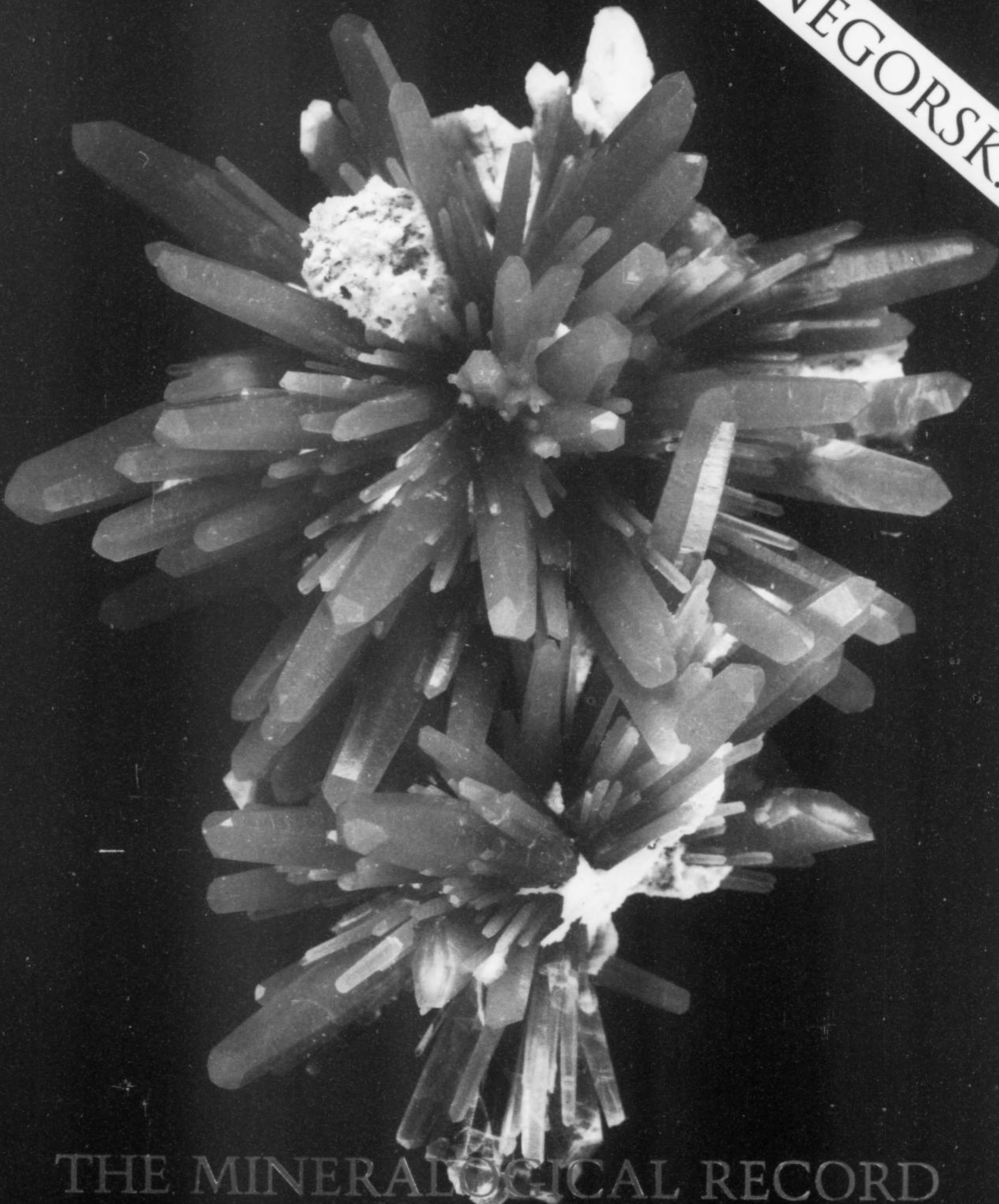


DAL'NEGORSK!

THE MINERALOGICAL RECORD

VOLUME 32 • NUMBER 1 • JANUARY-FEBRUARY 2001 • $12

Editor & Publisher
Wendell E. Wilson

Circulation Manager
Mary Lynn Michela

Associate Editors
Pierre Bariand
Sorbonne
Paris, France
Bill Birch
Museum of Victoria
Melbourne, Australia
Michael P. Cooper
Nottingham, England
Anthony R. Kampf
L.A. County Mus. of Nat. Hist.
Los Angeles, CA
Joseph A. Mandarino
Royal Ontario Museum
Toronto, Ontario
Steven R. Morehead
Riverside, CA
Donald R. Peacor
University of Michigan
Ann Arbor, MI
Andrew C. Roberts
Geol. Surv. of Canada
Ottawa
George W. Robinson
Seaman Mineral Museum, MTU
Houghton, Michigan
Abraham Rosenzweig
Tampa, FL

Correspondents
Miguel Calvo
Zaragoza, Spain
Thomas P. Moore
Niantic, CT
Joe Polityka
Staten Island, NY
Jeffrey A. Scovil
Phoenix, AZ
Pierre-Nicolas Schwab
Orléans, France

Associate Photographers
Nelly Bariand
Sorbonne
Paris, France
Dan Behnke
Northbrook, IL
Werner Lieber
Heidelberg, W. Germany
Eric Offermann
Arlesheim, Switzerland
Jeffrey A. Scovil
Phoenix, AZ
Harold and Erica Van Pelt
Los Angeles, CA

Founder
John Sampson White

Editing, advertising
4631 Paseo Tubutama
Tucson, AZ 85750
520-299-5274 • FAX: 520-299-5702
E-mail: minrec@azstarnet.com

Subscriptions
(Subscriptions, back issues, reprints, book sales, shows)
P.O. Box 35565
Tucson, Arizona 85740
520-297-6709 • FAX: 520-544-0815
E-mail: minrec@aol.com
- **Individuals (U.S.):** $51 for one year; $96 for two years. (First-class mailing available; write to circulation manager for rates.)
- **Individuals (outside the U.S.):** $55 for one year, $99 for two years. (Airmail mailing available; write to circulation manager for rates.)
- **Libraries, Companies and Institutions (worldwide):** $150 for one year.

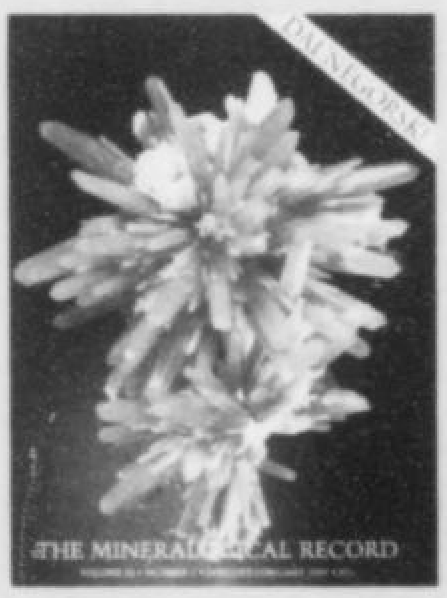
*Continued on p. 79

THE
MINERALOGICAL
RECORD

January–February 2001 Volume Thirty-two, Number One

Articles

Columns



COVER: QUARTZ crystal cluster, 8.2 cm, from the Second Sovietskiy mine, Dal'negorsk, Russia. Jeff and Gloria's Minerals specimen: photo by Jeff Scovil.

Visit our Website: www.MINREC.org

The Mineralogical Record (ISSN 0026-4628) is published bi-monthly for $51 per year (U.S.) by Mineralogical Record, Inc., a non-profit organization, 7413 N. Mowry Place, Tucson, AZ 85741. Periodicals postage paid at Tucson, Arizona and additional mailing offices. POSTMASTER: Send address changes to: The Mineralogical Record, P.O. Box 35565, Tucson, AZ 85740.

notes from the EDITOR

RUSSIA *in the* MINERALOGICAL RECORD

Talk about a tough nut to crack, getting authoritative articles on Soviet mineral localities prior to the fall of the "Iron Curtain" was just about impossible. Every minable commodity was considered to have "strategic significance" in some way, and consequently the publishing blackout covered nearly all of the information we wanted. Getting specimens out wasn't easy either, as the brave mineral dealers operating in that theater in those days will attest.

Happily, those problems began to crumble away in 1988. Beginning at the Munich Show that year (see vol. 20, no. 1, p. 69–75) we started seeing wonderful *recently mined* Soviet minerals in quantity for the first time, coming from localities we had never heard of, such as Dal'negorsk and Akchatau. Old classics began turning up anew as well, such as crocoite from Berezovsk and dioptase from Altyn-tyube. We discovered that we had mineral collecting brethren in the Soviet Union who were becoming more active and were building excellent collections. Curators of important Russian mineral museums were suddenly able to travel outside of their country, and we had the opportunity to meet them face-to-face in places like Munich and Tucson. Truly it has been a boon to all collectors to see that great land become fully integrated into the world mineralogical community.

It required a bit more time before mineralogical publishing caught up to the changes taking place in Russian and former Soviet societies. During the first 25 years of the *Mineralogical Record*, 1970–1994, we published not a single significant locality article on any occurrence in the lands of the former Soviet Union. Michael Leybov and his associates in Moscow broke the ice by beginning publication of the Russian mineral-collecting journal, *World of Stones—in English*—in 1993. In 1994 we got started ourselves with a review of early Russian mineral collectors in "The history of mineral collecting, 1530–1799" (vol. 25, no. 6).

In 1995 we finally got down to localities, with "A guide to mineral localities in the former Soviet Union," by Bill and Carol Smith (vol. 20, p. 517–549). (Bill had gotten a head start, as a former Deputy Director of the National Security Agency.) That same year we also described an important antiquarian work on Russian mineralogy, "Nickolay Ivanovich Koksharov and his *Mineralogie Russlands* (1853–1891)" in the 1995 Books Issue (vol. 26, no. 4). In 1996, Lutz Nasdala *et al.* gave us an interesting study on "Unusually shaped quartz aggregates from Tirniauz, Russia" (vol. 27, p. 205–206 and 223). Louis Cabri *et al.* contributed an article on "Platinum-group minerals from the Konder Massif, Russian Far East," in 1997 (vol. 28, p. 97–106). Evgeni Burlakov provided us with two important articles on the Dodo and Puiva deposits in 1999 (vol. 30, p. 427–442 and 451–465). And in the September–October 2000 issue we featured a "Collector Profile" of Vladimir Pelepenko, Russia's leading private collector and one of the first to display his minerals in the West.

In this issue we cover one of Russia's most important and prolific modern localities, Dal'negorsk, and we also present the abstracts from this year's mineralogical symposium in Tucson, focusing on Russian and former Soviet localities and minerals. We hope this is just the beginning of what will ultimately be a lengthy and thorough documentation of important localities in the former Soviet Union. Authors with ideas for articles are invited to contact the editor.

In the meantime, schedule a trip to the Tucson Gem & Mineral Show this February, where the special topic will be—you guessed it—gems and minerals of Russia and the former Soviet Union. Show chairman Bob Jones and exhibits chairman Peter Megaw have arranged a stunning banquet of sights that may well constitute a once-in-a-lifetime opportunity.

RATE INCREASE

We never like raising the subscription price of the *Mineralogical Record*, but we have found that we must do so every two years in order to catch up with our increasing production and mailing costs. This policy has kept us viable for over a quarter of a century, serving the world's mineral collectors and specimen-oriented professionals.

Although the need for increases is inescapable, we have always tried to mete them out in the smallest doses possible. In comparison to most other U.S. periodicals, we've done pretty well in keeping increases to a bare minimum. For example, the average increase for all U.S. periodicals (according to a study by the journal *American Libraries*) from 1988 to 1998 was 10% per year, and for just the scientific journals it was 7.6% per year. Over that same time period the price of the *Mineralogical Record* increased an average of less than 5% per year.

Major subscription agencies (EBSCO, Faxon, Blackwell's, etc.) are projecting an average price increase of 10% for U.S. periodicals in 2001. This is based on higher postage costs (the non-profit rate will rise by 10%–16%), higher paper costs (5% to 6% for 2001), and general inflation in publishing-related services that considerably exceeds the projected increase in the Consumer Price Index. Our increase for 2001 will still amount to less than 5% annually over the last two years.

Our non-U.S. subscribers get a break, too. The average surcharge for overseas subscriptions to U.S. journals is $16.98 for six issues. Our surcharge is only $4!

No one likes increases, but we hope our readers will still consider the *Mineralogical Record* to be a bargain. Subscription fees cover only a portion of our total costs; the rest we raise in other ways, so that our subscribers can receive their favorite mineral magazine at the lowest possible price.

Famous Mineral Localities:

DAL'NEGORSK

PRIMORSKIY KRAY RUSSIA

Raymond Grant
Mesa Community College
1833 W. Southern Avenue
Mesa, Arizona 85202

Wendell E. Wilson
The Mineralogical Record
4631 Paseo Tubutama
Tucson, Arizona 85750

The mines near Dal'negorsk in eastern Russia have yielded world-class specimens of fluorite, pyrrhotite, ilvaite, datolite, danburite and calcite, plus fine examples of apophyllite, chalcopyrite, galena, hedenbergite, manganaxinite, sphalerite and other minerals. The mines are still in production, and are open to visitors by prearrangement.*

INTRODUCTION

The first significant exposure of fine Dal'negorsk mineral specimens to the Western mineralogical community took place at the Munich Show in 1988. That was the first year in which Russian collectors and museums were able to freely visit and exhibit in the West as a result of the new *glasnost* policy. One of Russia's leading private collectors, Vladimir Pelepenko, put in several display cases of beautiful Russian specimens that left showgoers stunned. Huge, colorless, water-clear fluorite crystals, giant pyrrhotite crystal groups, large and lustrous black ilvaites, superb galena groups and outrageous fist-size crystals of green danburite the like of which no one in the West had ever seen made quite an unforgettable impression. Though unlabeled, the specimens were later revealed

*Дальнегорск; the apostrophe is the transliteration of the cyrillic letter ь, which is not pronounced but serves to soften the pronunciation of the preceding consonant.

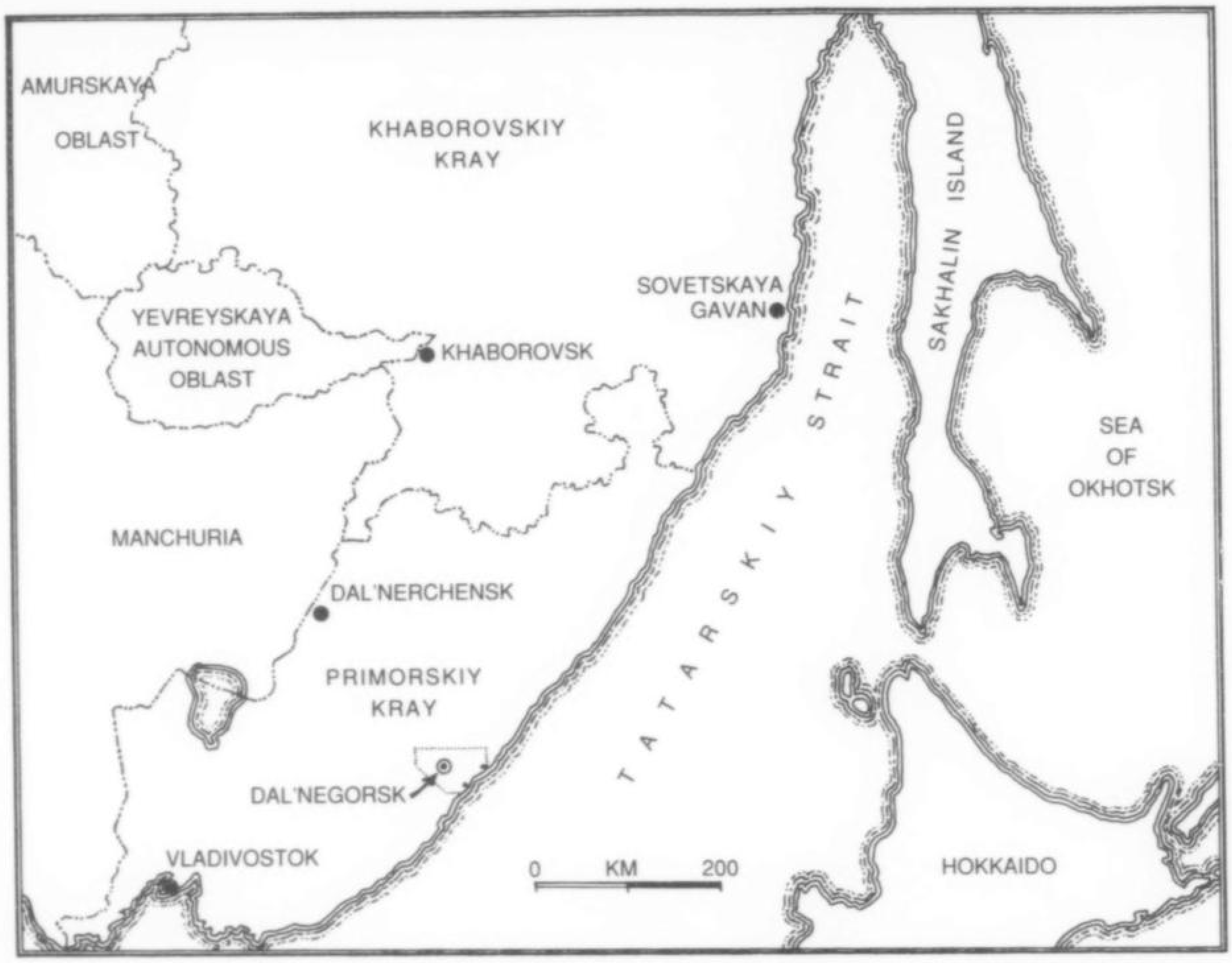


Figure 1. **Location map.**

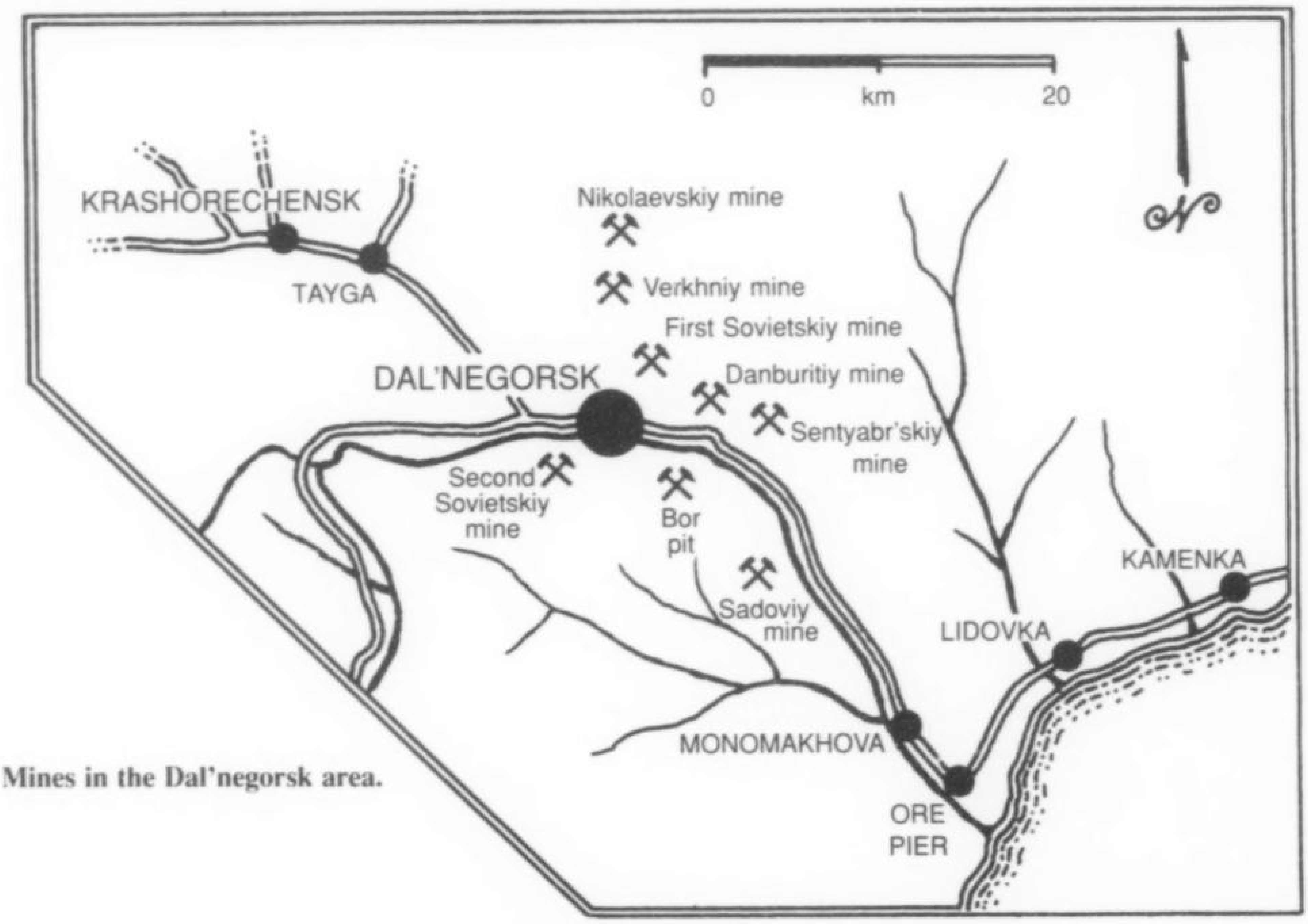


Figure 2. **Mines in the Dal'negorsk area.**

to be from the mines around the far eastern town of Dal'negorsk.

Since that time, many more excellent specimens have made their way onto the Western mineral market and now reside in major private and public collections. Conducted tours for collectors are permitted by the friendly mine management, and visitors have even been allowed to collect their own specimens underground. There is no predicting how long the mines will remain open and productive, but for now they remain one of Russia's best sources for new mineral specimens.

LOCATION

The town of Dal'negorsk is located a little over 35 km inland from the sea of Japan and 300 km northeast of Vladivostok, in the Rudnaja ("Ore") River Valley. It serves as the center of a very active mining area; a narrow-gauge railway for hauling ore passes directly through the center of town. Other ore deposits in the area include Kavalerovo (disseminated cassiterite), Sinerecenskoe (a skarn deposit that has yielded beautiful andradite-grossular), and Zabytoe (greisens and pegmatites yielding good topaz).

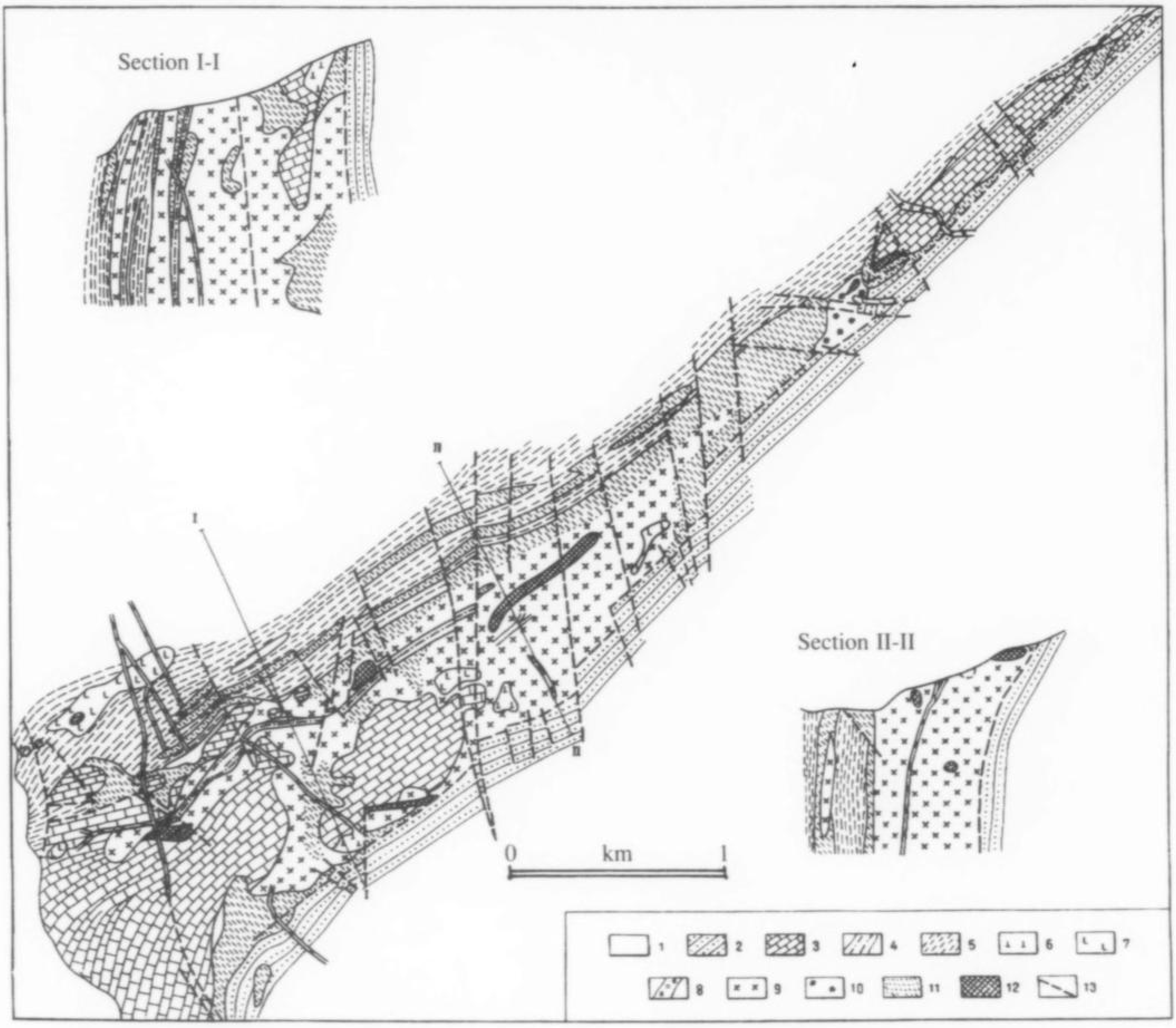


Figure 3. **Schematic geologic map and cross-sections of the Dal'negorsk deposit (after Smirnov *et al.*, 1983).**

(1) Loose deposits
(2) Siliceous Shale and Sandstone—Upper Jurassic
(3) Limestone—Upper Triassic
(4) Siltstone and Sandstone—Upper Triassic
(5) Sandstone, Siltstone, Shale—Upper Triassic
(6) Diabase Porphyry—Paleogenic
(7) Sikhakinskii Complex (Trachyte, Trachyandesite, Essexite-Diabase, Shoukinite)—Paleogenic
(8) Felsite, Quartz Porphyry—Paleogenic
(9) Datolite Skarn
(10) Danburite Skarn
(11) Garnetiferous Skarn
(12) Quartz-Calcite Veins and Lenses
(13) Faults

The mines are situated on the western slope of the Sikhote-Alin Range, in an area of taiga and mixed forest with subtropical vegetation in the deep valleys. Temperatures can reach close to 90°F in April, with high humidity and encephalitis-bearing mosquitoes adding to the discomfort.

Up until 1972 the River was known by its Chinese name, Tetyukhe. But in that year a decree by the Supreme Soviet ordered that all geographic features in Siberia be given Russian names to replace names of other ethnic origins, so Tetyukhe was renamed the Rudnaja ("ore") River, and the ore deposits took on the name of a nearby town, Dal'negorsk (Lisitsyn and Malinko, 1994). Nevertheless, some specimen labels even now still carry some spelling variation of Tetyukhe; these should all be relabeled Dal'negorsk. (The name simply means "most distant or remote mining town.")

HISTORY

The area around Dal'negorsk was for many years under the control of Manchuria, but in the late 1800's it became the focus of Russian expansion and settlement. The Dal'negorsk mineral deposits were discovered by the Chinese in 1872, and were mined for silver and borosilicates for glassmaking. In 1887 Russians moved into the area and purchased the rights to the Verchniy mine. Operations to extract copper, lead and zinc began in 1897. In 1910 a railway was completed to the Sea of Japan, and Dal'negorsk ore was shipped to the United States, Holland and Germany.

World War I resulted in closure of the mines, and in 1924 the mining rights were sold to a British company, Tetyukhe Mining Corporation. The lease was for 20 years but Russia forced the British to leave in 1931 and nationalized the mining operations.

For many years following the opening of the lead-zinc mines, the steep, pale-colored cliffs near the mining offices were assumed to be marbleized limestone. In 1945 a visiting geologist named S. S. Smirnov observed that the fine datolite specimens found in the polymetallic ore cavities might indicate the presence of some type of boron orebody in the area. In the following year an extensive sampling program discovered that the cliffs facing the

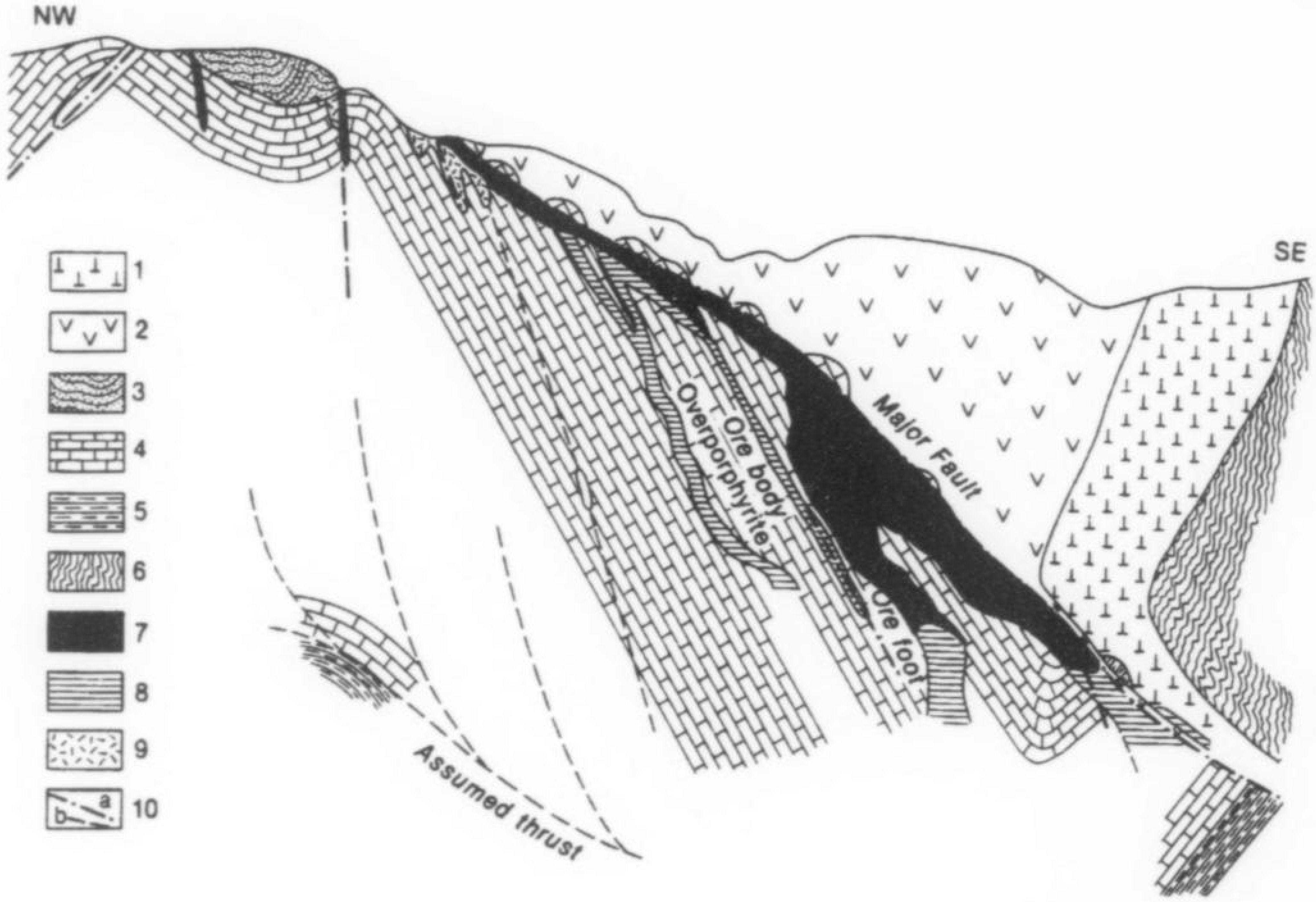


Figure 4. **Schematic geologic section through the Verchniy deposit (after Smirnov *et al.*, 1983).**
(1) Andesite
(2) Quartz Porphyry
(3) Siliceous Shale and Sandstone
(4) Limestone
(5) Shale and Sandstone
(6) Chert
(7) Skarn Orebody
(8) Projection of the Orebody
(9) Oxidized Ore
(10) Faults (a - certain, b - supposed)

river valley were not limestone at all but solid, massive datolite. Consequently a large-scale boron-mining operation developed at Dal'negorsk, along with chemical plants to reduce the ore to useful boron compounds; this operation has grown to surpass the local metal mining in economic importance, and has become Russia's primary source of boron.

Two Russian mining companies currently have active operations in the Dal'negorsk area. The Bor Company operates the Bor open pit for datolite (boron), and the Dal'polymetal Company owns six mines, three currently operating, for the recovery of lead, zinc, bismuth, silver, cadmium and indium. In 1997 they celebrated the centennial of Russian mining at Dal'negorsk.

GEOLOGY

The geology of the Dal'negorsk region is tectonically complex because of its relationship to a major subduction zone on the Pacific Rim. Here the oceanic plate moving westward plunges into the mantle at the continental boundary, as oceanic sediments accrete at the continental margin.

The oldest rocks in the area are oceanic limestones, sandstones and siltstones of Upper Triassic to Upper Jurassic age. Deformed lenses and sheets of these units collided with the continental margin as a result of plate movement, and are intensely faulted and intruded by igneous rocks. The earliest intrusions consist of Late Cretaceous and Tertiary andesite-granodiorite associated with the formation of sulfide deposits.

The Dal'negorsk boron deposits appear to be paragenetically related to two post-orogenic magmatic complexes, the Sikhote Alin and the Dolinna. The Sikhote Alin complex consists of small potassium-alkali-rich intrusions (shonkinite, essexite-diabase, trachyandesite, leucitic trachyte) with high boron and titanium content. Rare-earth element (REE) studies show a positive europium anomaly which is unique among the various intrusive rocks of the region. Xenoliths of eclogite and lherzolite suggest a mantle origin; isotopic studies indicate an emplacement age around 35.6 to 70.5 million years. The datolite itself has been dated at 32–38 million years.

The Dolinna complex is known only from core-drilling samples taken from depths of 1100 to 1200 meters. The potassic latite granites are high in chromium, with an REE europium depletion similar to that of island-arc andesites, and thus are of shallower magmatic origin than the Sikhote Alin complex. The Dolinna complex has been dated at 32–56 million years. Danburite mineralization at Dal'negorsk appears to be directly associated with the Dolinna granites (Lisitsyn and Malinko, 1994).

The Dal'negorsk boron deposits consist of several boron-rich skarn bodies extending for 3.5 km parallel to the local fold structures. The main orebody, in the central part of the deposit, is over 500 meters thick and dips vertically. The complex and colorfully banded skarn rock has been used for ornamental stone lining the interiors of some metro stations in Moscow, and covering the floor of the mineralogical museum in the Northeast Complex Institute of the Russian Academy of Science at Magadan.

The first skarn was formed during the Late Cretaceous. It contains grossular, wollastonite, hedenbergite, and danburite. This was followed by the intrusion of andesite and diabase dikes. This andesite filled some of the pockets which had formed in the earlier skarn. Next, there was a second period of skarn formation of a lesser quantity than the first. The second skarn has andradite, less wollastonite, more hedenbergite, and datolite. At this time all the danburite in the Bor pit was altered to datolite. All the sulfide deposits in the district formed during the second period of skarn formation.

Smirnov *et al.* (1983) have observed that mineral formation at the Verchniy mine involved four phases: (1) the pre-ore skarn phase with wollastonite and garnet depositing at over 600°C, (2) the skarn-sulfide phase forming at 400° to 600°C, (3) the sphalerite-galena phase forming at 120° to 350°C, and (4) the chalcedony-calcite phase at 20° to 100°C, in which minerals were deposited as druses in open cavities. Coarse-aggregate hedenbergite at shallow depths grades into a finer grained variety with increasing axinite at depth. The sphalerite:galena ratio increases with depth, as total metal concentration decreases. The ores were precipitated from colloform solutions, as evidenced by residual parent solution in some open cavities which consists of a jelly-like silica gel.

The major host rocks for the sulfide and boron deposits are the skarn. The primary skarn minerals are wollastonite, hedenbergite, garnet (andradite and grossular), and manganaxinite. The altered skarns contain, in addition, datolite, hisingerite, quartz, calcite, sepiolite, and siderite (Bulavko, 1984).

Of particular interest to mineral collectors are the ancient hydrothermal cavities found in the host rock. These range from a few centimeters across to house-size. Although some became filled during the last period of intrusion, others remained open as an ideal environment for the crystallization of fine mineral specimens.

Some geologists believe that the skarns are so atypical as to require a different classification, such as "high-temperature hydrothermal-metasomatic" similar to the deposits at Trepča, Yugoslavia and El Potosí, Mexico (Hamet and Štedrá, 1994).

MINES

There are eight mines in the area immediately surrounding Dal'negorsk (within 15 km). Today, four of these mines are operating and four are closed. The minerals described in this article are from these eight mines. In the larger region around Dal'negorsk there are additional mines and minerals not listed here. The names given for the mines generally follow the suggestions of Smith and Smith (1995) and local usage. Because in the Russian language the mine name used must agree with the noun following it, the names will appear as several variants. For example the name of one mine is the Nikolaevskiy mine, but the Nikolaevsk*oe* deposit is also referred to in the literature. The names are given as the Russian name transliterated into English, followed by the English translation of the name. The first two are operated by the Bor Company, and the others by the Dal'polymetal company.

Bor Pit or Quarry

The Bor (Boron) quarry, opened in 1958, is the only operating open pit in the area, and is being mined for datolite as a source of boron. (Note: the iy ending is not used because there are several meanings for the word bor in Russian and the least confusing name is simply Bor.) In Dal'negorsk the local people call it "Kar'er Bor" or just the "Kar'er" (quarry). There are two parts to the mine at present: the central pit and the west pit. They may ultimately merge into one large pit. The mine now produces 200,000 tons a year of boron concentrate (8 to 10 percent B_2O_3) from ore with 30 to 45 percent datolite (Carr, 1994).

Danburitiy Mine

The Danburitiy (Danburite) mine is an abandoned open pit once mined briefly for boron. It is also referred to as the "east pit." Since it is separated from the central pit by a river and highway, and is the only locality where danburite has been found, a distinct name is appropriate.

First Sovietskiy Mine

The First Sovietskiy (Soviet) mine opened in 1934 and closed around 1965. Specimens are still available from local collectors.

Second Sovietskiy Mine

The Second Sovietskiy (Soviet) mine also opened in 1934, and is still operating at present. The name is applied to a series of mines on the same deposit. Earlier mine names used included the Eastern Partizan mine, Western Partizan mine, and Svetly Otvod mine. At the Dal'negorsk Museum the specimens from these mines are all labeled Second Sovietskiy mine.

Sentyabr'skiy Mine

The Sentyabr'skiy (September) mine opened in the early 1930's and has been closed for 30 years. Underground access is still available to collectors, and specimens from this mine are continuing to be found and sold.

Verchniy Mine

The Verchniy (Upper) mine was the first mine in the region, and is still in operation. It was initiated as an open pit mine before 1897, by the Chinese, but is now an underground operation. The surface workings are still accessible to collecting. The oldest workings at the very top of the hill are known as the Brenner mine, after an early British mine director at Dal'negorsk.

Below the Brenner workings are several large open pits and underground workings that constitute the Verchniy mine proper. The main underground workings are entered by a tunnel at the bottom of the hill. The upper workings exploit an oxidized Pb-Zn-Cu deposit and its well-developed gossan. A number of fine secondary minerals can still be collected there.

Nikolaevskiy Mine

The Nikolaevskiy (Nickolas) mine was opened in 1982 and at present is the largest producer in the district.

Sadoviy Mine

The Sadoviy (Garden) mine is currently closed and no mineral specimens are being produced; very few were found there in the past.

Other mines in the Dal'negorsk region have produced specimens; most of the mineral dealers in Dal'negorsk sell specimens from these deposits and often they are labeled as being from Dal'negorsk. Kavalerovo, which is about 70 km from Dal'negorsk, has produced some very good fluorite: green and purple octahedrons, cubes and complex crystals. Some sphalerite and galena specimens are also on the market from Kavalerovo. Local Dal'negorsk collectors can differentiate the Kavalerovo specimens from Dal'negorsk specimens. Many of the Dal'negorsk dealers collect at the Blue River garnet deposit about 180 km from Dal'negorsk. There are many specimens of andradite and green quartz from Sinya Rechka for sale; some of the quartz is outstanding, and has sometimes been labeled as coming from Dal'negorsk.

MINERALS

Over 160 minerals (Table 1) have been reported from the Dal'negorsk area. Information about the minerals and their occurrence is from Bulavko, personal communication, 1995 and 1997;

Table 1. **Mineral species reported from the Dal'negorsk area.**

Native Elements
- Antimony
- Arsenic
- Bismuth
- Copper
- Gold
- Graphite
- Silver
- Stibarsen

Sulfides, Sulfosalts
- Acanthite
- Alabandite
- Andorite
- Arsenopyrite
- Bornite
- Boulangerite
- Bournonite
- Carrollite
- Chalcopyrite
- Chalcocite
- Covellite
- Cubanite
- Freibergite
- Galena
- Galenobismutite
- Gersdorffite
- Jamesonite
- Lillianite
- Linnaeite
- Marcasite
- Matildite
- Miargyrite
- Millerite
- Owyheeite
- Polybasite
- Proustite
- Pyrargyrite
- Pyrite
- Pyrrhotite
- Sphalerite
- Stannite
- Stephanite
- Sternbergite
- Stibnite
- Tellurobismuthite
- Tennantite
- Tetrahedrite
- Valleriite
- Wittichenite
- Wurtzite
- Zinkenite

Tellurides, Arsenides, Selenides
- Altaite
- Clausthalite
- Domeykite
- Hedleyite
- Hessite
- Ikunolite
- Joseite
- Löllingite
- Safflorite
- Skutterudite

Halides
- Fluorite

Oxides, Hydroxides
- Anatase
- Cassiterite
- Chalcophanite
- Cuprite
- Goethite
- Hematite
- Ilmenite
- Lepidocrocite
- Litharge
- Magnesioferrite
- Magnetite
- Minium
- Pyrolusite
- Rutile
- Senarmontite
- Spinel
- Valentinite

Carbonates
- Aragonite
- Aurichalcite
- Azurite
- Bismutite
- Calcite
- Cerussite
- Dolomite
- Hydrozincite
- Kutnohorite
- Malachite
- Rhodochrosite
- Siderite
- Smithsonite

Oxalates
- Weddellite
- Whewellite

Sulfates
- Anglesite
- Barite
- Brochantite
- Chalcanthite
- Gypsum
- Jarosite
- Melanterite
- Plumbojarosite

Borates
- Ludwigite
- Vonsenite

Phosphates
- Apatite
- Pyromorphite

Tungstates
- Scheelite

Arsenates
- Adamite
- Beudantite
- Dussertite
- Erythrite
- Mimetite
- Scorodite
- Thometzekite

Silicates
- Actinolite
- Albite
- Andradite
- Apophyllite
- Chlorite group
- Chrysocolla
- Clinozoisite
- Cummingtonite
- Danburite
- Dannemorite
- Datolite
- Dickite
- Diopside
- Epidote
- Grossular
- Hedenbergite
- Hemimorphite
- Heulandite
- Hisingerite
- Ilvaite
- Johannsenite
- Laumontite
- Manganaxinite
- Margarite
- Montmorillonite
- Muscovite
- Nontronite
- Olivine group
- Opal
- Orthoclase
- Palygorskite
- Phlogopite
- Prehnite
- Pumpellyite
- Quartz
- Rhodonite
- Scolecite
- Sepiolite
- Serpentine
- Siderophyllite
- Stilbite
- Stilpnomelane
- Talc
- Thomsonite
- Titanite
- Tourmaline group
- Tremolite
- Vesuvianite
- Willemite
- Wollastonite
- Zircon
- Zoisite

England, personal communication, 1996; Ponomarenko, personal communication, 2000; Hamet and Štedrá, 1992; Lisitsyn and Malinko, 1994; an unpublished report by K. A. Moysyuk and E. E. Dramsheva, 1989; and information from company reports where the following are cited: C. P. Garbuzov, 1982; L. N. Khetchikov, 1953; and B. V. Kuznetsov, 1979. Table 2 is a summary of the occurrence of the minerals which occur as outstanding specimens.

Acanthite Ag_2S

Acanthite is found in small amounts with other sulfides in the district. Masses up to 1 cm (but no crystals) have been recovered at the Verchniy mine.

Actinolite $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$

Actinolite is a rare accessory mineral in skarns throughout the district, especially in the Bor pit.

