pa\bar{3}$. a 12.845 Å. Dark red; adamantine; transparent. Isotropic, n > 2.0. 3.01 (87), 2.790 (100), 2.608 (100), 2.332 (44), 2.134 (53), 1.510 (99), 1.0020 (35). IMA No. 97-050.

$TlAg_2(As,Sb)_3S_6$

Orthorhombic: Pnmb or $P2_1nb$. a 12.479, b 15.522, c 5.719 Å. Dark grey; metallic; opaque. In reflected light: pure white, extremely weak anisotropism, no bireflectance, nonpleochroic. R_{min} & R_{max}: (31.43, 33.43 %) 470 nm, (28.31, 30.52 %) 546 nm, (27.10, 29.11 %) 589 nm, (25.57, 27.44 %) 650 nm. 3.655 (16), 3.363 (50), 3.290 (23), 3.210 (26), 3.118 (27), 2.822 (100), 2.540 (17), 2.070 (15). IMA No. 97-051.

PROPOSALS FROM PREVIOUS YEARS APPROVED IN 1997

$Na_4SrCeTiSi_8O_{22}F \cdot 5H_2O$

Monoclinic: P2/a (?). a 23.88, b 14.40, c 7.238 Å, β 91.0°. Yellow, pink-yellow or cream; vitreous and silky; translucent. Biaxial (–), α 1.542, β 1.569, γ 1.571, 2V(meas.) 28°, 2V(calc.) 30°. 12.36 (100), 3.232 (13), 3.190 (29), 3.108 (29), 3.087 (21), 3.058 (13), 2.708 (12). IMA No. 93-029.

$Mg_4Cl(OH)_7 \cdot 6H_2O$

Orthorhombic: Pcmm, $Pcm2_1$, or Pc2m. a 11.215, b 3.124, c 19.21 Å. Yellowish-white; vitreous or pearly; translucent. Biaxial (–), α 1.532, β ~ γ 1.562, 2V(meas.) ≤ 5°. 11.41 (29), 9.78 (46), 9.60 (38), 4.25 (20), 3.498 (100). IMA No. 96-016.

$\square(LiAl_2)Al_6(BO_3)_3(Si_6O_{18})(OH)_4$

A member of the tourmaline group

Hexagonal (trigonal): R3m. a 15.770, c 7.085 Å. Pink; vitreous; translucent. Uniaxial (–), ω 1.645, ε 1.624. 4.181 (58), 3.950 (100), 3.434 (52), 2.924 (56), 2.552 (93), 1.898 (72). IMA No. 96-018.

$Fe^{3+}AsO_4 \cdot 2H_2O$

An hexagonal or trigonal dimorph of scorodite

Hexagonal: P-c- (extinction symbol). a 8.9327, c 9.9391 Å. White to light yellow-brown; vitreous; translucent. Uniaxial (sign unknown), ω and ε > 1.72. 4.973 (61), 4.184 (44), 4.076 (100), 3.053 (67), 2.806 (68), 2.661 (59), 2.520 (54), 2.2891 (44). IMA No. 96-061.

The Friends of Mineralogy

Who We Are:

Vol 1, No 1, Mineralogical Record, Spring 1970
The *Friends of Mineralogy* was founded in Tucson, Arizona, on February 13, 1970. Its objectives were to promote better mineral appreciation, education and preservation. The chief aims and activities of *FM* include:

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

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

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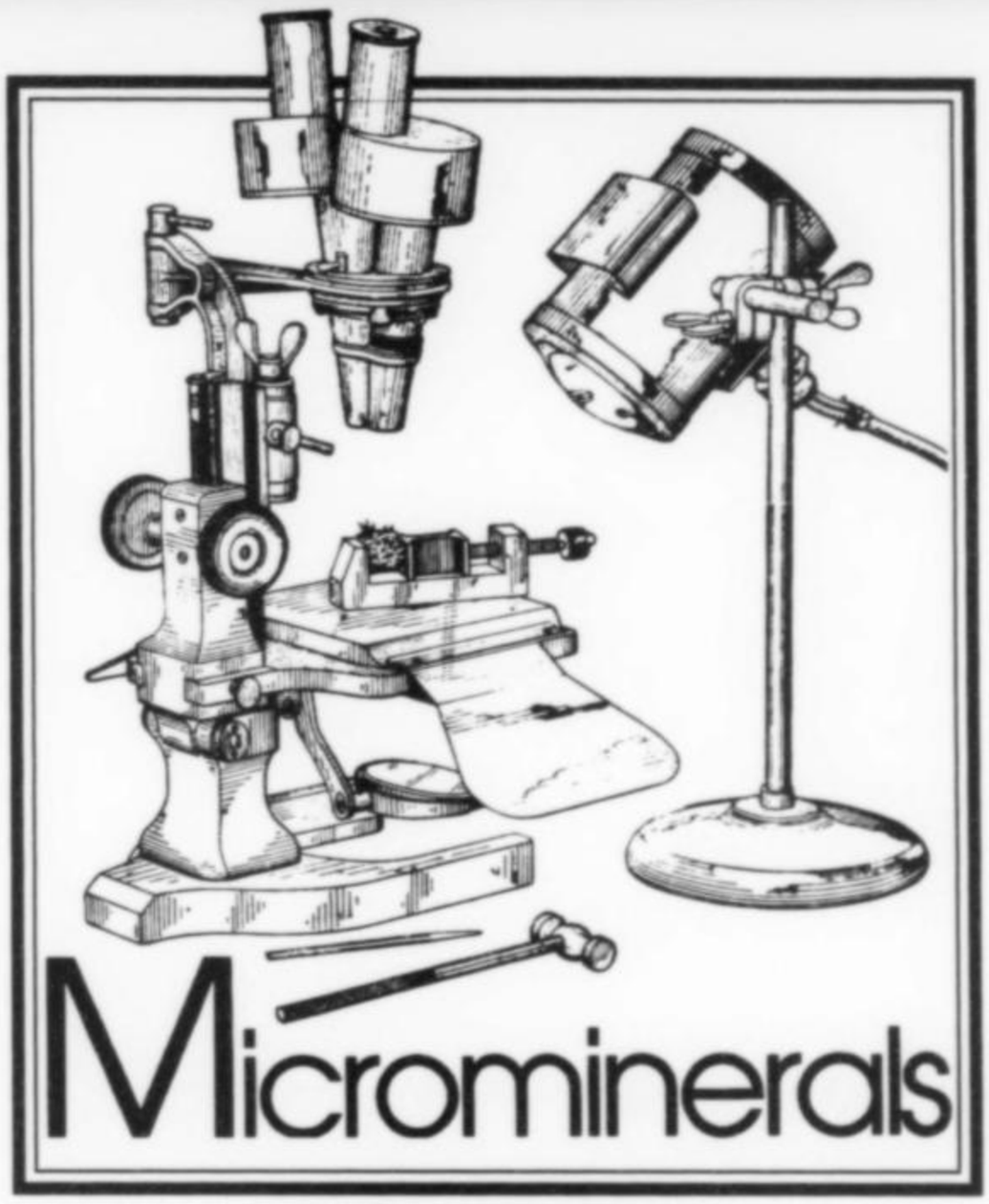


by Wm. A. Henderson

Identifying Unknowns

Many beginning and even advanced collectors of minerals feel that, if they cannot identify a mineral visually, it is acceptable to ask a more advanced collector or even a professional to identify it. Not so! It is the author's opinion that they should do everything they can to determine whether an unknown is worth the time and effort that would be required by others to identify it. Their time should not be wasted on unimportant or easily identified unknowns. Besides being considerate of others, screening unknowns to the best of one's ability and reporting one's observations to a professional will make it much more likely that he will devote some of his time to identifying them. This can be of substantial benefit to the person requesting identification work, as will be seen.

Before working on an unknown, read up on the properties of suspected species. Check hardness and cleavage. Check crystal symmetry. Look at twinning, striations, associations, etc. Is the unknown likely to be a phosphate or a carbonate? Run a carbonate and acid-solubility test, perhaps also a phosphate test. Learn how to run easy tests such as those for Ca^{2+}, Fe^{2+}, Fe^{3+}, CO_3^{2-} and PO_4^{3-} as described in *Dana's Manual of Mineralogy* (Hurlbut, 1952) or other sources. At the very least, run a carbonate test, as described below.

CARBONATE TEST

There are a number of pitfalls in testing for carbonate minerals using acids. First, many beginners use vinegar, a source of acetic acid. While it works with highly reactive species such as calcite and strontianite, it is less effective for slowly dissolving carbonates. There is no reason why every collector cannot use hydrochloric acid, which is much more reactive and thus more reliable. It is sold at most hardware stores under the name *muriatic acid,* and costs only a dollar or so for a quart. A quart will suffice for a lifetime of tests, or will be sufficient for 20–50 members of a club.

The acid should be diluted to about 20% of its original concentration by adding one part acid to four parts of water (do *not* add the water to the acid). It can be stored in a small glass bottle with a plastic, or plastic lined, closure. The lid should not have a metal surface above the acid because metals may be attacked by the acid and its fumes. I have found that the acid can be used in small amounts, and its effect observed under the microscope for a minute or so, without any effect on the optics or body of the scope. This is in part because hydrochloric acid is a non-oxidizing acid (nitric acid, an oxidizing acid, would be another story). During tests taking more than a minute, I move the test sample away from the scope most of the time, cover it, and observe it only at intervals.

For hand-specimen collectors, a test is easy; slosh acid onto a chunk of the unknown, or drop a piece into a milliliter of the acid. For micromineral collectors, of course, "chunks" are unknown, and more delicate methods are needed. In most cases, it is sufficient to remove a single tiny crystal or crystal fragment from a specimen using a sharp needle mounted point-outwards in a 10-cm balsa wood handle. Rubbing the needle on the side of one's nose (not in one's eye) greases the needle point such that the fragment adheres to it temporarily. Next, the sample is put in a tiny drop of acid previously placed on an unreactive substrate. A microscope slide or a shard from a black piece of porcelain will do, but the best and most convenient substrate is the outside of a black plastic micromount box. We speak here of a micro-drop, *not* one applied using a medicine dropper. The amount picked up on a thin glass rod or a fiber from a broom is sufficient. The fragment will fall free into the acid, and *significant* effervescence can be easily observed.

In a recent letter, Robert Ramik at the Royal Ontario Museum in Toronto pointed out one of the good reasons for using a *small* drop of acid relative to the size of the sample. He points out that the acid used may not be saturated with carbon dioxide, and may at first *absorb* any effervescence. He (and I) have observed that there is often a significant delay in the first appearance of a gas bubble, a delay which may well represent the time needed for carbon dioxide released by the sample to saturate the acid droplet. If this is the case, then the gas generated by a small sample in a large drop may simply dissipate invisibly without ever reaching saturation and forming a bubble.

There is a reason why the word "significant" was emphasized two paragraphs above. If the test mineral is a quite unreactive carbonate, the slowly evolved carbon dioxide can diffuse from the tiny acid drop so quickly that no bubbles will be formed. Alternatively, the acid drop can evaporate if the test takes on the order of several minutes. Effervescence may also be missed if the sample is fibrous, very small, and/or highly reactive. In these cases, bubbles may quickly form and leave the acid drop before it can be placed under the microscope for observation.

The test can be done in a far more definite and sensitive manner, however. The procedure is to first transfer the sample to a microscope slide or top of a black plastic box. Next, place a cover slip over the sample. Both slides and cover slips are easily obtained from scientific supply houses such as Edmund Scientific. Then, place a drop of acid on the slide *near, not on* the cover slip. Under the microscope, using the needle, drag tiny increments of the acid drop to the edge of the cover slip, where they will be drawn under it by capillary action. The tiniest, very reactive samples will dissolve like a flash when the acid reaches them, and a bubble or bubbles will be left under the cover slip. Because the cover slip produces a much flattened bubble, its apparent size is far greater than without the cover slip, making a positive test more noticeable. Care must be taken, however, when dealing with fibrous or porous samples. Because of the magnification effect of the cover slip, such samples on contact with or dissolution in the acid, may produce small bubbles composed only of air. Real carbon dioxide bubbles will generally be larger than the original sample in size. Unreactive

samples may sit without the appearance of a bubble for minutes but a bubble will eventually form since the carbon dioxide is trapped under the cover slip. This is the surest and best way to test for carbonates on a microscopic scale.

An acid test reveals a great deal more than just whether the unknown is a carbonate. For example, I recently ran such a test on some very small, crude, white, rhombohedral crystals, almost certainly a rhombohedral carbonate, from Mt St-Hilaire, Quebec. A single group of radiating crystals was detached and treated with hydrochloric acid under a cover glass as above. Bubbles were evolved rapidly, but under the scope, it could be seen that all the bubbles formed at the point where the crystals had been attached to the matrix! After about five minutes, the interiors of all the crystals were completely dissolved, but the outer shells remained. The little shells could be crushed under the cover slip to leave curved shards of themselves. They were, moreover, colorless, not white. It was concluded that the *cores* of the crystals were certainly a carbonate, most likely a nearly pure calcite. Substantial amounts of iron or magnesium would have led to much slower reaction of the crystals. The outer shells could still be a rhombohedral carbonate with a high iron content, or they could be something very unreactive, such as a silicate. At any rate, careful observation of the test had resulted in the discovery that these crystals were composed of two phases, and not one.

Many zeolites and some other silicates dissolve in acid, but leave a residue of silica gel. Although no effervescence is seen, the presence of such a residue strongly suggests that the unknown is a zeolite. Still other minerals will dissolve without either effervescing or leaving a residue. Such species are ideal candidates for further testing for the common anionic groups or cations.

POLARIZING MICROSCOPE

Even though it is a relatively old technique and has been replaced by microprobes and X-ray methods in the hands of professionals, the use of a polarizing microscope by amateur mineralogists is a very powerful technique. In the following section, I'll cover the pros and cons of using one, how I came to have one, and a few examples illustrating their value.

For several years, I had been saying casually to my good wife that, if I had a polarizing microscope, I would be able to quickly identify many unknowns which absolutely could not be identified by eye or simple chemical tests. Then, one Christmas, I found such a scope under the tree! That was some 25 years ago, and the price for a new Unitron microscope was just $289.

Well, she had certainly called my bluff, because it was now up to me to learn how to use it. I did so by buying a good text by Bloss (1967) and studying the theory and practice of using a polarizing microscope from cover to cover. At the same time, I applied the techniques described to known samples of chosen minerals. That took about six months, and constitutes one of the "cons" of using this technique. It takes a good bit of time to read about the stuff and even more time to become familiar with real-life examples rather than the idealized ones in the literature. Further, it must be admitted that a technical background or inclination is a big help.

Another drawback is the substantial cost involved, which is many times that of a bottle of acid. These days, a good, new, polarizing microscope will cost $4000–5000 or more. However, used scopes can be purchased for $400–700. The latter must be checked carefully for missing accessories, improper or damaged lenses, etc. In addition, an acceptable set of *index of refraction liquids* must be obtained. These too can sometimes be obtained in "pre-owned" condition, but most likely must be purchased new. A good set with intervals of 0.002 in index and covering the range 1.400–1.700 will run about $1,400, while sets with intervals of 0.004 or 0.010 will cost about $700 or $300, respectively.

