the Mineralogical Record

Volume Twelve, Number Three
May–June 1981 $3.50

affiliated with the Friends of Mineralogy

the Mineralogical Record

(USPS 887-700)

Volume Twelve, Number Three
May–June 1981

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Mineralogical Record

address
The Mineralogical Record
P. O. Box 35565
Tucson, Arizona 85740

published
bimonthly by the
Mineralogical Record Inc.

subscriptions
$16 per year, domestic and foreign. Checks from subscribers outside of the U.S. must be written in U.S. dollars and drawn on an American bank.

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notes from the EDITOR

GLOSSARY UPDATE

The first set of additions and corrections to the *Glossary of Mineral Species 1981* was published in the January–February issue of this year. *Glossary* owners may simply xerox those pages and keep them with their copy of the *Glossary* for easy reference. However, for the luxury lovers among you, we have re-stripped and reprinted those additions and corrections into an 8-page insert which is of the same page size as the *Glossary,* and which may be easily attached inside the back cover. These are now available from the circulation manager at 50¢ per copy (in stamps if you like).

CHANGES AT THE SMITHSONIAN

Mineral collectors commonly like to keep in touch with events related to the Smithsonian's famous collection. As a result, many have recently been wondering about rumors of changes taking place. There have been some changes and this seems like an appropriate time to bring everyone up to date.

Most important, Paul Desautels, who has been "Curator-in-Charge" of the Gem and Mineral Collections for many years, has asked to be relieved of his assignment. The request was granted and became effective on October 1, 1980. John White has agreed to assume the duties of "Associate Curator-in-Charge" of the Gem and Mineral Collections. Desautels retains his position as Curator in the Department of Mineral Sciences, assigned to special projects relating to the collections. White now has responsibility for the collections and all activities relating to them.

Desautels' "special projects" are to include, among other things: (1) fully implementing the department's computer as a supporting tool for curation and collection-oriented research; (2) encouragement and solicitation of major acquisitions of specimens, collections, and grants; and (3) planning and supervising the development of a new exhibit hall of minerals and gems, including obtaining funding for the design and construction of the hall.

John White, of course, will be continuing, improving and expanding on the traditional functions of the collections—research, education, exhibition, preservation. Lecturing, writing, preparing special exhibits, procurement of specimens through purchase and exchange, and supervision of all those working in the collections will occupy most of his time.

Pete Dunn remains as Museum Specialist whose duties center on supplying most of the scientific and technical support for the curators' work. This includes specimen identification and maintenance of the X-ray film files. Also working with White is a new general aide, Kathy Sullivan, who has been hired to assist in the many non-technical aspects of collection keeping. Of course, the department will continue to have the assistance of eleven highly competent and carefully selected volunteers and part time assistants including Cynthia Barnes, Esther Claffey, Dot Clement, Judy Frosh, Nancy Gross, Nancy Perkins, Mary Winters, Burt Ashley, Herb Corbett, Martha Hattleberg and Maryann Nordyke.

John S. White (Dane Penland photo)

Paul Desautels (Saul Krotki photo)

Kathy Sullivan **(J. S. White photo)**

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Presented here is a listing of everyone, according to our records, who donated to the auction this year or made cash donations to the *Mineralogical Record* during the last 12 months or so (except a few who wished to remain anonymous). If you made a donation and are not listed here, or if you did not get a letter of acknowledgment (usable for tax purposes), please write to me and I will rectify the matter.

I know all the readers of the *Mineralogical Record* will join with me in saying thanks to these generous people who help to keep our magazine going year after year.

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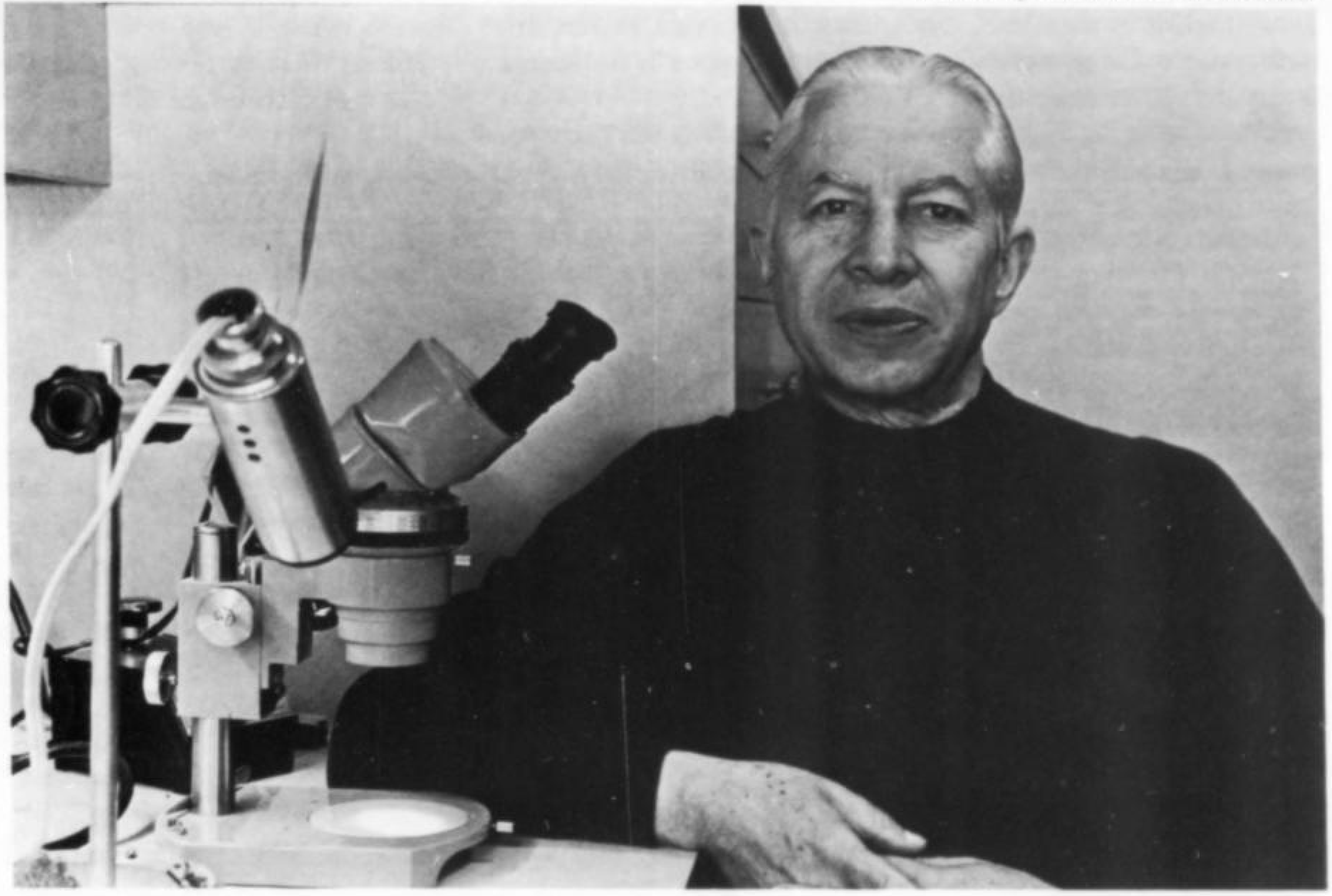
Personality: Randolph S. Rothschild

Photo by Amalie R. Rothschild



Over the years the *Mineralogical Record* has been aided by many people in its struggle for survival. Among the *major* benefactors, however, must be included the name of Randolph Rothschild, for it was he who first subsidized color photography in the *Record* in 1972. And he has continued that support by funding 16 pages of color annually since that time. It is very likely that, without the boost in circulation which color photography has provided over the years, the *Record* would not have survived to this day. Knowing this, many readers will be interested to learn more about him, and so this sketch was prepared.

Randy Rothschild, it turns out, is a charming, cultured and widely educated man who looks and sounds at least 15 years younger than his 72 years. His father Solomon Rothschild (not one of the famous line of European Rothschilds) came to the U.S. in 1875, at the age of 14. During his first year, Randy's father earned 25 cents a week; he subsequently went on to build the Sun Life Insurance Company of America, which he founded with his brother in 1890.

During his years of schooling, Randy studied chemistry, attended the Wharton School majoring in insurance, and also law school. He studied music, and played piano in a dance orchestra. In addition, he is fluent in German and French, is knowledgable in photomicrography, and is still an avid student of archeology and art. But his life's love has always been classical music.

From childhood he learned to appreciate opera and symphony. Over the last 35 years he has accumulated a huge library of over 2000 recordings of 20th century symphonic and chamber works as well as classics, most of which he recorded himself from live broadcasts of premier performances, using his own professional disc and tape recorders. He has been president of the Chamber Music Society of Baltimore since 1954, is on the boards of the Baltimore Symphony Orchestra and the Peabody Conservatory of Music, and was a member of the Maryland State Arts Council from 1974 to 1980.

Under his direction, the Chamber Music Society has brought the world's best groups to Baltimore to give performances (more than half of the concerts consist of 20th century music, especially atonal-dissonant works), and has commissioned each year a new work from a living composer. Randy himself has commissioned 13 works for the Chamber Music Society, and others for the Baltimore Symphony.

But how did he become interested in minerals? Clearly he was primed by his background in chemistry and his appreciation for art. But it took a vacation to the Southwest in 1956 to spark his interest. It seemed that every gas station in Utah, Arizona and Nevada had a small display of minerals for sale in those days, and after buying a few gas station specimens, he was on his way. Upon returning to Baltimore, his collection continued to grow, and finally in 1961 he joined the Baltimore Mineral Society.

As specimens began taking more and more storage space, the logical course seemed to be micromounts, and today Randy boasts a fine collection of perhaps 5000 mounts. These are stored in drawers in his mineral room, next to his microscope and collection of mineral books. Describing Randy's collection is too much of a task, but among the notable items are several suites including Mont St.-Hilaire, the Jeffrey mine in Quebec, and a personally collected suite of dioptase and other copper minerals from the Harquahala mine in west-central Arizona.

Randy perfers to make his own mounts from larger pieces, carefully trimming them down with a tiny diamond saw. This usually results in many duplicates which he sells to benefit the Baltimore Mineral Society.

In 1964 he took over as editor and publisher of the *International Directory of Micromounters,* an indispensible guide with which micromounters worldwide can locate each other. Copies are sold at less than cost.

Randy, well acquainted with the staff of the Smithsonian Institution, was among those encouraging John White to start the *Mineralogical Record* in 1970. He handled the job of increasing subscriptions in the east-central states, and has given away countless free subscriptions to people and institutions in order to spread interest in the *Record.* During the *Record's* third year he sponsored color in a major article on the 79 mine (in Arizona), and has since added immeasurably to the beauty and appeal of the magazine by his annual donations of funds for color.

After serving for 37 years as vice president and general counsel for Sun Life, Randy retired in 1972 and presently lives with his wife of 44 years, Amalie, on their beautifully wooded property in suburban Baltimore. Their house is of contemporary design (naturally), and a large studio nestling nearby gives Amalie the space she needs to produce her abstract sculptures and paintings. (Their daughter Amalie is a documentary film maker in New York, and their daughter Adrien graduated recently in biology from Johns Hopkins University.) The Rothschilds are busier than ever since his retirement, producing art, collecting micromounts, taking archeology-oriented vacations, continuing their involvement in cultural civic organizations, supporting the work of modern composers, and supporting the *Mineralogical Record.* True patrons of the arts and sciences are all too uncommon these days. The Rothschilds are among those rare, enlightened few to whom *Record* readers and music and art lovers alike must be grateful.

W.E.W.

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Letters

COLORADO IN THE OLD DAYS

Allan Caplan, in his interview here (Vol. 11, p. 351), briefly discussed his early collecting days in Colorado. This brought a response from someone who also remembered those times, George White of Colorado Springs. Caplan thought Record *readers might enjoy White's letter, and so he forwarded it to us. Mr. White was also agreeable, and even furnished some photographs to complement his letter.*

Ed.

Dear Mr. Caplan,

I very much enjoyed the interview you had with the *Mineralogical Record,* as told in the last issue of that fine magazine. Of course I recall when those big topaz crystals were found.

Of particular interest to me was your mention of the first pocket of fine rhodochrosite from Alma, which was divided between Mr. Hart of Manitou Springs and Mr. Pohndorf of Denver. I recall seeing those fine rhodochrosites in Hart's store. I'm not too sure of the exact date, but I think it was in 1929 or 1930. I dropped by to chat with him before he left for the winter to open his Palm Beach store.

On a large table was spread out a splendid lot of beautiful crystals, both singles and groups. These were from the famous Home Sweet Home mine, in old Buckskin Gulch above Alma, Colorado. (Ed. note: see the article on the Home Sweet Home mine by R. A. Kosnar in Vol. 10, p. 333.) I'm not sure whether the ones that Hart had were the entire lot or merely his half of the find. They were the finest I had ever seen.

No, I didn't get anything for my own collection. I suspect that the prices were too steep for my modest income of the time. Even though the specimens were cheap by today's standards, it was hard to find extra money to spend out of the low wages of the Depression Era.

Your mention of Hart brings to my mind many pleasant memories of that very well-known mineral dealer. I knew him back in 1916 when my father gave me a dollar to purchase a box of minerals. There were 16 to 20 specimens in the selection, and they were quite nice. I still have three of them—a good Kelly mine smithsonite, an agate, and a polished piece of petrified wood.

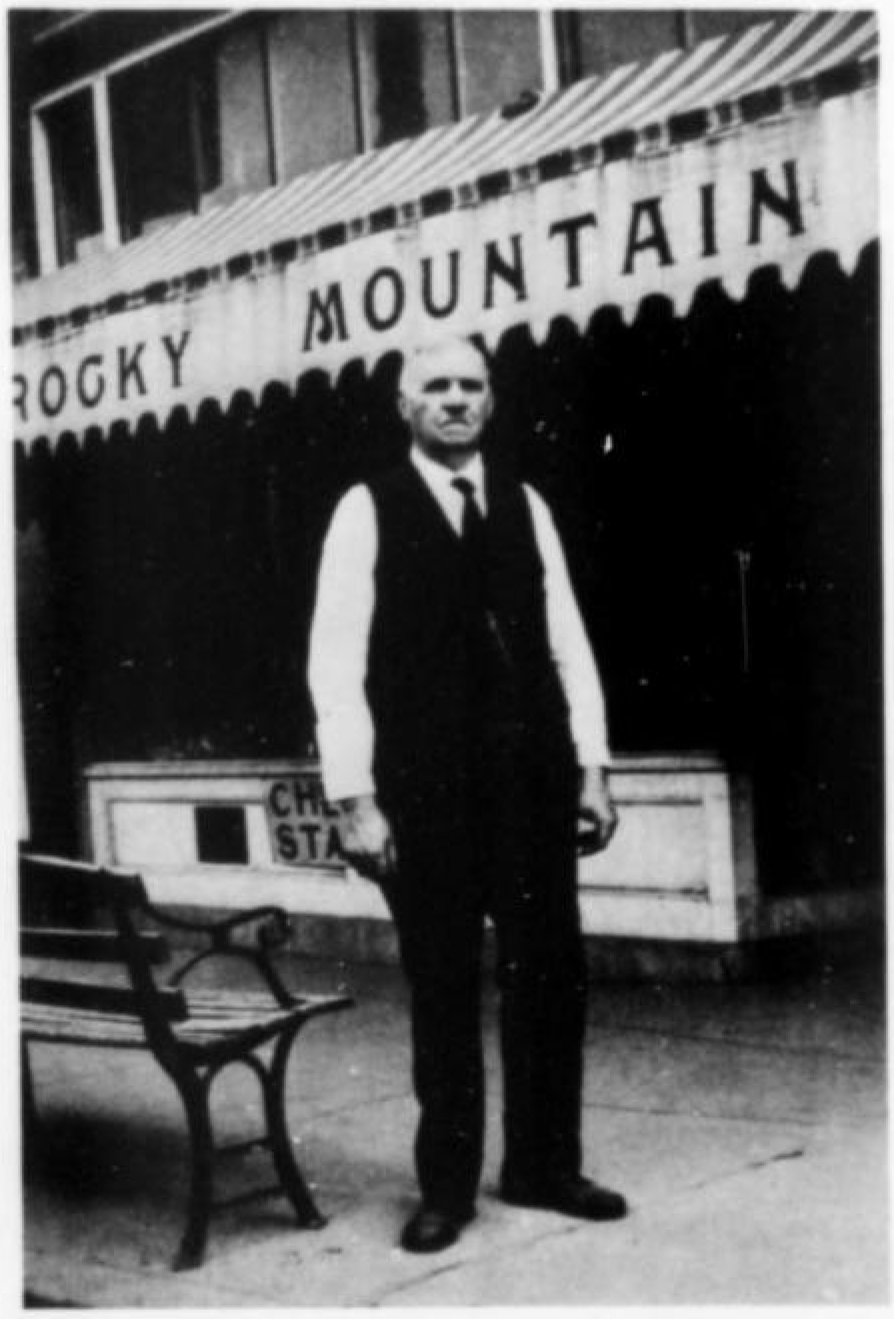
I was only 11 years old then, and we came out to Manitou Springs for three weeks each summer, from our home in northwest Missouri. At the time there were at least three good mineral stores in Manitou: the famous J. G. Hiestand collection at Iron Springs, Hart's equally good collection, and a smaller but nice one in the Soda Springs Pavilion. Being interested in minerals, I spent a lot of time admiring these displays.

When we moved to Colorado Springs in 1920 I wasted no time in getting acquainted with Mr. Hart. Mr. Hiestand had died in 1916, but Hart was to live until 1936.

During the 20's and 30's I spent many pleasant hours in Hart's store. He was a kindly disposed man who let me prowl around through the drawers in his store and pick out things I could afford. Looking through my collection today I find many of Hart's things which I have retained—fine Missouri calcites, English fluorites, Crystal Peak (Colorado) amazonites and other microclines, Arkansas quartz, Guchab dioptase, etc.

Back in 1922 I acquired a large group of stubby, clear quartz crystals, probably from the San Juan district (Colorado), from a lady who was using it in the border of her garden. I paid her $1.00 for it. Mr. Hart liked it and I traded it to him for an anglesite crystal on matrix from Utah and a fine 2-inch by ¾-inch elbaite crystal from Pala (California), a very fair exchange indeed!

Hart told me many fascinating tales of his years collecting in Colorado. He had come to Manitou Springs in the early 1890's, and of course was already closely in touch with the minerals of the Pike's Peak region, Leadville, Cripple Creek, Ouray, etc. I understood it was he who marketed many of the first fine epidotes in the early 1900's, from Prince of Wales Island, Alaska. He had a picture in his store of a very large, fine group of these crystals.



W. C. Hart in front of his Rocky Mountain Gem Store, Manitou Springs, Colorado (1934)

Some of the packed cabinets in Hart's store.

He told of having seen, in the window of a Leadville building, a fine group of topaz crystals which was supposed to have come from near the Buffalo Peaks in South Park. And he told an equally tempting tale of some fine canary-yellow topaz crystals from near the Oil Creek tunnel on Pike's Peak. I tried in vain to follow up on that. I always doubted the existence of topaz on Pike's Peak itself until Clarence Coil found a fine one above Glen Cove—that was in 1944 or 1945, and he and O. A. Reese, Ed Over and John Alexander took from that peg some of the finest topaz crystals ever found in the U.S.

One of Hart's tips did pay off for me. As far back as 1922 I had followed his description of the site of some fine celestine in the Garden of the Gods, which had been worked thoroughly in the 1880's and was thought to be exhausted. I didn't find the spot until 1929, but for about four years I took some nice specimens from there and another site nearby, found by my old collecting buddy Willard Wulff. My first and finest geode, about 5 inches across, I broke in two and gave one half to Hart in appreciation for his tip.

Hart died in his mid-80's, a very respected man who had been on the town council and active in civic affairs. His two daughters, with assistance, carried on the business for a while, but his large stock was eventually disposed of. Some of it went to a Mr. Elmer Brown, who was also a local mineral dealer.

It has been my good fortune to have known a number of the early Colorado mineral dealers such as Hart, Lazard Cahn, A. B. Whitmore (owner of the Crystal Peak gem mines), and George Reeser, an old prospector at Crystal Peak who sold much material to Cahn and Hart. And some of the later breed of avid and capable collectors—Willard Wulff, Edwin Over, O. A. Reese, J. P. Osborn, and Clarence Coil among others. All of them are gone now except Wulff, the one I have known the longest, since 1921.

I'm sure I have worn you out with so many reminiscences, but at my age one likes to think back a lot. Thanks for a fascinating interview. Such accounts are one of the reasons why the *Mineralogical Record* is such a splendid mineral magazine.

George M. White
Colorado Springs, Colorado

ERRATA

In the article "Copper acetate hydrate with native copper" by Pete J. Dunn, which appeared in Vol. 12, p. 49: the two sentences regarding the presence of insects in the copper acetate hydrate, beginning "Two possible interpretations present themselves . . ." and ending ". . . the former is born out by additional observation," were added in the review stage, and their deletion was subsequently requested by the author at the galley stage. Due to unexplained reasons the deletion was not made, and for this we apologize to the author. Ed.

Dear sir,

The tone of your story on *Pakistani pegmatite discovered* (Vol. 11, p. 321) suggests that the area concerned is under Chinese jurisdiction, and that the Pakistani government is involved in aiding freedom fighters in Afghanistan; this is not true.

R. Nawaz
Belfast, Ireland

It turns out that the road in question, along which the pegmatite was found, was actually built by the Chinese two years ago, before the recent Soviet-Afghan unpleasantness. We regret the error; it was the best information we had at the time.

Ed.

An unfortunate error resulted in misnumbering of several photographs in the article "Zeolites in Yellowstone National Park" (vol. 12, p. 29–38). The captions for Figures 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, and 15 describe photographs that were misplaced in the article as figures 7, 8, 11, 9, 2, 3, 4, 5, 6, 10, 15, and 14, respectively (the Figure 2 caption describes the Figure 7 photograph, the Figure 3 caption describes the Figure 8 photograph, etc.). The authors would like to apologize to the reader for the inconvenience and to the editorial staff of the *Mineralogical Record* who did such an excellent job of putting the article together.

Keith E. Bargar
Menlo Park, California

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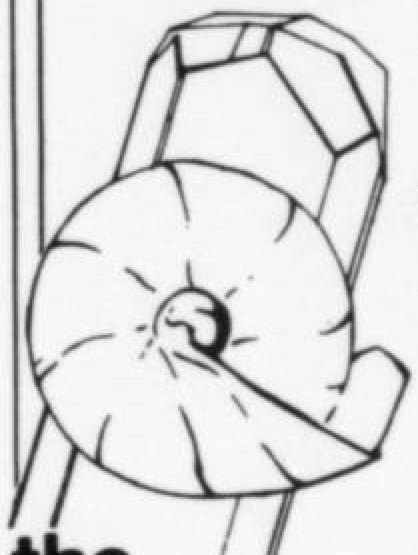

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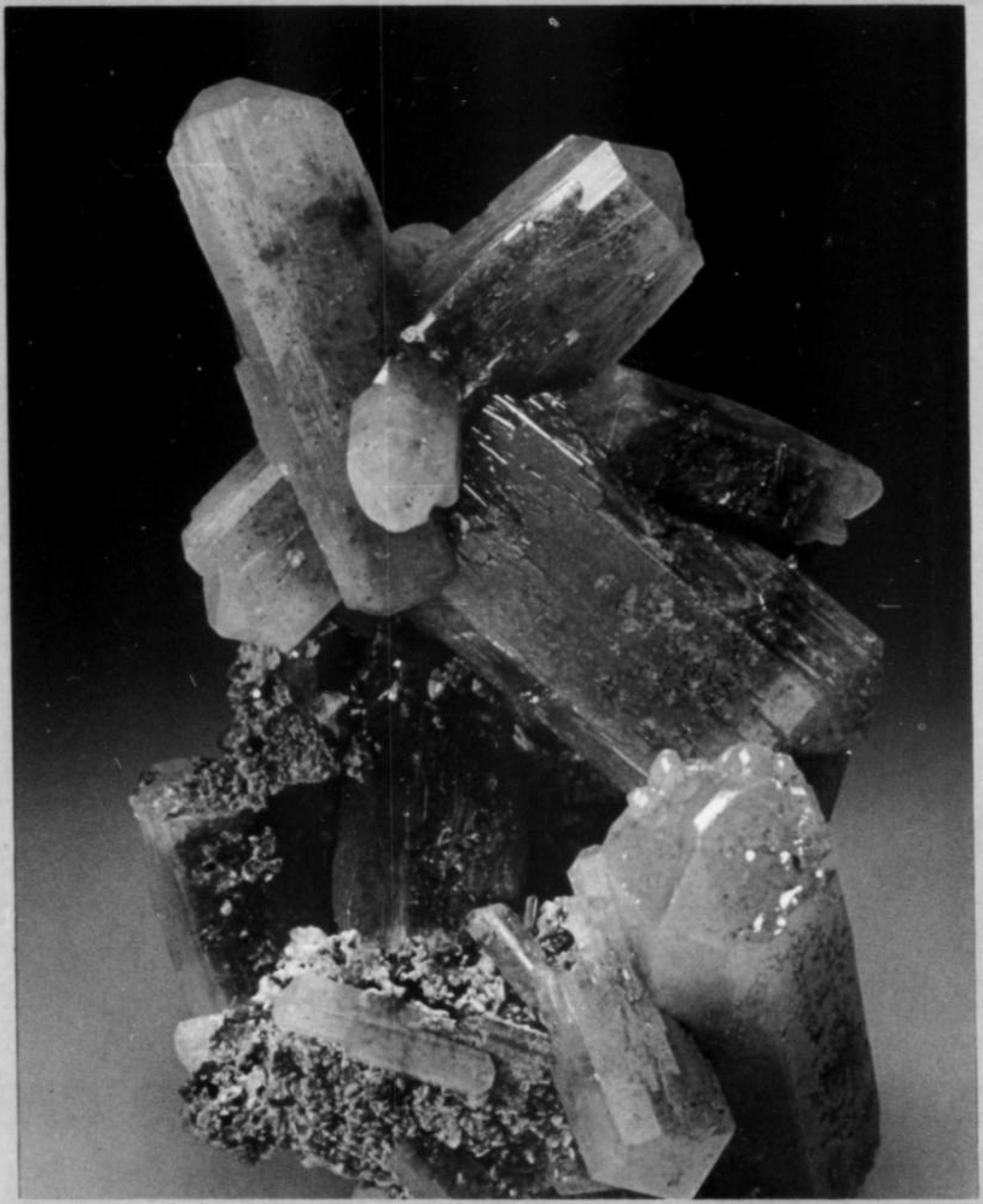

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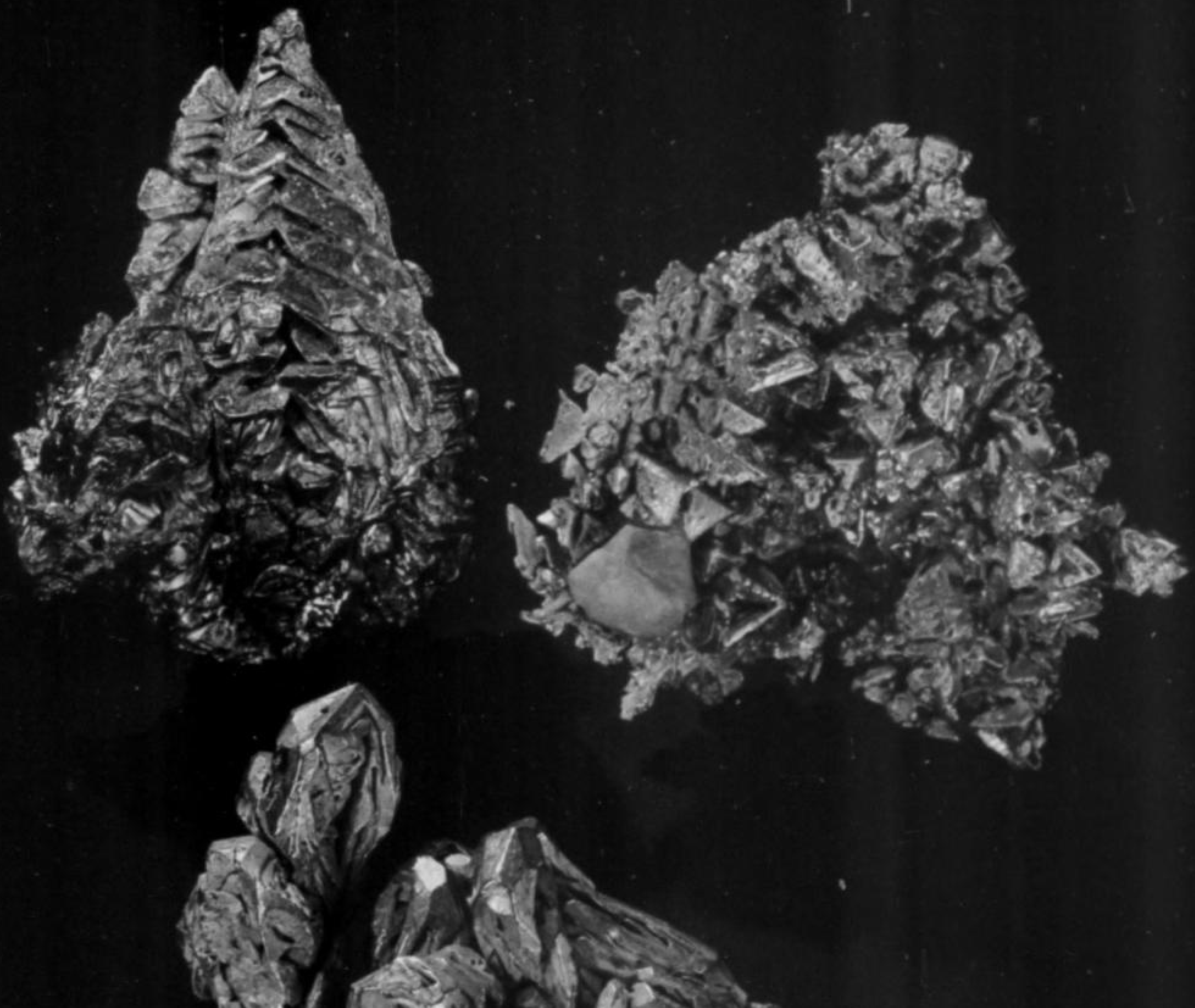

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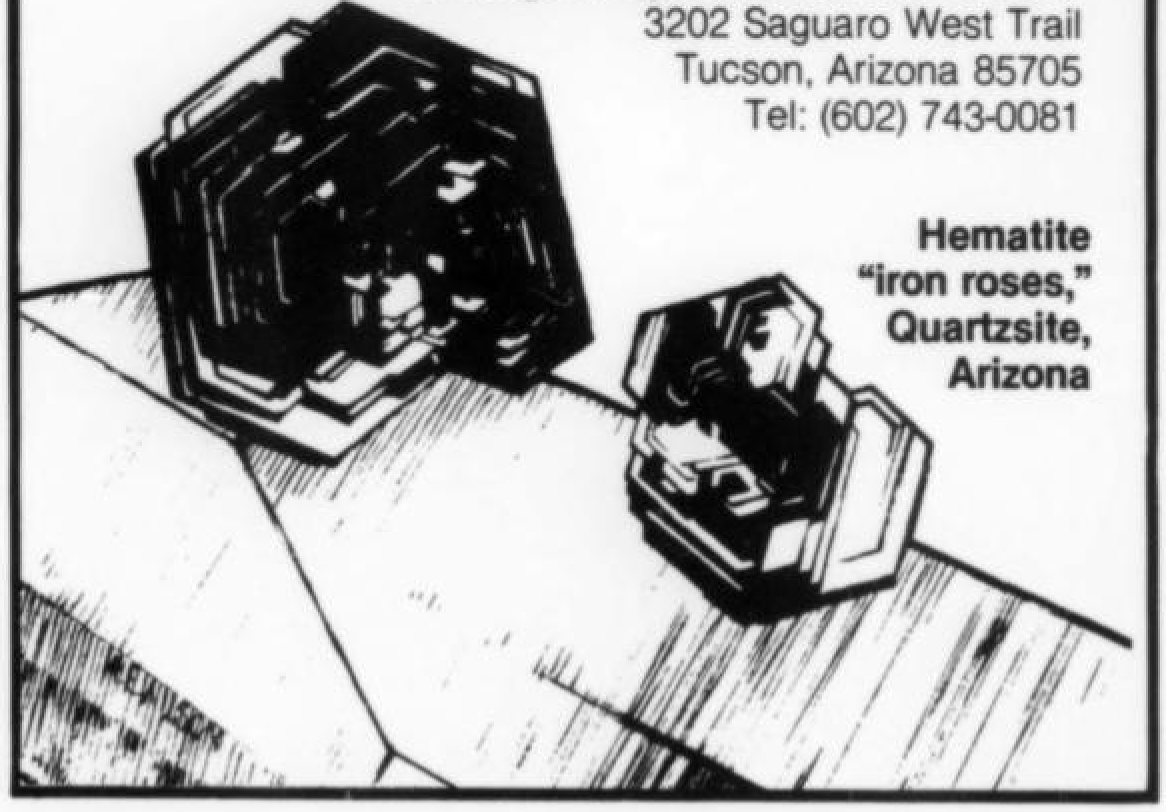

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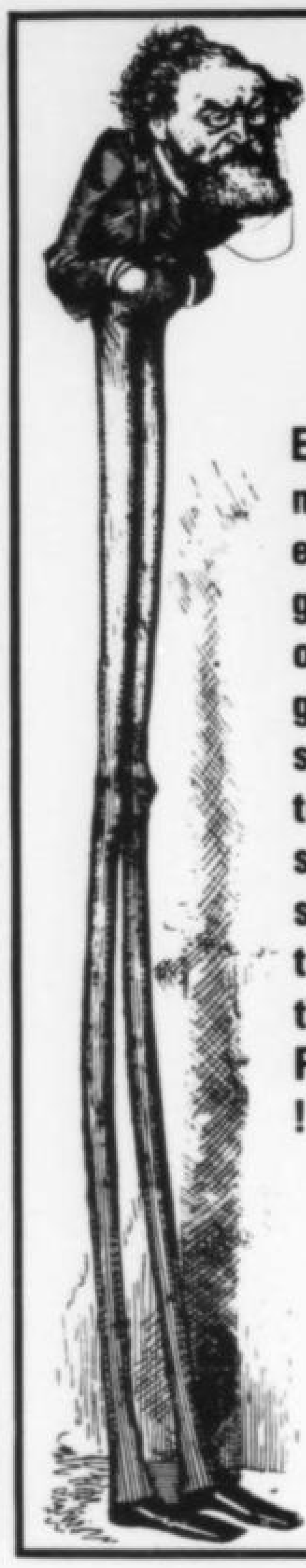

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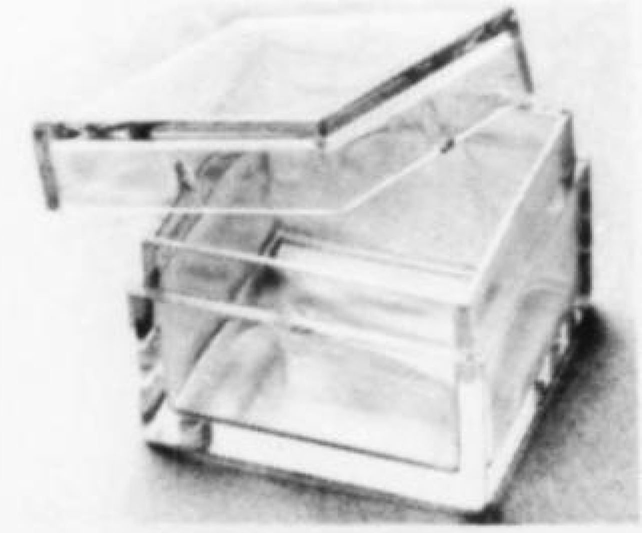

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Mcguinnessite,

a new carbonate from California

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INTRODUCTION

A bluish green mineral that was found with vuagnatite at Red Mountain, Mendocino County, California (Pabst *et al.,* 1977), has been determined to be a new species, which we name mcguinnessite in honor of Albert L. McGuinness of San Mateo, San Mateo County, California. Mr. McGuinness has a worldwide reputation as a capable mineralogist and scrupulous mineral dealer; he has most generously donated many rare specimens from his collections for scientific studies, and he has discovered several new mineral species. Specimens of mcguinnessite have been deposited at the U.S. National Museum, Washington, D.C. (NMNH #147169), and in the Mineralogical Collection of the University P. and M. Curie, Paris. The mineral has been commercially available under this name since 1977 (*Mineralogical Record,* **8,** 435).

The name and description have been approved by the Commission on New Minerals and Mineral Names, I.M.A.