Figure 5. **The Danburitiy mine. R. Grant photo.**

***Table 2.* Distribution of the common minerals in the mines of the Dal'negorsk region. X = mineral is found at that mine; R = the mineral is found in that mine but only rarely; and G = the mineral is found as good to outstanding specimens in that mine.**

Minerals \ Mines	Bor	Danburitiy	First Sovietskiy	Second Sovietskiy	Sentyabr'skiy	Verchniy	Nikolaevskiy	Sadoviy
Apophyllite	G	R	X	R	R	G	X	G
Calcite	G	X	G	G	X	G	G	X
Chalcopyrite	X	R	G	X	X	X	G	X
Danburite		G						
Datolite	G	X	G	R	G	G	R	
Fluorite	X	R	G	X		R	G	X
Galena	R		X	G	X	X	G	X
Hedenbergite	X	R	X	X	R	X	G	
Ilvaite	X		G	X	X	G	G	
Manganaxinite	G	X	X	X	G	G	X	R
Quartz	G	X	X	G	X	G	G	X
Pyrrhotite			X	X		X	G	
Sphalerite	X		X	G	X	X	G	X

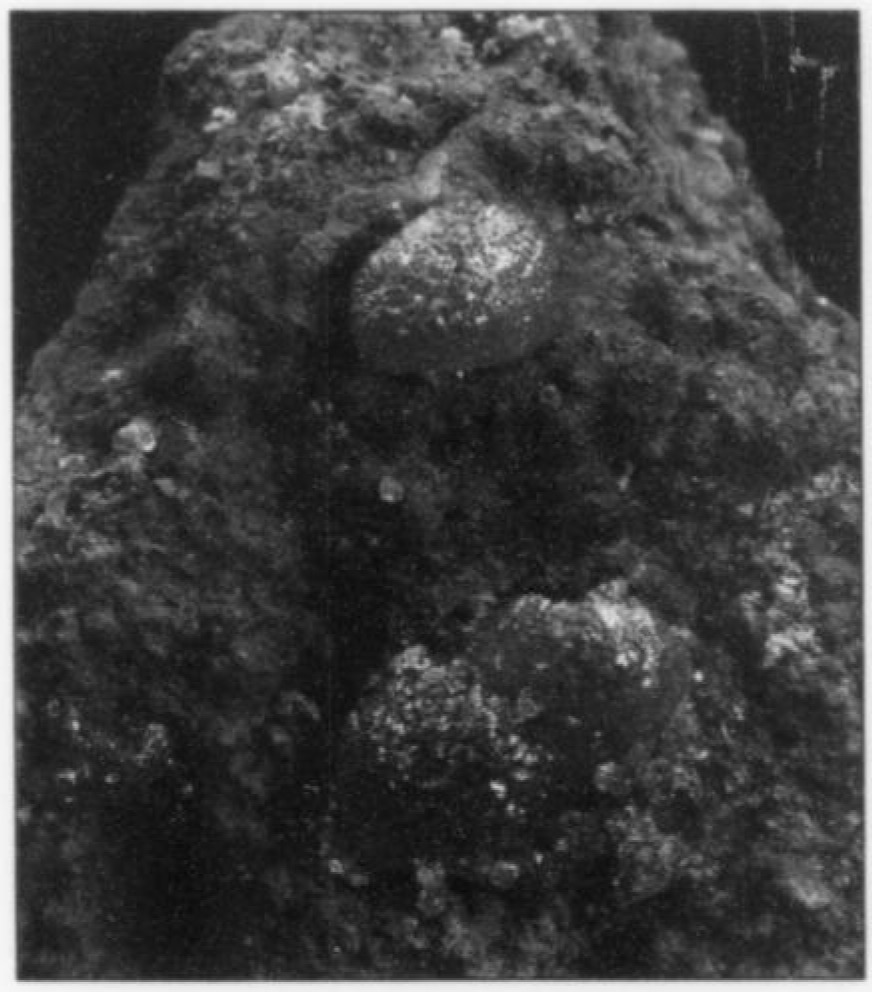


Figure 6. **Adamite crystal clusters to 1.1 cm from the Brenner mine. Jeff and Gloria's Minerals specimen; Jeff Scovil photo.**

Adamite $Zn_2(AsO_4)(OH)$

Attractive green cuprian adamite occurs at the Brenner mine, in radiating aggregates to 1 cm and as crude crystals to over 2 cm. During the summer of 2000 several hundred adamite specimens were recovered from the Brenner workings. Specimens were preserved for a time in the Dal'negorsk Museum.

Alabandite MnS

Massive black alabandite has been found in a tunnel connecting the Verchniy and Nikolaevskiy mines.

Anatase TiO_2

Anatase crystals have been found as a rare secondary mineral in the Nikolaevskiy mine.

Andorite $PbAgSb_3S_6$

Andorite has been identified with other sulfides in granules to 1.2 cm and small crystals to 1 mm from the Nikolaevskiy mine.

Andradite $Ca_3Fe_2(SiO_4)_3$

Andradite occurs as a skarn mineral throughout the district; it is a major component of the skarn in the Verchniy pit, and is found as dark green crystals to 2 cm in the Bor pit. The reddish brown andradite crystals being sold by Dal'negorsk dealers are actually from the Blue River occurrence about 180 km away.

Anglesite $PbSO_4$

Anglesite has been found as microcrystals in the Brenner mine and as an alteration coating on galena in the Second Sovietskiy mine.

Antimony Sb

Native antimony has been identified as microscopic inclusions in bismuth from the Bor pit.

Apatite group $Ca_5(PO_4)_3F$ (?)

Crystals of apatite (as yet unanalyzed) are found as microscopic accessories in skarns throughout the district.

Apophyllite $KCa_4Si_8O_{20}(F,OH)\cdot 8H_2O$

Apophyllite occurs as good specimens of clear, white, green and pink crystals up to 6 cm and as fine-grained crusts coating quartz, calcite and datolite. Crystal forms include the typical {111}, {100} and {001}. Apophyllite is found as good specimens at the Bor pit and the Verchniy mine, but in the past the best and largest specimens have come from the Sadoviy mine. The pink crystals to 1.5 cm are the most desirable.

Aragonite $CaCO_3$

Aragonite is an uncommon secondary mineral in the district, found as acicular masses at the Second Sovietskiy mine, as crystals and twins to 3 cm in the Bor pit, and as small crystals in the Verchniy mine. Recently a pocket of greenish aragonite with nice pyrite crystals was discovered at the Second Sovietskiy mine.

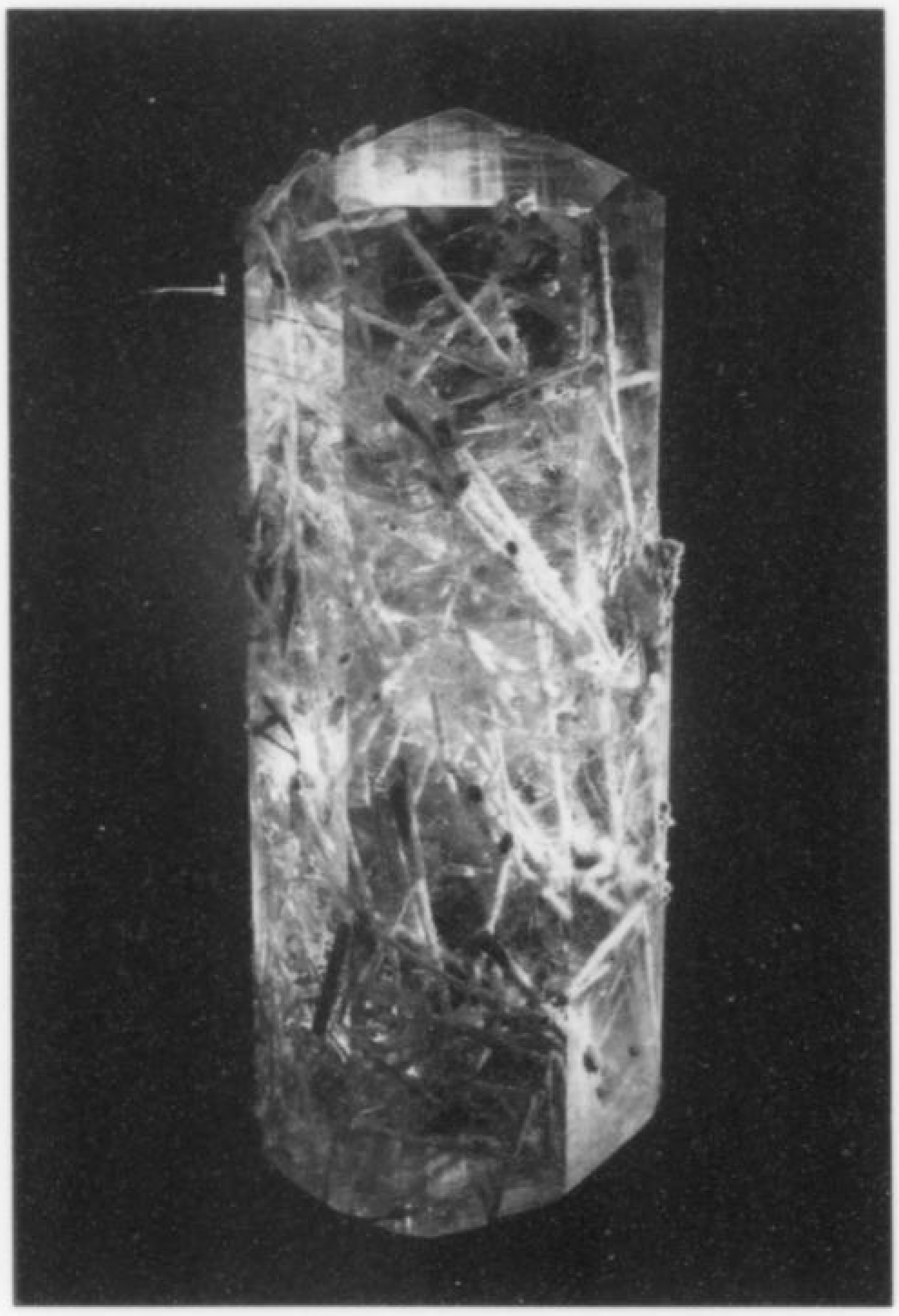


***Figure 7.* Calcite crystal with included aragonite crystals, 11.8 cm, from Dal'negorsk. Terry Huizing collection; Jeff Scovil photo.**

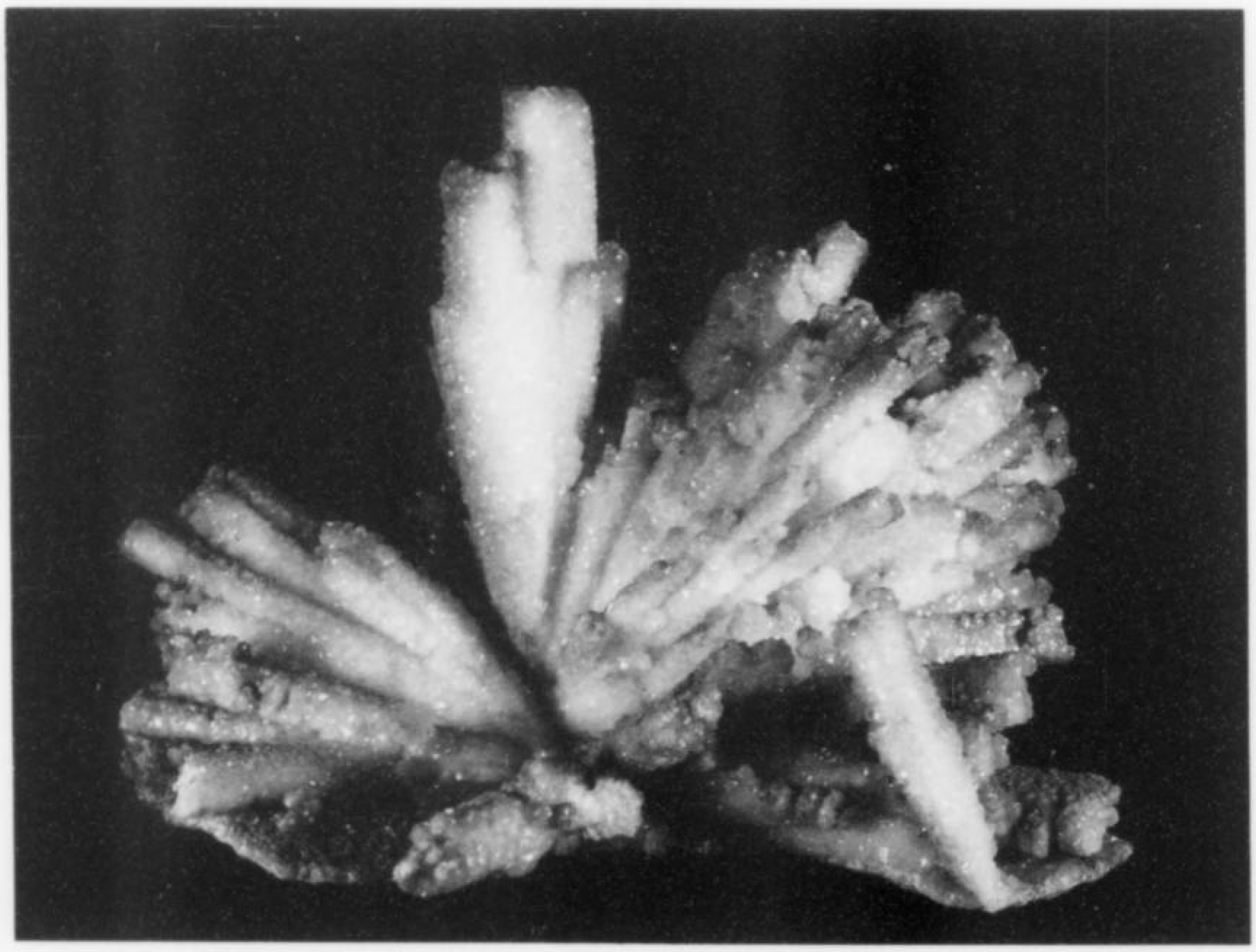


***Figure 8.* Calcite-coated aragonite crystals, 17.5 cm, from Dal'negorsk. Carnegie Museum of Natural History collection; Debra L. Wilson photo.**

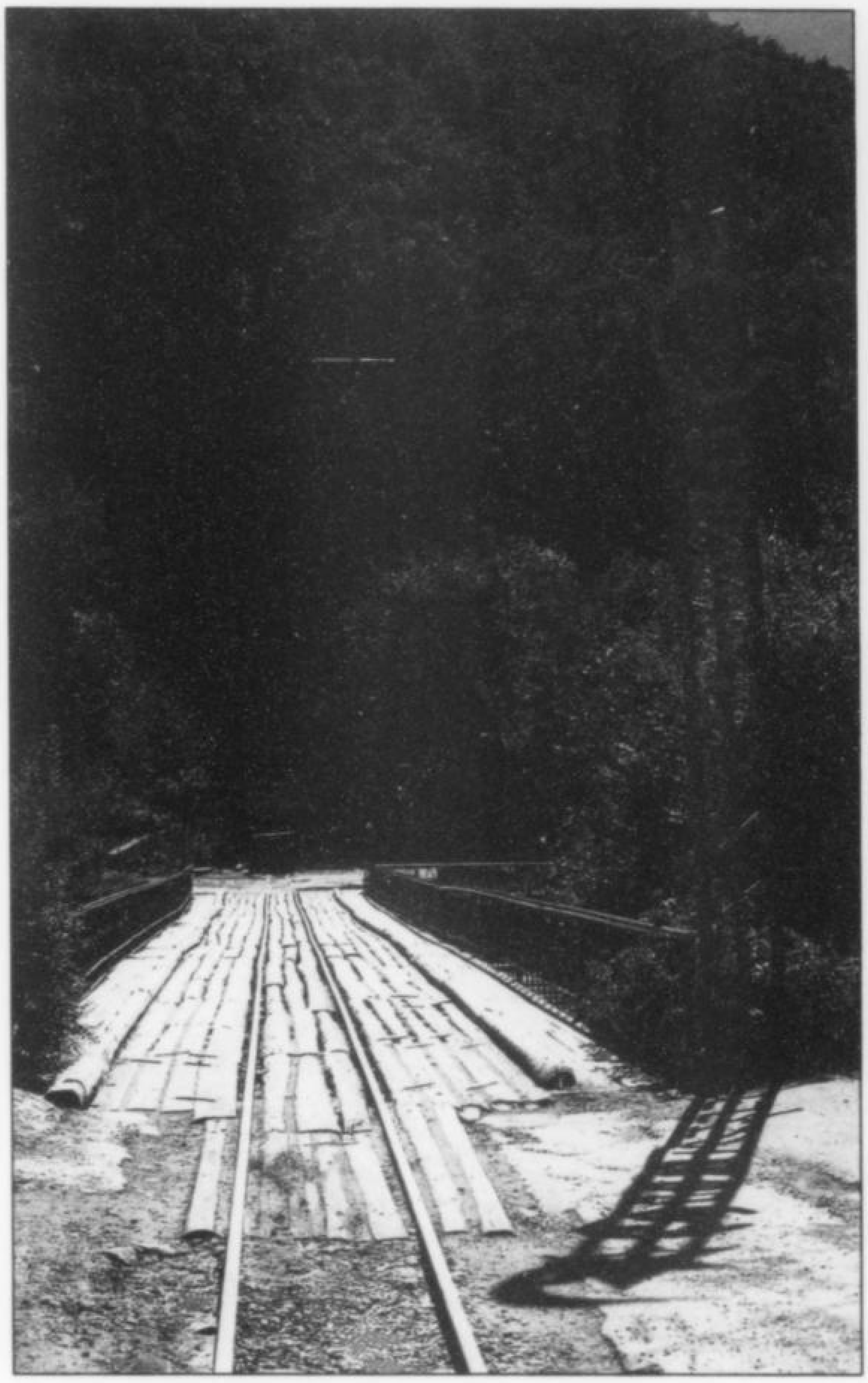


***Figure 9.* The Second Sovietskiy mine. Photo by Brian England.**

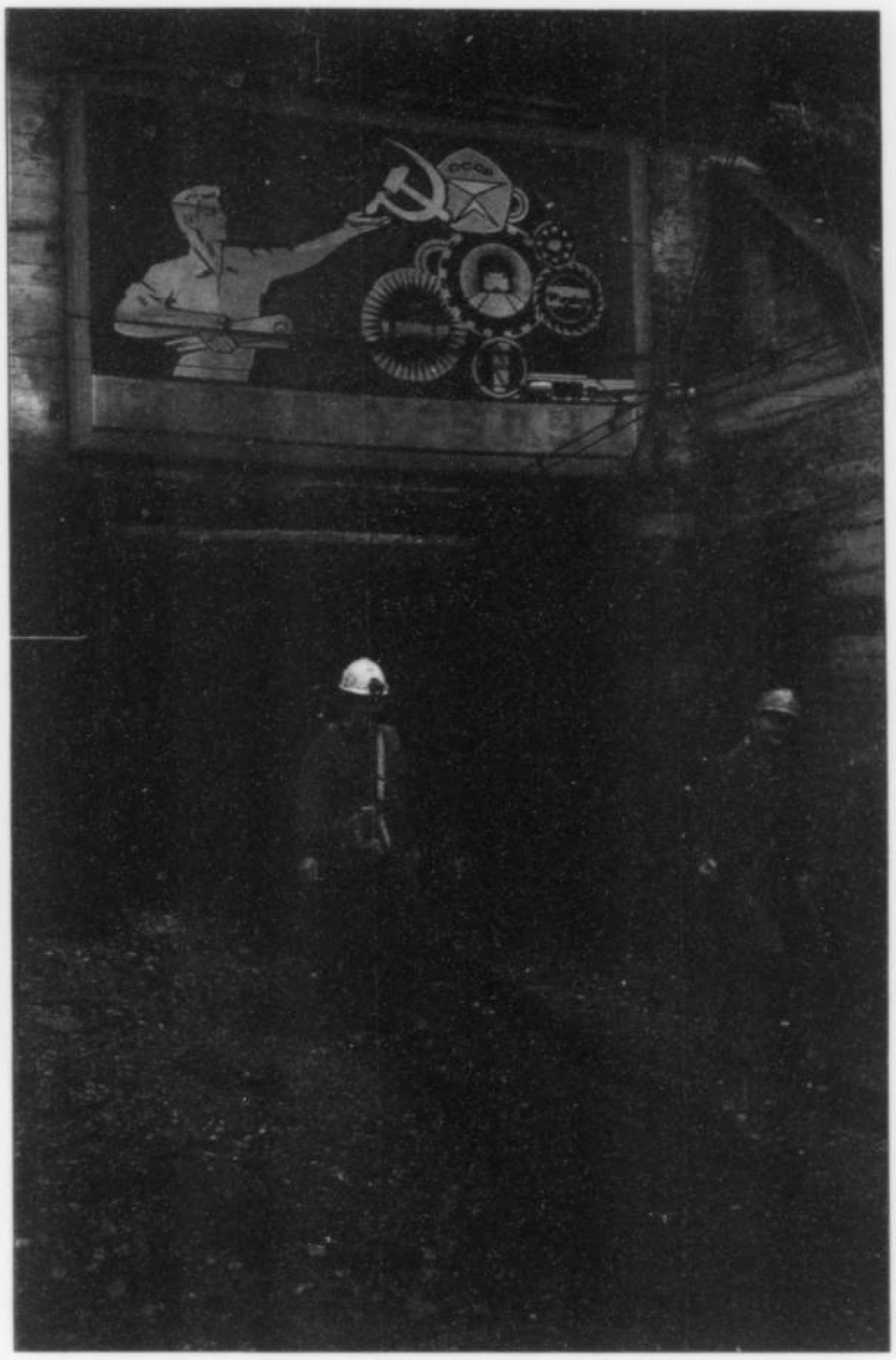


***Figure 10.* Entrance to the Verchniy mine. R. Grant photo.**

Arsenic As

Native arsenic, intergrown with stibarsen (SbAs), is found in the Bor pit rarely as black crusts and radial aggregates.

Arsenopyrite FeAsS

Well-crystallized arsenopyrite is common in the district, as crystals to 2 cm with galena in the First Sovietskiy mine, as crystals to 3 cm in the Verchniy and Nikolaevskiy mines, and as small crystals from the Second Sovietskiy mine. Arsenopyrite is often associated with pyrrhotite. The habit consists of typical crystals and twins with {110} and {014} dominant. A superb specimen from the Nikolaevskiy mine, 24 cm across and covered with arsenopyrite and calcite crystals, was preserved for a time in the Dal'negorsk Museum.

Aurichalcite $(Zn,Cu)_5(CO_3)_2(OH)_6$

Blue to blue-green aurichalcite spherules up to 8 mm in size are found at the Brenner and Verchniy mines.

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

Thin, blue coatings of poorly crystallized azurite occur in the Bor pit, the Brenner mine and the First Sovietskiy mine.

Barite $BaSO_4$

Crystallized barite is encountered occasionally in the Verchniy mine.

Beudantite $PbFe_3(AsO_4)(SO_4)(OH)_6$

Beudantite has been identified as microcrystals in gossan from the Brenner mine by B. England (personal communication, 1995).

Bismuth Bi

Masses and nodules of native bismuth to 16 cm have been found in skarn at the Bor pit and as a rare mineral in the Nikolaevskiy mine. The nodules contain numerous inclusions of other species including hedleyite, joseite, hessite, electrum and graphite.

Bismutite $Bi_2(CO_3)O_2$

Bismutite has been identified as an alteration product in the Bor pit.

Bornite Cu_5FeS_4

Massive bornite occurs with galena in the September and Second Sovietskiy mines, and at the latter also with chalcopyrite.

Boulangerite $Pb_5Sb_4S_{11}$

Boulangerite has been found rarely in the deep portions of the Nikolaevskiy mine as typical acicular "feather ore," and rarely also at the First Sovietskiy mine. It was originally assumed to be jamesonite.

Bournonite $PbCuSbS_3$

Bournonite has been found in good crystals up to 1 cm in size at the Nikolaevskiy mine.

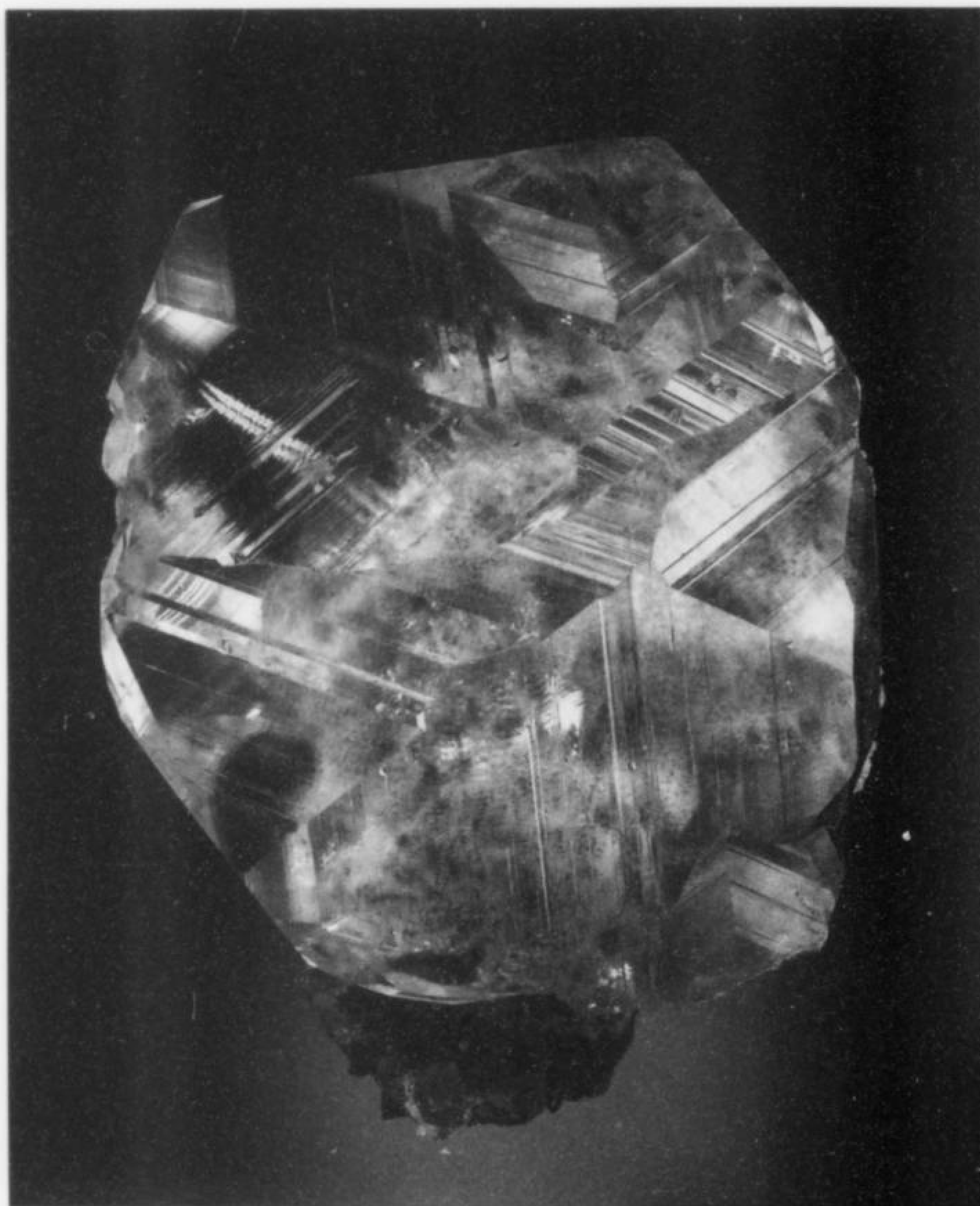


Figure 11. Calcite crystal, 8 cm, from the Verchniy mine, Dal'negorsk. Van Scriver specimen; Jeff Scovil photo.

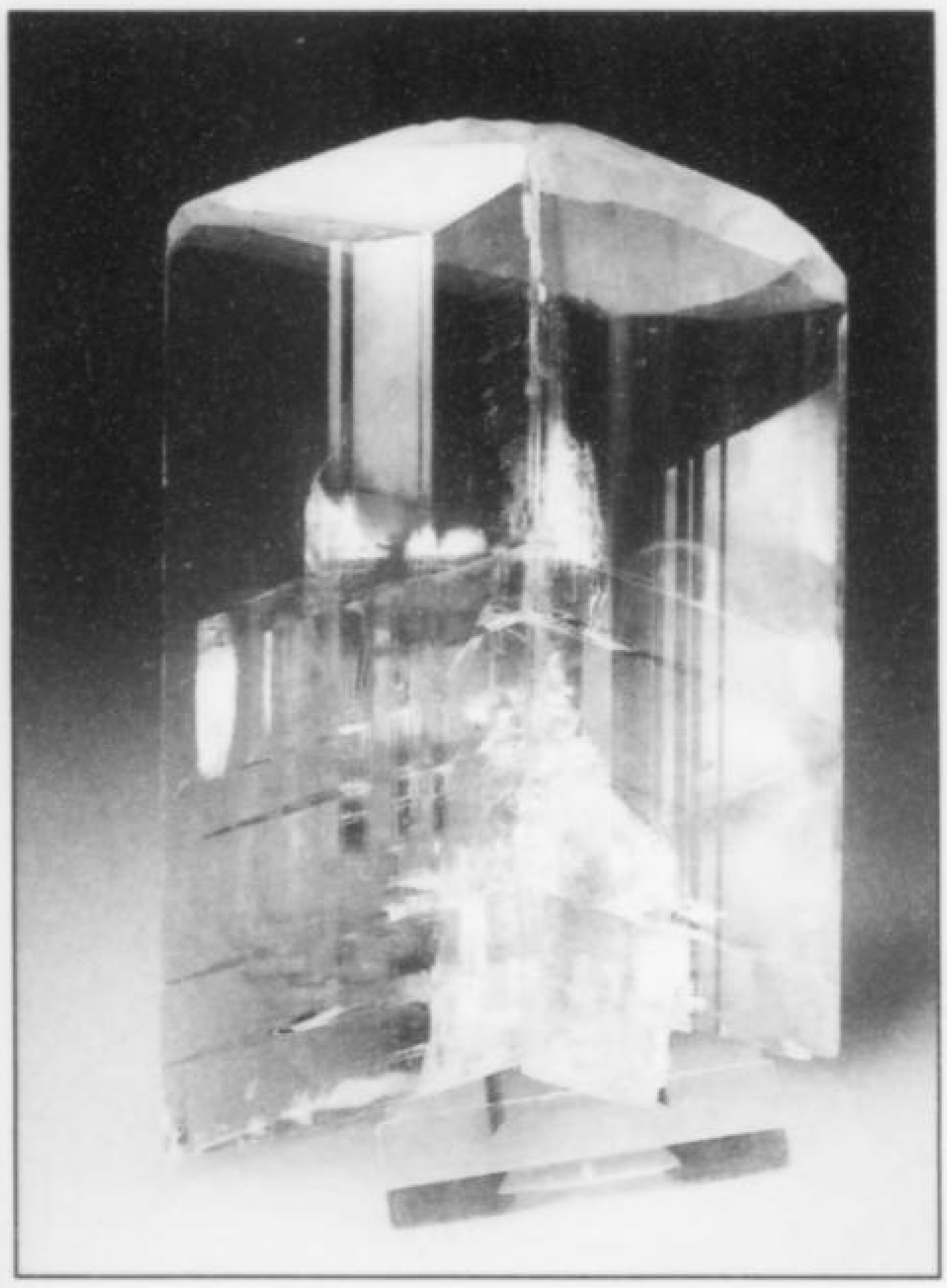


Figure 13. **Calcite crystal, 11 cm, from Dal'negorsk. Vladimir Pelepenko collection; Wendell Wilson photo.**

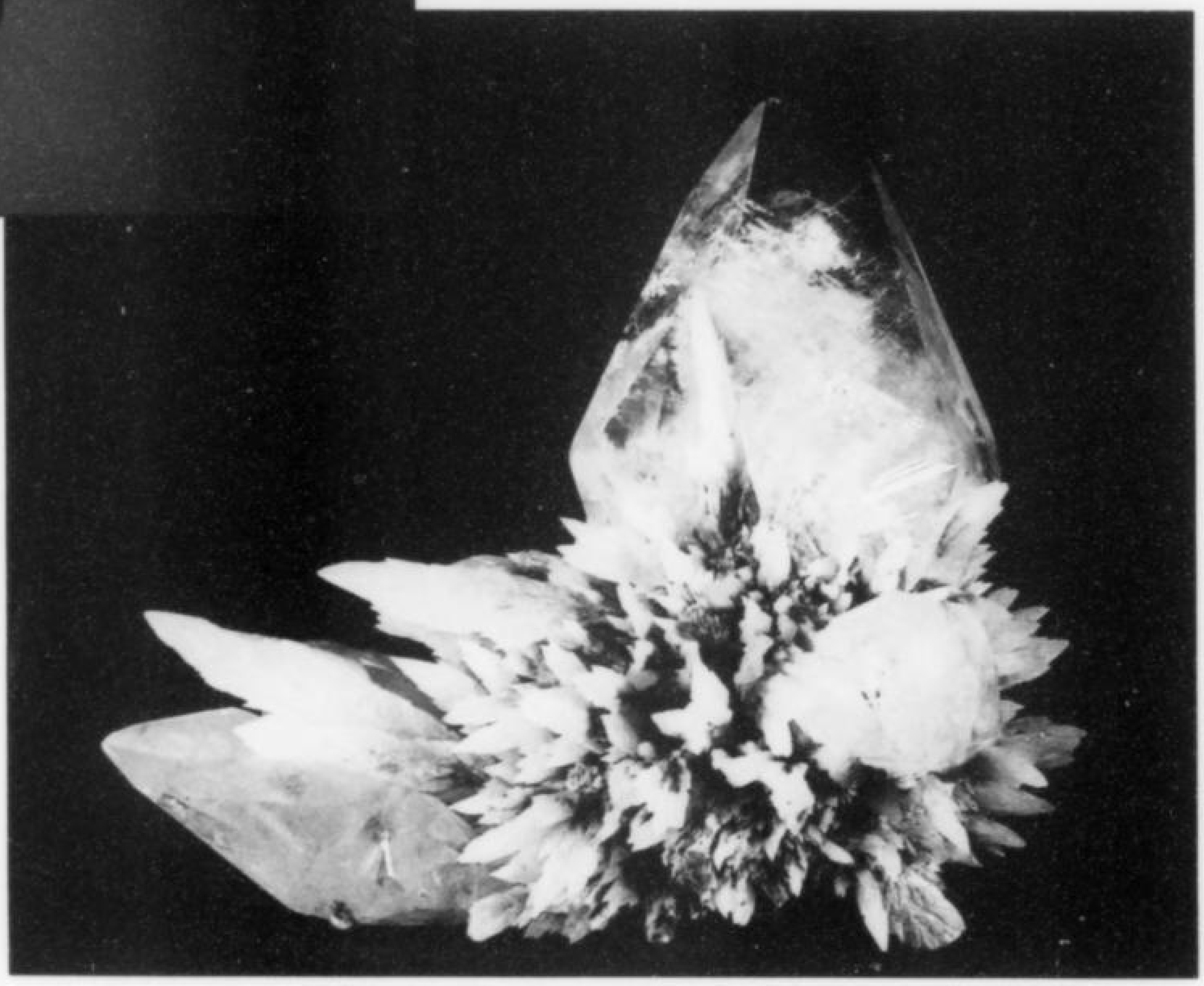


Figure 12. **Calcite crystal cluster, 18.5 cm, from Dal'negorsk. Carnegie Museum of Natural History collection; Debra L. Wilson photo.**

Brochantite $Cu_4(SO_4)(OH)_6$

Brochantite has been found with other oxidized Pb-Cu minerals in the Brenner mine, and as an alteration of tennantite in the Bor pit.

Calcite $CaCO_3$

Calcite is a common gangue mineral throughout the district. It occurs in a large variety of habits: thin plates to 40 cm, rhombohedrons to 45 cm, scalenohedrons to 60 cm (2 feet!), and long and short prisms, plus a range of combinations of the above. At least four generations of calcite formation have been identified by Bulavko (personal communication, 1995). The largest crystals come from the Verchniy mine. Twins on {0001} and $\{01\bar{1}\bar{2}\}$ have also been found. The crystals are commonly transparent and colorless to white, manganoan pink (Second Sovietskiy mine), brown and nearly black. Calcite pseudomorphs after axinite (to 2 cm) and after danburite (to 15) cm have been found in the Bor pit. Many of the large hydrothermal cavities encountered during mining are completely lined with spectacular calcite crystals.

Carrollite $Cu(Co,Ni)_2S_4$

Carrollite is one of the minerals identified as microscopic inclusions in bismuth nodules from the Bor pit.

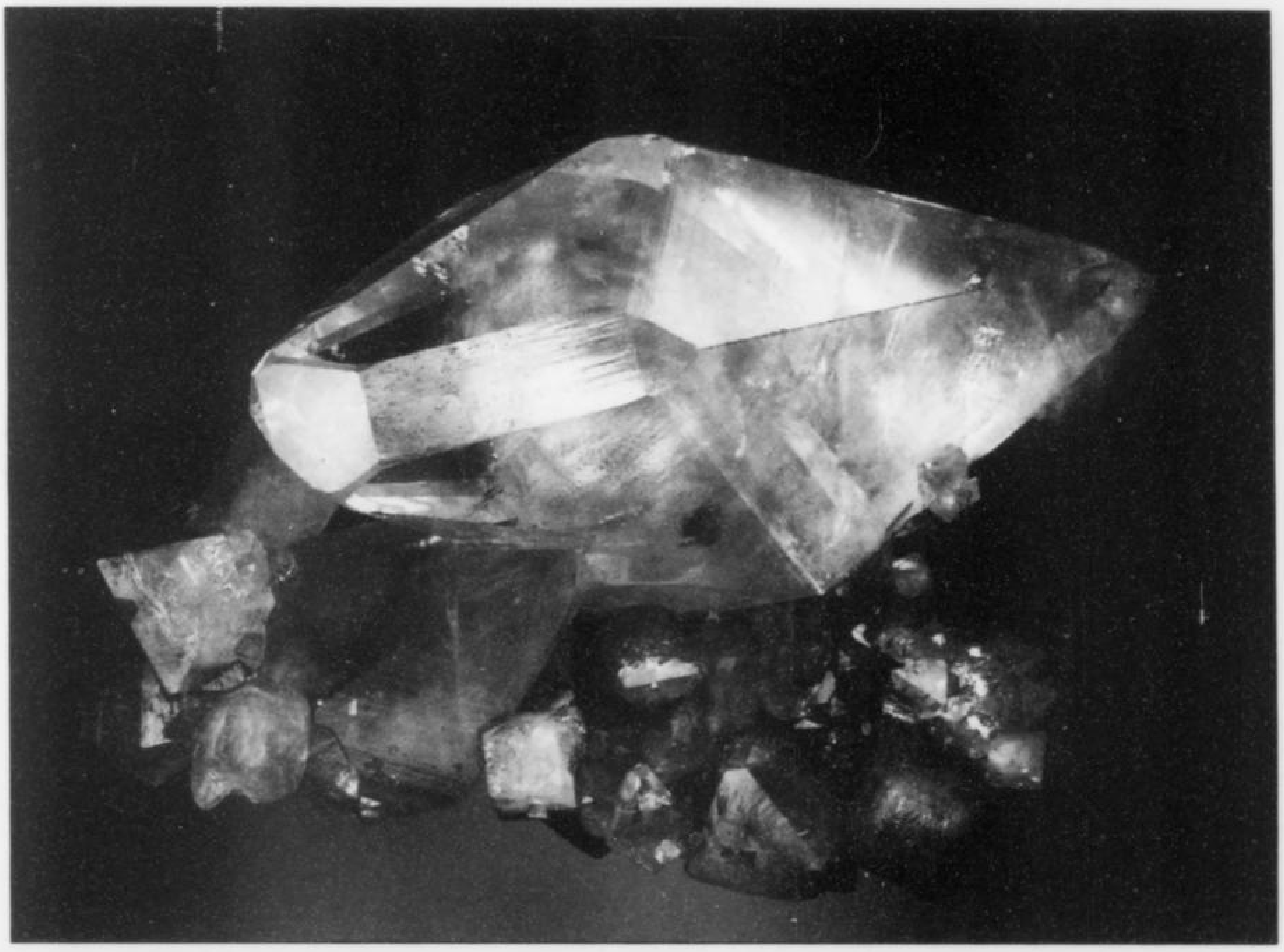


Figure 14. **Calcite crystals on fluorapophyllite crystals, 8 cm, from the Verchniy mine, Dal'negorsk. Van Scriver specimen; Jeff Scovil photo.**

Figure 15. **Calcite crystal, 5.3 cm, on matrix, from Dal'negorsk. Francis Benjamin collection; Jeff Scovil photo.**

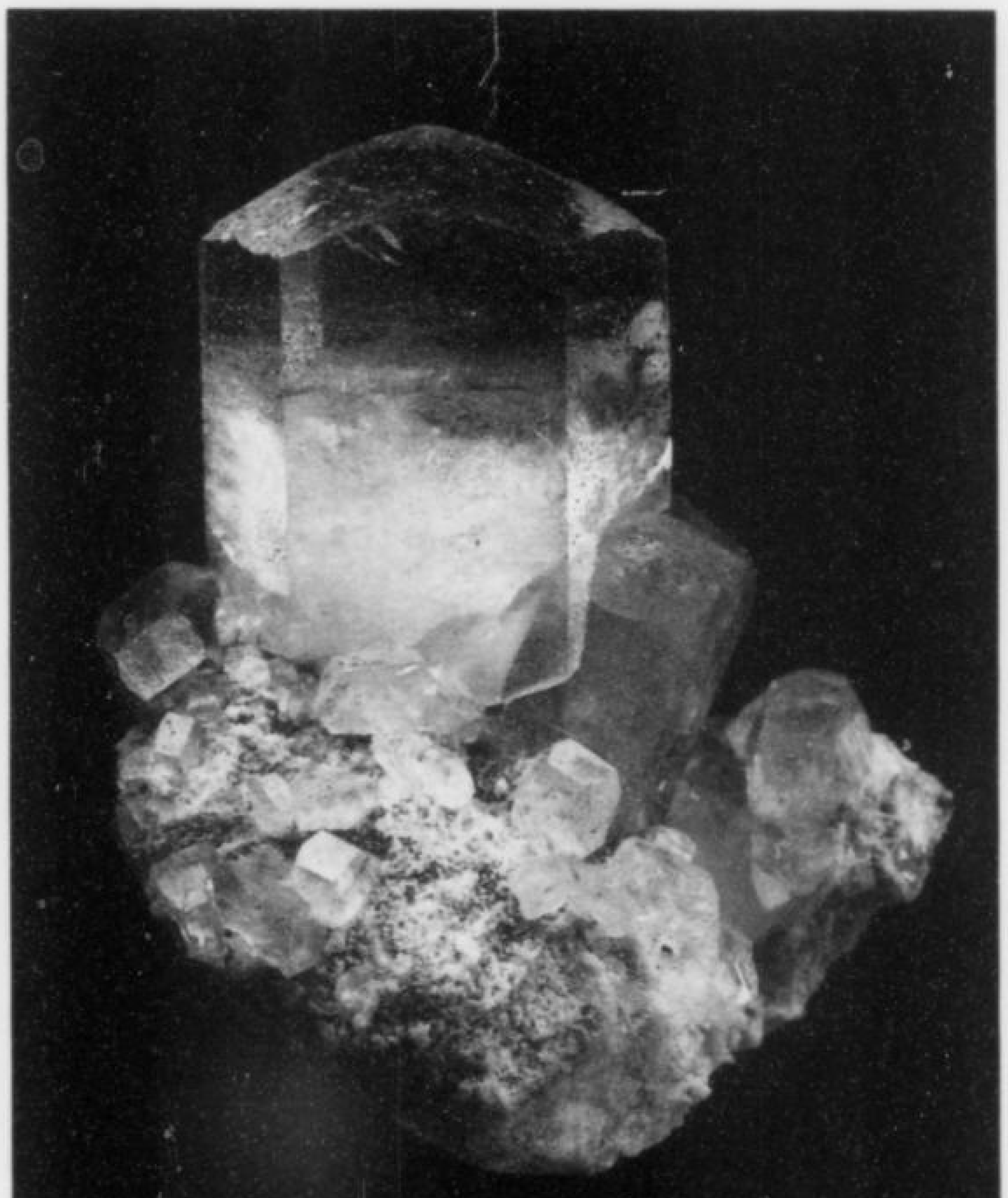


Figure 16. **Calcite crystal, 5.2 cm, from the Nikolaevskiy mine, Dal'negorsk. Dave Bunk Minerals specimen; Jeff Scovil photo.**

Cassiterite SnO_2

Cassiterite is a rare accessory mineral at the Nikolaevskiy mine.

Cerussite $PbCO_3$

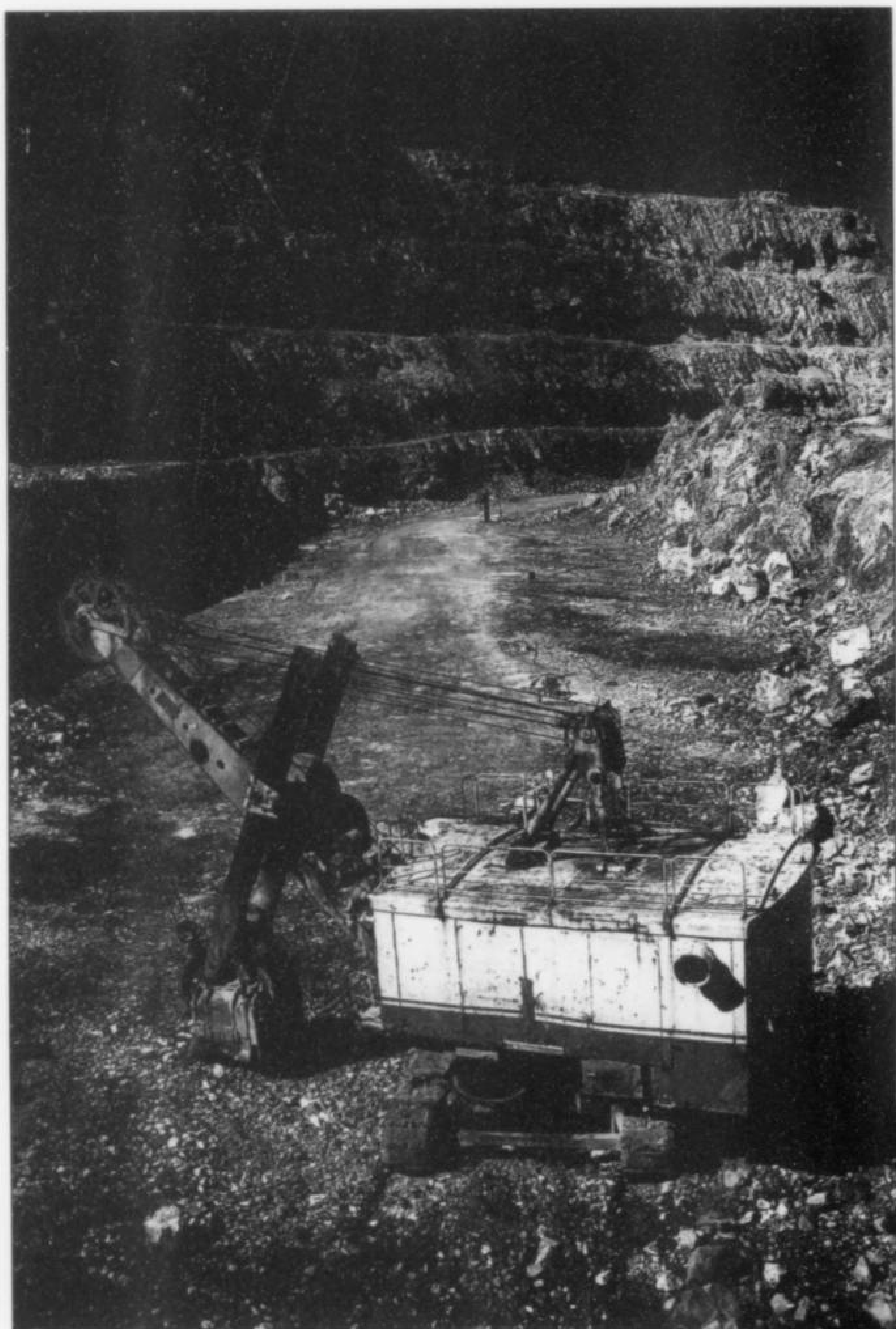
Cerussite occurs as acicular microcrystals in the secondary Pb-Zn suite at the Brenner mine, and is also found at the Second Sovietskiy mine and the Verchniy mine.