Thus, it can be seen that there is a sizeable investment in time, effort and money necessary to use this technique. However, the ability to identify unknowns, to check questionable identifications made by others, to do things yourself rather than depend on the experts, and even to personally make discoveries and push forward the mineralogical frontiers will give you an enormous amount of satisfaction. I hope the anecdotal examples which follow will make this clear.

I will begin with a very recent example. In May of 1997, collectors at Mont Saint-Hilaire in Quebec found a number of very nice microminerals in a white to gray rock composed mostly of albite, located in close proximity to hornfels, a rock we call "contact rock." The easy-to-identify species were glass-clear analcimes with cube, {211} trapezohedron, and {332} trisoctahedron faces; large for the species, transparent, very sharp, almost single crystals of gobbinsite; molybdenite; donnayite; pyrochlore; and tetranatrolite. In addition, one collector had found colorless, transparent, columnar to acicular crystals occurring in sprays of well-defined individuals (see Fig. 1). A group of us speculated as to

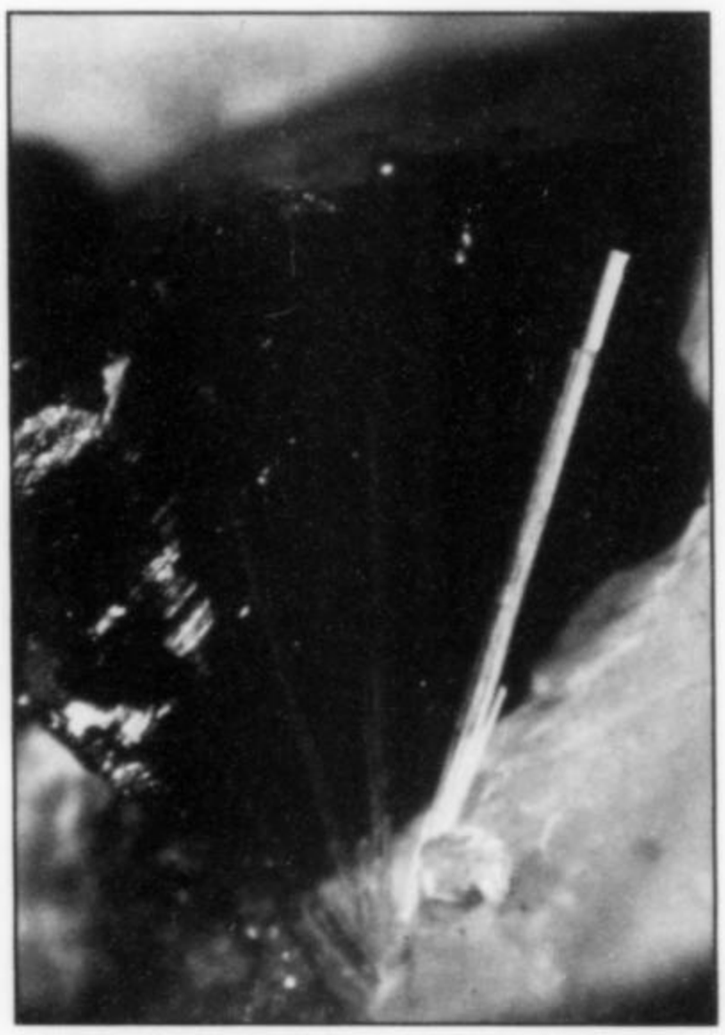


Figure 1. **Acicular dawsonite crystals to 1 mm in length, silhouetted against a chalcopyrite crystal tarnished a deep blue; Poudrette quarry, Mont Saint-Hilaire, Quebec, Canada.**

whether the unknown was one species or another; suggestions included leifite, nenadkevichite, apatite, dawsonite, natrolite, phillipsite, strontianite, and aragonite. Careful study of the unknown might rule out some of the above, but we can keep this whole list in mind.

The discoverer admitted that, this time, he had not run an acid test, and gave me three samples for identification. I removed a broken crystal about 0.2 mm long and immersed it in acid. It dissolved fairly slowly but steadily with effervescence. Thus, in a minute or two, it was clear that (a) the unknown was a carbonate and (b) it dissolved so slowly that it was not likely to be either strontianite or aragonite. Most of the other species in the above list were eliminated since they are not carbonates. Next, the indices of refraction and their directions with respect to the crystal axes were

looked up for dawsonite, strontianite and aragonite. Another damaged crystal was immersed in two index liquids matching the two indices of dawsonite most likely to be seen in lath shaped crystals of that mineral. The index match was perfect: the unknown is *dawsonite*, and cannot possibly be strontianite or aragonite, which have different indices and other optical properties. Elapsed time was perhaps two hours.

Subsequently, somewhat thicker crystals with complex terminations (Fig. 2-left) were examined using a homemade goniometer (Henderson, 1970). The faces observed were several common ones for dawsonite, plus the less common brachydome {031} as shown in the crystal drawing in Figure 2-right.

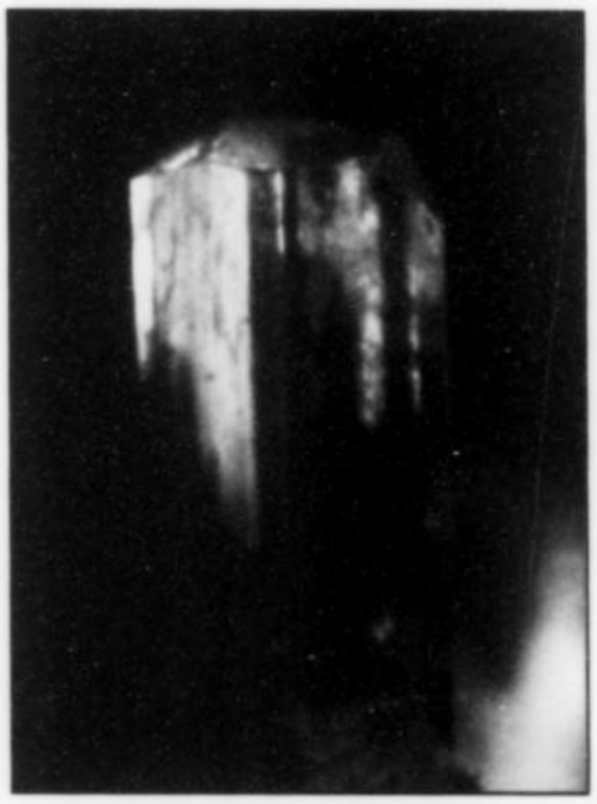


Figure 2. (left) **Columnar dawsonite with complex termination, 0.8 mm long; Poudrette quarry, Mont Saint-Hilaire, Quebec, Canada.** ***(right)*** **Crystal drawing of the dawsonite shown in Figure 2, exhibiting the forms *b*{010}, *c*{001}, *m*{110}, *d*{011} and *f*{031}. Drawn by R. Peter Richards.**

In another example, local collectors had acquired specimens of a compact, fibrous zeolite (assumed to be natrolite) from a roadcut near Reynold's Bridge in Connecticut (see Fig. 3). Of course, it could just as easily be any one of the acicular zeolites listed below with some of their optical properties.

Zeolite	*Extinction Angle, Degrees*	*Sign of Elongation*
Natrolite	0	+
Thomsonite	0	+/−
Scolecite	18	−
Mesolite	8	+

A single crystal fragment was examined and found to have negative elongation and an extinction angle of at least 15°. Thus, in less than five minutes, it could be shown that the mineral was probably *scolecite* and was *not* one of the other three. Another few minutes' work checking its indices of refraction showed that they fit scolecite. A club full of mineral collectors using sight identification alone could never have been sure of that mineral's identity. Shortly thereafter, the identification was confirmed using X-ray methods, and a new mineral was thus added to the species list for Connecticut.

Still another example of the usefulness of a polarizing microscope was found in studying a suite of rare and beautiful minerals collected at Mont Saint-Hilaire. These were collected from a

Figure 3. **Radiating, acicular scolecite in individual fibers to 3 cm, from Reynolds Bridge, Litchfield County, Connecticut.**

single, large block of nepheline syenite in August of 1996 by Mike Swanson and myself. Others had collected much the same material before us. The most sought-after species were sharp, hexagonal crystals of calcioburbankite and petersenite-(Ce) (Fig. 4). The former occurred as white, pale tan to pink outer layers of opaque material forming skins (apparently epitaxial) on white to colorless cores of the latter. Both are new species for which Mont Saint-

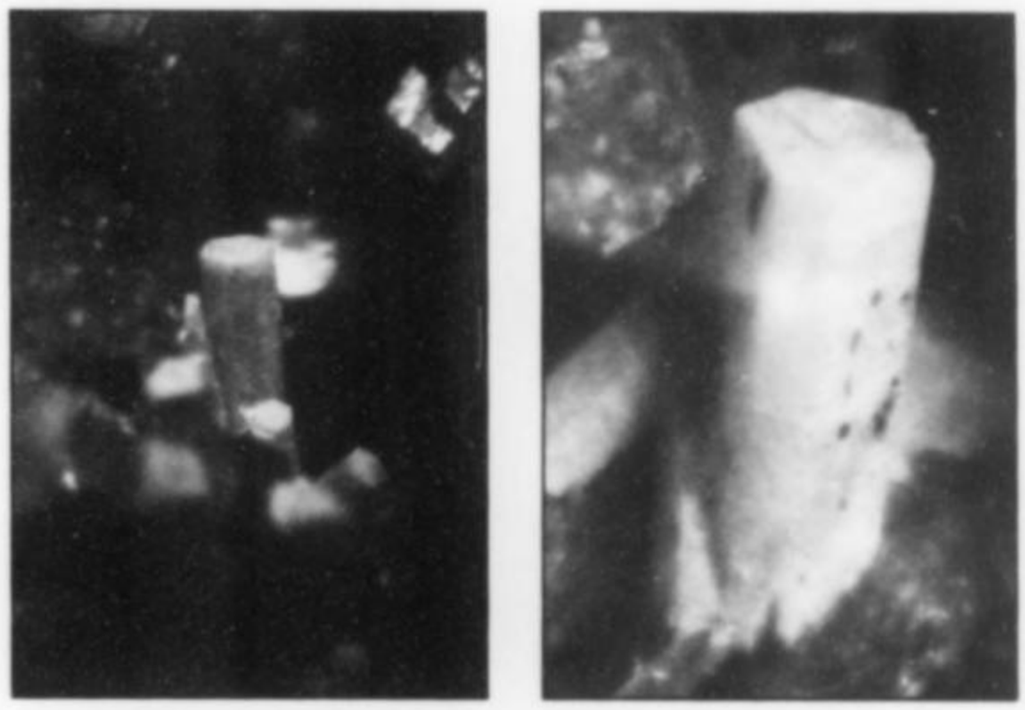


Figure 4. (left) **Calcioburbankite covering a core of petersenite-(Ce), 1.2 mm, from the Poudrette quarry, Mont Saint-Hilaire, Quebec, Canada.** ***(right)*** **Calcioburbankite/petersenite-(Ce) crystals, the largest 0.8 mm long, from the Poudrette quarry, Mont Saint-Hilaire, Quebec.**

Hilaire is the type locality. In the same type of rock are found large, sharp, *euhedral* crystals of gobbinsite, as in Figure 5. These are especially remarkable, as Tschernich (1992) states that gobbinsite occurs only in small laths or fibrous masses. Other associated minerals were aegirine, siderite, garronite, and an unknown, white, platy mineral. The last, shown in Figure 6, is of interest to us here.

It was quickly found by Mike Swanson that (a) the unknown is a carbonate (acid test again), and (b) it shows rare-earth absorption lines when a small spectroscope is inserted in the optical path of his binocular microscope. Subsequently, a qualitative EDX analysis without using standards showed the presence of significant amounts of REE (Ce predominant), carbon, and fluorine. Even with these limitations, and especially given the very large number of unknowns and undescribed species found at Mont Saint-Hilaire, it

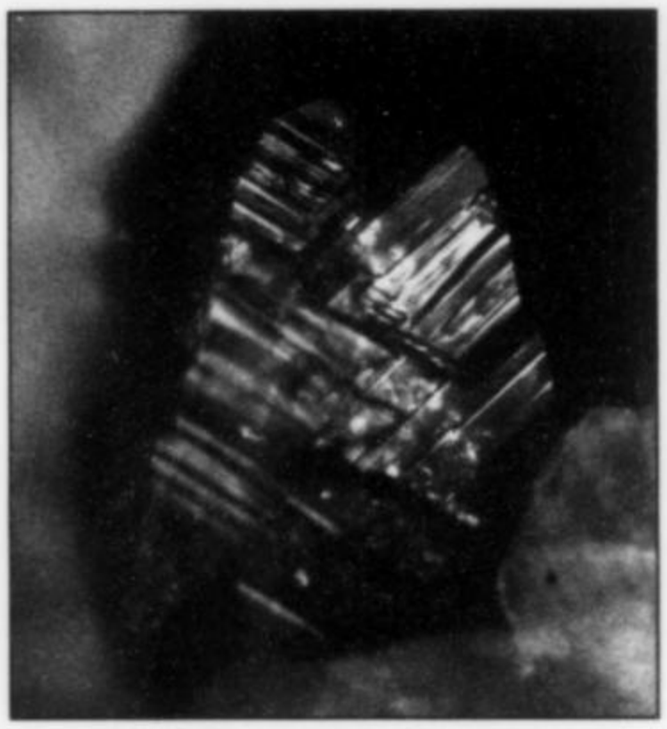


Figure 5. **Heavily striated, 1.5-mm crystal of gobbinsite, from the Poudrette quarry, Mont Saint-Hilaire, Quebec.**