OCCURRENCE

Mcguinnessite occurs sparsely at Red Mountain as spherules (Fig. 1 and 2) on joint and vein surfaces with goethite, malachite, azurite, chrysocolla, copper sulfides, chlorite and vuagnatite in rodingitized metagabbro dikes in a serpentinized peridotite of Mesozoic age. A detailed description of the locality and geology is given by Pabst *et al.* (1977). Most commonly, mcguinnessite is found on thin crusts of hydrous iron oxides on weathered joint surfaces. However, mcguinnessite may also be found either directly on fresh host rock surfaces or on vuagnatite crystals. In a few places a thin crust of malachite covers mcguinnessite as the last-formed mineral. Mcguinnessite has also been found coated with, and possibly replaced by, chrysocolla. Mcguinnessite spherules are incomplete, being either hemispherical or flattened out into films along the joint surfaces. The spherules range in size from 0.1 to 2 mm in diameter, the average diameter being 0.5 to 0.7 mm. They are composed of extremely small radiating fibrous crystals, individuals of which are less than 2μm long. The small crystal size made measurement of the optical properties difficult and single-crystal X-ray study impossible. The spherules are concentrically color banded (Fig. 2), corresponding to compositional variation in Mg and Cu which is described below. It was impractical to separate mcguinnessite according to its color and composition, and the data presented in this paper are either for material of average composition (especially the X-ray powder data) or give the range observed (optical data, etc.).

PHYSICAL AND OPTICAL PROPERTIES

Mcguinnessite is brittle and inelastic; fracture is even, parallel to the fiber length; and the mineral has a hardness of 2½ (Mohs). The calculated density (in g/cm^{-3}) ranges from 3.076 for Mg-rich rims of spherules, to 3.234 for Cu-rich cores, and 3.117 for material with Mg/Cu = 1.17 along the fibers. The corresponding range in measured specific gravity is between 3.02(2) and 3.22(2); for most material (fibers), the specific gravity is 3.11(2). Mcguinnessite is nonfluorescent in ultraviolet light.

The color of the fibers which constitute the main mass of the spherules is light blue-green (Munsell number 5BG 6/6), but the Cu-rich cores are a slightly darker blue, and the Mg-rich rims are very pale blue-green to nearly white (Fig. 2). Mcguinnessite is translucent; the luster varies from vitreous to silky.

Optically, mcguinnessite is biaxial negative with α = 1.602(2), β = 1.730(3), γ = 1.732(3) (Na); but the range (Mg- to Cu-rich) is from α = 1.596–1.607(2), $\beta \approx \gamma$ = 1.724–1.740(3). The optical orientation could not be determined completely; mcguinnessite has negative elongation with a maximum inclined extinction of X to *c* of 11° in the (010?) plane. The external morphology of crystal fragments does not permit us to know whether the extinction of X to *c* in the (100?) plane is parallel (indicating monoclinic symmetry) or very slightly inclined (triclinic). The mineral is weakly pleochroic with Z, Y (light bluish green) $>$ X (very pale green).

X-RAY CRYSTALLOGRAPHY

The unit cell data for mcguinnessite (Table 1) show that it is closely related to the rosasite series of minerals. In common with other members of this series, mcguinnessite is too fine grained to permit single crystal X-ray study. The unit cell data were obtained by least-squares refinement of the X-ray diffraction data (Table 2) indexed on the basis of a monoclinic rosasite-like cell (*see* Jambor, 1976a, b). As Jambor has pointed out (1976a, p. 574), ". . . the principal unknown in these minerals is the value of *c* sinβ." Mcguinnessite shows strong preferred orientation for *hk*0 reflections, and only a few reflections having a *c* component appear in the diffractometer pattern. Nonetheless, the agreement of observed *hkl* reflections with those calculated for the monoclinic cell seems reasonably good. If mcguinnessite is monoclinic, the X-ray data are compatible with the diffraction aspects P*/* or *P*/a*. However, given the limitations of our optical and X-ray evidence, we cannot rule out the possibility that mcguinnessite is triclinic.

Although there are many similarities between the powder patterns of mcguinnessite and those of the other members of the rosasite series, there are also easily recognizable differences that set mcguinnessite apart. These are: the (010) reflection at ~12Å is unique to mcguinnessite; the (100) reflection at ~9.4Å is present both in mcguinnessite and glaukosphaerite (previously unreported), but absent in rosasite; and most distinctive are the absences of the (200) reflection at ~4.7Å and the ($\bar{2}$01, 320) reflection at ~2.77Å in the mcguinnessite pattern. The last two reflections are present in all of the other members of this series.

Because mcguinnessite has nearly equal amounts of Mg and Cu, the suggestion of Professor J. Zemann, University of Vienna, Vienna, Austria, that these two atoms might be ordered in a malachite-*like* structure was tested. Using coordinates from Süsse (1967), we calculated powder intensities for three different models. The calculated intensities for an ordered model with Mg at the Cu(2) site of the malachite structure agree best with the observed intensities (Table 2).

CHEMISTRY

Fragments of mcguinnessite spherules from Red Mountain, Mendocino County, California, were analyzed with an ARL EMX-SM electron microprobe using an accelerating voltage of 15KV and a specimen current of 2.0×10^{-8} amperes on benitoite. The results of these analyses are shown in Table 3. Lines analyzed and the crystals used were: CuKα (LiF), MgKα (RAP), and CaKα (ADP). The standards used were chemically analyzed magnesite (contains 0.7 weight percent CaO) from Red Mountain, Stanislaus County, California (Bodenlos, 1950), and malachite from Bisbee, Cochise County, Arizona. Other elements sought for, but not found, were Fe, Mn, Ni, and Zn. Silica, ranging from 0 to 6 weight percent, is inhomogeneously distributed throughout the spherules and has not been included in the formulation of mcguinnessite.

The analyses listed in Table 3 represent 10-second counts for 6 to 15 sample points. Analyses 2 and 3 were tightly grouped to minimize errors due to inhomogeneities, whereas analysis 1 is the average of points along the radius of a 0.3-mm-diameter spherule whose rim was used for analysis 2. The core of this spherule was approximately 1 weight percent richer in Cu than the average. All data were reduced using a Fortran IV computer code "RABBIT" (Goff, 1977) which applies Bence-Albee corrections (Bence and Albee, 1968; Albee and Ray, 1970) to the raw analyses. The averaged values after correction for excess CO_2 and H_2O are shown in Table 3 compared with idealized compositions. The low summation of cations compared with the ideal may be due to the small quantity of silica present, to uncertainties in the Bence-Albee α-factors, or to the excess oxide routine of the "RABBIT" program.

Compositionally, mcguinnessite is defined as $(Mg,Cu)_2CO_3(OH)_2$ where Mg/Cu $\geq$ 1 (Table 3); compositions having Mg/Cu $<$ 1 should be termed cuproan mcguinnessite. Although $Mg_2CO_3(OH)_2$ is known as a synthetic compound (*Chemical Abstracts* Registry

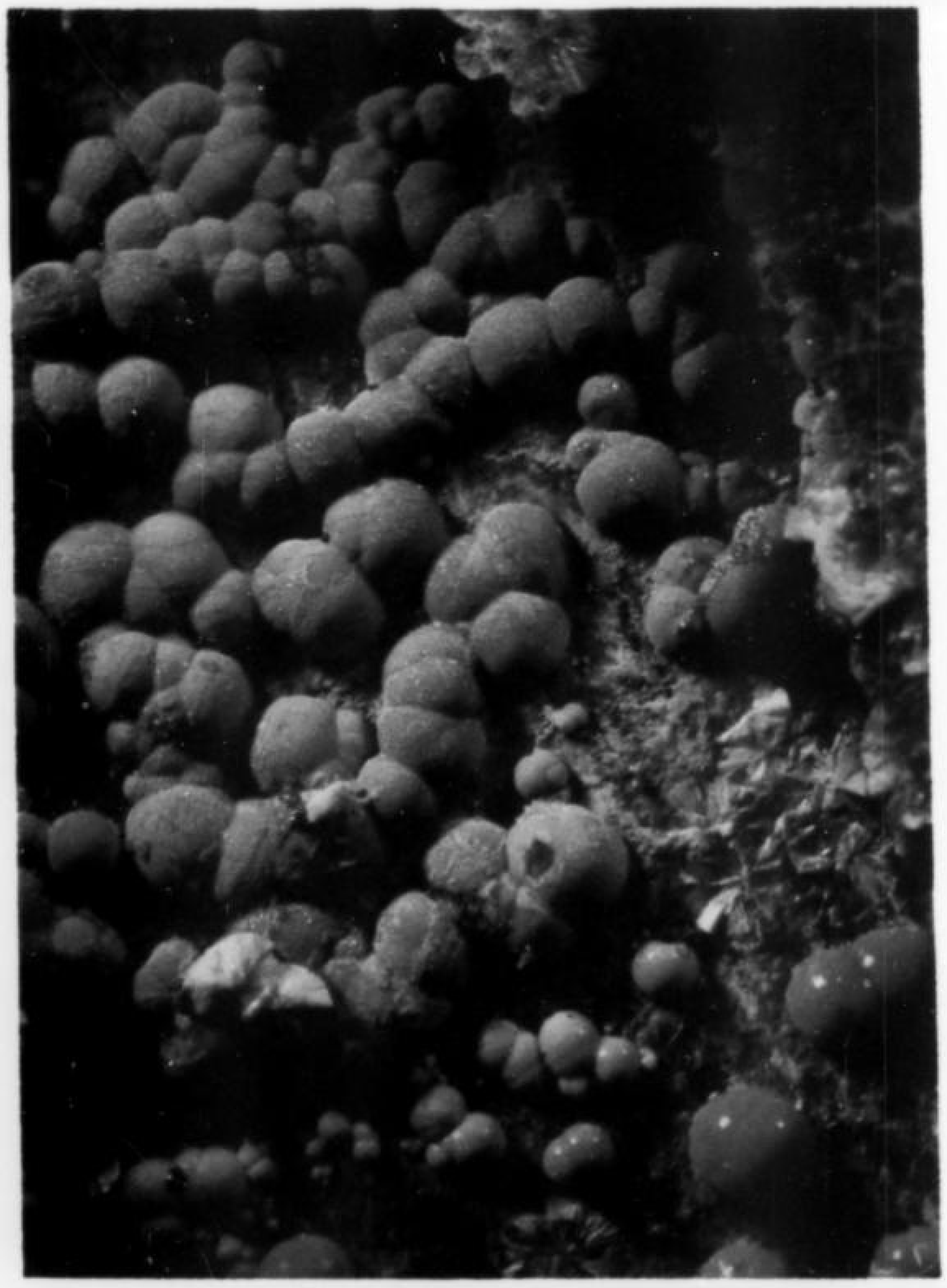

Figure 1. **Blue-green spherules of mcguinnessite with minor encrustations of fine green malachite crystals. The larger spherules are about 0.7 mm in diameter. (Photo by Nelly Bariand, Paris.)**

Figure 2. **Broken spherules of mcguinnessite, showing color zoning, on limonitic crust. Largest spherule visible, near the center of the photo, is 0.75 mm in diameter. (Photo by Norm Prime, U.S. Geological Survey.)**

Table 1. Unit-cell data for mcguinnessite and some related hydroxycarbonates (arranged in order of decreasing cell volume).

	Un-named[1]	Rosasite[2]	Mcguin-nessite[3]	Glauko-sphaerite[4]	Malachite[5]
a(Å)	9..338	9.344	9.398(2)	9.343(1)	9.502
b	12.076	12.069	12.011(2)	11.954(1)	11.974
c	3.396	3.392	3.379(2)	4.307(1)	3.240
β	90.78°	90.48°	93.28(5)°	91.70(12)°	98.75°
Vol. ($Å^3$)	382.9	382.5	380.8(2)	380.4(2)	364.3
a/b	0.773	0.774	0.782	0.782	0.794
D(calc.; g/cm^{-3})	3.781	3.865	3.117	3.827	4.031
D(obs.; g/cm^{-3})	——	3.88(2)	3.11(2)	3.96(2)	4.05(2)

[1] Cobaltoan malachite (Specimen M6; 18.46 weight percent Co) from Zaire (Deliens *et al.*, 1973), but with rosasite-like unit cell (Jambor, 1976b). D(calc.) assuming Co/Cu = 0.52.

[2] Rosasite (Jambor, 1976b) from Durango, Mexico (Zn/Cu = 0.68. D(obs.) by Y. Shimazaki (*in* Jambor, 1976b) for rosasite with Zn/Cu = 0.49 from Durango.

[3] Mcguinnessite (this study) from Red Mountain, Mendocino County, California (Mg/Cu = 1.17). D(obs.) by suspension in methylene iodide-acetone mixture checked with a Westphal balance.

[4] Glaukosphaerite (this study) from Carr Boyd Rocks mine, Glory Hole No. 2, Carr Boyd Rocks, Western Australia (Ni/Cu = 0.25; analysis and D(obs.) by Pryce and Just, 1974).

[5] Data by Swanson *et al.* (1960) for synthetic malachite. D(obs.) by M. E. Mrose (1947, *in* Palache *et al.*, 1951).

Table 3. Electron-microprobe analyses of mcguinnessite.

*Analysis 1**		*Expressed as oxide*		*Idealized composition*	
Mg	14.3	MgO	23.7	24.35	$(Mg_{0.54}Cu_{0.46})_2CO_3(OH)_2$
Cu	31.6	CuO	39.6	40.95	
Ca	0.05	CaO	0.07	——	(Average composition along fiber)
		CO_2	24.73**	24.62	
		H_2	10.13**	10.08	
			98.23	100.00	
*Analysis 2**					
Mg	15.2	MgO	25.2	26.05	$(Mg_{0.57}Cu_{0.43})_2CO_3(OH)_2$
Cu	30.2	CuO	37.8	38.78	
Ca	0.04	CaO	0.06	——	(Mg-rich rim of spherule)
		CO_2	——	24.95	
		H_2	——	10.22	
				100.00	
*Analysis 3**					
Mg	11.7	MgO	19.4	19.78	$(Mg_{0.46}Cu_{0.54})_2CO_3(OH)_2$
Cu	36.5	CuO	45.7	46.76	
Ca	0.06	CaO	0.08	——	(Cu-rich core of spherule)
		CO_2	——	23.74	
		H_2	——	9.72	
				100.00	

*Analyst: Fraser E. Goff. Data in weight percent.

**From 34.86 weight percent loss during TGA; Fabien P. Cesbron, analyst.

Table 2. X-ray powder diffraction data for mcguinnessite.

hkl	*d*(calc.)* (Å)	*d*(obs.)** (Å)	*I*
10#	12.001	11.98	6
100#	9.383	9.39	4
110	7.394	7.40	11
020	6.005	6.015	100
120	5.058	5.054	16
200	4.691	——	——
210	4.370	——	——
030#	4.004	——	——
220	3.697	3.694	67
310	3.027	3.024	10
040	3.003	3.002	12
021	2.941	2.942	9
140	2.860	2.857	9
320	2.774	——	——
211	2.604	2.605	12†
240	2.529	2.530	25
$\bar{1}31$	2.516	2.493	9
330	2.464	2.465	9
150	2.327	2.326	15
410	2.302	2.300	6
231	2.220	2.212	4
420	2.185	2.185	9
250	2.138	2.139	23
060	2.002	1.999	7
160	1.958	1.956	4
051	1.957		
350	1.905	1.906	8
500#	1.876	1.876	4
401	1.876		
520	1.791	1.791	3
421	1.791		
170	1.688	1.688	7
002	1.687		
360	1.686		
$\bar{4}41$	1.653	1.653	4
370	1.504	1.504	5
171	1.503		
180	1.482	1.482	5
550	1.479	1.477	5
451	1.479		
280	1.430	1.430	4
$\bar{6}21$	1.410	1.411	4
322	1.410		

*All calculated *hkl*'s listed for d_{hkl} » 3.500Å. Indices and *d*(calc.) from least-squares refinement of X-ray powder data using the digital computer program of Appleman and Evans (1973).

**Data for material from Red Mountain, Mendocino County, California. X-ray diffractometer conditions are: Chart No. X3911; Cu/Ni radiation, λCuK α_1 = 1.540598Å; Si used as internal standard; scanned at ¼° per minute from 5–72° 2Θ.

#Not permitted with the malachite space group ($P2_1/a$).

†Intensity equals approximately 80 on the powder photographs.

No. [23303-17-5]; we could find no crystallographic or optical data for this compound), material of this composition has not yet been reported as a mineral. Artinite, which is the trihydrate of this composition, probably forms instead of mcguinnessite in most geochemical environments. The combinations of major cations in the rosasite-like minerals now known are Cu + Zn (rosasite), Cu + Co (kolwézite), Cu + Ni (glaukosphaerite), and Mg + Cu (mcguinnessite). Combinations of Cu with major Fe, Mn, or Pb appear to be possible, but are yet to be discovered. The only naturally occurring end-members known so far are malachite (Cu) and nullaginite (Ni) (Nickel *et al.,* 1979).

Mcguinnessite is slowly but completely soluble with effervescence in cold dilute mineral acids.

THERMAL BEHAVIOR

The thermal behavior of mcguinnessite is shown in Figure 3 by the thermogravimetric (TGA) and differential thermogravimetric (DTG) curves. The only feature shown by these curves is that accompanying a rapid loss of CO_2 and H_2O peaking at 457°C on the DTG curve. Losses of 34.86 and 34.95 weight percent were recorded for duplicate runs of 5.482 and 5.436 mg samples respectively. The residual mass consists of periclase, tenorite, and poorly crystallized Cu_2MgO_3.

The differential thermo-analysis (DTA) curve for mcguinnessite is shown in Figure 4 compared with the DTA curves of malachite (Ural Mts., U.S.S.R.) and rosasite (Mapimi, Durango, Mexico), all obtained using a heating rate of 300° per hour. The DTA curve of mcguinnessite first shows a small, broad, endothermic trough near 100°C accompanying the initial loss of some of the H_2O. This is followed by a large endothermic peak at 498°C (loss of CO_2 and balance of H_2O); a very small exothermic peak at 810°C; and, finally, two endothermic peaks: a very small one at 1053°C and a large one at 1080°C. Cuprite, periclase, and well crystallized Cu_2MgO_3 appear after the second endothermic peak at 1080°C.

Heated in a closed tube, mcguinnessite gives off H_2O and CO_2 and turns dark reddish brown.

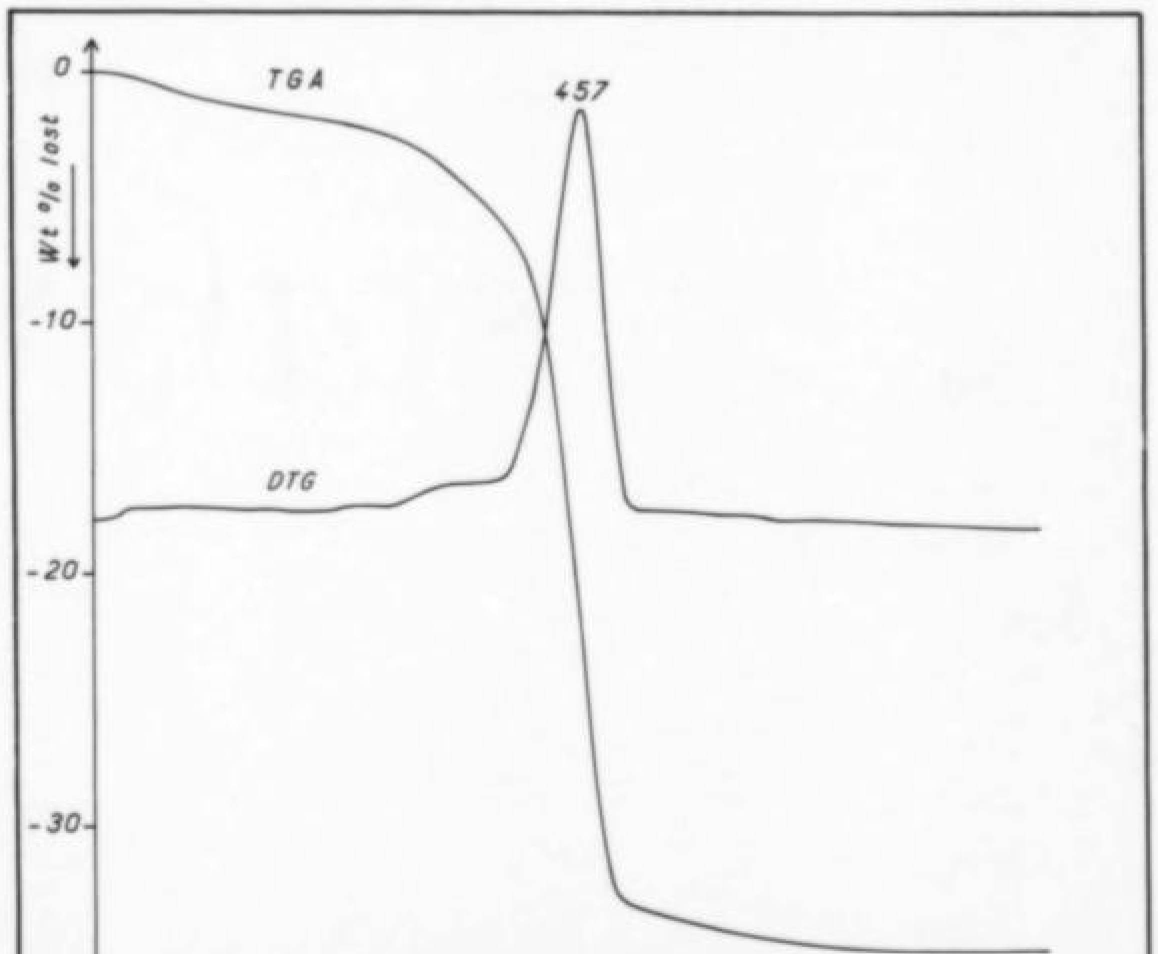

Figure 3. **Thermogravimetric (TGA) and differential thermogravimetric (DTG) curves for mcguinnessite.**

OTHER OCCURRENCES

Mcguinnessite has been reported to occur at Gabbs, Nevada (Oswald and Crook, 1979); the mineral partially described by Smith (1978) as "magnesian rosasite" from southwestern Lancaster County, Pennsylvania, is probably mcguinnessite; and a third occurrence in Austria has been brought to our attention by Walter Postl (written communication, 1978).

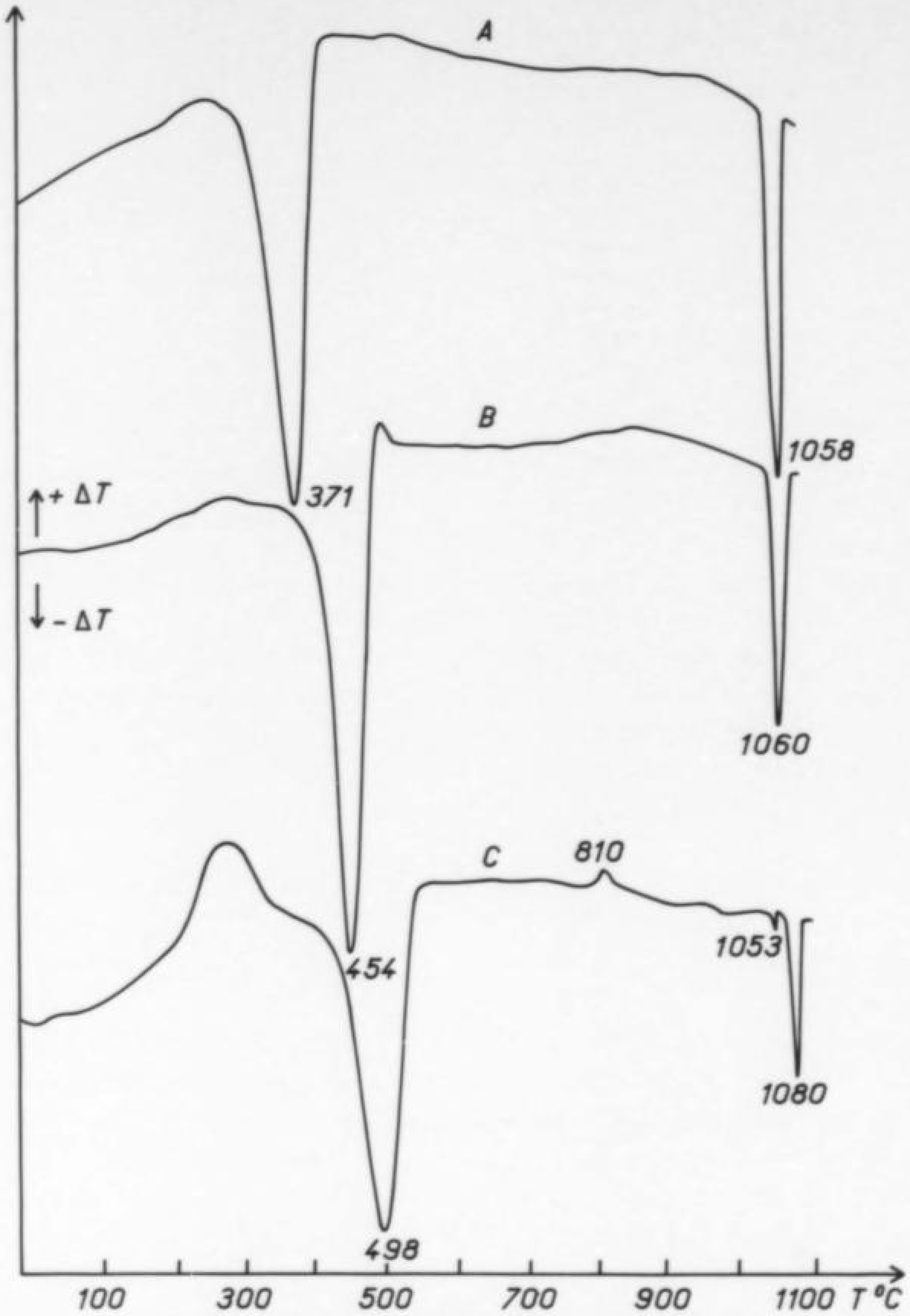

Figure 4. **Differential thermo-analysis (DTA) curves for (A) malachite from the Ural Mts., U.S.S.R., (B) rosasite from Mapimi, Durango, Mexico, and (C) mcguinnessite from Red Mountain, Mendocino County, California.**

DIAGNOSTIC TESTS

Mcguinnessite closely resembles the other members of the rosasite series in many of its properties. The following tests should be useful in identifying the mineral to the mineral collector who commonly does not have X-ray facilities available to him. First, mcguinnessite is distinctly bluer than rosasite or glaukosphaerite; second, its indices of refraction are well below those of the other members; and third, only mcguinnessite will float in pure methylene iodide.

ACKNOWLEDGMENTS

We are grateful to A. L. McGuinness for specimens of glaukosphaerite from Australia and Zaire; to Nelly Bariand (Paris) and Norm Prime (U.S. Geological Survey; deceased) for the color photos of mcguinnessite; and to Professor J. Zemann (University of Vienna), Akira Kato (National Science Museum, Tokyo), and Adolf Pabst (University of California, Berkeley) for helpful suggestions. Finally, the manuscript has benefited from reviews by Reba B. Fournier and Mary E. Mrose (U.S. Geological Survey).

Note added in proof:

The (Cu,Co) analog has now been named kolwézite and all members of the series proposed to be triclinic by Michel Deliens and Paul Piret ((1980) Bull. Soc. Franç. Min. Crist., **103**, 179–184).

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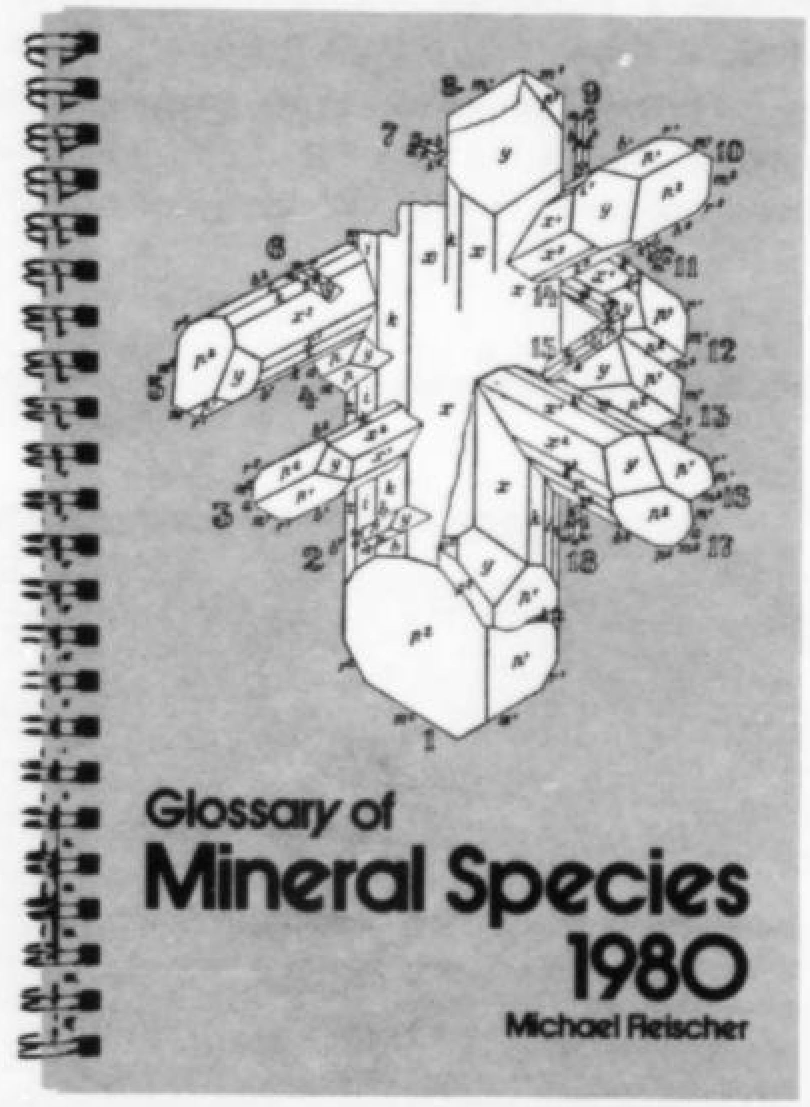

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Chromium Minerals

at the Line Pit, State Line chromite district, Pennsylvania and Maryland

by **Eugene E. Foord, Allen V. Heyl** and **Nancy M. Conklin**
U.S. Geological Survey
Denver Federal Center
Denver, Colorado 80225

INTRODUCTION

The State Line chromite district of Pennsylvania and Maryland was a principal source of chromite, yielding at least 175,000 tons between 1828 and 1882 (Pearre and Heyl, 1959). Minor production continued at intervals through World War I.

The Line Pit, Wood's mine and the nearby Cedar Hill serpentine quarry together comprise one of the most famous mineral localities for serpentine, and for chromium, nickel and magnesium minerals in the United States. The area is still providing mineralogically interesting minerals after 150 years of intermittent studies and production. In the 19th century the minerals from this area were commonly lumped under "Texas," Pennsylvania, named after a very small village northwest of the best known mineral localities. Of these three main localities, the Line Pit or Lowes mine, which straddles the Mason-Dixon Line between Pennsylvania and Maryland, is the least studied deposit mineralogically. It is best known for the high grade of chromite ore (Pearre and Heyl, 1960) and the former abundance of translucent emerald-green antigorite (variety *williamsite*) which is as beautiful as the finest jade. Most of the chromium-bearing minerals described in this paper are from the Line Pit mine.

Prior to 1950 most of the extensive Line Pit dumps were removed for secondary road material. The material which is left has been thoroughly dug over by mineral collectors, except along the old road to the mine near the mine shafts, and along the fringe of the east and south part of the main dump, where most of the minerals described here were found.

The Line Pit chromium mine is located 100 meters north of a secondary road about 1 kilometer northwest of Rock Springs, Maryland, which is on U.S. route 222 about 4.3 km north of its intersection with U.S. Highway 1 between Conowingo Dam and Rising Sun, Maryland. Wood's chromium mine lies about 4.5 km east of the Line Pit on the Wood farm, on the north side of Octoraro Creek in southernmost Lancaster County, Pennsylvania. It is the largest known chromite deposit in the district and the largest known podiform chromite deposit in the United States. The Cedar Hill quarry is located about 3.3 km east-northeast of the Line Pit and 1.7 km south of Wrightsdale on the north side of Octoraro Creek in southernmost Lancaster County, Pennsylvania.

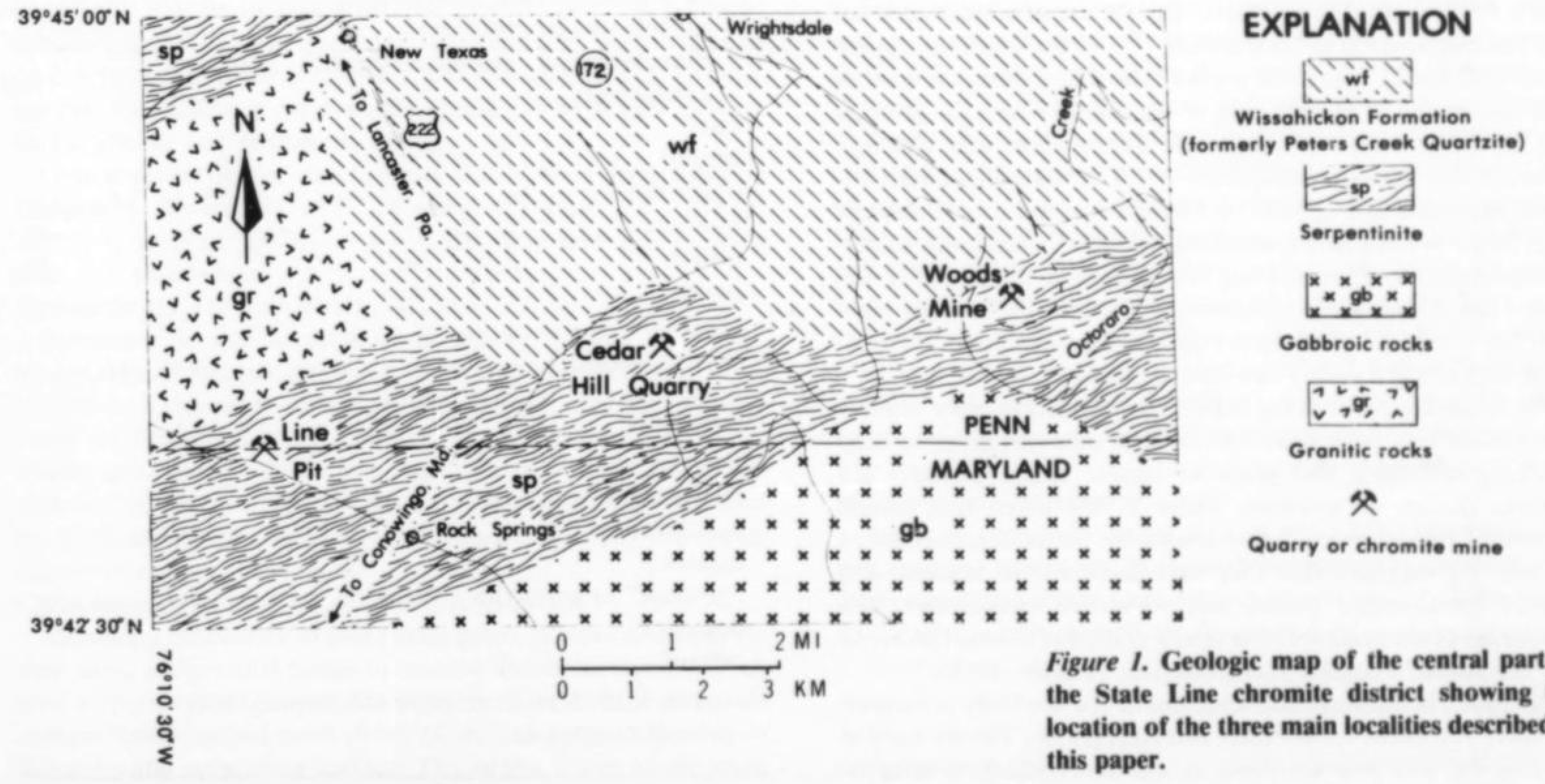

Figure 1. **Geologic map of the central part of the State Line chromite district showing the location of the three main localities described in this paper.**

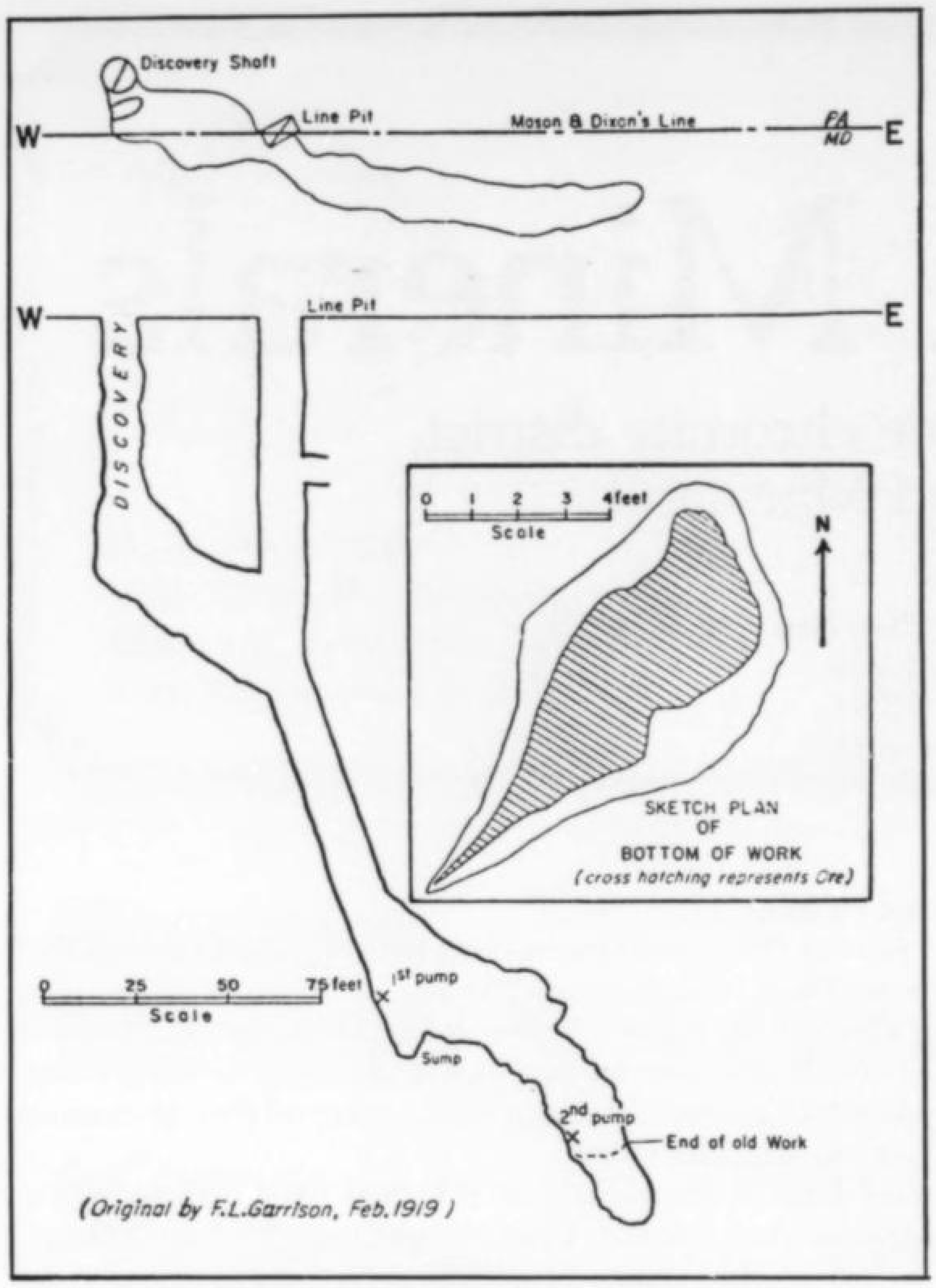

Figure 2. **Section and plan of the Line Pit mine.**

GEOLOGY OF THE DISTRICT AND THE LINE PIT

The State Line district extends from the Susquehanna River across northern Cecil County, Maryland, northeastward and eastward into southern Lancaster and Chester Counties, Pennsylvania, to Little Elk Creek—a total distance of about 25 km. The geology of the central part of the State Line chromite district is shown on the accompanying map (Fig. 1). As stated in Pearre and Heyl (1960), ". . . most of the district is a single belt of serpentine about 26.7 km long and 0.8 to 2.5 km wide. . . . to the south the serpentine is bordered by norite and gabbro. The wall-rock on the north is schist except in the western part of the district where the geologic map of Pennsylvania (Pennsylvania Topographic and Geologic Survey, 1931) shows granodiorite . . ." The northern contact between serpentine and uppermost Precambrian to Lower Paleozoic schist of the Wissahickon formation (formerly Peters Creek quartzite) dips steeply southward. Most of the chromite deposits of consequence also plunge steeply southward. The Line Pit orebody however, lies several hundred meters south of the contact in Pennsylvania, and plunges steeply east-southeastward.