Chalcanthite $CuSO_4 \cdot 5H_2O$

Chalcanthite is found with other secondary copper minerals in the First Sovietskiy mine.

Chalcopyrite $CuFeS_2$

Chalcopyrite is present with other sulfides but not in sufficient quantity to constitute ore. It is found as bright yellow tetragonal disphenoids and twinned crystals up to 6 cm in size, associated with pyrrhotite, galena and sphalerite at the First Sovietskiy,



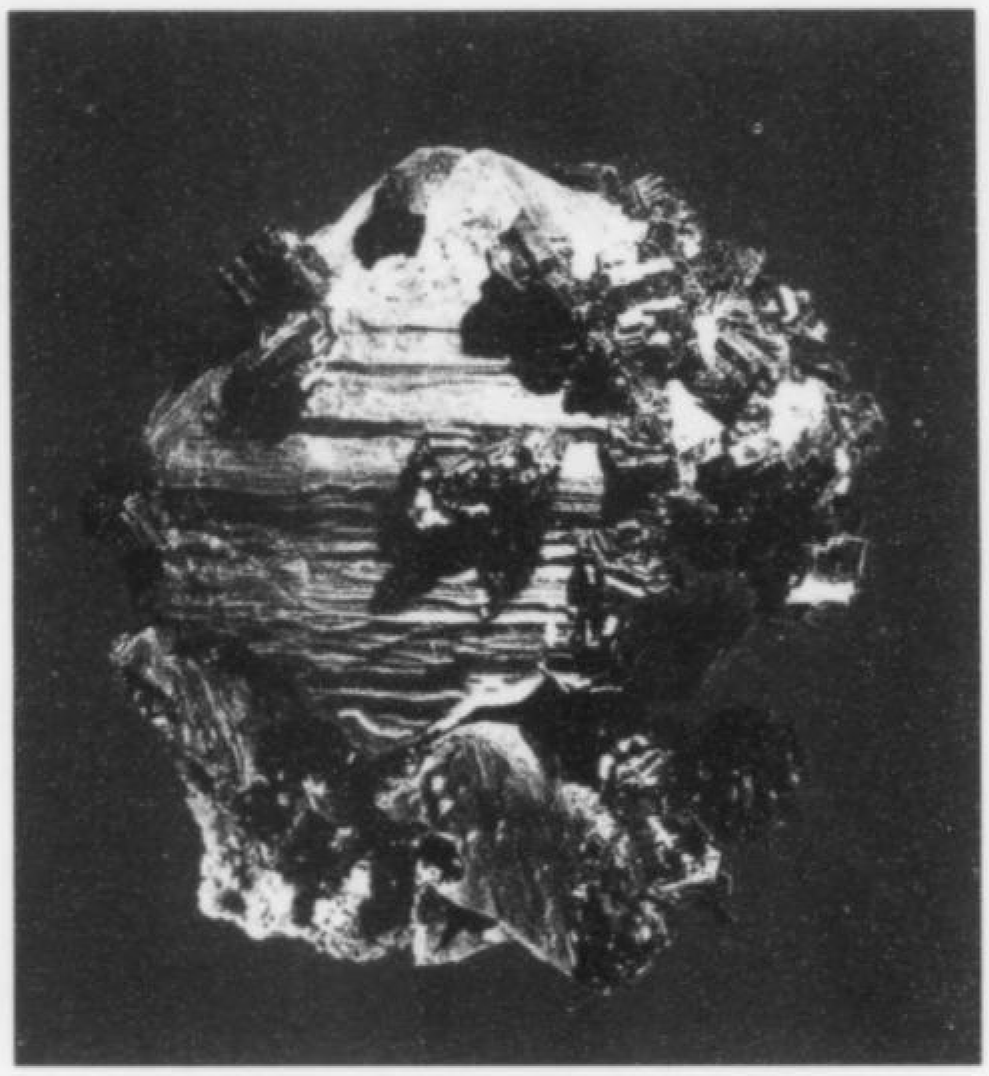


Figure 19. Chalcopyrite crystal with pyrrhotite, 4.3 cm, from Dal'negorsk. Carnegie Museum of Natural History collection; Debra L. Wilson photo.

Figure 20. Chalcopyrite crystal cluster, 5.8 cm, from the Nikolaevskiy mine, Dal'negorsk. Van Scriver specimen; Jeff Scovil photo.

Figure 17. The west pit of the Bor mine. Brian England photo.

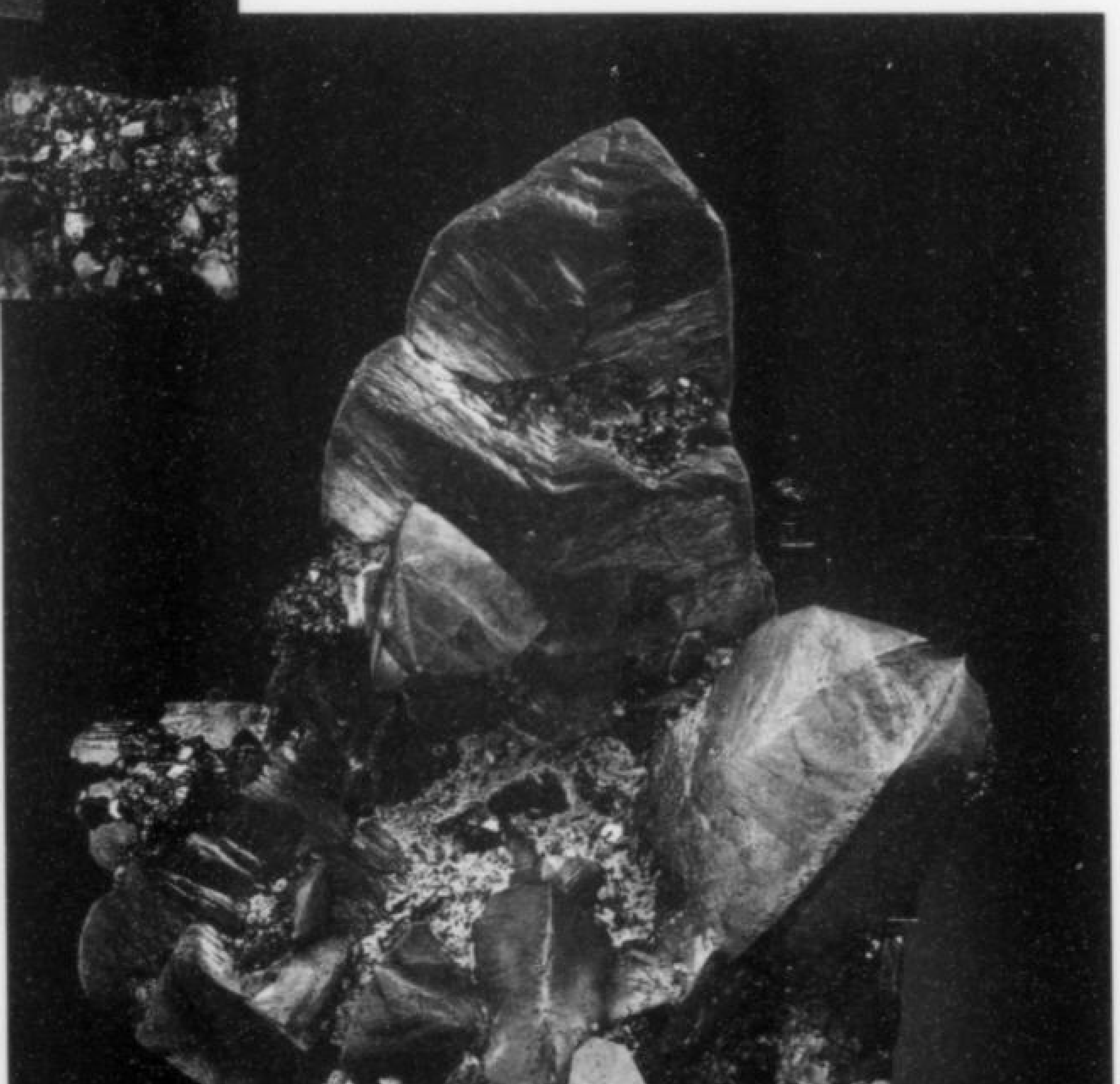


Figure 18. Chalcopyrite with galena on quartz, 8.5 cm, from Dal'negorsk. Carnegie Museum of Natural History collection; Debra L. Wilson photo.

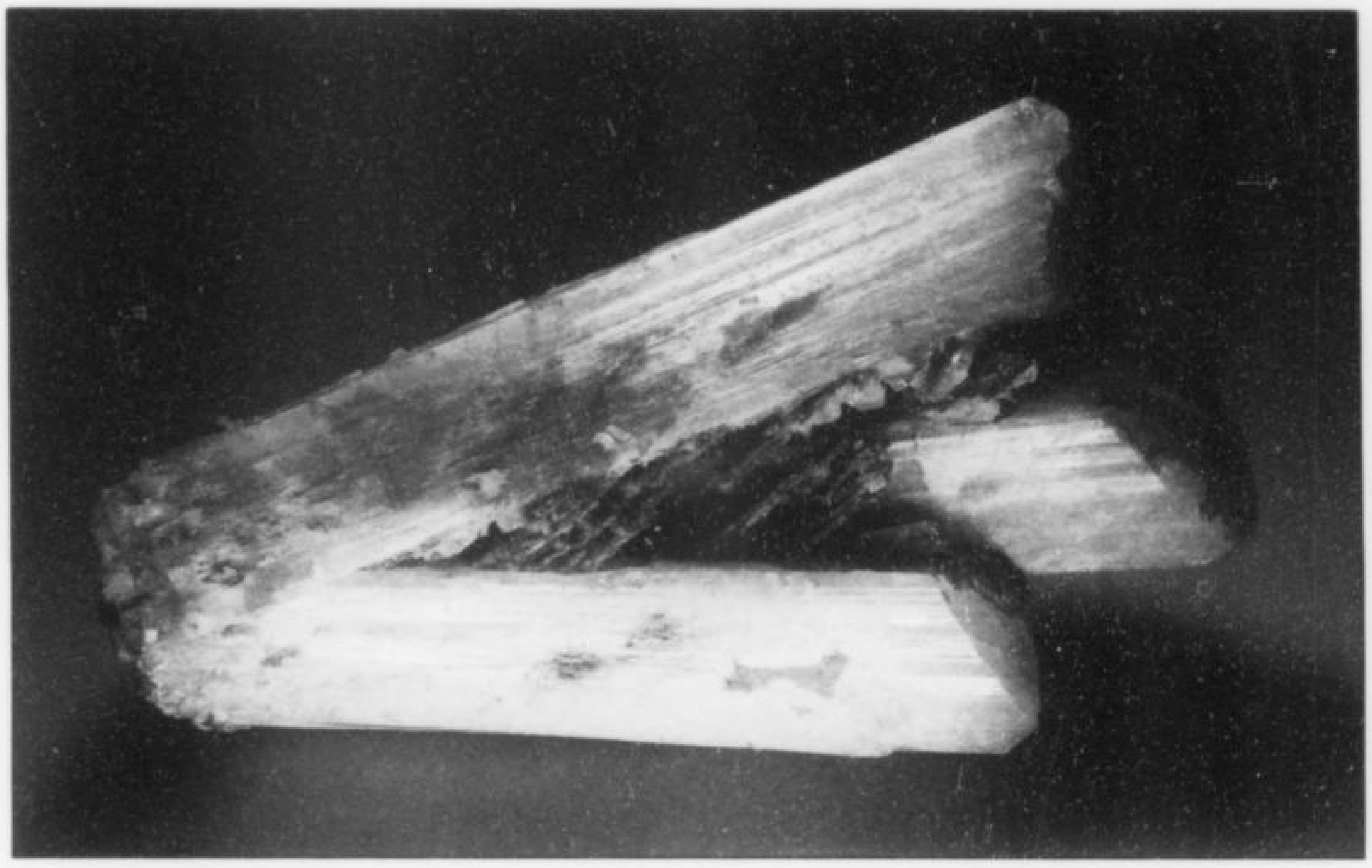


Figure 21. **Danburite crystals, 18.5 cm, from the Danburitiy mine, Dal'negorsk. Rock Currier specimen; Wendell Wilson photo.**

Second Sovietskiy, Sentyabr'skiy and Nikolaevskiy mines as well as the Bor pit. A pocket in the Nikolaevskiy mine yielded crystals up to 40 cm across.

Chalcocite Cu_2S
Chalcocite is rare in the district; it has been found with bornite in the Sentyabr'skiy mine.

Chalcophanite $(Zn,Fe,Mn)Mn_3O_7 \cdot 3H_2O$
Chalcophanite occurs as microcrystals in gossan at the Brenner mine (B. England, personal communication).

Chrysocolla $(Cu,Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$
Chrysocolla is found with the secondary Pb-Zn-Cu suite in the Brenner mine and also in the Bor pit.

Clausthalite PbSe
Clausthalite was reported from the Bor pit by Lisitsyn and Malinko (1994).

Clinozoisite $Ca_2Al_3(SiO_4)_3(OH)$
Clinozoisite occurs with other skarn minerals in the Bor pit.

Copper Cu
Small amounts of native copper have been found in the Brenner workings.

Covellite CuS
Covellite has been identified with chalcopyrite at the Nikolaevskiy, Sentyabr'skiy, First Sovietskiy and Second Sovietskiy mines.

Cubanite $CuFe_2S_3$
Cubanite is a rare accessory mineral associated with other sulfides at the First Sovietskiy and Nikolaevskiy mines.

Cummingtonite $(Mg,Fe)_7Si_8O_{22}(OH)_2$
Cummingtonite occurs as an accessory mineral in granodiorite in the district.

Cuprite Cu_2O
Cuprite occurs in small amounts with malachite and azurite in the Brenner mine.

Danburite $CaB_2(SiO_4)_2$
Danburite has been found only in the Danburitiy mine. It occurs as transparent, prismatic crystals from several mm in size to large 40-cm crystals. Most are clear although some of the larger ones are a brown color from clay inclusions. In the Bor open pit danburite is represented by pseudomorphs up to 60 cm which proved to be a mixture of calcite, quartz and datolite. In the ancient hydrothermal cavities filled with andesite large danburite pseudomorphs can be seen lining the cavities; they are mainly calcite with a dark carbonaceous coating. In the cavities not filled with andesite they have been replaced by crystals of quartz and datolite that have the general shape of the danburite. Some danburites from this locality have been irradiated to produce a deep golden orange color.

Dannemorite $Mn_2(Fe,Mg)_5Si_8O_{22}(OH)_2$
Dannemorite has been identified as a rare accessory mineral in skarn at the Nikolaevskiy mine.

Datolite $Ca_2B_2Si_2O_8(OH)_2$
Datolite is the most common boron mineral in the area and is the major ore of boron in the Bor pit. The average ore contains 8 to 10% B_2O_3. Most of the ore is massive datolite, but some of the hydrothermal cavities contain datolite crystals up to 15 cm, showing a number of elongated prismatic, tabular and equidimensional habits built mostly from {110}, {001} and {201}. There is a wide variety of colors, including colorless, white, blue, green and yellow. The yellow (honey-yellow to brown) color is caused by rare earth elements, and the green color is caused by chromium (Lisitsyn and Malinko, 1994). The best crystallized specimens come from the Bor pit, but green crystals to 5 cm are also found at the Sentyabr'skiy mine; gemmy crystals to 4 cm were once found in the Verchniy mine; and good crystals also occur at the First Sovietskiy mine.

Dickite $Al_2Si_2O_5(OH)_4$
Dickite clay has been identified as a secondary mineral at the Nikolaevskiy and Second Sovietskiy mines.

Diopside $CaMgSi_2O_6$
Diopside is one of the most common primary skarn minerals in the district. A manganese-rich variety has been found in the Bor pit as thin green crystals up to 10 cm long in datolite. Smaller crystals of this same variety occur at the Nikolaevskiy mine.

Dolomite $CaMg(CO_3)_2$
Dolomite occurs in small amounts at the Nikolaevskiy mine, and as massive material in the Bor pit.

Figure 22. **Datolite crystal cluster, 11 cm, from Dal'negorsk. Vladimir Pelepenko collection; Wendell Wilson photo.**

Figure 23. **Datolite crystal cluster, 8 cm, from the First Sovietskiy mine, Dal'negorsk. Heliodor Minerals specimen; Jeff Scovil photo.**

Figure 24. **Datolite crystal, 2.2 cm, from Dal'negorsk. Jeff Scovil collection and photo.**

Domeykite Cu_3As

Domeykite is a member of the suite of unusual sulfides found as inclusions in bismuth nodules from the Bor pit.

Dussertite $BaFe_3^{3+}(AsO_4)_2(OH)_5$

Dussertite has been found as part of the secondary Pb-Zn-Cu suite at the Brenner mine.

Epidote $Ca_2(Al,Fe)_3(SiO_4)_3(OH)$

Epidote is a common skarn mineral in the Bor pit.

Erythrite $Co_3(AsO_4)_2 \cdot 8H_2O$

Erythrite occurs as a rare secondary mineral in the Bor pit.

Fluorite CaF_2

Fluorite crystals of exceptional size and quality are found at several localities in Dal'negorsk. Green cubic crystals over 40 cm on a side have been found in both the Nikolaevskiy and First Sovietskiy mines. Fluorite also occurs in a variety of other habits

Figure 25. **Datolite crystals, 15.4 cm, from Dal'negorsk. Rock Currier specimen; Wendell Wilson photo.**

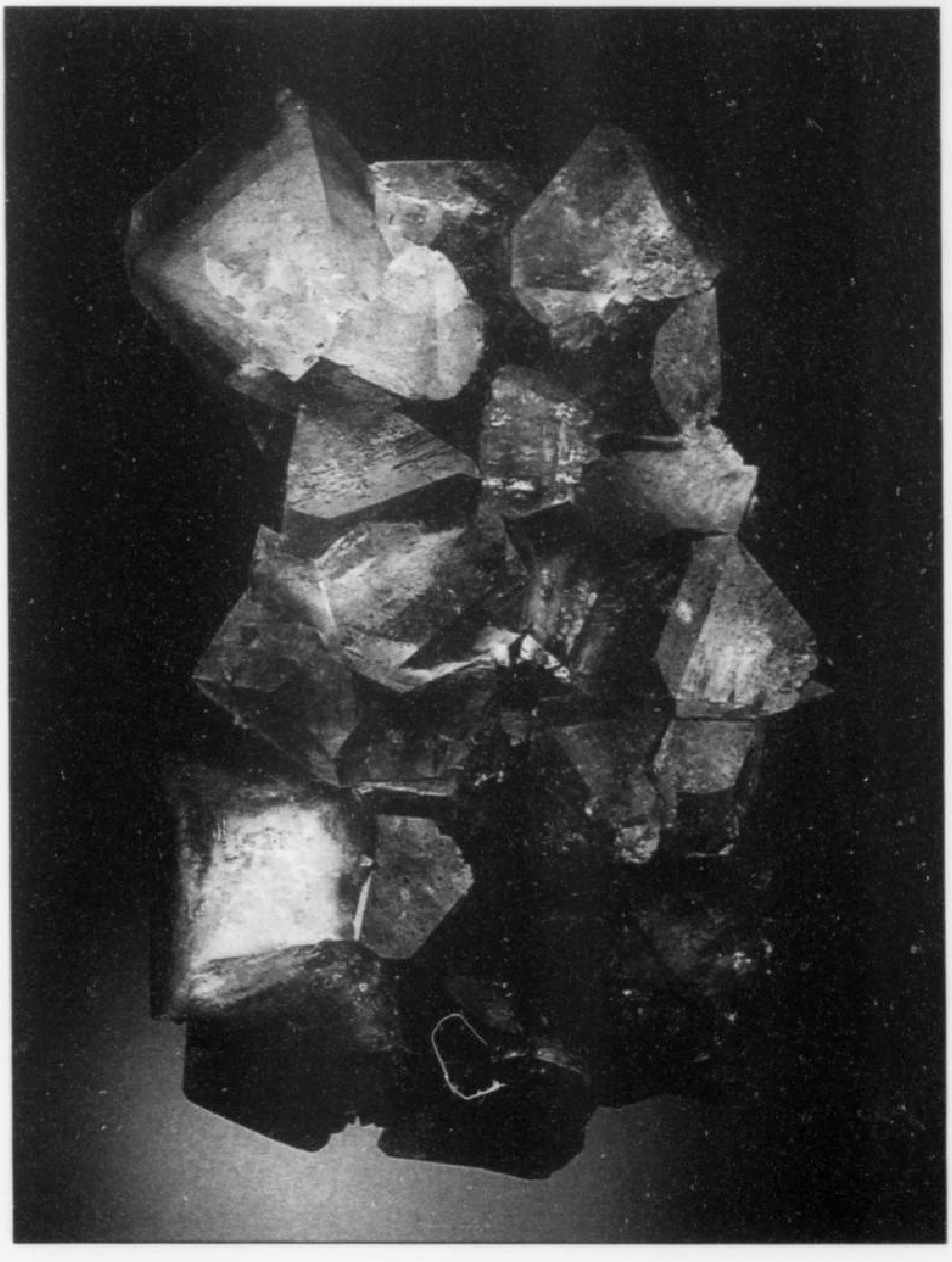


Figure 26. **Apophyllite crystal group, 6 cm, from the Verchniy mine, Dal'negorsk. I. C. Minerals specimen; Jeff Scovil photo.**

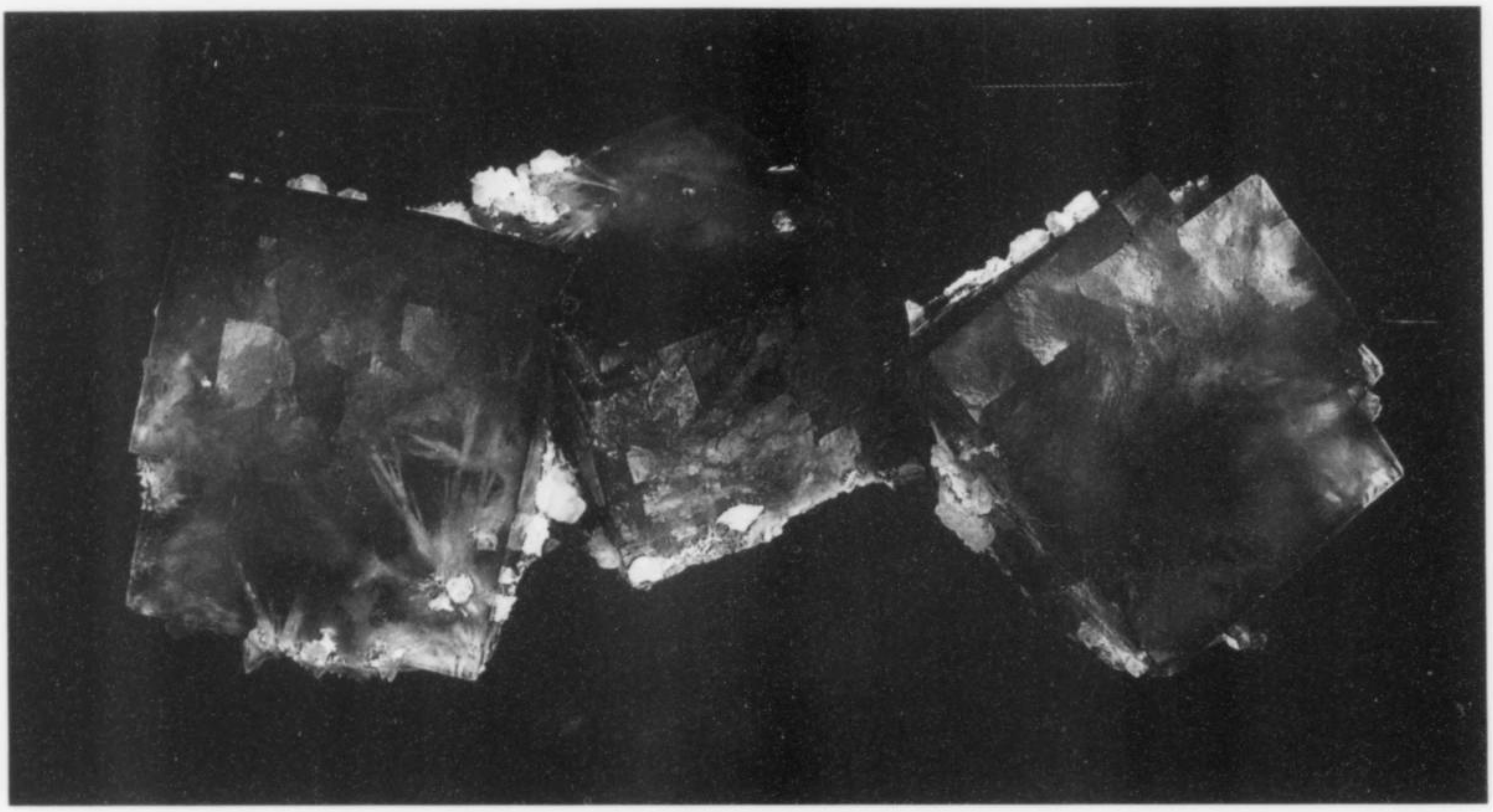


Figure 27. Fluorite crystals with aragonite, 17.2 cm, from Dal'negorsk. Bruce Carter collection; Jeff Scovil photo.

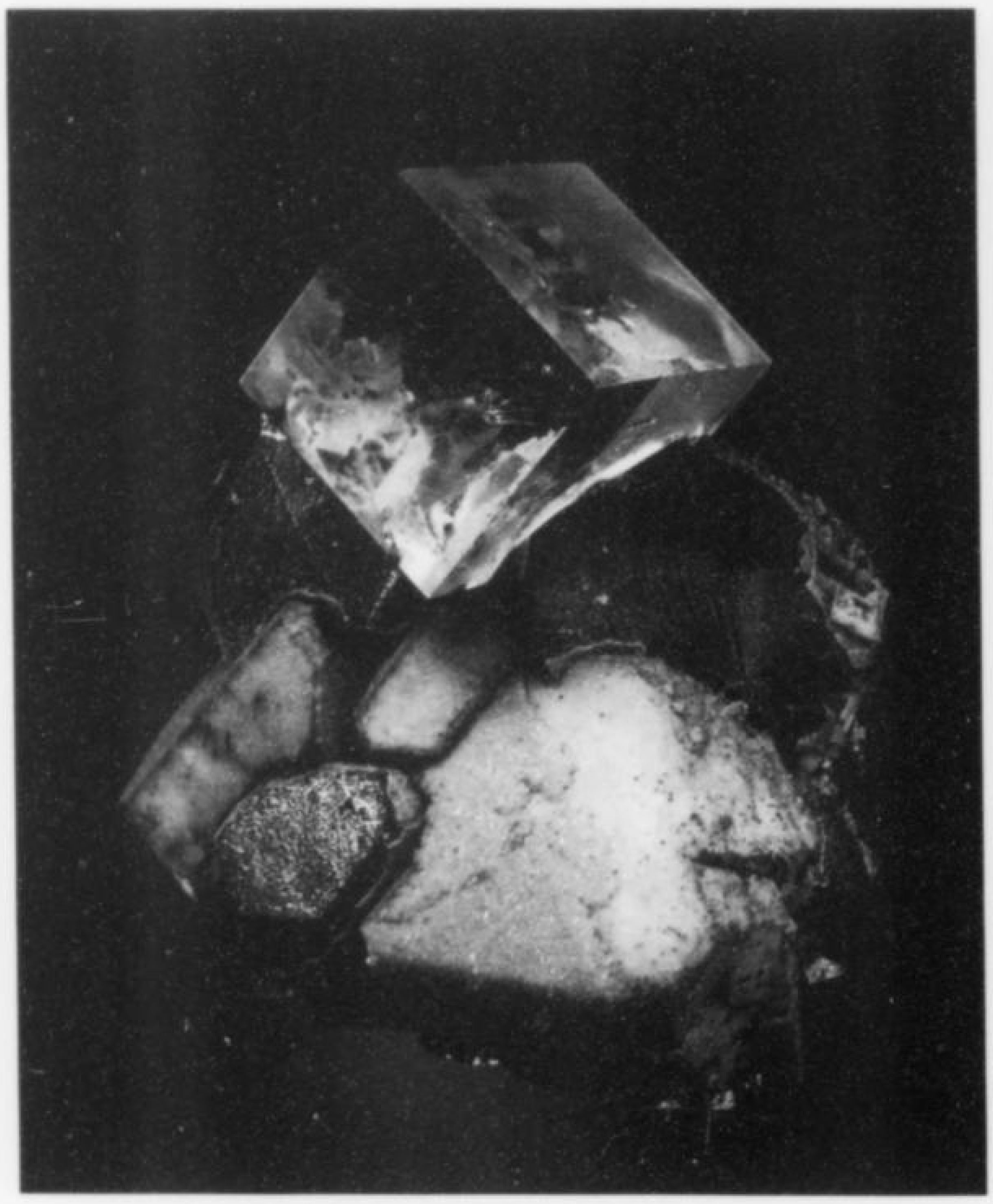


Figure 28. Fluorite on galena, 6.5 cm, from Dal'negorsk. Stuart Wilensky specimen; Jeff Scovil photo.

Figure 29. Fluorite, 3.1 cm, from Dal'negorsk. Syntaxis specimen; Jeff Scovil photo.

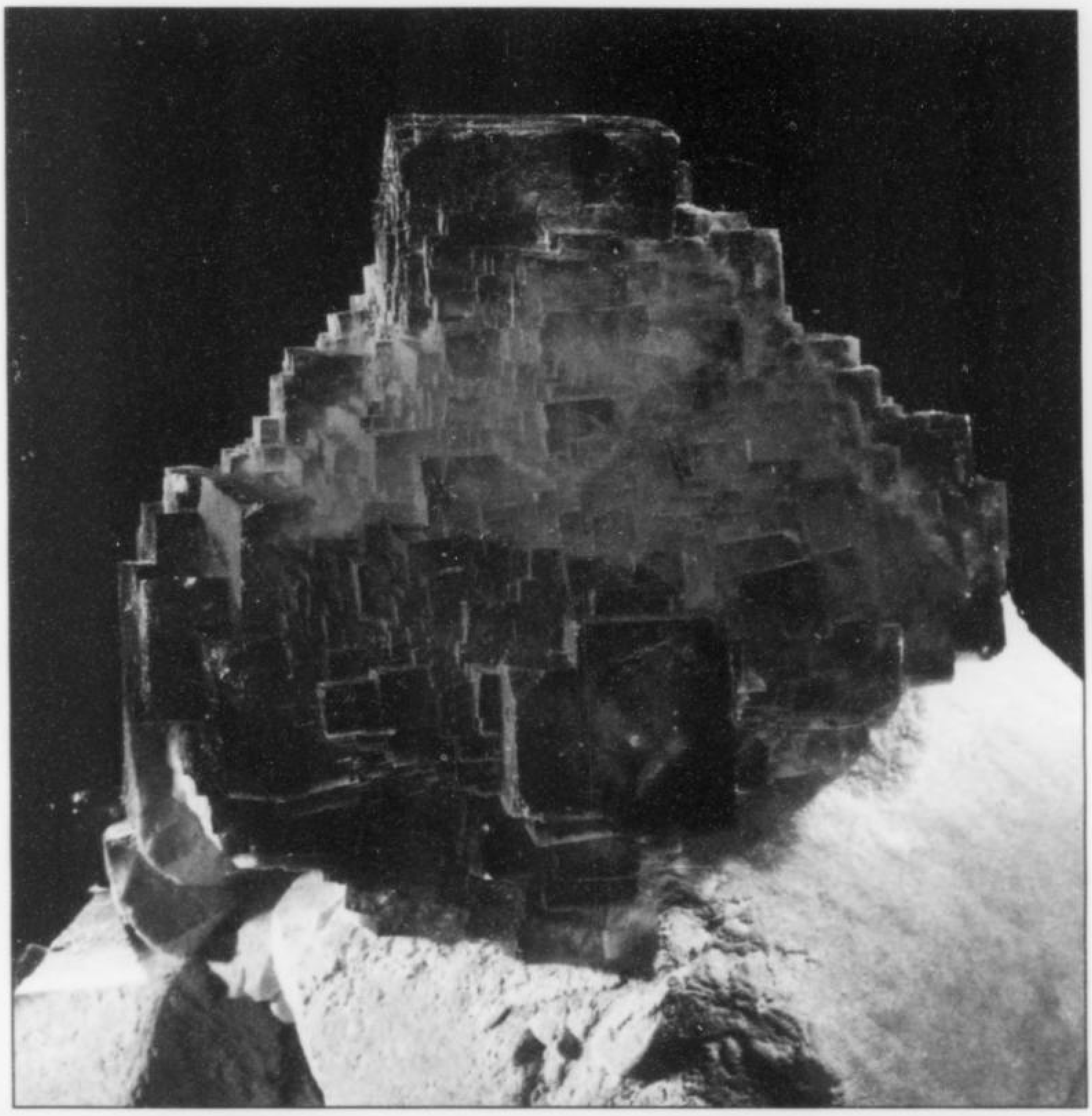


Figure 30. **Fluorite crystal, 6 cm, on milky quartz, from Dal'negorsk. Joseph Freilich collection; Harold and Erica Van Pelt photo.**

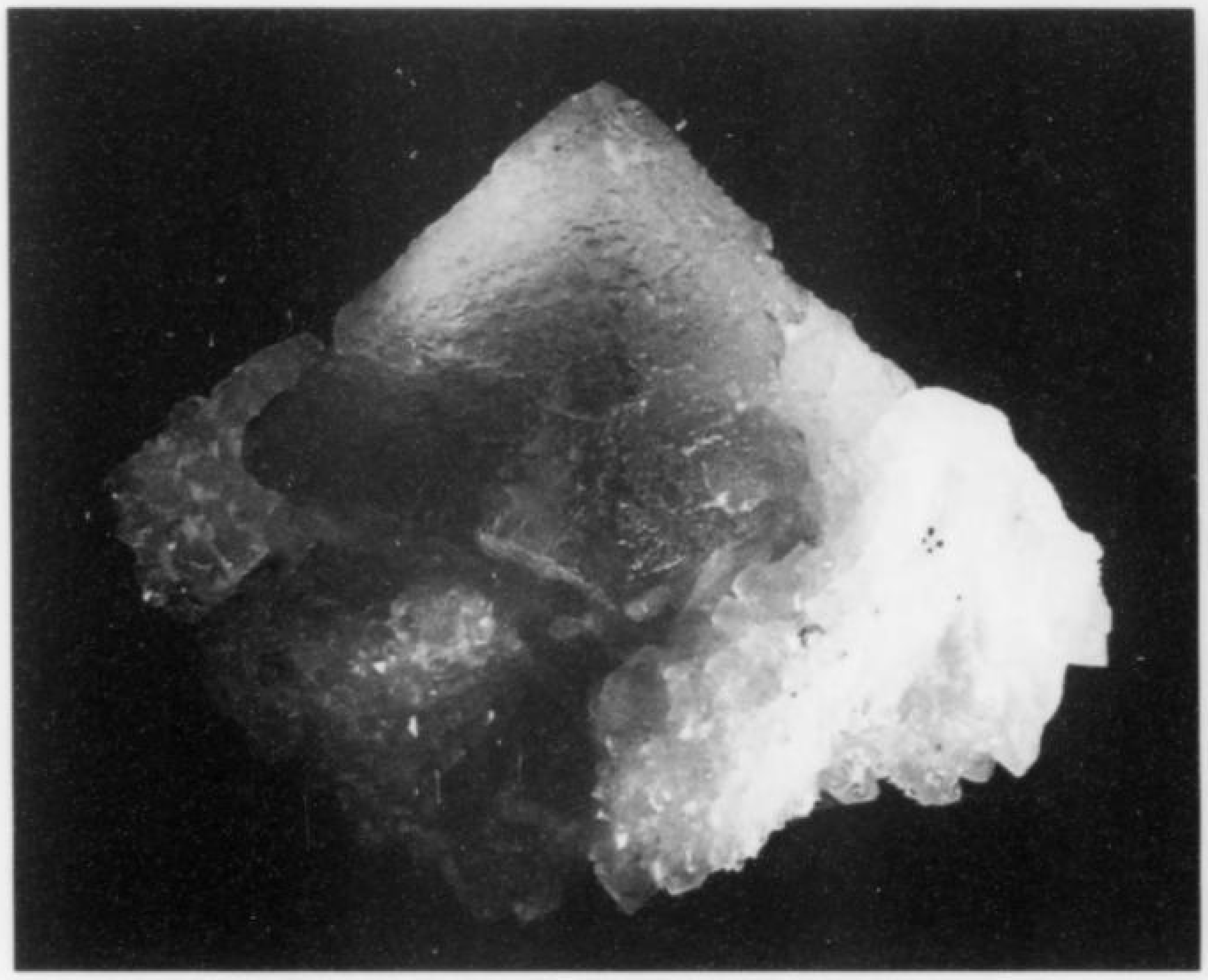


Figure 31. **Fluorite on quartz, 7.9 cm, from Dal'negorsk. Carnegie Museum of Natural History collection; Debra L. Wilson photo.**

Figure 32. **Fluorite, 11 cm, from the Nikolaevskiy mine, Dal'negorsk. Steve Neely collection; Jeff Scovil photo.**

and colors. Most notable are the green octahedrons from the First Sovietskiy mine and the perfectly lustrous, colorless ("optical"), water-clear crystals from the Nikolaevskiy mine, which are sometimes referred to as "invisible fluorites" because of their perfection. Rarely blue and purple crystals to 3 cm are found at the Second Sovietskiy mine. Miners have reported that a single fluorite crystal measuring 1 meter across rolled out of a cavity in the Nikolaevskiy mine.

Freibergite $(Ag,Cu,Fe)_{12}(Sb,As)_4S_{13}$

Freibergite has been found in the sulfide veins exposed in the Nikolaevskiy mine.

Galena PbS

Galena (an important ore mineral at Dal'negorsk) occurs as cubes, cubes modified by octahedrons, and as spinel-law twins flattened on (111). The largest crystals, over 25 cm on a side, are

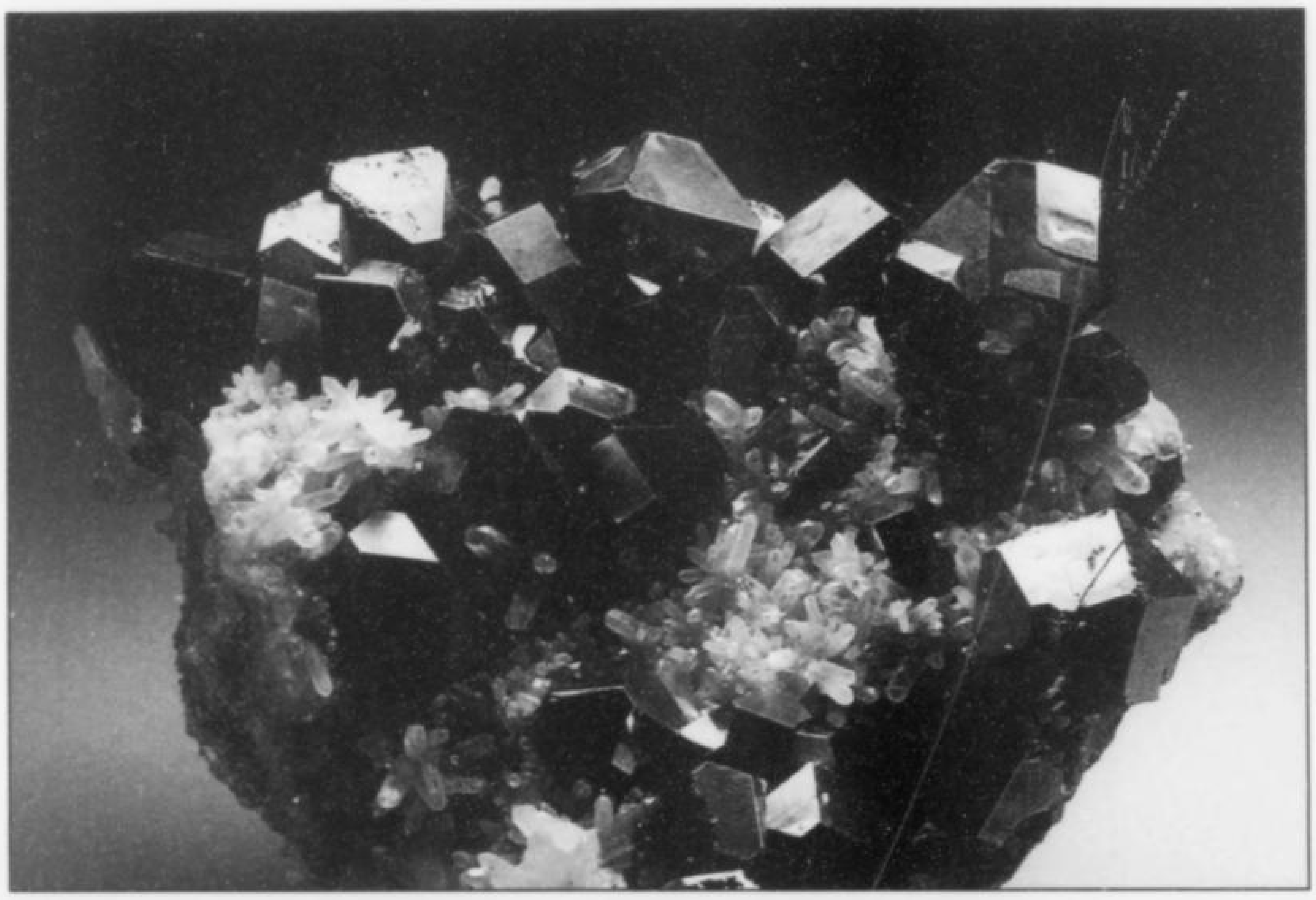


Figure 33. Galena crystals on quartz, 10 cm, from Dal'negorsk. Vladimir Pelepenko specimen; Jeff Scovil photo.

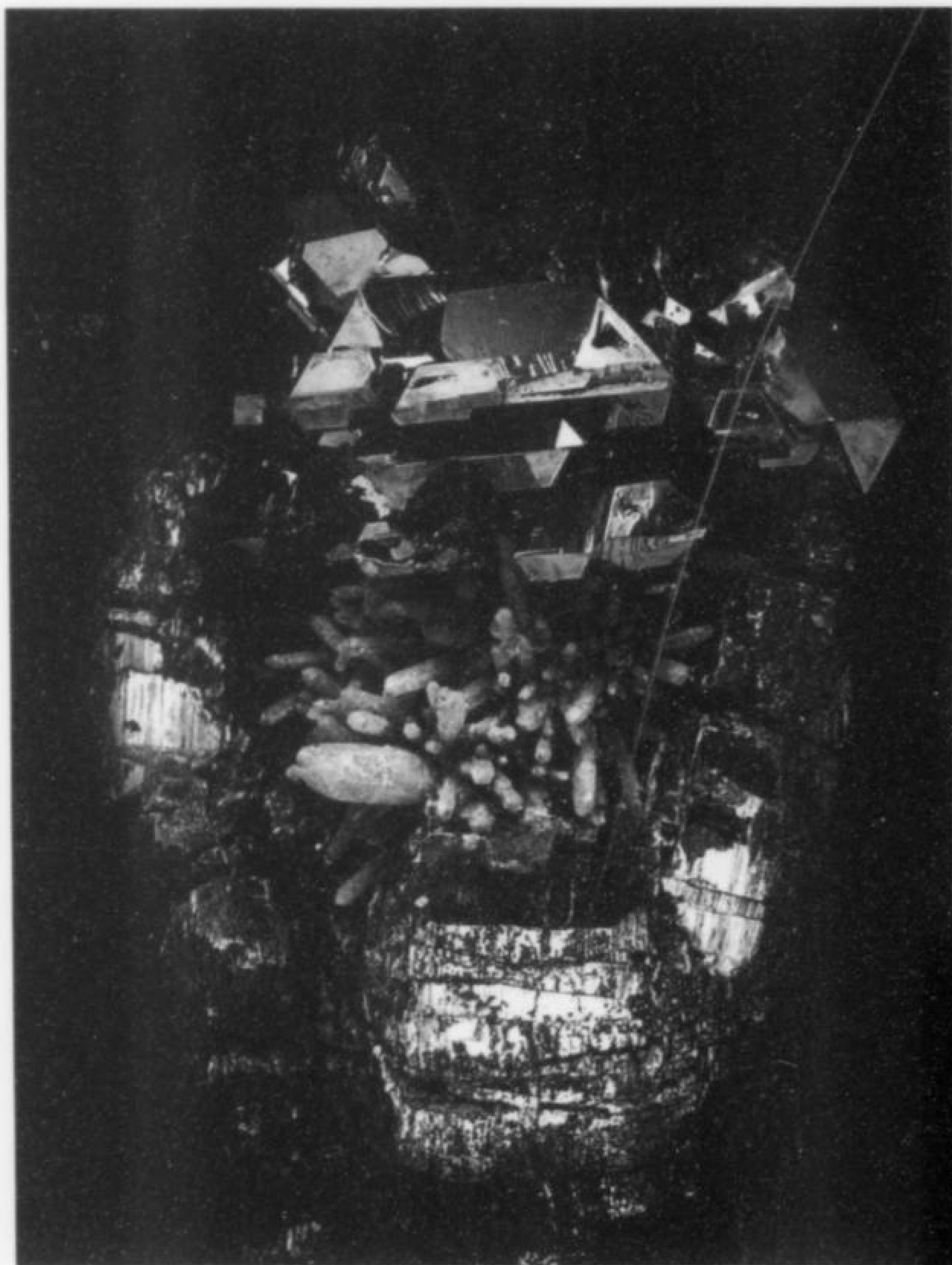


Figure 34. Galena crystals on quartz with pyrrhotite, 10.7 cm, from Dal'negorsk. Bill and Brigitta Wray collection; Jeff Scovil photo.