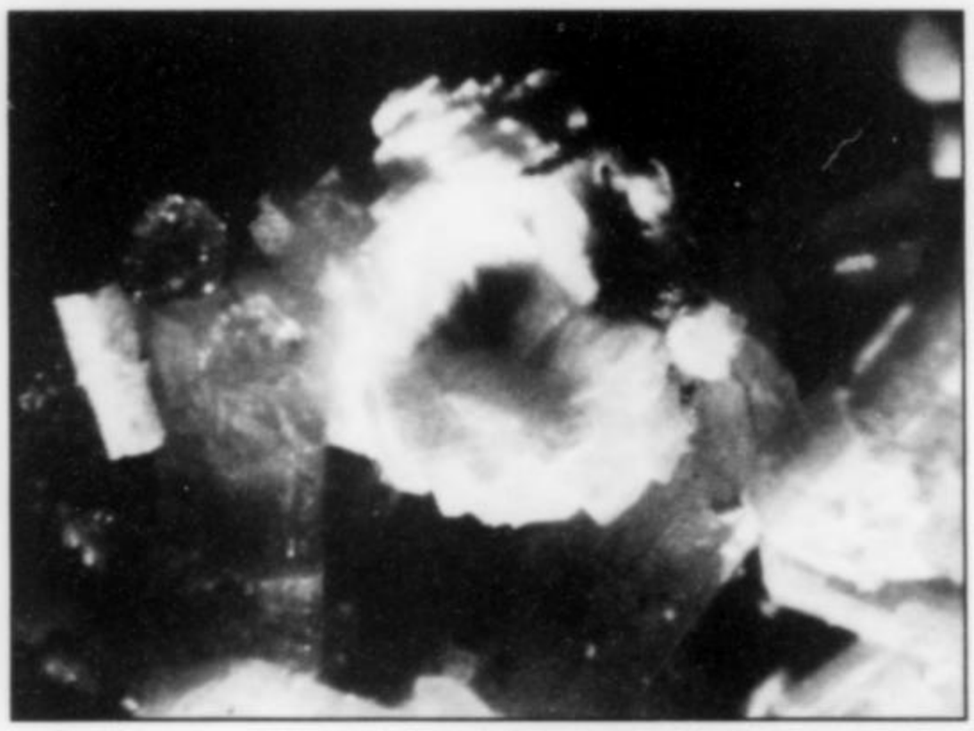
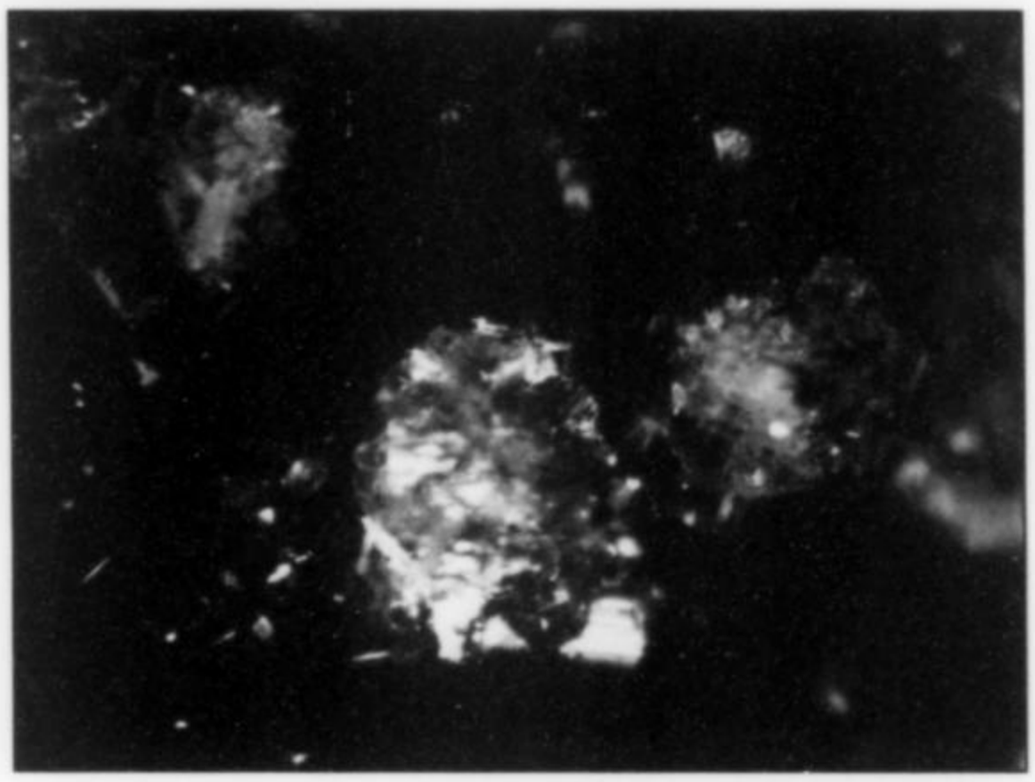


Figure 6. **A 1.8-mm rosette of lanthanite-(Ce) crystals, from the Poudrette quarry, Mont Saint-Hilaire, Quebec. Michael Swanson specimen.**

Figure 7. (below) **Clusters of twinned willhendersonite crystals to 0.2 mm in size, from Mayener Feld, Bellerberg, Eifel District, Germany.**



was impossible to identify the unknown by visual inspection. Identifying the unknown using the polarizing microscope was more difficult and time-consuming than previous examples (15–20 hours working time) because the largest faces of the crystals were either badly altered or coated with extraneous material, thus making it necessary to work on the extreme edges of a single, selected crystal. Further, it is always more difficult to identify a complete unknown than it is to distinguish between a small number of likely possibilities. However, it was found that it had remarkably low indices for a carbonate mineral, and that its indices matched those of *lanthanite-(Ce)* very closely. A sample was subsequently sent to Andy McDonald at Laurentian University, who ran the X-ray diffraction analysis of the unknown and confirmed the identification. Lanthanite-(Ce) is a new species for Mont Saint-Hilaire, and brings the total species list to about 364.

The last unknown to be discussed is one dear to my heart for reasons which will become obvious later. The specimen involved was sent to me in 1978 by Gianni Porcellini, an advanced collector living in Rimini, Italy, and was labeled, "Opale-Phillipsite-Gismondina, S. Venanzo Quarry, Terni, Umbria, Italy." Sure enough, the major species on the specimen was phillipsite, but there was also present a number of groups of blocky, rectangular, colorless crystals in groups which appeared to be highly twinned. These (see Fig. 8) did not look like any known zeolite, so I studied them using the polarizing microscope. The unknown appeared to be biaxial positive with a large 2V and had indices of approximately 1.512, 1.515 and 1.520. The indices were quite low, in the range expected for zeolites, but the data did not fit any known zeolite. Consequently, I sent a sample to Pete J. Dunn at the Smithsonian Institution in Washington, D.C., and suggested that it might be a new zeolite. A few weeks later, he called to tell me that it was indeed new, and when finally published, it was named *willhendersonite*! The mineral is now known from three localities in Europe: the type locality in Italy; various quarries in the Eifel District of Germany including the Ettringer Bellerberg near Mayen (Fig. 7); and Stradner Kogel, near Gleichenberg, Steirmark, Austria.

Figure 8. **Highly twinned, boxlike, 1.2-mm group of willhendersonite crystals, from the San Venanzo quarry, Terni, Umbria, Italy.**

CONCLUSION

I hope this column will convince readers to use the acid test more frequently and skillfully. And, who knows? Perhaps a few readers will attempt the challenge of learning to use a polarizing microscope. As can be seen, the practical advantages derived in terms of identifying unknowns, advancing mineralogical knowledge, etc., are considerable. In addition, the plain satisfaction of discovering things by yourself and the esthetic enjoyment of the beautiful color displays of crystals as seen through the polarizing microscope make its use even more of a pleasure.

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Wm. A. Henderson, Jr.
47 Robin Ridge Drive
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Letters

BOLÉO

Ed. Note: At the conclusion of Ed Swoboda's article we added a note about Bonni Mackintosh's find of cumengite. Like so much of the anecdotal collecting history surrounding famous localities, it was third-hand information containing some inaccuracies. In the letter below, Ms. Mackintosh sets the record straight about her discovery.

Your note stated that I am not a collector, but in fact I have collected minerals and fossils for 36 years, and have twice served as secretary for the Mineral Division of the San Diego Mineral and Gem Society. The find was not accidental. I had studied the U.S.G.S. Paper 273 on the Boléo district, especially the maps covering the area around the Amelia mine. Driving two days from San Diego, then going off-road, and finally hiking the last kilometers brought me to the site I had selected. The grueling heat in the desolate Arroyo de la Soledad is not inviting to the accidental collector.

I did indeed find hundreds of cumengite sixlings, and carefully noted the exact location. Along with my husband and two children, I have made a number of collecting trips back to the same site since my original discovery there in 1994. We worked like dogs to recover additional specimens, but the thrill of finding rare cumengites made this work pure joy. I sold only a part of what we found, and kept others.

Incidentally, we also found a few interesting cerussite crystals with the cumengites and boléites. On page 38 of the Boléo issue the authors state that early French mineralogists noted cerussite but did not describe it; our find confirms the occurrence.

Thank you for agreeing to correct the published remarks, and also for conceiving the special Boléo issue and the Mexico series. I'm sending off immediately for a new subscription to the *Mineralogical Record*.

Bonni Mackintosh
La Salida Gems & Minerals
San Diego, CA

COMPUTER PROBLEM

In 1994 I purchased a computer program for cataloging my mineral collection: the MINLOG System, designed by Jim Beaver of Beaver Software. Because it was programmed to operate through *Windows 3.1*, it will not run with the new *Windows 95*. Mr. Beaver is no longer available to provide upgrades. Does any *Mineralogical Record* subscriber have the necessary MINLOG disc(s) for the upgrade to *Windows 95*? I would certainly be willing to pay anyone who can help me get the program running, so that I can utilize the information already entered in my computer.

Donald L. Schuder
R.R. 1, Box 424
Calumet, MI 49913-4759

FRENCH TORBERNITE

A large number of fine torbernite specimens were recovered recently at the old locality of Margabal, near Entraygues, Aveyron, in the South of France. The occurrence was originally discovered in the late 1950's, during exploration for uranium

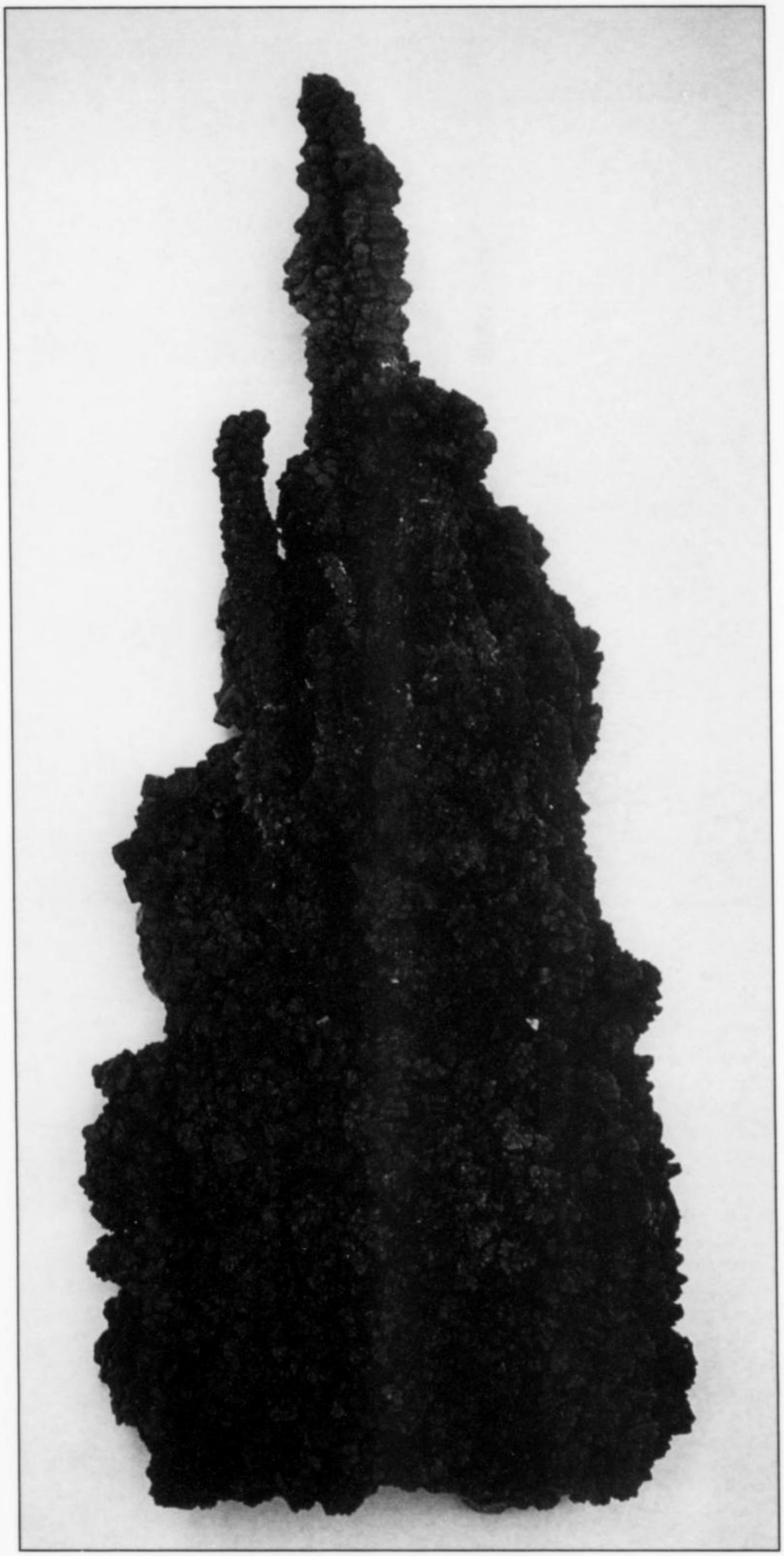


Figure 1. **Torbernite crystal stalactite, 47 cm, found in August 1997 at Margabal, Aveyron, France.**

sponsored by the CEA (French Atomic Energy Commission). At that time, very few specimens were recovered, but their high quality established the reputation of the find. [Editor's note: A fine example is illustrated on page 222 of Paul Desautels' famous 1968 book, *The Mineral Kingdom*; he refers to the material as being "unavailable to collectors."] Crystals up to 2.5 cm on edge were found in clusters on matrix up to 10 cm across, in colors ranging from deep green to blackish green. The cores of the Margabal crystals are in some cases actually autunite.

In June 1997 a new strike was made at the old occurrence, resulting in about 1,000 specimens being offered for sale at the Sainte-Marie-aux-Mines Show on June 26–29. Crystals of torbernite up to 2 cm were found, some of them perched on smoky quartz, as were many of the 1950's specimens. Then, in August of 1997, four more pockets were hit which yielded over 1,700 additional specimens, with crystals up to 3.4 cm (1.5 inches!)

The most extraordinary of the August specimens is a stalactitic cluster measuring 47 cm tall (18.5 inches) by 7 x 19 cm. It is entirely composed of torbernite crystals to 2 cm on edge, and even shows a central solution channel.

This exceptional specimen, unique in French mineralogical history, was acquired by the National Museum of Natural History in Paris, thanks to the patronage of the Elf Foundation. It is now on permanent exhibit in the Museum entrance, as part of the current thematic exhibition on radioactivity. Additional information is available from assistant curator Pierre-Jacques Chiappero (E-mail: chiapper@mnhn.fr).

Pierre-Nicolas Schwab
Paris, France

FAN MAIL

I'd like to take this opportunity to thank you for your magnificent publication. I've been enjoying it for years, and look forward to each issue with anticipation. You have added a higher dimension to my collecting experiences and to my personal collection. Thanks for enriching a very personally pleasing aspect of my life.

I am delighted that you are undertaking the special series of Mexico Issues. I have a number of specimens from Naica, Santa Eulalia and Mapimi that I would like to know more about. Hopefully you will touch on some of these areas in the upcoming issues.

Fred Hurd
Las Cruces, NM

That is our intention. Ed.