The serpentine rocks of the district range widely in color and texture. Colors vary from light buff or light yellowish green to deep emerald-green, dark blue-green or almost black. Textures are massive, fibrous or schistose. Fisher (1929) noted that several varieties of serpentine are found among the chromiferous rocks of the belt. He suggested that they were derived from saxonite and wehrlite (peridotites), dunite, and websterite (pyroxenite). The association of chromite with the dunite and other olivine-rich rocks near the northern contact is characteristic (Thayer, 1956).

The Line Pit workings and a section of the ore body are shown on Figure 2, reduced from Pearre and Heyl (1959). The ore body at the Line Pit was well described by Gordon (1922a). It is an irregular, pinching and swelling pipe-like mass of very coarse, massive chromite, with short veins of chromite and white magnesite extending from it into the surrounding serpentine. The coarse chromite grains are up to 1 cm across, interlocking and slightly fractured, but not sheared or rounded as in a boudin. At and near the surface the central mass was dumbbell-shaped in horizontal section and plunged vertically or nearly so, whereas near the bottom of the mine (Fig. 2) the body was elliptical in plan and plunged eastward. Average diameters of the ore body in the lower part of the mine were 1.7 meters and nearly 3 meters.

MINERALS

Table 1 is a compilation of minerals from the Line Pit, including all those previously reported and seven varieties and species reported here for the first time. Sources for the previously reported minerals include Gordon (1922a, b); Beck (1952); Pearre and Heyl (1960); and Speer (1977). Varieties and species which have *not* been previously identified at the Line Pit include: chromian dravite,

Table 1. Minerals identified at the Line Pit chromite mine.

Magmatic
- forsterite
- magnesiochromite
- chromite
- magnetite

Early and late hydrothermal and metamorphic
- magnesiochromite
- chromite
- serpentine
  - antigorite, plus distinctive varieties williamsite and chromian-antigorite
  - chrysotile
  - lizardite? (see section on serpentine minerals)
- muscovite (var. fuchsite)
- margarite
- chromian dravite
- chromian grossular
- chlorite
  - clinochlore
  - chromian clinochlore
  - Al-clinochlore (var. sheridanite)
  - clinochlore (var. pennine)
  - clinochlore (var. chromian pennine)
  - kämmererite
- talc
- brucite
- magnesite
- awaruite
- quartz
- pyrite
- pentlandite*
- heazlewoodite
- millerite
- maucherite

Supergene minerals
- hydromagnesite
- pyroaurite
- zaratite
- "genthite" or garnierite
- dolomite?
- calcite?

* - species identification tentative (McKague, 1964)
? - probably supergene

pyroaurite, chromian clinochlore, fuchsite, sheridanite, margarite and chromian pennine. We have also made additional analyses of the chromite of the deposit.

Chromian dravite $Na(Mg,Cr)_3(Al,Cr)_6(BO_3)_3Si_6O_{18}(OH)_4$

Medium to dark green, hexagonal, prismatic, translucent crystals with rhombohedral terminations and small, dark green, matted, acicular, microcrystalline masses of chromian dravite occur at the Line Pit. The largest crystals are 1 cm long and 2 mm in diameter. Fracture is subconchoidal to uneven, luster vitreous, hardness 7 to 7.5, streak white. The chromian dravite is associated with talc, sheridanite, kämmererite and chromite, and occurs along veinlets and seams in fractured black to dark brown chromite. Dunn (1977) has discussed chromian dravite from worldwide localities, one of which is the Etchison chromium mine about 20 miles north of Washington, D.C., in Maryland. Table 2 lists a partial analysis of the Line Pit dravite. The Cr_2O_3 content was found to range from 2.6 to 5.4 weight percent and the MgO content from 9.5 to 10.9 weight percent. The chromian dravite from the Etchison mine (Gill, 1889) is remarkably similar to that from the Line Pit. Cr^{+3} is probably substituting for both Mg^{+2} and Al^{+3}. Cr^{+3} and Mg^{+2} were shown to occupy both octahedral positions Y and Z in an extremely chromium-rich tourmaline from Nausahi, India (17.84 weight percent Cr_2O_3) (Nuber and Schmetzer, 1979).

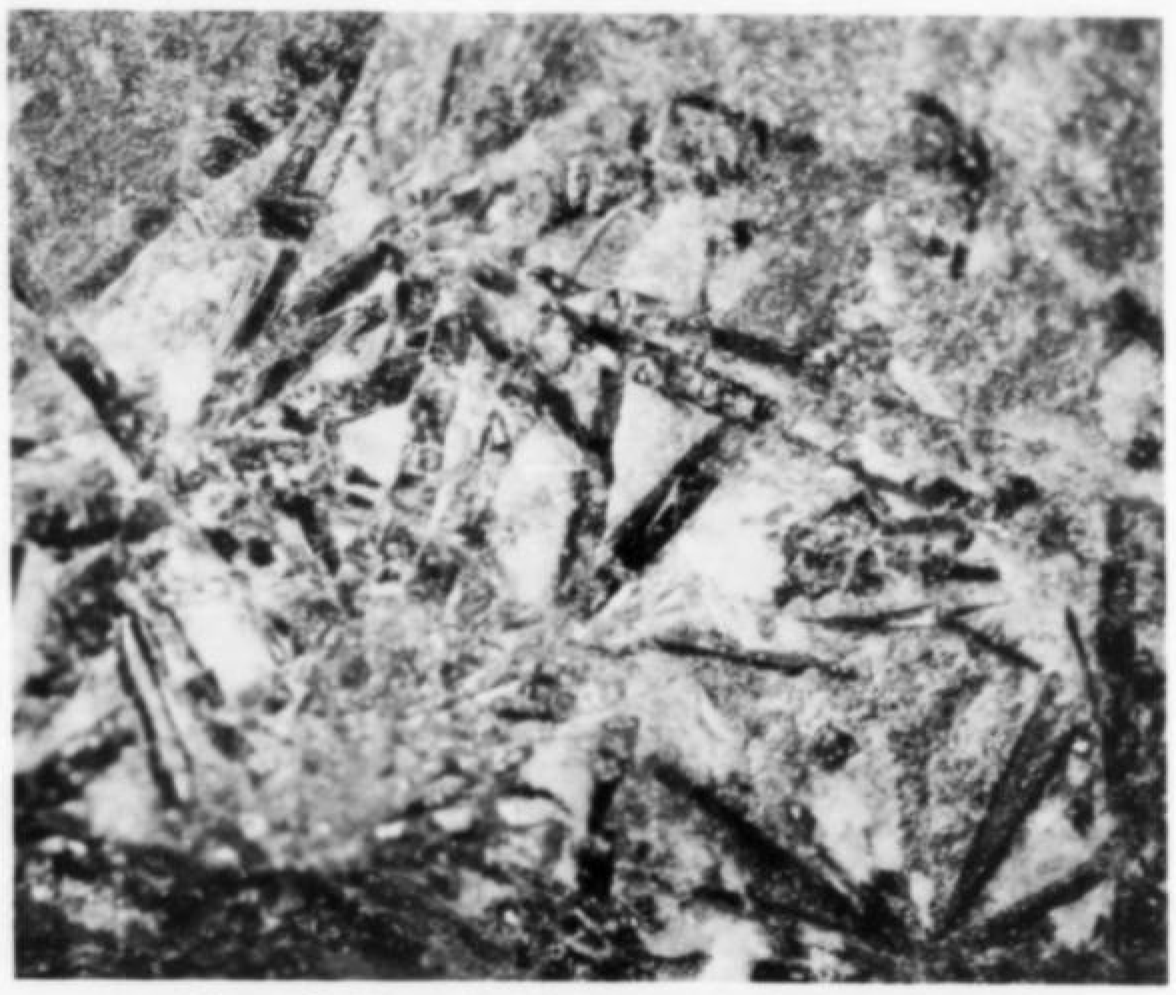

Figure 3. **Chromian dravite crystals about 2 mm in length, from the Line Pit.**

Optical properties for the chromian dravite were determined by Douglas M. Sheridan of the U.S. Geological Survey: $\omega = 1.655$ ($\pm$ .003), $\epsilon = 1.629$ ($\pm$ .002), $\omega - \epsilon = 0.026$, dichroism: ω = greenish blue, ϵ = pale yellow.

Pyroaurite $Mg_6Fe_2^{+3}(CO_3)(OH)_{16} \cdot 4H_2O$

Pyroaurite is not uncommon as minute, tabular, flattened, orange crystals and coatings along seams and surfaces of antigorite, brucite and chromite. It was initially thought that this mineral might be desautelsite, the Mn^{+3} analogue of pyroaurite (Dunn, Peacor and Palmer, 1979) which was reported from the Cedar Hill quarry, Pennsylvania. Identification of the mineral was confirmed by X-ray diffraction and scanning electron microscope (with energy dispersive analysis) techniques.

Clinochlore $(Mg,Fe^{+2},Cr^{+3},Al)_6(Si,Al)_4O_{10}(OH)_8$

Table 2. Electron microprobe and emission spectrographic (semiquantitative) analysis of chromian dravite from the Line Pit.

	Line Pit**	Etchison mine (Gill, 1889)
SiO_2	36.1 weight percent	36.56 weight percent
Al_2O_3	32.3	32.58
FeO*	0.5 (*total Fe reported as FeO)	0.79
Cr_2O_3	4.1	4.32
MgO	10.2	9.47
MnO	0.0	trace
CaO	0.4	0.75
K_2O	0.1	0.13
Na_2O	2.1	2.22
TiO_2	0.1	0.09
F	«0.05	0.06
B_2O_3	not determined	8.90
H_2O^+	not determined	
H_2O^-	not determined	3.74
O for F	nil	0.02
Total	85.9	99.63

Natural tourmalines used as standards for all elements except chromium. Chromite used for chromium. Average of five points, 15 kV accelerating voltage, 40 nanoamperes sample current, 10 micron beam diameter.

**Spectrographically determined: Pb - 0.003 weight percent
Cu - 0.003 weight percent
Ni - 0.07 weight percent
Sr - 0.02 weight percent
V - 0.07 weight percent

Chromian clinochlore in pale pearly green, translucent scales occurs along slickensided shears in massive chromite, locally associated with chromian dravite. Seams as much as 3 cm wide locally contain some emerald-green plates of chromian muscovite (fuchsite) along the same shear surface. The largest flakes of chromian clinochlore are about 3 mm across. The streak is pale greenish white, crystals have perfect basal cleavage, the hardness is about 4 and the laminae are brittle. A partial microprobe analysis is given in Table 3. The analysis and X-ray diffraction data served to distinguish chromian clinochlore. Non-chromium bearing clinochlore occurs as dull blue-gray to white plates with a slightly greasy luster in the serpentinites. It is flexible but not elastic and has perfect basal cleavage.

Pennine (penninite), a variety of clinochlore with more silicon and less aluminum, similar to that at Wood's mine a few km east of the Line Pit, occurs at the Line Pit in pseudohexagonal crystals on chromite. It is chromium, iron, and nickel-bearing and colored dark gray-green, in flexible but not elastic plates, usually translucent and slightly greasy in luster. Crystals are as much as 4 mm across. The form of the crystals is rhombohedral and commonly twinned on (001). Crystals are tabular and often tapering with a well-developed basal cleavage and striations parallel to the prism. In places the mineral grades into lavender kämmererite. Dark green striated and twinned crystals line vugs and seam-like cavities in massive chromite at Wood's mine associated with emerald-green zaratite and apple-green "genthite" (garnierite), grayish white magnesite and clear, elongated, bladed crystals of hydromagnesite. The mineral was formerly common but now is found generally as plates in seams of chromite.

Although pennine occurs at the Line Pit, a Wood's mine sample was analyzed and shown in Figure 4 because of its unusually fine quality and large crystal size (as much as 1 cm across). Table 3 contains partial analytical data for the mineral.

In addition, kämmererite, another chlorite (a variety of chromian clinochlore), is common in light to deep purple or lavender flakes or crystals as much as 1.5 cm in diameter. It also occurs in scaly masses in chromite and associated with chromian dravite and

Table 3. Microprobe analyses and emission spectrographic data for chromian pennine (dark green), chromian clinochlore (pale green) and fuchsite (chromian muscovite, emerald green).

Element or Oxide	1 Wood's mine chromian pennine no. 2231	2 Line Pit chromian clinochlore no. 2083a	3 Line Pit fuchsite no. 2083a	4 Line Pit fuchsite no. 2083
SiO_2	33.9 weight percent	31.3 weight percent	45.8 weight percent	46.5 weight percent
Cr_2O_3	2.0	2.5	2.9	4.8
FeO	2.9	1.9	0.9	0.9
MgO	33.3	32.5	1.0	0.8
CaO	0.1	0.0	0.1	0.1
MnO	0.0	0.0	0.0	0.0
Al_2O_3	16.4	19.9	33.6	31.8
Na_2O	0.05	0.0	0.7	0.7
K_2O	«0.05	0.0	9.4	9.5
TiO_2	«0.05	«0.05	«0.05	«0.05
ZnO	«0.05	«0.05	«0.05	«0.05
BaO	«0.05	«0.05	«0.5	0.1
Total	88.7	88.1	94.4	95.2
Ni	1500 ppm	———	300 ppm	———
V	30	———	70	———
Cu	20	———	5	———
Pb	none	———	100	———
Sr	none	———	150	———
Sc	none	———	100	———
B	none	———	70	———

Note - Fe reported as FeO. Operating conditions 15 kV, 40 nanoamps sample current. Antigorite and other silicates used as standards. Chromite for Cr. 10 micron spot.

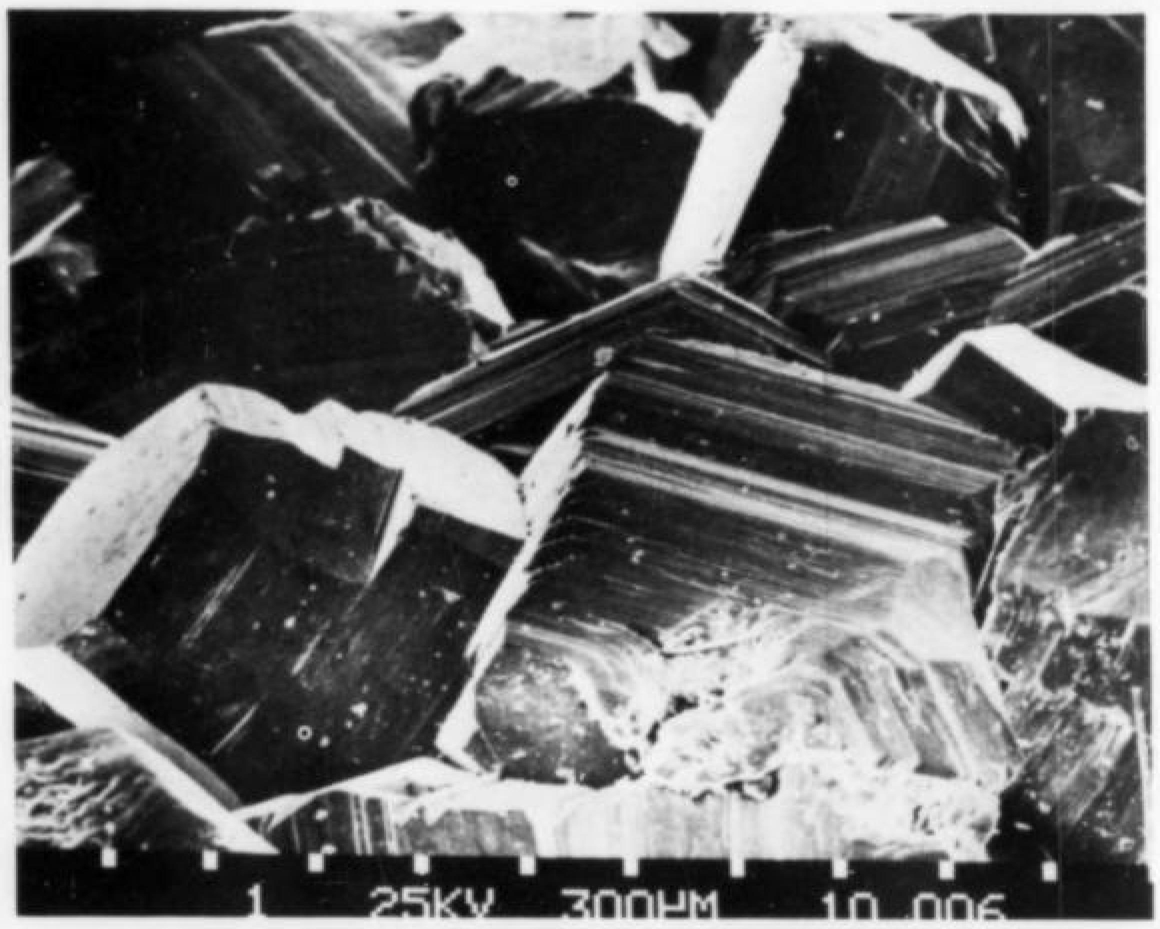

Figure 4. **Euhedral pennine crystals showing excellent development of basal cleavage. Distance between tic marks is 300 microns. Wood's mine.**

margarite. The kämmererite and chromium-antigorite are the only two lavender-violet-purple minerals identified from the Line Pit.

A semiquantitative spectrographic analysis of a sample of deep lavender-purple kämmererite from the Line Pit yielded the following results: Fe - 0.7 percent, Mg - 7.0 percent, Ca - 0.3 percent, Ti -none, Mn - 300 ppm, Ba - 1.5 ppm, Sr - 7 ppm, Co - 10 ppm, Cr -2.0 percent, Cu - 2 ppm, Ni - 1500 ppm, V - 15 ppm, Si - major, Al -0.7 percent, Na - 0.02 percent, K - 0.7 percent, Ga - 15 ppm. All other elements were not detected at respective limits of detection.

It is reasonable to consider the behavior of chromium as a chromophore in chromium-containing minerals. As pointed out by Thilo, *et al.* (1950), corundum, Al_2O_3, with Cr^{+3} up to about 8 atomic percent, is red at room temperature; with more chromium it is green. Antigorite, variety williamsite, was determined by us to have only about 150 ppm chromium. The emerald-green color is believed to be due to nickel with or without chromium. Chromium-antigorite on the other hand has about 3 percent chromium and is a distinctive lavender to deep purple color. Both varieties have less than 1 percent iron. Similarly, chromian clinochlore which is pale green, contains about 2.5 percent Cr_2O_3 whereas kämmererite contains as much as 8 percent or more Cr_2O_3 and is violet-purple-lavender. As defined by Lapham (1958), for chlorites having a chromium content greater than about 2 percent, if the chromium is in the octahedral sites the mineral should be called kämmererite; if it is in the tetrahedral sites, the mineral should be called kotschubeite. Both kämmererite and kotschubeite are purple-violet-lavender in color. Optical absorption spectral and X-ray studies by Bish (1977) on ten chromian chlorites showed no evidence for tetrahedrally coordinated chromium. Phillips, Loveless and Bailey (1980) determined by structural refinement of ten chromian chlorites that all Cr^{+3} occurs in octahedral interlayer coordination rather than tetrahedral and octahedral coordination; confirming the results of Bish (1977). Both have proposed that the names kämmererite and kotschubeite be dropped and that the prefix "chromian" be applied to the accepted Mg-Fe chlorite species nomenclature. The site occupancy proposed by Lapham (1958) for chlorites may or may not apply to the serpentine minerals as well. If so, regular antigorite and williamsite have chromium in tetrahedral positions, whereas chromian-antigorite has chromium in octahedral sites.

It appears that chlorite and serpentine minerals low in chromium (less than 2 or 3 percent) are generally green, being colored by iron with or without nickel, which dominates over the chromium. Those with more chromium are pale to deep purple in color. The chromium-bearing muscovite, fuchsite, however, is emerald-green. No purple 10Å chromium-bearing micas are known.

Clinochlore (aluminian variety *sheridanite*) $(Mg,Fe^{+2})_5Al(Al,Si)_4O_{10}(OH)_8$

Pale green flakes of sheridanite occur with chromian dravite and chromite on the margin of the central massive chromite pipe. A partial analysis is given in Table 4. Its physical properties resemble regular clinochlore, and it can be distinguished only by chemical means. Notably, it contains less SiO_2 and more Al_2O_3, and also less than 1 percent Cr_2O_3.

Table 4. Microprobe analysis of clinochlore (sheridanite).

Oxide	Line Pit
SiO_2	26.2 weight percent
TiO_2	0.1
Al_2O_3	25.1
FeO*	0.95
MnO	0.0
MgO	33.4
CaO	0.0
Na_2O	0.0
K_2O	0.0
Cr_2O_3	0.2
Total	85.95

* = Fe reported as FeO. 15 kV, 10 micron spot, 40 nanoamps sample current.

Chromian muscovite (fuchsite) $K(Al,Cr)_2(Al,Si)_3O_{10}(OH,F)_2$

Fuchsite occurs at the Line Pit as transparent, emerald-green, pseudo-hexagonal, monoclinic plates with fine basal cleavage, imbedded in black to dark brown chromite. It also occurs in thin seams of emerald-green plates associated with lavender kämmererite in unsheared chromite. Locally, it is found with chromian dravite and chromian clinochlore. The largest flakes are about 4 mm across. Laminae are flexible and elastic, hardness from 2 to 2.5 with a greenish white streak. Fuchsite has also been reported by Gill (1889) and Shannon (1926) at the Etchison mine in south-central Maryland. Analyses of the fuchsite are given in Table 3. The mineral was also identified by X-ray diffraction analysis in which it gives a distinctive 10Å mica pattern.

Margarite $CaAl_2(Al_2Si_2)O_{10}(OH)_2$

Margarite occurs as white to pale green, pearly, intersecting laminae up to 1 cm across. Some crystals are pseudo-hexagonal, monoclinic, translucent plates. The hardness is 3.5 to 4. It occurs as crusts and seams in chromite associated with chromian dravite and sheridanite. X-ray diffraction, optical, and qualitative microprobe studies confirmed identification of the mineral. Minor constituents in the green margarite are Cr, Fe, Na and Mg. Colorless margarite contains less Cr and Mg but more Fe and Ba. Chromian margarite has also been reported at the Etchison mine region in southern Maryland by Shannon (1924, 1926).

Magnesiochromite - Chromite $(Mg,Fe)(Cr,Al)_2O_4$ - $(Fe,Mg)(Cr,Al)_2O_4$

The species magnesiochromite (Smith, 1978)[1] has been reported from the Line Pit. Chromite has also been identified from the Line Pit in this study and previously with less complete analyses by Pearre and Heyl (1960). Chromite and magnesiochromite are two of the few remaining primary minerals, the others being forsterite and magnetite. They occur in three varieties: (1) black, coarse, massive chromite from the main central pipe in grains up to 1 cm across; the grains are interlocking, unsheared, although locally fractured material; (2) black to very dark brown, massive, granular chromite in veins extending from the central pipe-like ore body of massive chromite and (3) disseminated and schlieren-banded magnesiochromite (Smith, 1978), and irregular octahedral crystals of either magnesiochromite or chromite, as much as 1 mm in diameter, disseminated in the wall rock serpentine, which originally was probably dunite. The disseminated chromite and magnesiochromite were the earliest formed and were deposited by crystal settling at the time of crystallization of the dunite. The two massive magnesiochromite-chromite varieties are almost certainly late magmatic to early hydrothermal chromites injected into the crystallized or nearly crystallized dunite after the rock was at least partly consolidated. The coarse unsheared grains indicate that the massive chromite is not a boudin but a younger pipe-like mass.

A semiquantitative spectrographic analysis is given in Table 5 for the black, coarse, massive chromite from the pipe (type I). A complete wet chemical analysis for type I chromite is available as well (Smith, 1978, Table 17, p. 165). A microprobe analysis is given for marginal material from the main ore body (type II) associated with chromian dravite and sheridanite.

A magnesium-rich and chromium-lean chromite is reported by Shannon (1926) from the Etchison chromium mine in Maryland, where it is associated with chromian dravite, fuchsite, and margarite, as opposed to the chromium-rich chromite associated with these minerals at the Line Pit.

Antigorite (variety *williamsite*) $(Mg,Fe^{+2})_3Si_2O_5(OH)_4$

The dunite is now almost entirely serpentine, but remnants of olivine (forsterite) remain and can be recognized in thin sections. The main body is massive, dark to light green, waxy and microplaty lizardite(?)[2] associated with fibrous green antigorite and rare thin lustrous and fibrous bands of chrysotile. An unusual variety of deep emerald-green micro-fibrous antigorite, "williamsite" forms an envelope or casing 30 to 60 cm in thickness around the central massive chromite pipe. It also occurs as border zones along faults. This variety of antigorite is highly prized by mineral collectors and now is uncommon on the remaining dumps. Semiquantitative spectrographic analysis of the williamsite showed major Si and Mg with about 1 percent Fe, 0.05 percent Al, 50 ppm Mn, 15 ppm B, 15 ppm Pb, 15 ppm V, 150 ppm Cr, 30 ppm Co, 30 ppm Cu, and 2000 ppm Ni. A complete analysis of "williamsite" from the Line Pit mine is available in Nagy and Faust (1956): SiO_2 - 44.50, Al_2O_3 - 1.41, Fe_2O_3 - none, FeO - 0.35, MgO - 41.56, Na_2O - none, K_2O - none, H_2O^- - none, H_2O^+ - 12.36, TiO_2 - none, Cr_2O_3 - 0.06, NiO - 0.095, CoO - not determined, MnO - none, Total - 100.36. Haefner (1976) examined the williamsite and felt the color to be due to iron rather than chromium as previously reported. Because of the unusual emerald-green coloration and the spectrographic results, we feel that the color may be due to Ni with or without Cr.

A less common antigorite variety, chromian antigorite (Glass, Vlisidis and Pearre, 1959) is present throughout the district at several deposits, as lavender to deep purple fibrous masses in chromite; it occurs along shears in nearby serpentine (Pearre and Heyl, 1960). Spectrographic analyses of the chromian antigorite from the Line Pit and from Wood's mine are given in Table 6. The chromian antigorite is still common on the dumps of the Line Pit

---

[1] It is worthy of note, since Smith makes a point that his material is purer than that of Pearre and Heyl, that actually the purified concentrates of Dinnins such as samples 17, 20, and 22 (Table 6 of Pearre and Heyl, 1960) are just as pure as his equivalent analyzed samples.

[2] Robert C. Smith, II, states that all of the serpentine from the Line Pit that he has examined by modern mineralogic methods has proven to be mostly antigorite with much smaller amounts of chrysotile. Much more study is needed to prove the presence or absence of the common serpentine mineral lizardite. (Oral commun., R. C. Smith, II, to A. V. Heyl, Dec. 27th, 1979.) For other comments on lizardite see Montgomery, 1969, p. 54–55.

Table 5. Microprobe analysis of type II chromite from the Line Pit mine (sample no. 2083) and semiquantitative emission spectrographic analysis for type I chromite.

Oxide	Type II	Element	Type I
Cr_2O_3	59.8 weight percent	Cr	Major (»20 percent)
FeO	22.5	Fe	Major 15 percent
MgO	6.6	Mg	7 percent
CaO	0.1	Ca	.07 percent
MnO	0.6	Mn	.15 percent
Al_2O_3	10.1	Al	5 percent
Na_2O	«0.05	Na	«.1 percent
K_2O	«0.05	K	none
TiO_2	0.1	Ti	.03 percent
		Co	200 ppm
Total	99.8	Cu	15 ppm
		Ni	1500 ppm
		V	300 ppm
		Si	.15 percent

Fe reported as FeO. 15 kV, 40 nanoamps, 10 micron beam, natural chromite standard. A calculated structural formula for the Type II chromite is: $(Fe^{+2}_{.64}Mg_{.33}Mn_{.02}Ca_{.004}Ti_{.003})_{.997}(Cr^{+3}_{1.60}Al^{+3}_{.40})_{2.00}O_4$

Table 6. Semiquantitative spectrographic analyses of chromian antigorite from the Line Pit mine and Wood's mine.

Element	Line Pit mine medium lavender	Wood's mine deep lavender
Fe	0.7 weight percent	1.0 weight percent
Mg	Major	Major
Ca	0.005 wt. percent	0.3 wt. percent
Ti	0.007 wt. percent	0.007 wt. percent
Cr	0.7 wt. percent	3.0 wt. percent
Si	Major	Major
Al	5.0 wt. percent	3.0 wt. percent
Na	ND 0.05 wt. percent	ND 0.05 wt. percent
K	ND 0.7 wt. percent	ND 0.7 wt. percent
Mn	70 ppm	300 ppm
B	none	30 ppm
Ba	2 ppm	15 ppm
Co	«10 ppm	«10 ppm
Cu	1 ppm	30 ppm
Ni	1500 ppm	700 ppm
Sc	7 ppm	5 ppm
Sr	none	none
V	70 ppm	70 ppm
Ga	15 ppm	15 ppm

ND - not detected at the limit shown
All other elements looked for but not detected

mine but care is needed to distinguish it from flaky chromian chlorite (kämmererite) which was long confused with it, and a massive lavender serpentine as yet unidentified. Some of the chromian antigorite is in green antigorite (williamsite) masses and associated with kämmererite. Smith (1978) has pointed out that much of the material collected as chromian antigorite may not be such but rather another variety of serpentine.

Talc $Mg_3Si_4O_{10}(OH)_2$

Talc occurs as greenish white to white foliated masses. The extreme softness (hardness of 1 to 1.5) and soapy feel are distinctive. Less commonly talc occurs as soft but lustrous black slickensided masses. Flakes 1 cm in diameter are common.

Brucite $Mg(OH)_2$

Brucite occurs in laminated pearly masses (Gordon, 1922a, b), slightly harder than talc (hardness 2.5). Less commonly it occurs in seams of platy, pearly white crystals to several mm across. (See Fig. 5.)

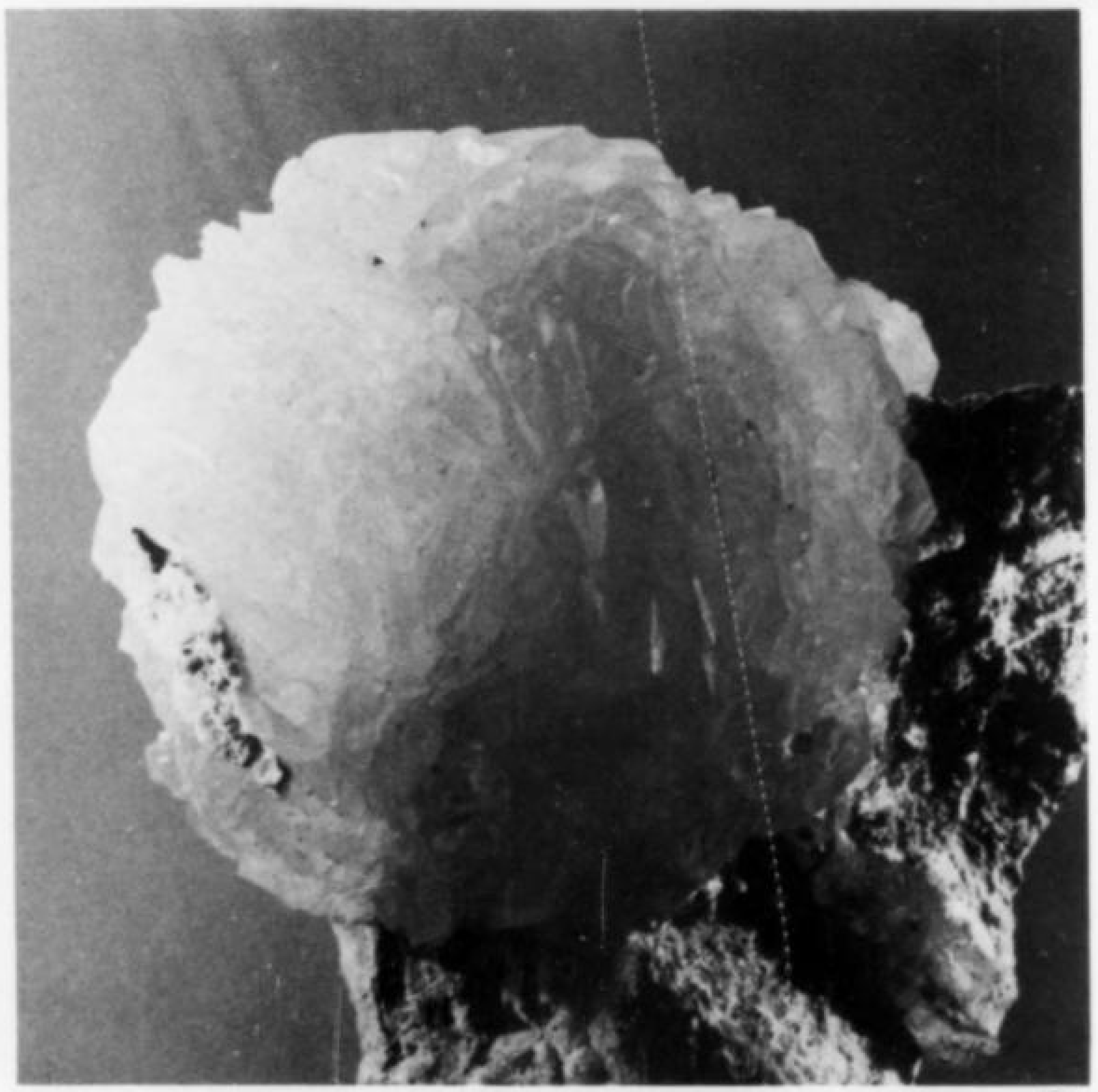

Figure 5. **A 4.3-cm spherical aggregate of very pale green brucite crystals from Wood's mine. Smithsonian specimen.**

Magnesite $MgCO_3$

Magnesite is commonly present in chalky white masses and veins up to 2.5 cm across (Gordon, 1922b). Small, white, translucent crystals of magnesite showing prismatic hexagonal rhombohedral habit are less common in small vugs and cavities in gouge.