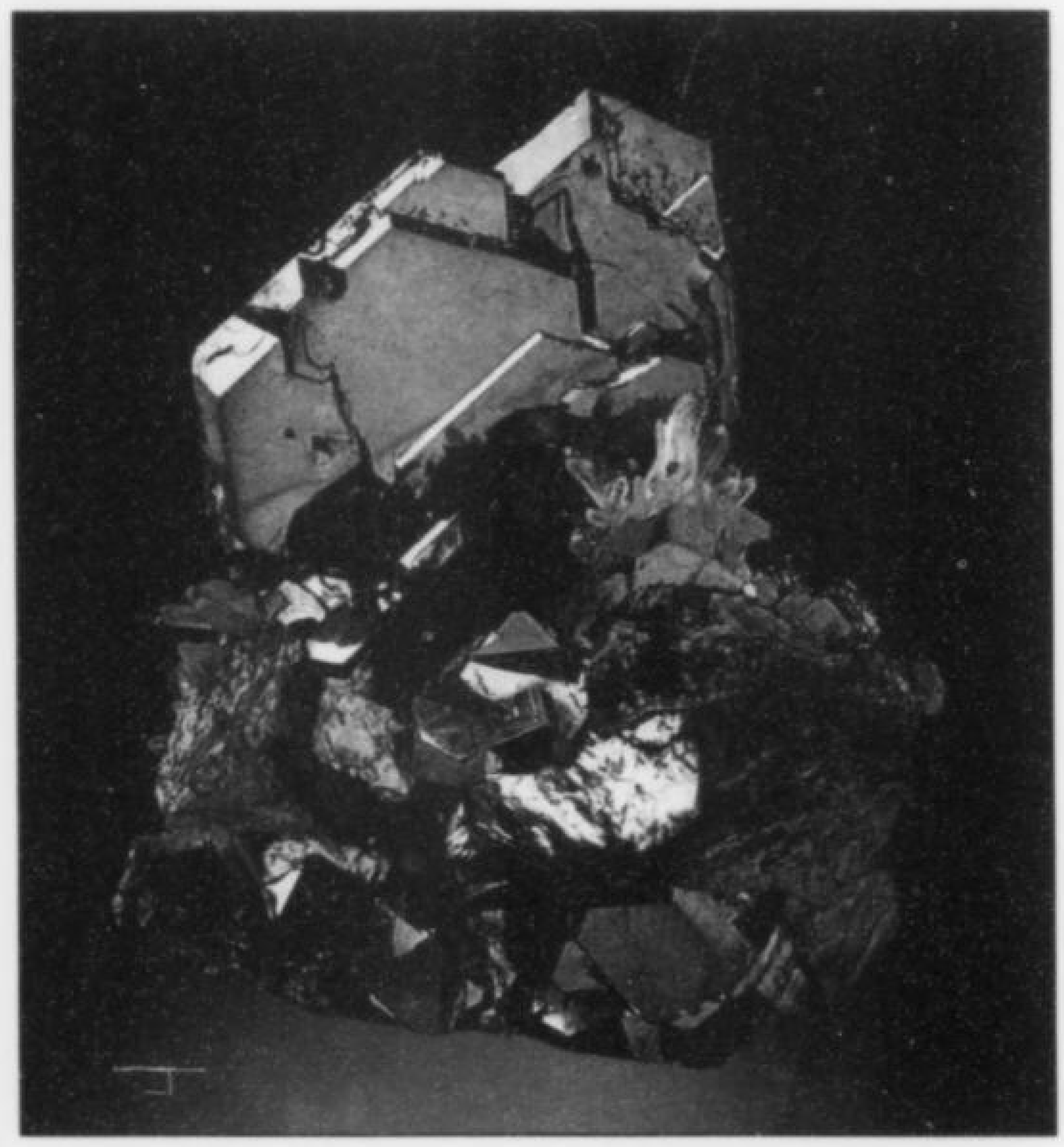


Figure 35. Galena in flattened, spinel-law twins on chalcopyrite, 6.3 cm, from Dal'negorsk. Francis Benjamin collection; Jeff Scovil photo.

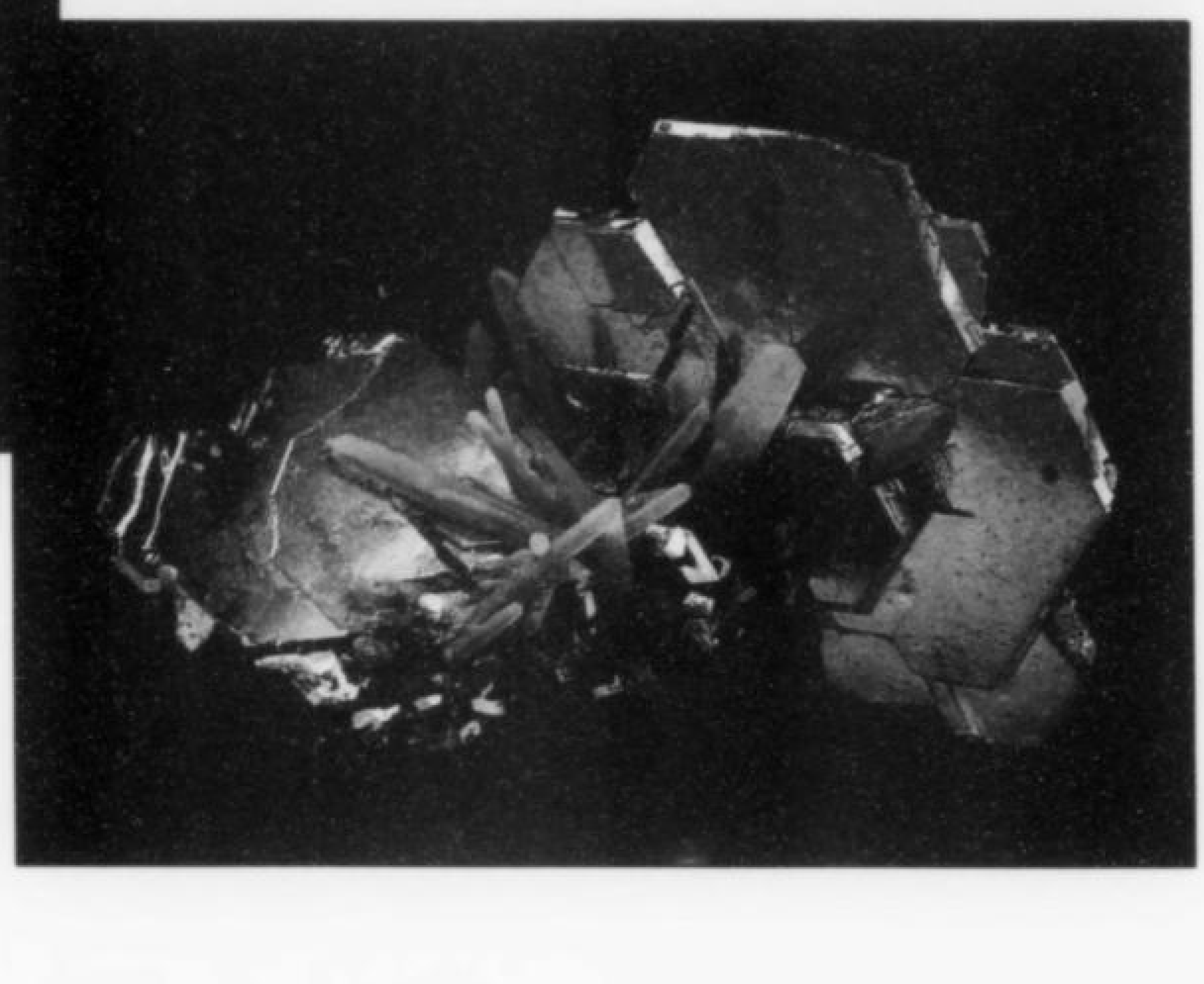


Figure 36. Galena cluster of flat, spinel-law twins on quartz, 4.9 cm, from the Nikolaevskiy mine, Dal'negorsk. Van Scriver collection; Jeff Scovil photo.

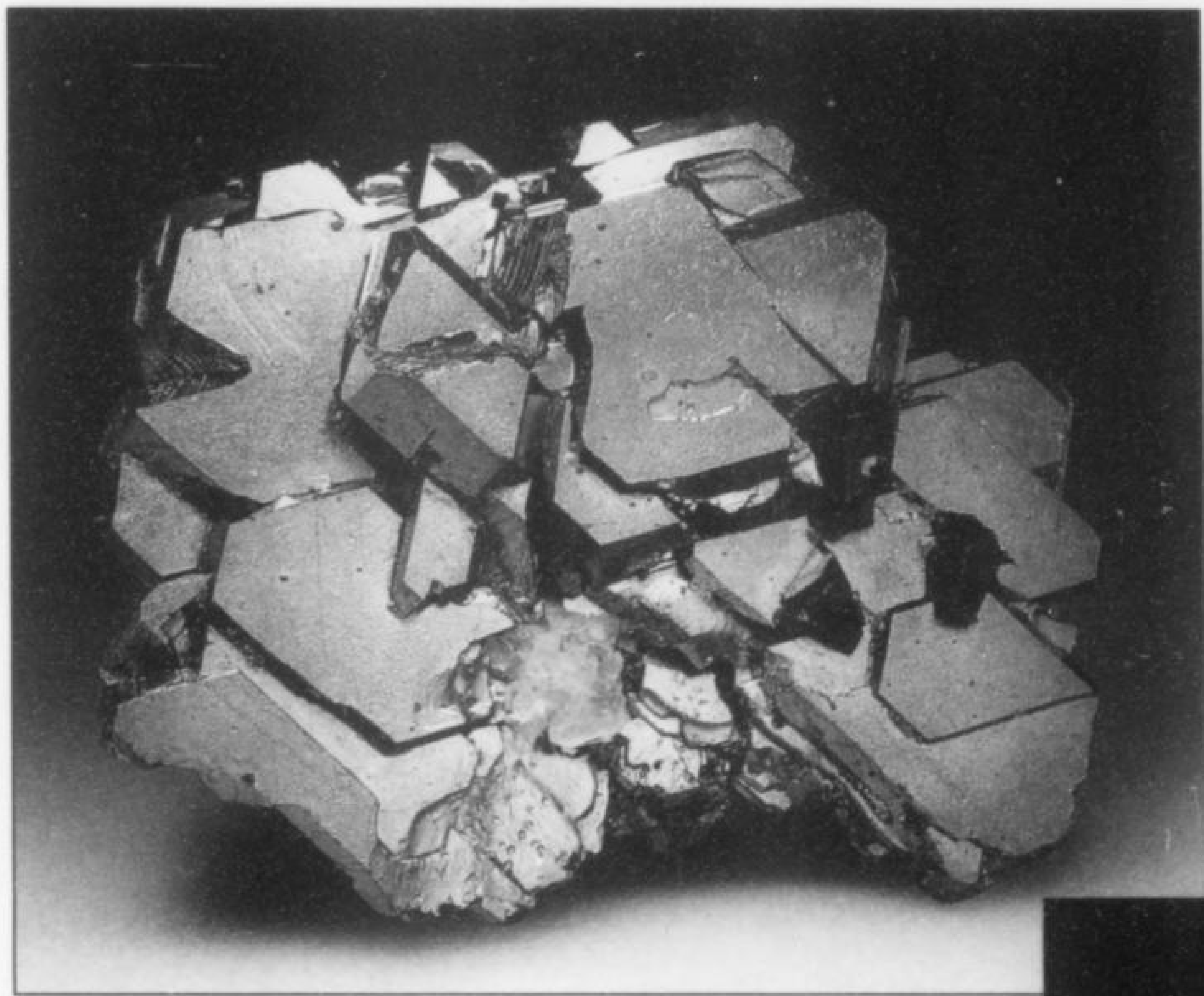


Figure 37. **Galena twin, flattened parallel to the composition plane (111) (spinel law), 14 cm, from the Nikolaevskiy mine, Dal'negorsk. Heliodor Minerals specimen; Jeff Scovil photo.**

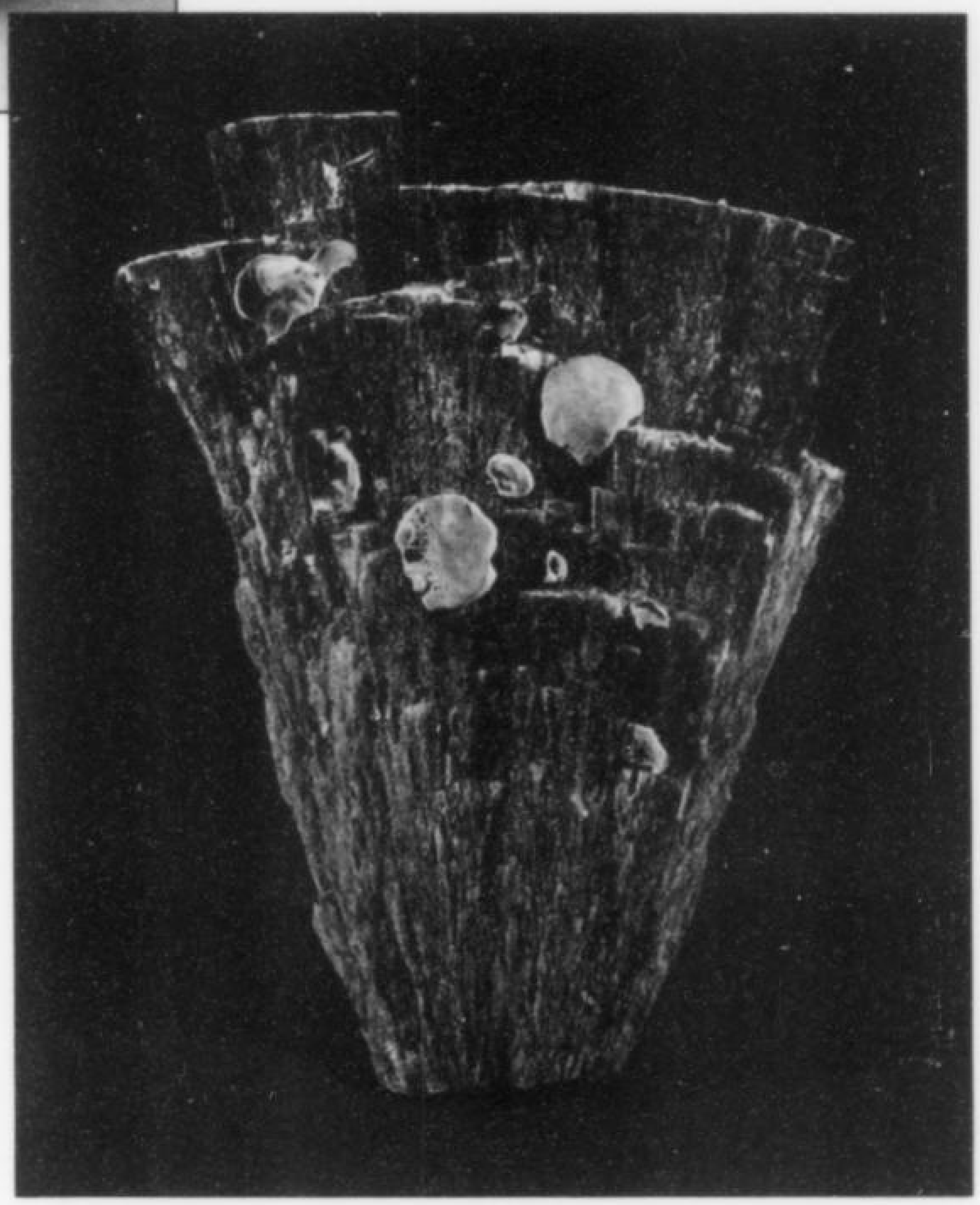


Figure 38. **Hedenbergite crystal fan, 9 cm, from the Nikolaevskiy mine, Dal'negorsk. Carnegie Museum of Natural History collection; Jeff Scovil photo.**

from the Second Sovietskiy mine; the best specimens available at present are from the Nikolaevskiy mine. Some of the galena specimens have a smooth, lustrous, rounded surface that looks as if they have been melted or partially resorbed. Massive galena and crystals to 3 cm have been found in the Bor pit; and crystals up to 6 cm occur at the Sadoviy mine. Most recently, in the summer of 2000, a large pocket of spinel-law galena twins was found in the Second Sovietskiy mine; flat plates of galena up to 15 cm across and covered with sphalerite crystals were recovered.

Galenobismutite $PbBi_2S_4$

Galenobismutite occurs as a rare accessory sulfide mineral in the Nikolaevskiy and First Sovietskiy mines.

Gersdorffite NiAsS

Gersdorffite is among the trace sulfides that have been identified as inclusions in bismuth nodules from the Bor pit.

Goethite FeO(OH)

Goethite is a common constituent of the gossan that once covered the Verchniy.

Gold Au

Small amounts of native gold have been found rarely in the Verchniy mine pits.

Graphite C

Graphite occurs as microscopic inclusions in bismuth nodules from the Bor pit.

Grossular $Ca_3Al_2(SiO_4)_3$

Grossular is among the principal components of skarn in the Verchniy mine, First Sovietskiy mine and the Bor pit, occasionally as good green to yellow-green crystals to 2 cm.

Gypsum $CaSO_4 \cdot 2H_2O$

Small crystals of gypsum have been collected near the Brenner mine and at the First Sovietskiy mine.

Hedenbergite $CaFeSi_2O_6$

Hedenbergite, a common mineral in the skarn, also occurs as sprays of flattened prismatic crystals up to 12 cm long. The best specimens are from the Nikolaevskiy mine, where it is often covered with quartz and ilvaite. Small crystals have also been found in the Bor pit and the First Sovietskiy mine.

Hedleyite Bi_7Te_3

Hedleyite is one of the rare microminerals comprising the suite of inclusions found in bismuth nodules from the Bor pit.

Hematite Fe_2O_3

Hematite has been found as small 5-mm rosettes in the Second Sovietskiy mine, as small crystals in the Sadoviy mine, as massive material with garnet in the Bor pit and in alteration zones and gossans throughout the district. It also occurs as pseudomorphs after ilvaite in the Second Sovietskiy mine.

Hemimorphite $Zn_4Si_2O_7(OH)_2 \cdot H_2O$

Hemimorphite occurs as small, colorless crystals with other

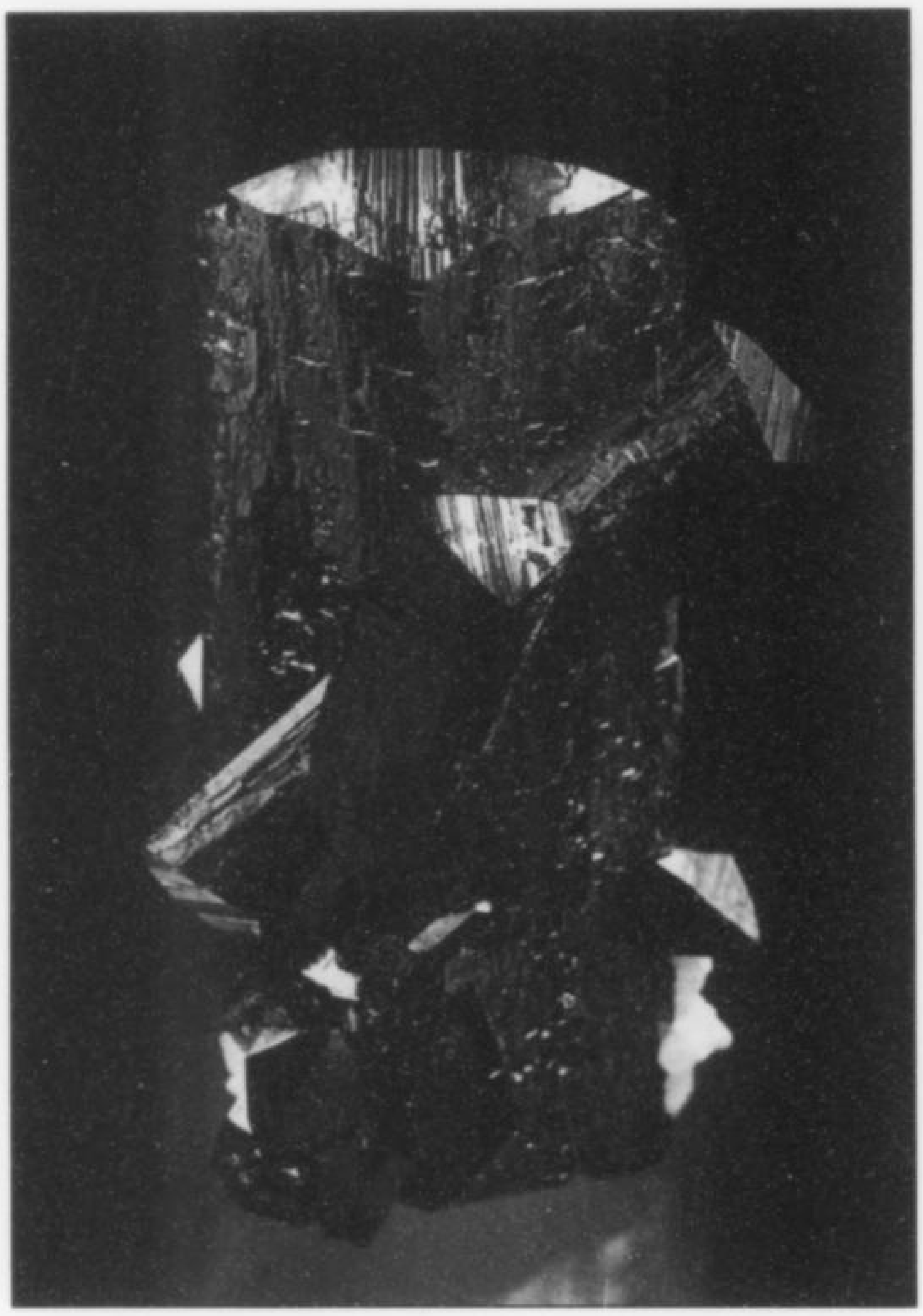


Figure 39. **Ilvaite crystals, 3.6 cm, from the First Sovietskiy mine, Dal'negorsk. Heliodor Minerals specimen; Jeff Scovil photo.**

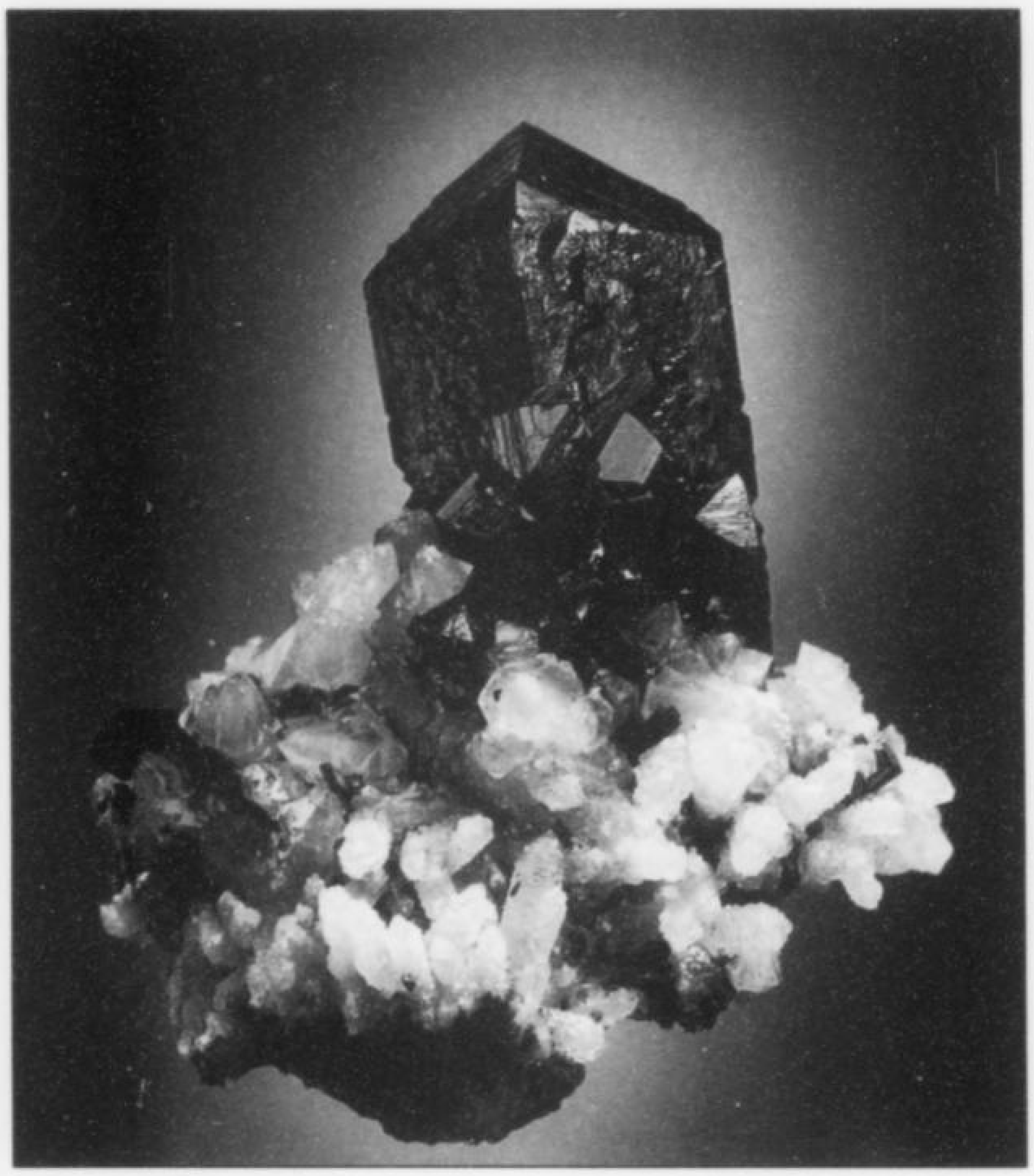


Figure 41. **Ilvaite crystal on quartz, 6 cm, from Dal'negorsk. Eric Asselborn collection; Jeff Scovil photo.**

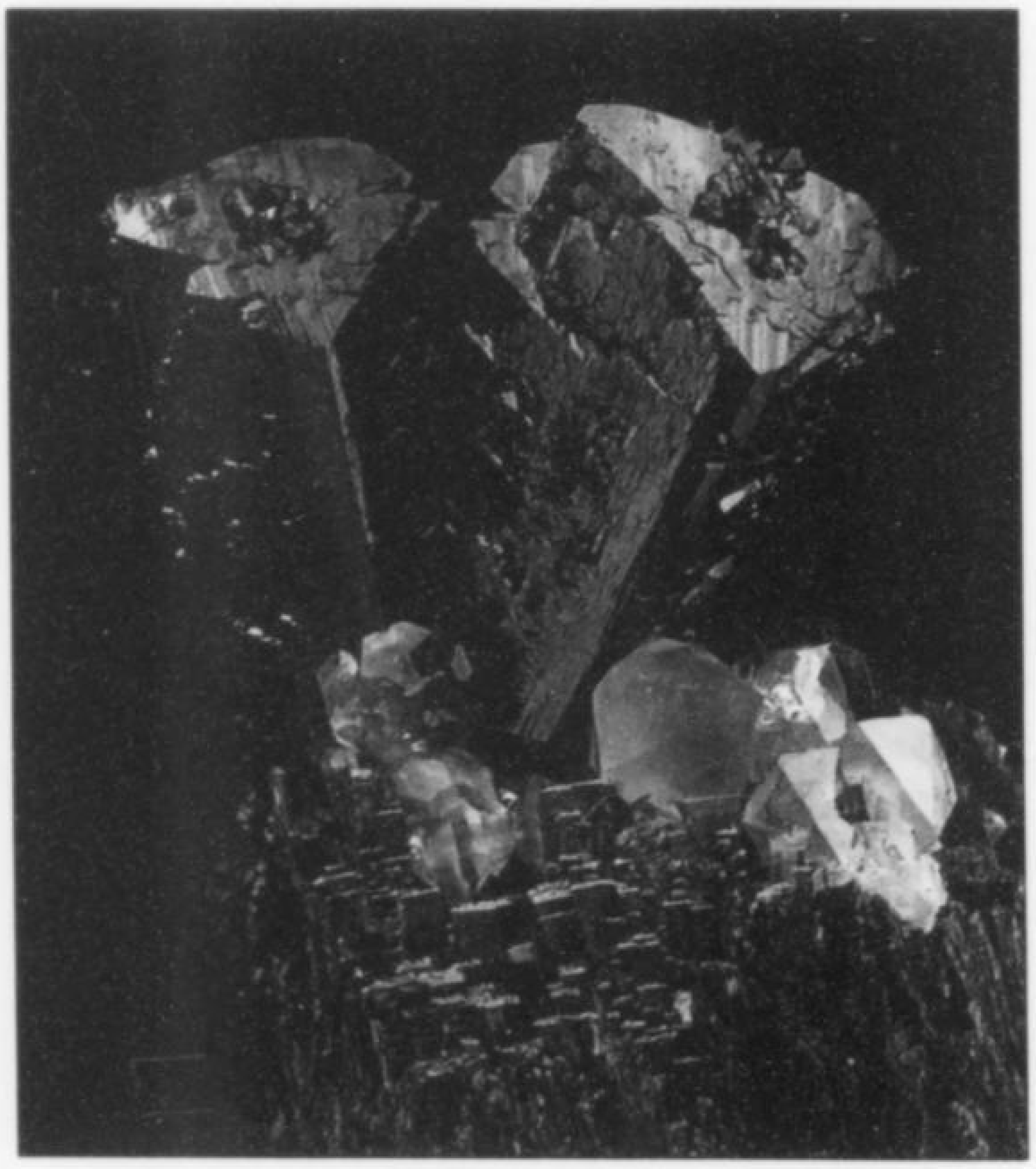


Figure 40. **Ilvaite crystals, 2.7 cm, on hedenbergite with quartz, from the First Sovietskiy mine, Dal'negorsk. Irv Brown collection; Jeff Scovil photo.**

secondary Pb-Zn-Cu minerals in the Brenner mine, and as small, pale blue, botryoidal crusts with smithsonite from the Second Sovietskiy mine.

Hessite Ag_2Te

Hessite is a member of the suite of rare microminerals found as inclusions in bismuth nodules from the Bor pit.

Heulandite $(Na,K,Ca,Sr,Ba)_5(Al_9Si_{27})O_{72}\cdot 26H_2O$

Heulandite has been found as single crystals to 2 cm on manganaxinite from the Second Sovietskiy mine.

Hisingerite $Fe_2Si_2O_5(OH)_4\cdot 2H_2O$

Hisingerite occurs as typical earthy masses and coatings in altered skarn in the Bor pit, and also in the Verchniy and Second Sovietskiy mines.

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

White coatings of microcrystalline hydrozincite have been found in the Brenner workings.

Ikunolite $Bi_4(S,Se)_3$

Ikunolite is a member of the suite of rare microminerals found as inclusions in bismuth nodules from the Bor pit.

Ilmenite $FeTiO_3$

Ilmenite occurs as an accessory mineral in rocks throughout the district.

Ilvaite $CaFe_2FeOSi_2O_7(OH)$

Ilvaite occurs as superb, lustrous black prismatic crystals up to 10 cm in size, in sulfide ore and in boron-rich skarn. Good specimens showing dominant {110} and {111} have come from the Nikolaevskiy, First Sovietskiy and Verchniy mines, where it is associated with quartz, calcite, hedenbergite and datolite. Very small crystals have been found in the Bor pit. Pseudomorphs of calcite, siderite, pyrite, pyrrhotite, iron oxides, clays and quartz after ilvaite are common, and range in color from brown to black. Ilvaite spherules to 3 cm have been found on diopside from the Nikolaevskiy mine.

Jamesonite $Pb_4FeSb_6S_{14}$

Jamesonite specimens from the Nikolaevskiy mine are thought to be at least in part boulangerite. It is possible that both minerals are present in acicular aggregates where they are not visually distinguishable from each other.

Jarosite $KFe_3(SO_4)_2(OH)_6$

Jarosite is a common component of the gossan at the Brenner mine.

Johannsenite $CaMn^{2+}Si_2O_6$

Some of what was initially thought to be diopside from the Bor pit has proven to be the manganese pyroxene, johannsenite.

Joseite Bi_4TeS_2

Joseite is a member of the suite of rare microminerals found as inclusions in bismuth nodules from the Bor pit.

Kutnohorite $Ca(Mn^{2+},Mg,Fe^{2+})(CO_3)_2$

Kutnohorite occurs as blocky, lusterless, milky white crystals to 5 or 10 mm in size, usually on quartz crystals, in the Bor pit.

Laumontite $CaAl_2Si_4O_{12}\cdot 4H_2O$

Laumontite is found as small, white, prismatic crystals in the Second Sovietskiy mine, the Danburitiy pit and the Bor pit.

Lepidocrocite $\gamma\text{-}Fe^{3+}O(OH)$

Lepidocrocite has been identified as an earthy component of the "limonite" in the Verchniy mine and other mines in the area.

Litharge PbO

Litharge is a member of the secondary Pb-Zn-Cu suite at the Brenner mine.

Löllingite $FeAs_2$

Löllingite has been identified in microscopic blebs and masses in ore from the Second Sovietskiy mine.

Ludwigite Mg_2FeBO_5

Ludwigite is a boron mineral found as microscopic inclusions in native arsenic from the Bor pit.

Magnesioferrite $MgFe_2O_4$

Magnesioferrite, like ludwigite, has been found as microscopic inclusions in native arsenic from the Bor pit.

Magnetite Fe_3O_4

Magnetite is a microscopic accessory mineral in gabbro and in carbonate rocks near contacts with diabase intrusions.

Malachite $Cu_2(CO_3)(OH)_2$

Malachite coatings are part of the suite of secondary Pb-Zn-Cu minerals at the Brenner mine, and are also found in the Bor pit and the First Sovietskiy mine.

Manganaxinite $Ca_2Mn^{2+}Al_2BSi_4O_{15}(OH)$

Manganaxinite is a common constituent of the skarns, and also occurs in cavities. Curved masses of bladed lustrous, translucent brown bladed crystals up to 10 cm long are found in the Bor pit and Sentyabr'skiy mine. Smaller crystals are found in the Verchniy and Second Sovietskiy mines. Most crystals are the typical brown color, but green crystals have also been found.

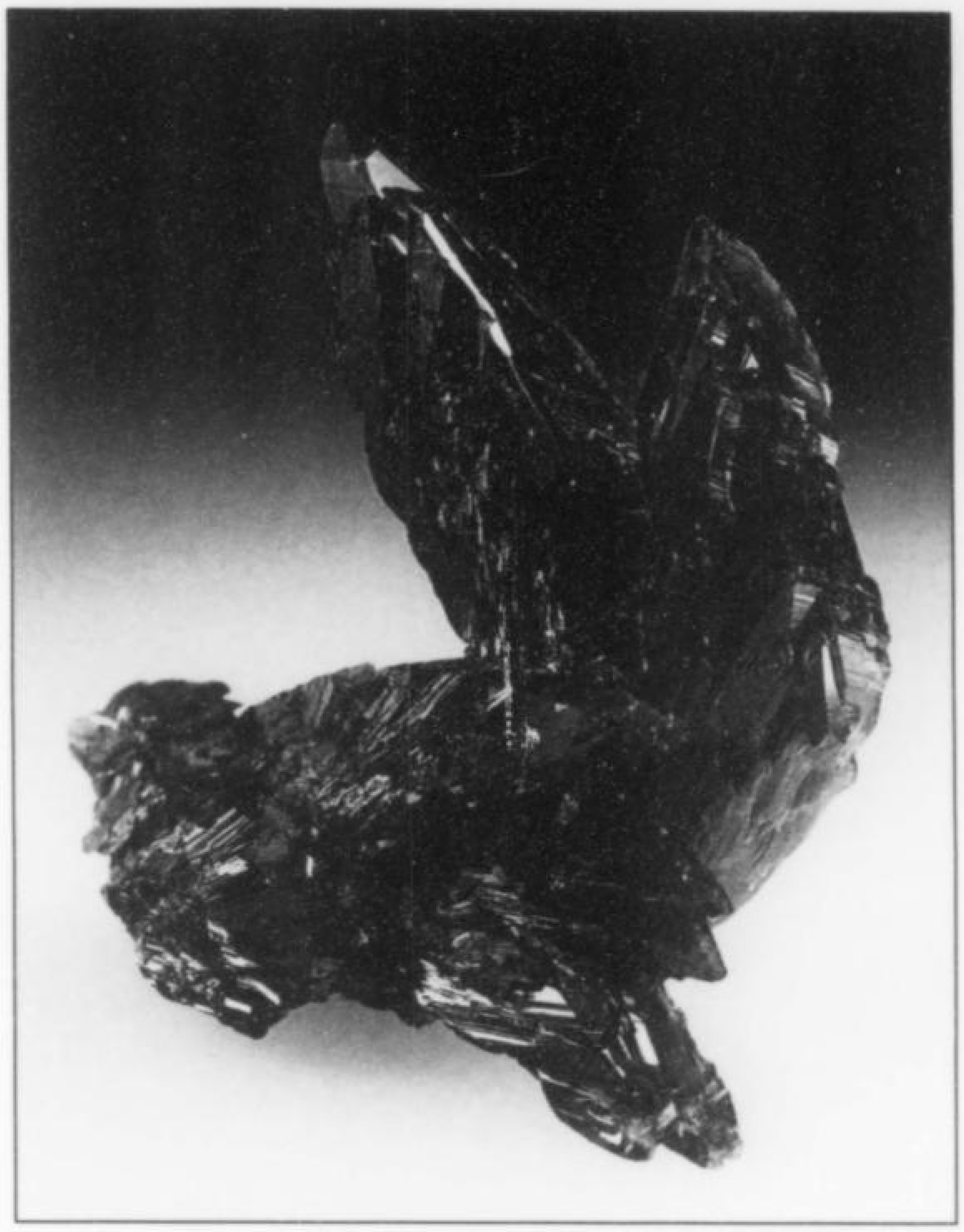


***Figure 42*. Manganaxinite, 5.6 cm, Dal'negorsk. Heliodor Minerals specimen; Wendell Wilson photo.**

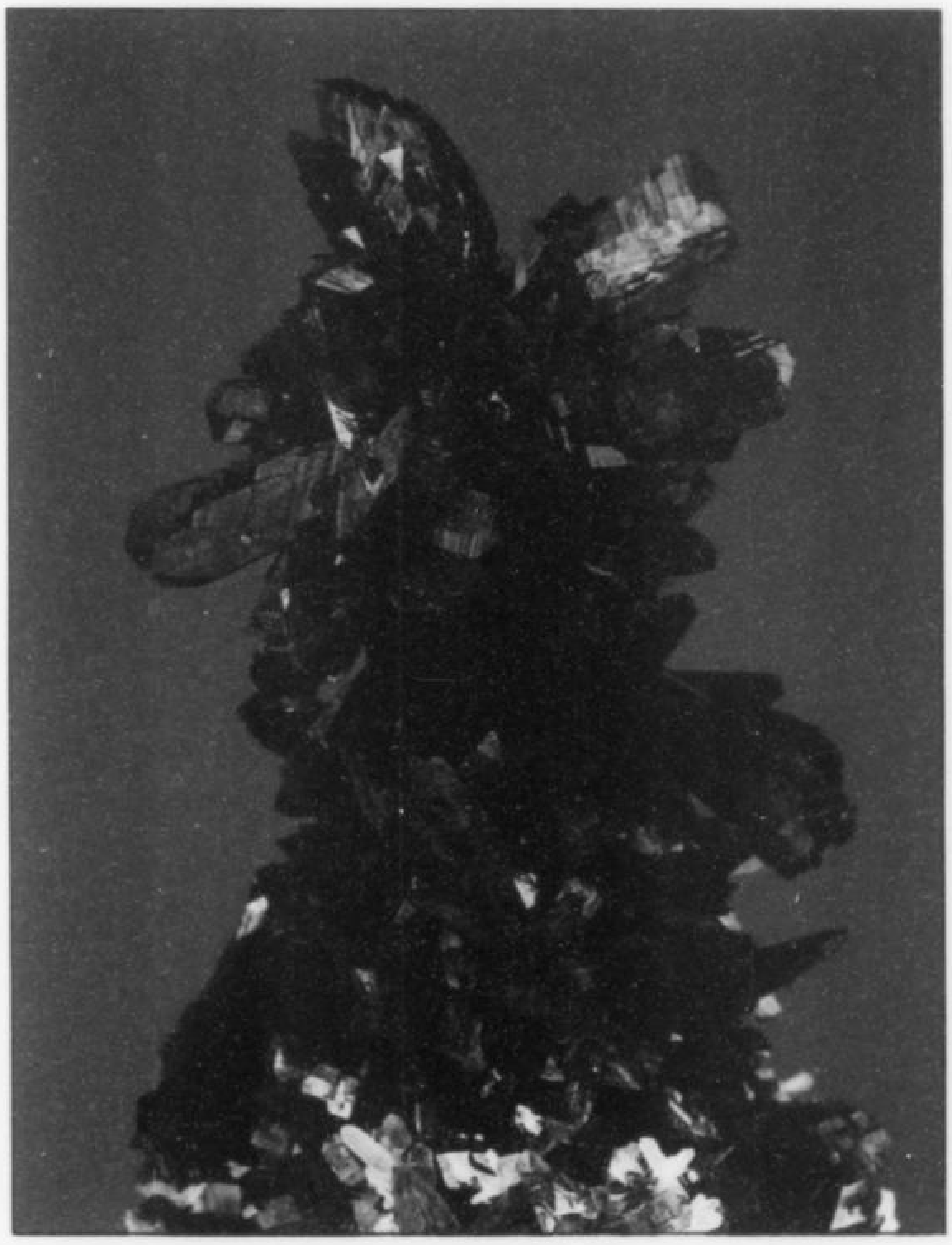


***Figure 43*. Manganaxinite, 9.7 cm, from the Verchniy mine, Dal'negorsk. Richard Kosnar specimen; Jeff Scovil photo.**

Marcasite FeS_2

Small spherical masses of marcasite have been found in association with pyrite and pyrrhotite in the Nikolaevskiy, First Sovietskiy and Second Sovietskiy mines.

Margarite $CaAl_2\square Al_2Si_2O_{10}(OH)_2$

Margarite, a brittle mica, is a rare accessory mineral in the Dal'negorsk skarn deposits.

Matildite $AgBiS_2$

Matildite occurs as minute embedded masses in ores of the Nikolaevskiy mine.

Melanterite $FeSO_4\cdot 7H_2O$

Greenish brown melanterite has been found as an alteration product of iron sulfides in the Brenner mine.

Miargyrite $AgSbS_2$

Miargyrite has been reported as a rare accessory sulfide mineral in the Nikolaevskiy mine.

Millerite NiS

Millerite is present as microscopic inclusions in sulfide ores at the Bor pit.

Mimetite $Pb_5(AsO_4)_3Cl$

Mimetite microcrystals have been identified in the secondary Pb-Zn-Cu suite at the Brenner mine (B. England, personal communication, 1995).

Minium Pb_3O_4

Minium has been identified in the gossan of the secondary Pb-Zn-Cu suite at the Brenner mine.

Montmorillonite $(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2\cdot nH_2O$

Montmorillonite clay is found as thin coatings at the Verchniy mine and as white massive material at the Second Sovietskiy mine.

Muscovite $KAl_2(Si_3Al)O_{10}(OH,F)_2$

Muscovite occurs as microscopic flakes resulting from metasomatic alteration in all of the mines.

Nontronite $Na_{0.3}Fe_2(Si,Al)_4O_{10}\cdot nH_2O$

Yellow to yellow-green nontronite clay occurs on chalcedony at the Bor pit.

Olivine group $(Fe,Mg,Mn,Ni)_2^{2+}SiO_4$?

A mineral of the olivine group (exact composition unknown) occurs in ultramafic rocks intersected by a tunnel connecting the Nikolaevskiy and Verchniy mines.

Opal $SiO_2\cdot nH_2O$

Massive white common opal is common in the Bor pit.

Owyheeite $Pb_{10-2x}Ag_{3+x}Sb_{11+x}S_{28}$

Owyheeite has been identified as a rare accessory sulfide mineral at the Nikolaevskiy mine.

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

"Mountain leather" mats of palygorskite up to 50 x 50 cm have been found in the First Sovietskiy, Second Sovietskiy and Verchniy mines.

Phlogopite $KMg_3AlSi_3O_{10}(OH)_2$

Phlogopite is an uncommon component of Dal'negorsk skarns.

Plumbojarosite $PbFe_6(SO_4)_4(OH)_{12}$

Plumbojarosite occurs as a component of the gossan at the Brenner mine.

Polybasite $(Ag,Cu)_{16}Sb_2S_{11}$

Polybasite is found rarely as microscopic crystals in the Nikolaevskiy mine.

Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$

Prehnite is found as a minor component of dike rock at the Nikolaevskiy mine and Bor pit.

Proustite Ag_3AsS_3

Proustite has been found as a rare accessory sulfide mineral in the First Sovietskiy mine.

Pumpellyite $Ca_2(Mg,Fe)Al_2(SiO_4)(Si_2O_7)(OH)_2\cdot H_2O$

Dark green pumpellyite in earthy compact masses has been reported from the Bor pit.

Pyrargyrite Ag_3SbS_3

Pyrargyrite has been found as a rare accessory sulfide micromineral in the Nikolaevskiy and First Sovietskiy mines.

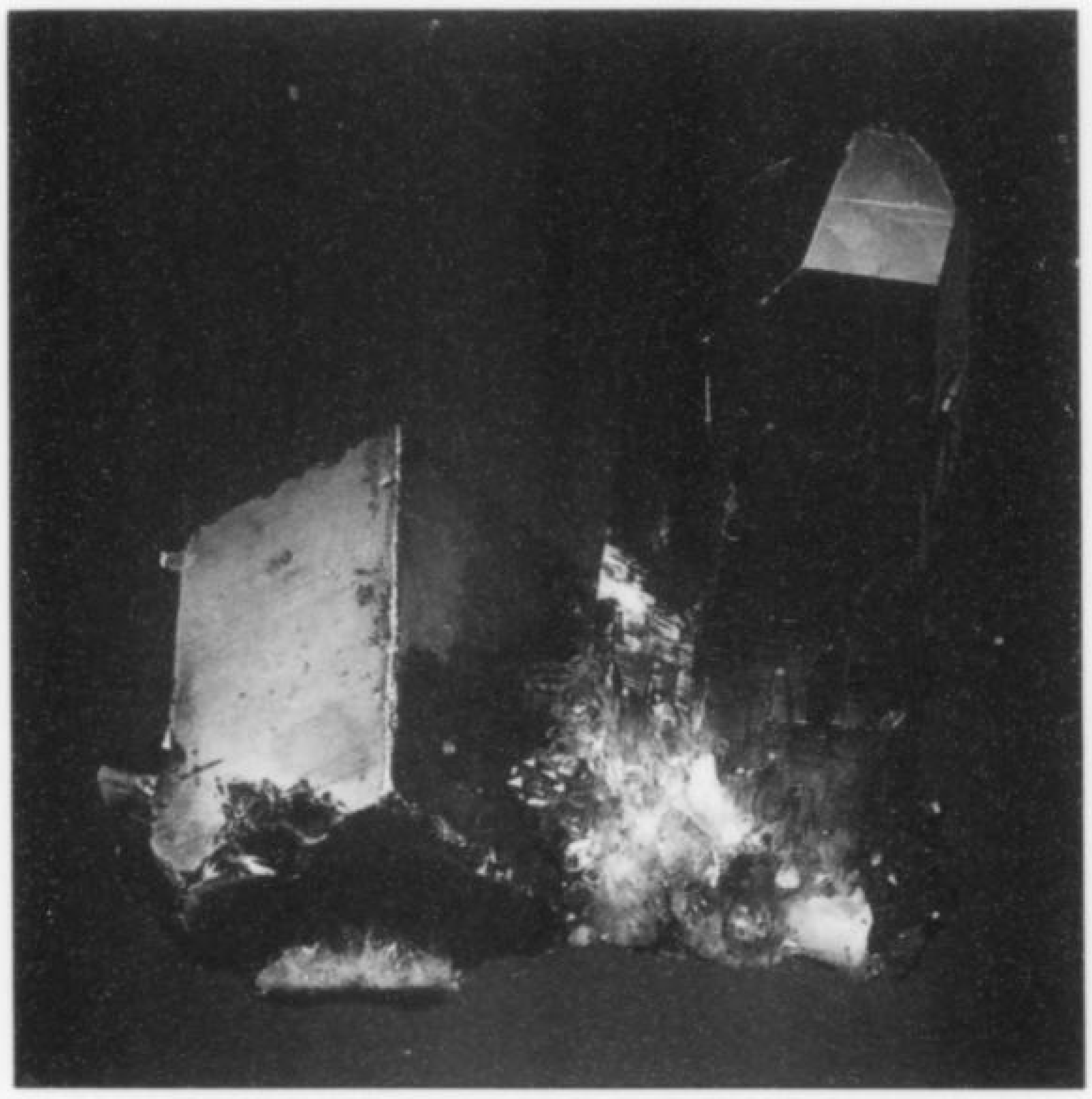


Figure 44. **Pyrite with quartz, 7.5 cm, from Dal'negorsk. Danny Trinchillo specimen; Jeff Scovil photo.**

Pyrite FeS_2

Pyrite has been found as cubic crystals to 10 cm and as large crystalline masses up to 24 cm at the Verchniy and Nikolaevskiy mines. It also forms pseudomorphs after pyrrhotite at the Nikolaevskiy mine, and occurs as small crystals at the First Sovietskiy and Second Sovietskiy mines.