Figure 2. **Torbernite crystal group on matrix, about 8 cm, found in the late 1950's at Margabal, Aveyron, France. Photo by Lee Boltin, from Paul Desautels' *The Mineral Kingdom* (1968).**

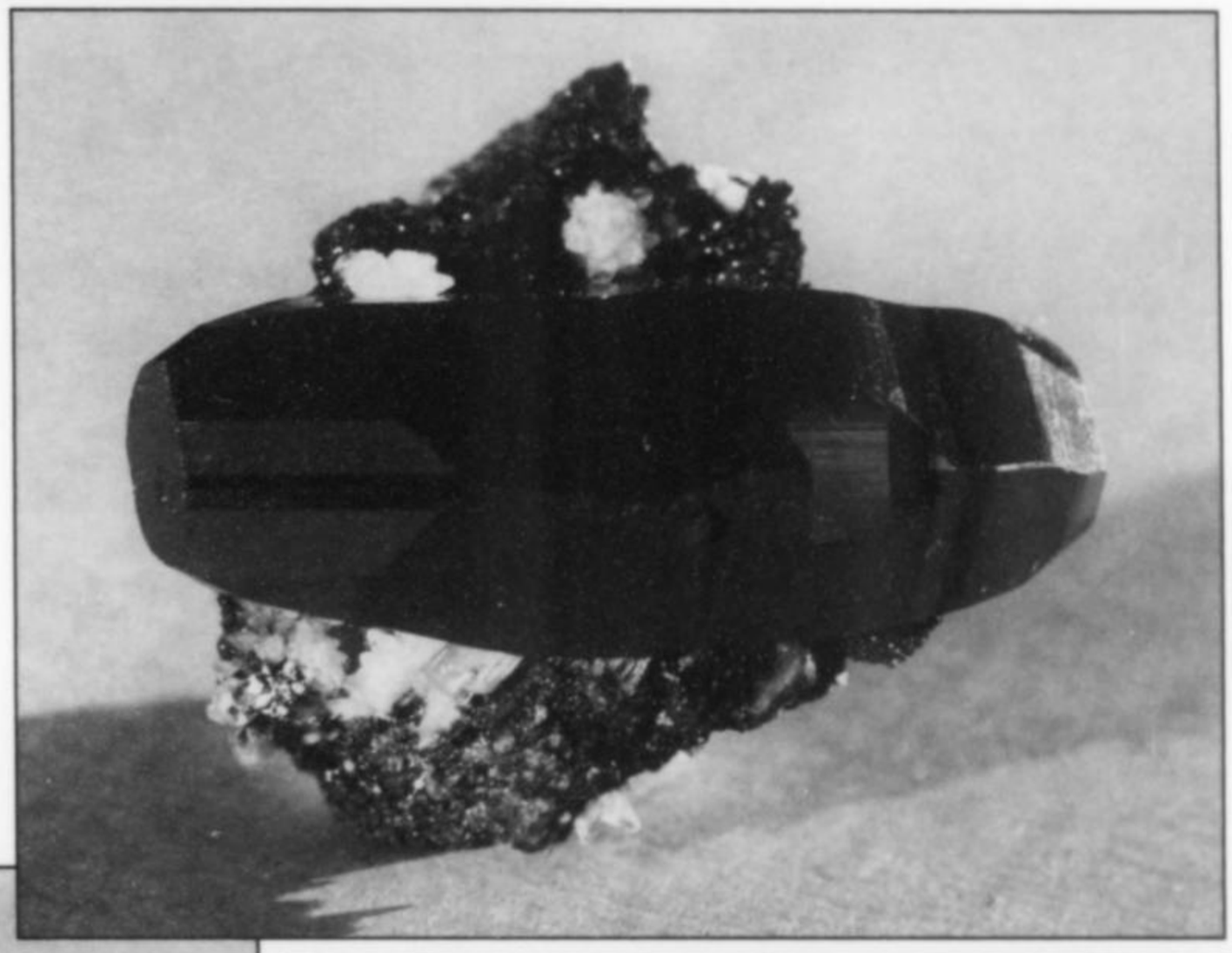
Figure 4. **Doubly terminated hematite crystal, 4 cm, on matrix with white calcite, from the N'Chwaning II mine, Kuruman, South Africa. Colin R. Owen specimen, collected February 1998.**

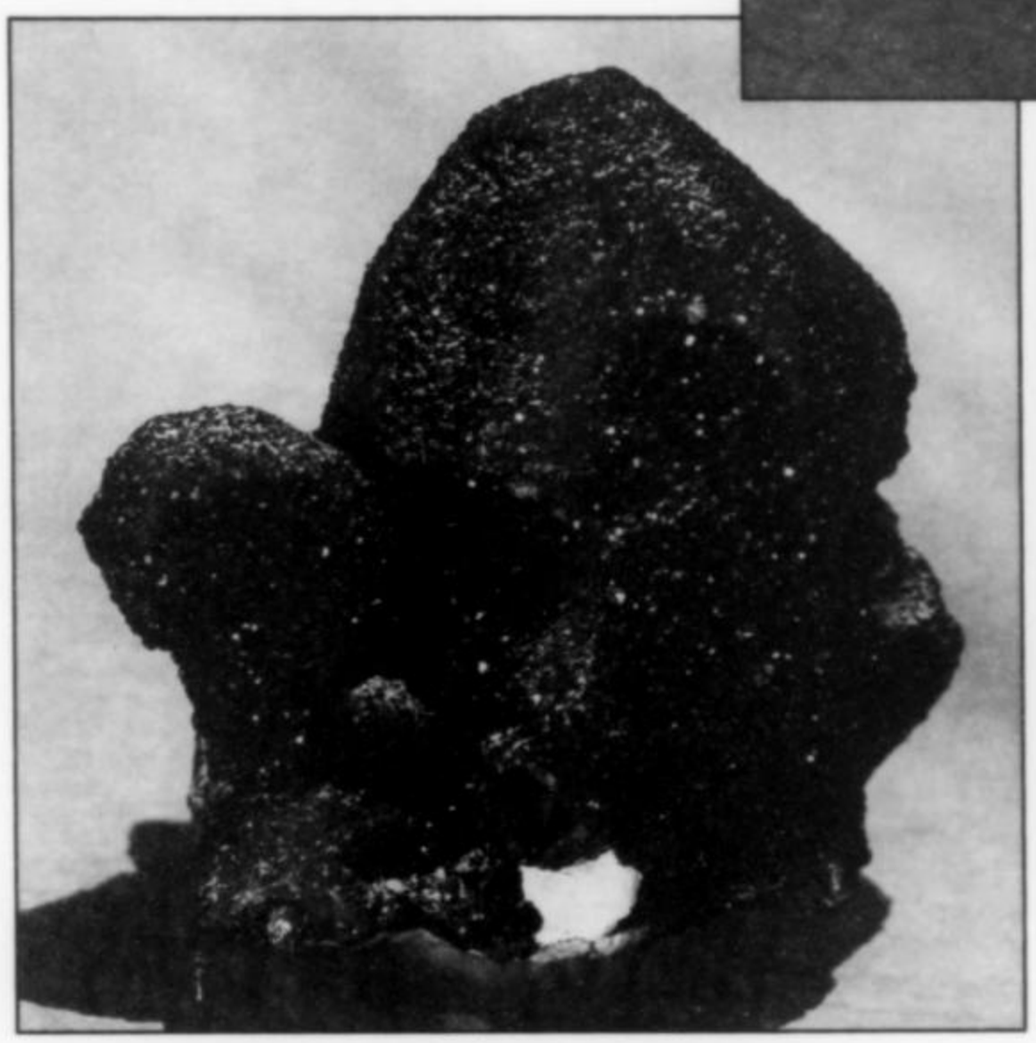
N'CHWANING MINERALS

While at the last Tucson Show I showed you [the editor] some rare N'Chwaning mine specimens, and you asked about photos. Here are several, as requested. Note that the calcite ball is from the N'Chwaning *I* mine (not *II*); that mine is the source of all the nice red rhodochrosites that came out years ago. Mining is again under way at the N'Chwaning I, and just last week a pocket of pink rhodochrosites came out. We are all now waiting for some more RED!

Colin R. Owen
Somerset West, South Africa

Figure 3. **Hematite crystals coated with drusy red andradite, 4.2 cm, from the N'Chwaning II mine, Kuruman, South Africa. Colin R. Owen specimen, collected October 1997.**





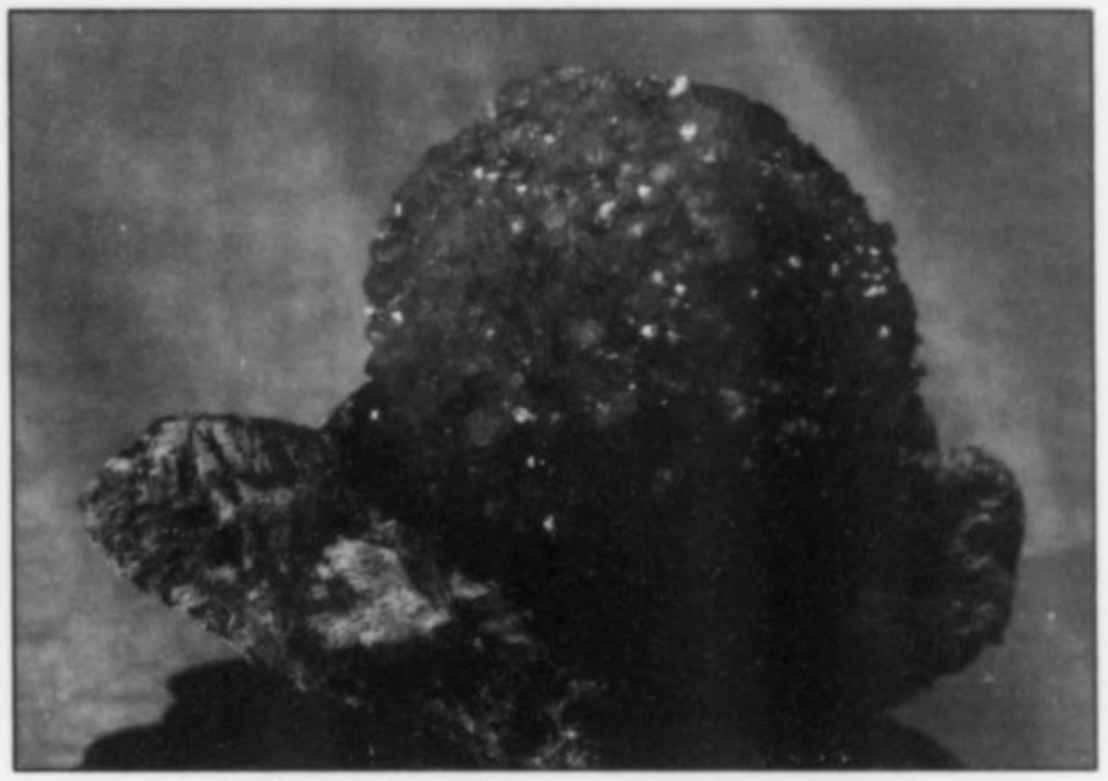


Figure 5. **Ball of gray calcite crystals on matrix, 3 cm, from the N'Chwaning I mine, Kuruman, South Africa. Colin R. Owen specimen, collected February 1998.**

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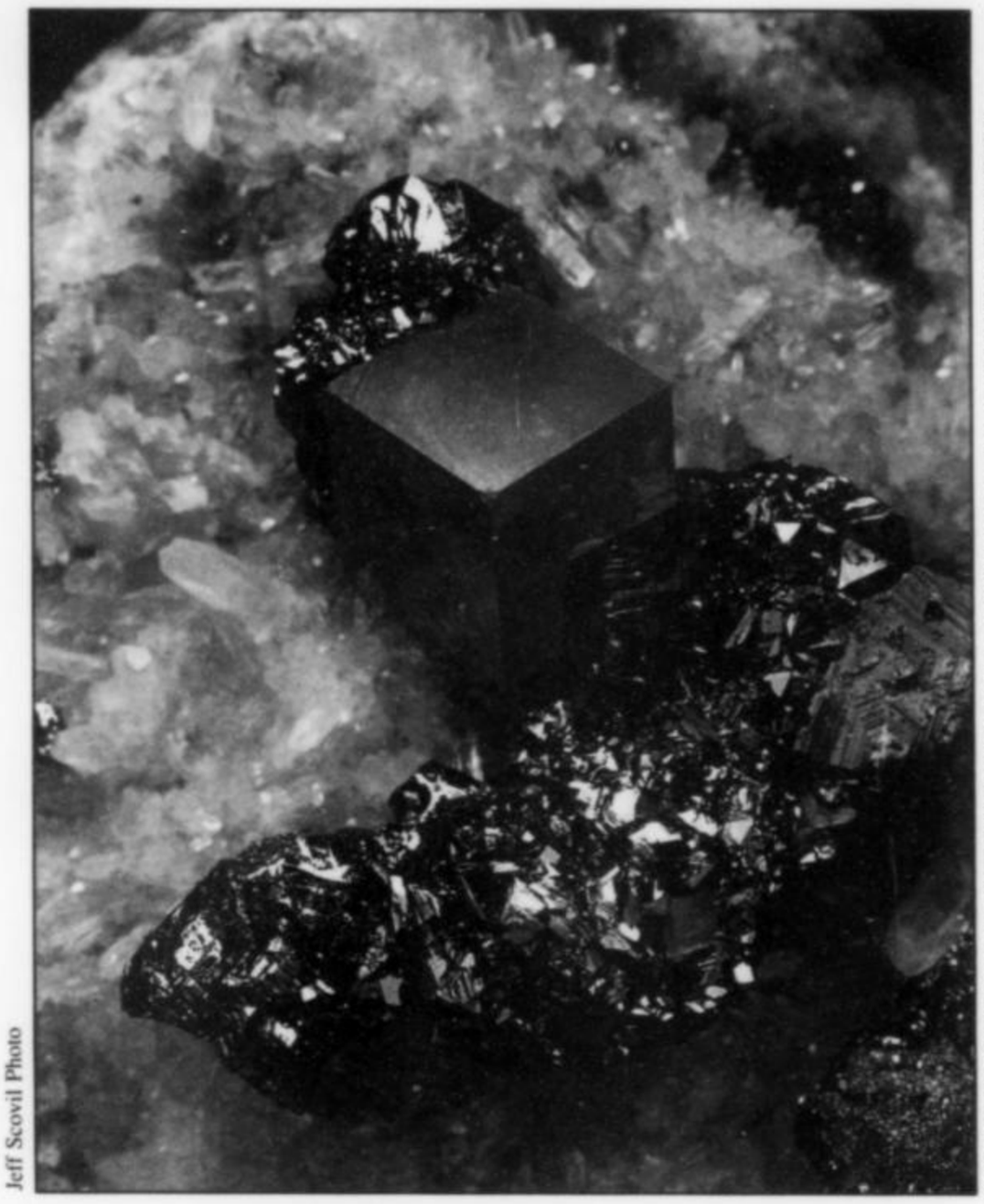