Hydromagnesite $Mg_5(CO_3)_4{\cdot}4H_2O$

Hydromagnesite is now uncommon, but can be found as acicular white to colorless crystals and as thin, radiating, botryoidal crusts on and in seams in brucite (Gordon, 1922b). Most crystals are 1 to 2 mm in length.

Zaratite $Ni_3(CO_3)(OH)_4{\cdot}4H_2O$

Zaratite, the emerald-green nickel carbonate, has been found

(Gordon, 1922b) as a transparent crust on various minerals but has not been commonly found in recent years. It can readily be distinguished from the paler green "genthite" by X-ray diffraction techniques and effervescence in dilute hydrochloric acid.

"Genthite" (garnierite) hydrous Ni silicate

Genthite, the apple-green, opaque, hydrous Ni silicate is also present (Gordon, 1922b) at the Line Pit, but has not been common in recent years. More data are needed to define this mineral beyond the general group of garnierite.

Grossular $Ca_3Al_2(SiO_4)_3$

Green chromian grossular garnet was found by Beck (1952) as small, bright green, dodecahedral crystals. Beck stated that Michael Fleischer identified this garnet as chromian grossular rather than uvarovite, but the details of his determinations have been lost. In the past such green garnets have been called uvarovite in this district. To the authors' knowledge this garnet has not been found in recent years at the Line Pit. Speer (1977) reported uvarovite and Cr-grossular garnet from Wood's mine, and provided pertinent mineralogic data identifying both species. Quite possibly uvarovite could be found also at the Line Pit with careful searches of the old dumps.

Quartz SiO_2

Quartz, variety chalcedony, is not uncommon on the mine dumps and in the adjacent woodland.

Forsterite $(Mg,Fe)_2SiO_4$

The Mg-rich end-member of the olivine series occurs in very pale green, rounded grains as a major primary constituent of the dunite and peridotite. It is now largely altered to serpentine, but small residual grains and masses are commonly seen in thin sections made of the serpentine.

Awaruite ordered $FeNi_3$

Awaruite, a nickel-iron intermetallic compound, was identified from the Line Pit mine by Uytenbogaardt (*in* McKague, 1964, p. 60) occurring as thin, silver-white, metallic, intergranular sheets in massive chromite. It has not been recognized in this study. A description of this mineral can be found in Uytenbogaardt and Burke (1971) and Botto and Morrison (1976).

Magnetite Fe_3O_4

Magnetite is not an uncommon mineral in the serpentine (Pearre and Heyl, 1960). It occurs as lenses and very lustrous, shiny, rounded, disseminated grains in serpentine which are common throughout the serpentine masses. It is very magnetic, unlike the chromite. Locally it was mined, but the bodies were usually small and the magnetite too high in titanium to make a good iron ore.

Dolomite $CaMg(CO_3)_2$

Dolomite occurs as gray to colorless colloform bands as a common constituent of the magnesite veins that cut the chromite, "williamsite," and chromian varieties of antigorite in the central and border parts of the chromite deposit. Commonly the dolomite bands are 3 to 5 mm wide between the "williamsite" and the magnesite and double-banded on both sides of the magnesite veins. Similar bands, some in association with small flakes of brucite, occur between magnesite and chromite or chromian antigorite.

Calcite $CaCO_3$

Clear to white calcite is a less common mineral than dolomite and is closely associated with it.

Heazlewoodite Ni_3S_2

Euhedral heazlewoodite occurs as widely scattered grains in antigorite at the Cedar Hill quarry. Heazlewoodite was one of the nickel sulfides that Gordon (1922a) was unable to identify at Wood's mine (McKague, 1964).

Pentlandite?

"At the Line Pit mine a lighter yellow mineral, which tarnishes much more slowly in HNO_3 than heazlewoodite, is present. This mineral is probably pentlandite," (McKague, 1964).

Pyrite FeS_2

Minute brass-yellow grains were found by Robert C. Smith, II in green antigorite at the Line Pit in 1978. A sample was sent to one of us (AVH) and analyzed on the SEM in cooperation with James M. Nishi. Only Fe and S were found in the sample with S about twice as abundant as Fe; thus, the mineral is probably pyrite. No other elements of consequence were found and the amount of material available was too small for X-ray diffraction work.

Millerite NiS and ***Maucherite*** $Ni_{11}As_8$

These two nickel minerals have recently been found in small quantities in antigorite at the Line Pit mine as small brass-yellow grains. A detailed study including microprobe analyses has been completed by Smith and Speer (1980). The maucherite occurs intergrown with millerite. Millerite has long been reported from Wood's mine (Gordon, 1922b) as small grains and nodules in kämmererite.

SUMMARY

The chromian minerals (other than chromite) described here are uncommon or rare younger silicates formed during the later stages of formation of the massive chromite pipe and its emerald-green antigorite casing. They crystallized prior to the magnesite and pyroaurite which are in veins or veinlets crossing all other minerals. The chromite pipe itself was emplaced relatively late compared to the early magmatic disseminated and schlieren-banded magnesiochromite and the olivine of the original dunite. The rare younger silicates were deposited prior to most serpentinization within the edges of the chromite pipe and casing.

Such minerals as the chromian dravite, fuchsite and margarite have not previously been described from the massive chromite deposits of the State Line district; the nearest locality for these minerals in chromite deposits is the Etchison chromium mine in south-central Maryland on the northwest fringe of Washington, D.C. The sheridanite variety of clinochlore and the pyroaurite are new to this locality, and modern analyses of chromian pennine are presented. All of these minerals and varieties can probably still be found in the remaining parts of the mine dumps.

ACKNOWLEDGMENTS

The authors are indebted to Douglas M. Sheridan of the U.S. Geological Survey who measured the indices of refraction for the chromian dravite. We are also indebted to Donald Schmerling and Martin Anné of the Friends of Mineralogy Pennsylvania Chapter who pointed out possible desautelsite or pyroaurite at the Line Pit, and to M. L. Heyl who helped collect many of the specimens used in this study in the early 1950's. Thanks are also due to Robert C. Smith, II for providing unpublished information on the mineralogy of the Line Pit.

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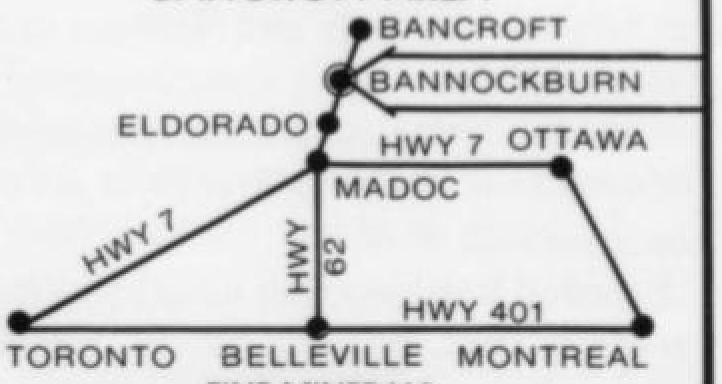

Příbram
Czechoslovakia

by **J. Stobbe**
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Netherlands

Mining has been under way at this famous Dana locality since the thirteenth century. Although the last mine in the region closed in 1978, and collecting is officially forbidden, many collections throughout the world still possess Příbram specimens.

INTRODUCTION

Příbram, a town of about 30,000 inhabitants, is situated in central Bohemia, Czechoslovakia, about 55 km from the capital city of Prague. A very old city and one of the oldest mining towns in Czechoslovakia, Příbram celebrated its 750th anniversary in 1966. The Príbram ore field has long been a subject of study by geologists and mineralogists, and has yielded important scientific insights as well as voluminous amounts of ore over the years. Though a famous mineral locality among the cognoscente, Příbram trails in popularity the other famous eastern European localities such as Baia Mare and Verespatak in Romania, Trepča in Yugoslavia, and the Ural Mountains in the Soviet Union.

GEOLOGY

The Příbram ore field constitutes part of the southeastern limb of the Barrandian synclinorium. The Barrandian sedimentary complex is represented by the Proterozoic (Bohemian Algonkian) and Cambrian only. The Paleozoic of the Barrandian was affected by the Variscan orogeny, during the course of which the previously folded Proterozoic sediments were also reworked. The axis of the Barrandian synclinorium is oriented WSW-ENE; numerous folds roughly paralleling this axis originated during the Variscan orogeny.

In the Příbram region the faults have a northeast-southwest orientation and a steep northwest dip, and are characterized by overthrust of the northwestern blocks. The so-called Clay fault *(Lettenkluft)* along which Proterozoic rocks were thrust over Cambrian units, is the most important with respect to ore deposits. Among the smaller faults of varying strike, the most important are those running roughly north-south which, prior to emplacement of the Central Bohemian pluton, were injected with diabases.

Ores in the Příbram field are generally connected in some physical way with the diabase dikes. Minor dislocations are most abundant in the neighborhood of the major faults such as the Clay, Dedov, and Dubenec-Druhlice faults. The emplacement of ore is genetically related to the post-magmatic phase of the Central Bohemian pluton. The Bohutín quartz diorite, located to the southwest of Příbram, is considered to be a differentiate of the pluton.

The most important ore veins of the Příbram ore field are concentrated in three zones: (1) the Clay fault zone, (2) the Dedov and Dubenec-Druhlice fault zone, and (3) a zone within the pluton proper.

THE MINES

Among the most historic workings in the Příbram field are the Brezové Hory ore district and the Bohutín ore district, both located near the Clay fault. The principle mines are the Anna, Vojtech and Prokop mines at Brezové Hory, and the 25 Únor mine (formerly

the Stefánik, the Rudolf, and the Bohutín II mines) at Bohutín. Mining had already commenced in the Příbram as early as the late thirteenth century. Silver-rich near-surface veins were worked at the beginning of the 16th century. After these rich veins were exhausted, mining proceeded to lower depths. The Vojtech mine became the first major deep-level mine in the Brezové Hory district in 1779. It was also in this mine, in 1875, that a mine depth of 1000 meters was reached for the first time anywhere in the world. Today the maximum depth of the Breżové Hory mines is 1520 meters, and of the Bohutín mine 1300 meters.

At present, the Bohutín mines include several shafts opened during the 19th century. The Stepánka mine (formerly the Bohutín I mine, founded in 1827) serves mainly for drainage and ventilation.

The Frantisek mine (founded in 1843) was closed in 1862. The Rimbaba mine (formerly the Segen Gottes ("God's Blessing") mine, founded in 1843) presently serves as a school mine. The main 25 Únor mine (founded in 1878) intersects the most important vein in the region, the Klement vein, on 33 levels to a depth of 1199 meters. The Rimbaba mine is connected with the 25 Únor mine by a cross-cut at the 21st level. The Hurka mine was opened during World War II, and later went out of operation.

PARAGENESIS OF THE POLYMETALLIC VEINS

The two most important areas of mineralization are the Klement vein at Bohutín and the Brezové Hory veins. Studies by Kutina (1963) suggest that the classical Příbram mineralization, typified by the Klement vein, was deposited in four stages, within which 12 periods of introduction can be distinguished. Kutina's suggested paragenesis may be outlined as follows:

- **First stage** (polymetallic, galena-sphalerite)
  - 1st period: *sphalerite I*
  - 2nd period: *siderite I*
  - 3rd period: *barite I, quartz I, galena I*
  - 4th period: *pyrite I, sphalerite II*
  - 5th period: *siderite II, sphalerite III, ankerite-dolomite I, calcite I*
- **Second stage** (polymetallic, sulfantimonide)
  - 6th period: *quartz II, arsenopyrite, pyrite II*
  - 7th period: *geocronite, bournonite, tetrahedrite, chalcopyrite I, bornite, pyrite III*
  - 8th period: *quartz III, galena II, boulangerite*
  - 9th period: *quartz IV, pyrite IV, sphalerite IV, semseyite, jamesonite, goethite, calcite II*
- **Third stage** (stibnite)
  - 10th period: *quartz V, barite II*
  - 11th period: *quartz VI, berthierite, stibnite*
- **Fourth stage** (carbonate)
  - 12th period: *chlorite, dolomite II, calcite III, pyrite V, chalcopyrite II, calcite IV, kaolinite*

QUARTZ VEINS

Pegmatite-aplite veins and younger quartz veins containing molybdenite and pyrite were intruded in association with the intrusion of the Bohutín quartz diorite (Pisa, 1966). The quartz diorite is cut by quartz veins carrying a slight gold content, and ranging from 1 cm to 10 cm in thickness.

MINERALS (KLEMENT VEIN)

Sphalerite, (Zn,Fe)S

Sphalerite I is among the earliest-formed minerals in the Klement vein. The color ranges from blackish brown to brown and rarely reddish brown. Sphalerite II is present in lesser amount; its color ranges from dark brown to brownish red. Rare, foliated, spherulitic aggregates of the polymorph **wurtzite** are usually part of the second generation. Sphalerite III, with its characteristic ruby color, is a very conspicuous mineral of the vein fillings, although the quantity is minimal in comparison to earlier generations. It commonly forms perfectly developed crystals in cavities in earlier minerals. Locally a superficial blackish brown coating has been produced by later hydrothermal solutions, and by impregnation with Pb-sulfantimonides. Sphalerite IV is yellow and is rarely encountered, usually only in microscopic studies.

Figure 1. **Yellow sphalerite crystals to 4 mm, with quartz and buff-colored, irregular calcite, from Příbram. Photo by H. Stÿfhoorn, Den Helder; collection of the author.**

Galena, PbS

Most galena in the deposit formed as the first generation, galena I. The rare crystals of galena I are largely of cubic habit, whereas later generations are cuboctahedral *(steinmannite). Steinmannite* is a varietal term applied to arsenic and antimony-bearing galena. Natural etch figures are common on cube faces as a result of later

Figure 2. **Galena crystals (variety** ***steinmannite*****) to about 2.8 cm from Příbram. Collection of the author.**

Figure 3. **Galena crystals to 6 mm on quartz from Příbram. Smithsonian collection, #B3720.**

Figure 4. **Galena crystals to 1.3 cm on calcite from Príbram. Smithsonian collection, #B1951.**

hydrothermal activity. The cube faces were corroded first, the other forms later. This corrosion was probably most intense at the beginning of the second paragenetic stage. Boulangerite and jamesonite are the most common associates of galena I, and galena II is associated with the formation of quartz II. Rare, minute crystals of galena II always have the cuboctahedral appearance of *steinmannite* and are unetched. The silver content averages 0.278 percent.*

Bournonite, $PbCuSbS_3$

Bournonite is the most common copper mineral in the Klement vein. It forms as crystal druses in cavities and may be replaced by chalcopyrite I.

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*Average of 42 quantitative analyses ranging from 0.06 to 0.52 percent.

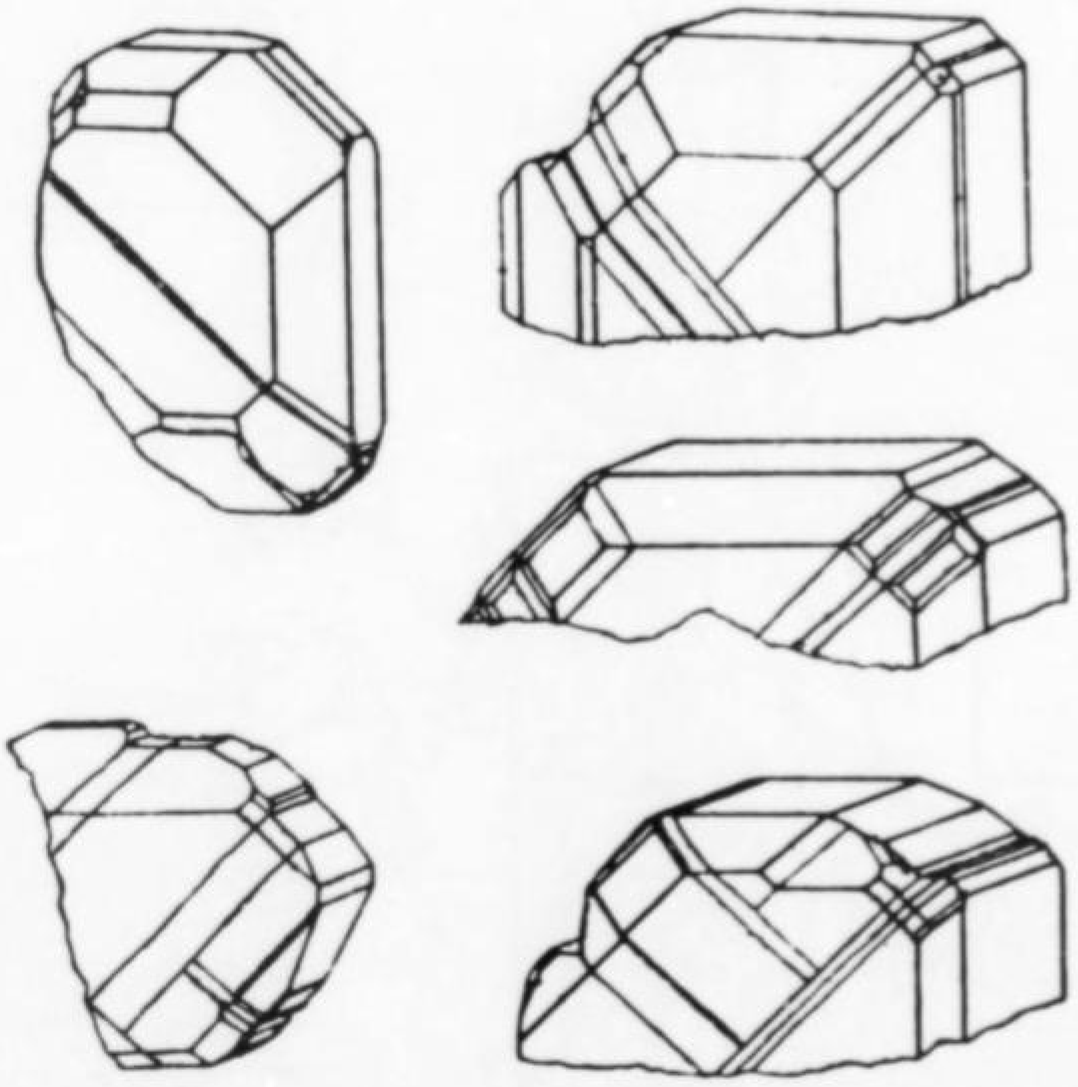
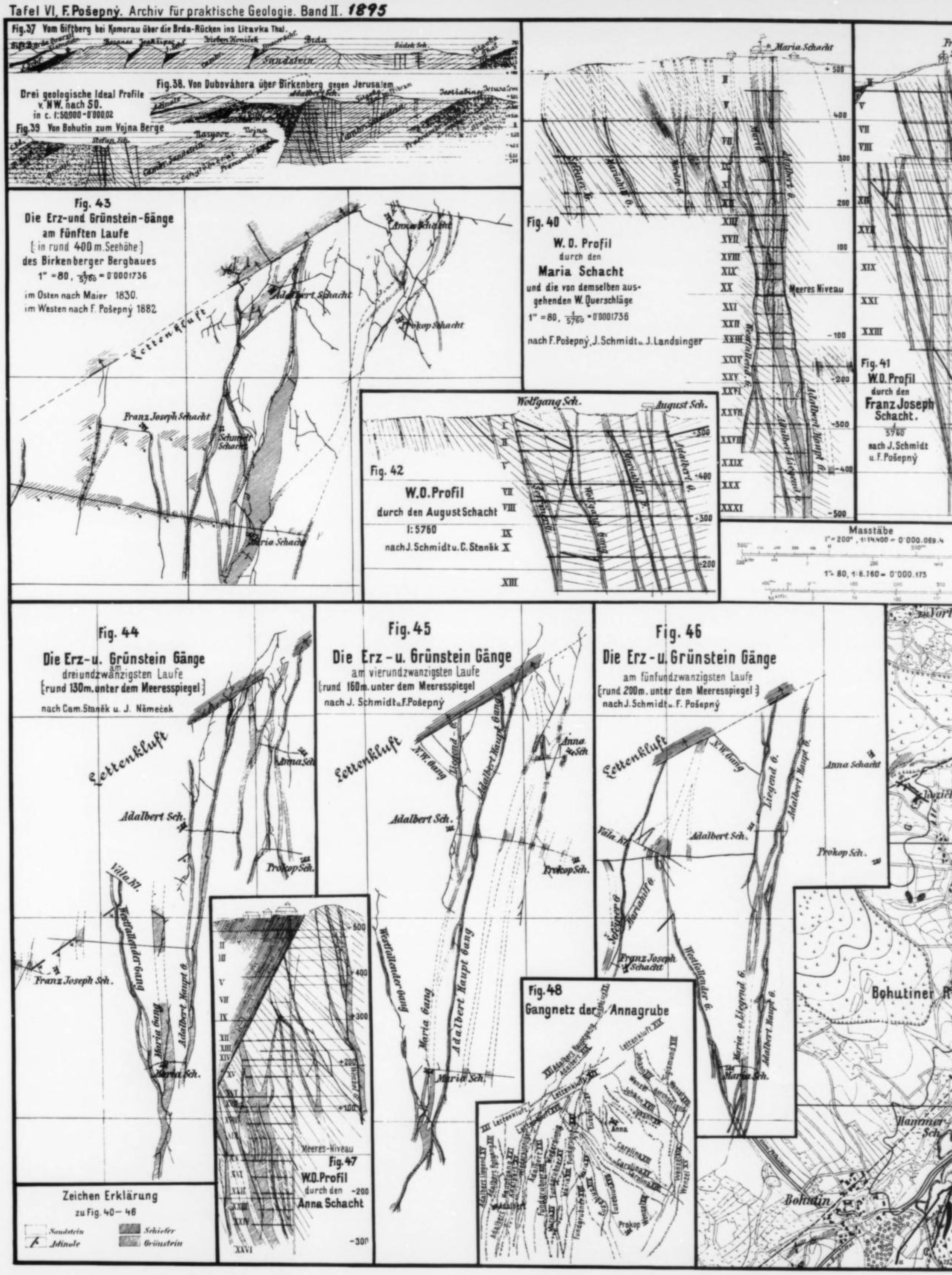


Figure 5. **Příbram bournonite (Goldschmidt, 1913).**

Figure 6. **Bournonite crystals to 7 mm from Příbram. Collection of the author.**

Tafel VI, F. Pošepný. Archiv für praktische Geologie. Band II. 1895



Drei geologische Ideal Profile v. NW. nach SO. in c. 1:50000 - 0'000.02

Fig. 37 Vom Giftberg bei Komorau über die Brda-Rücken ins Litavka Thal.

Fig. 38. Von Dubováhora über Birkenberg gegen Jerusalem

Fig. 39 Von Bohutin zum Vojna Berge

Fig. 40 W. O. Profil durch den Maria Schacht und die von demselben ausgehenden W. Querschläge 1" = 80, $\frac{1}{5760}$ = 0'0001736 nach F. Pošepný, J. Schmidt u. J. Landsinger

Fig. 41 W.O. Profil durch den Franz Joseph Schacht. $\frac{1}{5760}$ nach J. Schmidt u. F. Pošepný

Fig. 42 W.O. Profil durch den August Schacht 1:5760 nach J. Schmidt u. C. Staněk

Fig. 43 Die Erz- und Grünstein-Gänge am Fünften Laufe [in rund 400 m. Seehöhe] des Birkenberger Bergbaues 1" = 80, $\frac{1}{5760}$ = 0'0001736 im Osten nach Maier 1830. im Westen nach F. Pošepný 1882

Fig. 44 Die Erz- u. Grünstein Gänge am dreiundzwanzigsten Laufe [rund 130 m. unter dem Meeresspiegel] nach Cam. Staněk u. J. Němeček

Fig. 45 Die Erz - u. Grünstein Gänge am vierundzwanzigsten Laufe [rund 160 m. unter dem Meeresspiegel] nach J. Schmidt u. F. Pošepný

Fig. 46 Die Erz - u. Grünstein Gänge am fünfundzwanzigsten Laufe [rund 200 m. unter dem Meeresspiegel] nach J. Schmidt u. F. Pošepný

Fig. 47 W.O. Profil durch den Anna Schacht

Fig. 48 Gangnetz der Annagrube

Masstäbe
1" = 200°, 1:14400 = 0'000.069.4
1" = 80, 1:5.760 = 0'000.173

Zeichen Erklärung zu Fig. 40 - 46
- Sandstein
- Schiefer
- Adinole
- Grünstein


Montangeologische Karte
des
PŘIBRAMER BERGDISTRICTES
nach Aufnahmen in den Jahren 1880–1888
von F. Pošepný
im Masstabe 1:14.400.
Zeichenerklärung.
Lehm
Cambr. Sandstein
" Adinole
" Conglomerat
Schichten Streich.
Ideale Gesteinsgrenzen.
Præcambr. Schiefer
Grünstein
Granit
Alte Goldseifen
Unterirdisch, angefahrener Granit
Franz Joseph Schacht
Meeres Niveau
Reichenbroster Sch.
Deutsch Lhota
Trhové Dušníky
Erbstollen
Schmelzhütte
Května Stollen
Května Sch.
Osec
Dubová
Schwarzgrubner Revier
Čertův pahorek
Strachen Sch.
Lill Schacht
Mathias St.
Ferdinand Sch.
Podlesy
Karl Boromäi St.
Anna Schacht
Březové Hory
Birkenberg
PŘIBRAM
Birkenberger Revier
Adalbert Sch.
Josef Maria St.
Prokop Schacht
Franz Josef Sch.
Svatá hora
Maria Sch.
Heiligerberg Sch.
Haté Stollen
Philippinen St.
Saský
Lázně
Lazec
Kozičín
Haté
August Schacht
Wolfgang Sch.
Zdaboř
Drkolnover Revier
Segen Gottes Sch.
Neu-
Alt. Broder St.
Mansfeld St.
Jerusalem
Zdaboř Schacht
Rudolf Sch.
Hatka
Florentiner St.
Franz Sch.
Wenzel St.
Leopold
Brod
Stefan Sch.
Hora
Tisov
Žežice
Schwarzenberg Sch.
Vorlov
ner Revier

Figure 7. **Tetrahedrite crystal to 9 mm from Bohutín, Příbram. Collection of the author.**

Figure 8. **Pyrite crystals to 4 mm from Příbram. Collection of the author.**

Figure 9. **Acicular boulangerite with quartz crystals to 1.3 cm, from Příbram. Collection of the author.**

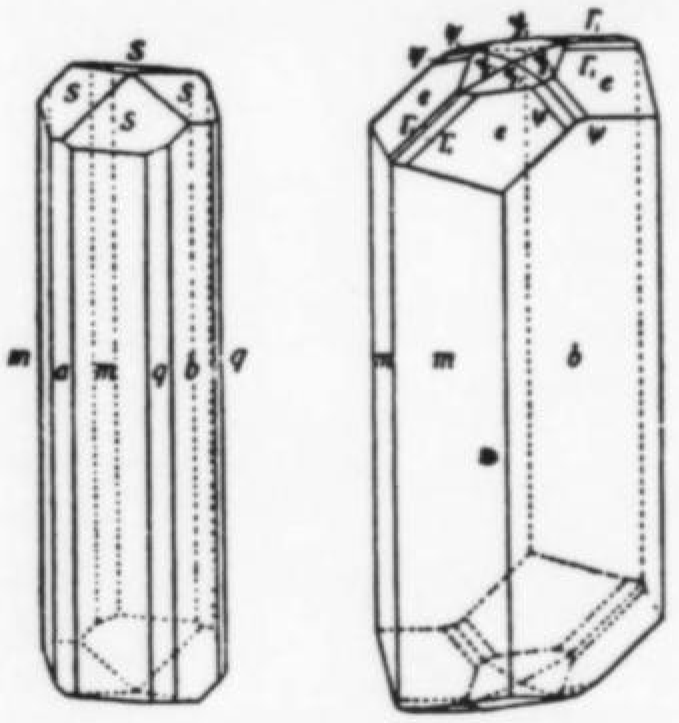


Figure 10. **Příbram stibnite (Goldschmidt, 1913).**

Tetrahedrite, $(Cu,Fe)_{12}Sb_4S_{13}$

Tetrahedrite is significantly rarer than bournonite in the vein.

Chalcopyrite, $CuFeS_2$

Crystals of chalcopyrite I are typically microscopic in size. Traces rarely accompany pyrite V as a dusty coating on the surface of calcite III crystals. Very rare **bornite** and **covellite** also accompany chalcopyrite.

Pyrite, FeS_2

Most of the pyrite in the deposit formed as the first generation, pyrite I, typically crystallizing in pyritohedrons. Pyrite II accompanies arsenopyrite as a rare constituent, frequently as cubes and rarely as pyritohedrons. Pyrite III is very rare, forming only as small, spindle-shaped aggregates accompanying copper sulfides. Pyrite IV is also rare, typically forming sheaf-like to spherulitic aggregates of tabular crystals in quartz IV. Pyrite V most frequently occurs as coatings of dusty microscopic cubes and cuboctahedrons on calcite III crystals.

Arsenopyrite, FeAsS

Arsenopyrite occurs in nearly negligible amounts as simple crystals.

Boulangerite, $Pb_5Sb_4S_{11}$

Boulangerite is the youngest Pb-sulfantimonide in the deposit. It occurs with quartz III as fibrous material filling cavities.

Jamesonite, $Pb_4FeSb_6S_{14}$

Jamesonite is comparatively rare, occurring as fibrous crystals 0.0001 to 0.0005 mm in diameter.

Semseyite, $Pb_9Sb_8S_{21}$; Geocronite, Pb_5SbAsS_8

Semseyite and geocronite are very rare, noted only from Bohutín as part of the second paragenetic stage.

Berthierite, $FeSb_2S_4$

Berthierite accompanies stibnite as rod-like aggregates of brownish gray crystals.

Stibnite, Sb_2S_3

Next to galena and sphalerite, stibnite is perhaps the best known mineral from the Bohutín deposit. It forms as coarse aggregates of prismatic crystals, fine-grained inclusions in quartz VI, and crystals lining cavities. Beautiful specimens may be seen in the Hornicke Museum of Brezové Hory.

Goethite, FeO(OH)

Goethite forms very fine aggregates of fibrous crystals.

Quartz, SiO_2

Aside from the carbonates, quartz is the most common gangue mineral in the deposit. Quartz I occurs in small amounts of clean crystals frequently accompanying galena I. Quartz II has inclusions of arsenopyrite and pyrite II, is usually milky-white in color and less common than quartz I. Quartz III is the most abundant mineral in the deposit. It forms light gray to black aggregates, its color due mainly to inclusions of boulangerite and galena II. Quartz IV accompanies pyrite IV, jamesonite, sphalerite IV and goethite. Usually it is difficult to distinguish from quartz III. Quartz V is explicitly confined to occurrences of barite as milky-white crystals with a bluish tint. Quartz VI is associated with berthierite and stibnite, and ranges from milky to black depending upon the amount of inclusions. Quartz VI also occurs in a honeycomb habit, which is the result of a quartz-barite breccia in which the barite has been dissolved away.

Barite, $BaSO_4$

Barite I is a very rare mineral in the deposit, occurring as yellowish brown aggregates. Barite II represents the bulk of the barite in the deposit.

Siderite, $FeCO_3$

Siderite I is the most abundant siderite generation and a typical gangue mineral, although it rarely forms crystals in cavities. Siderite II is present in nearly negligible amounts.

Ankerite-Dolomite, $Ca(Fe,Mg,Mn)(CO_3)_2$

Ankerite-dolomite I is the most common mineral of the 5th period of crystallization, its composition variable between ankerite and dolomite. Upon exposure to air it soon turns yellow. Dolomite II is a younger phase, less common than dolomite I, and found in association with calcite III.

Calcite, $CaCO_3$

Calcite I is a rare mineral in the first stage of crystallization, calcite II accompanies a small quantity of minerals of the 9th period, and calcite III, aside from quartz and siderite, is the youngest gangue mineral. It occurs in different crystal forms, many of them resembling the well known crystals from Trepča, Yugoslavia, but with a white to rosy or yellowish color. Rose-colored specimens are the famous *manganocalcite* variety. Calcite III fluoresces a light red to orange color under ultraviolet light. The fluorescence is apparently not due to the content of MnO, FeO, Fe_2O_3 or SrO. The rose color in ordinary light is due to the MnO content, but this seems unrelated to fluorescence. Calcite IV is a very common generation of yellow to orange color.

Others

Other minerals found in small amounts include kaolinite, chlorite, pyrargyrite, gypsum, melanterite, limonite, psilomelane, stibiconite and malachite. These minerals have not yet been assigned a place in the paragenetic sequence.

MINERALS (FRANTISEK VEIN)

The substantially less important Frantisek vein (formerly known also as the Fe-ores vein) is oriented almost identically to the Klement vein. The following minerals have been identified from the mine workings and dumps: galena, sphalerite, chalcopyrite, pyrite, hematite, quartz, siderite (the most abundant), ankerite, dolomite, calcite, pyromorphite and limonite. The sequence of crystallization, oldest to youngest, is as follows: siderite I, galena I, sphalerite II, siderite II, sphalerite III, ankerite I, quartz, hematite, pyrite, chalcopyrite, galena II, dolomite and calcite. These represent the first and fourth paragenetic stages seen at the Klement vein.

MINERALS (BREZOVÉ HORY DISTRICT)

The earliest stage of ore in the Brezové Hory district is represented by what is called *dürrerz,* an intimate intergrowth of siderite, quartz, pyrite, arsenopyrite, sphalerite I, galena, boulangerite and others. During the deposition of *dürrerz,* siderite was partially replaced by quartz forming metacrysts, and the remaining siderite was later replaced by numerous ore minerals of the regular sequence. In reopened fissures a considerable amount of siderite II was deposited, followed by quartz and various ore minerals, particularly sphalerite II and chalcopyrite. Third stage ankerite and fourth stage calcite (most of it manganocalcite, in considerable amounts) were deposited, preceded by tectonic movements which crushed the earlier vein fillings.

Brezové Hory galena is silver-bearing, and sphalerite of both generations contains Fe, Cd, Mn, In, Ga, Ge, Hg, Sn, S, Cu, Ag, Pb and Sb in varying amounts. The deposit is zoned vertically, with most of the silver minerals in the upper levels. These upper levels have been the source of the famous Příbram stibnite, pyrargyrite, proustite, stephanite, diaphorite and native silver. Very fine examples of these minerals are preserved in the Hornicke Museum in Brezové Hory and the Narodní Museum in Prague. The Hornicke Museum, one of the best local museums I have ever visited, also has minerals from the Uranové Doly (uranium mines).