Pyrolusite MnO_2

Pyrolusite in black powdery masses and coatings occurs in small quantities at the Bor pit and in the Verchniy, Nikolaevskiy and Second Sovietskiy mines.

Pyromorphite $Pb_5(PO_4)_3Cl$

Pyromorphite microcrystals have been identified in the secondary Pb-Zn-Cu suite at the Brenner mine.

Pyrrhotite FeS

Pyrrhotite occurs as first-generation flat hexagonal plates and parallel aggregates, and as second-generation prismatic crystals

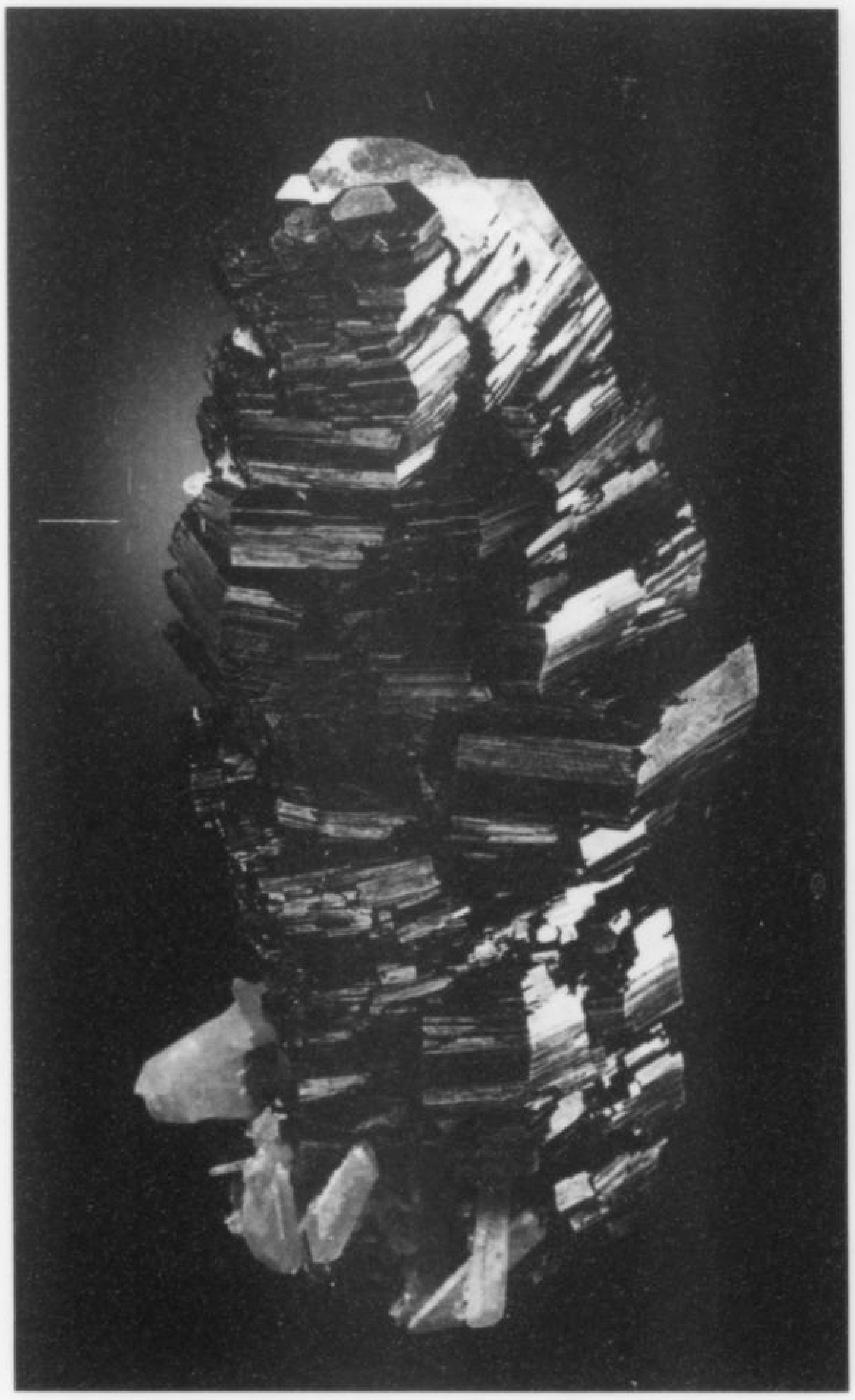


Figure 45. **Pyrrhotite, 6.8 cm, from the Nikolaevskiy mine, Dal'negorsk. Shirley Fiske collection; Jeff Scovil photo.**

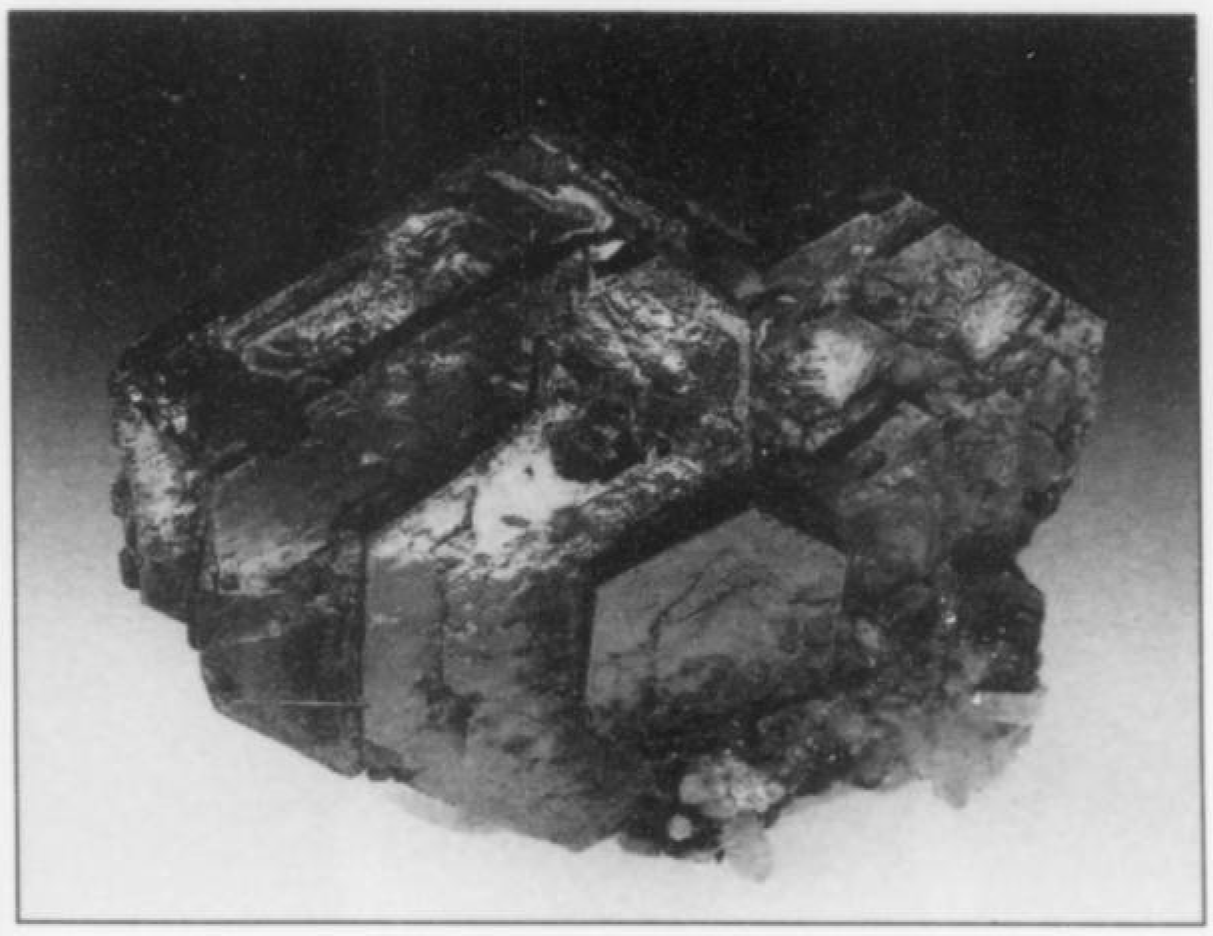


Figure 46. **Pyrrhotite crystal, 4 cm, from the Nikolaevskiy mine. Wendell Wilson collection and photo.**

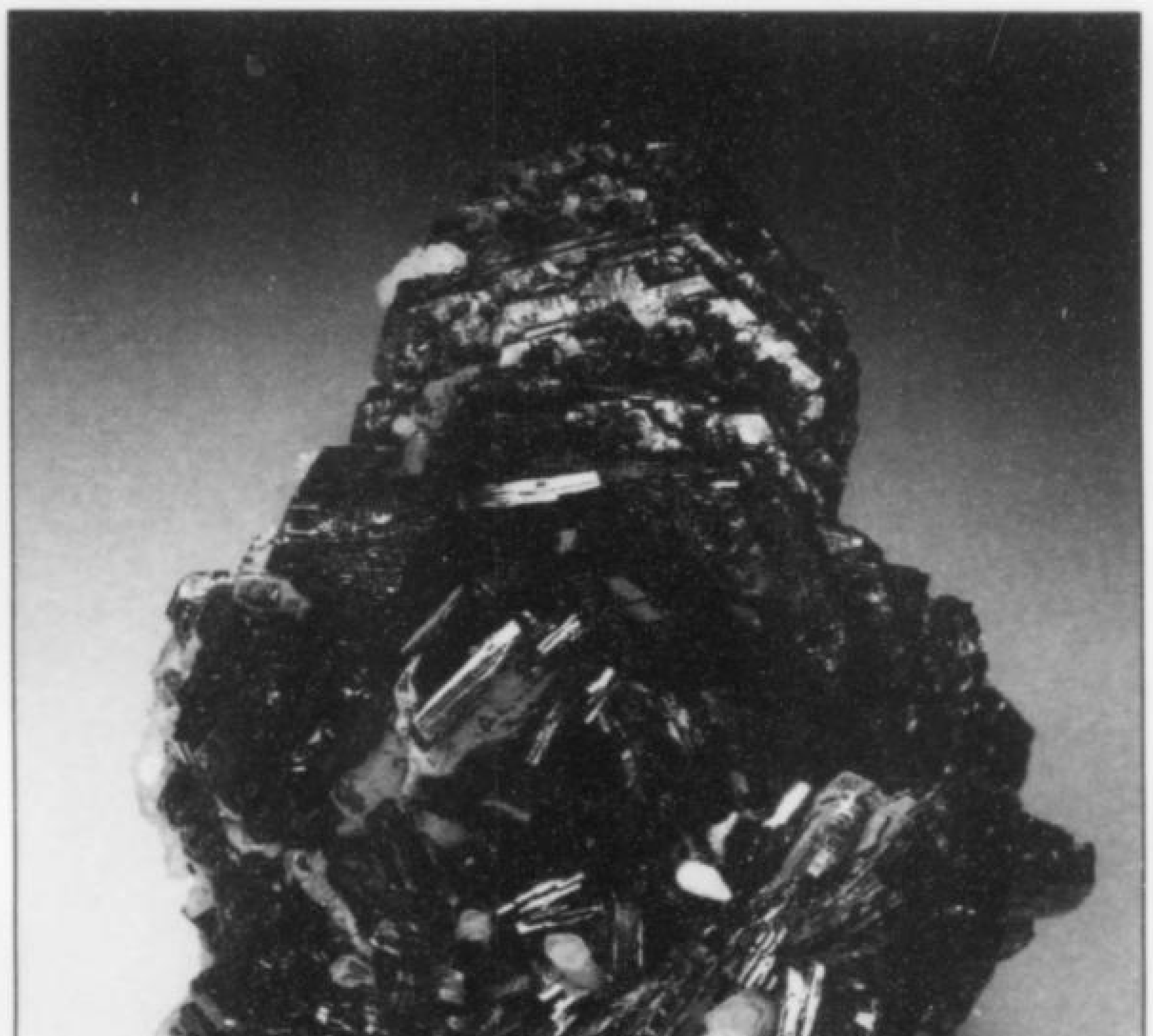


Figure 47. **Pyrrhotite, 8 cm, from the Nikolaevskiy mine, Dal'negorsk. Vladimir Pelepenko collection; Wendell Wilson photo.**

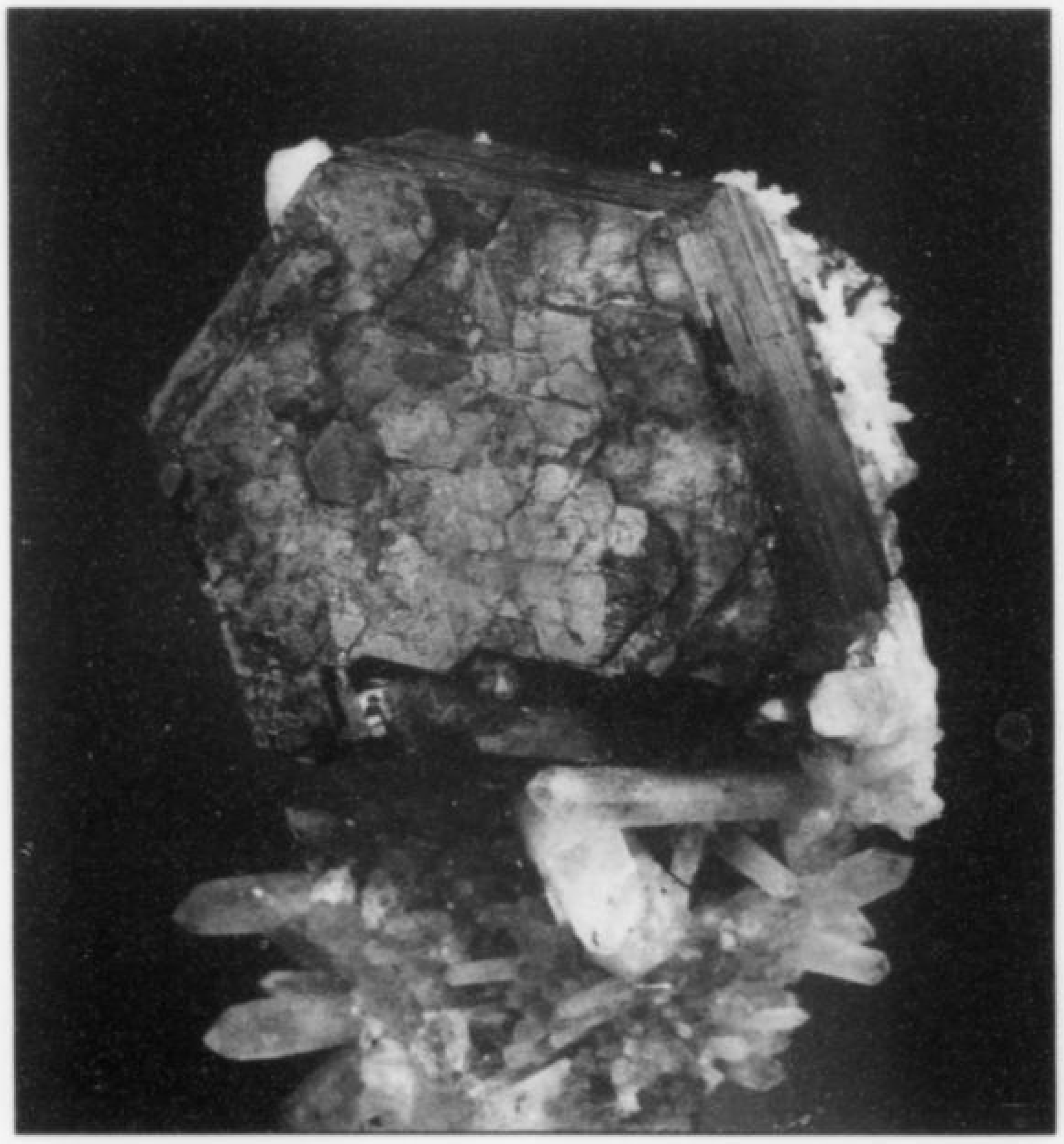


Figure 48. **Pyrrhotite crystal with quartz, 5.3 cm, from Dal'negorsk. Jeff Scovil collection and photo.**

Figure 49. **Adit in the Nikolaevskiy mine. Rock Currier photo.**

and columnar aggregates up to 25 cm across. It also occurs as attractive rosettes of flat plates. The largest and best specimens are from the Nikolaevskiy mine. Some of the pyrrhotite is replaced by pyrite. Small crystals have also been found in the Verchniy and First Sovietskiy mines.

Quartz SiO_2

Quartz is among the most common minerals in the ancient hydrothermal pockets, many of which have yielded hundreds of crystallized specimens. They are transparent and range in color from milky white to smoky, citrine, red, pale green and pale amethyst. The Bor pit has produced pale amethyst crystals to 15 cm and smoky crystals to 5 cm. Chalcedony is also found in the Bor pit. Crystals composed almost entirely of termination faces with little or no prism development (and often doubly terminated) have been found at the Verchniy, Nikolaevskiy, Second Sovietskiy and Sentyabr'skiy mines, associated with ilvaite and hedenbergite. Red quartz was first encountered in a pocket at the Second Sovietskiy mine in 1996; the crystals are red in the outer zone, with a white core, and are up to 8 cm in length. Most, if not all, of the red and orange crystals have been etched in hydrofluoric acid. Clusters can be spectacular. In the same pocket were found large pseudomorphs of iron oxides and clays after ilvaite. Quartz pseudomorphs after danburite have been found in the Bor pit. Most recently (2000) a

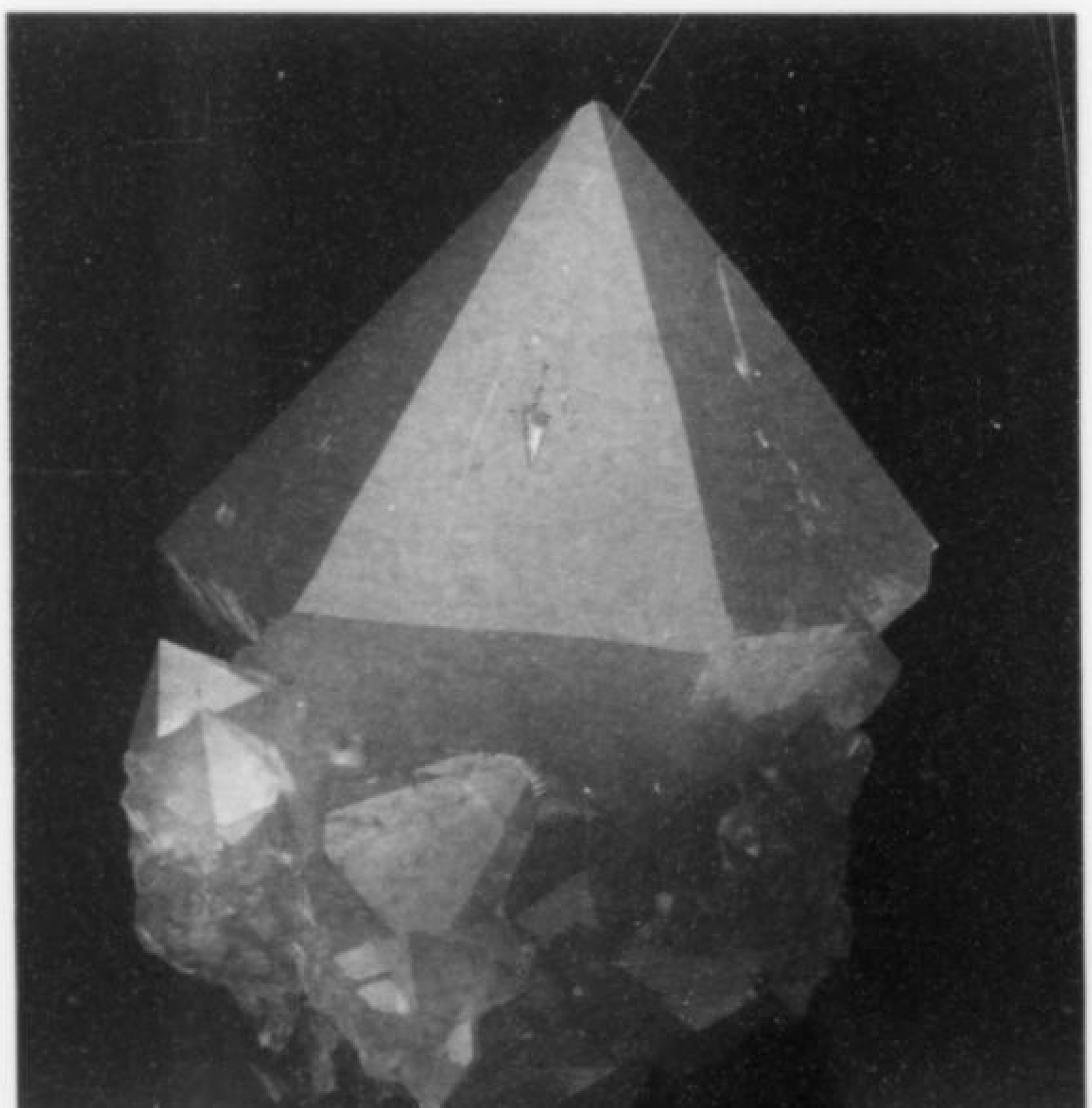


Figure 50. **Quartz, 5.2 cm, from the Second Sovietskiy mine. Jeff Scovil collection and photo.**

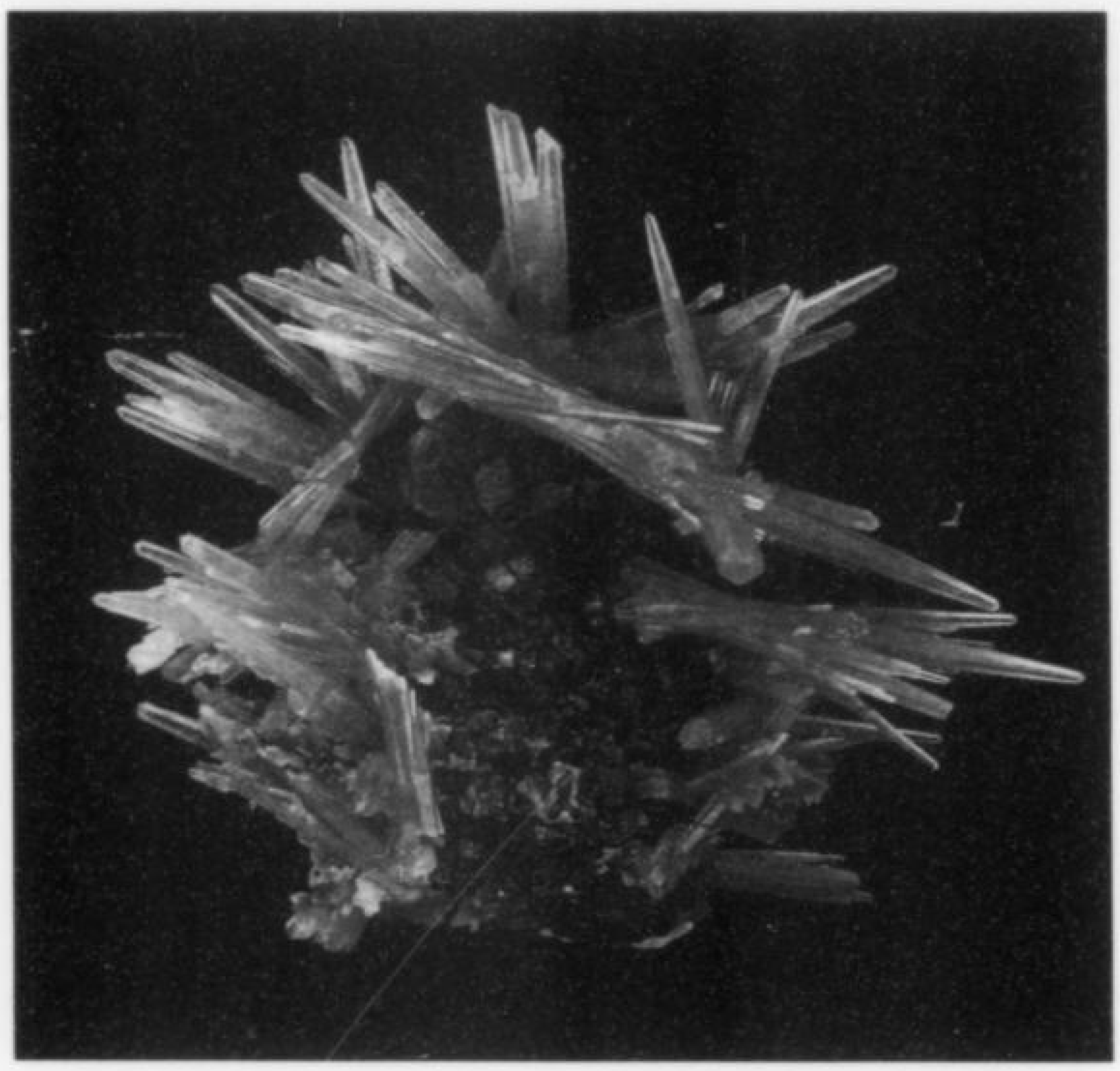


Figure 51. **Quartz on sphalerite, 8.8 cm, from the Second Sovietskiy mine. Terry Huizing collection; Jeff Scovil photo.**

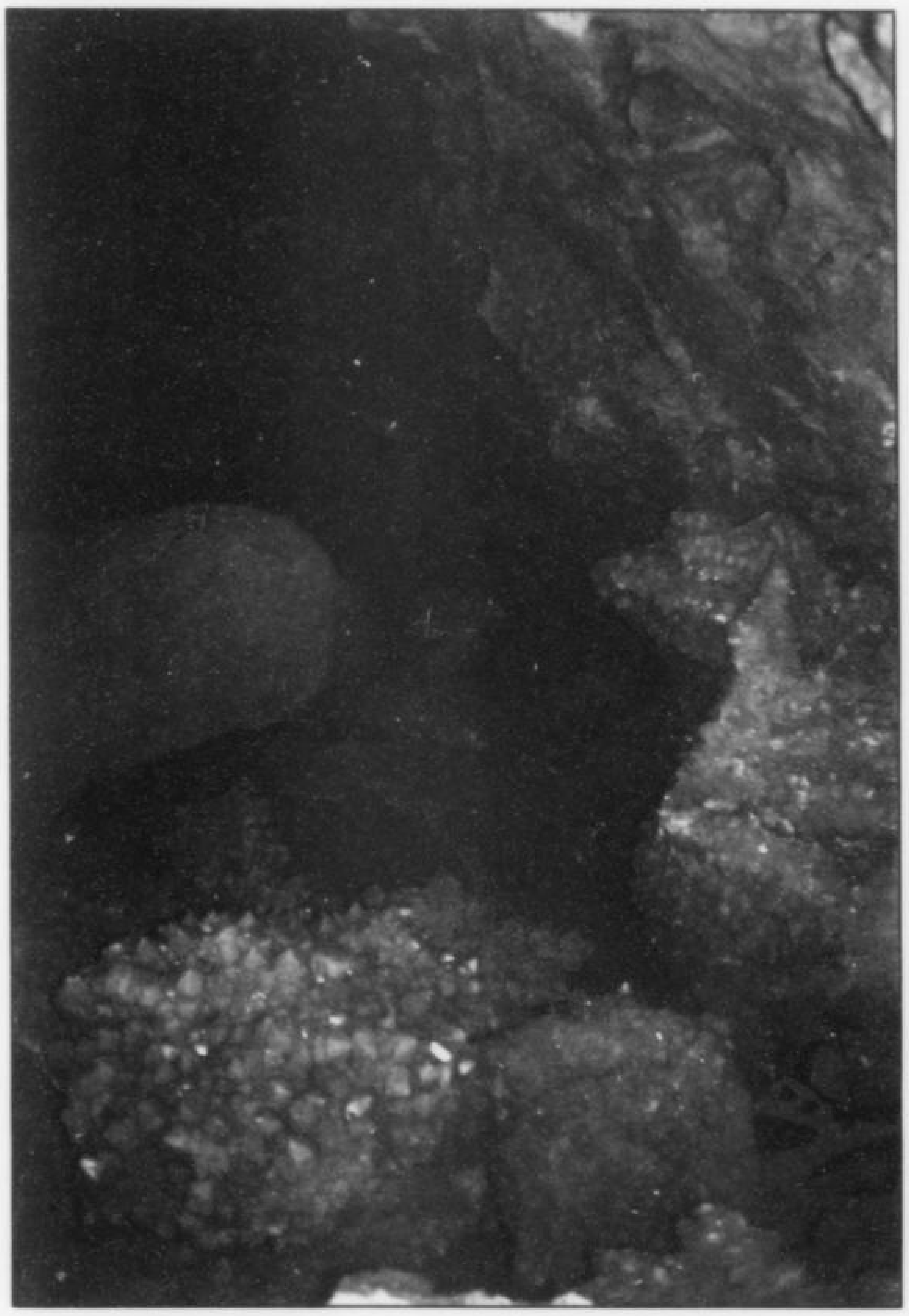


Figure 52. **Collecting quartz specimens from a hydrothermal cavity in the Bor mine. R. Grant photo.**

large pocket of pale green quartz crystals with no prism faces was found in the Second Sovietskiy mine. These pseudo-bipyramidal crystals, ranging from less than 1 cm to more than 10 cm across, make striking specimens. Japan-law quartz twins have been found in the Bor pit, the Verchniy mine, and the Nikolaevskiy mine. An unusual X-shaped Japan-law twin on axinite from Dal'negorsk (no mine name given) is pictured in *Lapis* (**24**, no. 2, p. 7, February 1999).

Rhodochrosite $MnCO_3$

Rhodochrosite has been found as small pink crystals in the Nikolaevskiy and Verchniy mines.

Rhodonite $(Mn,Fe,Mg,Ca)SiO_3$

Small amounts of pink rhodonite have been reported from the Sadoviy mine.

Rutile TiO_2

Acicular rutile has been found as inclusions in quartz from the First Sovietskiy mine, and as small masses in the Nikolaevskiy mine.

Safflorite $CoAs_2$

Safflorite has been identified as microscopic inclusions in native arsenic from the Bor pit.

Scheelite $CaWO_4$

Scheelite is said to occur very rarely in the Nikolaevskiy mine; good crystals are not mentioned.

Scolecite $CaAl_2Si_3O_{10}\cdot 3H_2O$

Scolecite has been found as acicular white material in the Sadoviy and Second Sovietskiy mines.

Scorodite $FeAsO_4\cdot 2H_2O$

Scorodite microcrystals have been identified in the Pb-Zn-Cu secondary suite at the Brenner mine, and as a rare secondary mineral in the Nikolaevskiy mine.

Senarmontite Sb_2O_3

Senarmontite has been identified as a rare secondary mineral in the Bor pit.

Sepiolite $Mg_4Si_6O_{15}(OH)_2\cdot 6H_2O$

Sepiolite occurs in altered skarns in the Sadoviy, First Sovietskiy and Nikolaevskiy mines.

Serpentine group

Dark green serpentine has been reported from a tunnel connecting the Nikolaevskiy and Verchniy mines.

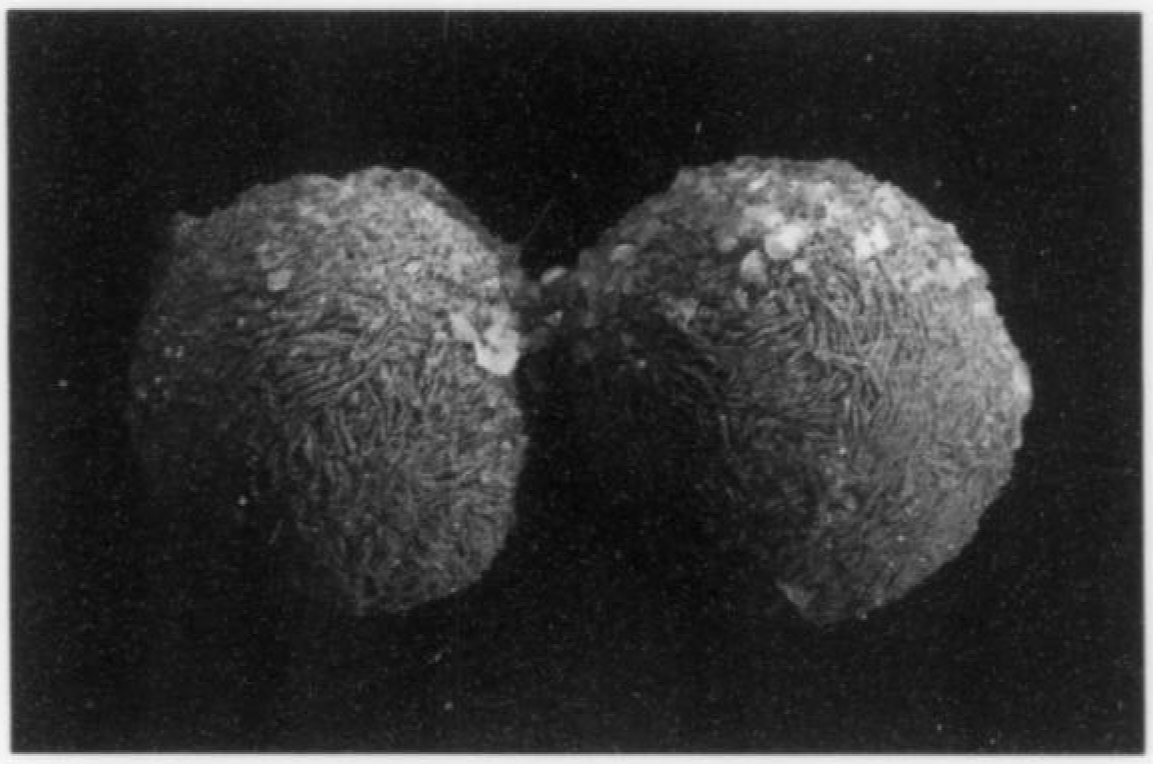


Figure 53. **Siderite spheres, 4.6 cm, from the Nikolaevskiy mine, Dal'negorsk. Carolyn Manchester collection; Jeff Scovil photo.**

Siderite $Fe^{2+}CO_3$

Siderite occurs at Dal'negorsk in a range of compositions grading into other carbonate species. Most of the carbonates form spherical aggregates to 6 cm in various shades of gray, green, yellow and brown. Siderite is also known as bright rhombs and scalenohedrons with quartz, calcite and sulfides from the Nikolaevskiy and Verchniy mines.

Silver Ag

Silver is a member of the suite of rare minerals found as inclusions in bismuth nodules from the Bor pit; it has also been identified in ore from the First Sovietskiy mine.

Skutterudite $CoAs_{2-3}$

Skutterudite has been reported from the Bor pit.

Smithsonite $ZnCO_3$

Smithsonite occurs as pale green, violet, blue, gray, white and brown botryoidal crusts associated with aurichalcite and other minerals of the secondary Pb-Zn-Cu suite at the Brenner mine. It also forms white botryoidal balls to 3 cm from the Second Sovietskiy mine.

Sphalerite (Zn,Fe)S

Sphalerite is common at Dal'negorsk, as tetrahedral crystals showing twinning and parallel growth. Attractive crystals have

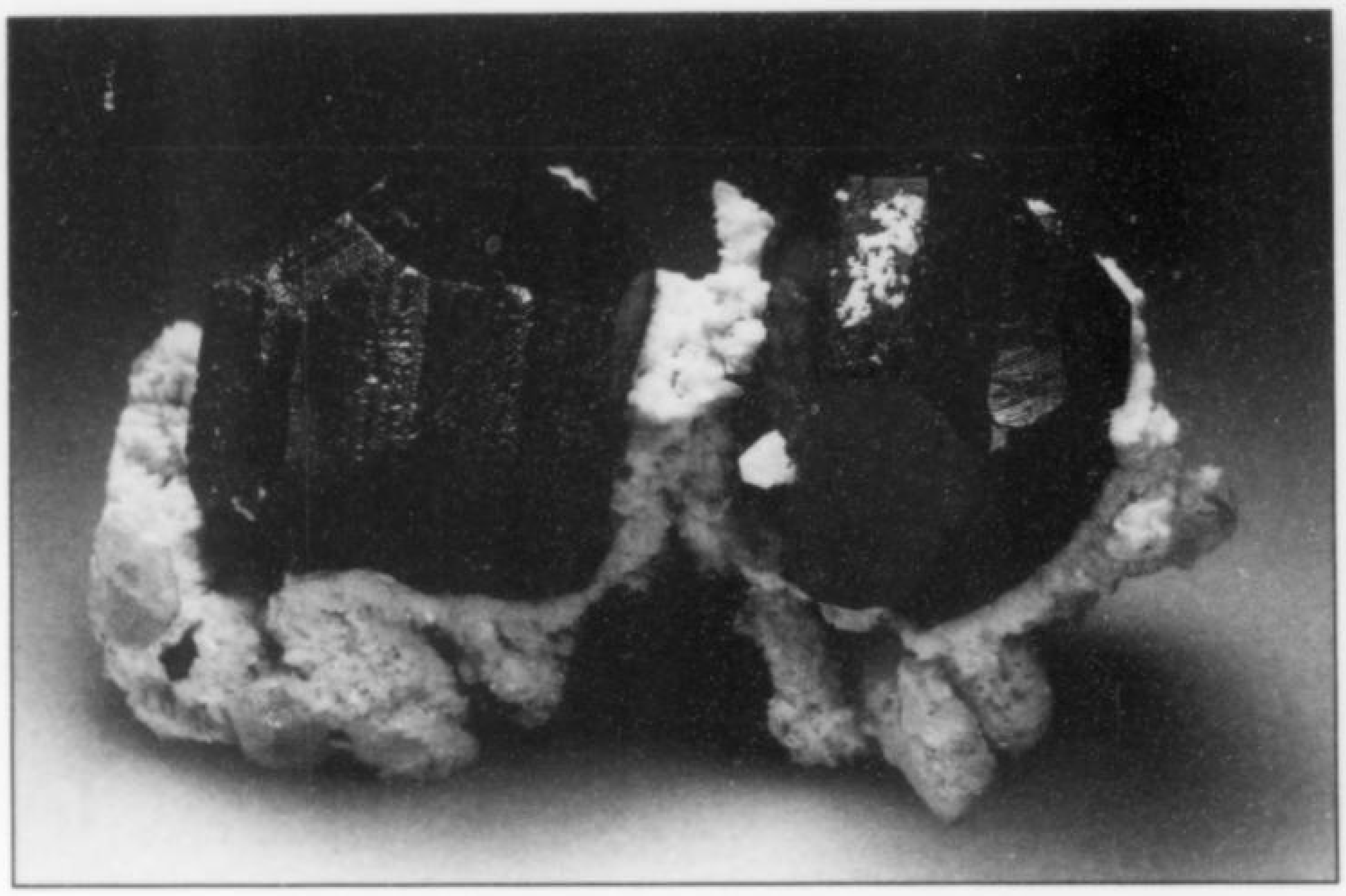


Figure 54. **Sphalerite crystals, 11 cm, from Dal'negorsk. Vladimir Pelepenko collection; Wendell Wilson photo.**

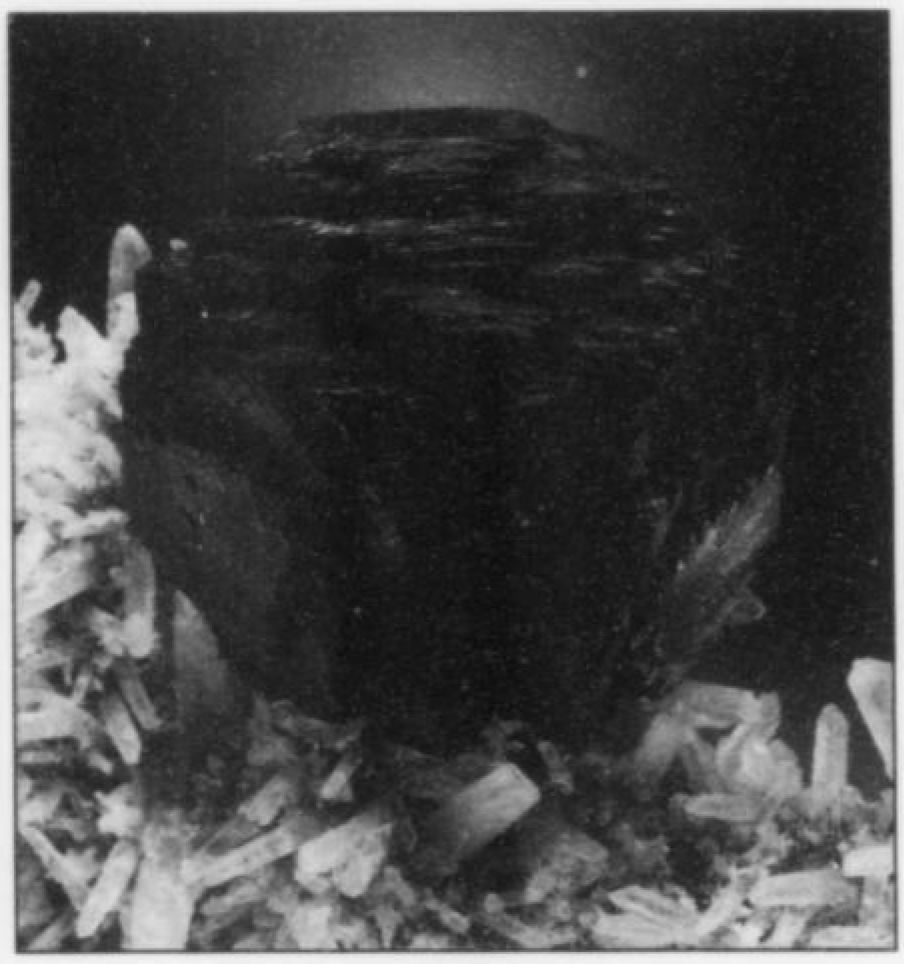


Figure 55. **Sphalerite crystal, 4.5 cm, on quartz, from Dal'negorsk. Steve Neely collection; Jeff Scovil photo.**

been found at the Nikolaevskiy mine (to 16 cm), the First Sovietskiy mine (to 2 cm), the Verchniy mine (to 3 cm) and the Sadoviy mine (to 8 cm). It occurs intermixed with other sulfides, as is occasionally seen as a coating on chalcopyrite crystals. Small amounts of massive sphalerite have been seen in the Bor pit.

Spinel $MgAl_2O_4$

Spinel has been found as a rare accessory mineral in the Nikolaevskiy mine; the color was not noted.

Stannite Cu_2FeSnS_4

Stannite has been identified as an accessory mineral in the sulfide suite at the Nikolaevskiy mine.

Stephanite Ag_5SbS_4

Stephanite has been identified as a rare accessory mineral in the sulfide suite at the First Sovietskiy mine.

Sternbergite $AgFe_2S_3$

Sternbergite has been identified as a rare accessory mineral in the sulfide suite at the First Sovietskiy mine.

Stibarsen SbAs

Stibarsen occurs intergrown with native arsenic in masses up to 12 cm in the Bor pit.

Stibnite Sb_2S_3

Stibnite is an accessory mineral in the sulfide suite at the Nikolaevskiy mine.

Stilbite $NaCa_2Al_5Si_{13}O_{36}\cdot 14H_2O$

White crystals of stilbite to 3 cm have been found at the Second Sovietskiy mine.

Stilpnomelane $K(Fe,Al)_{10}Si_{12}O_{30}(OH)_{12}$

Stilpnomelane occurs as an accessory mineral in rocks of the district.

Talc $Mg_3Si_4O_{10}(OH)_2$

Talc has been found associated with an ultramafic body encountered in a tunnel connecting the Verchniy and Nikolaevskiy mines.

Figure 56. **Black sphalerite with distorted quartz crystal, 9.5 cm, from Dal'negorsk. Danny Trinchillo specimen; Jeff Scovil photo.**

Tellurobismuthite Bi_2Te_3

Tellurobismuthite has been identified as microscopic grains in the Nikolaevskiy mine.

Tennantite $(Cu,Ag,Fe,Zn)_{12}As_4S_{13}$

Tennantite occurs as masses up to 4 cm across in skarn in the Bor pit.