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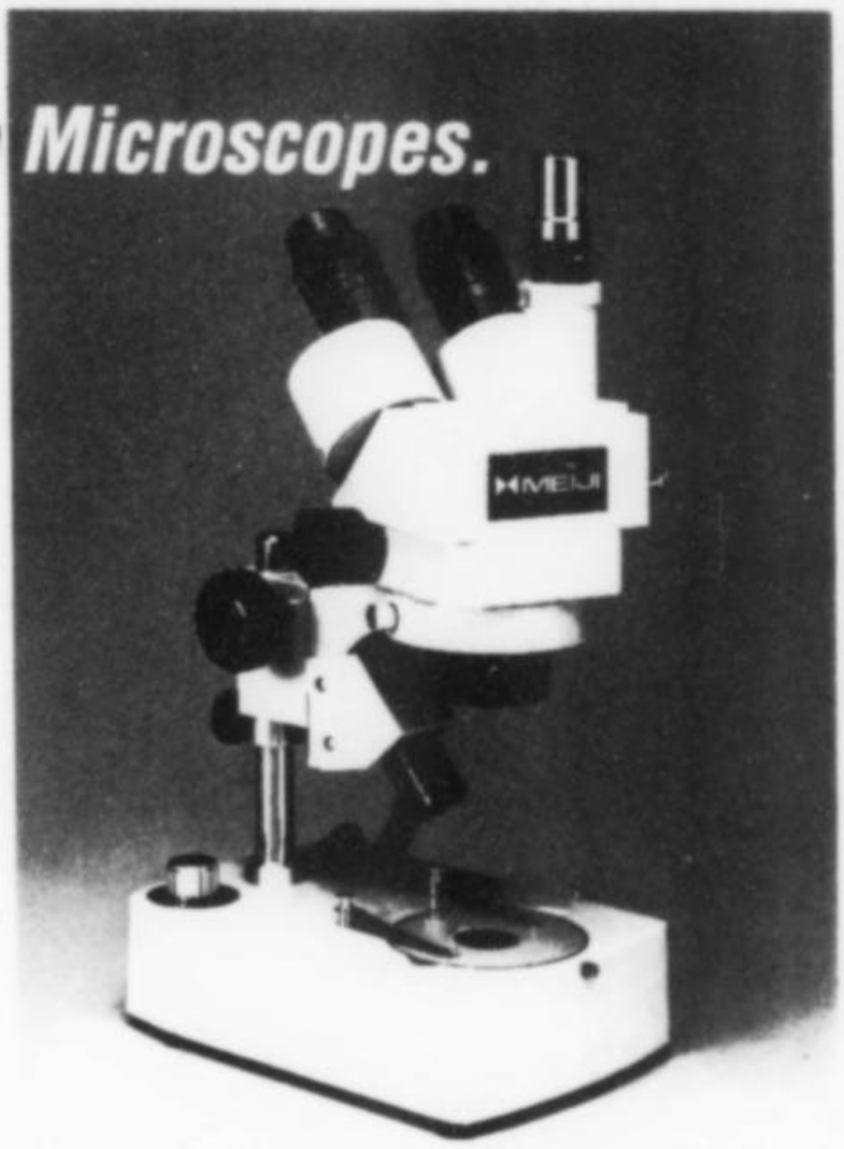

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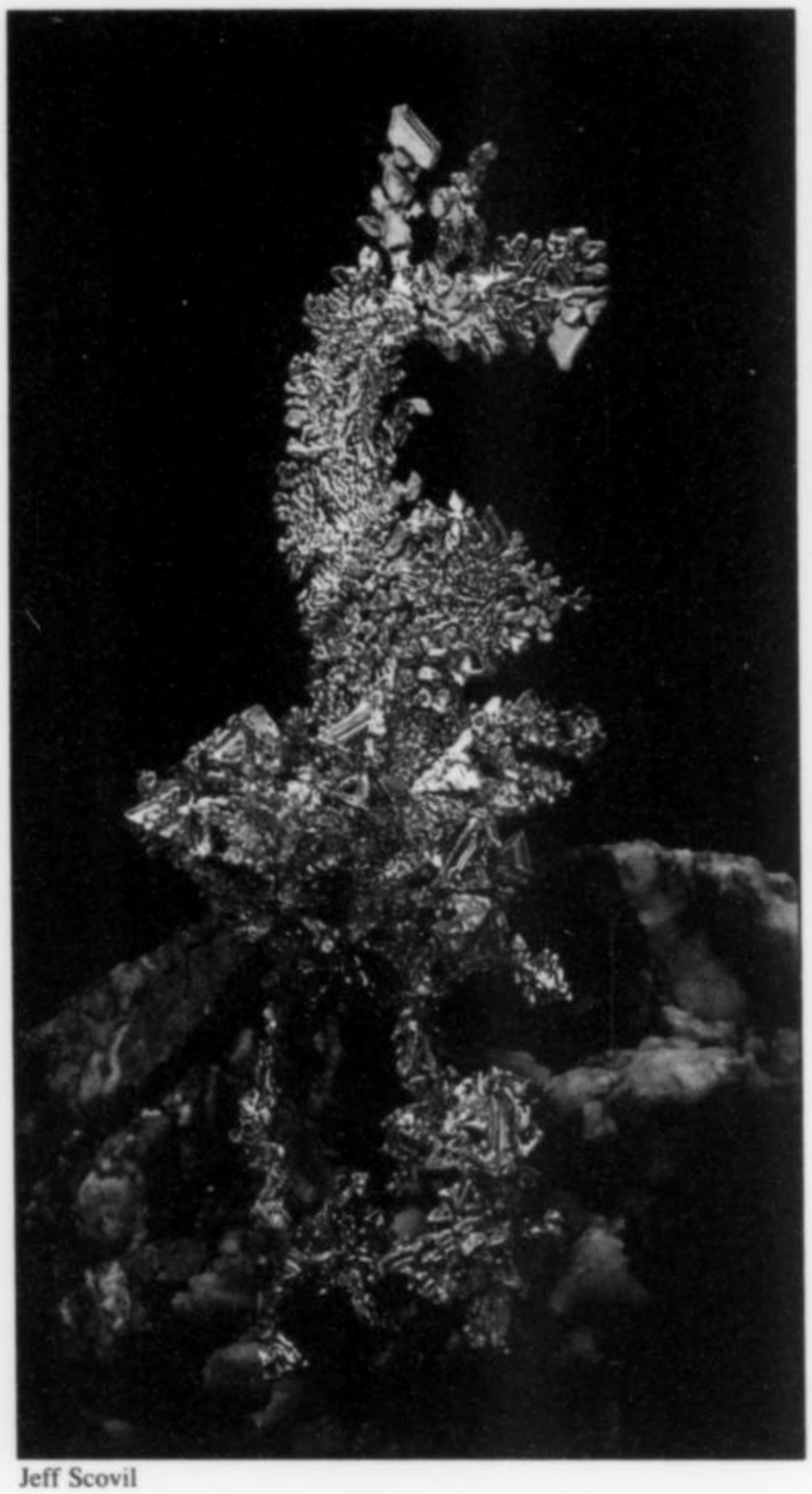

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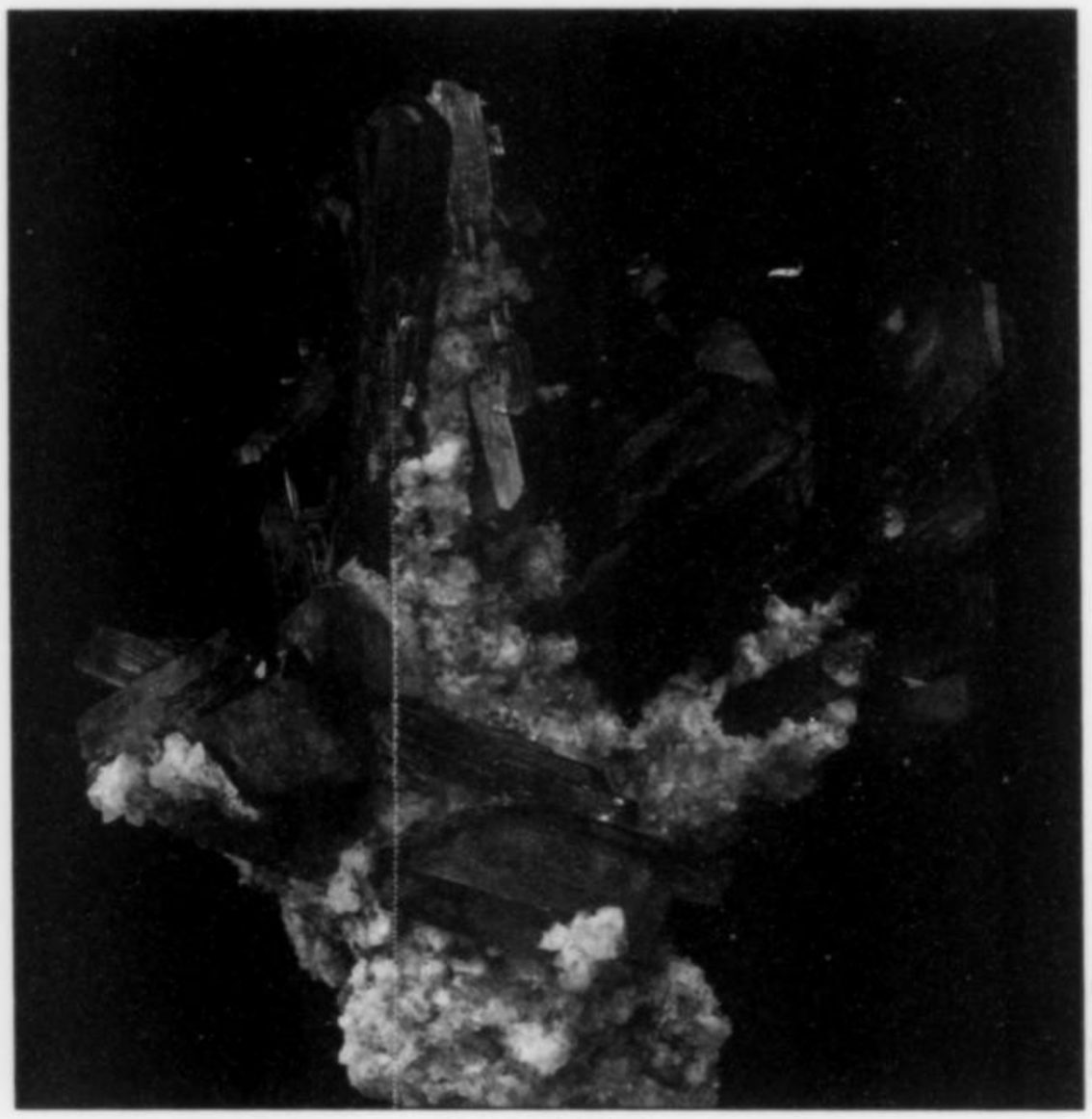

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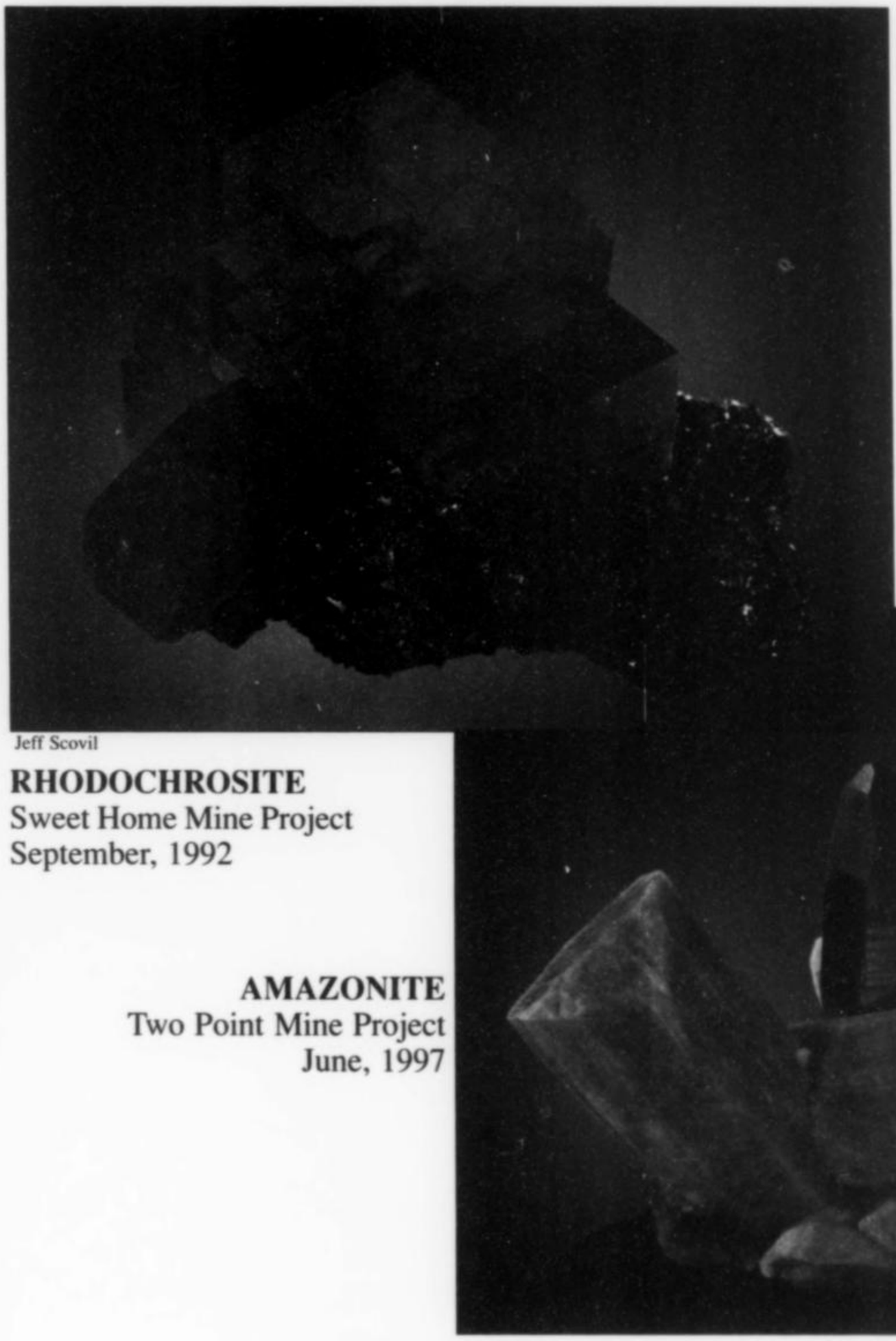