Figure 11. **Barite crystals to 2 cm from Příbram, collected in 1947. Collection of the author.**

Figure 12. **A 4-cm, colorless barite crystal from Příbram. Smithsonian collection, #B15893.**

Figure 13. **Calcite crystals to 2 cm from Příbram. Collection of the author.**

Figure 14. **Pyrargyrite crystals to 1.5 cm on calcite, from Příbram. Smithsonian collection, #C787.**

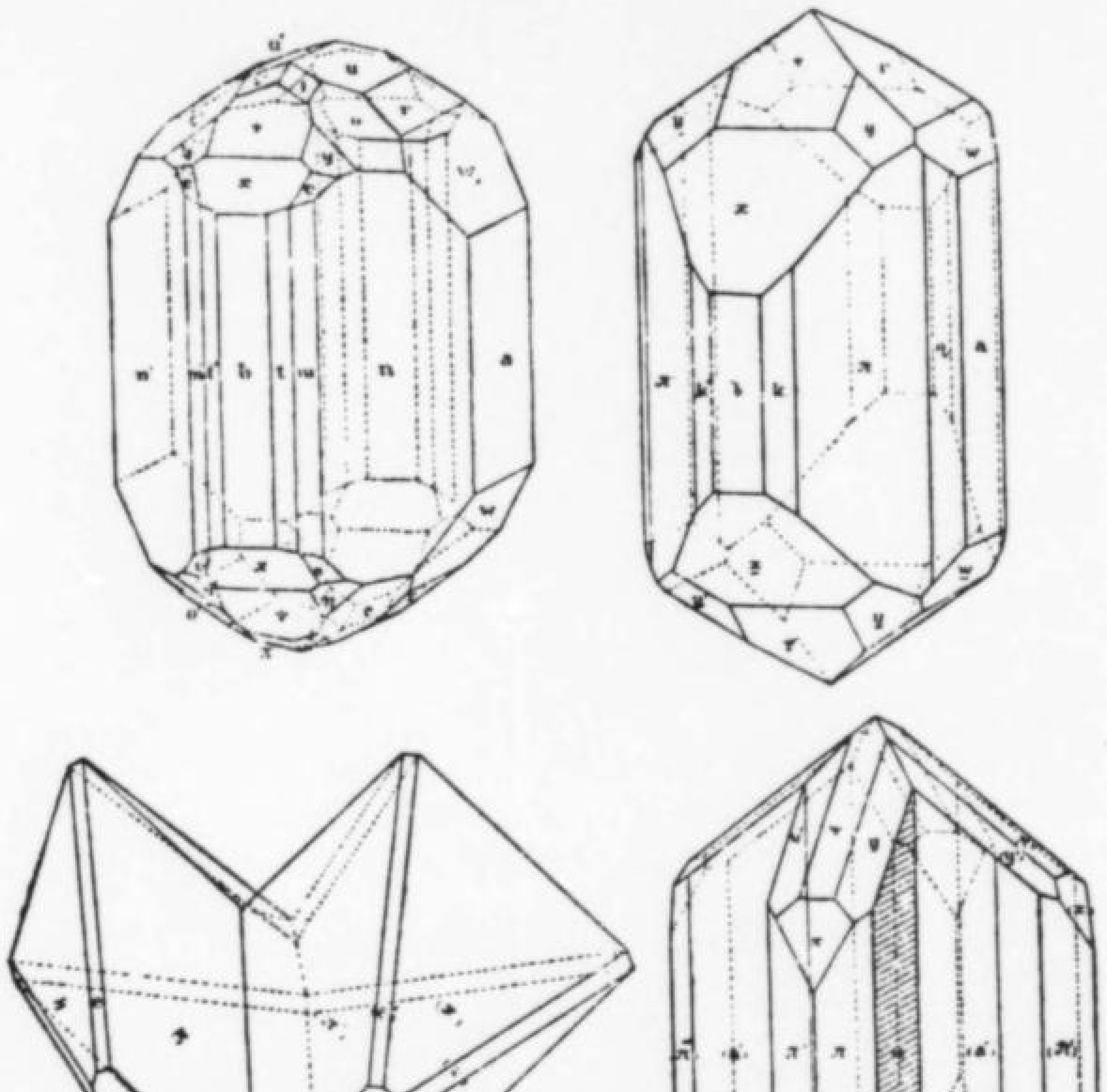


Figure 15. **Příbram diaphorite (Goldschmidt, 1916).**

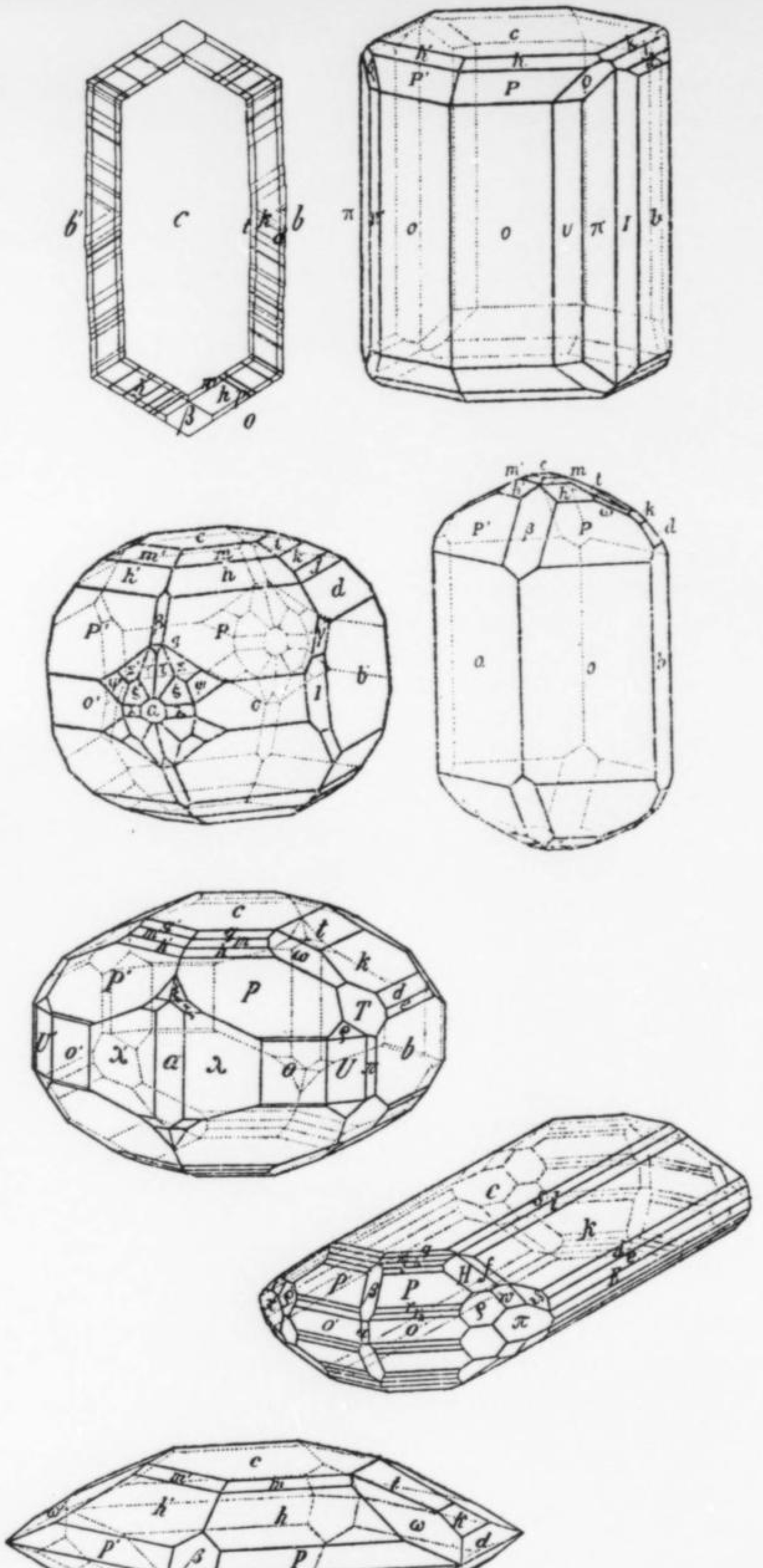


Figure 16. **Příbram stephanite (Goldschmidt, 1920).**

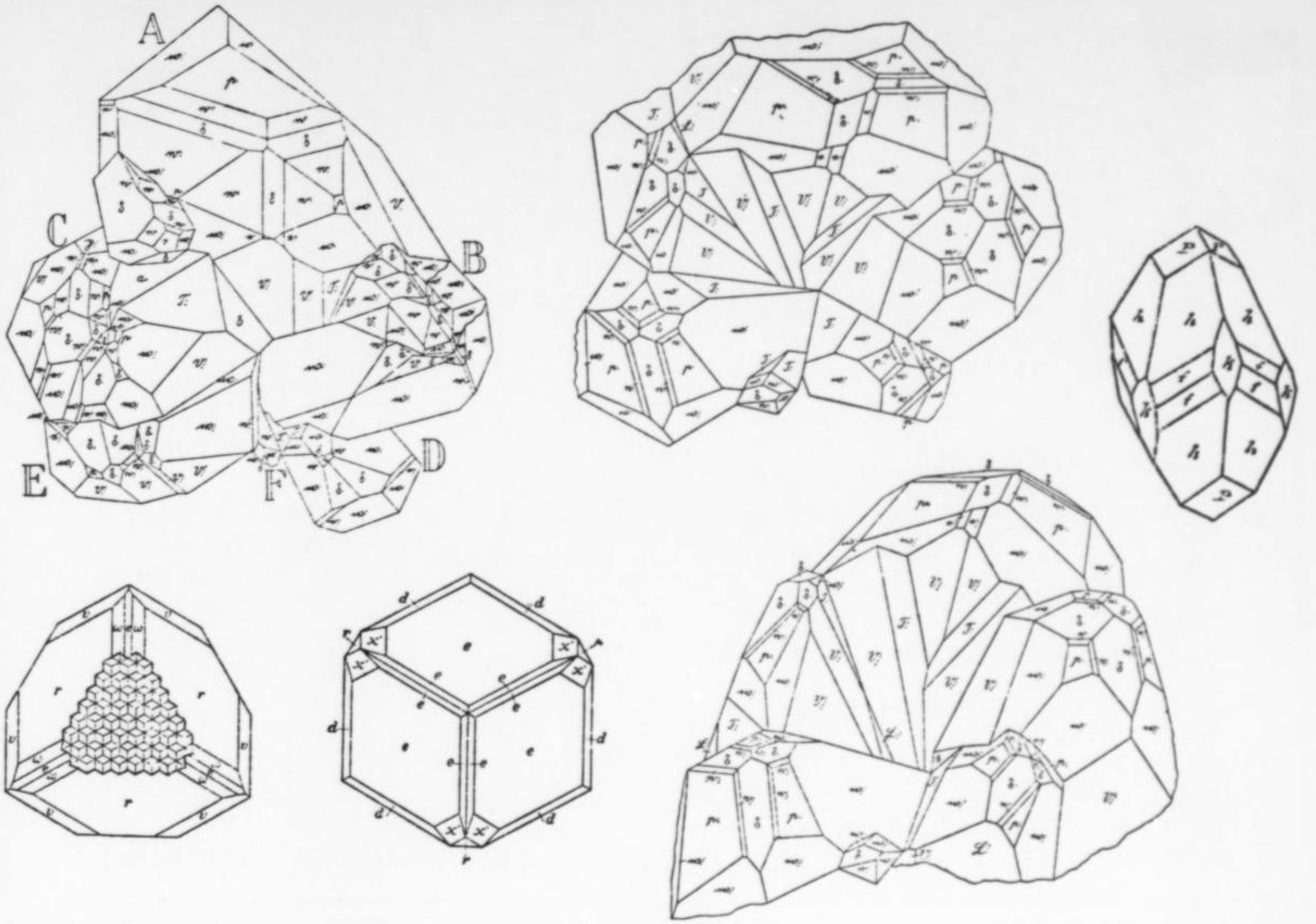


Figure 17. **Přibram proustite (Goldschmidt, 1922).**

FIELD COLLECTING

Field collecting of minerals is forbidden in every country in eastern Europe. In particular, all specimens of economic value are not to be collected. The only places where minerals are available are the tourist shops and some museums.

ACKNOWLEDGMENTS

I give special thanks to Miroslav Pisa (Geological Society of Czechoslovakia) and Jaroslav Sv̌enek (Národní Museum) for their assistance in the writing of this paper. The photos shown in Figures 2, 6, 7, 8, 9, 11 and 13 were taken by E. de Boer, Den Helder.

POST SCRIPT

According to a German collector's report, the last mine in production in the Přibram area (Rudné Doly at Brezové Hory) was closed in late 1978 and the personnel transferred to other Czechoslovakian mines.

OTHER MINERALS

Though not discussed here, many other minerals have been reported from the various mines at Přibram. These include acanthite, allemontite, cerussite, cronstedtite, diaphorite, embolite, erythrite, freieslebenite, greenockite, heteromorphite, loellingite, marcasite, miargyrite, mimetite, nickeline, polybasite, proustite, pyrolusite, pyrostilpnite, scheelite, senarmontite, silver, stephanite, stibarsen, strengite, uraninite, valentinite, vesignieite, willemite, wulfenite and xanthoconite among others.

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Manganese Minerals
of Bald Knob, North Carolina

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ABSTRACT

The manganese deposit at Bald Knob, North Carolina, is a lensoid concentration of manganese minerals interpreted to be of metamorphic origin. The deposit is composed of two distinct assemblages of manganese-rich rocks. There are manganese-carbonate-rich rocks having a broad range of Ca/Mn ratios, and there are silica-rich rocks typically containing spessartine and quartz. The minerals found at Bald Knob include calcite, kutnahorite, rhodochrosite, sonolite, manganhumite, alleghanyite, tephroite, kellyite, caryopilite, rhodonite, pyroxmangite, tirodite, spessartine, andradite, manganoan stilpnomelane, pennantite, pyrophanite, galaxite, jacobsite, cattierite, cobaltite, alabandite, chalcopyrite and apatite.

INTRODUCTION

The Bald Knob deposit is a manganese prospect in western North Carolina that was mined on a small scale during the late 1920's and early 1930's. The deposit is situated on the southeastern flank of a small hill known as Bald Knob near the town of Sparta in Alleghany County, North Carolina (Fig. 1). The deposit was originally

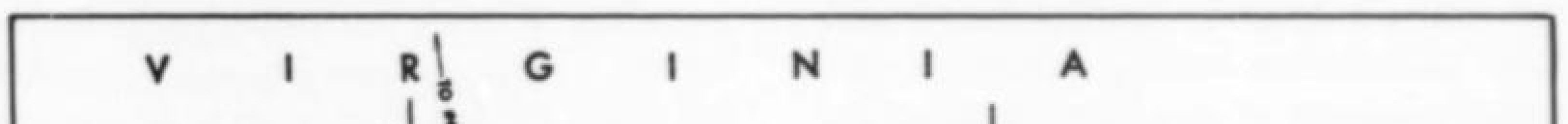

Figure 1. **Location map. The Bald Knob manganese deposit is 1.8 miles northeast of Sparta, North Carolina, on NC 18, and 0.9 miles on Alleghany County road 1416. The deposit is located ½ mile southeast of the road, on a small hill known locally as Crouse Knob. Note that the deposit is actually about 1 mile southeast of Bald Knob.**

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Figure 2. **Dumps of chiefly manganese carbonate that remain at the Bald Knob locality. The peak in the background is known locally as Bald Knob. All of the material still available in the dump is coated with soot-black manganese-rich oxidation products.**

described by Ross and Kerr in 1932. They reported the occurrence of a large number of manganese minerals, the most interesting of which were the two new minerals galaxite, $MnAl_2O_4$, and alleghanyite, $Mn_5(SiO_4)_2(OH)_2$. The authors recently reexamined this locality, principally to collect specimens of these two rare minerals, and a suite of samples was obtained from the two small 3-foot-high dumps that remain (Fig. 2). Subsequent research on this material has resulted in the identification of a number of rare manganese silicates and other minerals previously unreported from this locality. One of these is the unique serpentine-family species kellyite, $Mn_4Al_2(Si_2Al_2)O_{10}(OH)_8$, whose type occurrence is Bald Knob. Others are the humite-family minerals sonolite, $Mn_9(SiO_4)_4(OH)_2$, and manganhumite, $Mn_7(SiO_4)_3(OH)_2$, which have only recently been described as new minerals from other localities. The Bald Knob deposit is thus of considerable mineralogical interest because it has been the source of three new manganese species as well as a wide variety of other unusual manganese minerals.

At present, little evidence remains of the former mining activity. The shaft has been filled and only a few small dumps of waste rock mark the site of the original prospect. The largest dump measures less than 4 feet in height. Until recently the entire area was overgrown with trees and brambles, but about six years ago the hillside was cut for lumber and subsequently cleared by bulldozer for pasture land. Fortunately several of the small dumps were spared obliteration. Considering their small size and the treatment that they have survived, the material that remains is amazingly well preserved. Collectors in the eastern United States are all too aware of how difficult it can be to collect good specimens at old mineral localities which have been combed over by thousands of previous collectors. Luckily such is not the case with Bald Knob. It should be pointed out, however, that this locality produces no specimens of spectacular beauty. All of the surface rocks are coated with black, soot-like, Mn-rich oxidation products and the interesting materials occur principally as tiny grains that in general would be of interest only to the micromounter. The limited nature of the material poses a problem. It would not take many collectors to rapidly deplete this locality. Indeed, we have hesitated to publicize the locality through this paper for fear that it might lead to overzealous collecting of large volumes of material by a few individuals, to the detriment of collectors generally. For this reason it is hoped that some action can be taken by Friends of Mineralogy that would help to preserve this remarkable mineral deposit for further studies in the future.

GENERAL GEOLOGY

The metamorphic country rocks surrounding the deposit are composed of hornblende and biotite gneisses and muscovite-biotite schists that are part of the Precambrian core of the Appalachian Blue Ridge Mountains. These units belong to the Ocoee group as presently mapped, but were originally referred to as Roan gneiss by Ross and Kerr. The units appear to be equivalent to the Lynchberg gneiss in Virginia.

The deposit consists of a lensoid concentration of manganese minerals enclosed within the N50°E-trending gneisses and schists of the enveloping country rock. The presence of the black manganese oxides at the surface was undoubtedly the first indication that manganese minerals existed at depth. The area was first commercially prospected about 45 years ago by a "60-foot inclined shaft which exposes a width of from 5 to 7 feet" (Ross and Kerr, 1932). Beneath the surface in the unoxidized portion of the deposit, massive spessartine was reported by Ross and Kerr to envelop a carbonate-rich zone. This carbonate zone is the source of most of the more unusual minerals. Ross and Kerr reported that zones of garnet about 2 feet thick enclose a 1-foot-thick lens of the carbonate-rich assemblage. They also observed a zone of massive rhodonite with minor garnet and tephroite (in fact probably sonolite) in contact with the hanging wall and the upper zone of massive garnet. We have interpreted the origin of the deposit to correspond simply to regional metamorphism of manganese oxide-rich sediments, some of which were especially rich in silica and others in carbonate (Winter *et al.*, 1981). Such local concentrations of manganese-rich sediments led to a number of similar deposits of manganese silicates, all of very limited extent, throughout the Appalachians.

The manganese minerals occur in two distinct assemblages. There are manganese-carbonate-rich rocks, having a broad range of Ca/Mn ratios, and silica-rich rocks which typically contain spessartine and quartz. Both assemblages contain a large number of accessory mineral species (Table 1). Both also display conspicuous banding resulting from concentrations of one or the other minerals in layers, a banding which reflects compositional differences in the original sediment. A few samples contain bands of both the silica-rich and the carbonate-rich assemblages. Others have intermediate bulk SiO_2/carbonate ratios such that no quartz is now present but there was sufficient silica to have yielded the pyroxenoids and amphiboles otherwise typical of the siliceous facies. The carbonate rocks contain the greatest variety of rare and interesting minerals. These include alleghanyite, galaxite, jacobsite, pyrophanite, sonolite, manganhumite, caryopilite, and kellyite, as well as some unusual sulfide minerals. All of these minerals except manganhumite and caryopilite are relatively abundant and can usually be identified using a binocular microscope. The silica-rich samples contain, in addition to spessartine and quartz, rhodonite, pyroxmangite, tirodite (Mn-amphibole) and a manganese-rich member of the stilpnomelane group.

Table 1. **Minerals of Bald Knob. Minerals occurring primarily in the carbonate-rich rocks are identified with a C, those occurring in the silica-rich rocks with an S, and those occurring in silicate rocks lacking quartz with an (S).**

C	Calcite-kutnahorite-rhodochrosite	$(Ca,Mn)CO_3$
C	Sonolite	$4Mn_2SiO_4 \cdot Mn(OH,F)_2$
C	Manganhumite	$3Mn_2SiO_4 \cdot Mn(OH,F)_2$
C	Alleghanyite	$2Mn_2SiO_4 \cdot Mn(OH,F)_2$
(S)	Tephroite	Mn_2SiO_4
C	Kellyite	$[Mn_4Al_2][Si_2Al_2]O_{10}(OH)_8$
C	Caryopilite	$Mn_8Si_6O_{15}(OH)_{10}$
C, S	Rhodonite	$CaMn_4Si_5O_{15}$
C, S	Pyroxmangite	$MnSiO_3$
C, S	Tirodite	$(Mn,Ca)_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
S	Spessartine	$Mn_3Al_2(SiO_4)_3$
C	Andradite	$Ca_3Fe_2(SiO_4)_3$
S	Manganoan stilpnomelane	$K_{0.6}(Fe,Mg,Mn)_6(Si_8Al)(O,OH)_{27} \cdot 2\text{–}4H_2O$
C	Pennantite	$(Mn,Al)_6(Si,Al)_4O_{10}(OH)_8$
C	Pyrophanite	$MnTiO_3$
C	Galaxite	$MnAl_2O_4$
C	Jacobsite	$MnFe_2O_4$
C	Cattierite	CoS_2
C	Cobaltite	$CoAsS$
C	Alabandite	MnS
C	Chalcopyrite	$CuFeS_2$
C	Apatite	$Ca_5(PO_4)_3F$

MINERAL DESCRIPTIONS

Manganese Carbonates. Coarse-grained Ca-Mn carbonate is abundant on the dumps and is the host for most of the accessory manganese silicates and oxides such as alleghanyite and galaxite. All samples on the dump are coated with a black soot-like oxidation film. This coating is the result of oxidation of the manganese carbonate to manganese oxides. Freshly broken surfaces are white or, more rarely, pale pink.

A series of both Ca- and Mn-rich carbonates has been identified through X-ray diffraction and electron microprobe analysis. Thus there are at least some examples which appear to span almost the complete range of solid solution between manganoan calcite and calcian rhodochrosite (Winter *et al.*, 1981). A single hand specimen may contain carbonate grains from different layers covering a wide range of composition, including that for kutnahorite. The rare grains of rhodochrosite are easily identified by their deep pink color.

Manganese Humites

Bald Knob is one of the few localities in the world where manganese humite minerals are found. As shown in Table 1, these minerals are the manganese analogs of the minerals chondrodite, humite, and clinohumite. They have the general formula $n(Mn_2SiO_4) \cdot Mn(OH,F)_2$. Alleghanyite has $n = 2$, manganhumite has $n = 3$, and sonolite has $n = 4$. The manganese analog of norbergite, with $n = 1$, has not been observed, and is not known elsewhere.

Alleghanyite. Alleghanyite was originally described as a new mineral from this locality by Ross and Kerr. It occurs as bright, strawberry-pink, rounded, anhedral grains. Typically the grains are about 0.5 mm in diameter and nearly spherical in shape. In hand specimen they so closely resemble garnets that as Ross and Kerr report they "were not distinguished until examined microscopically." Their most striking optical property is the polysynthetic twinning which is revealed between the crossed nicols of a polarizing microscope. The twinning closely resembles that of the plagioclase feldspars.

Manganhumite. Manganhumite is a new mineral recently described by Moore (1978) from Långban. We discovered it in Bald Knob specimens only through the use of the electron microprobe on polished thin sections and by using single-crystal X-ray diffraction techniques. No visual identification of it is possible as it so closely resembles alleghanyite. Indeed, it occurs intimately intergrown with alleghanyite and thus even powder X-ray diffraction photographs may yield ambiguous results. Such intergrowths of two humites are generally abundant and may lead to some ambiguity in hand-specimen identification.

Sonolite. This mineral has not been previously reported from this locality. Generally the sonolite is similar in appearance to alleghanyite. Both may be almost the same shade of pink, but larger masses of sonolite tend to be slightly darker brownish pink to brownish red. Instead of equant, small, rounded grains as for alleghanyite, the sonolite tends to occur in very irregular masses. Typically the anhedral sonolite masses are larger than the alleghanyite grains, with some exceeding 2 cm in diameter. The more typical material is relatively easy to distinguish in hand specimen, but occasional grains are so similar to alleghanyite as to be virtually indistinguishable. In thin section larger sonolite grains are generally untwinned. Twinned grains are also present, but the twin individuals are usually larger and less numerous than crystals of alleghanyite. Numerous twinned grains display only a single twin plane.

Because this mineral is quite abundant and conspicuous in some of the samples, we wondered why it was not reported by Ross and Kerr. It seems likely that the similarity of sonolite to alleghanyite and tephroite is the reason. Ross and Kerr apparently concluded that the larger masses of browner pink material were a different form of alleghanyite. Their chemical analyses (which may have been from mixed material) led them to that conclusion in spite of the differences in physical appearance. Table 2 shows the close

Table 2. **Chemical analyses of Bald Knob olivine and humite-family minerals ("—" = not analyzed).**

Oxide wt percent	*Manganknebelite*		*Tephroite*		*Alleghanyite*		*Manganhumite*			*Sonolite*
SiO_2	30.39		29.98		24.65		26.21			27.24
Al_2O_3	0.07		0.03		0.00		0.00			0.08
FeO	9.19		5.96		0.84		0.94			0.83
MnO	57.93		62.77		70.15		69.47			70.74
MgO	2.06		1.79		0.78		0.73			0.45
TiO_2	0.01		—		0.14		0.17			0.00
CaO	0.06		0.11		0.11		0.13			0.10
ZnO	0.22		—		—		—			—
H_2O	—		—		2.61		1.88			1.40
F	—		—		2.20		1.46			1.37
TOTAL	99.93		100.64		101.48		100.99			102.21
–(OΞF)					0.93		0.61			0.58
CORRECTED TOTAL					100.55		100.38			101.63
Number of Ions on the Basis of 18 Anions										
Si	4.53	4.54	4.45	4.46	3.60	3.60	3.88	3.88	4.00	3.99
Al	0.01		0.01		0.00		0.00			0.01
Fe^{+2}	1.15		0.74		0.11		0.12			0.10
Mn	7.32		7.89		8.69		8.72			8.78
Mg	0.46	8.96	0.40	9.05	0.18	9.02	0.15	9.03	9.00	0.10
Ti	0.00		—		0.02		0.01			0.00
Ca	0.01		0.02		0.02		0.03			0.02
Zn	0.02		—							
OH	—		—		2.57	3.60	1.90	2.58	2.00	1.37
F	—		—		1.03		0.68			0.63

similarity in chemical composition between these three minerals and the tephroite analysis. The chemical similarity of these three minerals is further illustrated by noting the ratio of silicon plus aluminum to the sum of all other cations, when all are calculated on the same basis (18 anions as for sonolite). Bald Knob tephroite has a ratio of 4.46/9.05, sonolite has 4.00/9.00, and alleghanyite has 3.60/9.03. For whatever reason, sonolite, which would have been another new mineral at the time, was overlooked.

Manganese Olivine

Tephroite. The only olivine group mineral present at Bald Knob is tephroite, Mn_2SiO_4. It is rare, having been found in only a small percentage of the rock samples and thin sections we examined. Tephroite is present as very small (< 0.1 mm), equant, anhedral grains in ill-defined clusters associated with abundant carbonate. Because of its fine grain size and intimate association with carbonate, its color in thin section is difficult to determine, and its presence in rock samples is not easily detected. Tephroite is not found with the manganese humite minerals, but is associated with spessartine and rhodonite/pyroxmangite in the quartz-free silicate rocks. Two analyses of Bald Knob tephroite (from different rock samples) are given in Table 2 and show them to be $(Mn_{1.63}Fe_{0.26}Mg_{0.10}Zn_{0.01})SiO_4$ and $(Mn_{1.75}Fe_{0.16}Mg_{0.09})SiO_4$. If the nomenclature of Henriques (1956) for the tephroite-fayalite series is strictly applied here, the former analysis would fall into the compositional range of the variety *manganknebelite* (with 10–30 mole percent fayalite), while the latter would be true tephroite (0–10 percent fayalite).

Pyroxenoids

Rhodonite. Rhodonite is relatively rare on the dump but a few specimens up to 10 centimeters in diameter have been found. They are composed of intergrown, deep pink grains that may reach up to 3 cm in diameter. More typically, however, rhodonite occurs as fine-grained aggregates intergrown with Ca-Mn carbonates and spessartine and are identifiable only in thin section. Rhodonite has not been found in contact with the Mn-humites or the spinels. Microprobe analysis indicates rhodonite compositions range from $(Mn_{0.95}Fe_{0.02}Ca_{0.02}Mg_{0.01})SiO_3$ to $(Mn_{0.75}Fe_{0.10}Ca_{0.08}Mg_{0.07})SiO_3$.

Pyroxmangite. This mineral has not been observed in hand specimen, and has been identified only by using the universal stage microscope or the electron microprobe. The grains are on the order of 100 microns in diameter and are generally directly associated with rhodonite. In thin sections the pyroxmangites can be distinguished from rhodonite by their lower 2V angles: 46°, while rhodonite has a 2V of 66°. No attempt should be made to identify pyroxmangite in hand specimen. Pyroxmangite has a composition close to $(Mn_{0.68}Fe_{0.20}Ca_{0.03}Mg_{0.09})SiO_3$.

Spinels

Galaxite. Ross and Kerr reported galaxite ($MnAl_2O_4$) as a new mineral from Bald Knob. It forms brilliant, dark orange to brown, octahedral crystals about 0.5 mm in diameter. The crystals are found in the carbonate assemblage intergrown with Ca-Mn carbonates and alleghanyite and sonolite. In thin section the crystals are a yellow to deep mahogany-red in transmitted light. The galaxites have, on the average, from 8 to 10 mole percent jacobsite in solid solution; the former are yellowish and the latter deep red.

Jacobsite. Jacobsite has ideal end-member composition $MnFe_2O_4$. Through electron microprobe analysis we have found that jacobsite and galaxite coexist at Bald Knob, suggesting that there is not complete solution between the two spinels. The more iron-rich jacobsites are jet-black in color and resemble ordinary magnetite as opposed to the more Al-rich, lighter colored galaxites. Hand specimen identification is reasonably accurate on this basis. Analyzed jacobsites from Bald Knob contain approximately 20 mole percent galaxite.

Garnets

Spessartine. The most abundant mineral from the dump is spessartine. Typically it is massive and forms irregular lenses or masses. Ross and Kerr report lenses of nearly pure spessartine reaching maximum widths of 60 cm. A few boulders of spessartine up to 30 cm in diameter still remain on the dump. Most is a light brown or buff color and monotonously dull in appearance. Much of the massive material is associated with quartz and pyroxenoids. A microprobe analysis of garnet from a silica-saturated assemblage revealed the composition $(Mn_{2.8}Ca_{0.2})(Al_{1.9}Fe_{0.1})Si_3O_{12}$. Smaller crystals of buff-colored spessartine also occur rarely disseminated in the carbonate-rich rocks.

Andradite. Rare small crystals of canary-yellow to pale yellow andradite are also found scattered in the carbonate-rich rocks. Generally these somewhat rounded grains are from 0.2 to 0.5 mm in size. There is extensive solid solution between andradite and spessartine, so care should be used in hand-specimen identification of the rarer andradite.

Layer Silicates

Kellyite. This is one of four layer silicates at Bald Knob, the others being manganese-rich chlorite, caryopilite and a manganese member of the stilpnomelane group. Kellyite has only recently been described by the authors as a new mineral of the serpentine group (Peacor *et al.*, 1974). It occurs as relatively abundant, transparent, yellow, micaceous grains disseminated through the carbonate-rich rocks. Individual grains are normally no larger than 0.5 mm in diameter and a binocular microscope is usually necessary in order to identify it. Powder X-ray diffraction studies show that it is the Mn-equivalent of amesite. In thin section the grains show a low birefringence and are similar to serpentine in appearance except for their yellowish color and higher refractive index. The grains show irregular and undulose extinction similar to serpentine and it seems likely that Ross and Kerr may have identified these grains as serpentine. Electron microprobe analysis of this mineral shows it to be near the ideal composition of $(Mn_4Al_2)(Si_2Al_2)O_{10}(OH)_8$.

Caryopilite. Caryopilite is a hydrated manganese silicate whose status has been somewhat vaguely defined. Until recently it was generally thought to be an manganese member of the serpentine group, but Peacor and Essene (1980) have argued that it belongs in the friedelite group of minerals with a formula near $Mn_8Si_6O_{15}(OH)_{10}$. At Bald Knob it was found in a single sample as 0.5 cm diameter rosettes of radiating yellow-brown plates. These were included within material in a fault which cuts across both carbonates and silica-rich layers. Caryopilite did not appear to be a primary mineral of metamorphic origin, as consistent with its usual occurrence as a hydration alteration product of primary manganese silicates.

Pennantite. Rare brown, micaceous grains less than 1 mm in diameter occur in the carbonate-rich assemblage, closely associated with kellyite. Kellyite and pennantite appear to be identical except for the color difference. X-ray powder and single-crystal diffraction studies show that the mineral is a member of the chlorite group. Microprobe analysis of pennantite gives the formula $(Mn_{5.2}Al_{1.8})(Si_{3.2}Al_{0.8})O_{10}(OH)_8$. Further studies of this material and samples of the ill-defined mineral grovesite appear to show that the Bald Knob manganese chlorite and type grovesite from Benallt, Wales, are the same mineral species as pennantite (Peacor *et al.*, 1974).

Manganoan stilpnomelane. The quartz-rich rocks contain relatively abundant flakes of a brittle, micaceous mineral that are up to 5 mm across. Their color is quite variable, ranging from nearly black to reddish brown to yellow brown. X-ray diffraction studies show that the mineral has the stilpnomelane structure. Qualitative microprobe analyses show that it is a potassic manganese-aluminosilicate.

Other Minerals

Tirodite. Prismatic grains of this manganese amphibole ranging from colorless to a light buff color are found in the more silica-rich assemblages. It occurs generally as fibrous aggregates that reach up to 5 mm in length, and it is fairly abundant. Microprobe analysis shows that this amphibole has the formula $(Mn_{1.8}Ca_{0.2})(Mg_{3.3}Fe_{1.7})Si_8O_{22}(OH)_2$.

Pyrophanite. Small (0.5 mm diameter) grains of pyrophanite ($MnTiO_3$), the manganese equivalent of ilmenite, are widespread in all rock types, but especially in association with spessartine. It is jet-black in hand specimen, as is jacobsite, but lacks the octahedral crystal shape of the latter and often forms tabular laths. In thin section it is translucent ruby-red, and occasionally this red color can be seen in grains under the binocular microscope.

Alabandite. A very few irregular grains of black alabandite (MnS) were found embedded in carbonate-rich rocks. It is rare, but easily recognized by its cubic cleavage. In thin section under transmitted light it stands out as a translucent to semi-opaque green mineral.

Cattierite and cobaltite. Both these minerals occur in the carbonate-rich rocks. They occur as irregular metallic grains and more rarely as octahedral crystals. Their silvery metallic luster helps to identify them as one of the cobalt sulfides. Electron microprobe analyses show that some of the cobalt sulfide grains are nickelous cattierite ($Co_{0.9}Ni_{0.1}S_2$). Typically the euhedral crystals are cobaltite ($CoAsS$) and the irregular anhedral grains are cattierite. However the two cannot always be distinguished visually.

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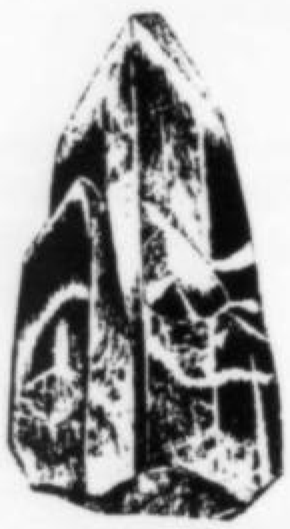

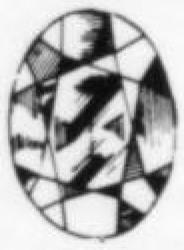

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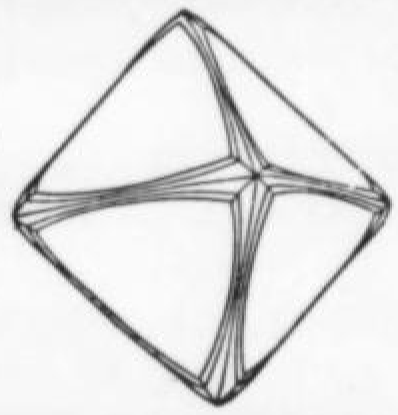

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THE HISTORICAL RECORD

by **Ron Bentley**
1822 S. Carthage Place
Tucson, Arizona 85730

The rooms are empty. The carpeted halls no longer abound with carts, or feet carrying inquiring bodies from floor to floor. Here and there a wall which was covered with hundreds of posters shows only tattered pieces of scotch tape. The Community Center is quiet and bare, walls resounding with echoes of the lone footfall or voice. No, this isn't a scenario for a mystery story; it's the day after the fabled Tucson gem and mineral extravaganza. Every year, in February, mineral madness descends upon the people of Tucson. For two weeks, a weary traveller is fortunate to find accommodations in any of the motels near the Tucson Community Center, site of the three-day show hosted by the Tucson Gem and Mineral Society. For those three days, the Center is packed with many of the people who have been wandering among the 600 or so registered dealers set up in motel rooms. This year some of the dealers were open for business as early as ten days prior to the Friday opening of the main show!

Once again the main show boasted some of the finest displays to be seen anywhere, bar none. It was gratifying to see several exhibits reflecting interest in our mineral history. Jack Streeter's triple whammy consisted of three very impressive cases of antique books. His cases contained the following: *Metallotheca Vaticana* (1719) by Mercati, detailing the rock-mineral-fossil collection of the Vatican; *Mineralogia Cornubiensis* (1778) by William Pryce, *Fodinae Regales* (1670) by Sir John Pettus, describing the chief mines in England, Wales and Ireland; *Fleta Minor* (1683) also by Sir John Pettus, about metals, assaying and refining; The collected works of Agricola (1657) including his famous *De Re Metallica; A Lapidary* (1652) by Thomas Nicols; *The Prodromus of Nicolas Steno* (1671), first English translation; *Metallographica, or, An History of Metals* (1671) by John Webster; *Exotic Mineralogy* (1804 and 1811 versions) by James Sowerby, a classic book with many hand-colored mineral engravings (incidentally, an original Sowerby copper engraving plate and colored print were donated to the *Record's* annual auction by Fred Pough; the two items sold together for $1750!); *Ore Specimens and Rock Types* (1753) edited by John Seligmann; and *Specimens of British Minerals Selected from the Cabinet of Philip Rashleigh* (1797). Those of us who thought we had a few rare books in our own collections felt like pretty small change in front of these elegant cases.

Wendell Wilson had a superb case of antique miners' lamps, including examples of his specialty, rare German frog lamps; and Dona and Wayne Leicht offered a combination of mineral memorabilia and exquisite mineral specimens modeled after their full page color advertisement seen in this very publication. (Unfortunately, at this time, the Leichts have no plans to make their ad into a poster as a complement to their gold poster.)

A continuing highlight of the show for me is the Saturday night *Mineralogical Record* auction. Sponsored by donations from friends and dealers (totaling over 185 specimens this year), the auction often offers high-spirited and competitive bidding among well known dealers, as well as real bargains for those with a fast enough hand.