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

Tetrahedrite has been found as single crystals to 2 cm, with

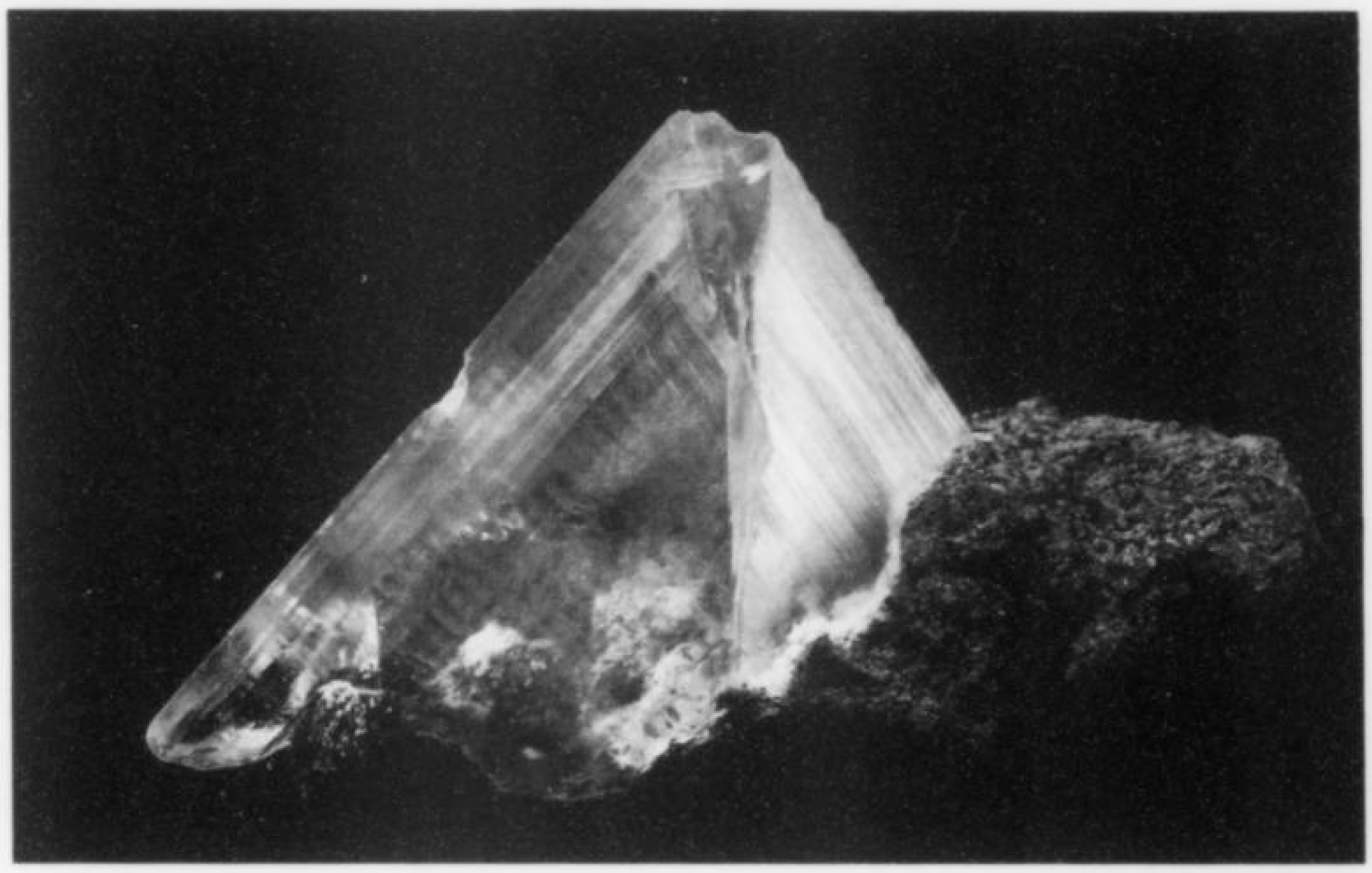


Figure 57. **Whewellite twin, 5.7 cm, on matrix, from the Nikolaevskiy mine, Dal'negorsk. Joseph Freilich collection; Harold and Erica Van Pelt photo.**

Figure 58. **Zinkenite on quartz, 8.8 cm, from Dal'negorsk. Jordi Fabre specimen; Jeff Scovil photo.**

quartz from the Second Sovietskiy mine, and as small crystals with pyrrhotite from the Nikolaevskiy and First Sovietskiy mines.

Titanite $CaTiSiO_5$

Titanite has been reported as an accessory mineral in rocks of the district.

Thometzekite $Pb(Cu,Zn)_2(AsO_4)_2 \cdot 2H_2O$

The rare mineral thometzekite has been reported from the gossan of the Brenner mine, as part of the secondary Pb-Zn-Cu suite (B. England, personal communication, 1995). This may be only the second known world occurrence after the type locality at Tsumeb, Namibia.

Thomsonite $Ca_2Na[Al_5Si_5O_{20}] \cdot 6H_2O$

Thomsonite has been found as a rare mineral in the Bor pit.

Tourmaline group

Tourmaline of an undetermined species has been found in skarn at the Bor pit and also at the Nikolaevskiy mine.

Tremolite $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$

Tremolite occurs as a component of skarn in the Bor pit and the Nikolaevskiy mine.

Valentinite Sb_2O_3

Valentinite has been found as a rare secondary mineral in the Bor pit.

Valleriite $4(Fe,Cu)S \cdot 3(Mg,Al)(OH)_2$

Valleriite has been identified as a rare accessory sulfide in the First Sovietskiy and Nikolaevskiy mines.

Vesuvianite $Ca_{10}Mg_2Al_4(SiO_4)_5(Si_2O_7)_2(OH)_4$

Vesuvianite occurs as a component of skarn at the Nikolaevskiy mine.

Vonsenite Fe_3BO_5

Vonsenite has been identified as belonging to the suite of microminerals found as inclusions in native arsenic at the Bor pit.

Weddellite $Ca(C_2O_4) \cdot 2H_2O$

Small, cloudy crystals of weddellite have been identified in a pocket with whewellite at the Nikolaevskiy mine (Ponomarenko, personal communication, 2000).

Whewellite $Ca(C_2O_4) \cdot H_2O$

Whewellite in good crystals up to 7 cm has been found in a single pocket, with wedellite, in the Nikolaevskiy mine in 1987 (Ponomarenko, personal communication, 2000).

Willemite Zn_2SiO_4

Willemite has been found as small white needles and white crusts in the Verchniy pit.

Wittichenite Cu_3BiS_3

Wittichenite has been identified as microscopic masses in ore at the Nikolaevskiy mine.

Wollastonite $CaSiO_3$

Wollastonite is a common component of skarn throughout the district. Fine-grained wollastonite with hedenbergite comprises the white to green skarn from the Bor pit that is utilized as an ornamental stone. Material with wollastonite fibers up to 2 cm long is also known from the same mine.

Wurtzite ZnS

Wurtzite occurs rarely in sulfide ores of the Nikolaevskiy and Second Sovietskiy mines.

Zinkenite $Pb_9Sb_{22}S_{42}$

Acicular zinkenite, looking like jamesonite in habit and color, has been identified on specimens from Dal'negorsk (X-ray identification; Brad Van Scriver, personal communication).

Zircon $ZrSiO_4$

Zircon occurs as an accessory mineral in igneous rocks of the Dal'negorsk area.

Zoisite $Ca_2Al_3(SiO_4)_3(OH)$

Zoisite has been identified as an accessory mineral in skarn at the Sadoviy mine.

DAL'NEGORSK MUSEUMS

The City Museum in Dal'negorsk has a remarkable mineral collection. The head of the Geology Department at the Museum is Nadezda Bulavko. She was born in Minsk and studied geology in Moldavia and Moscow, and has devoted her life to the collection and study of Dal'negorsk minerals. She has personally collected thousands of specimens. In the Museum the minerals are arranged by mine, with many hundreds of specimens from each mine on exhibit. There is a second smaller museum at the Bor Company plant that also has an excellent collection of minerals from the Bor pit.

ACKNOWLEDGMENTS

We would like to thank Gennady Skoublov for arranging (RG's) trips to Dal'negorsk, and for reading the manuscript. Also, we would like to thank the following people from Dal'negorsk for their hospitality and for sharing information on the region: Victor Nikiforov, Sasha Zaytsev, Victor Korchevskiy, Natasha Korchevskaya, and Vladimir Dmitriev. We want to give special credit to Nadezda Bulavko, who shared her life's work with us. Brian England, Klim Moysyuk and Victor Ponomarenko added several minerals to the list.

BIBLIOGRAPHY

BULAVKO, N. V. (1984) Relationship between skarns and hydrothermal polymetallic ores. In *Dal'negorsk Ore District Geology*, Krasnov, E. V., and Buriy, G. I., editors. Vladivostok, p. 125–136. (in Russian).

CARR, D. (editor) (1994) *Industrial Minerals and Rocks*. Sixth edition, SMME, Littleton, Colorado, p. 181.

HAMET, M., and ŠTEDRÁ, V. (1992) Die blei-zink und borlagerstatte Dalnegorsk in Ostsibirien. *Mineralien Welt*, **6**, 46–53.

HAMET, M., and ŠTEDRÁ, V. (1994) Il giacimento a Pb-Zn-B di Dalnegorsk, Siberia oriental. *Rivista Mineralogica Italiana*, **17** (3), 259–270.

KIEVLENKO, E. S., TSCHUPROV, V. I., and DRAMSCHEVA, E. E. (1987) *Dekorativnye kollekcionnye mineraly*. Nedra, Moskva.

LISITSYN, A., and MALINKO, S. (1994) The Dal'negorsk boron deposit: a unique mineralogical object. *World of Stones*, **4**, 30–40.

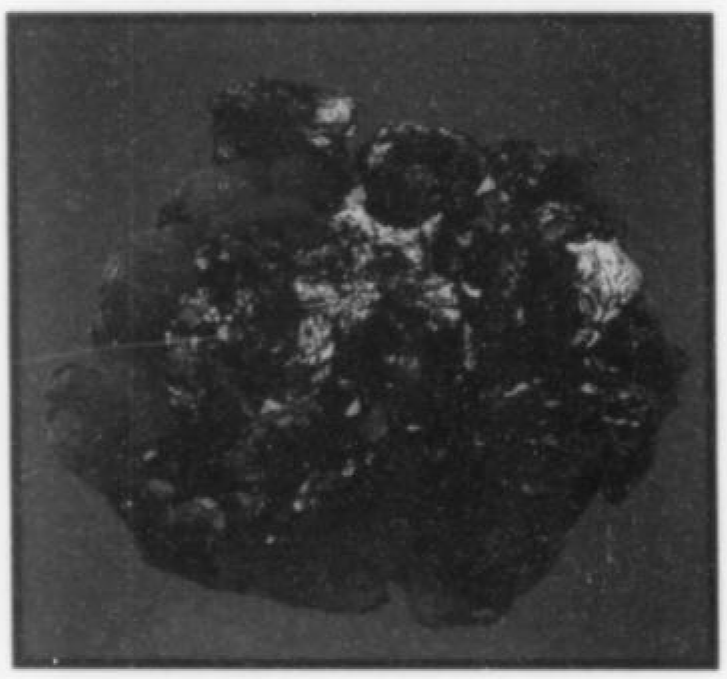
MALINKO, S. V., DUBINCUK, V. T., and NOSENKO, N. A. (1992) Samorodnys bismut v datolitovych rudach Dalnegorskovo bornovo mestoroshdenya. *Mineralogitscheskij Zhurnal*, **14** (1), 42–52.

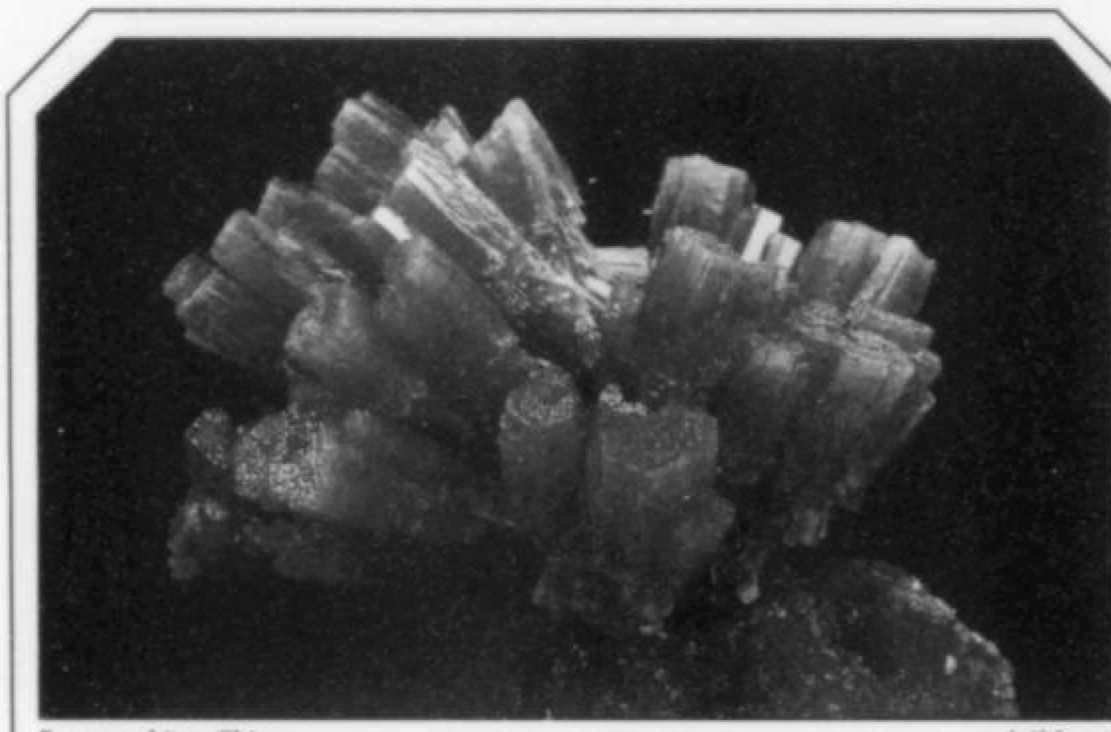
NATAROV, A. G., SVERSHNIKOVA, O. L., and GALJUK, V. A. (1972) Pervaya nachodka andorita v. sssr. *Doklady Akademia Nauk SSSR*, **206** (1), 189–192.

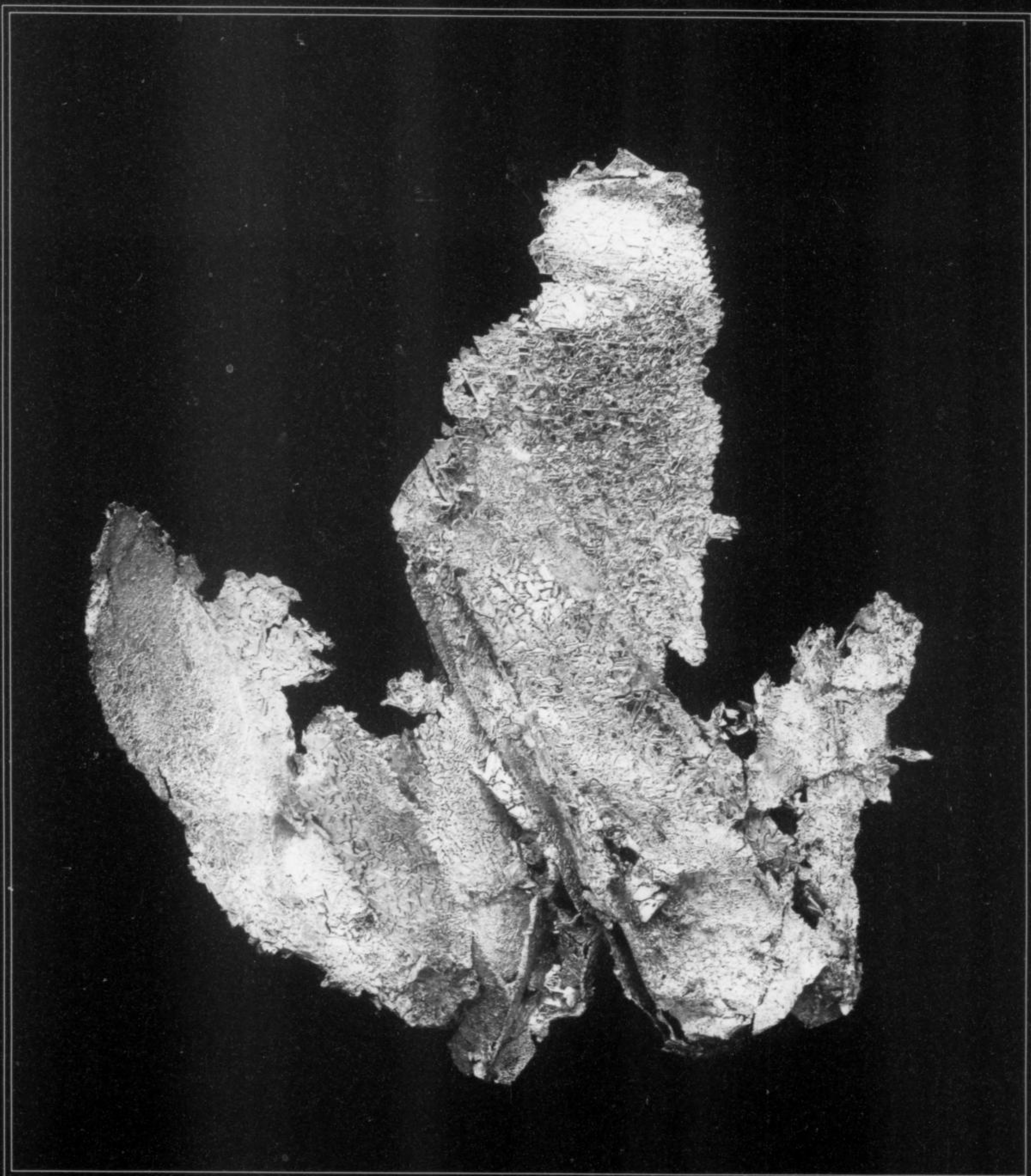
SMIRNOV, V. I. (1978) *Rudnye mestorozhdenya SSSR*. Nedra, Moskva, 1–3.

SMIRNOV, V. I. (editor), GINZBURG, A. I., GRIGORIEV, V. M., and YAKOVLEV, G. F. (1983) *Studies of Mineral Deposits*. Mir Publishers, Moscow, p. 112–113.

SMITH, B., and SMITH, C. (1995) A guide to mineral localities in the former Soviet Union. *Mineralogical Record*, **26**, 517–549.







Gold (11.5 cm), Farncomb Hill, Breckenridge, Colorado

Wayne A. Thompson

FINE MINERALS

P.O. BOX 32704, PHOENIX, AZ 85064 • 602-678-0156

photo by Jeff Scovil


JOHN BETTS
FINE MINERALS
WWW.JOHNBETTS-FINEMINERALS.COM
Online Catalog
-Classic Minerals
-Quality Photos
-Weekly Updates
Send for catalog
John Betts
215 W. 98 St.
NY, NY 10025
212-678-1942

THE MUSEUM DIRECTORY

New York State Museum
Curator (Geol.): Dr. William Kelly
Tel: 518-474-7559
Collections Mgr. (Geol.):
Michael Hawkins
Tel: 518-486-2011
Fax: 518-486-3696
3140 Cultural Education Ctr.
Albany, NY 12230-0001
Website; www.nysm.nysed.gov
Hours: 10–5 daily (closed Thanksgiving, Christmas, New Years)
Specialty: New York & worldwide minerals
Support Org.: NY State Acad. of Mineralogy (www.nysm.nysed.gov/nysam)

Geology and Meteorite Museums University of New Mexico
Curators: Gary Smith (Geology), Rhian Jones (Meteorites)
Tel: (505) 277-4204
Dept. of Earth & Planetary Sciences
Northrop Hall, Univ. of New Mexico
Albuquerque, NM 87131
Hours: 8–12, 1–4 M–F (closed on school holidays)
Specialties: Worldwide minerals and meteorites, New Mexico fossils, Harding Pegmatite Mine Collection

Colburn Gem & Mineral Museum
Tel: (704) 254-7162
Fax: (704) 251-5652
Website: www.main.nc.us/colburn
Pack Place Education, Arts & Science Center
2 South Pack Square
Asheville, NC 28801
Hours: 10–5 Tues.–Sat. (all year); 1–5 Sun. (June-Oct.); Closed Mondays and holidays
Specialties: North Carolina and worldwide minerals and gems
Accessible to persons with disabilities

Harvard Mineralogical Museum
Curators: Dr. Carl A. Francis
William Metropolis
Tel: (617) 495-4758
24 Oxford Street
Cambridge, Mass. 02138
Hours: 9–4:30 M–Sat.; 1–4:30 Sun.
Specialties: Systematic Mineral Coll'n

Cleveland Museum of Natural History
Curator: Position open
Tel: 216-231-4600
1 Wade Oval Drive, University Circle
Cleveland, OH 44106-1767
Hours: 10–5 M–Sat, 1–5 Sun
Specialties: Gems, Jewelry, Mineralogy

Western Museum of Mining & Industry
Curator: Terry A. Girouard
Tel: (719) 495-2182
email: curatewmmi@juno.com
Dir. of Educ.: Gary Renville
Tel: (719) 488-0880
Fax: (719) 488-9261
www.wmmi.org
1025 North Gate Road
Colorado Springs, CO 80921
Hours: 9–4 M-Sat., (12-4 Sun., June–Sept. only), closed holidays
Specialties: Colorado minerals & ores, Western mining memorabilia, 14,000-vol. research library

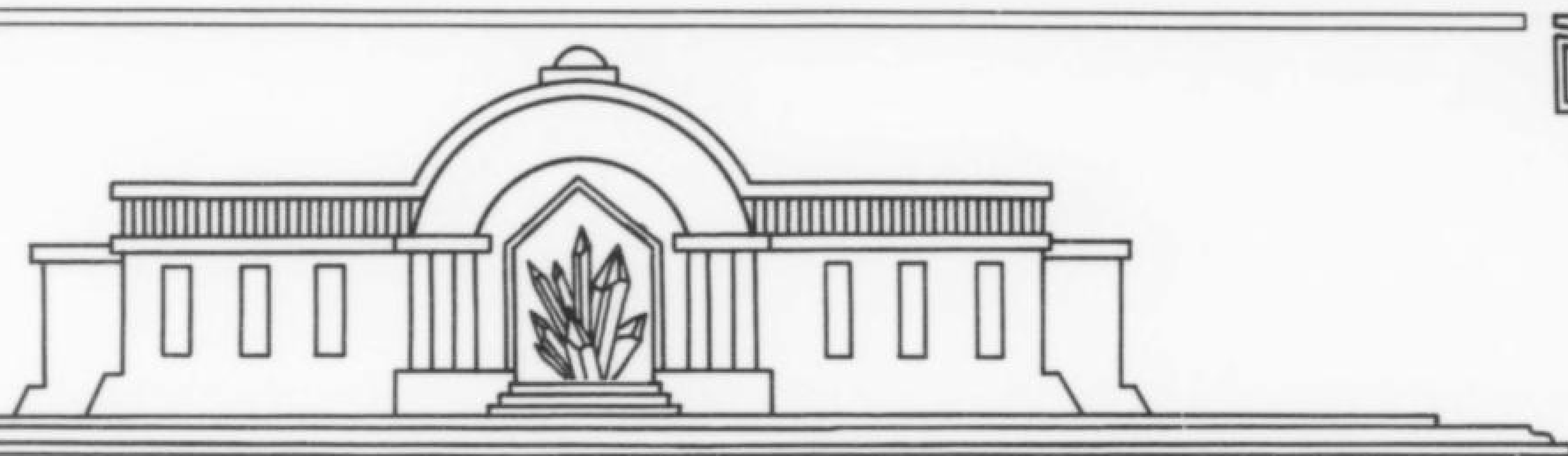
The Gillespie Museum of Minerals, Stetson University
Curator: Dr. Bruce Bradford
Tel: (904) 822-7331
E-mail: bbradfor@stetson.edu
Assistant Director: Holli M. Vanater
Tel: (904) 822-7330
E-mail: hvanater@stetson.edu
Fax: (904) 822-7328
234 E. Michigan Avenue
DeLand, Florida
Mailing: 421 N. Woodland Blvd., Unit 8403, DeLand, FL 32720-3757
Hours: 9–noon, 1–4 M–F when university is in session (closed on holidays, university breaks & in the summer)
Specialties: Worldwide comprehensive collection of rocks & minerals; Florida rocks, minerals & fossils; large historic fluorescent collection

Denver Museum of Natural History
Curator of Geology: Jack A. Murphy
Tel: (303) 370-6445
Dept. of Earth Sciences
20001 Colorado Blvd.
Denver, CO 80205
Hours: 9–5 daily
Specialties: Colorado minerals

Geology Museum Colorado School of Mines
Curator: Virginia A. Mast
Tel: (303) 273-3823
Golden, Colorado 80401
Hours: 9–4 M–Sat., 1–4 Sun. (closed on school holidays & Sundays in the summer)
Specialties: Worldwide minerals; Colorado mining & minerals

A. E. Seaman Mineralogical Museum
Director: Stan Dyl
Curator (mineralogy):
George W. Robinson
Adjunct Curator: Dr. John A. Jaszczak
Tel: (906) 487-2572
Michigan Technological Univ.
Houghton, Michigan 49931
Hours: 9–4:30 M–F
Specialty: Michigan minerals, copper minerals & worldwide minerals

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



THE MUSEUM DIRECTORY

Natural History Museum of Los Angeles County

Fax: (213) 749-4107
Website: http://nhm.org/minsci
Curator (Mineral Sciences):
Dr. Anthony R. Kampf
Tel: (213) 763-3328
e-mail: akampf@nhm.org
Collections Manager:
Dorothy L. Ettensohn
Tel: (213) 763-3327
e-mail: dettenso@nhm.org
900 Exposition Blvd.
Los Angeles, CA 90007
Hours: 9:30–5:00 Daily
Specialties: Calif. & worldwide minerals, gold, gem crystals, colored gemstones
Support organization:
The Gem and Mineral Council

Arizona Mining & Mineral Museum

Department Director: Doug Sawyer
Curator: Sue Celestian
Tel: (602) 255-3795
1502 W. Washington Avenue
Phoenix, AZ 85007
Hours: 8–5 M–F, 11–4 Sat., closed Sun. & holidays
Specialty: Arizona minerals

Carnegie Museum of Natural History

Collection Manager: Marc L. Wilson
Tel: (412) 622-3391
4400 Forbes Avenue
Pittsburgh, PA 15213
Hours: 10–5 Tues.–Sat., 10–9 F, 1–5 Sun., closed Mon. & holidays
Specialty: Worldwide minerals & gems

New Mexico Bureau of Mines & Mineral Resources—Mineral Museum

Director: Dr. Virgil W. Lueth
Tel: (505) 835-5140
E-Mail: vwlueth@nmt.edu
Fax: (505) 835-6333
Associate Curator: Robert Eveleth
Tel: (505) 835-5325
E-mail: beveleth@gis.nmt.edu
New Mexico Tech, 801 Leroy Place
Socorro, NM 87801
Hours: 8–5 M–F, 10–3 Sat., Sun
Specialties: New Mexico minerals, mining artifacts, worldwide minerals

Museum of Geology

Director: Philip R. Bjork
Tel: (605) 394-2467
South Dakota School of Mines & Technology
501 E. St. Joseph Street
Rapid City, SD 57701-3995
Hours: 8–5 M–F, 9–4 Sat., 1–4 Sun.
Specialty: Black Hills minerals, esp. pegmatites

Penn State Earth & Mineral Sciences Museum

Curator: Dr. Andrew Sicree, PhD
Tel: (814) 865-6427
E-mail: sicree@geosc.psu.edu
Steidle Building
University Park
State College, PA 16802
Hours: 9–5 M–F & by Appt. (closed holidays)
Specialties: Mineral properties exhibits; "velvet" malachite; old Penna. minerals, mining art

Arizona-Sonora Desert Museum

Collections Manager & Mineralogist: Anna M. Domitrovic
Tel: (520) 883-1380 ext. 152
Fax: (520) 883-2500
2021 N. Kinney Road
Tucson, AZ 85743-8918
Hours: 8:30-5 Daily (Oct.-Feb.)
7:30-6 Daily (Mar.-Sept.)
Specialty: Arizona minerals

Pacific Mineral Museum

Director/Curator: Mark Mauthner
Tel: (604) 689-8700
E-Mail: markm@pacificmineralmuseum.org
848 West Hastings Street
Vancouver, B.C., Canada V6C 1C8
Hours: M–F 10–5, Weekends 10–6 (Closed Mondays in winter)
Specialties: BC–Yukon–Pacific NW, worldwide, gold, silver

William Weinman Mineral Museum

Asst. Curator: Doug Gravely
Tel: (770) 386-0576
51 Mineral Museum Dr.
White, GA 30184
Hours: 10–4:30 Tues.–Sat., 2–4:30 Sun.
Specialty: Georgia & worldwide minerals & fossils

Europe

Giazotto Mineralogical Museum

Curator: Adalberto Giazotto
Tel: 011-39-050-501-587
Cell: 011-39-347-371-8870
E-mail: adalberto.giazotto@pi.infn.it
Lungarno Gambacorti 39
I-56100 **Pisa, Italy**
Tel: 011-39-050-501-587
Cell: 011-39-347-371-8870
E-mail: adalberto.giazotto@pi.infn.it
Hours: by Appointment
Specialty: Italian and Worldwide—minerals

Additional listings welcome!

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

Museums listed alphabetically by city

22nd Annual
FM-TGMS-MSA
Mineralogical Symposium

The Minerals of Russia

9:30 AM – 4:20 PM
Saturday, February 10, 2001
Crystal Ballroom, Tucson Convention Center

Program

9:30–9:40 Introduction and Welcome—Symposium Chairman
Raymond Grant

9:40–10:00 Famous Russian Mineral Localities; and Mineral Collecting in the former Soviet Union, Past and Present
Dmitriy Belakovskiy

10:00–10:20 Alkaline Massifs in Russia and the former Soviet Union—A Mineral Heaven
Dmitriy Belakovskiy

10:20–10:40 Kola Peninsula: The Greatest Mineral Treasure of Russia Today
Igor Pekov

10:40–11:00 Mineralogy of the Burpala Alkaline Massif (North of Lake Baikal)
Aleksandr Portnov

11:00–11:25 Recent Mining of Minerals and Gems in Russia by the Stone Flower Company
Nikolai Kouznetsov

11:25–11:40 Nomenclature of Quartz Color Variations—Pink and Rose
Hidemichi Hori

11:40–12:00 Trace Element Zoning in Metamorphic Minerals
Sergei Skublov

12:00–1:20 Lunch Break

1:20–1:40 The Crystal Structure and Charge Density Analysis of Kovdorskite ($Mg_2(PO_4)(OH)\cdot 3H_2O$)
Charles Lake and Bryan Craven

1:40–2:00 The New Russian Classics
William Shelton

2:00–2:20 Tourmaline from the Malkhanskiy Pegmatite District
William B. Simmons, Karen L. Webber, and Alexander U. Falster

2:20–2:40 Gem Pegmatites and Greisens Deposits of Russia in the Twentieth Century
Peter Lyckberg

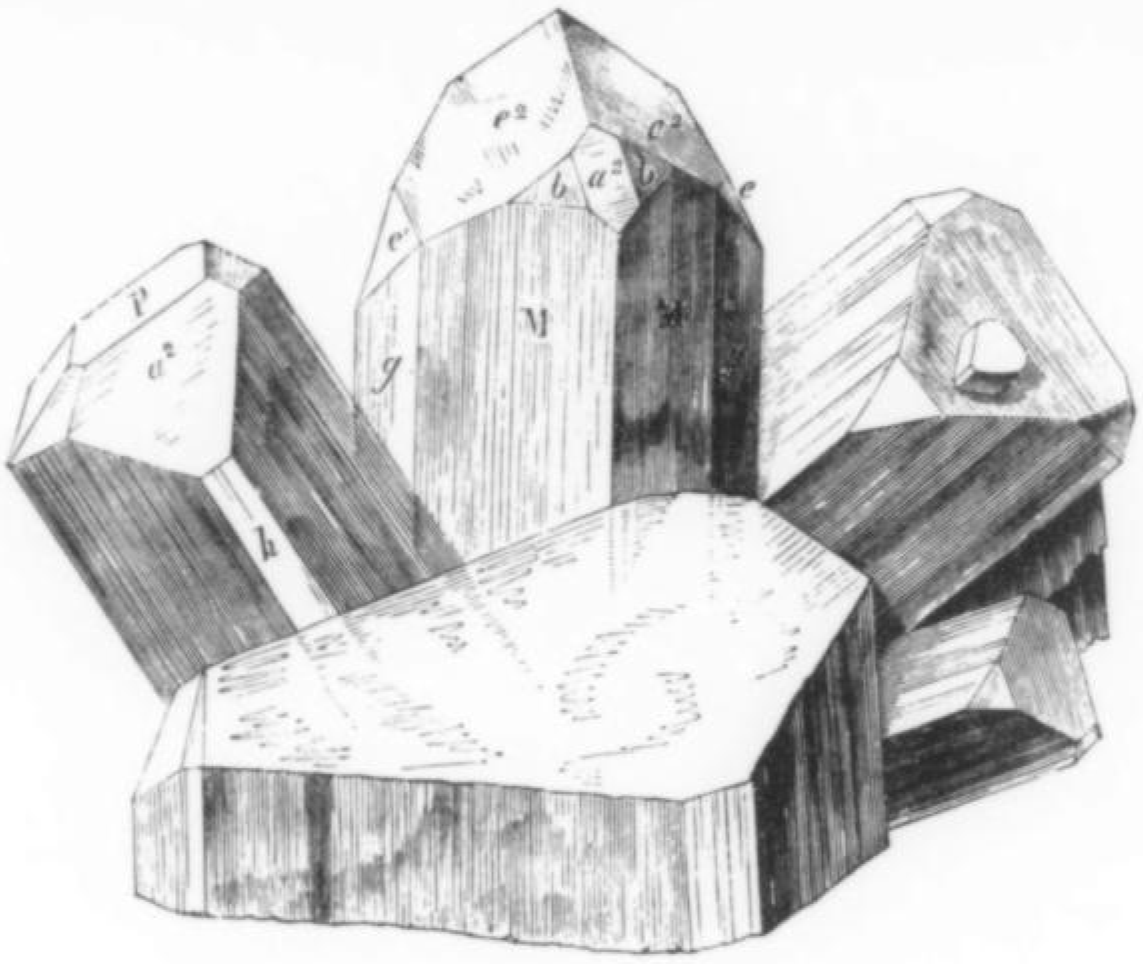
2:40–3:00 Gem pegmatites of the Ukraine, Kazakhstan and Tajikistan
Peter Lyckberg

3:00–3:20 Gem Beryl and Topaz of Scherlovaya Gora, Transbaikal, Russia
Peter Lyckberg

3:20–3:40 Chromate Minerals from Berezovskoye Deposit, Ural Mountains, Russia
J. A. McGlasson

3:40–4:00 Nickel-Platinum Group Element Deposits, Noril'sk, Siberia
J. A. McGlasson and Rosie Moore

4:00–4:20 Mines and Minerals of Dal'negorsk, Russia
Raymond Grant, John Weide, and Victor Korchevskiy



Topazes de Sibérie

Introduction

The 22nd Annual Tucson Mineralogical Symposium sponsored by the Friends of Mineralogy, the Tucson Gem and Mineral Society, and the Mineralogical Society of America will be held on Saturday, February 10, 2001 at the Tucson Convention Center. Admission is free and everyone is welcome. *Minerals of Russia and the former Soviet Union* are the featured minerals at the Tucson Show and are also the subject of the 2001 symposium.

Present-day Russia is a country of over 6.5 million square miles, and the former Soviet Union was much larger. In this vast region are many and varied mineral deposits. The large number and the range of types of mineral deposits coupled with an active mining industry and a long history of mineralogical research have led to an extensive and rich history for the study of Russian minerals and localities. The Saint Petersburg Mining Institute and the associated museum were founded in 1773 and continue their activities today. In more recent years many scientific institutes and university departments were established across Russia to do research in geology and mineralogy. The studies and literature related to Russian minerals and localities are as extensive as those of any country in the world.

The papers presented in this year's symposium cover a wide range of material, from regional studies to individual localities to specific mineral data. There are amateur collectors and professional mineralogists presenting papers. One goal of the Friends of Mineralogy is to bring these groups together, and this symposium is one of the main ways this goal is reached. There are also seven Russian authors or co-authors of papers (also one author from Sweden and one from Japan), making this symposium an international effort.

A continuing problem with Russian mineral localities is the transliteration of the locality names from Russian to English. Different authors have used a variety of spellings for the names of the Russian localities, which leads to some confusion. A complicating factor is that the name of a locality will have a different ending in Russian depending on whether it is the name of a town, a deposit, or a mine. For example, *Orlovskiy* is the name of a town and *Orlovskoye* is the name of a deposit. Another source of difficulty is the soft sound in Russian. Some authors ignore it while others use an apostrophe to indicate that the preceding consonant is softened; for example, the use of Norilsk or Noril'sk. A third source of confusion in transliteration is whether to use the Russian vowel in the word or the English vowel which reflects more accurately the Russian pronunciation. I have tried to standardize the names in the abstracts presented here based on Smith and Smith (A guide to mineral localities in the former Soviet Union, 1995, *Mineralogical Record*, **26**, 517–541) and a National Geographic Map (*Russia and the Newly Independent Nations of the Former Soviet Union*, March 1993). For a few of the localities, I found no information and the Russian spelling was not available. I am wholly responsible for the spelling of locality names used in the abstracts.

Raymond Grant
Symposium Chairman

Famous Mineral Localities and Mineral Collecting in the Former Soviet Union, Past and Present

Dmitriy Belakovskiy, Curator
Fersman Mineralogical Museum
Moscow, Russia
dmz@minmuz.msk.su

Interest in the collecting of fine mineral specimens started in Russia at the beginning of the eighteenth century. Since that time there have been two main periods for the discovery of world-famous localities in Russia. There are political reasons for both these periods of discovery.

A considerable number of localities were discovered in the middle of the eighteenth century. This was the time of the development of Siberia and the far eastern territories of Russia.

The great Siberian expeditions, besides discovering many gold, silver and other ore deposits, also found a number of aquamarine, heliodor, topaz and tourmaline occurrences in the Transbaikal and the Urals, the lapis deposits in the Lake Baikal area, the wiluite at Viluy river and many other mineral localities.

The other great period of discovery was in the second quarter of the twentieth century, when valuable additions of outstanding mineral localities were made during the geological investigations of the Kola Peninsula, the Central Asian Republics, the northern Urals and Siberia and other regions of Russia.

We can now describe about 200 important mineral localities in the territory of the former Soviet Union. Approximately a dozen of them produced an enormous amount of crystalline materials and a number of different minerals. The *Dal'negorsk area* skarn deposits are famous for crystals of sulfides (galena, sphalerite, arsenopyrite, pyrrhotite etc.) and also for exceptional high-quality crystals of quartz, calcite, fluorite, datolite, danburite, ilvaite and others. *Kara-Oba, Akchatau* and other W-Mo greisen deposits in Kazakhstan have produced excellent crystals of hübnerite, creedite, different kinds of fluorite, topaz, rhodochrosite, bertrandite, pyrite and many other minerals. In the *Northern Urals* alpine type veins gave us endless varieties of quartz and crystals of axinite, brookite, anatase, rutile, hematite, ilmenite, kainosite, adularia, calcite and more. Two very similar magnesium skarn deposits, one in *Sludyanka* (Lake Baikal), and the other around *Aldan* in Sakha-Yakutia, are famous for huge crystals of blue apatite, phlogopite, pargasite, diopside, spinel, forsterite and zircon. The *emerald mines* east of Ekaterinburg are well known also for excellent alexandrite twins, phenakite crystals, apatite and spessartine. And located just a couple of miles south of the emerald mines are the rhodingites of the *Bazhenovskoe* asbestos deposit (a twin of the Jeffrey mine in Canada) with different colors of vesuvianite, grossular, diopside, clinochlore, and huge blue brucite crystals. *Kovdor* in the Kola Peninsula has yielded magnetite, phlogopite, and forsterite crystals plus a number of crystalline rarities (kovdorskite, bobierite, and manasseite).

Another dozen localities are interesting in terms of the number of mineral species found in one place. There is no competition for the number of species found in the alkaline complexes such as *Khibiny* and *Lovozero* in Kola (more than 400 species), *Ilmenskie* and *Vishnevye Mountains* in the South Urals (more than 300 species), and the *Murun massif* in Sakha-Yakutia.

Another three dozen localities are well-known for attractive examples of two to four species. For example, the *Murzinka* area in the Urals is famous for topaz, heliodor, and amethyst. The *Kerch area* in the Crimea Peninsula, Ukraine, is famous for vivianite and anapaite.

Finally, the remainder of the localities are known as a source of good specimens for one mineral species such as the tourmaline at *Malkhanskiy* district, Transbaikal.

During the time of the Soviet Union, mineral collecting was not very popular. This was unfortunate, because many extremely interesting materials (often from the most interesting upper parts of deposits) were crushed during excavation or buried in the dumps because of the lack of interest. The few existing mineral museums and private collectors could not collect all of the minerals available. At the beginning of the 1990's, when the export and trading of minerals became possible, there was a wave of interest and a lot of excellent material was mined and sold abroad. Currently a large number of important mines are closed due to the military and economic collapse. There are still many possibilities for getting fine minerals in Russia today, but the poorly designed licensing system for mining and the senseless export requirements make the hunt for and export of mineral specimens rather difficult.

Alkaline Massifs in Russia and the Former Soviet Union—A Mineral Heaven

Dmitriy Belakovskiy, Curator
Fersman Mineralogical Museum
Moscow, Russia
dmz@minmuz.msk.su

Alkaline massifs contain more mineral species than any other type of deposit. In some of them it is possible to find more than one tenth of all the mineral species known on the earth (about 4000), and these minerals can be found in a small area, sometimes just a few hundred square miles. In most other types of deposits we can find just a couple of dozen mineral species. There are a few exceptions, such as Franklin, New Jersey, and Långban, Sweden, but the number of species found in these localities is still less than the number found in the richest alkaline massifs. One of the main reasons why there are so many different minerals is the chemistry of alkaline magmas. Almost every element of the periodic table is found in alkaline rocks in concentrations above the average concentration of that element in the earth's crust. Only five elements have a lower-than-average concentration in alkaline rocks.

The Khibiny and Lovozero massifs hold the world's record. The number of species found there so far is close to 500. Those massifs have been very well described. Therefore, in this report we will concentrate on lesser-known localities such as the Murun massif in Sakha-Yakutia, the Ilmeno-Vishnevogorskiy alkaline complex in the Urals, the Dara-i-Pioz alkaline massif, Tajikistan, the Oktyabrskiy massif, Ukraine, and a few other locations.

The mineral specimens that come from these localities are not only "ugly rare species," but there are also some beautiful specimens of rare minerals. A brief description of the geological features, mineralogy, local landscapes, and most remarkable specimens will be given.

Kola Peninsula: The Greatest Mineral Treasure of Russia Today

Igor Pekov
Lomonosov Moscow State University
Moscow, Russia
igorpekov@mtu-net.ru

Extensive research has been carried out on the minerals of the Kola Peninsula region of Russia for the past one hundred years. In the Kola region there is an abundance of unique mineral localities in a very small area. These localities represent a variety of different genetic types, and the deposits are characterized by an unusual mineral diversity.

The list of minerals from the Kola Peninsula numbers about 1,000 species, and Kola is the type locality for 180 mineral species. There are economic concentrations of more than 60 elements, which have led to extensive mining in the region; that mining is responsible for the avalanche of new mineral discoveries. More than half of the minerals are found in the world's largest alkaline igneous complex, the *Khibiny-Lovozero complex*. The Khibiny complex is the type locality for 130 of the 180 type minerals. Giant deposits of apatite and loparite are currently being mined at the Khibiny complex.

Many of the famous Russian mineral localities such as the Urals, Altai, and Transbaikal are of historical interest, but the Kola region is very active and is producing mineral specimens at present. Many of the Kola localities have become classics. Kola is best known for rare minerals, including the new species, many of which are found as large, perfect crystals, the world's best specimens of these minerals.

Among the many deposits of the Kola are the Khibiny-Lovozero agpaitic massif, the alkaline ultrabasic massifs such as Kovdor, Afrikanda, Turiy, and Mys, the amazonite pegmatite of the western Keivy Plateau, and the Li-Ta-enriched Voron'i Tundry pegmatite. Some interesting occurrences are also found in Precambrian metamorphic rocks, and in younger sedimentary rocks.

Mineralogy of the Burpala Alkaline Massif (North of Lake Baikal)

Aleksandr Portnov
Moscow Geological Prospecting Academy
Moscow, Russia

The Burpala alkaline massif has an oval form and covers an area of 230 square kilometers. The rocks of the massif are Paleozoic in age. Burpala, located 100 km to the north of Nizhneangarsk on Lake Baikal, consists of nepheline syenites in the central part and syenites in peripheral parts of the massif. These rocks are intruded into sandy-schistose sediments of Cambrian age. Veins of nepheline syenite pegmatites cut the massif in the central part and syenite pegmatites are present in contact zones with zones of nepheliniti-zation being typical for exocontacts.

The following minerals are found in the nepheline syenites: britholite, titanite, eudialyte, lamprophyllite, and apatite. The syenite pegmatites contain calcium catapleiite, titanium-rich lavenite, lorenzenite, cesium-rich astrophyllite, kupletskite, pyrophanite, leucophanite, strontium-apatite, loparite, calcium-rich seidozerite, strontium-rich and zirconium-rich perrierite, brookite, landauite, murataite, polylithionite, brewsterite, chabazite, monazite, ancylite, bertrandite, vlasovite, hambergite. Melanocerite, ortholavenite, loparite, thorite, thorianite, eudialyte, perrierite, chevkinite, zircon, leucophanite, catapleiite, astrophyllite, tainiolite, calcium-rich seidozerite are found in nepheline-albite phenites at the exocontact.

Mineral associations from Burpala are typical of alkaline massifs with an intermediate position between miaskite and agpaite alkaline rocks; the associations are similar to the mineralogy of alkaline pegmatites from Langesundfjord (southern Norway) and Colorado (USA).

Recent Mining of Minerals and Gems in Russia by Stone Flower Company

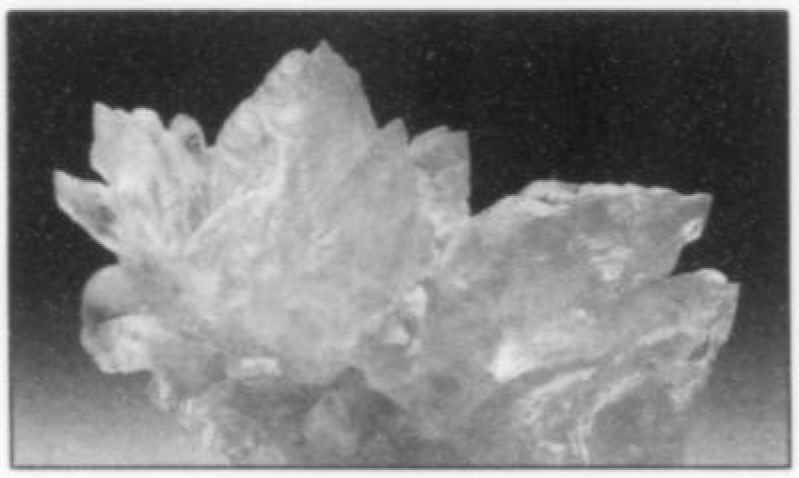
Nikolai Kouznetsov
Stone Flower Company
Moscow, Russia
Nikki@hawkaccess.com

The Stone Flower Company was founded in 1986 as a cooperative. It was the first private company in Russia to deal with gems, minerals, and fossils. Its purpose was to send specialists to various parts of the USSR to mine or buy material to sell to the public and to collectors.