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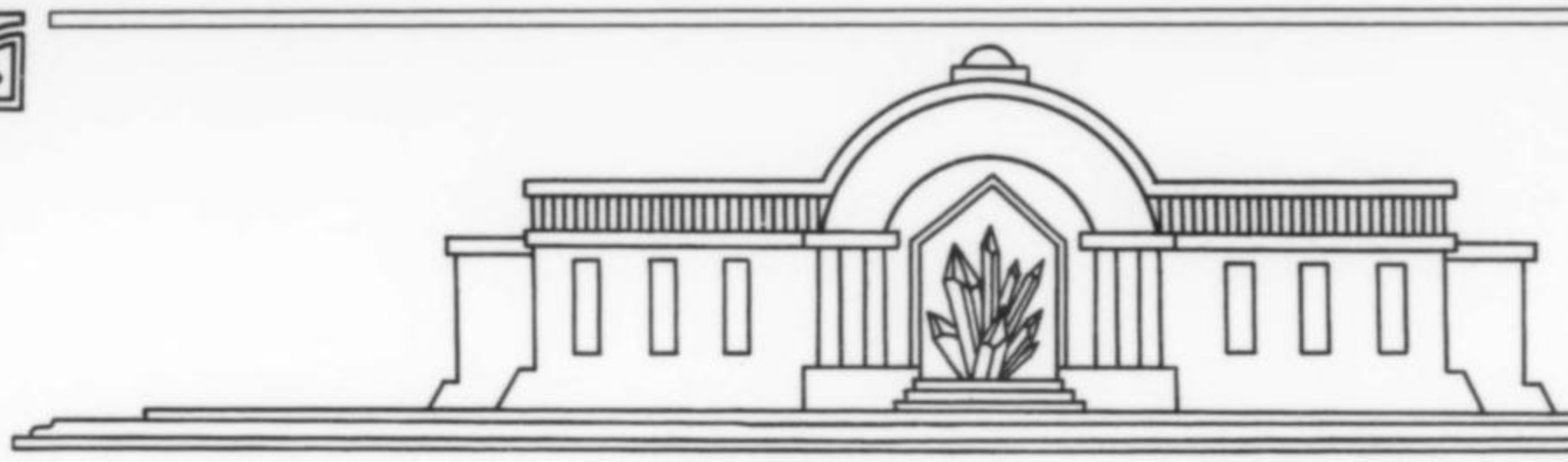

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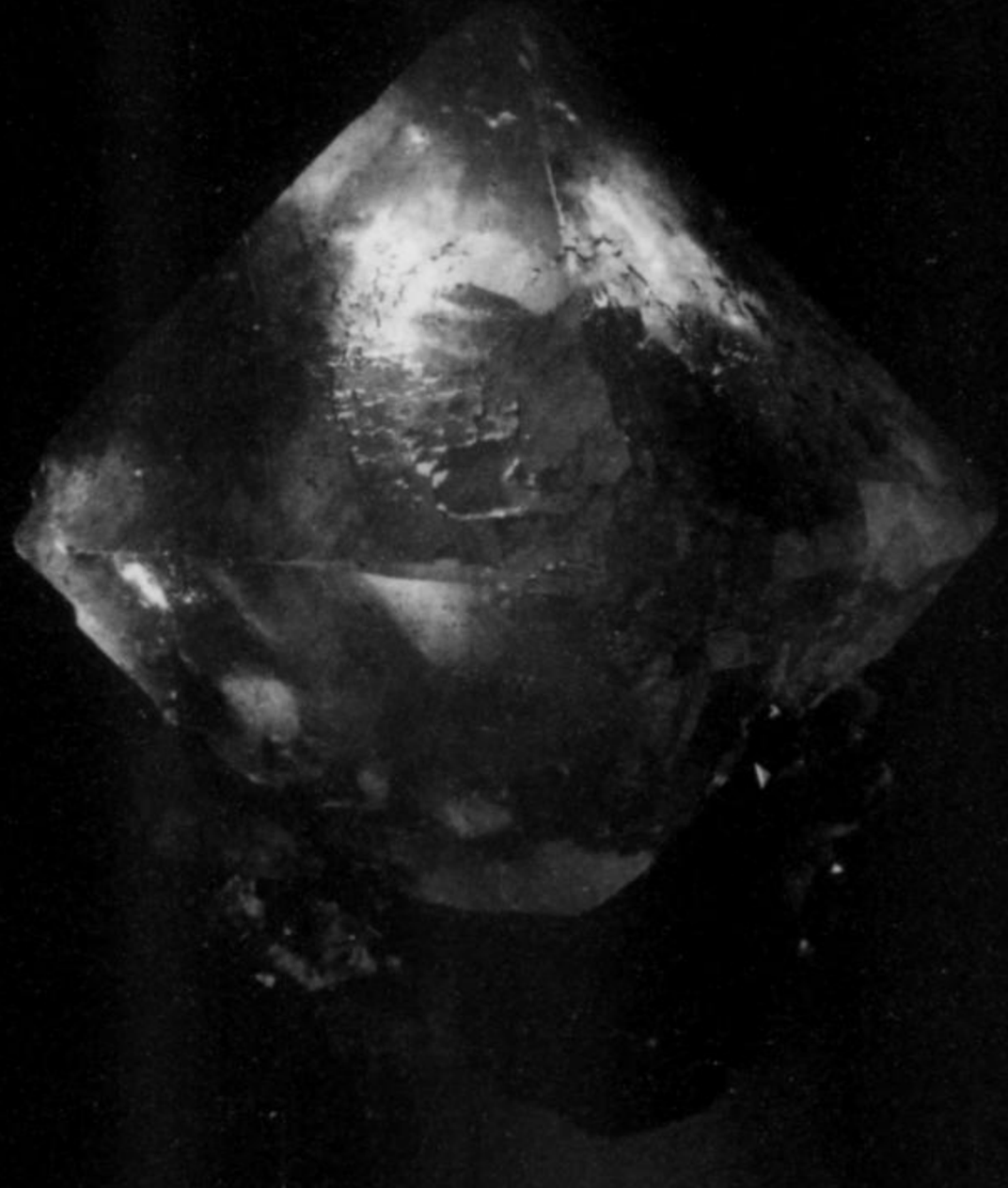

Fluorite. Huanzala Mine, Dos de Mayo Prov., Peru. Photo by Jeff Scovill.

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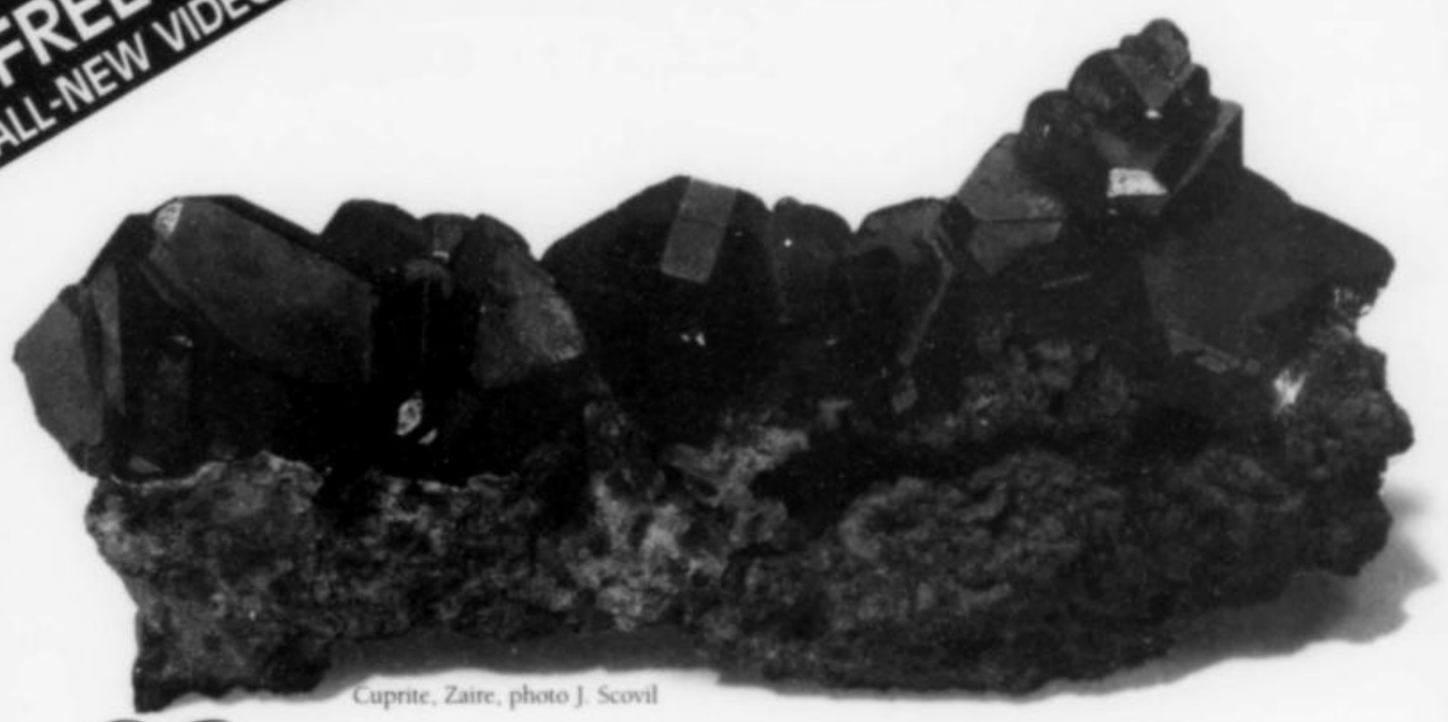

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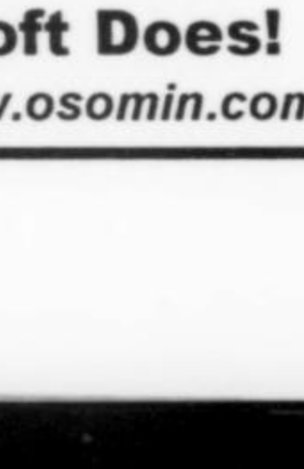
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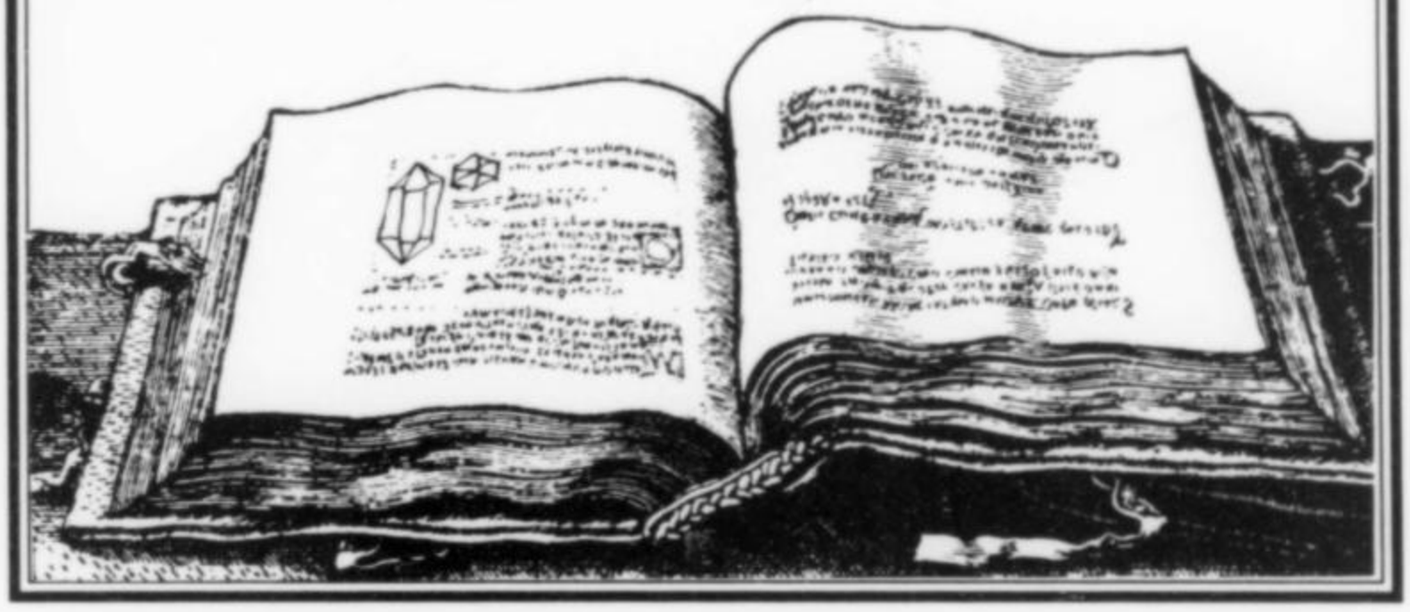

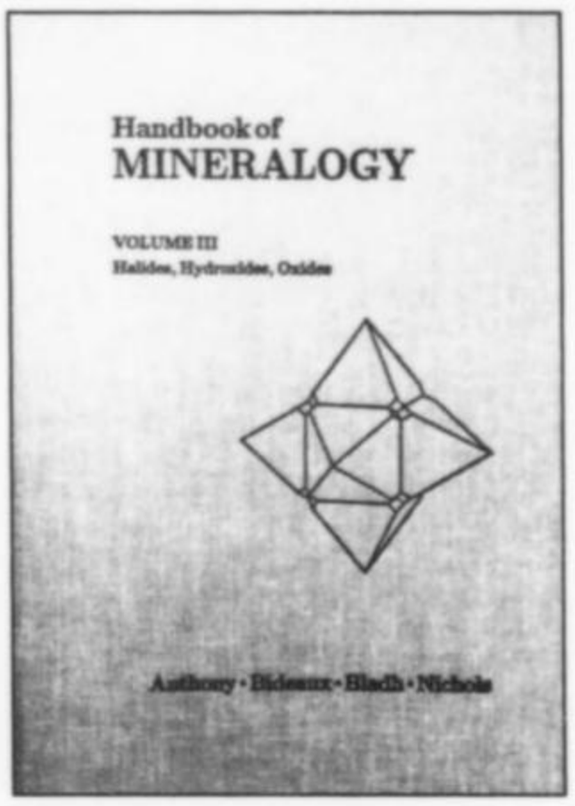

Handbook of Mineralogy

Volume III: *by John W. Anthony, Richard A. Bideaux, Kenneth W. Bladh, and Monte C. Nichols. Published (1997) by Mineral Data Publishing, P.O. Box 37072, Tucson, Arizona 85740. Hardcover, buckram, without dustcovers, 18 x 26 cm, 628 plus ix pages, ISBN 0-9622097-2-4. $100 plus $6 shipping and handling.*

The *Handbook of Mineralogy*, Volume III, is superb. This great work is already well established as the definitive reference work in mineralogy, and this is the third volume of the five projected. The first volume, on elements, sulfides and sulfosalts, was published in 1990 and reviewed in the *Mineralogical Record*, **22**, 59–60. The second volume, on silica and silicate minerals, was published in 1995 in two books, and reviewed in the *Mineralogical Record*, **26**, 563.

Volume III is devoted to **halides, hydroxides and oxides**, and presents the data in the order of: crystal data, physical properties, optical properties, cell data, X-ray data, chemistry, occurrence (geological), association, distribution, name, type material and references. The very well written introduction eases the reader into a species page, explains the approach of the authors, and does not presume a familiarity with the previous volumes. This is a stand-alone book as well as part of a set.

Careful reviews of many selected entries turned up no typographical errors (or any other kind of errors) and much in the way of very interesting new knowledge. This volume, like those that preceded it, is a valuable tome. The collector will delight in its listings of localities for each species, and will probably be surprised at how much new information is presented. The mineralogist will find needed data, and, most importantly, will treasure the reference sections, current through 1996, and including some new minerals present or abstracted in *American Mineralogist* in 1997. This careful ingredient, the provision of carefully chosen, up-to-date references, too often treated cavalierly, carelessly, or worse in some compendia, is a jewel-like feature of the *Handbook*.