Sometime back, I suggested that it would be nice if there were to be a repository for historical documents, information, etc. pertaining to mineralogy. Well, last year I received the following notice from Dr. Mark Stauter of the University of Missouri at Rolla. Unfortunately during the two moves by yours truly, it was temporarily misplaced, but rediscovered during a recent house-cleaning. I thank (and applaud) the University for undertaking such a prodigious effort.

> The Western Historical Manuscript Collection—State Historical Society of Missouri Manuscripts (Joint Collection) has established an office at the University of Missouri-Rolla. This office has a special interest in locating, obtaining, and preserving historical papers relating to science and technology.
>
> Formerly the Missouri School of Mines and Metallurgy, the University of Missouri-Rolla (UMR) today has one of the largest engineering enrollments in the United States. Complementary to the heritage and curriculum of UMR, the new manuscript operation is seeking material which documents scientific advances in industry, research, and scholarship, as well as technological applications in mining and engineering. The papers, including correspondence, journals, diaries, notes, photographs, legal documents, and business and financial records, would be professionally arranged and cataloged, stored under archival conditions, and made available for scholarly use.
>
> Dr. Mark C. Stauter is in charge of the UMR office, and John F. Bradbury, Jr. is the Manuscript Specialist. Inquiries are welcome, and should be addressed to the Western Historical Manuscript Collection, Room G-3 Library, University of Missouri-Rolla, Rolla, MO 65401. The telephone number is (314) 341-4874.

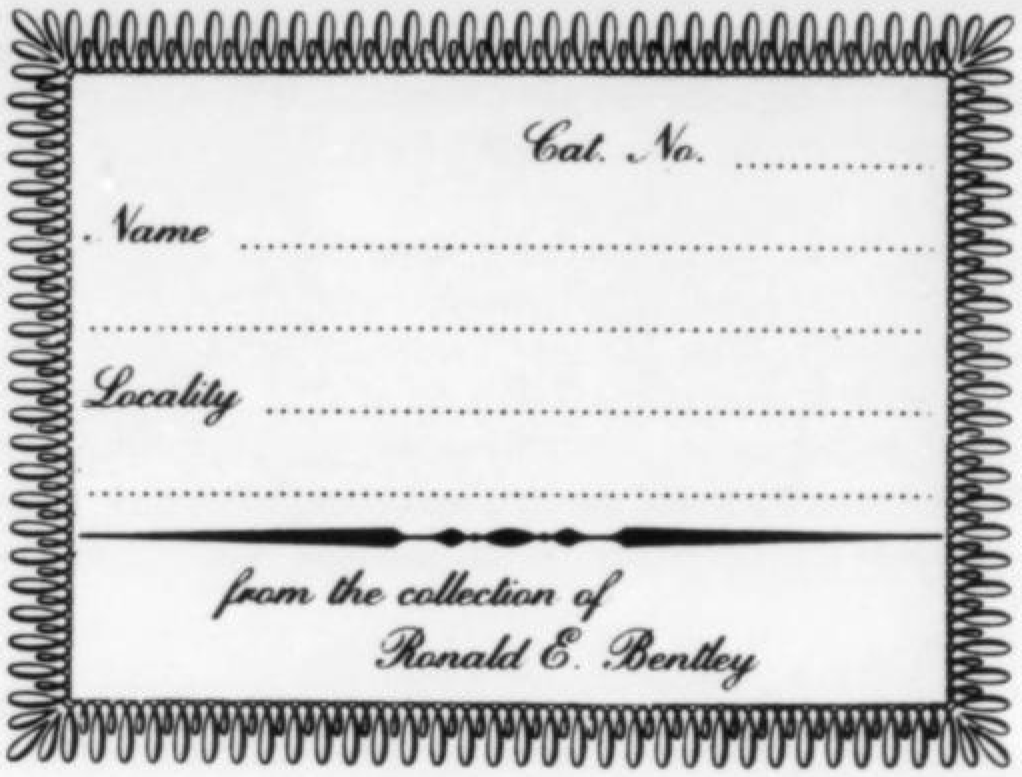
While I'm cleaning up correspondence, here's another method of preserving your label collection, offered by Bob Witkowski, W. Mifflin, Pennsylvania.

> I continue to enjoy your Historical Record column in *MR*. The letter from Mr. Tarassoff (Sept.–Oct. 1978) detailing the use of stamp collector mounts for holding mineral labels is most appropriate—I, being a stamp collector, in addition to collecting minerals, have been using these for years. Included for your information are two different sizes of *Showgard* mounts. These are available at most stamp collector shops, can be cut to various sizes and when moistened on the back provide a self-sticking holder. I've taken the liberty to send you one of my labels in addition to those used for the University of Pittsburgh collection.

Many thanks to Bob for his suggestions. In the event that you might be interested in using Showgard Mounts, I was able to pry their address out of a stamp dealer in Phoenix. The mounts are available in almost any size so maybe the home office would be able to provide a catalog as well. The address is:

Showgard Service
Box 488
New York, New York 10956

Many of you have indicated a reluctance about having personalized labels printed up because of the cost. Since my move to Tucson, I've had new labels made up and was pleasantly surprised at some of the recent technological innovations which have reduced printing costs. If you look around your area, you should be able to find a shop specializing in typesetting. There you can pick out type styles, borders, and sizes and have a master sheet typeset very reasonably. In Tucson, I had ten labels set in two columns on an 8½ x 11 format at a cost of $12.00. I then took this sheet to one of



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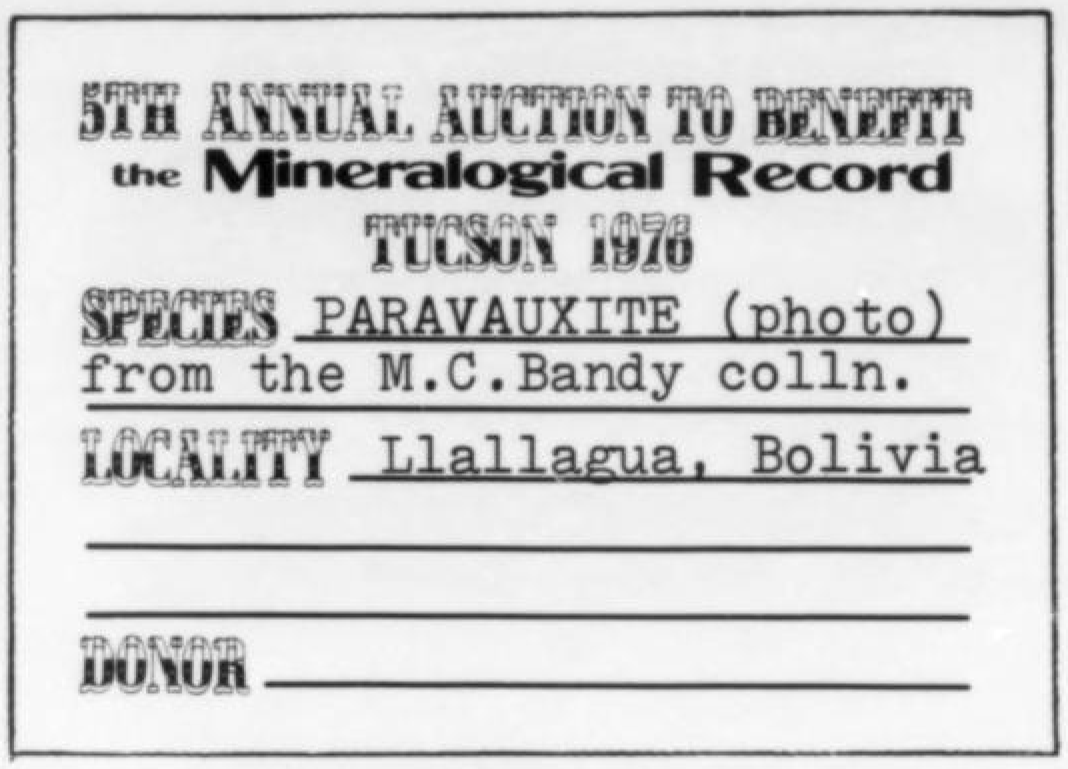
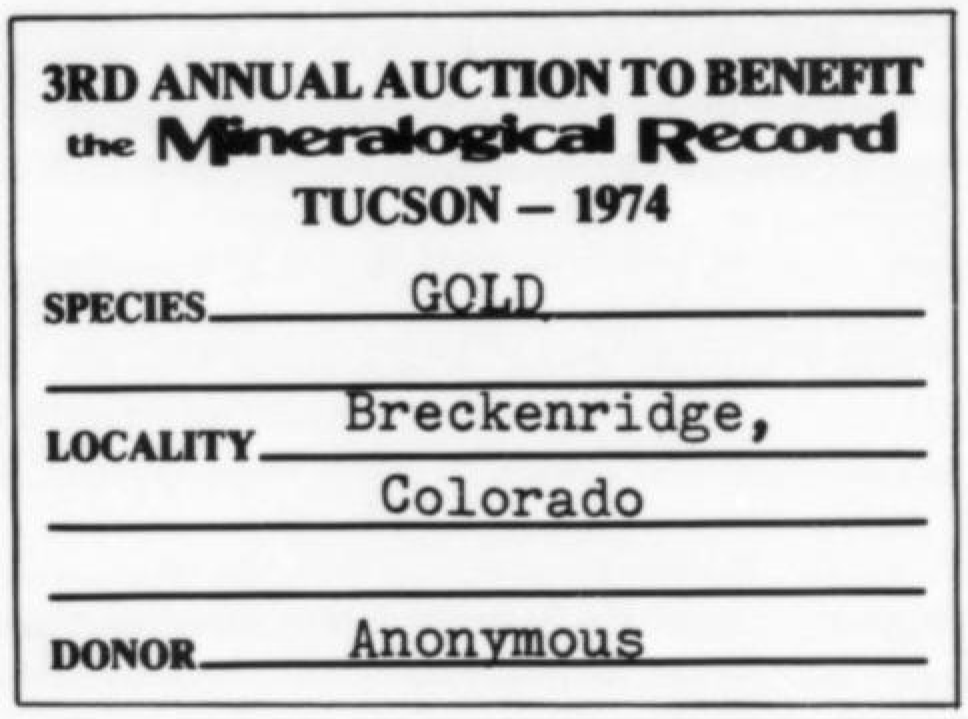


5TH ANNUAL AUCTION TO BENEFIT
the Mineralogical Record
TUCSON 1976

SPECIES PARAVAUXITE (photo)
from the M.C.Bandy colln.

LOCALITY Llallagua, Bolivia

DONOR

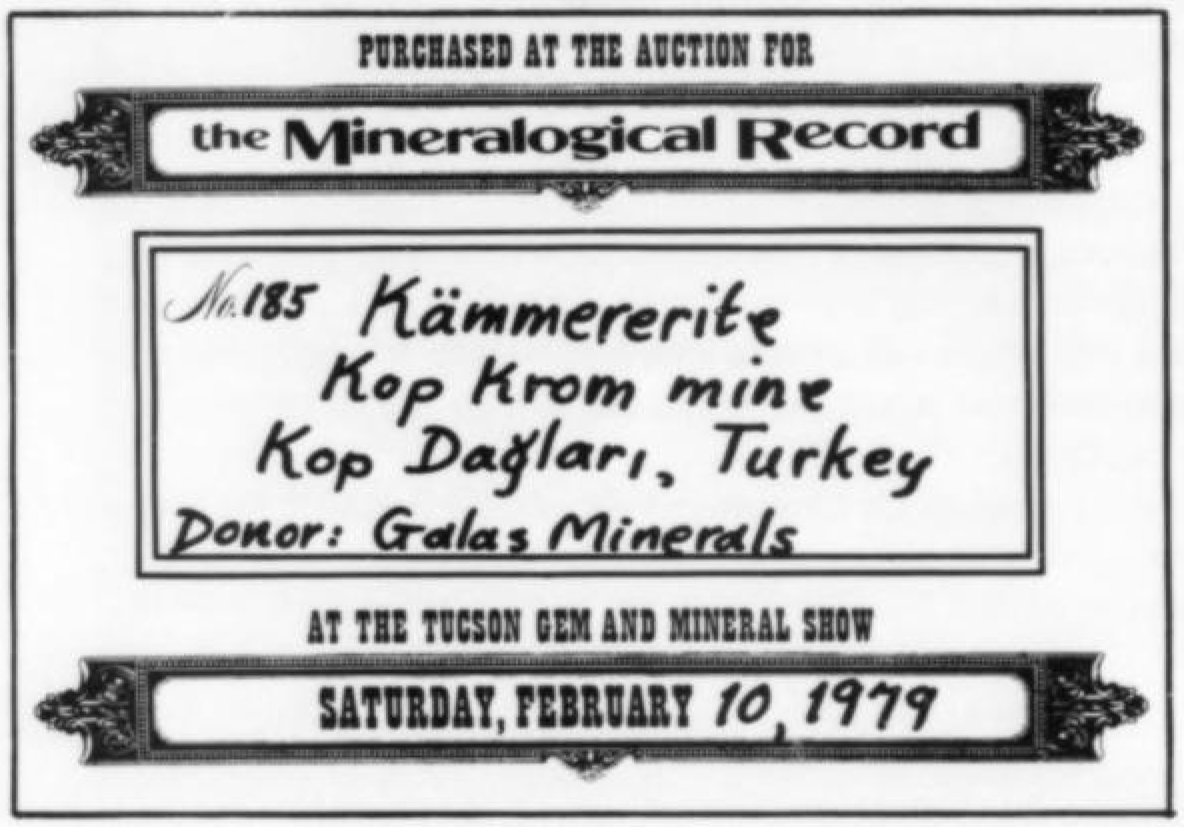


3RD ANNUAL AUCTION TO BENEFIT
the Mineralogical Record
TUCSON – 1974

SPECIES GOLD

LOCALITY Breckenridge,
Colorado

DONOR Anonymous



PURCHASED AT THE AUCTION FOR
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No.185 Kämmererite
Kop Krom mine
Kop Dağları, Turkey
Donor: Galas Minerals

AT THE TUCSON GEM AND MINERAL SHOW
SATURDAY, FEBRUARY 10, 1979

the quick-copy stores where they reproduced it on a colored card stock while I waited. A hundred sheets cost $14.00, and with ten labels on each sheet gave me 1000 labels and a total cost of 2.8 cents per label!

The shop can also cut them if you desire or, if you want to type them, keep them on the sheet for easier insertion into the typewriter and cut them after. Some printing ships specialize in business cards, and will include typesetting in the price. If you design your labels to be about business card size, you can sometimes get a good deal that way too.

If there's one thing that a show like Tucson promotes, it's dealers and collectors and curators getting together talking, arguing, complaining about prices, the economy, the lack of new minerals on the market, agreeing on perhaps no one answer, but each gaining a little insight into the other's problems. With all this in mind, I was reminded of an article I found in the *Mineral Collector* by a noted mineral dealer of the time, Charles H. Pennypacker. The article appeared in the November 1901 issue (Vol. VIII No. 9) and is reprinted here for your reading:

Does It Pay?

Every collector of minerals has to answer this question. I regret to say that too often the reply is so full of circumlocution and explanation, that the questioner doubts the sincerity of his scientific friend, who has made the mistake of "too much language."

The collecting of minerals does pay, and the answer to this query should be a square "Yes!" as plain and solid as a trip-hammer.

It all depends on the collector. If his is of a narrow, grasping, suspicious nature; if he has a mean, stingy soul, which measures every action in human life by the scales or the yard-stick, his labors will consist of a lot of "turnpikers" which will be just as contemptible as was their owner in life.

One good specimen for which a good price was paid by the first purchaser will grow in value at the rate of five percent interest compounded. Show me the man who begins to growl about the price before he says a word about the quality of the specimen, and I will point to you one of the throng of fly-blown mineralogists who lag in the way of those who believe that it is impossible to get something for nothing.

In the three decades that have passed, again and again has one of these "penny wise and pound foolish" people asked me how it was that all the fine things went to the Bement collection. I would reply: That's an easy one! You belong to the skinflint fraternity. You are always afraid that you will pay too much for a mineral, and when you find out that some other collector has secured a better specimen that yours at a less price than you paid, you mourn as one without hope.

None of these traits exist in Mr. Bement. He long since understood the situation. There is no standard of value, there is no rule whereby specimens may be assessed. Many circumstances govern and modify the demand and supply. Only about one dealer in five lays up any treasures on earth. The other four are like the collectors, they fall into the notion that numbers count ahead of quality, and retain boxes of rubbish and call it "stock" or a "cabinet."

Yes! first class examples increase in value at the rate of five percent compounded. But there is another view to take of this case. A genuine student of nature learns how to keep well. He understands the dangers of gluttony, neither does he become a freak on fasting. If he learns the lessons of the rocks, he realizes the meaning of a crystal in creation's plan. He becomes philosophic and acquires that even disposition which preserves the symmetry of his soul.

The late William S. Vaux was in London and went into the mineral store of Bryce M. Wright. There had just arrived a consignment of zeolites from Poonah, India. It had been made by a civil engineer who had been engaged in railroad building in that region. The Philadelphian was amazed. St. Andreasberg in the Harz

Mountains had afore time turned out rose-colored apophyllites which seemed to have the rays of a sunset, but these specimens from the hills of Hindoostan surpassed them all. He wanted to see all the old dealer had. Mr. Wright said in a tone that smacked of the Cumberland "pits":

"Well, Mr. Vaux, you can take what you want and you will see the prices on the labels! I cannot unpack boxes which won't be touched until these reach a low stage."

It was evident there was a best and a second best. While he was waiting for the Poonah "things" to be packed, he suddenly remembered that his cabinet in Philadelphia yawned for a rhomb of Iceland Spar.

Oh! yes said the old Cumberland miner, what size? With that he lifted a curtain behind the counter and there was a huge mass, about three feet square, from which the chisel and mallet could excavate the article. "How did you get that?" Bought it from the captain of a vessel.

The only depressing factor in the situation is the lack of public and general interest in scientific collecting. There is some reason for this to be found in the deficiencies of the individual sometimes. Make your conversation interesting. Keep abreast of the times. Take a group of quartz crystals or a polished smithsonite and place them on the parlor mantel along side of some wild Japanese dream, and observe how much attention your specimen will get. My conclusions are that collecting minerals pays:

1. In increase of cash value.
2. In gain to health and strength.
3. In the cultivation of an inquiring spirit and in general knowledge.

Provided:

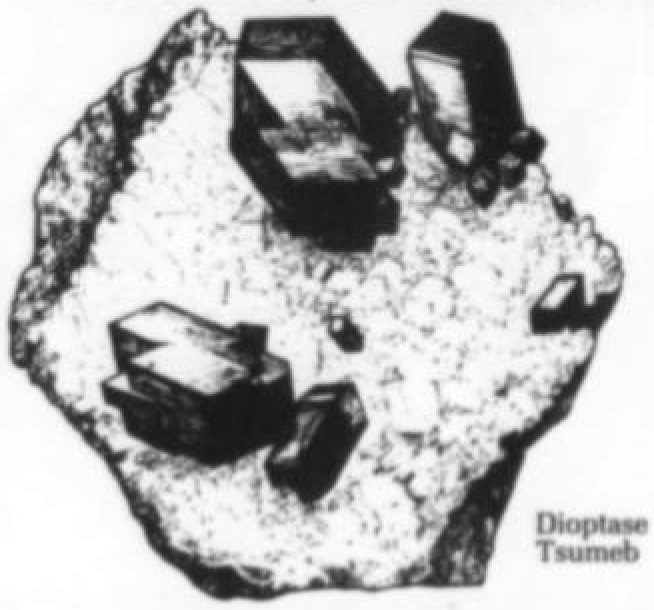
1. You select the best.
2. Destroy a mean streak of selfish economy.
3. Grow in grace and manhood and a broadened view of your duty to your fellow man.

I should not have written thus had I not had this question thrust at me by people who could not distinguish a crystal from a sky-rocket, yet could see a dollar in the middle of a mud-hole on the darkest night; and by some sucking scientists who want the best, are unwilling to pay for it, and are dreadfully afraid of being "stuck" in some fifty cent purchase requiring hours of thought and diplomacy.

These festering and pestering souls are mineralogical mosquitoes and geological gad-flies. They don't seem to know that there are several things in this world of love and beauty and long life and fun, which cannot be appraised.

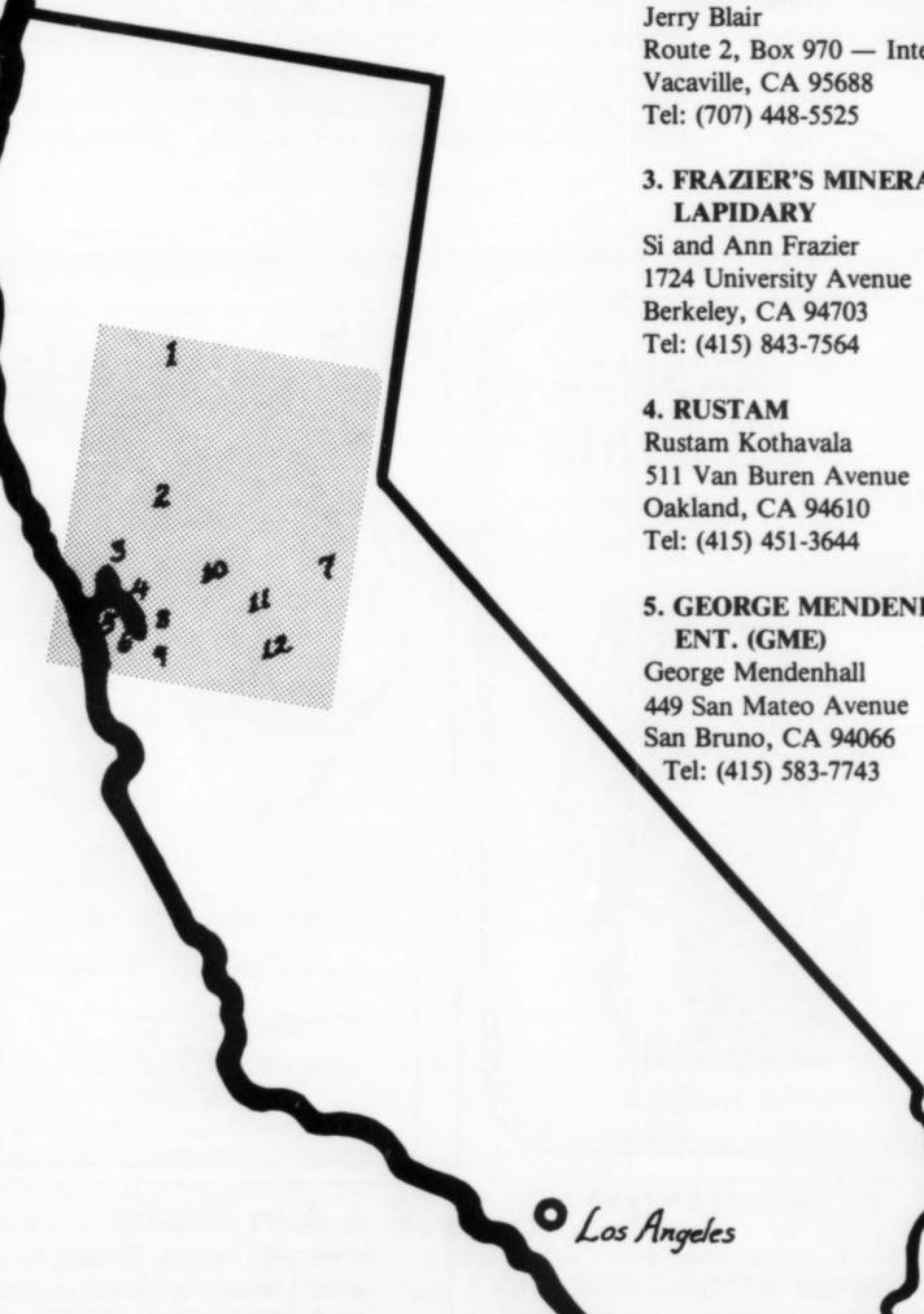
The law of general average hinges all things even at last. If the wayfaring mineralogist develops freakish notions, such as seeking a vegetable pasture exclusively, or refusing to consume chloride of sodium, or living on one meal a day, or drinking south-running water, he is "called hence" in the morning of his day, and the world continues to do business at the old stand.

The study of the natural sciences ought to expand the mind and enlarge the ability to grasp intellectual problems. And yet there is always somebody who will stop at a church door, halt at a jail door, pause at a court-house door, tarry at the door of his sweetheart's home, and ask the question: Does it pay?



Northern California Dealers

Northern California has many quality mineral dealers. Some are wholesale, some are both wholesale and retail, all give quantity discounts to dealers. Come and see us the next time you're in the West. (Appointments are encouraged, as travel for specimens often takes dealers away.)



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Tel: (209) 586-2110

8. PATHFINDERS MINERALS
Dick and MaryJean Cull
41942 Via San Gabriel
Fremont, CA 94538
Tel: (415) 657-5174

8. MATHIASEN MINERALS
Gary and Carol Mathiasen
41149 St. Anthony Drive
Fremont, CA 94538
Tel: (415) 657-0994

9. MINERALOGICAL RESEARCH CO.
Gene and Sharon Cisneros
704 Charcot Avenue
San Jose, CA 95131
Tel: (408) 263-5422

10. CURETON MINERAL CO.
Forrest and Barbara Cureton
4119 Coronado Ave., Unit 4
Stockton, CA 95204
Tel: (209) 462-1311

11 . GALAS MINERALS
Chris and Agatha Galas
10009 Del Almendra
Oakdale, CA 95361
Tel: (209) 847-4782

12. RUNNERS
Bruce and Jo Runner
13526 South Avenue
Delhi, CA 95315
Tel: (209) 634-6470

What's New in Minerals?

TUCSON 1981

Superlatives seem to come naturally to any description of the famous Tucson Gem and Mineral Show, but this year's show was even better than usual. In fact, the 1981 show probably ranks with that of 1978 as the best in the history of the event. Displays were excellent, many new mineral discoveries were available, dealers I spoke with reported that sales were very good, there was a general atmosphere of excitement about the show, and the weather was superb. Attendance was up too: 13,161 paid admissions, and 1871 businesses registered for admittance to the wholesale room. (Each business may have had several employees admitted.) Of the businesses registered, 279 firms were from outside the U.S.

Figure 2. **Two pink fluorite octahedrons interpenetrating in a parallel growth. The crystals, actually tri-colored, from Huanzala, Peru, are modified by small cube and dodecahedron faces, have green centers, and tiny triangular purple zones near the centers of the octahedral faces (see inset). The specimen is 1.35 inches tall; Jonathan Weiss collection.**

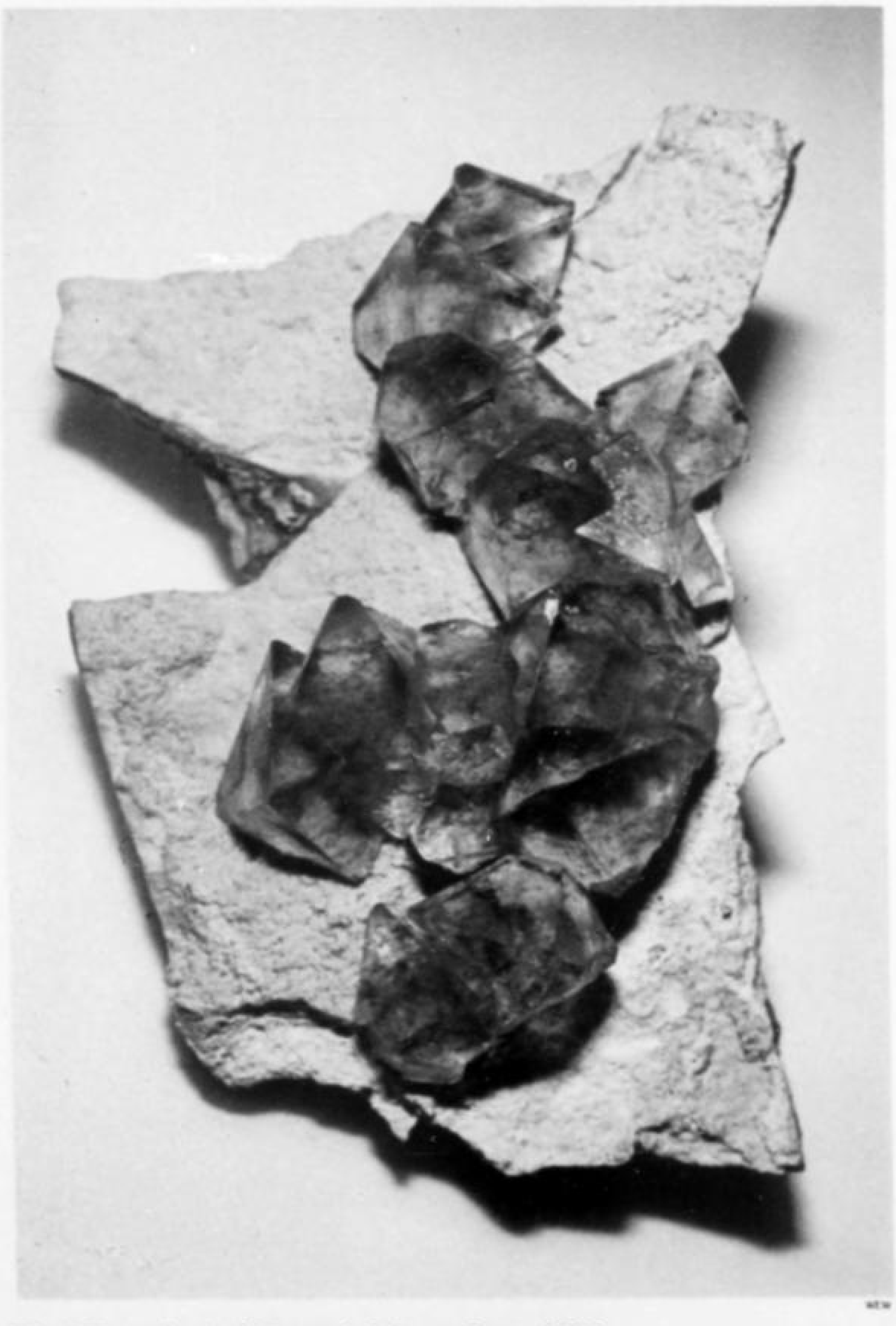
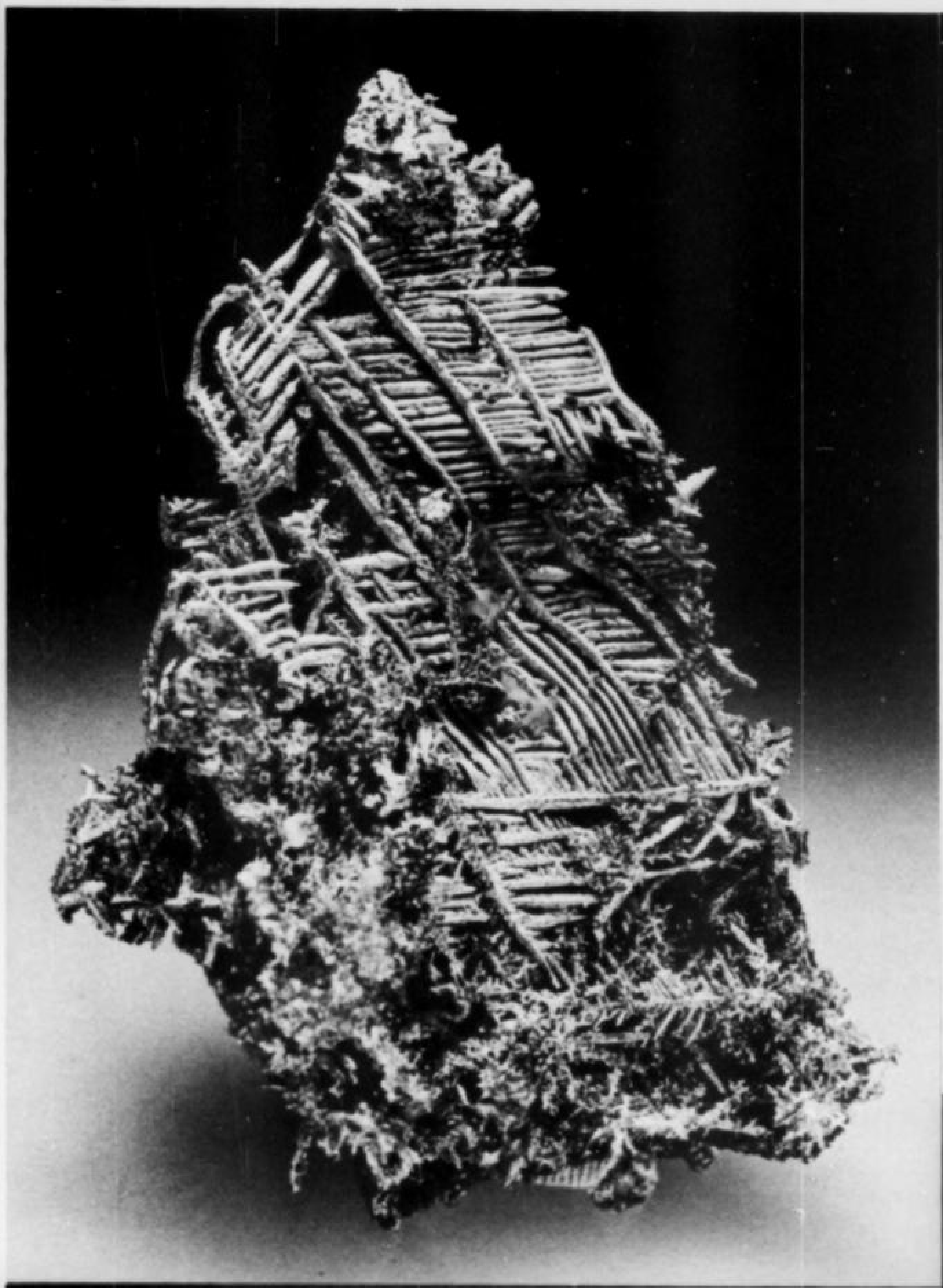
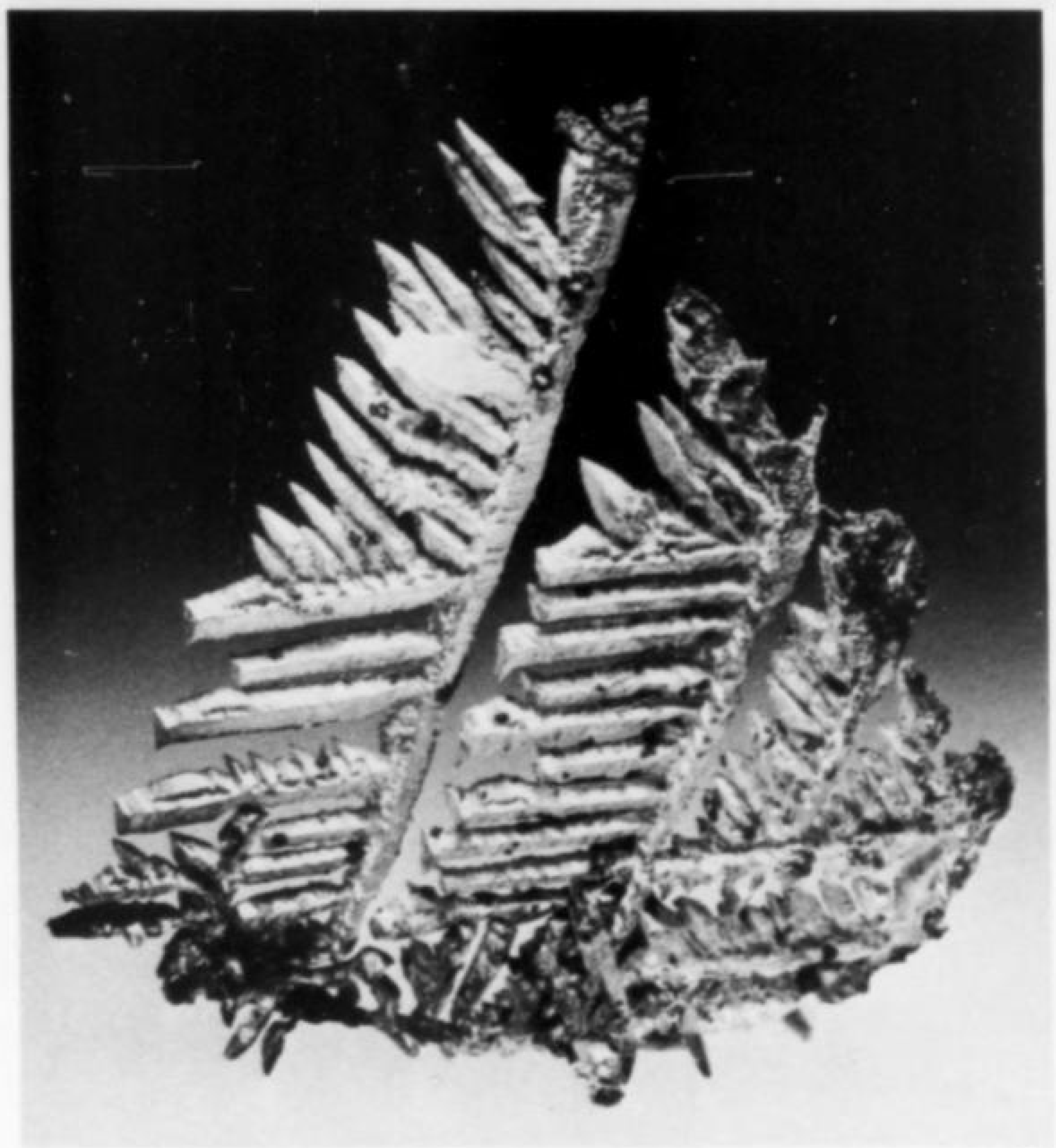


Figure 1. **Pink fluorite octahedrons on matrix from Huanzala, Peru. The crystals all have dull green centers (of varying size and indeterminate shape) and measure about 1 inch each. Rock Currier *(Jewel Tunnel Imports)* specimen.**

Calcite was the mineral chosen by the Tucson Gem and Mineral Society as the focus of the single-species competition this year. Tom Palmer's calcite, two richly colored, reddish amber crystals on matrix from the Elmwood mine, Tennessee, won in the cabinet-size category. Bill Larson's calcite, a group of colorless, prismatic crystals from Fritzington, Cumberland, England, won in the small cabinet category. Carol Barnes's colorless twin from the Magma mine near Superior, Arizona, won in the miniature category. Joe Kielbaso's amber-colored twin on matrix from Madison County, Indiana, won in the Thumbnail category. And Bill and Roberta McCarty's miniature of yellow crystals with red cuprite inclusions from the Ray mine won the award for best Arizona specimen. The calcite competition also inspired a number of other non-competitive displays devoted to calcite. Malachite will be the subject for next year.