Areas of interest included: *Kazakhstan*—the Altyn-Tyube mine for dioptase; Karaganda and Dzhezkazgan for silver, wolframite, rutilated quartz, rhodochrosite, and other minerals; Itmurundy for jadeite; *Ural Mountains near Ekaterinburg*—Malyshevo for alexandrites and emeralds; Murzinka for topaz and other minerals; Potanino near Chelyabinsk for sapphire and other minerals; *Polar Urals*—Raiz for ruby; Kechpel and Pusyerka for jadeite; *Far East*—Dal'negorsk for fluorite, calcite, axinite, and other minerals.

After the collapse of the Soviet Union there was tremendous chaos in all activities in Russia, and the Stone Flower Company and the nature of its business changed dramatically. These changes involved new personnel, different tasks and goals, and different motivations.

Some of the recent mining activities of the Stone Flower Company include: Polar Urals—Kechpel for jadeite (1993–1994); Ural Mountains—Kakodino mine for demantoid (1995–1998); Caucasus Mountains, Dashkesan mine, Azerbaijan for quartz, epidote, magnetite, calcite, garnet, and amethyst (1996 to present); Caucasus Mountains, Kapuldzhyk, Azerbaijan for rutile (1999 to present); and Pamir Mountains, Kyrgyzstan for ruby, quartz, and demantoid (1999 to present).



Pink quartz, Pitorra mine, Brazil

Nomenclature of Quartz Color Variations—Pink and Rose

Hidemichi Hori
Hori Mineralogy Ltd.
P.O. Box 50, Nerima,
Tokyo, Japan 176-0013

Massive rose quartz is a common occurrence in nature, but crystals of rose quartz are very rare. The rarity of crystallized rose quartz is one of the mysteries of the mineral world.

Recently, the Russians have been selling synthetic pink quartz as a commercial product, manufactured for the gem market. Research by Russian scientists found that the origin of the pink color of the *crystals* from Brazil is related to a trace amount of phosphorus in the crystals. The color of the *massive* rose quartz, on the other hand, is believed to be related to a trace amount of titanium. The Russians have used this information about phosphorus to grow gem-quality pink quartz. It is probably no coincidence that natural occurrences of rose quartz crystals are usually found associated with phosphate minerals, for example the occurrence of childrenite with the pink quartz crystals from Brazil.

It is proposed, based on this information, that massive rose quartz should continue to be referred to as "rose quartz," whereas the crystallized material should henceforth be referred to as "pink quartz," in recognition of the different chromophores.

References

BALITSKY, V. S., *et al.* (1998) Russian synthetic pink quartz. *Gems and Gemology*, Spring, 34–43.

Trace Element Zoning in Metamorphic Minerals

Sergei Skublov
Institute of Precambrian Geology and Geochronology
Russian Academy of Sciences
St. Petersburg, Russia

Zoned amphiboles and clinopyroxenes in a garnet amphibolite from the Nyurundukan ophiolitic complex, in the northwest Baikal region, have been analyzed by electron microprobe for major elements and by ion microprobe for their REE, Cr, Ti, V, Zr, Y, and Nb content. The samples investigated contain the assemblage hornblende + garnet + clinopyroxene +/– plagioclase + epidote + sphene. Rims of blue-green hornblende are found around brown hornblende. This zoning has been attributed to regressive metamorphism consistent with the granulite to amphibolite facies transition. Increasing pressure toward a paleosubduction zone is the probable cause of this regressive metamorphism. Previous work on the thermobarometry suggests that the metamorphic conditions of the Nyurundukan complex were 600 to 650°C and 10 to 11 kilobars.

The amphibole studied is zoned with regard to both major and trace elements. From the core to the rim Ti content drops by a factor of 2.7. Na and Al increase slightly to the rim and Cr and V remain virtually constant. Zr (factor of 4), Y (factor of 4.5), and Nb (factor of 7) all decrease from the core to the rim. The amphibole core has higher REE amounts than the rim. All the REE decrease in abundance toward the rim by a factor of about 4 to 5, except for the HREE (factor of 10 for Yb).

The clinopyroxenes from eclogitized gabbros are also zoned. The igneous clinopyroxene relicts in the cores are diopsides with relatively high TiO_2 contents (approximately 1.2 weight %). The clinopyroxene rims display a strong increase in Na (up to 13 mole percent of jadeite). The REE, Ti and Y in the clinopyroxenes decrease in abundance from the core to the rim at a slightly lower rate than the rate of decrease in the amphiboles studied.

The trace element compositions of the amphiboles and clinopyroxenes reflect a high-pressure metamorphic event. For example, the rims of metamorphic minerals in the eclogites and garnet amphibolites are more strongly REE depleted than the cores of these minerals, which formed during a previous lower-pressure metamorphic stage.

The Crystal Structure and Charge Density Analysis of Kovdorskite ($Mg_2(PO_4)(OH)\cdot 3H_2O$)

Charles H. Lake and **Bryan M. Craven**
Department of Chemistry
Indiana University of Pennsylvania
Indiana, Pennsylvania 15705

Kovdorskite ($Mg_2(PO_4)(OH)\cdot 3H_2O$) is a mineral named after the town of Kovdor in the Kola Peninsula of Northern Russia. Our particular specimen came from the Precambrian Lovozero Massif, located between Lake Lovozero and Lake Umbozero, and was provided from the private collection of Professor Robert Newnam (Penn State). The mineral is found in pegmatites, which were crystallized from an alkaline magma possessing high concentrations of magnesium and phosphate ions. The ionic structure crystallized in the monoclinic space group $P2_1/n$ with the cell dimensions a = 4.724 Å, b = 12.729 Å, c = 10.134 Å and β = 102.22° with 4 formula units per unit cell.

The MgO_6 octahedra are arranged in clusters of four units in a raft-like structure, with neighboring octahedra sharing an edge (two formula units per raft). At the center of each raft are two special corners where three octahedra are joined. These corners are occupied by the hydroxyl ions. The tetrahedral phosphate ions form bridges between different rafts of octahedra so as to form a rigid 3-D framework. This 3-D framework possesses tube-like structures perpendicular to the *ac* face of the crystal. All the water hydrogen atoms are directed into these cavities where they form a system of hydrogen bonds. The hydroxyl ions, which are located in the middle of the rafts, contribute little, if at all, to the hydrogen bonding system.

Kovdorskite was found to be an excellent candidate for charge density analysis. The atoms in the structure of kovdorskite are bound very tightly. This resulted in very small and well-defined thermal parameters and consequently, allowed us to collect Mo Kα diffraction data out to $\sin\theta/\lambda$ = 1.26 Å^{-1}. This corresponds to a resolution of 0.41 Å. In this study we will present the electronic charge density in the crystal structure. Electronic deformations have been modeled by the least squares method based upon the pseudo atom model with multipole expansion to the octapole level. The $R(F^2)$ for all 9,883 unique reflections was 4.7%. The experimental net charges obtained for the magnesium, phosphate and hydroxyl ions were +1.2, –2.0 and –0.5, respectively. At the saddle points, in the total electron density, the principal values of the curvature are being determined. The results will be of importance in estimating the ionic vs. covalent character of the various bonds.

The New Russian Classics

William Shelton
19 Highland Avenue
Westfield, Massachusetts 01085

During the past ten years the number of mineral specimens from Russia and the former Soviet Union available to the public has increased greatly. A large number of specimens have found their way to the American market. Collectors can buy superb specimens that have been recently produced from several significant localities in this region, and can also buy good-quality older material from the region. Some of these mineral specimens will become "classics." This is one private collector's experience with some of the newly available material. Several examples are included to illustrate the quality of the material and reasons are given why these specimens may or may not become "classic."

Bornite crystals from Kazakhstan are truly exceptional in size, quality, and abundance. These factors will make this bornite a classic. Quartz with inclusions, which has been labeled "strawberry quartz," is also available from Kazakhstan, but there are not enough really high-quality specimens to make it a classic.

Heliodor (golden beryl) from Tajikistan is truly outstanding. There are many specimens with a color and quality that rivals the best heliodor in the world.

The alpine veins of the northern Urals of Russia have produced many fine specimens. The two classics are the axinite specimens that are the world's finest and the quartz "gwindels" which rank among the best ever found.

Another occurrence of note is Dal'negorsk in far eastern Russia. Fluorite, quartz, pyrrhotite, ilvaite, and calcite are found as stunning specimens and in sufficient abundance to supply the major ning specimens and in sufficient abundance to supply the major collections in the world. Many unusual quartz specimens are available including orange colored examples unlike any others. The ilvaites are of an exceptional quality.

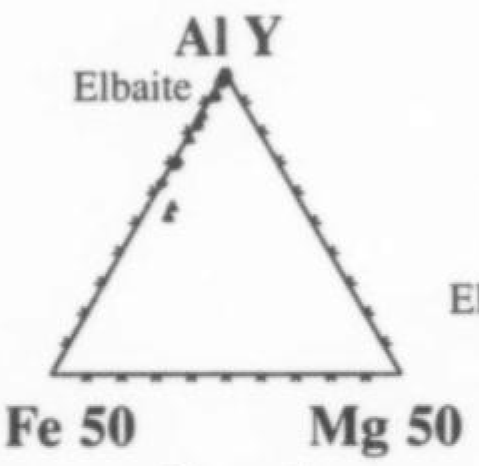


Figure 1

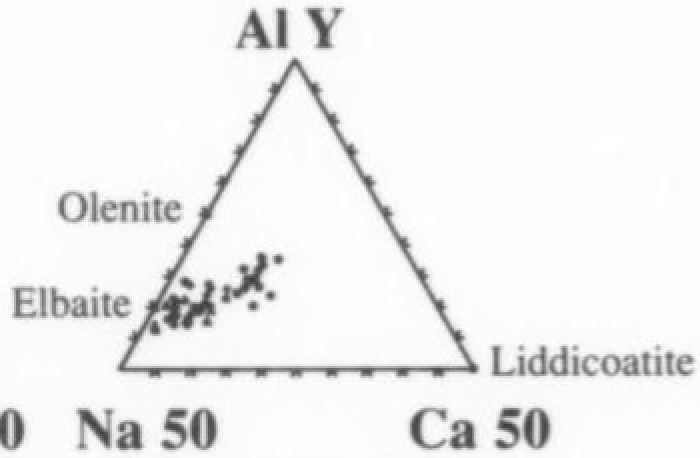


Figure 2

Figure 1. **Y-site Fe-Al-Mg composition of Malkhanskiy tourmaline.**

Figure 2. **Na-AlY-Ca composition of Malkhanskiy tourmaline.**

Tourmaline from the Malkhanskiy Pegmatite District

William B. Simmons, Karen L. Webber,
and **Alexander U. Falster**
Department of Geology
University of New Orleans
New Orleans, Louisiana 70148

The Transbaikal region of southern central Siberia is famous for its gem tourmaline. Pegmatites of the Malkhanskiy district are currently being mined, principally for gem-quality polychrome tourmaline. The pegmatites appear to be related to Jurassic granitic plutons that have intruded Proterozoic metamorphic and igneous rocks.

At least 200 pegmatites are located within the Malkhanskiy district. Of these, seven are currently productive. These include the Mokhovaya, Svetlaya, Orieshnaya, Sosedka, Oktyabrskaya, Zapadnaya and Karkadilovaya pegmatites. The most extensive and productive of these is the Mokhovaya pegmatite, which is granitic in composition and contains abundant miarolitic pockets. The pocket mineralogy consists of gem rubellite, bicolor tourmaline, albite and smoky quartz, with minor pink beryl, lepidolite, danburite, cookeite and pollucite. In some pockets tourmaline is coated with a crust of fine-grained danburite. A few pockets contain large (up to 5 cm), gemmy orange danburite crystals. Additional accessory minerals identified in the Malkhanskiy district include manganocolumbite, monazite, ixiolite, strüverite, bismuthinite, bismutite, topaz, spessartine, cesian beryl, biotite, amazonite and fluorite. Other minerals reported include xenotime, euxenite, bismutocolumbite, bismutomicrolite, microlite, hambergite, petalite, stilbite and apatite.

A suite of polychrome tourmaline, collected from throughout the Malkhanskiy district, ranges in color from dark pink to yellow to green to brown. Electron microprobe analyses reveal that the tourmalines are principally elbaitic in composition (Fig. 1) with fluorine contents of approximately 0.5 apfu.* Color is found to correlate strongly with Y-site chemistry. Pink tourmaline approaches nearly end-member elbaite composition. Green caps and overgrowths on pink tourmaline contain higher total iron and manganese. The unusual yellow-orange to yellow tourmaline has the highest concentration of Mn (up to 8.1 weight % MnO), but contains virtually no iron. Interestingly, yellow tourmaline contains less liddicoatite (Ca) component than do the rims of some elbaite crystals, which contain up to 42% Ca in the X-site. Overall, X-site vacancies are the highest in pink tourmaline, ranging up to 0.3 apfu. Calculated Li concentrations show a strong negative correlation with Mn content in all tourmalines. Although there is variability in the amount of Mn and Ti, there is a general trend of low Mn and Ti in pink tourmalines and high Mn and Ti in most yellow tourmalines. This suggests that the yellow color of Mn-rich, Fe-poor tourmaline may be the result of the Mn^{2+}-Ti^{4+} charge transfer.

*apfu = atoms per formula unit

The district is characterized by elbaite as the principal lithium mineral (which is more abundant than lepidolite), and by the low abundance of late-stage phosphate minerals. Tourmalines are Mn-rich and F-rich with low X-site vacancies. Elbaite is associated with late-stage danburite and hambergite. Based on these characteristics, the Malkhanskiy pegmatites can be classified as belonging to the elbaite subtype of the rare-element class of granitic pegmatites.

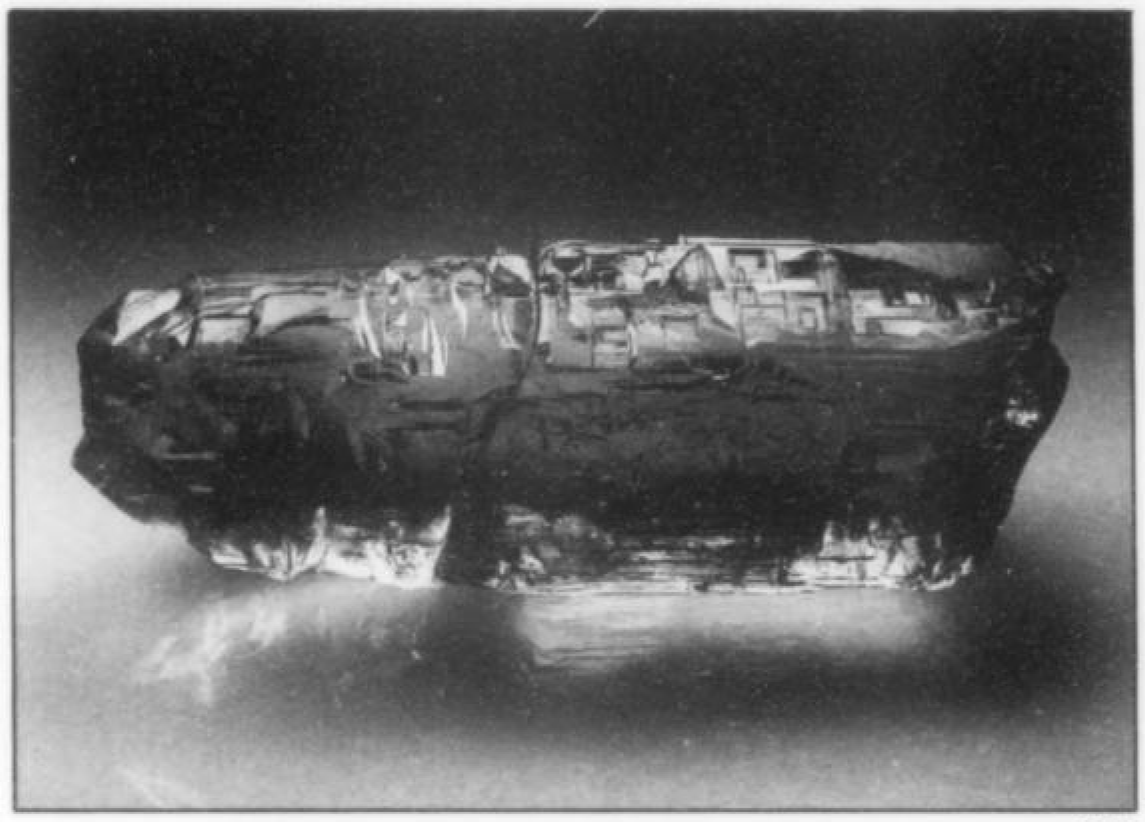
The Malkhanskiy pegmatites have an unusual late-stage chemistry very rich in calcium and boron, as evidenced by the very late crystallization of danburite and hambergite as pocket minerals and overgrowths on miarolitic tourmaline. Tourmaline composition, especially that of the latest tourmaline, is influenced by this enrichment of calcium, which produces elbaite with significant calcium substitution for sodium in the X-site.

Gem Pegmatite and Greisen Deposits of Russia during the Twentieth Century

Peter Lyckberg
BP2785, L-1027 Luxembourg
lyckberg@p&t.lux

Russia has produced some of the finest topaz, beryl, emerald and alexandrite specimens in the world, primarily from the classic deposits in the Urals and Transbaikal. During the twentieth century, renewed mining has taken place.

During the years 1940–2000 the Takovaya district was mined heavily for Be, Ta, Nb and Mo. Many large emerald specimens and alexandrites up to 2 cm were found. The Alabashka-Murzinka-Adui gem pegmatites were studied intensively beginning in 1968 and well into the 1990's. During this period exceptional topaz and beryl specimens were recovered. In Transbaikal, the Malkhanskiy Mountain pegmatites were found in the 1970's carrying fine pink, green and yellow tourmaline. Vodorazhdelnye, in the Menza district south of Malkhanskiy, mined for optical quartz, produced green dravite and flawless elbaite bicolor gem pencil tourmalines. In the Borshchovochniy Range deposits mined for lithium produced tourmaline, topaz, and beryl (Savateeva etc.). Beryl has been found at the Urinskoye pegmatite field and tourmaline at the Polymineralnaya vein. Gem heliodor crystals were found sporadically in the Mama district muscovite pegmatites and, together with topaz, native tin and lead, at Orlovskiy. The classic Sherlovaya Gora greisen deposit was mined for Sn and W, and local collectors found beryl, topaz and smoky quartz. At the nearby Adun Chelon pegmatites a few pockets up to 4 x 3 x 2 meters produced smoky quartz crystals up to 240 kg (90 cm), yellow and blue topaz up to 6.4 kg, and some beryl. Further new deposits include the Svetloye tungsten greisen on Chukotka, producing beryls and topaz, and a mica schist north of Vladivostok producing beryl and topaz; recently gem beryl was found at Pitkäranta near the Finnish border.



Beryl, Volodarsk Volynsk, Ukraine WEW

Gem Pegmatites of Ukraine, Kazakhstan and Tajikistan

Peter Lyckberg
BP2785, L-1027 Luxembourg
lyckberg@p&t.lux

The rapakivi granites of the Korosten pluton in the Ukraine are rich in vuggy pegmatites containing yellowish green to olive-green beryl crystals up to 1 meter and champagne to blue and bi-colored topaz up to many kg in weight. Mining for piezoelectric quartz in Volodarsk (from 6 main shafts connected by main tunnels at the 50, 100 and 150 m level) produced dozens of pegmatites, with pockets to 30 m on each level, until mining ceased in 1996. In Ukraine a little-known pegmatite deposit, possibly mined already by the Scyths near the Krim Peninsula, yields emerald crystals to 2 cm.

In Kazakhstan the Kalban district has produced some fine bicolored green-red tourmalines as well as rare, flawless indicolites to 5 cm. Novoromanovskoye, Bayanolskogo and the Kent massif deposit of zoned pegmatites carry pockets with flawless, large, light purple fluorite and quartz. Akzhailyau massif pegmatites have pockets up to 2 cubic meters with quartz, microcline, cleavelandite and rarely fluorite. Other pegmatites and greisen have yielded beryl up to 15 cm in association with lepidolite, pollucite, amblygonite, spodumene and topaz.

The Pamir pegmatites of Tajikistan occur in the Muzkol'skovo metamorphic complex of the Rangkul' region, the most prolific veins being Chila MiKa, Polychromnaya, Dorozhniy, Amazonitovaya, Fantaziya, Pegmatite-3, and Beryl-7. Surface collecting and exploration work has reveled blue and champagne topaz to 8 cm, blue beryl, multicolored tourmaline, goshenite, gem purple etched scapolite to 4 cm, rare colorless jeremejevite crystals to 2 cm, and white and sometimes partly purple hambergite crystals. In the southwest Pamir the Besdarinskaya Leschosovskaya and Museinaya veins are also miarolitic and mineral-bearing.

Gem Beryl and Topaz of Sherlovaya Gora, Transbaikal, Russia, A Commonly Mislabeled Locality

Peter Lyckberg
BP2785, L-1027 Luxembourg
lyckberg@p&t.lux

The Sherlovaya Gora greisen deposit, discovered in 1723, is the greatest gem beryl producer in Russia. Labels often read "Adun Chelon," "Murzinka," or simply "Ural." In the old days Sherlovaya Gora was seen as part of the Adun Chelon Mountain Range. Specimens were historically brought to trading centers in the Urals and mislabeled. The Sherlovaya Gora beryl crystals are typically heavily striated, color-zoned across the *c*-axis, and cylindrical in shape due to di-hexagonal and tri-hexagonal faces. Terminations are simple pinacoids. They are greenish blue, blue or green, and rarely yellowish green or true golden heliodor color. Crystals reach a size up to 31 cm by 5 cm. Topaz occurs as white to transparent, non-gemmy, doubly terminated crystals with smoky quartz, and is often found iron-stained with green or purple fluorite.

Adun Chelon mountain is a separate coarse-grained porphyritic granite intrusion with vertical pipe-like pegmatites from 1 meter to a few meters in diameter. These were commonly mined to 20–34 m depth. The area is believed to have been mined since antiquity, and was relocated in 1835. Lovely sharp yellowish green and green hexagonal (Glubokaya Vein) or etched beryl crystals to 25 cm have been found. Typical etching occurs commonly along the edges. Smoky quartz to 90 cm weighing 240 kg have been found in association with tourmaline and large gem topaz (Chastochina vein) in yellow and blue colors weighing 5.6 and 6.3 kg (1989). The mines of Adun Chelon are located in several valleys and along the ridges just south of the Buryat church "Zagan-Obo," also called Kuku-Sirken in the old days. This latter name often occurs on old labels of specimens from the true Adun Chelon.

Chromate Minerals from Berezovskoye Deposit, Ural Mountains, Russia

J. A. McGlasson
The Collectors Stope
9641 East Hickory Tree Drive
Tucson, Arizona 85749

Some of the most colorful minerals known today were originally found in the Berezovskoye gold mine in the middle Ural Mountains, Russia. This deposit is the type locality for five of the known 22 chromate species (cassedanneite, crocoite, embreyite, phoenicochroite, and vauquelinite). The best information indicates that mining in the region began around 1744, as the gold mines were developed. Berezovsk is located approximately 16 kilometers from the town of Ekaterinburg. A second location in the Tochil'naya Gora region (80 kilometers away) also produced chromate minerals during this time. Crocoite was the first of the chromate species to be recognized, by J. G. Lehman in 1766. Lehman called the mineral "nova minera plumbi" from the Tsvetoni mine, where it occurred with ores of gold, copper, lead and silver. The crystals were described as four-sided prisms of bright yellow-orange color with a saffron streak, associated with cerussite and pyromorphite. It was not until 1841 that the name crocoite was used. The name is from the Greek *krokos*, saffron, because of the saffron-colored streak.

In 1796, N. L. Vauquelin and his assistant Macquart described the element chromium from material found at Berezovsk. Macquart described a dark green mineral occurring with the crocoite from Berezovsk, but thought that it represented a dark mineral described earlier by Lehman. In 1818 J. J. Berzelius described the dark green mineral that occurred in flattened crystals up to 5 millimeters, as vauquelinite.

In 1833, H. R. Hermann described a third chromate from Berezovsk. This mineral, blood-red and tabular in habit, was initially named melanochroite, and later (1839) changed to phoenicochroite. The latter name is in reference to the dark red color, not black as implied by the former name. In 1968, while completing research on lead chromates at the British Museum, Dr. S. A. Williams described embreyite. This was the fourth chromate to be described from the Berezovsk specimens. Embreyite was first recognized in 1880, by F. Pisani, who described the mineral as botryoidal and red-orange with a yellow streak. The mineral was named for Mr. Peter G. Embrey, former curator at the British Museum.

The last chromate species to be described from Berezovsk is cassedanneite. This mineral is known to occur on only one specimen in the museum of the mining university in Paris. F. Cesbron described it in 1988. Cassedanneite occurs as fine, red-orange, flattened pseudohexagonal crystals associated with embreyite in a crack in massive crocoite. The mineral was named for J. P. Cassedanne, at the University of Rio de Janeiro.

In 1885 Arzruni compiled a list of 54 species occurring at the Berezovsk deposits. Several additional minerals have been added since then, but it gives an idea of the wide variety of minerals associated with the deposit. With the large number of species reported from Berezovsk it is surprising that so few specimens of any material, other than chromate minerals, are seen in modern collections. Outside of the Soviet Union, the British Museum may have the best collection of Berezovsk specimens.

References

BUSHMAKIN, A. F. (1996) Crocoite from the Berezovsk gold mines. *World of Stones*, **10**, 28–31.

WILLIAMS, S. A. (1974) The naturally occurring chromates of lead. *Bull. of British Museum (Natural History) Mineralogy Series*, **2**, No. 8, 379–419.

Nickel and Platinum-Group Element Deposits at Noril'sk, Siberia

J. A. McGlasson
The Collector's Stope
9641 East Hickory Tree Drive
Tucson, Arizona 85749

Rosie Moore
Pan American Silver Corp.
1500 - 625 Howe Street
Vancouver, British Columbia, V6C 2T6 Canada

The Noril'sk region is located near the 70th parallel, on the southern end of the Taimyr Peninsula. In this very hostile environment, where average temperatures are below 0°C for more than nine months of the year, a world-class copper-nickel-platinum deposit is being exploited. In 1998 Noril'sk Nickel, the largest metal mining company in Russia, produced approximately 19% of the world's nickel, 40% of the platinum, 24% of the palladium, 20% of the rhodium, and 6% of the cobalt from deposits in this region.

Copper-nickel ore was known from the area in the 17th century, but exploration and exploitation did not begin in earnest until the 1920's. In 1935 the "Noril'sk Combine" cooperative was founded and produced the first nickel matte in 1939. The Noril'sk Combine produced metals from the area until 1989 when the Council of Ministers of the USSR passed a resolution making Noril'sk Nickel a "State Concern For Non-Ferrous Metals Production." In 1994 the company was privatized to a Russian Joint Stock Company and shares distributed to over 250,000 persons. The state held the majority of the shares until 1997 when they were transferred to Uneximbank as part of a mortgage auction.

Ore from this region is produced from several mines (including the Medvezhy Ruchey and Zapolyarniy pits and the Taimyrskiy mine) to 1,500 meters depth. The Talnakh and Oktyabr'skoye deposits are hosted in a series of Late Permian to Early Triassic flood basalts and associated ultramafic intrusions. This 3.5 kilometer-thick volcanic sequence consists of alternating lavas and tuffs. The Noril'sk intrusions have several characteristics which set them apart from other PGE (platinum group elements) source rocks: (1) They contain 2–10% of their total mass in sulfides; (2) These sulfides contain a very high concentration of PGE; (3) There are very large contact metamorphic halos surrounding the intrusions; and (4) the sulfur isotope ratios suggest that the sulfur may have originated in-part near the surface as opposed to the mantle. The sulfide platinum-copper-nickel deposits form a series of different ore horizons with varying composition and internal structure within the differentiated intrusions of the Noril'sk type.

Disseminated ores are confined to the lower differentiates (the structure determined by the morphology of the host rocks) with thicknesses of up to 50 meters. The disseminated ores contain the lowest total PGE concentrations but the highest concentrations normalized to sulfide content. The majority of the platinum (90–95%) in disseminated ore is found as sperrylite, with 1.2 ppm in pyrrhotite and pentlandite. Palladium is primarily concentrated in pentlandite (50–1000 ppm); palladium minerals rarely occur in disseminated ore. Rhodium, iridium, and osmium occur as solid solutions in pyrrhotite and pentlandite.

Massive ores occur near the margins of the intrusions and can extend laterally (several hundred meters) into the surrounding late-Paleozoic host rocks. They range from a few centimeters to 45 meters in thickness. The massive ores are the most important economically. The sulfide assemblage is complexly zoned with differing ratios of chalcopyrite, pyrrhotite, pentlandite, and cubanite representing the Cu-Fe-S assemblage. The PGE mineralogy in the massive ores is controlled by the dominant Cu-Fe-S mineralogy. Platinum massive ores occur as sperrylite in pyrrhotite ores and as tetraferroplatinum, rustenburgite, maslovite and moncheite. Palladium occurs as solid solutions in pentlandite, and as discrete minerals, especially in the chalcopyrite ores where minerals of the complex Pd-Pt-Cu-Sn-As assemblage form. Rhodium, iridium, ruthenium and osmium are nearly always concentrated as solid solutions in sulfides, with ruthenium rarely being represented as hollingworthite.

Veinlets in metamorphic rocks form a distinct aureole around the massive ores and are found as 2 to 3-meter-thick lensoid-to-layer-shaped bodies generally concordant with the host rocks. There is a distinct compositional zoning of these veinlets, from pyrrhotite-chalcopyrite-pentlandite near the intrusion to a chalcopyrite-millerite-bornite assemblage distal to the intrusive. Ores in the millerite-bornite portion of the assemblage show the highest PGE content. Platinum is represented mainly as sperrylite. The PGE assemblage forms a complex series of arsenides, stibioarsenides, arsenostannides, stibiostannides of palladium.

Veinlets in intrusive rocks form 2–5 meters away from the lower contact of the massive ores, as lenses and layered bodies parallel to the lower contact of the massive ore. These ores show a zonation from chalcopyrite-pyrrhotite to chalcopyrite ± cubanite. The PGE mineralogy is similar to that of the massive ores rich in chalcopyrite, but the concentrations tend to be greater.

Sulfide-poor mineralization is located near the upper contact of the intrusions where chromite becomes dominant, and sulfides comprise less than 3% of the ore. The PGE mineralization is very fine-grained (less than 20 microns) and comprised of tellurides, telluro-bismuthides, stannides, stibnides and arsenides.

Very fine sperrylite and native platinum crystals are available for the collector; however, the rare platinum, palladium, iridium, rhodium, osmium and ruthenium minerals are found mainly as microscopic grains.

References

LUL'KO, V. A. *et al.* (1996) Geology, magmatism and sulfide platinum-copper-nickel ores. *In* Noril'sk Nickel (1996) *Geology and Ore Deposits of the Noril'sk Region—Guidebook for the 7th International Platinum Symposium*, 1994, 1–67.

NALDRETT, A. J. (1994) The Sudbury Noril'sk Symposium, an overview. *In* Proceedings of the Sudbury Noril'sk Symposium (editors P. C. Lightfoot and A. J. Naldrett) *Ontario Geological Survey Special Publication No.* **5**, 3–8.

STEKIN, A. I. (1994) Mineralogy and geochemical characteristics of the Cu-Ni ores of the Oktyabr'sky and Talnakh deposits. *In* Proceedings of the Sudbury Noril'sk Symposium (editors P. C. Lightfoot and A. J. Naldrett) *Ontario Geological Survey Special Publication No.* **5**, 217–230.

Mines and Minerals of Dal'negorsk, Russia

Raymond Grant and **John Weide**
Mesa Community College
1833 W. Southern Avenue
Mesa, Arizona 85202

Viktor Korchevskiy
Perbomayskaya St. g2, kv 25
Dal'negorsk, Russia

Mines in the region of Dal'negorsk, Russia, have produced world-class specimens of calcite, danburite, datolite, fluorite, ilvaite, quartz and pyrrhotite. They have also produced good specimens of apophyllite, chalcopyrite, galena, hedenbergite, manganaxinite and sphalerite. Over 150 different minerals are reported from the mines in the Dal'negorsk area. The town of Dal'negorsk is located a little over 300 km northeast of Vladivostok and about 35 km from the sea of Japan.

The Dal'negorsk mineral deposits were discovered in 1872 by the Chinese. They mined in the area for silver and used some of the borosilicates for glass. In 1887 the Russians settled the region and started mining. In 1924 the mining rights were sold to a British Company, Tetyukhe Mining Corporation. After the English left in 1931, the Russians started to mine lead and zinc again. In 1946 the massive datolite ores were sampled and eventually they were mined as a source of boron. At present there are two companies operating in Dal'negorsk: the Bor Company that operates the Bor open pit mine for boron, and Dal'polymetal that has three underground mines for lead, zinc, bismuth, silver, cadmium and indium.

There are eight mines that have produced mineral specimens in the area close to Dal'negorsk (within 15 kilometers). Today, four of these mines are operating and four are closed. The *Bor pit or quarry*, the only operating open pit in the area, is being mined for datolite as a source of boron (mainly for boric acid). The *Danburitiy mine* is an abandoned open pit mined briefly for boron. It is the only locality where danburite has been found. The *First Sovietskiy mine* opened in 1934 and closed about 1965. The *Second Sovietskiy mine* also opened in 1934 and is operating at present. (The name Second Sovietskiy is used for a series of mines including Eastern Partizan mine, Western Partizan mine, and Svetly Otvod mine.) The *Sentyabr'skiy mine* opened in the early 1930's and has been closed for 30 years. The *Verkhniy mine* was the first mine in the region; mining by Russians started in 1897 and is still underway; it was operated first as an open pit mine (even before 1897 by the Chinese) and is now an underground mine. The surface workings are still accessible to collecting. These surface workings are also referred to as the *Brenner mine* (Hamet and Stedra, 1992). The *Nikolaevskiy mine* opened in 1982 and at present is the largest producer in the district. The *Sadoviy mine* closed in 1997 and only a few mineral specimens were found in the past.

The geology of the Dal'negorsk region is complex because of its plate tectonic history of repeated accretion and subduction processes. The oldest rocks in the area are limestones, sandstones and siltstones of Upper Triassic to Upper Jurassic age. They were pushed into their present position as a result of the subduction under the East Coast of Russia. Overlying the sediments are Cretaceous tuffs. All of these rocks are faulted and are intruded by a series of igneous rocks. The first was a Late Cretaceous-Tertiary andesite-granodiorite complex associated with the sulfide deposits. This was followed by two series of Tertiary intrusions associated with the boron mineralization in the region (Lisitsyn and Malinko, 1994). The major host rocks for the sulfide and boron deposits are skarns. The primary skarn minerals are wollastonite, hedenbergite, garnet (andradite-grossular), and manganaxinite. The altered skarns contain in addition datolite, hisingerite, quartz, calcite, sepiolite and siderite (Bulavko, 1984). There are many combinations of these minerals in the skarns, and they form a very striking rock used as an ornamental stone for mosaics, boxes, tiles, and other decorative purposes.

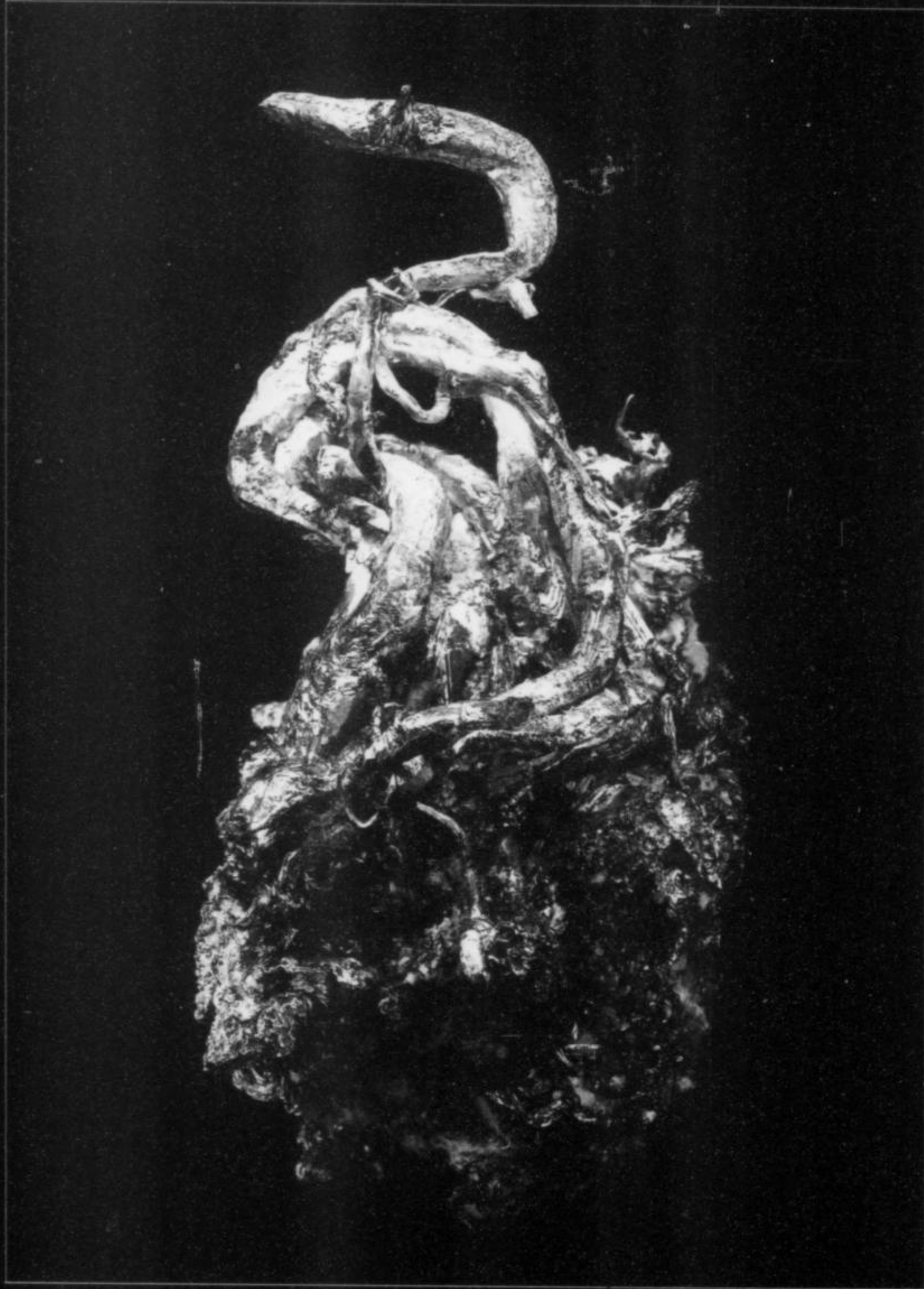
Also of interest to mineral collectors are the ancient hydrothermal cavities found in the mines. They range in size from a few centimeters across to the size of a house. Because they were present before the intrusion of the last magma, some of these cavities are filled with andesite and other igneous rocks. Others are still open cavities and are the source of many of the fine crystallized mineral specimens.

References

BULAVKO, N. V. (1984) Relationship between skarns and hydrothermal polymetallic ores. *In Dal'negorsk Ore District Geology*, Krasnov, E. V. and Buriy, G. I., editors. Vladivostok, p. 125–136 (in Russian).

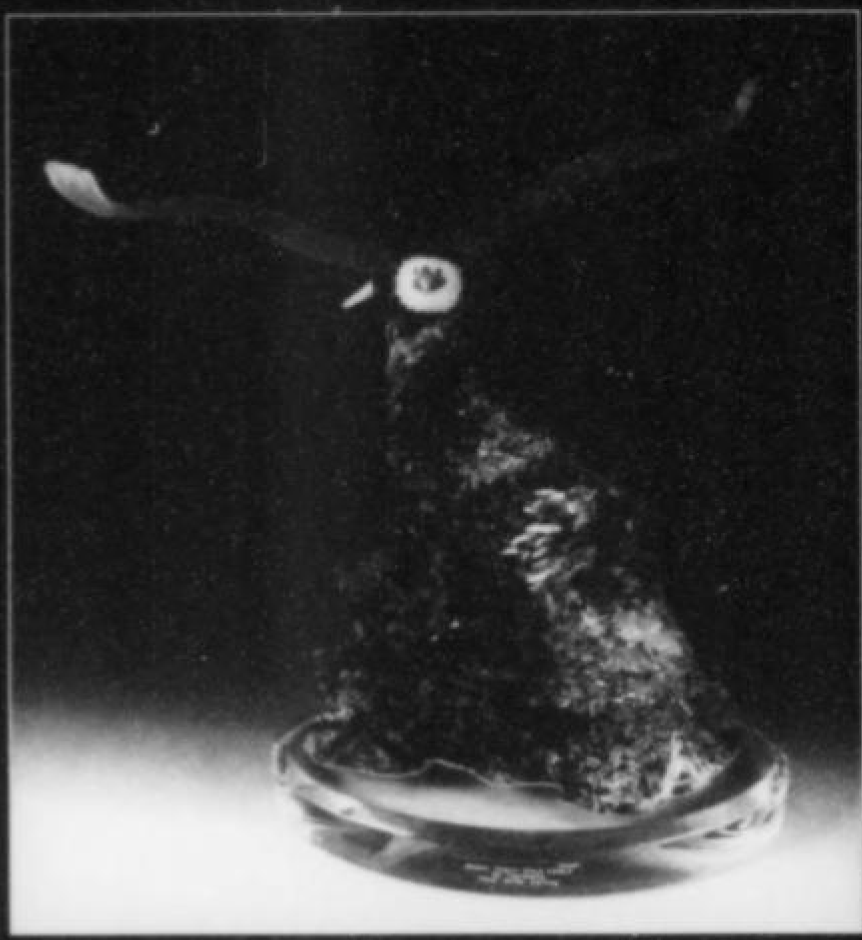
HAMET, M., and STEDRA, V. (1992) Die blei-zink-und borlagerstatte Dalnegorsk in Ostsibirien. *Mineralien Welt*, **6**, 46–53.

LISITSYN, A., and MALINKO, S. (1994) The Dal'negorsk boron deposit: a unique mineralogical object. *World of Stones*, **4**, 30–40.