Two aspects of this work stand out. The first is the very obvious diligence of the writers in being extremely careful. Again and again, one sees careful work; one is aware that this is a compilation done with caution, a very high degree of professionalism and intimate teamwork. It is not sloppy in any way at all. The reader has a sense that this work was put together with much respect for the concept of "doing things right." The work is internally consistent and wholly consistent with the preceding volumes of the *Handbook*. Those who own the preceding volumes will see no changes; it fits like a glove with its brethren.

The second outstanding aspect of this work is the very high quality of its publication. The book is comfortable to hold. The pages are stark white and durable, and any print-through is truly minimal and not at all distracting. The book lies flat when open, is sturdily bound, and has a real essence of quality. When I opened the package and removed this book, I had a friend in hand, one I want to keep forever.

Pete J. Dunn
Smithsonian Institution

Mineralien finden in den Vogesen

*["**Mineral Collecting in Vosges**"] by Artur Wittern and Jean-Renaud Journée. Published (1997) by Sven von Loga, Köln. Softcover, 160 pp., 11 x 21 cm, ISBN 3-87351-255-0, price: DM 24.00.*

A useful field guide to the minerals of the Vosges area which straddles the border between France and Germany. Short introductory chapters describe the general geology and mineralization; the text then outlines 40 areas with maps and details of how to reach mineral sites. Local mineralization is given in each case. Area descriptions are followed by an alphabetical list of minerals with their chemical composition and crystal system given. A glossary and 47-entry bibliography complete a useful pocket-sized survey.

Michael O'Donoghue

Sarrabus, miniere e minerali

*["**Mines and Minerals of Sarrabus**"] by Paolo Stara, Roberto Rizzo and Giancarlo Brizzi. Published (1993) by the Associazione Mineralogica Sarda and seven other mineral organizations, under the patronage of the Comune di San Vito, Sarrabu, Cagliari, and of the Ente Minerario Sarda, Cagliari. Hardcover, 208 pp., 17.5 x 24.5 cm, illustrated in color. Price on application.*

Sarrabus, in the southeastern portion of the island of Sardinia, is best known to mineralogists for the gold-silver lode and its associated mineralization. This well-illustrated survey discusses the geology and mineralization of the area before describing a dozen or so itineraries and a full descriptive list of minerals in chemical order. The book is especially notable for its generous provision of maps, some of which are in

color. There is a bibliography of over five pages. A good deal of cooperation between a number of interested groups has finally produced an excellent field and academic guide.

M.O'D

Die Mineralien und Fundstellen von Schweden

*["**The Minerals and Mineral Deposits of Sweden**"] by Hans-Jürgen Wilke. Published (1997) by Christian Weise Verlag, Orleansstr. 69, D-81667 München, Germany. Hardcover, 200 pp., 21.5 x 30 cm, ISBN 3-921656-41-9, price: DM 80.00.*

Printed in the A4 format, this is a masterly survey of Sweden's mineral deposits and the species they host. Readers will need no reminding that four chemical elements take their names from Ytterby in the Stockholm area, nor that the Långban deposit is also in Sweden. With these points in mind, we can look at the organization of the book.

Unusually and most usefully, the first three pages of text refer the reader to the sheets of the Swedish geological map series and, both for this purpose and for the remainder of the text, data is organized into four divisions, south Sweden, south-central Sweden, north-central Sweden and north Sweden. All the reader has to do is to find the appropriate portion of the text dealing with the area of interest and then turn to pages 3 through 5 to find the number of the sheets which will illustrate the relevant geology. This most useful start leads to a short general discussion of the geology of Sweden, here, as with the deposits throughout the book, accompanied by black-and-white sketch maps.

The geographical discussion of mineral deposits begins on page 12 and continues to page 172; after this comes a glossary, a list with addresses of the geological societies and clubs in the country (in the same geographical arrangement), with telephone numbers provided; and a 10-page bibliography, one of the most comprehensive I have yet to see, even from this publisher who is always reliable in this context. The references are arranged in the same geographical order and then by province. Finally there are locality and subject indexes; a useful feature is the inclusion of the province name after the site name.

The mineral deposits are precisely located as well as being shown on the sketch maps. In all instances there is a short note on the geology of the area, which precedes a discussion of the mineralization. A list of the species to be found completes each entry, and every so often a set of color photographs, averaging three to a page, brightens the text. Both the black-and-white and the color photographs are of good quality.

The book is most attractively printed and quite strongly bound. Readers from all parts of the world will welcome this survey of a country whose minerals are not always spectacular but which are of special importance to the history of mineralogy and of chemistry.

M.O'D

Perticara: La miniera di zolfo, la sua gente

*["**Perticara: The Sulfur Mines and their People**"] by Ido Rinaldi. Published (1988) by Pazzini Ind. Grafica s.r.l., Via dei Martiri 65, Verucchio (Fo). Softcover, 218 pp., 20 x 21 cm, with color maps inserted loose; price on application.*

Although nearly ten years old and really a mining history rather than a mineralogy, this interesting work may be worth noting for *Mineralogical Record* readers.

Sulfur mining has taken place in the Perticara area (Pescara province of northeastern Italy) since the middle of the 18th century. Located in the Bologna mineralogical province and situated southeast of that city, the mines lie in the gypsum-sulfur formation of the Upper Miocene. Since they are hard to find on maps, not being shown on the 1 :500,000 (sheet 2) of *Carta geologica d'Italia* [look for Santa Agata for the closest citation], the present book is valuable as a guide to the area.

The geology of the sulfur deposit is described, and there are close details of the mine galleries and methods of working. A social and financial history of the operations of the Montecatini company is given as well; this company worked the mines between the two world wars. Perticara was the major sulfur producer in Italy and, at the height of its production, employed around 1600 workers.

M.O'D.

Mineralien-Fundstellen in der Tchechischen und Slowakischen Republik

*["**Mineral Localities in the Czech and Slovakian Republics**"] by Petr Paulíš and Reiner Haake. Published (1997) by Bode Verlag, Oerter Pütt 28, D-45721 Haltern, Germany. Softcover, 96 pp., 11 x 21 cm, ISBN 3-925094-51-2, illustrated in black-and-white; price: DM 19.80.*

The main mineral collecting sites in the neighboring Czech and Slovakian republics are listed and briefly described, each entry consisting of a black-and-white photograph, a sketch map and details of the mineralization and of the species found. Maps of each country, placed at the beginning of the book, show the locations by numbers, which then have to be referred to a list which gives the appropriate page number. There is no geographical or species list but a bibliography cites many useful references, largely in those journals which are linguistically inaccessible to English-speaking readers. Despite some user difficulties and the absence of color photographs, the book should be welcome as a survey of these locations which are less well-known than they ought to be.

M.O'D.

Gemme del Vicentino

*["**Gems of Vicenza**"] by M. Boscardin and O. V. Tescari. Published (1996) by Museo Civico "G. Zannato," Montecchio Maggiore, Italy; available through the Museum and through Christian Weise Verlag, Orleansstr. 69, D-81667 München, Germany. Softcover, 114 pp., 17 x 24 cm; price: L12,000.*

Though the specimens illustrated are fashioned, this is not a gemmological text but an account of the minerals of the Vicenza area of northeastern Italy. Well-illustrated specimens come from the collections of the Museo Civico "G. Zannato" at Montecchio Maggiore. Specimens are described in chemical order with an account of their type of occurrence and in some cases an investigation of their composition. A useful guide for both mineral collector and gemmologist.

M.O'D.

Mani-Málá, or a Treatise on Gems

by Sourindro Mohun Tagore. Reprinted (1997?) from the first edition of 1879 by Nandkishor A. Barot, P.O. Box 47928, Nairobi, Kenya. Two vols., 15 x 21 cm. Price on application.

This is the ultimate lore and legend book on the gem minerals as far as south Asia is concerned. Before the prospective reader turns away from the text he should know that many of the terms still in use today (and not only in India and Sri Lanka) are spelled out and attributed here and only here, since this is one of the very few translations into English from the vernacular of any gem/mineral books from Asia. The text leaps about fairly randomly but attractively, from color descriptions to medicinal and magical properties to sections in which minerals are described in terms easily recognizable today. Details of fa-

mous stones are given in a number of places and, for the Sanskrit scholar, that text is provided in parallel with the English. The original is scarcely ever obtainable and only then at a very high price. For some reason, one part (of the two) is often bound alone, though at a glance the whole book may appear to be complete. This reprint includes both parts.

M.O'D.

Gold im Herzen Europa: Gewinning, Bearbeitung, Verwendung. Aufsatz und Katalog.

*["**Gold in the Heart of Europe: Extraction, Treatment, Use. Essay and Catalog**"] Published (1996) by the Bergbau- und Industriemuseums Ostbayern in Kümmersbruck, Germany, as vol. 34 of their Publication Series* (Schriftenreihe). *Softcover, 294 pp., 21.5 x 23 cm, illustrated in color, ISBN 3-925690-33-6; price postpaid: DM 44. The Museum is located in Schloss Theuern, Portnerstrasse 1, D-92245 Kümmersbruck, Germany.*

Based on the catalog of a museum exhibition of gold artifacts and gold mining equipment and of reproductions from early mining texts, this treatment of the gold produced from southern Germany and a few neighboring states will be of considerable value to all with an interest in gold and in early mining. Chapters by a number of different authors cover gold coins, gold as a vehicle for applied art, and the history of gold mining and techniques. Each chapter has its own bibliography and some of the lists are very extensive. Despite the title, eastern Bavaria is not the only area covered!

Items in the catalog (some reproduced in black-and-white, some in color) are given complete descriptions with size, provenance and publication (where given, these are especially full and helpful). The standard of reproduction is good and the book is well-printed and well-behaved in that it lies open quite readily. Full accounts of European gold mining are not common: this one is especially welcome and is most reasonably priced.

M.O'D.

Laacher See: Mineralen, Mineralien, Minéraux

*["**Laacher see: Minerals**"] by Eddy Van der Meersche. Published (1997) by a number of mineral groups and publishers but copyrighted by Mineralcolor vsw., Frank Baurstraat 11, B-9000 Gent, Belgium. Text in German, French and Dutch, softcover, 162 pp., 17 x 24 cm, illustrated in color, ISBN 90-74669-02-6; price: DM 38.00.*

An alphabetical, fully illustrated catalog of the minerals of the Laacher See volcanic region of Germany, conveniently published in three languages but easily followed by readers, proficient only in English! A page is devoted to each species, with dimensions given for the illustrated specimens, chemical composition, crystal form and habit, mode of occurrence and associated minerals. There is an extensive bibliography and the standard of color reproduction is high. There is a short (very short) introduction to the geology of the area, which is sufficiently important for the guide to be welcome.

M.O'D.

Vom Kobalterz zum Königsblau—zur Geschichte des Skuteruder Kobaltbergbaus und des Modumer Blaufarbenwerkes in Südnorwegen.

*["**From Cobalt Ore to Royal Blue—The History of the Skutterud Cobalt Mines and the Modum Blue-Dye Works in southern Norway**"] by W. Liebmann. Published (1994) as* Emser Hefte *monograph issue vol. 15, no. 4, 62 pp., illustrated in color and in black-and-white; published by Bode Verlag, Oerter Pütt 28, D-45721 Haltern, Germany; softcover.*

The history, geology, mineralization and workings of the Skutterud, Norway, cobalt deposit and the Modum blue dye works are described. The mineral skutterudite, found with sphene and cobaltite in gneiss, is named for the deposit. In addition a short geology of southern Norway is given with a biographical note on Carl Johann August Theodor Scheerer (1813–1875) who described skutterudite in 1837, giving it the name *arsenikkobaltkies* after Breithaupt had named it *Tesseral-Kies* or *Hartkobaltkies* in 1827. There is a bibliography and a short glossary of technical terms.

M.O'D.

Das Bergbaurevier von St. Ulrich in Südschwarzwald und seine Mineralien

*["**The St. Ulrich Mining District in The Southern Black Forest and its Minerals**"] by C. Schlomann and Helge Steen. Published (1994) as* Emser Hefte *monograph issue vol. 15, no. 3, 40 pp., illustrated in color and in black-and-white; published by Bode Verlag, Oerter Pütt 28, D-45721 Haltern, Germany; softcover.*

The St. Ulrich mine in the southern Schwarzwald of Germany, lying south of Freiburg, has been known since the eleventh century. Two main mineralizations are known: quartz-pyrite-tetrahedrite with lead-zinc-copper ores; and quartz-pyrite-antimony. The geology and mineralization of the area are described, with a bibliography, list of minerals with descriptions, maps and historical notes.

M.O'D.

Les anciennes mines de Padern-Montgaillard (Aude): géologie, histoire et minéralogie

*["**The Ancient Mines of Padern-Montgaillard (Aude): Geology, History and Mineralogy**"] by M. Deliens, C. Berbain and G. Favreau. Published (1993) by the Association française de microminéralogie, Paris. Softcover, 84 pp., illustrated in color; price: FF 100.*

Lead, copper and barite have been mined in the Padern-Montgaillard area of the Département of Aude, southeast France, since the Middle Ages. Examples of some of the minerals found in the area are shown as micromounts in color, and details of the geology of the area and its associated mineralization are given, together with a useful bibliography. A guide to this area is particularly welcome, and the standard of production is excellent; the price is very reasonable for today.

M.O'D.

Quarz-Monographie. Die Eigenheiten von Bergkristall, Rauchquarz, Amethyst, Chalcedon, Achat, Opal und anderen Varietäten

*["**Quartz Monograph. The Peculiar Qualities of Rock Crystal, Smoky Quartz, Amethyst, Chalcedony, Agate, Opal and Other Varieties**"] by R. Rykart. Published (1995) by Ott Verlag, Thun, Germany. Second revised edition, hardcover, 462 pp., 16 x 23 cm, illustrated in color, ISBN 3-7225-6204-x; price: DM 69.*

Rykart's excellent book is becoming a classic on the forms and habits of the silica minerals. As always, there is particular emphasis on rock crystal from European Alpine regions, but there is much more, plus a really superb bibliography. The text covers all the easily visible silica varieties with colorful photographs and considerable crystallographic data, along with accounts of the work of the Alpine strahlers and details of many of the major world occur-

rences. This is not a textbook but a celebration of some of the world's most beautiful minerals, with enough mineralogy and geology to encourage the reader to study further. This is a noble, perhaps the most noble aim for any book. Photographs are of the now-accustomed high standard and specimens are given their dimensions. While often omitted from works on quartz, opal has a few pages which include an accurate account of how the play of colors arises. Further information for the gemstone collector is given in the section on agates, which are especially colorfully depicted.

M.O'D.

Minerals of the Lavrion Mines

by A. Katerinopoulos and E. Zissimopoulou. Published (1994) by the Greek Association of Mineral and Fossil Collectors in Athens. Softcover, 304 pp., 16.5 x 24 cm, illustrated in color, ISBN 960-85515-0-1; price: DM 58.