Of course the other two major competitions at the Tucson Show are for the McDole and the Lidstrom awards. The McDole trophy is given simply for "best rocks in the show," as the legendary Montana mineral dealer Ed McDole might have judged it. There are virtually no rules, and the judges don't usually attempt to explain their choice, but one factor they keep in mind is that McDole was color blind, and tended to like the rare sulfosalts, sulfides, ugly classics, and Butte minerals. This year there were five entrants: Jim Blees,





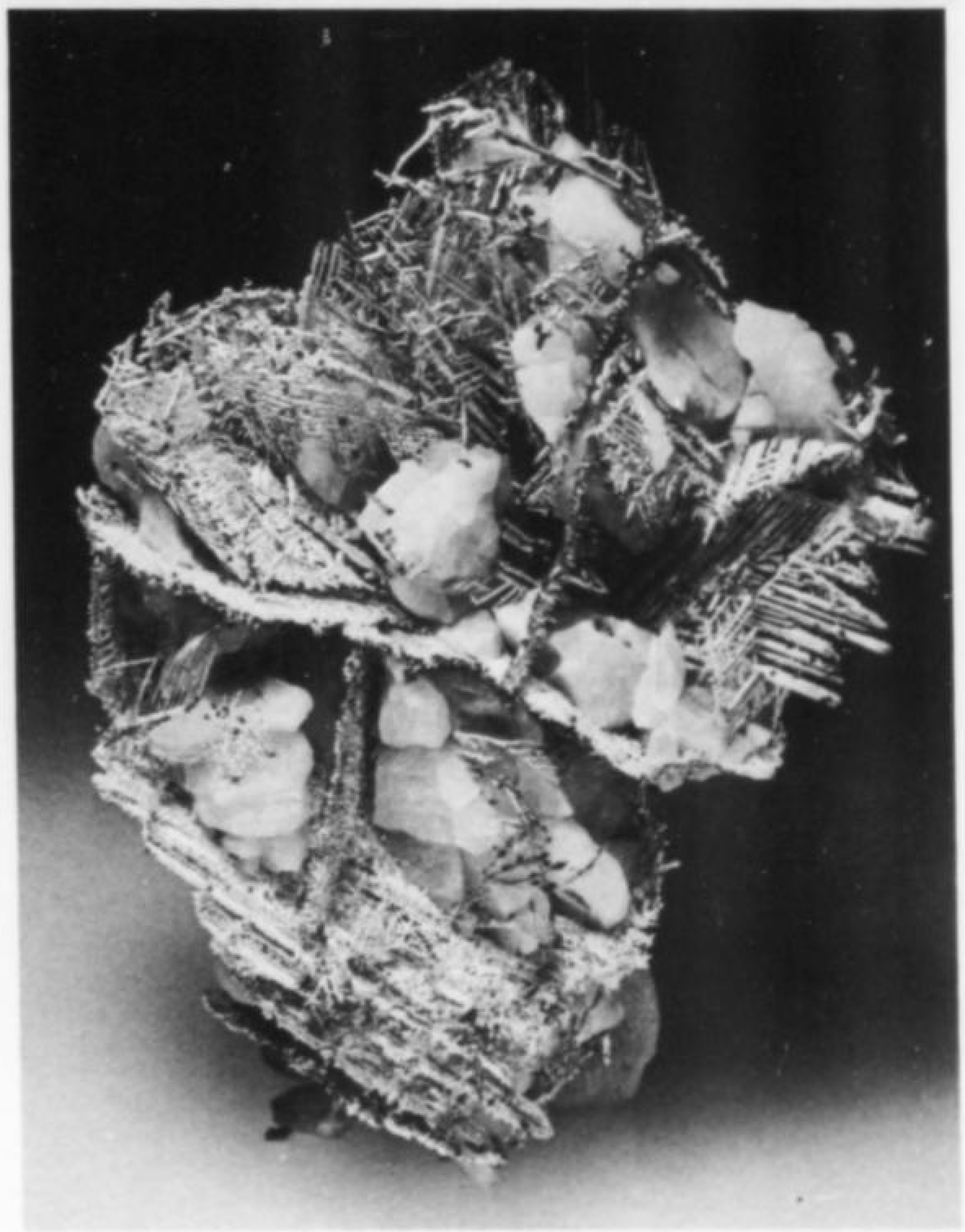


Figure 3. (opposite page, above left) **Silver from the New Nevada mine, Batopilas, Mexico. (The specimens on these two pages are all from this locality, and all originated with John Whitmire of *Artrox.*) The specimen is 3.3 inches tall; Don Olson collection.**

Figure 4. (opposite page, above right) **Height: 2.3 inches; Don Olson collection.**

Figure 5. (opposite page, lower left) **Height: 2.7 inches.**

Figure 6. (opposite page, lower right) **Height: 2.5 inches; Jonathan Weiss collection.**

Figure 7. (above left) **Height: 1.25 inches; Don Olson collection.**

Figure 8. (above right) **Height: 2.6 inches.**

Figure 9. (below) **Length: 3.3 inches.**

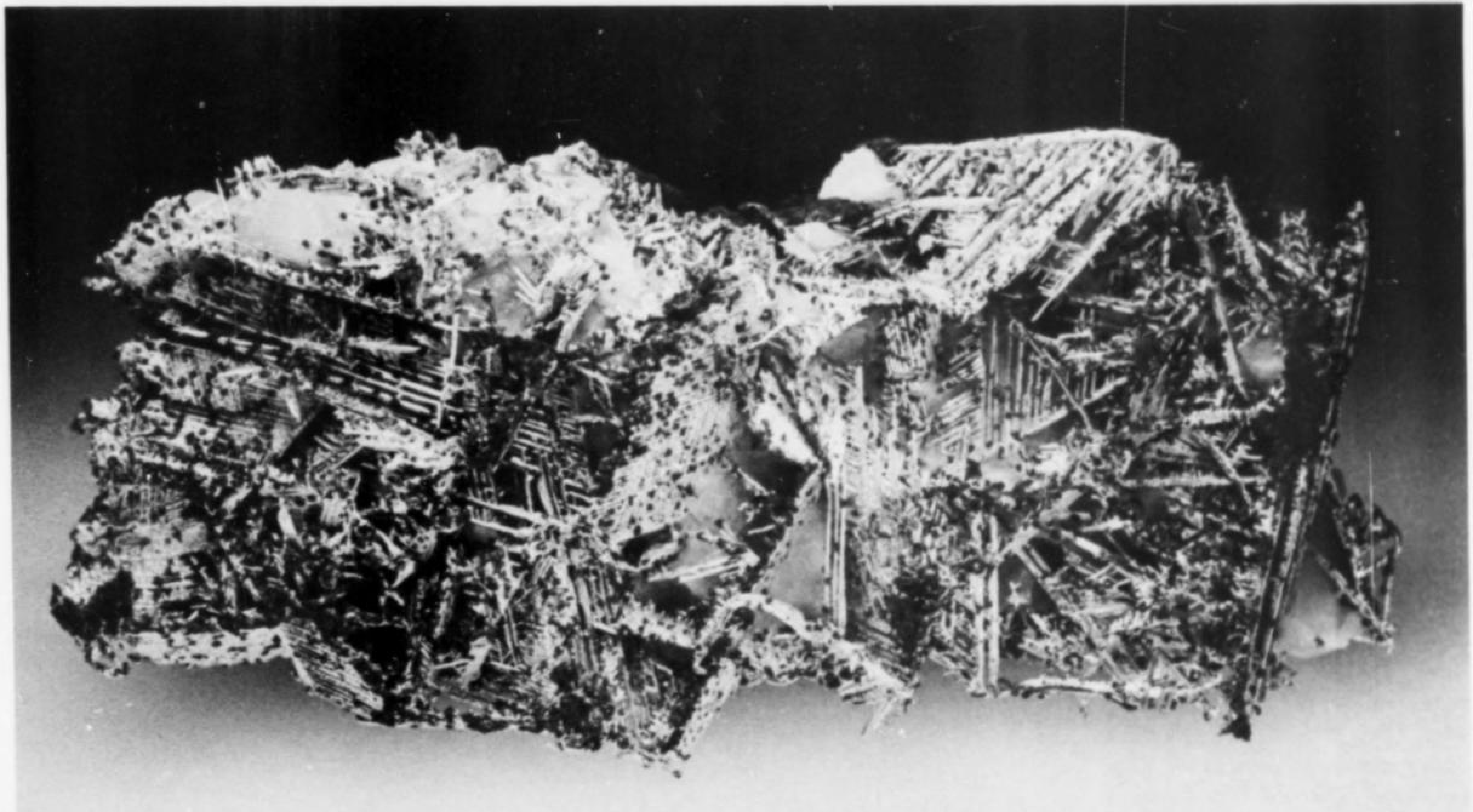


Figure 10. **N'Chwaning mine (South Africa) rhodochrosite specimens from the invitational case presented by Ken and Betty Roberts.** ***Top row, left to right:*** **collections of Will Fresch, Don Olson, David Eidahl, Miriam and Julius Zweibel, Smithsonian Institution.** ***Bottom row, left to right:*** **collections of the American Museum of Natural History, Wendell Wilson, William Larson, Norm and Roz Pellman, Jack Halpern. For scale, the single crystal (top row center) is exactly 1.6 inches tall.**

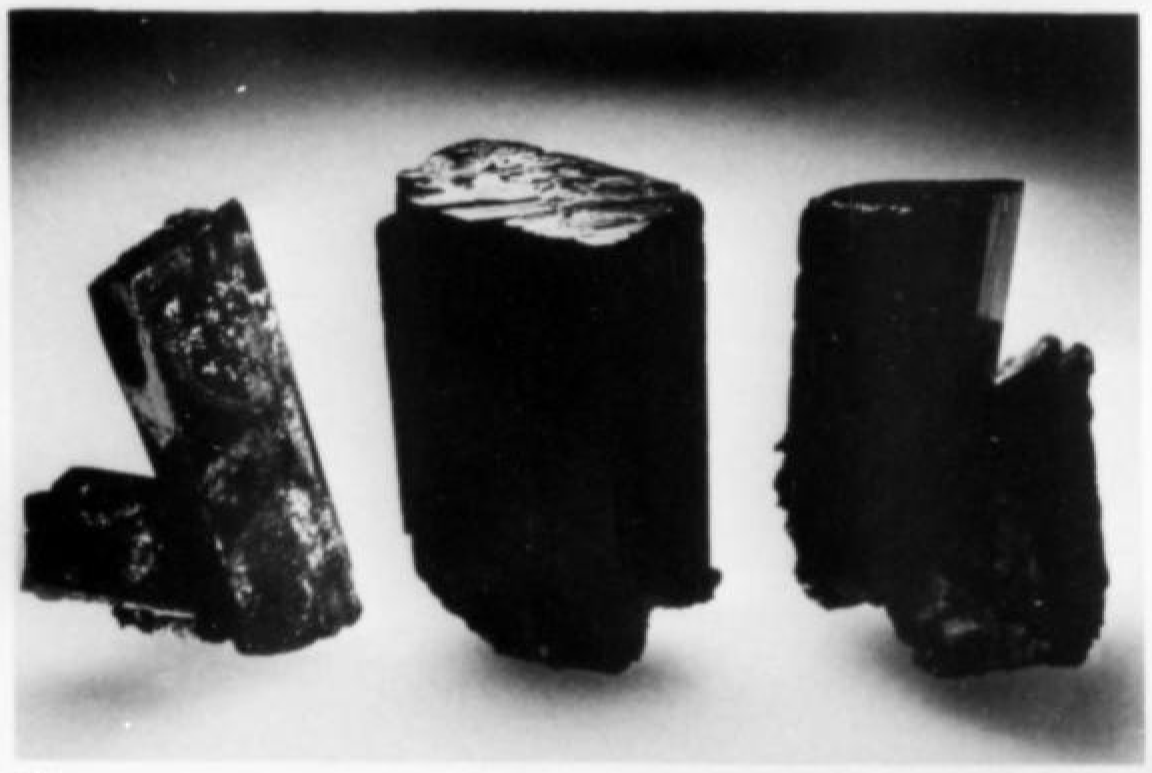


Figure 11. **Azurite crystals from the recent find at the Tsumeb mine, Southwest Africa. The center crystal is 2.4 inches tall. Miriam and Julius Zweibel specimens.**

Figure 12. **Fluorite from the Berbes mine, Oviedo, Spain. The large crystal on the left is ¾ inch on an edge. Chris Wright** ***(Wright's Rock Shop)*** **specimens, now in the Tom Gressman collection (left specimen only).**

Figure 13. **Milarite crystals from Jaguaraçu, Minas Gerais, Brazil. The left crystal is 1 inch tall. Carlos Barbosa specimens.**

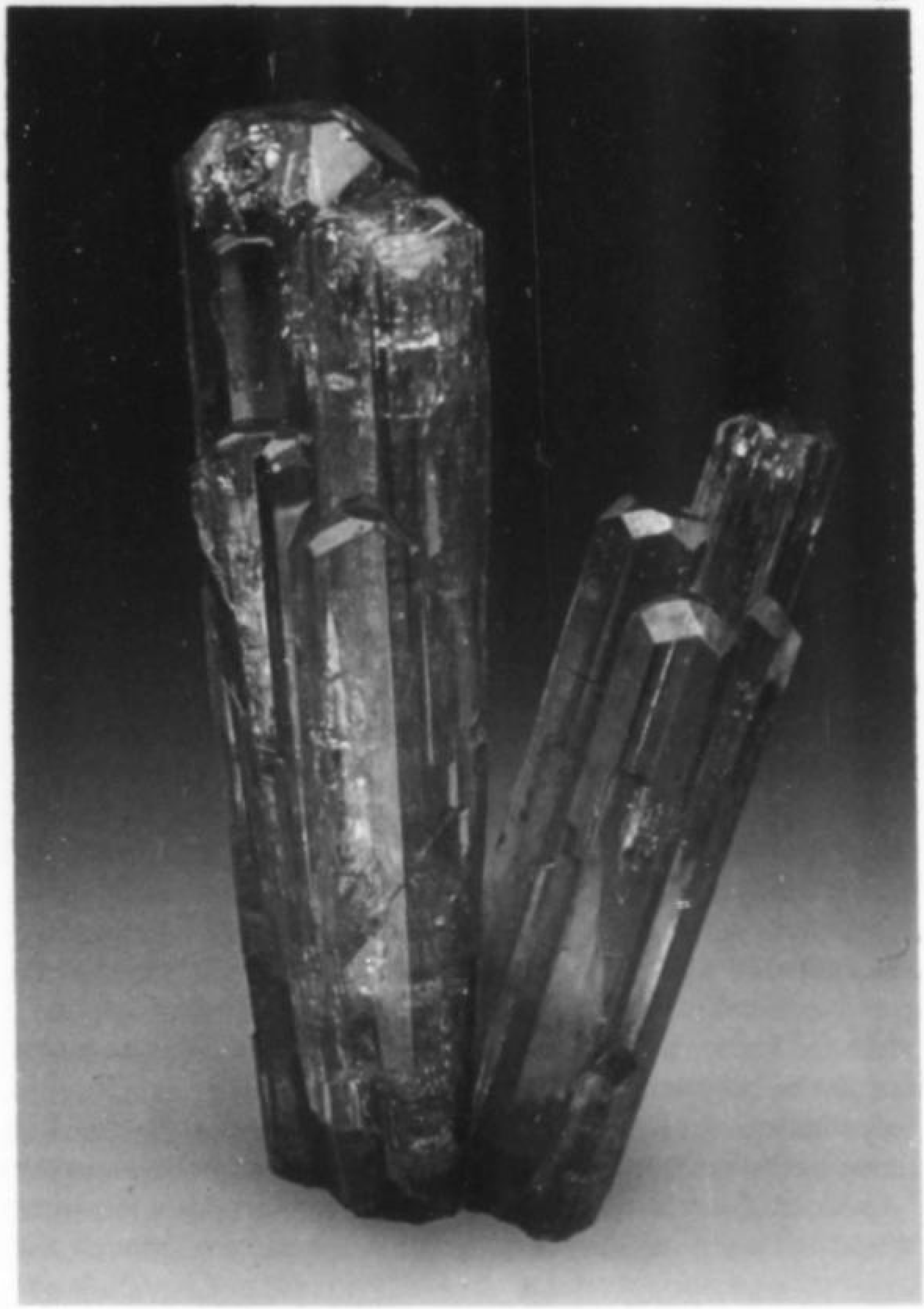


Figure 14. **Crystals of beryl (aquamarine) from Idaho. The tallest crystal is 2.8 inches. Geary Murdock specimen.**

Philip Scalisi, Rustam Kothavala, Les Presmyk, and William Larson . . . Larson attempted the difficult feat of winning the trophy using *only* specimens he acquired during 1980. All of the cases were magnificent; the judges chose the Scalisi case . . . a tough choice to make indeed. Scalisi also won the Lidstrom trophy for best single specimen (any species) in the show, his large azurite rose from Bisbee, Arizona.

So much for competitions. Among other displays were several beautiful cases assembled by dealers. Wayne and Dona Leicht's *(Kristalle)* case of golds, wulfenites, fluorites, silvers, mining relics, and other items was the most spectacular. Rock Currier's *(Jewel Tunnel Imports)* case of Peruvian pink fluorite was a show-stopper (Fig. 1). A number of dealers obtained the pink fluorite, including Tony Jones *(California Mineral Supply),* Ken and Betty Roberts *(Roberts Minerals),* Don and Dee Belsher *(Eldorado Enterprises,* 4472 Prado Dr., Boulder, CO 80303), *Van Scriver's Minerals,* and no doubt others. The crystals are large (to about 1 inch on edge) octahedrons, some modified by small cube faces on the points and narrow dodecahedron faces running along the edges (Fig. 2). The pink color is not quite as warm in tone as that of the Swiss counterparts, and in fact the Leichts thoughtfully put a Swiss specimen in their case next to the Peruvian pieces for comparison. The Peruvian crystals are commonly zoned with a dull green area in the center, and rarely small triangular purple zones in the centers of the octahedron faces. The matrix varies from a greenish white, fine-grained rock to crystals of pyrite and sphalerite. These specimens were the big news of the show, and were priced accordingly. The locality given was Huanzala. Fine thumbnails and miniatures were rather few; cabinet specimens, small and large, were more abundant.

Figure 15. **Gold on chrysocolla from Inca de Oro, Chile. The wires are about ¼ inch in size. Hellmut Wiedner specimen; photo by Julius Weber.**

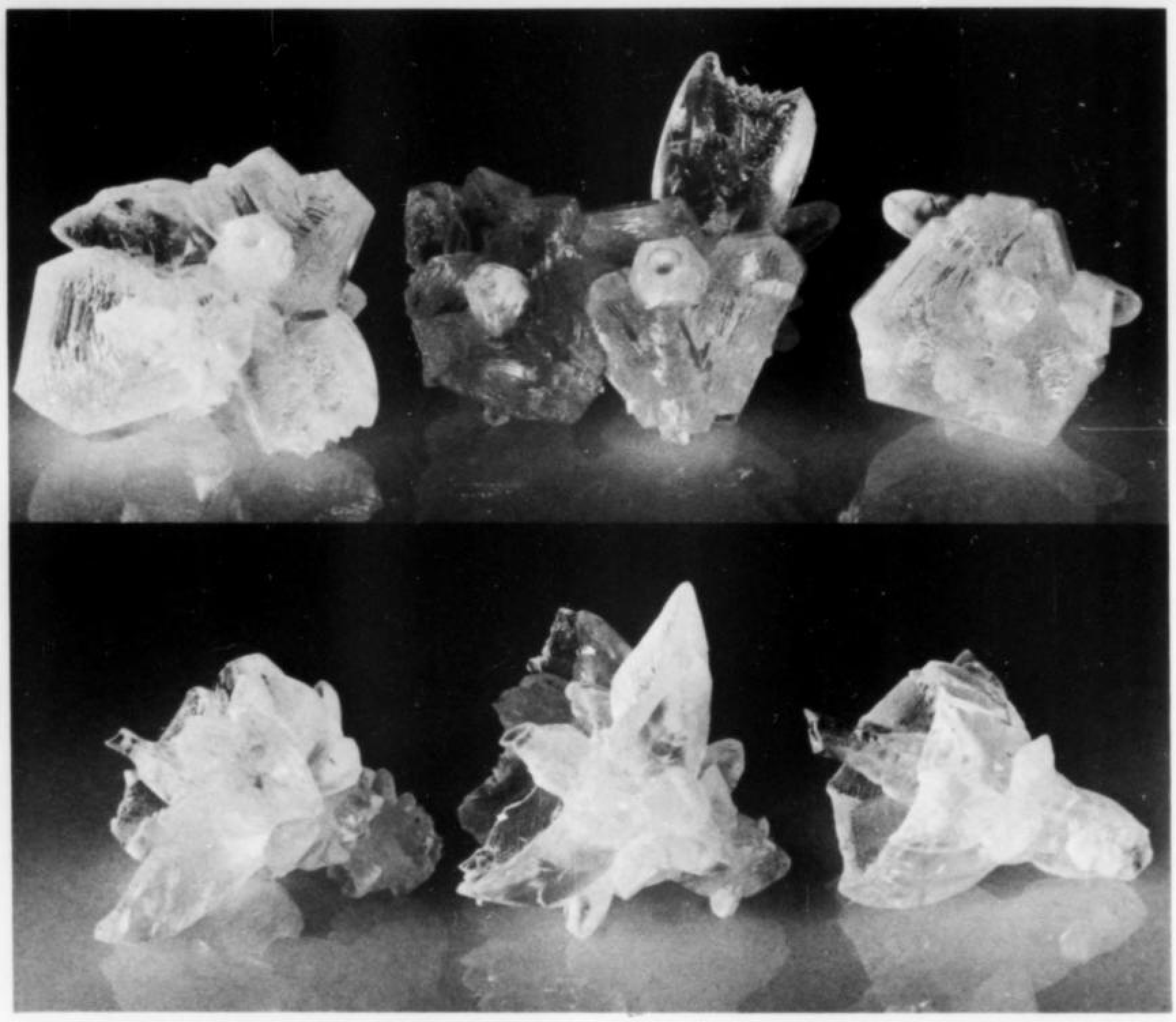


Figure 16. **Pale yellow calcite groups in flower-like shapes from the Florida Limestone quarry, Hernando County, Florida. The three specimens are shown in front views (top) and side views (bottom). The crystal group on the right is about 1½ inches across. Chris Wright specimens.**

Ken and Betty Roberts' case of N'Chwaning mine rhodochrosite was extremely attractive, as might be expected (Fig. 10). The Roberts have been assembling a special case each year since 1979, containing specimens invited from museums and private collections. The idea is to gather together some of the finest pieces of one mineral from one locality . . . the case is appropriately titled "A Distinguished Gathering." In 1979 it was green pyromorphite from Corrèze, France; last year it was red wulfenite from the Red Cloud mine in Arizona. No decision has yet been made regarding the topic for their 1982 case.

Edward Swoboda exhibited a large case containing 95 pseudomorphs, from thumbnail to cabinet size. This may well be the biggest and best collection of pseudomorphs ever shown publicly, and it was quite an eye-opener. Other noteworthy dealer displays included Keith Proctor's enormous elbaite (shown on the cover of the previous issue) (it was "officially" named the "Rose of Itatiaia") from the Jonas mine in Brazil, David Eidahl's miniatures, and a number of others.

Institution displays were of excellent quality as well, and too numerous to recount individually, but the most impressive was the Smithsonian's spectacular case of 1980 acquisitions. Most museums would be happy to have acquired those specimens through the course of a century; obtaining all of them in only one year is almost unbelievable, and certainly a tribute to the curatorial staff and the many donors who made it possible.

The quality and quantity of fine minerals were as high as they have ever been at the show but, for some reason, the *new* discoveries seemed to be concentrated in the Desert Inn and the Newton Travelodge this year. For the sake of those who have never attended the show, it should be explained that the main show hall is far too small to accommodate the number of dealers who arrive in Tucson each year. Consequently, those without floor space at the show operate out of motel rooms nearby. The Desert Inn and Travelodge hold most of the mineral dealers; the two Holiday Inns, the Ramada Inn, the Hilton, the Spanish Trail Motel, the Sheraton-Pueblo and the Marriott hold the gem and lapidary dealers. Motel selling generally begins more than a week preceding the actual show.

Artrox (John Whitmire, Delma Perry, *et al.*, 12496 Montana, El Paso, TX 79935) had a very large batch of new silver from the New Nevada mine, Batopilas district, Mexico (Fig. 3–9). Readers may recall the earlier find reported here in 1976 (vol. 7, no. 2, p. 59). These specimens are with calcite (from which they have been partially freed by acid) as before, and form beautiful herringbone patterns, intergrowths and sprays. The prices were very reasonable, with many good specimens priced under $100, and some truly fine pieces for $200. Tony Otero, the Van Scrivers, and several other dealers acquired some of these specimens through Artrox.

The Van Scribers carried some cabinet specimens of water-clear gypsum from Santa Eulalia, Chihuahua, Mexico. These are the most attractive and perfectly formed crystals possible, and brought rather high prices for gypsum.

Miriam and Julius Zweibel *(Mineral Kingdom)* had some "small" examples of the new find of azurite at Tsumeb, Southwest Africa (Fig. 11). These consist of simple monoclinic crystals with brilliant black luster, to at least 2½ or 3 inches. The larger specimens from the find are altered to malachite on the prism faces, but have a secondary growth of blue azurite covering the terminations. According to Charles Key, a 9-inch doubly terminated crystal of schultenite was also found as Tsumeb recently.

Chris Wright *(Wright's Rock Shop)* had several new items, among which were some new purple fluorites from the Berbes mine near Ribadesella, Oviedo, Spain (Fig. 12). Earlier specimens from this locality tended to be of large cabinet size, but these are in the

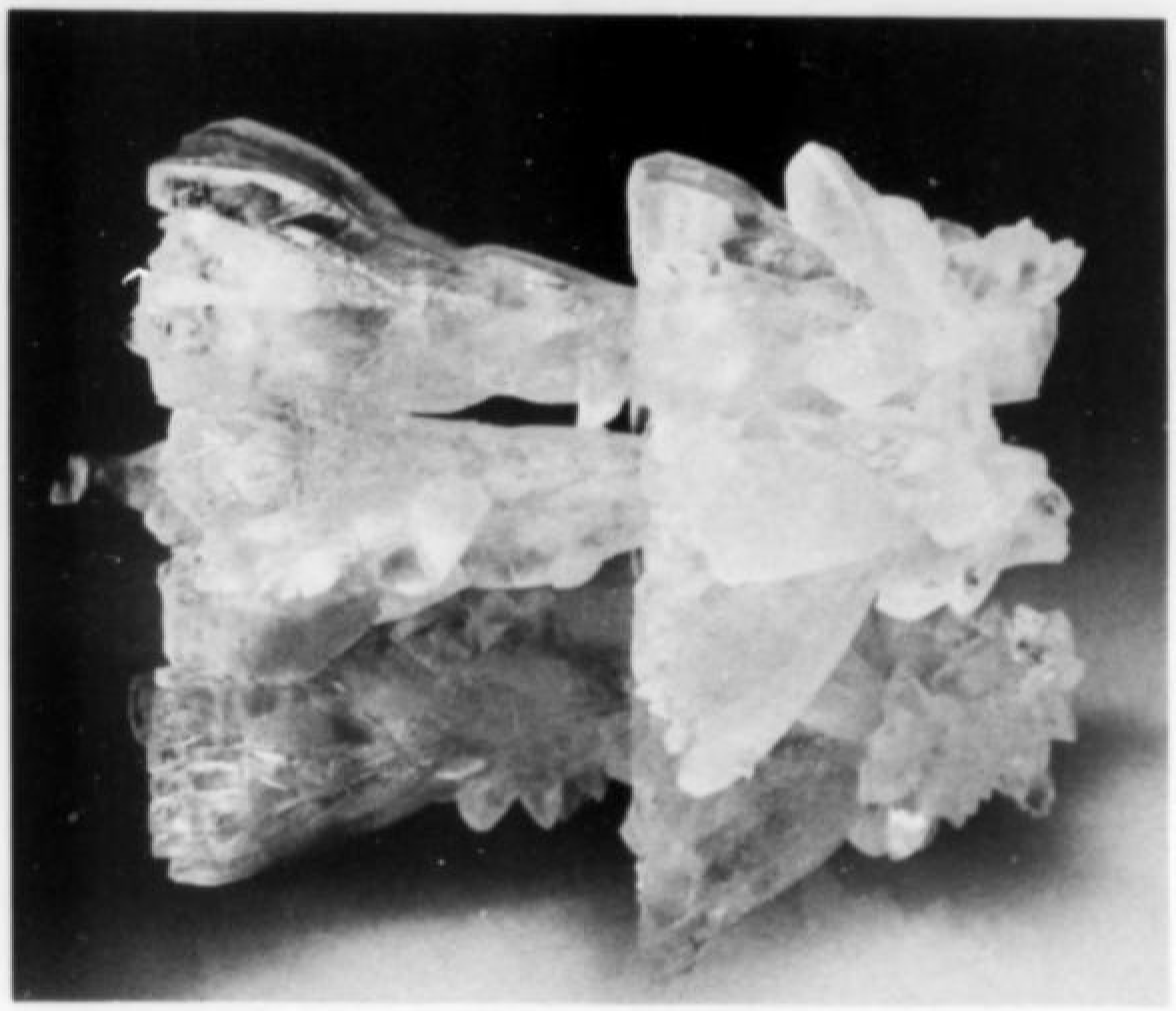


Figure 17. **A large group (3½ inches) of pale yellow calcite from the Florida limestone quarry, Hernando County, Florida. The planar alignments of the "flowers" (shown running vertically here) presumably represent water lines during crystallization. Chris Wright specimen.**

thumbnail, miniature and small cabinet range, and very reasonably priced. The purple color, good transparency, and high luster make these crystals particularly attractive, especially when perched on white barite. The crystals were generally less than an inch on an edge.

Wright also brought a large lot of several hundred cave calcites from the Florida limestone quarry, Hernando County, Florida. The crystals are transparent to slightly milky, and aggregate to form roses with a small hole down the middle (Fig. 16–17). Artrox obtained a few of these from Wright.

Neal Pfaff recently discovered a new locality for blue tufted cyanotrichite (very similar to that found at the Grandview mine in the Grand Canyon): the Maid of Sunshine mine near Gleeson, Arizona. Several flats of specimens were for sale in his room.

Veszelyite from Philipsburg, Montana, was reported here last year, but this year the person who has been collecting them (Jack Winninghoff, Box 374, Philipsburg, MT 85958) arrived with the contents of a new pocket. These remarkable crystals reached nearly an inch, though the finest were around a third to a half inch in size. The dark blue-green color and brilliant luster contrasted attractively with the chrysocolla matrix. The prices were very high, but it must be admitted that these are the world's finest crystals of veszelyite, and they are attractive besides. According to Jack, the veszelyite occurs over a zone at least 1000 feet wide, so there seems a good chance of finding more. About 36 good specimens were taken from one vug.

John Gorham and Rod Tyson (8507 - 111 Street, Edmonton, Alberta, Canada T6G 1H6) had a large number of specimens from two discoveries. Fine brown axinite specimens from the Grey Cloud claim, near Hart River, Yukon Territory, Canada, in gemmy crystals to 1¼ inches, comprised one find, which they discovered themselves. They do not plan to return to the remote locality for more, so anyone interested in one of these fine axinites should contact them soon. They also offered a large number of very fine silver specimens from the El Bonanza mine, Port Radium, Northwest Territories (Canada), a locality on Great Bear lake. The crystals form needles in a cubic reticulation pattern (as opposed to the herring-bone pattern of the Batopilas specimens). About a thousand specimens were brought to the show, and it appeared that they were being unjustifiably overshadowed by the volume of Batopilas specimens available, judging by sales. With so much fine silver available, buyers were becoming temporarily numb. Some of the El Bonanza silvers are associated with exquisite micro crystals of sharp, gemmy pyrosmalite.

Carlos Barbosa (Praca N.S. Gloria, 135, Rio de Janeiro, Brazil) brought several interesting items: childrenite crystals of a soft, pink-brown color, to an inch or so in size (though a few are much larger) from Linopolis, Minas Gerais, Brazil; pink apatite crystals, very sharp, lustrous and gemmy, from the famous Jonas mine in the Itatiaia district of Minas Gerais; and some excellent milarite crystals to one inch in size and a fluorescent yellow in color, from Jaguaraçu in Minas Gerais (Fig. 13). These may be the best milarites known, though they have very little transparency.

Associate editor Richard Gaines also described two specimens of the milarite which he had but did not bring to the show. One consists of a druse of cleavelandite plates with a 1½-inch, tan-colored crystal. The other specimen is a group of bright yellow-green crystals to 1 inch, associated with a new mineral, a crusty, purple beryllium silicate.

Geary Murdock (628 Whittier Street, Idaho Falls, Idaho 83401) set up several cases of the new Idaho aquamarine specimens (Fig. 14) in his booth on the mezzanine floor of the Desert Inn. Virtually all crystals are free of matrix, but the color is a very clean, attractive blue and the terminations are fairly complex, making these fine specimens anyway. A few consist of two or three crystals grown together in a diverging group, or in parallel, and these were among the first to sell despite significant prices. Many people who saw them opined that they were the finest North American aquamarines, though others might argue that point. Good examples were priced at $500 to $2000, some crystals reaching over 3 inches. Wine-colored topaz and smoky quartz also occur at the locality. The Murdock claim, near Centerville, Boise County, Idaho, is the exact locality name and, according to Geary, it is located on a well-known pegmatite belt which some researchers have traced for over 200 miles.

For the fans of Mont St.-Hilaire minerals, Les Horvath *(Monteregian Minerals)* had leifite crystals in small white sprays, yellow petarsite crystals to over ¼ inch, and clear pink crystals of monteregianite to ⅛ inch, among many others.

Bryon Brookmyer (Box 19, Blue Ball, PA 17506) shared a room with Carousel Gems and Minerals this year, and had several interesting items. From the Grace mine, Morgantown, Berks County, Pennsylvania, Brookmyer had groups of black, dodecahedral magnetite crystals to about an inch, some groups reaching cabinet size. And from the old French Creek locality in Chester County, Pennsylvania, he had several huge chalcopyrite groups of crystals in parallel growth.

Fred Haynes (114 Tucker Avenue, suite 2, Kingman, AZ 86401) carried some excellent groups of hollandite composed of black, lustrous crystals to ¼ inch each. The crystals are pseudocubic (actually they are monoclinic, and commonly called pseudotetragonal, but these crystals are so equant in shape that they appear nearly cubic), with four lustrous, striated faces and two rounded, frosty "macrodomes." Specimens were available from thumbnail to cabinet size, and were priced very reasonably at $8 to about $25. They were selling well, but Haynes and his partners expect to return to the locality for more. Consequently they would only give the locality as Yavapai County, Arizona.

This seemed to be the year for fluorite, and Don Knowles *(Golden Minerals)* had some very unusual specimens of *botryoidal* purple fluorite of almost cryptocrystalline texture from Canon City, Colorado. The pieces reach cabinet size, and though they are rather light in color, they would make an interesting addition to

Figure 18.* Cerussite twins from the Touissite mine, Morocco. The left group, composed of three intergrown twin pairs, measures 2.8 inches and was donated to the Los Angeles County Museum of Natural History by the Mineralogical Society of Southern California. The crystal on the right is attached to a "matrix" which is actually a white anglesite crystal. Loaned for photography by *Pala Properties.