The Lavrion mines, south of Athens, Greece, are famous for the minerals found in the slags left in the sea by miners in classical times. The present book is an attempt to list them and to give their chemical, physical and optical properties, with color photographs of many of them, in a form (one mineral per page opening) that collectors will find easy to use. Preceded by a short introduction and history of mining in the area, the text first covers the main metallic and gangue minerals, followed by rock-forming minerals and then the secondary minerals from the slags. There is a short list of references, and the descriptions include more than 120 X-ray diffraction patterns of single mineral phases. The book is a welcome addition to the hitherto mainly periodical literature on one of the world's most interesting mining areas. The color photographs are quite good in the main.

M.O'D.

Das Binntal und seine Mineralien. Der Strahler Andre Gorsatt—vom Steckenpferd zur Lebensexistenz

*["**The Binn Valley and its Minerals. The Strahler Andre Gorsatt—from the Hobby to Life's Work**"] by Johannes Schwarz. Published (199X) by Andres Gorsatt, Binn, Switzerland; available from Johannes Schwanz, Hangstrasse 8, D-79539 Lörrach, Germany. Hardcover, 271 pp., 17 x 23.5 cm, illustrated throughout in color, ISBN 3-952-0657-0-6; price postpaid: DM 91.*

The minerals of the Binntal need no introduction and, while there are other monographs and a profusion of papers on the sulfosalts and other species of the area, this text is clearly written and very well illustrated, beginning with a description of the area and its flora, some species of which are shown. The bulk of the text is taken up by the descriptive section which is arranged in chemical order. Entries contain a good deal of material on type localities, of which there are several, and on mode of occurrence, as well as the usual details of composition and forms. Particularly interesting and useful are the details of how a particular species was found in the Binntal, and this theme is continued in a following chapter which describes the work of the strahlers. There is a very extensive and welcome bibliography. The book forms a valuable addition to the literature of a classic mineral area.

M.O'D.

Geologists and the History of Geology: An International Bibliography Supplement II: 1985–1993

by William A. S. Sarjeant. Published (1996) by Krieger Publishing Company, P.O. Box 9542, Melbourne, Florida 32902-9542. Hardcover, in three volumes, 2,386 pp., ISBN 0-89464-880-2; price: $299.50.

This, the latest supplement in Sarjeant's monumental bibliography, runs the series now to a total of ten volumes (all ten are available for $650). The initial five volumes cover the period "from the origins to 1978," and the two volumes of the first supplement cover 1979–1984. The ten volumes total 8,656 pages, in which are contained 10,188 separate bibliographies.

Geologists and the History of Geology is truly a landmark publication on the history of geological literature published in the Latin alphabet. It provides comprehensive listings of use to geologists, museologists, scientific booksellers, librarians, and students of the history of science.

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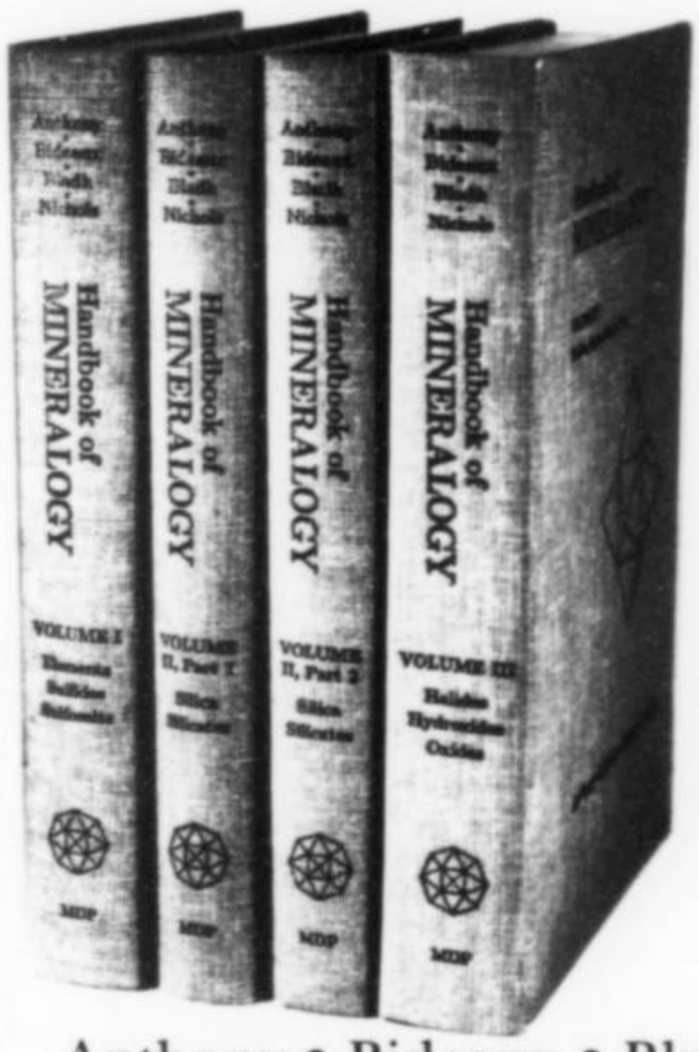

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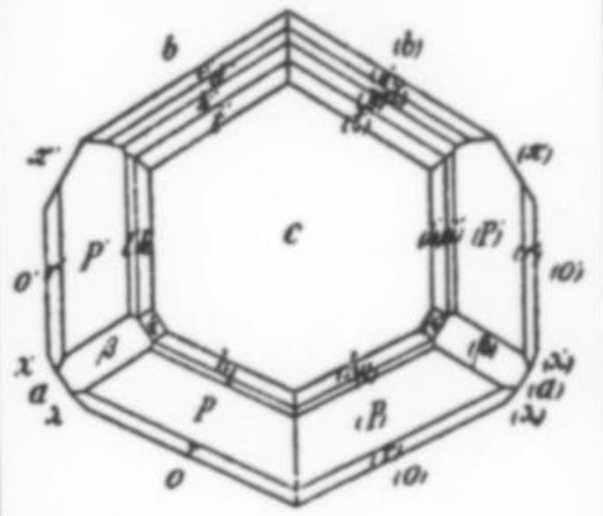

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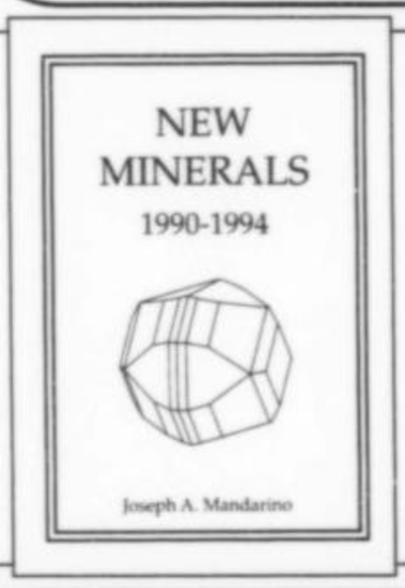

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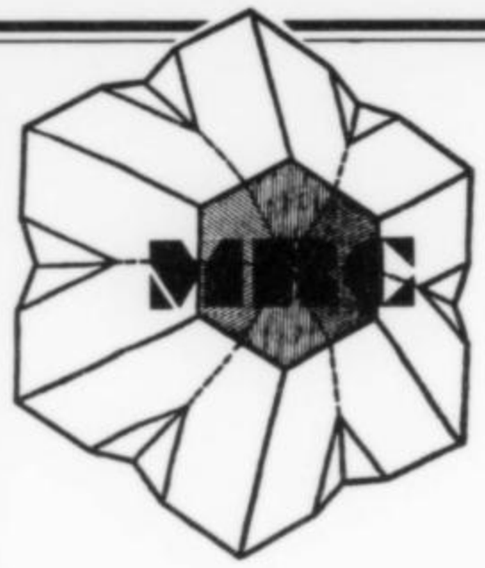

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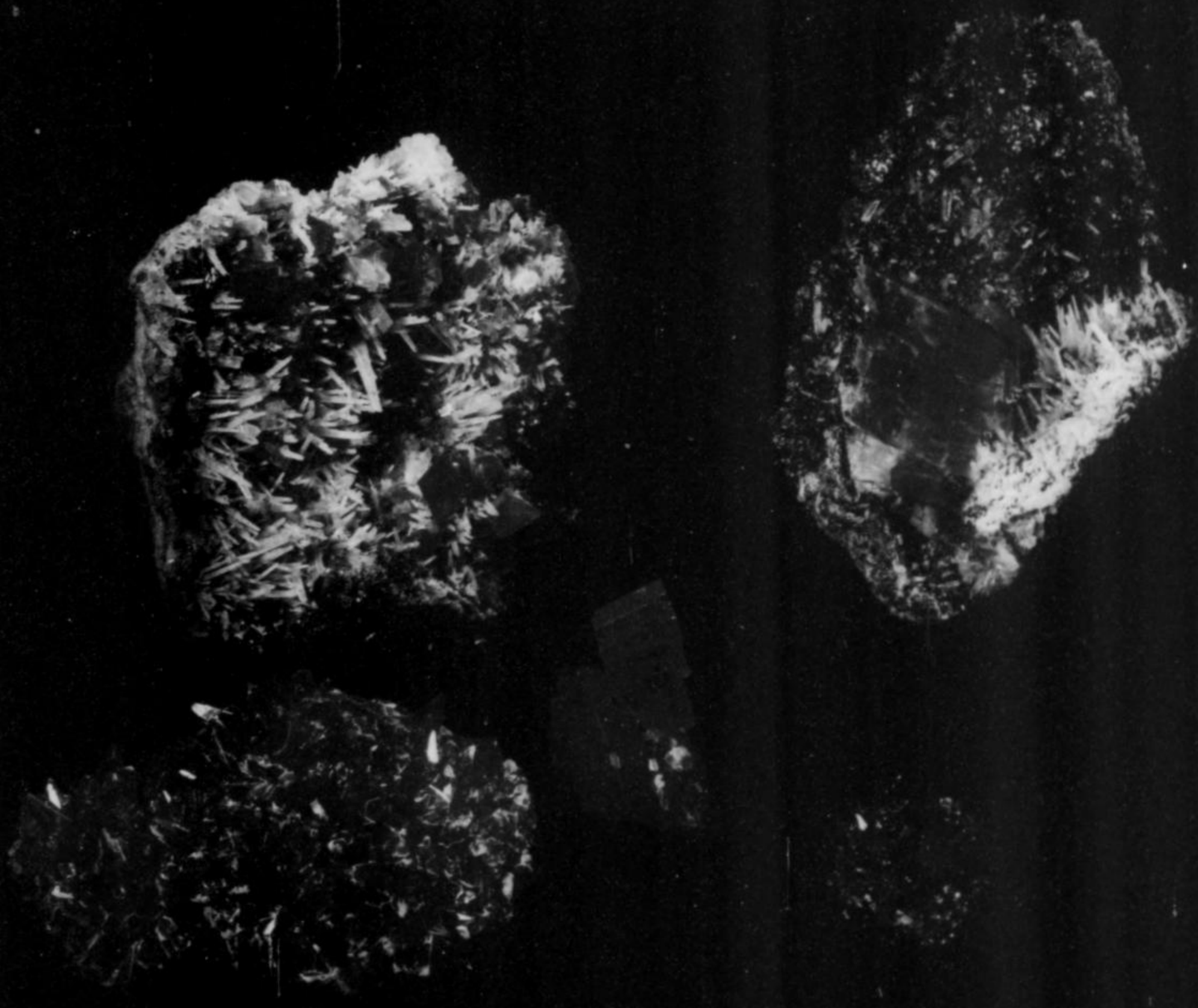

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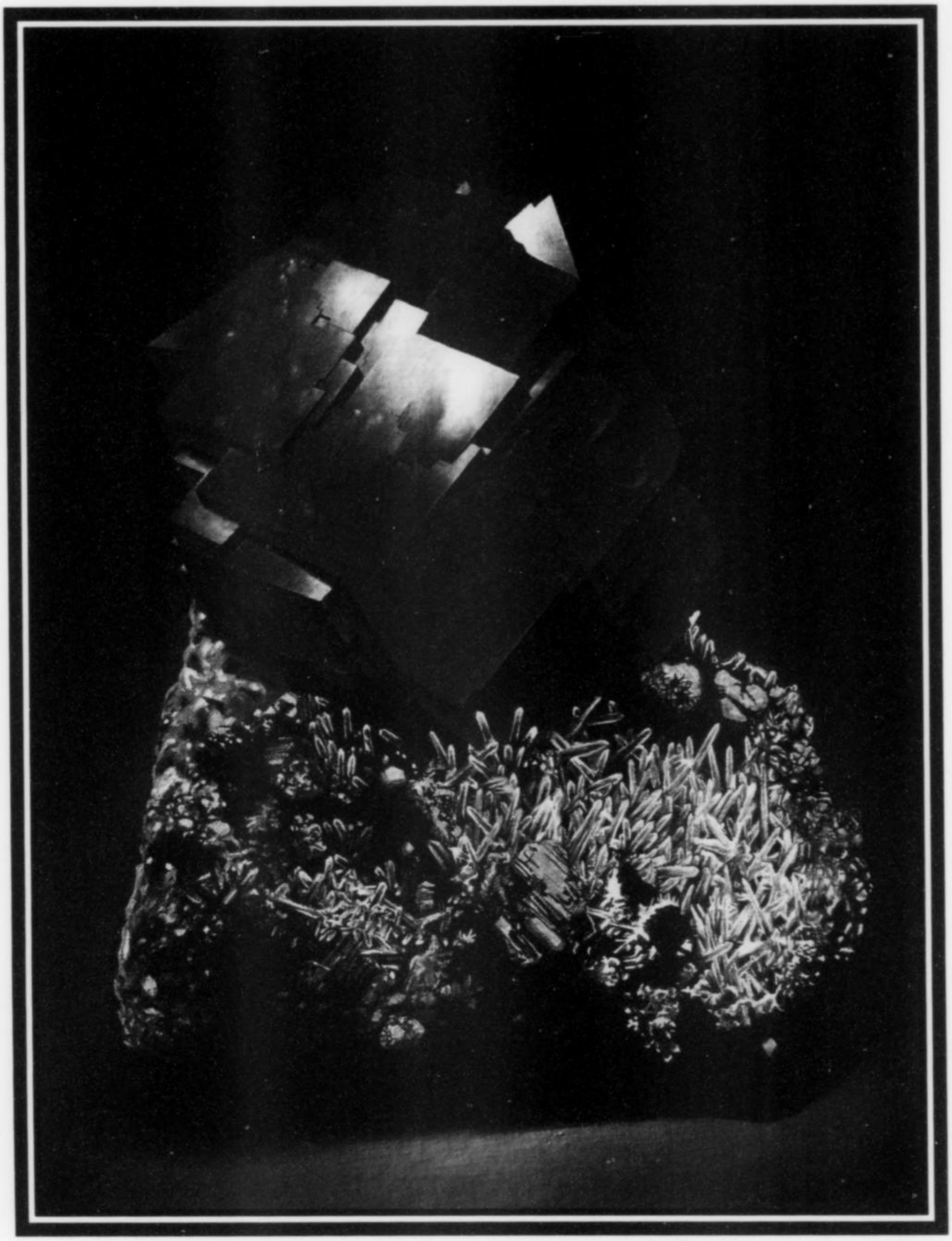

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