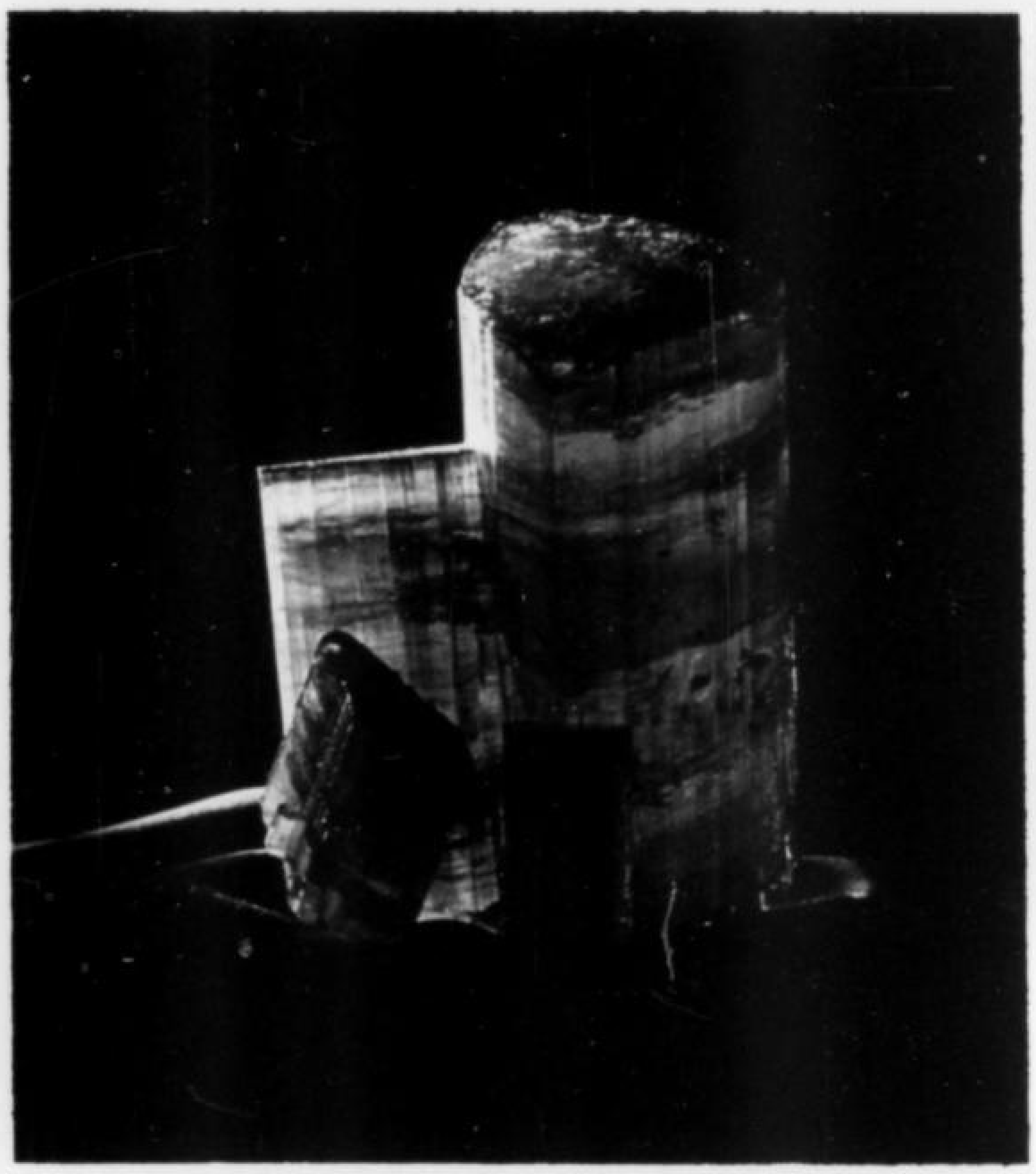


***Figure 19.* Elbaite from the Tourmaline Queen mine, Pala, California. American Museum of Natural History specimen. This photo, by Arthur Singer, won first place in the professional category of the annual slide competition.**

***Figure 20.* Galena from Neudorf, West Germany. American Museum of Natural History specimen. This photo, by Arthur Singer, won second place in the professional category of the annual slide competition.**

a fluorite collection.

Hellmut Weidner *(Gemexport Ltda.,* Merced 821 Local 13, Casilla 3576, Santiago, Chile) was offering a lot of over 500 specimens of gold in and on chrysocolla (Fig. 15) from Inca de Oro, Chile, a locality about 40 miles north of Copiapo. The gold is in wires and sheets, always small, and with its matrix forms thumbnail to small miniature-size specimens. Weidner also carried his usual stock of attractive atacamite, brochantite and cyanotrichite in micromounts to cabinet specimens.

Mineralogical Research, at the main show, had a wide selection of rare minerals including the new strontiojoaquinite from the Mina Numero Uno, San Benito County, California (the type locality). Robert Gill's display case had samples and photos of this mineral and another, bario-orthojoaquinite. They are both virtually impossible to distinguish from joaquinite in hand specimens. Sharon Cisneros of *Mineralogical Research* acquired a large suite of very rare, usually unobtainable uranium minerals from the William Pinch collection, a suite of Yukon phosphates from the Royal Ontario Museum, and a lot of the Mont St.-Hilaire rhodochrosite described here from the last Detroit Show. Readers interested in any of these specimens should contact Sharon soon; many were acquired at the end of the show and therefore were not sold out (or even offered at the show in some cases).

Victor Yount scored this year with a batch of superb cerussite specimens (Fig. 18) from the Touissite mine in Morocco (previously famous for azurite). The cerussites are V-twins of a transparent to translucent brown and reaching about 2 inches in size. A few are associated with white, altered anglesite crystals, but most are loose twins with blocky terminations and a sharp point at the other end, looking rather like fat arrowheads. Pala Properties and a few other dealers had some of these, but Vic had the bulk of the lot for sale in his booth at the main show.

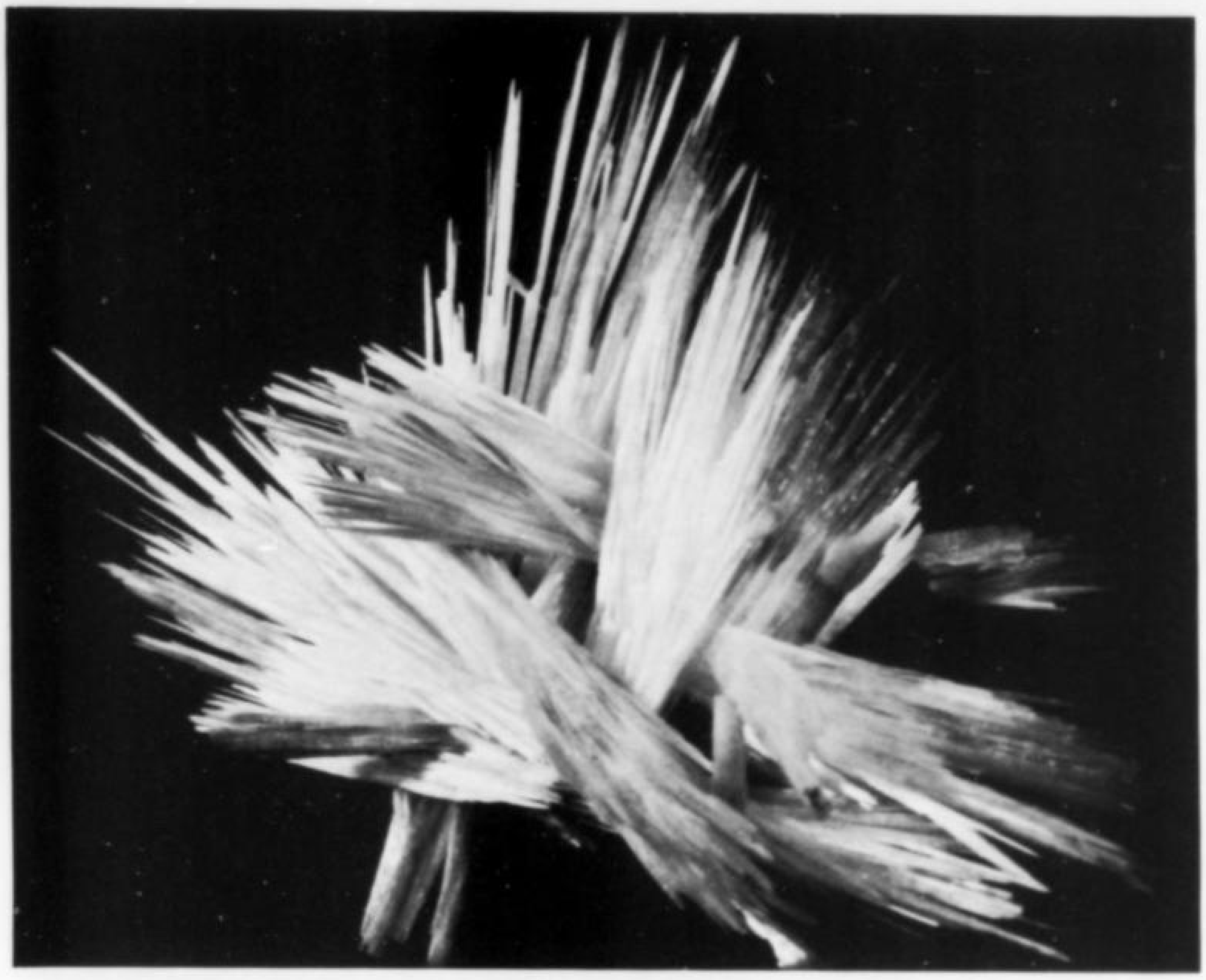


Figure 21. **White cerussite from the Flux mine near Patagonia, Arizona. This photo, by Stan Esbenshade, won first place in the amateur category of the annual slide competition.**

A Brazilian geologist, Luiz Alberto Dias Menezes (Caixa Postal 5, Jacupiranga 11940, Sao Paulo, Brazil) arrived in Tucson with a number of different specimens from the mine where he is employed, the Jacupiranga mine. The deposit is a well-known carbonatite phosphate mine, but has an interesting assortment of accessory minerals: black spinel-twins of magnetite to more than ½ inch; snow-white edingtonite to ¼ inch on white natrolite tufts; pale yellow titanite crystals with edingtonite and actinolite; brilliantly lustrous magnetite octahedrons to ½ inch, some modified by the dodecahedron, in groups to cabinet size for under $50; perovskite crystals to more than ½ inch with blocky phlogopite crystals to 1 inch, white apatite and green augite; and what appears to be a new mineral which is orange, lustrous and transparent.

This column usually treats individual discoveries of minerals, and tends not to generalize about particular dealers' stocks. However, from time to time a dealer will begin rising rapidly from relative obscurity toward the level of the top dealers by virtue of the overall quality of his specimens. Such dealers deserve a mention. The most recent example is the dealership of Mark and Jeanette Rogers (P.O. Box 1093, Yucaipa, CA 92399). Over the last year their show stock has improved significantly with each new show, and their material at the Travelodge this year was by far the best yet. I saw *many* fine miniatures and small cabinet pieces of a quality equal to that of the top established dealers. Competition collectors keep a mental list of dealers to check at shows, and to this list should be added the Rogers.

Rubens de Vasconcelos, a well-known dealer in Governador Valadares, Brazil (Caixa Postal 112, Minas Gerais), had two remarkable specimens of morganite (pink beryl) which show great promise for the future. The larger of the two is 3¼ inches across, on matrix, and absolutely flawless and water-clear, with mirror-smooth faces. The color is a deep pink, and better than most morganite. The locality was only given as Minas Gerais, which suggests that they expect to bring more specimens out and wish to avoid interference until they have finished.

Gilbert Gauthier (11 bis Av Poniatowski, 78600 Maisons-Lafitte, France) had a number of interesting lots at his booth at the main show. These included some large (¼ to ½ inch, a few near 1 inch), lustrous octahedrons and cuboctahedrons of carrollite, a copper-cobalt-nickel sulfide of the linnaeite group. The crystals are very similar in appearance to sperrylite, and occur with calcite and quartz, in some cases in groups. Gilbert was confident that the pieces in his case were the world's finest, and that no more would be recovered.

Figure 22. **A. L. McGuinness (left) and John Patrick (right) congratulate Philip Scalisi on winning both the McDole trophy and the Lidstrom trophy. Kent England photo.**

Miners' lamp collectors were in heaven at the motels this year, where approximately 170 lamps, not to mention other assorted memorabilia, were for sale. Most of these items sold within the first day that the dealers (Don Olson, David Crawford, and Mike Larner) were open. Collectors are accustomed to attending antique shows and flea markets in search of lamps, where they feel very fortunate to see a single piece . . . 170 lamps for sale in one area was almost unbelievable. Miners' lamps are becoming ever more scarce these days as collectors become more aggressive and numerous, so this large selection may have been a one-time opportunity.

Occasionally people ask where they can purchase rock trimmers. Ed Allabough (37–189 Ferber Drive, Rancho Mirage, CA 92270) is now carrying trimmers and minerals.

This year marked the first publication of a Tucson Show color poster (2 by 3 feet, on heavy stock). The subject is Vera Cruz (Mexico) amethyst, and the Van Pelt photo is particularly fine. This poster would be a striking addition to the wall of anyone's mineral room (or bedroom, bathroom, garage, etc.). A copy may be obtained by sending $4 to the Tucson Gem and Mineral Society, P.O. Box 42543,

Figure 23. **Fred Pough (left) presented Richard Bideaux (right) with the new Friends of Mineralogy award for the best article published in the *Record* during 1980. Kent England photo.**

Figure 24. **A. L. McGuinness (along with Gary Hansen and John Patrick) acted as auctioneer Saturday night during the annual auction to benefit the *Mineralogical Record*. Kent England photo.**

Tucson, AZ 85733. The poster will be sent rolled, in a mailing tube. The price includes the tube and postage; additional posters in the same order are only $3 each. The poster sold very well at the show, but a few more need to be sold to help guarantee that the tradition will continue. Shop owners might consider purchasing several to resell.

Calcite collectors may be interested in a new, non-dues, nonstructured organization of calcite collectors being organized by Bob Park (1608 Utah, Golden, CO 80421; 303-279-1015). The purpose is simply to locate other collectors for mutual benefit, to gather information, and view each others' collections.

SATURDAY NIGHT

The Saturday night program was a big success as usual, with everyone having a fine time. As I've mentioned here before, the program and auction were originally started to benefit the *Mineralogical Record* (and they still serve that purpose), but many people now consider the evening to be the entertainment high-point of the entire show week.

The program began with a lecture and slide show by Joe Tenhagen on emeralds from Colombia. Joe straightened out some of the confusion regarding locality names, gave pointers on how to recognize the locality of a given crystal, and provided some fascinating cultural information on the area.

Following the lecture was the annual slide competition, in which there were again nearly a hundred excellent entries. These were reduced to 20 semi-finalists, and the audience chose the winners by ballot. The winners, incidentally, do not receive trophies or plaques or other relatively useless awards, they receive cash . . . useful for buying minerals, photo equipment, etc. We have this competition every year, to encourage mineral photography and to recognize those people who have developed significant skill at this rare specialty. Many a professional photographer who first tries minerals discovers that it's not as simple as it sometimes appears to be, and that it requires some peculiar skills which only long practice and study can provide. A unique feature of the competition, which separates it from several European counterparts, is the role of the audience in selecting the winners. Other competitions are juried by a panel of photographers, who select the winner on the basis of their own standards. In the *Record* competition, the entrants must impress an audience of laymen who know little about technique but who have very definite opinions about the quality of the finished product. I think it's important that at least one competition be structured this way.

The winners were as follows:

Professional category:
First: Arthur Singer (Pala tourmaline) (Fig. 19)
Second: Arthur Singer (Neudorf galena) (Fig. 20)
Third: Peter Russell (Durango apatite)

Amateur category:
First: Stan Esbenshade (Flux mine cerussite) (Fig. 21)
Second: Andre Gherzi (French cyanotrichite)
Third: Anthony Kampf (Colorado Quartz mine gold)

For two years in a row now, a first place prize has gone to an essentially black and white photo. This is in contrast to the earlier years of the competition in which it seemed a red mineral was required to win.

Following the break, during which people examined the specimens to be auctioned, there was a short but entertaining awards ceremony culminating in Phil Scalisi taking his mandatory shot of black rum from Ed McDole's original bottle, so that he could officially join the ranks of the "old bounders" with Ed, and receive his trophy.

Then the inimitable Fred Pough rose to present a new award, sponsored by the Friends of Mineralogy, for the best article published in the *Mineralogical Record* during 1980 (Fig. 23). The honor was won by Richard Bideaux for his article on Tiger, Arizona, in the Arizona-I issue (May–June); the honor includes a lifetime subscription.

Finally the auction began, with tag-team auctioneers Gary Hansen, A. L. McGuinness and John Patrick. It would be pointless to attempt a description of why this auction is so much fun. But it wound up generating a healthy sum for the *Record,* and enough laughter to make everyone's mouth hurt. The auction donors are listed at the beginning of this issue, but I wish to thank here those people who volunteered their time to work as record-keepers, spotters, specimen-handlers, and labelers: Dick Hull, Don Olson, Tom Gressman, Walt Risch, Jonathan Weiss, Ron Bentley, Jim Logan, Terry Huizing, Marie Huizing (editor of *Rocks and Minerals* magazine), Pat Carlon, Bob Jones, Tony Kampf, my wife Carolyn, (in no particular order), also our three auctioneers, and of course circulation manager Mary Lynn White, and publisher John White. Congratulations are also in order for auctioneer A. L. McGuinness (Fig. 24), who has a new mineral named in his honor (mcguinnessite) in this very issue of the *Record.*

W.E.W.

BOB SULLIVAN'S

LETTER from EUROPE

Europe's 1980 fall bourses have gone into history with only one really notable new mineral find being reported, this at the Basel bourse in early December. However quite a bit more of that super vanadinite on white barite did show up following summer trips by several European dealers to the Mibladen, Morocco area. In my last column (vol. 11, no. 5) I did mention this find but the facts as I had them at the time have been considerably clarified. The real news is the fact that the Mibladen mine is back in commercial ore production although on a greatly reduced scale from prior to January 1976 when it was closed. This new productivity not only accounted for the initially reported find, actually in January or February 1980, but for the increased quantity of specimens that came out later in the spring and well into the summer. The super specimens all came from the middle of the *Assif filon,* or Assif vein of barite, from which the more attractive specimens have always come in the past. Commercial ore production is continuing and presumably the flow of vanadinite will continue as it always has in the past. It could be sometime however before any more of those super specimens do appear for, as no one will deny, last year's rather limited quantity was historically the best the mine has ever produced in its 20-plus years of commercial operation. Fine collections of them were to be seen this past fall at Altdorf, then Munich, but by Zurich time they had been pretty well snapped up. Several nice collections also made their way to the U.S. in time for the Detroit and Pasadena shows.

A big question mark since the big azurite hit made in the summer of 1979 has been the mine at Touissite, Morocco. A small assortment of specimens continue to trickle out of Touissite, most of them badly damaged, and according to some of the regular Moroccan travelers the situation does not look promising. The area is still a risky one and the danger of being thrown in the jug is ever present according to one recent visitor, but a few fine examples of anglesite and azurite continue to drift onto the European scene. The transparent yellow to orange anglesite crystals have ranged in size from ½ to 2 inches and are quite similar in coloring to the topaz from Ouro Preto, Minas Gerais, Brazil. Some of the best of these specimens have been with anglesite crystals perched on brilliant crystal clusters of octahedral galena, but damage-free examples of this terrific combination have been exceptionally rare. The same story has been generally true with respect to the few azurite specimens being brought out, but hopefully the Touissite situation will improve at some time in the future.

A fine collection of Moroccan vanadinite was the big winner at Geneva in early October, but there was one rather pleasant additional surprise when each exhibitor and dealer was presented with a bottle of white wine by the organizing Geneva mineral club. "Since the bourse had been somewhat of a slow one for most dealers, perhaps this was done to encourage some to come back," cracked one of the more successful people!

And so it went, busy and well attended bourses at Munich and Zurich, but somewhat of a bust at Basel when the early December weather failed to cooperate. Ice and sleet storms kept attendance down and in particular kept the big spenders from nearby France and Germany close by their firesides. Basel, however, did come up with the beginning of what could become the mineral of the year for 1981, the instantly famous pink fluorite specimens from Huanzala, Peru. There were only a few specimens, but being in the gorgeous class they were justifiably expensive. The one Swiss dealer who showed them had been to Peru in early November but had turned down most of the offered fine collection of them as being "too expensive." I think he later regretted it for, as many of you have probably heard by now, they were perhaps THE sensation of the Tucson show about 3 months later (see Wendell Wilson's report in *What's New in Minerals* in this issue).

There was one question about these specimens that I was asked a number of times at the Tucson show that I would like to answer here: "How do they compare with the Swiss pink fluorite?" This is a difficult question to answer because in some respects it becomes a matter of personal taste. However there is not much doubt in my mind that they are quite a bit more attractive than those from the Swiss Central Aar Massif area (Göschener Tal, Zinggenstock, etc.) which tend to be on the weak side of pink and do not occur as gemmy as the Peruvian ones. With regard to the rarer pink fluorite octahedrons sometimes found associated with dark rich brown smoky quartz in the Mont Blanc area of southwest Switzerland, I think it is pretty much of a tossup. The Peruvian crystals tend to be gemmier but the Swiss ones are slightly pinker. The background of smoky quartz is indeed a beautiful contrast to the Swiss pink, but the brilliant pyrite formations associated with some of the Huanzala specimens also make them quite striking. I think it is a case of "you pays your money and you takes your choice," and as Tucson visitors learned, the Peruvian specimens were not exactly cheap. In this aspect of what became somewhat of a controversy at Tucson, I quote from the English version of Hellmuth Boegel's book *A Collector's Guide to Minerals and Gemstones:* "the pink (fluorite) octahedrons of Switzerland are much prized and astonishingly expensive!" The reasoning of those Peruvians who brought out the relatively small collection of pink fluorite was then, why not the Huanzala specimens too? I believe they were correct in their appraisals for after all, where else in the world other than in Switzerland have fine examples of beautiful pink octahedral fluorite been found?

With the help of Jean Kemp, curator of the A. E. Seaman Mineralogical Museum, I am able to report that there is now a third locality for spinel-law-twinned crystallized copper as mentioned in my last column. It is the classic Keeweenaw Peninsula area of Michigan and, according to Jean, they are pretty rare. She had sent me an out-of-date museum brochure containing a number of photos including a fine "spear twin" from the area and I just plain missed it. In summary, the three areas are Keeweenaw Peninsula, Michigan; Pearl Handle Pit, Ray, Arizona; and the Andacollo mine near Coquimbo, Chile. Photos and previous references on the Chilean find will be found in my column in the March–April and September–October 1980 issues of the *Record.*

A correction and an addition regarding the Arizona "iron roses" illustrated as Figure 2 of my column in the September–October 1980 issue: the caption should have read "the largest rose is a little over 0.8 inch," not ½ inch, and the text is correct in this respect. Regarding other possible American sources for "iron rose" hematite, Julian Cranfill of Texas writes that some time back they were reported from the famous Magnet Cove area of Arkansas and that with diligent searching an occasional specimen could still be turned up. He writes that, "most of the recently found examples have some damage but they have been found as floaters with rutile 8-lings." In support of the claim he included a small specimen he found in 1977 and a photo copy of page 330 of the *Annual Report of the State Geologist* published by the Geological Survey of Arkansas in 1890 and authored by John C. Branner. I quote from this report as follows: "Hematite occurs sparingly on the hillside at the western side of the Cove not far from Perofskite Hill. The crystals are usually found in the stream between this hill and the western hill and occur as far up the hill towards the west as the Paleozoic rock extends.

"Two varieties have been found viz. the large flat plates 20 to 25 mm in diameter, which are bounded by the base {0001} and a positive rhombohedron {1011}. Other faces have been detected on some of the crystals, but they are too imperfect to be accurately determined. It is on such crystals as these that the rutile crystals occur (previously noted as seldom more than 2 mm in length).

"The second variety of crystals consist of what are known as 'iron roses' (eisenrosen). These are seldom more than 5 to 8 mm in diameter and are made up of numerous, very thin plates arranged in rosettes so as to resemble a full blown rose. These crystals are very similar to those found on St. Gothard Mountain in Switzerland.

"Both of these varieties of hematite are imbedded in the sandstone or are loose on the surface and in direct association with it. They are probably related to menaccanite (ilmenite) in their chemical composition."

The ½-inch example sent to me by Julian, however, was not an iron rose, but because of its poor condition it was a bit difficult to tell. It could possibly have been a poor example of the flat plate variety described by Branner, but rutile was not present. Branner did quite accurately describe the iron roses but in the past there has been some confusion on the subject, which does raise the question of how an iron rose is defined. In my limited library I could only find one definition, this in the American (1973) edition of *The Collectors Encyclopedia of Rocks and Minerals,* (edited by A. F. L. Deeson) published first in England and then by Clarkson N. Potter, Inc. of New York. "Iron rose" is defined as a "type of crystal habit displayed by hematite or ilmenite where large crystals radiate from a centre in a rose-like pattern."

From all of this one can conclude most probably the Arizona iron roses are not America's first, for Branner did seem to know what he was talking about. Julian is attempting to locating some better examples but meanwhile how about some more comment on the subject from some of you Magnet Cove experts?

Sometime back I received a rather impressive envelope marked "Department of State, Washington, D.C." My reaction was, oh-oh, what did I do now! I was surprised to learn when I opened it that the subject was indeed minerals and the author, Mary Lee Garrison, Country Officer for Zaire, did have some interesting facts to offer on what has now become known as my "copper belt dioptase dilemma." For the sake of accuracy, I reproduce her letter exactly.

"A colleague of mine was kind enough to forward to me a copy of your column from the March–April issue of the *Mineralogical Record,* which I read with much interest. While I know nothing about dioptase and have been unable to find Renneville on a map, I do know a little bit about the area of Africa you discussed, and thought the following comments might be in order. The four countries that made up the old Federation of French Equatorial Africa are Cameroon, Gabon, the People's Republic of the Congo, and the Central African Republic (ex-Ubangi-Shari). The former Belgian Congo was not broken up at independence, despite several regional secessionist attempts, and became the Democratic Republic of the Congo. Since October 1971 it has been called the Republic of Zaire. The former Belgian colony of Ruanda-Urundi was divided to form the present-day states of Rwanda and Burundi. Zambia, a former British colony, was known as Northern Rhodesia prior to independence and formed part of the Federation of Rhodesia and Nyasaland. Despite the proximity of Brazzaville and Kinshasa, there is no bridge between the two cities. They lie on opposite sides of Malebo (ex-Stanley) Pool, a spectacularly beautiful five-mile-wide stretch of the Zaire (ex-Congo) River immediately above the Nqaliema Falls. There is a regular ferry that runs between the two capitals several times daily. Although the border between the two countries has occasionally been closed because of political problems internal to one of the two countries, this has been for a matter of days and generally commerce flows actively between the two cities. All one needs have is the patience to obtain the necessary travel documents and to enjoy the 20 minute ferry ride. I trust this information will be of use to you and your readers."

A further and final clarification on the "dioptase dilemma" comes once again from J. Hintze of the Dr. F. Krantz mineral company in Bonn, West Germany. He comments as follows: "I have just received the March–April *Mineralogical Record* with your "Letter from Europe," quoting my story about Renéville, Congo. I would like to mention—to avoid errors—that not the late Dr. Krantz visited this locality but I myself (Hintze).

"The information about the mines of Mindouli (closed), M'Fouati and Pimbi areas are partially correct. I visited all of those mining areas at various times. You can get some minor dioptase in Mindouli on the dumps or in the old galeries. M'Fouati presents very nice cerussite and wulfenite, but I couldn't find any dioptase. Worthy of mention is the mine of M'Passa in the same area. In 1973 I could get there the best chalcosite crystals ever found in the world. The largest crystal was 25 cm long, well terminated and with a high luster. There was only one large cave."

I will really feel sorry for those curators some 50 years from now when they try to untangle the old labels on their minerals from these African areas.

There is a great chance for a double, or even a triple, if you want to hike your way over to Europe this fall. The Munich and Zurich bourses fall on successive weekends and by staying an extra week or two you can also catch the Berlin or Hamburg bourses. I nearly ran out of fingers trying to count the number of bourses listed in the January issue of *Lapis* but came up with 167. I would estimate the total number exceeds 250, as none of the Spanish, Scandinavian or Eastern shows are listed, and many of the Italian and French bourses are among the missing as well. Here are the fall dates for a few of the majors. *September:* Altdorf, 5–6; Brussels 12–13; Stuttgart 26–27. *October:* Hannover 10–11; Coblentz 18; Munich 30–Nov. 1 inclusive. *November:* Zurich and Hannover 7–8; Berlin 14–15; Hamburg 20–22; Stuttgart 28–29. In *December* there are two bourses in Paris, one December 4–6 and the other still unannounced. The Bremen, Germany, bourse on December 5–6 is also another possibility for late-in-the-year European travelers.

When one peruses the above list one gets the impression that the German bourses tend to dominate the scene in Europe. To a certain extent this is true, but there are also a number of major bourses in France and Italy. Most of the French dates can be found in *Monde et Mineraux,* but I have never been able to find an Italian publication listing their shows. Perhaps someone out there can help me on this?

Seeking to improve his 18th show, Johannes Keilmann will introduce several innovations for the 1981 Munich bourse. This year the competition will center on specimens from a well known locality, and the first is the Schneeberg, Saxony (Germany), area long famous for its cobalt, bismuth and nickel minerals as well as native silver. By choosing a famous locality as a new theme it is hoped that enough good specimens will be shown such that they can be photographed and subsequently reproduced in an historical booklet on the area by Rainer Bode. Rainer, you may recall, issued a very fine booklet on the Bad Ems area sometime back. (See the *Record,* vol. 11, no. 2, page 116.) If successful, the idea will be continued from year to year for other mineral localities, and the booklet may also be made available in English.

The Leitz Company of West Germany will be bringing a "live" electron microscope to the Munich bourse and will allow it to be used by collectors to make free photomicrographs of their specimens. Proper supervision and instruction will of course be provided and I can visualize a pretty long line forming at that stand!

A while back I received a very surprising letter from M. Bohaty, an avid *Record* reader from Brno, Czechoslovakia. In it he listed 15 significant mineral shows which take place annually in the "socialist countries." With the exception of the show at Triznic, Yugoslavia, I had never heard of these events but apparently some of them have been going on for quite a few years. The biggest of them all takes place at Tisnov, on the outskirts of the major city of Brno, Czechoslovakia, in the spring and repeats in the fall. With the exception of the two-day show at Triznic, all are one-day shows, but most of the majors have both spring and fall events. I have only the 1980 schedule but most of them repeat at about the same time. The Tisnov, CSSR, 1981 spring show is taking place on April 11, for example. The 1980 schedule was Prague, CSSR, March 8 and November 8; Freiberg, GDR, March 29 and September 27; Tisnov, CSSR, April 19 and November 22; Warsaw, Poland, May 18 and October 26; Strezegom, Poland, May 11; Usti Nad Labem, CSSR, June 1; Triznic, Yugoslavia, June 28–29; Aue, GDR, (the famous old Saxony silver area) August 23; Budapest, Hungary, September 6; Walbrzych, Poland, October 26.

It appears that the spring show at Tisnov is "the Tuscon" of the Eastern zone, according to Bohaty, with a "long-standing tradition and is the meeting place of collectors from both this country and the German Democratic and Federal Republics, Bulgaria, Yugoslavia, Poland, Hungary, Austria, Italy and Belgium."

The Tisnov show of 1980 was written up in the July–August 1980 issue of the French magazine *Mineraux et Fossiles,* in quite some detail according to Bohaty. This is a fine magazine, by the way, with emphasis principally on localities, especially French. Address is Editions Serre, 66 Ave. George V, 06000 Nice, France. It seems that for the most part minerals are exchanged at the shows but I have written to Bohaty with thanks and have requested further information on this aspect as well as competition, museums participation, lectures etc. I hope to report back later with more on this most interesting bit of news.

"Santa Rosa" has always been an exciting name in the gem and mineralogical history of Minas Gerais, Brazil, and when this mine closed quite a few years ago, tourmaline collectors all over the world felt a tinge of sadness. The Santa Rosa mines by then had produced for a long period of time an incredible amount of beautifully colored elbaite, varying from the most gorgeous of greens to the richest of reds, both as specimens and gem-grade crystals. Some tourmaline lovers remember Santa Rosa mostly by the famous green elbaite examples, others by the really fine "watermelon" varieties, but all instantly recognize examples of these specimens on sight. I have always remembered this area for the very beautiful, deep-red-tipped, greyish blue, slender elbaite crystals I first saw in Paris about 10 years ago, and they remain still as some of the most prized in my collection.

The news about these did not break with any fanfare at Tucson; in fact it was quite by accident I found out about it. I doubt if many others are even aware that Santa Rosa is now open again, and has been producing on a very limited scale since the fall of 1980. Thanks to my friend Reubens Vasconcelos of Brazil, who visited the area earlier this winter, I was able to get a much closer picture of this somewhat remote mystery area and the current activity there. Santa Rosa is not a town as I believed but is a fairly large mountain in a range some 90 miles from the nearest town of Itambacuri in Minas Gerais. The population of Itambacuri is about 15,000 and it lies roughly 35 miles from Teofilo Otoni and 55 miles from Governador Valadares. There is a tiny village about 3 miles from Santa Rosa Mountain and, according to Reubens, the whole area was quite a wild place in its day.

There were many small mines in the area and in addition to the main mountain, tunnels were dug into 4 or 5 smaller hills in the immediate area. When I asked Reubens about how large the entire mining area was, he struggled long and hard with some mental arithmetic, then finally announced that it was "about a million square meters." My first reaction was "Wow," but now it was my turn to calculate and after some similar mental gymnastics, I came up with the fact that it was only about one square kilometer or approximately 0.4 square miles, indeed a rather confined mining area. About 90% of the tourmaline production came from Santa Rosa Mountain and in time so many tunnels penetrated its sides it became an exceedingly dangerous area in which to work. It remains so today and this plus the associated low productivity was the principal reason for closing down the operations.

About 50 garimperos are now actively working Santa Rosa and while some of the old tunnels are being exploited, most of the working force is being concentrated on an effort to dig a new tunnel from the heretofore unexplored backside of the mountain. Results to date have been minimal but signs are encouraging. We did see about a dozen examples of some new, exceptionally fine green elbaite crystals and groups from a single pocket in the old diggings and the coloring on several of them was indeed special. Maudine and I were struggling hard to describe to each other the unique deep emerald-green color present in one particularly beautiful, large, 6 x 1-inch crystal with terms such as "Irish green" being bandied about. "How about Irish Cranberry," quipped Maudine, and with that the whole idea aptly collapsed. There was however one really fine, huge, 2¾-pound green crystal that was being referred to as "the little green giant." (But, in reality, what's wrong with just plain elbaite?) On the cover of the November–December issue of the *Record* is a photo of a green elbaite taken by Olaf Medenbach and the source is indicated simply as Minas Gerais, Brazil. The color is quite like that of the new Santa Rosa elbaite crystals and I strongly suspect Santa Rosa was the source of this very fine specimen.

Thanks to Linda Kubler, J.-P. Cand, C. Gobin, J. Kolarowitz, O. Meyer and a few others for helpful information on the European circuit and a very special *merci* to Reubens Vasconcelos for much of the "Irish Cranberry" story!

Until next time . . .

Cheers,

Bob Sullivan

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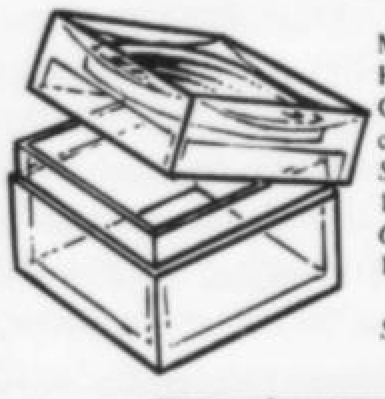

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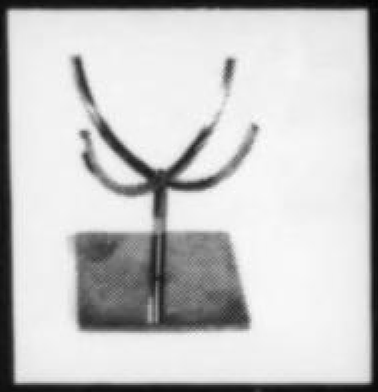

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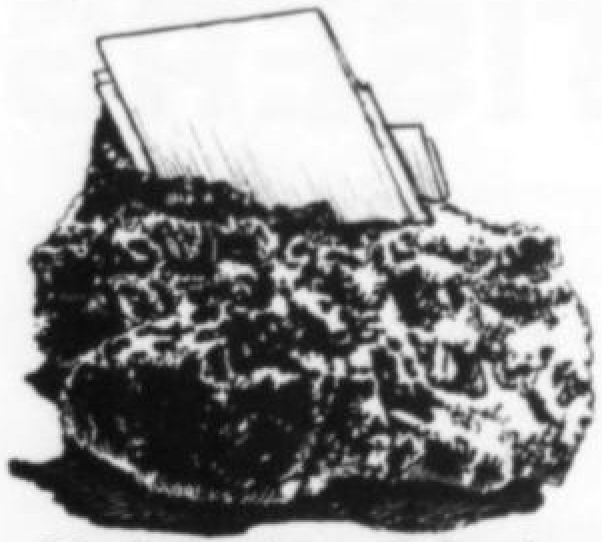

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