JEFF SCOVIL

Silver, 15 cm, Kongsberg, Norway. Acq. 1999



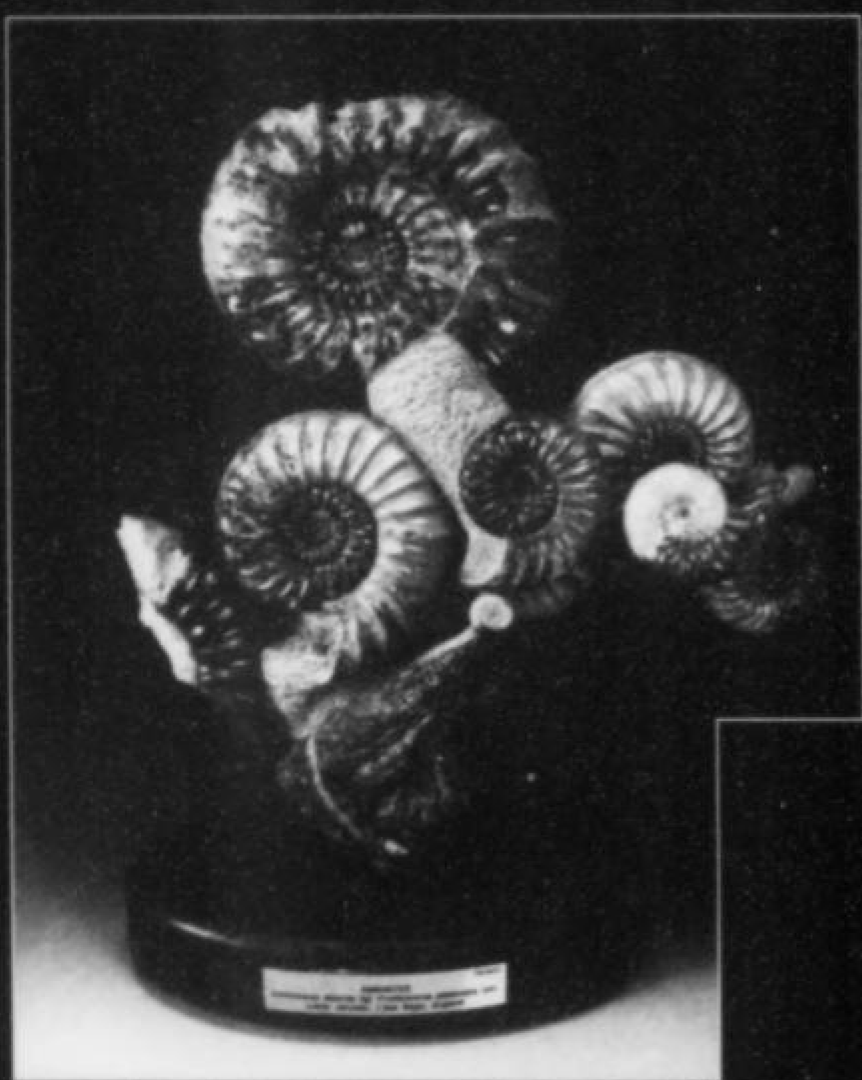
15"W x 15.5"H

THE SUNNYWOOD COLLECTION™

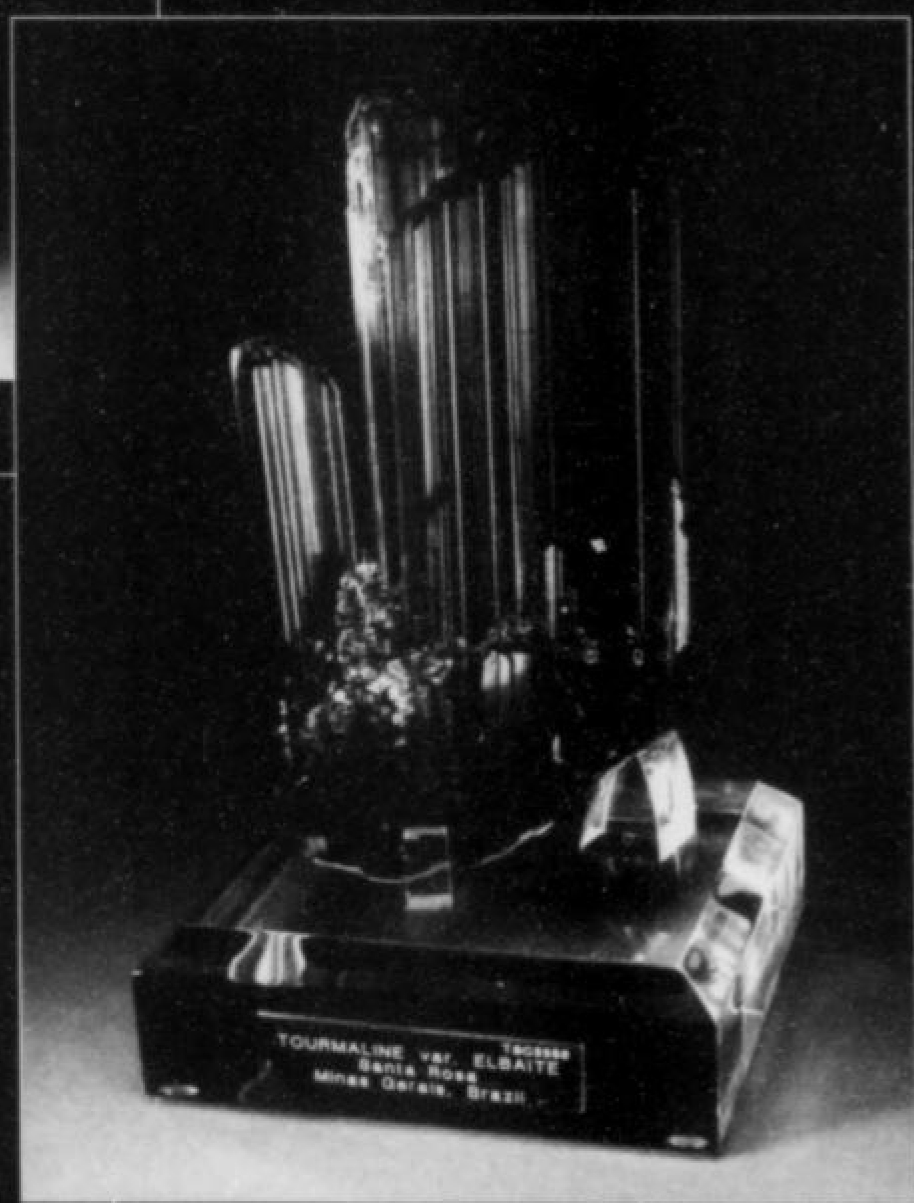
Specialists in Presentation of Natural Art

Fine Minerals, Fossils and Carvings
Mounted on Acrylic and Hardwoods
CUSTOM MOUNTING AVAILABLE
Showroom by Appointment
Aurora, Colorado
Phone/Fax 303-363-8588
minerals@sunnywood.com

www.sunnywood.com

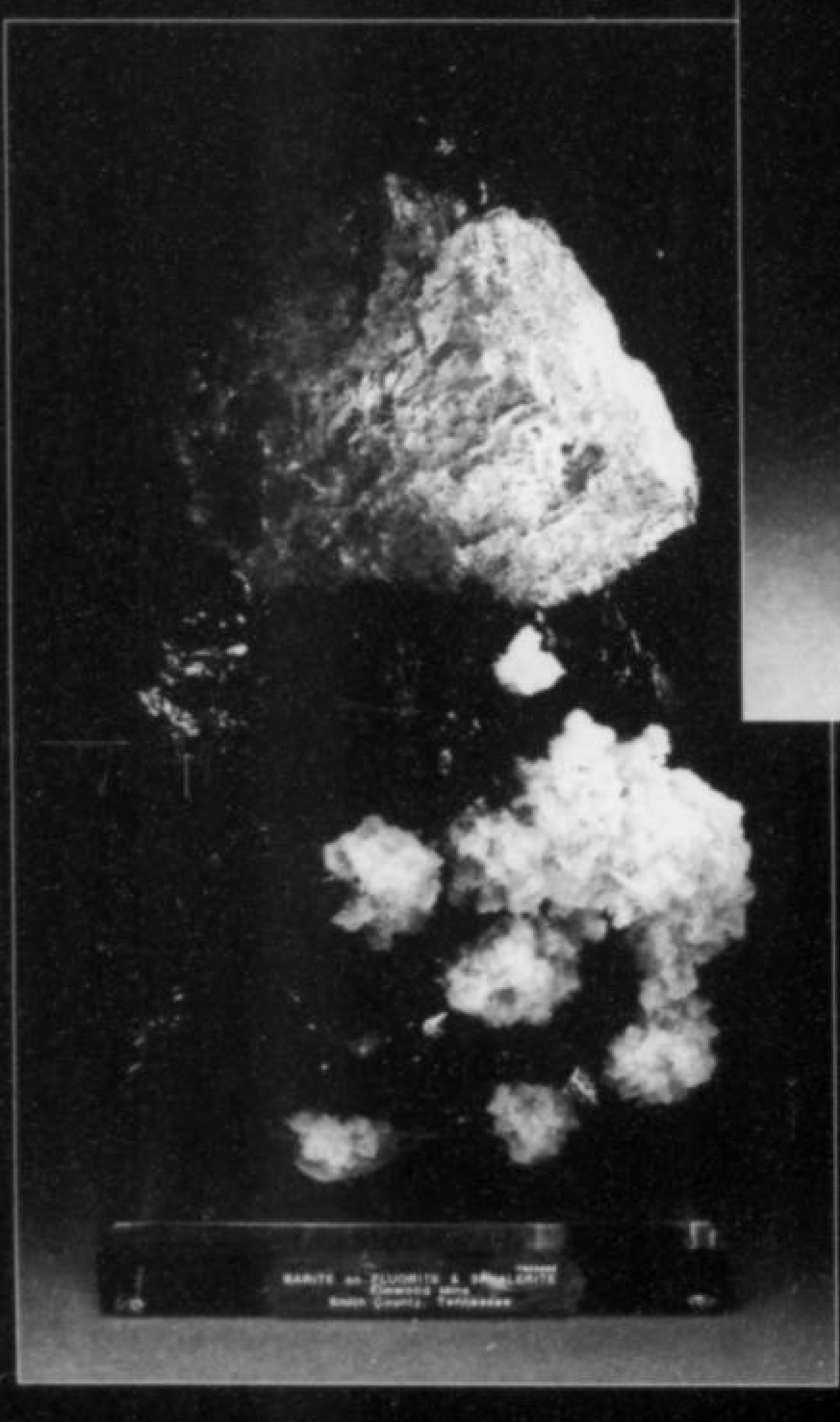


10"W x 10.5"H



3.25"W x 6.5"H

Visit Our Showroom



6.25"W x 10.75"H

8"W x 5.5"H

What's New

in Minerals

Springfield Show 2000

by **Tom Moore**

In March of this year I moved from my former Connecticut town on the Atlantic shoreline to a more northerly town (new address: 171 Washington St., Norwich, CT 06360), and one of the little advantages is that now I don't have quite as far to drive to Springfield in August for the East Coast's best mineral show. Through force of habit I left home for the show at the time I have always left, but arrived at the Eastern States Exposition Center in Springfield about half an hour earlier than I've been used to arriving, and consequently the show wasn't open yet. Nevertheless I still found that the big parking lot was already more than half full, and there was already a long line of visitors waiting for opening time, many complaining about how they hate to wait in long lines. All of this is my own long-winded way of saying (as I seem to do every year) that the Springfield Show continues to grow and to flourish. Again this year some major dealers made their debut appearances here: offhand I recall Les Presmyk from Arizona (*De Natura*) and the *KARP* dealership from the Czech Republic, but there were others too. The show format was unchanged, but whenever I saw Marty Zinn he had *almost* as wide a smile on his face as he'd had last year, when his own collection graced the exhibit area.

This time it was Dave Bunk's Colorado collection that filled the 53 cases that faced inwards to form the looping path of the Special Exhibit Section. Even though, necessarily, this collection featured more gray sulfides and fewer dramatically colored "aesthetic" pieces than did Marty's worldwide display last year, the knowledgeable seemed at least as impressed by what they beheld, and the general public gave every appearance of feeling due awe as well. Dave told me that he had inherited about half of this great collection two years ago from his mentor, the late George Robertson. Even so, it presents so large and comprehensive a range of Colorado mineral occurrences, past and present, that the fact that so young a man as Dave has already assembled so much Colorado wealth seems downright amazing.

Describing the contents of those 53 cases has to be, as for Marty's collection last year, a matter merely of listing bare names of subtopics; letting the roving spotlight play on high points. Dave himself did try, though, to direct viewers' attentions to what he'd have least wanted them to skip over: a "Some Of My Favorites" case held 18 top pieces, most memorably (for me) a 6-cm Wire Patch mine, Breckenridge gold; a wondrously gemmy sphalerite cluster from the Commodore mine, Creede; a 5 x 7-cm group of brilliant, sharp, white 2-cm anglesite crystals from Leadville; and a lush Sweet Home mine (Good Luck Pocket) rhodochrosite miniature with a deepest red, razor-sharp, flawless 3-cm rhomb on a matrix of quartz crystals and tetrahedrite.

The rest of the cases focused on specialties, either of species, locality, or combinations of these. Thus there were single cases devoted to (among others) pyrite, amethyst, sphalerite, Mt. Antero fluorite, Mt. Antero aquamarine, the Cripple Creek district, rhodochrosite (general), rhodochrosite (Sunnyside mine), and thumbnails (my favorite!) . Two cases each were allotted to barite, the San Juan Mts., the Pikes Peak Batholith, and the Sweet Home mine; three each to the Idarado mine, the Creede district, and the Eagle mine. Of special interest were two cases of "rarities" from Colorado; it is indeed rare, and of course educational, to see fine Colorado specimens of, for example, allanite, bismuthinite, chrysoberyl, chlorargyrite, and phosgenite. Of individual specimens fine and surprising enough to make me reach for my pen and notepad at the very first glimpse, I'll mention a foot-wide group of spiky white cerussite crystals from the Bulldog mine; a couple of just-as-giant matrix specimens of Book Cliffs barite, with vivid colorless prisms to 8 cm long on both; a handful of specimens of zircon from St. Peters Dome, with sharp lustrous brown crystals to 3 cm in matrix; and a Pelican mine, Clear Creek County acanthite such as would make Guanajuato or Freiberg proud—a deep, 3 x 5-cm cluster of sharp gray cubes individually to 1.25 cm across. Well, may this miscellaneous, breathless survey give you a sense of the bedazzlement afforded generally by this display. Congratulations, kudos, and maybe even a beer at someone else's expense, are clearly Dave Bunk's due.

Time now, though, to walk the show floor for awhile and see, as I think someone once said somewhere, what's new in minerals.

Harvey Gordon, visiting Back East for the second year in a row, was offering Barrick Meikle mine **barite** and Zapot claim **topaz** and **smoky quartz**, of course, but what was *new* here were ten flats or so of very pretty **calcite** specimens recently found at a so-far unspecified place in Fall River County, South Dakota. The limestone matrix for these specimens is of a buff to chalky white color, while open cavities are lined by solid crusts of lustrous, transparent, 1-cm calcite rhombs, tinted a pleasant orange by iron oxides. On some specimens there is a second generation of calcite, as translucent white flattened rhombs ("discoids," if you join me in liking this word) uniformly 5 mm or so across, sprinkled over the orange crystals for a pleasing snowflake-effect. Sizes of these attractive specimens range from 5 x 5 to 12 x 15 cm.

Still on the midwestern calcite motif . . . Carter Rich was showing a newly purchased (but long-ago mined) hoard of **calcite** from the extinct lead-zinc mining district of Shullsburg, Wisconsin. About 20 cabinet specimens exhibited a wide range of calcite habits, from transparent scalenohedrons to milky-translucent white modified rhombohedrons, with crystals sometimes reaching 3 cm, clustered or stacked in large groups or laid over galena/marcasite matrix. Specimens here are from about 4 x 6 cm to 10 x 10 cm.

Minerals America, a dealership run by Leonard Himes (P.O. Box 540257, Orlando, FL 32854), brought to Springfield this year something intriguing, pretty, and new, collected this past summer by Leonard's show manager, Michael Jacob, who was on hand to give me the scoop. A traprock (gabbro) quarry called the 11th Street quarry, right in the "downtown" section of Hickory, North Carolina, has afforded calcite-filled seams which, when the calcite is dissolved away, prove to be lined with beautiful, lustrous, pale yellow-orange **stilbite** crystals. These are simple, bladed, wedge-terminated singles of stilbite, pearly along the prism faces, to 1.5 cm long. Leonard and Michael had about 25 miniature and cabinet-sized specimens of loose clusters. Further, it seems that this same quarry has some Alpine cleft-type tension gashes with mineralogy featuring tiny **babingtonite** crystals; brilliantly black, thin **ilmenite** platelets to 1 cm with epitaxial **rutile**; and (a serious rarity) microcrystals of **kainosite-(Y)** on muscovite. Needless to say, the dealership will be monitoring further work at the quarry closely.

As everybody knows, the hearts of Wayne and Dona Leicht of the dealership of Kristalle *really* belong to California gold, but the Leichts lately have been indulging a winning habit of scooping the Springfield Show, each year, with recirculated collections of old classic items from the eastern U.S. and Europe. This year it was Bravo! for habit-forming behaviors, as the *Kristalle* booth proudly presented, for instance, four good large cabinet specimens of **pyromorphite** from the Wheatley mine, Phoenixville, Pennsylvania; about a half-dozen large pieces from the Tilly Foster mine, Brewster, New York, showing deep red-brown **chondrodite** crystals to 2.5 cm with clinochlore on massive magnetite; and a few loose gemmy prisms of **elbaite** whose distinctive, somehow faintly "oily," brownish green color marked them as having come from the old Gillette quarry, Haddam Neck, Connecticut. Best of all in the Eastern-classics department were the Leichts' eight top-class miniature and thumbnail specimens of **chalcocite** from Bristol, Connecticut, on all of which the luster is bright (not sooty) and the lines super-sharp on the multiply twinned black crystals, which reach 2 cm; four of the specimens have drusy quartz matrix, and four are loose chalcocite crystal groups. And under the table (because already sold) lurked the best Bristol **bornite** specimen I've ever seen: a quartz-matrix miniature with very sharp, iridescent black 3-mm bornite crystals tastefully grouped in little bunches all over it. Finally, to top off the old-classics feast, there were five choice **pyromorphite** specimens from the Bad Ems, Germany, district, two highly lustrous pale brown ones from the Friedrichssegen mine, each 6 cm across, and three olive-green ones with bright, fat curved crystals to 2 cm in rich, bloated-looking clusters of 4.5 and 8 cm.

Back, now, to what's truly new . . . Jeff Scovil has reported elsewhere on the new **barite** specimens from the Turt mine, Satu Mare, Romania, and yes, they're very attractive, as I learned when I saw them for the first time at Springfield. They were sporadically scattered about the dealerships, but the best were with Dan Weinrich and with Frank and Wendy Melanson (of *Hawthorneden*). The barite comes as rectangular sheaves of very thin tabular crystals growing in parallel, slightly pinched in the middles. These delicate sheaves, to 4 cm, are lustrous, transparent and almost colorless but for a hint of yellow-brown; they tend to stand on edge, or at least to be canted at high angles, like impossibly balanced little playing cards, on a rusty matrix of altered sulfide ore. So far, large cabinet specimens seem to predominate.

The Melansons of *Hawthorneden* also had a pleasant surprise among their abundant flats of miscellaneous thumbnails in Perky boxes: about 25 very fine, loose fishtail twins, and little clusters and matrix specimens, of **titanite** from the old locality of Capelinha, Minas Gerais, Brazil. Yes, this material dates back a few decades now, but has been missing from the market in specimens as good as these for most of that time. Frank Melanson said that he bought this lot from an Ottawa jeweler in the 1970's (thus probably saving them from the blade, for many are gemmy enough to yield fine faceted stones). The color is deep yellow-green, the luster is high, and the forms are sharp; and all of these thumbnails sell for under $50 each.

***Figure 1.* Barite, 4.5 cm, from the Turt mine, Turt, Satu Mare, Romania. *Hawthorneden* specimen; Jeff Scovil photo.**

My fellow Connecticut residents Jeff and Gloria Fast of *Jeff & Gloria's Minerals* (phone 860-267-4644) had what amounted to the merest tantalizing trace of what could prove to be an exciting what's-new from Russia. Just before this show, Jeff told me, a Russian "kid" brought in a small handful of thumbnail-sized **wire silver** specimens from "Ducat, Chukotka" and sold them to the Fasts, and as soon as I saw these specimens at their stand I went wow, and when I checked back half an hour later, the best of them were gone. Brilliantly lustrous, metallic white, thin wires loop and twine around each other, or around little white calcite shards, in sculptural groups, some alone, some rising from calcite/sulfide matrixes. In other words, it's "typical" native wire silver, but exceptionally bright and aesthetic, and very promising—that is, if that "kid" ever shows up again. The Fasts will keep their antennae out.

I've mentioned that the industrious Czech dealership of *KARP* (P.O. Box 54, 272 80 Kladno, Czech Republic) showed up at Springfield for the first time this year; and now I'll add that Dr. Ivo Szegeny, at this stand, had the first good **calcite** specimens I've seen from the copper mines of Dzhezkazgan, Kazakhstan. We must surely concede by now that Dzhezkazgan is one of the very greatest of contemporary specimen localities, but you'll only really turn on to it if you favor metallic minerals (world-class crystallizations of silver, copper, bornite, chalcocite, tennantite, stromeyerite, etc.). Well, the Dzhezkazgan calcites are not world-class for the species, but they are interesting and distinctive—excellent for your Calcite Suite. All crystals are shallow-angled butterfly twins of "winged" aspect, colorless and transparent although fairly heavily stained and infused with red hematite dust. Individual twins can reach 3.5 cm; typically they rise vertically, as if attempting takeoff, from a matrix of small, clear quartz prisms mashed up together. The matrix is dotted, further, with small, rusty-white spheres of intergrown **barite** blades and with sharp 1-mm **bornite** crystals. Ivo said he had obtained about 70 pieces in all, from thumbnail-size to 10 cm across, collected some months ago from a pocket in the active mine, and only a few of the smaller pieces (including *my* new thumbnail!) are without damage. Oh yes, and at this dealership, too, were a few unremarkable miniatures of blue **celestine**, for a second non-metallic Dzhezkazgan species entry.

Just inside the front entrance and to the left, as usual, Dudley Blauwet of *Mountain Minerals International* held court at a large stand full of wonders, some old and some new, from the pegmatites of Pakistan and Afghanistan. Most excitingly new, especially if you are a rare species and/or thumbnail collector, were about ten sharp little loose single crystals and groups of **bastnäsite-(Ce)** from a brand-new find at Shinwaro, Kunar Province, Afghanistan. The blocky crystals are basically sharp and crisp, though sometimes a bit edge-rounded; they have a dull to medium luster and a rich orange-brown color, and range from opaque to translucent to gemmy (sometimes all within the same crystal). The best of these thumbnail and small-miniature specimens represent, one would think, the world's-record crystal development (so far) of this very rare, rare-earth carbonate species—the earlier bastnäsite specimens from France having been found as very thin plates on matrix, not as thick gem-potential crystals like these.

Also brand-new were some excellent, razor-sharp, matte-lustered loose **magnetite** octahedrons to 3 cm on edge; Dudley gives their source as Biensla, above Arondu, Haramosh Range, Northern Areas, Pakistan. Just a handful of crystals were dug from what is apparently an extremely high-altitude (even for Pakistan) locale, atypically clear of snow last summer. The glistening, precise little black octahedrons closely resemble the ones found embedded in greenschist in earlier-known localities in Brazil, Sweden and Vermont, and, sure enough, the matrix here is also a green schistose metamorphic rock, though no matrix pieces made it to Springfield.

Finally, Dudley was proud of about 15 large (to *very* large) skeletal-growth, clay-included **quartz** crystal groups from Wanna, Waziristan, Northwest Frontier Province, Pakistan—very near the place which recently has yielded such abundances of "faden" quartz specimens. These pieces are at least fist-sized, hunky things, single crystals for the most part, the largest reaching 12 x 12 x 12 cm, and they are lustrous and transparent, nicely showing the zones of buff-colored clay that line areas of skeletal growth on and under large rhombohedron faces. Rather than trying to describe them, I can just refer you to the cover picture of vol. 23, no. 6 (November-December 1992), showing a Brazilian piece looking *exactly* like these new Pakistani specimens.

From Burma ("Myanmar"), a couple of interesting new items are now showing themselves (they'll be joining the recent lavish supplies of gemmy red **spinel** crystals in white marble and of the beautiful deep green **chromian dravite** in the same matrix, from "Mogok," famous provenance of classic rubies). From this same vague "Mogok" district, a couple of dealers at Springfield had lovely specimens of pale translucent pink **elbaite** in flaring parallel groups of thin prisms, the ends of the prism-bouquets sometimes *so* flaring that the term "mushroom tourmaline" was being bandied about. These glistening pink columns of not-quite-gemmy but very lustrous crystals reach 12 cm high. No, you wouldn't expect tourmaline in a regionally metaphorphosed calcareous rock such as seems to host the other Mogok species, but Frank Melanson (who had a couple of the new elbaites) says that he's seen other specimens wherein the elbaite crystals do grow in a pegmatite matrix. To deepen the mystery in another direction, refer now, please, to page 335 of the *Tourmaline* Special Issue (vol. 16, no. 5), where you'll see a drawing, with accompanying text, of a "rubellite" from "Burma" as shown in Sowerby's *Exotic Mineralogy* of 1817: individual terminal faces of individual crystals are much more strongly marked on the specimen in the old picture than in these new specimens, but otherwise the resemblance is close.

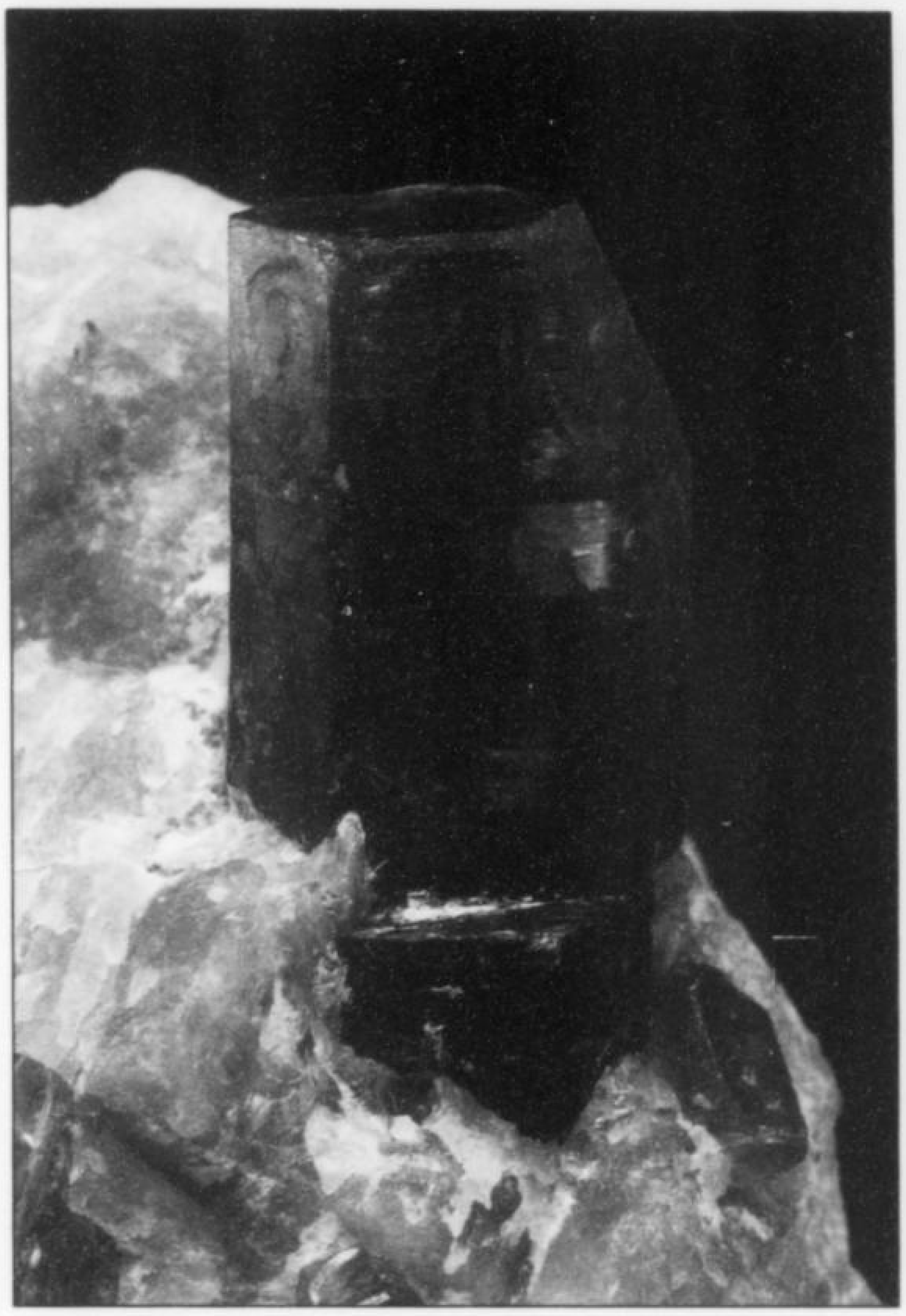


***Figure 2.* Phlogopite crystal, 2.6 cm, from Mogok, Burma. *Minerals America* specimen; Jeff Scovil photo.**

For another teaser from "Mogok, Myanmar" we return to Leonard Himes at *Minerals America*, who had four specimens showing embedded crystals of a *transparent* pale smoky brown **phlogopite** in massive gray-white marble. For crystals of a mica species, these are indeed extraordinary for size, sharpness and color; they reminded me of choice old-time phlogopites from Franklin, New Jersey (embedded in white Franklin limestone). In the miniature-size matrixes at Leonard's stand, the 1.5 x 1.5 x 2.5-cm phlogopite crystals lie flat, about half exposed by acid-etching. Two of the crystals show some tapering near the ends, and although the small flat "basal face" on each of these could be a cleavage plane, it could as well be a true terminal face. Be that as it may, the soft brown color and the transparency make these very fine specimens of phlogopite.

I'll conclude with a paragraph on a what's-new I've mentioned before, beginning in last year's Springfield report . . . by this time a what's-getting-rapidly-better. Most mineral folks are aware by now that a place in China is presently making its move to become a truly major locality for **pyromorphite**, its best specimens both resembling and rivalling the bright apple-green crystals from Cordoba, Spain, which surfaced a couple of years ago. At Springfield there was a fair amount of fine Chinese pyromorphite around, the best of it being offered by Danny Trinchillo of *DeTrin Minerals* and by *The Rocksmiths*. Danny had several flats of specimens, the colors ranging from electric yellow-green (Spanish style) to a kind of milky pale green *not* especially suggestive, to me anyway, of pyromorphite hues from any earlier place. Crystal forms range from simple, sharp hexagonal prisms approaching 1 cm to complex spindle shapes to 1.5 cm; very bright little groups without matrix make fine thumbnails, while dense coatings on pale brown gossany and/or white quartz matrix make for specimens up to about 5 x 5 cm. Somehow there is an energy, an up-and-comingness, about this material such that one senses that future specimens may well compete with French, German and Idaho pyromorphites at their most authoritative. The mystery, so far, of these Chinese specimens concerns, you guessed it, the locality. What with the problems of transliteration from Chinese characters added to the usual problems of error, vagueness, paranoid disinformation-giving, and other ills that flesh is heir to along the supply pipeline, confusion about the locality is not surprising, although it does seem unusually severe. Danny Trinchillo says that the source is "Gulin," in Guangxi Province; the Rocksmiths, as well as Ernesto Ossola, give "Yangshu," Guangxi; and Debbie Meng informs me by e-mail that it is "Baise," Guangxi. And none of these folks know, or say, whether Gulin or Yangshu or Baise is the name of a mine, or a town, or a district, hill, outcrop—or what. Well, perhaps at the upcoming Denver 2000 show [see following report] I'll be able to clear this up, or imagine that I have done so. Anyone who can help is invited to write, or e-mail me at tmoore09@snet.net.

Denver Show 2000

by **Tom Moore**

It seemed an unusually busy show this year, in part because of the rushes, thrills and general buzzing conniptions surrounding a few very new, very spectacular mineral finds. It must be said that general attendance, both at the hotel and Main shows, was somewhat off from that of past years, but it shouldn't have been, since those new finds—never mind the Main Show displays—were special indeed. For descriptions of the discoveries in question (oh, all right, I'll name the biggies right now: Moroccan erythrite, Afghanistan sodalite, Chinese pyromorphite), you'll have to be patient as I gawk my way through the usual What's-New World Tour . . . but suffice it to say that Denver was qualitatively strong on "very nice stuff" this year. Oh yes, and the ballroom dealers' enclave at the hotel has expanded also, into a generous new tent which one reached through one of the side ballroom doors. All aboard, then; no more than two bulging carry-off bags full of rocks per showgoer, please . . .

A new strike (in April 2000) of a very peculiar sort of **gold** was Nevada's chief contribution this year. The Olinghouse mine in Washoe County is now commercially inactive (in fact, bankrupt and litigation-haunted), but on 6030 Bench, 813 Pit, some seams in a greenish gray altered andesite yielded, when the calcite was etched away, pretty specimens showing delicate linings of filiform gold in lustrous, generous "nests" attached lightly to their matrix. This gold's color is pale, because silver content ranges between 5% and 30%, but under magnification the specimens turn into glittering dreamlands of cotton-candy-like mazes of interconnected wires, fibers and minute crystal shards. Perhaps a hundred specimens were being offered, from a few thumbnails (for around $75) up to a 9-cm "sandwich" of rock with a see-into seam running right down the middle for its full length ($1750). Marketing of these oddly beautiful specimens was being shared between Scott Kleine of *Great Basin Minerals* (3895 Lisa Ct., #C, Reno, NV 89503-1125), Ed Coogan of *Coogan Gold Company* (P.O. Box 1631, Turlock, CA 95381), and Piete Heydelaar and Debra Morrissette of *Global Treasures* (P.O. Box 3264, Quartzsite, AZ 85359).

At the Hecla-Newmont Rosebud mine, Humboldt County, Nevada, just before this mine closed in August, there were collected some 30 matrix specimens, toenail to small cabinet-size, showing **miargyrite** in little clusters of brilliant metallic black crystals on drusy quartz-lined seams in a gray altered rhyolite. Originally there was a white, sticky seam filling of dickite—this according to Casey and Jane Jones of *Geoprime* (11332 Hawthorne Ave., Hesperia, CA 92345), who were selling the specimens in a Holiday Inn room. The crystals of miargyrite are sharp, though only around 2 or 3 mm individually, the isolated clusters reaching 1.5 cm or so. Possibly some tiny pyrargyrite and pyrostilpnite crystals are in there too: Terry Wallace at the University of Arizona is working on it.

The only other U.S. item this time is a stash of top-quality **rutile** crystals from the famous locality at Graves Mountain, Georgia. It seems that Terry and Jean Ledford of *Mountain Gems & Minerals* (P.O. Box 239, Little Switzerland, NC 28749) struck a first big pocket in February of 1998; it was more than 2 feet across, and produced about 1000 specimens, some of them seen here, and some of them having been offered at Springfield in 1999. At Denver, the Ledfords had about 50 newly cleaned rutile specimens from this pocket, with sharp, highest-luster, blackish red crystals to 4 cm on edge, as loose singles and in big flashing blocky groups (the Houston Museum and John Barlow got the two best and biggest of this find). Then in December 1998/January 1999 the intrepid Ledfords broke into a second, almost as dramatic pocket, this time in a grayish greenish white pyrophyllite; specimens with hard felted pyrophyllite masses for matrix feature lustrous rutile singles and twins to 3.5 cm across. There were about 25 of these in Denver, toenail-size to 5 x 6 cm. Finally, the Ledfords had ten large single crystals of Georgia **lazulite**, dug in 1999: sandy, pale blue loose bipyramids with some adhering white mica/quartz dust. Subhedral to fairly sharp, and reaching to 5 cm, these are not pretty, but surely approach record size for this long-familiar material.

Dan and Shelley Lambert of *Lambert's Minerals* (156 Caithness St. E., Caledonia, Ontario, Canada N3W 1C6) are now busy renovating an old house they bought, but recently Dan somehow found time anyway to collect some very good, large **hornblende** specimens from the Bear Lake Diggings, Tory Hill, Ontario. The hornblende crystals are jet-black, show ideal monoclinic forms, and individually reach 15 cm long (!); they cluster in groups to 25 cm, with minor glassy gray-green apatite. In the best of these specimens, blocky 4 x 4-cm hornblende crystals make quite handsome groups.

Far up into the northwest Canadian boondocks, where the now-extinct mining town of Pine Point once thrived, the old Pine Point mine has been giving up to the Tysons of *Tyson's Minerals* some very nice examples of Mississippi Valley-type mineralization (this mine produced lead and zinc ores for 50 years before closing in 1984). Hydrothermal Pb/Zn veins in Devonian sediments yielded to the hard-digging Tysons such things as colorless to white to yellow to orange **calcite** in many habits, with sharp crystals to 7 cm in clusters to 17 cm; **galena** in sharp, lustrous cuboctahedrons in brilliant small groups; black **sphalerite** in crystals to 1.5 cm in groups of all sizes (but, sorry, no Tri-State-style chalcopyrite); and even **gypsum** in colorless to smoky gray translucent fishtail twins in parallel groups to 4 cm. The Tysons' offering at the Main Show was the first significant lot of these pretty specimens ever to reach the mineral market.

From Mexico comes another instance of an old find reintroducing itself as a hoard of just-released specimens, and what a hoard: I refer to the beautiful **wulfenite** and **mimetite** of the San Francisco mine, Sonora, this lot having been collected by Ed

Swoboda in 1994. Andy Seibel (P.O. Box 2091, Tehachapi, CA 93581) had a casefull of specimens in his Holiday Inn room, and the flamboyance of this case roped many a passing tourist into that room from 20 or so feet away. There were about 30 pieces, toenails to small cabinet-size, priced from $50 to $3000, all showing paper-thin, totally transparent, square tabular wulfenite crystals of rich orange color; on them, of course, perch many little still deeper orange mimetite balls to a couple of mm across. Matrix, present only on the larger pieces, consists of a weathered white/red rock; most specimens are loose clusters of wulfenite crystals, with individuals to 2.5 cm on edge.

Dave Bunk had some new specimens from two famous old mines in Peru; let's begin with the Uchucchacua mine, Dos de Mayo Province, Lima Department. A few lovely thumbnails from this locality bristle with thin, spiky scalenohedrons of **rhodochrosite** all over black matrix, the crystals brilliantly lustrous, rose-pink and totally gemmy. Also from the Uchucchacua, bright single **silver** wires twist straight up out of the slightly rough, rounded faces of single metallic black **acanthite** crystals, in more thumbnail specimens. And there is one remarkable, loose, slightly rounded but still impressively sharp single acanthite crystal measuring 3 x 3 cm.

From the San Genaro mine, Castrovirreyna District, Huancavelica Department, Dave had an entirely new style of the fine **silver** specimens for which this mine has long been well known. In about a dozen thumbnail and small miniature specimens, and one measuring 5 x 5 cm, slightly bronze-tinted, lustrous silver "herringbone" growths, with plenty of branching spikes, grow in and around and through pale brown microcrystallized siderite; it is as if the latticework silver structures are struggling to emerge from a sort of siderite foam engulfing them. Dave said that this is an entirely new association-find at the San Genaro.

A third Peruvian excitement was to be found in the Main Show booth of Marshall Kovall of *Silver Scepter Minerals* (P.O. Box 3025, Kirkland, WA 98083). Marshall had just four specimens, mined last June, with dramatically large and fine **chalcopyrite** crystals: richly golden, slightly iridescent, *just* slightly rough-surfaced sphenoids to 3.5 cm on edge. They perch lightly on translucent fluorite, the fluorite looking at first glance simply greenish white and massive, but proving on closer inspection to be big, deeply etched fluorite crystals, one of them noticeably pinkish. Yes, the locality is the one that got headlines for pink octahedral fluorite about 15 years ago: the Huanzala mine, Ancash Department, Peru. These four specimens range between 4 x 5 and 8 x 12 cm—and Marshall says there's a good chance that more will appear.

Coming now to Brazil, we must spend significant time in the Holiday Inn room of Luis Menezes (R. Esmeralda, 534, Belo Horizonte - 30410 - 080 - Brazil), who brought several new things to Denver. One of these, which alone must have put Luis far over his carry-on weight allowance, was several huge (to 45 cm across), weird-looking specimens of **muscovite on quartz** and **feldspar** crystals from the Ouro Fino mine, Coronel Murta, Minas Gerais. On these, a first generation of muscovite makes twinned, offset, silvery-white diamond-shaped books, but over these is deposited a second muscovite generation in solid blankets of sparkling spheres, and this second layer is a rich yellowish brown. On cleaved areas the very sharp boundary between the two depositions and colors can be strikingly seen. The boulders were collected last summer.

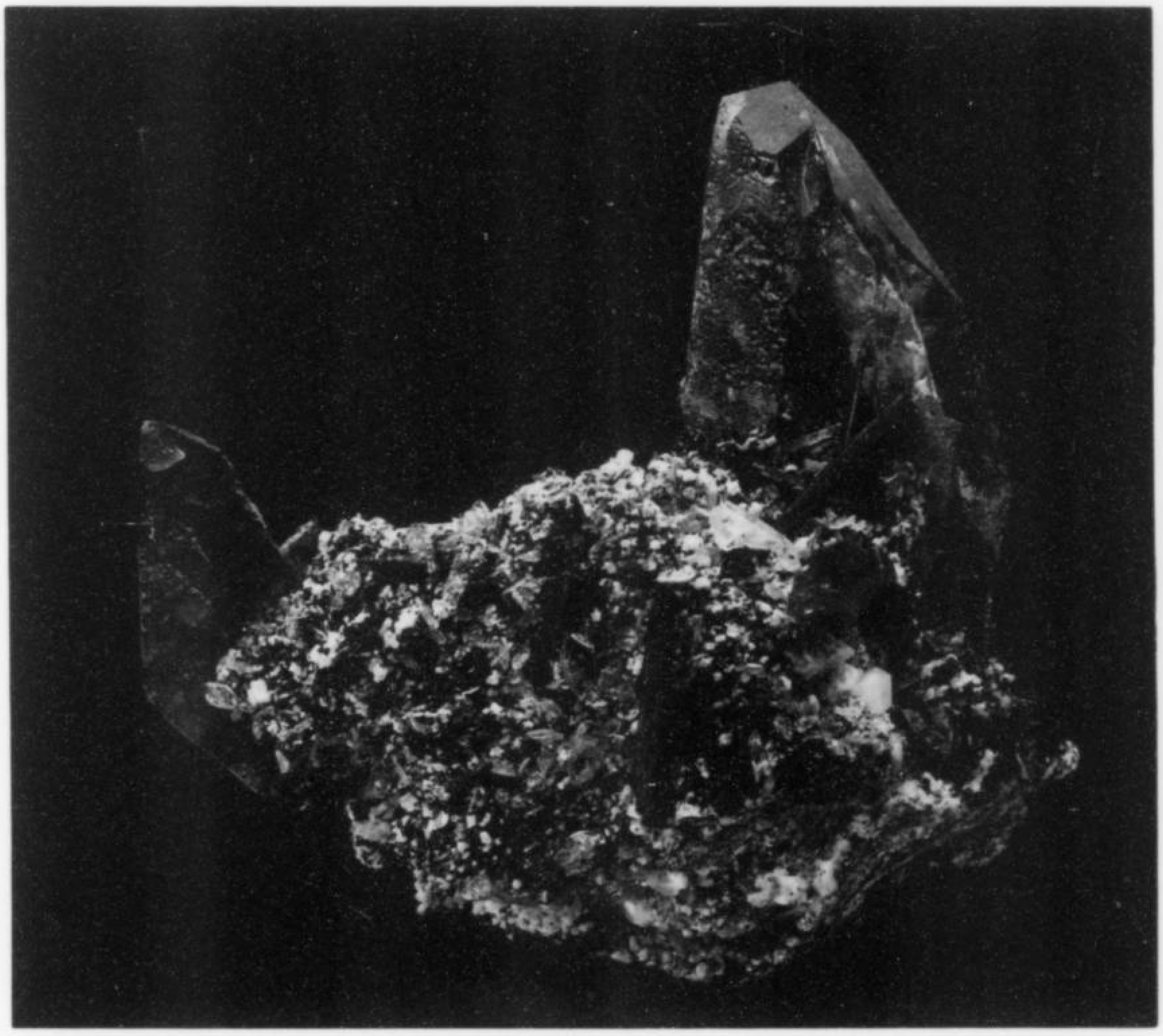


Figure 3. **Titanite with epidote, 12.9 cm, from Capelinha, Minas Gerais, Brazil. Wayne Sorensen collection; Jeff Scovil photo.**

Next, Luis had a good batch of **rutile** from Diamantina, Minas Gerais, found within the last few months. Lustrous, deeply striated prisms, brownish black but with nice red highlights, make parallel groups, with twinning showing on sharp terminal faces, and there are also a few small, cute V-twins. These all are thumbnails and small miniatures lacking matrix and associations, about 40 of them, for $50 to $200.

Near the older brazilianite prospects near Linopolis, Minas Gerais, is a new one being called the Telirio mine, and from here Luis had some nice new **brazilianite** with pale to medium-intense greenish yellow, prismatic to blocky crystals to about 1.5 cm; some specimens are loose clusters, while some have brazilianite crystals sitting up smartly on a matrix of snow-white albite crystals. Of these pieces there are about 40 in all, and they sell for $50 to $200. A greater surprise from the Telirio mine (or prospect, or ragged hole in the ground, or whatever it is) are some thumbnail-sized cyclic twins of **beryllonite**. Like beryllonite from elsewhere, these are not pretty, being milky grayish white and translucent, with wavy faces and a pearly luster. But the sixling forms are reasonably sharp, and the little specimens are very good indeed for the (rare) species. A second Denver dealer who had some of these beryllonite thumbnails, labeling them as being from the Pomarolli Prospect, Linopolis, was Steve Perry of *Steve Perry Minerals* (P.O. Box 136, Davis, CA 95617).

The young dealership of *Bulgarian Minerals & Gem Company* (128, Tzar Boris III blv. (complex Slavia) B1. 16 entr. B, Sofia 1618, Bulgaria) had an out-of-the-way booth at the Main Show fairly littered with recent products of the Madan and Laki mining districts in south-central Bulgaria. Here Dr. Ivan Pojarevski helped me see that there's hope yet for "competitive" specimens of gemmy green Madan **sphalerite**: a few small quartz/sulfide matrix specimens bear quite well isolated sphalerite crystals with fairly bright luster: it's not world-class sphalerite yet, but it's getting the right idea. Also from Madan come many specimens of the familiar spinal-twinned **galena**, huge plates of **manganoan calcite** crystals, and one **quartz** cluster with a Japan-law twin.

From the Droujba mine, Laki District, an appealing new kind of **calcite** was represented in this booth by at least 100 specimens in all sizes. Sharp scalenohedrons to 7 cm long are uniformly coated with a thin crust of **siderite**, such that the total effect is of dignified-looking groups of very pale brown, opaque, creamy-latté calcite dogteeth. On some of these groups a second calcite generation appears as translucent gray-white flattened rhombohedrons perched on the much larger scalenohedrons and in crannies between them. Too many specimens show ugly damage, but surely this will improve as collecting techniques do. And by the way, Keith Williams in *his* Main Show booth had maybe 50 nice thumbnails of these creamy-latté calcites from Laki.

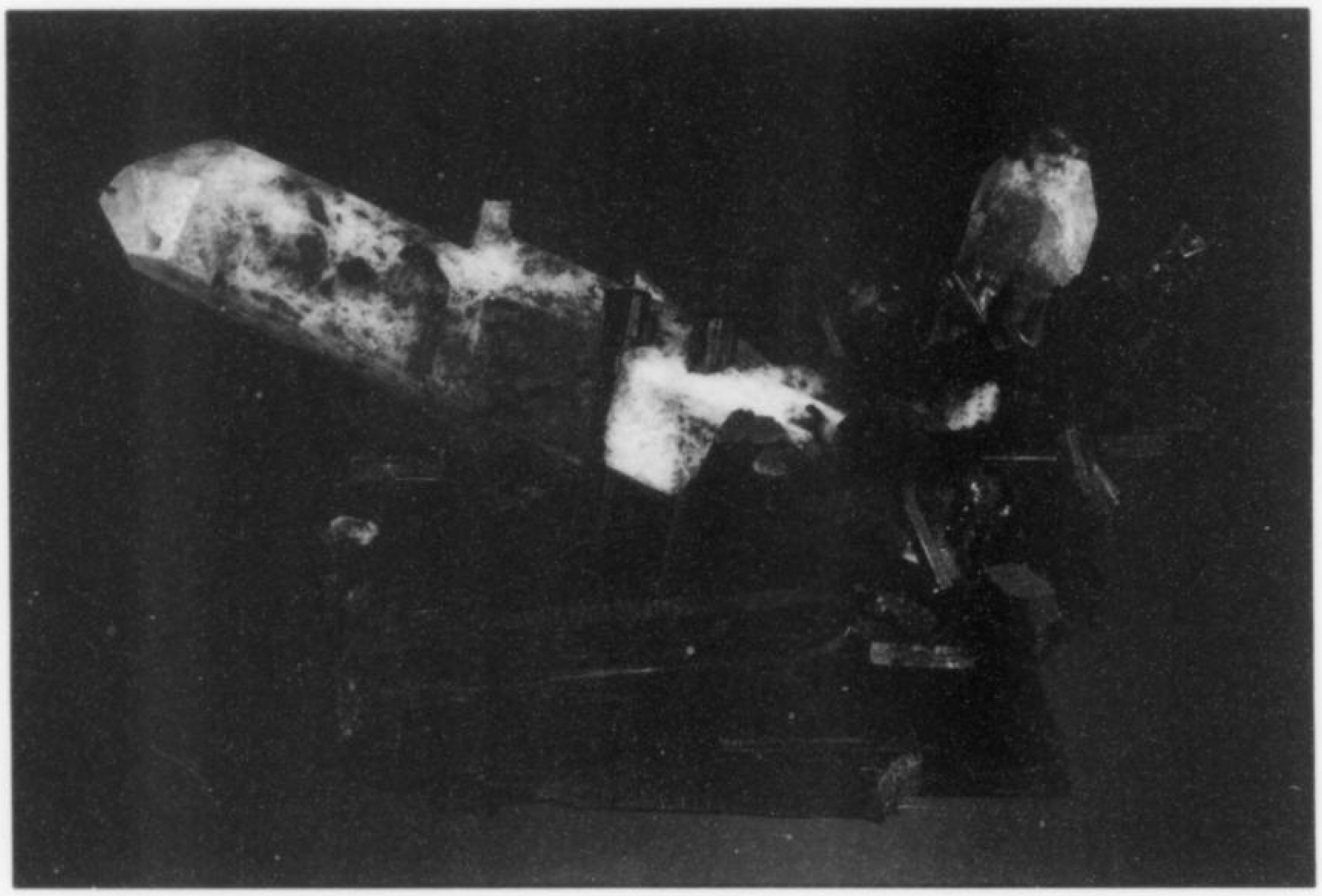


Figure 4. **Epidote and quartz, 17 cm, from Capelinha, Minas Gerais, Brazil. Jürgen Tron collection; Jeff Scovil photo.**

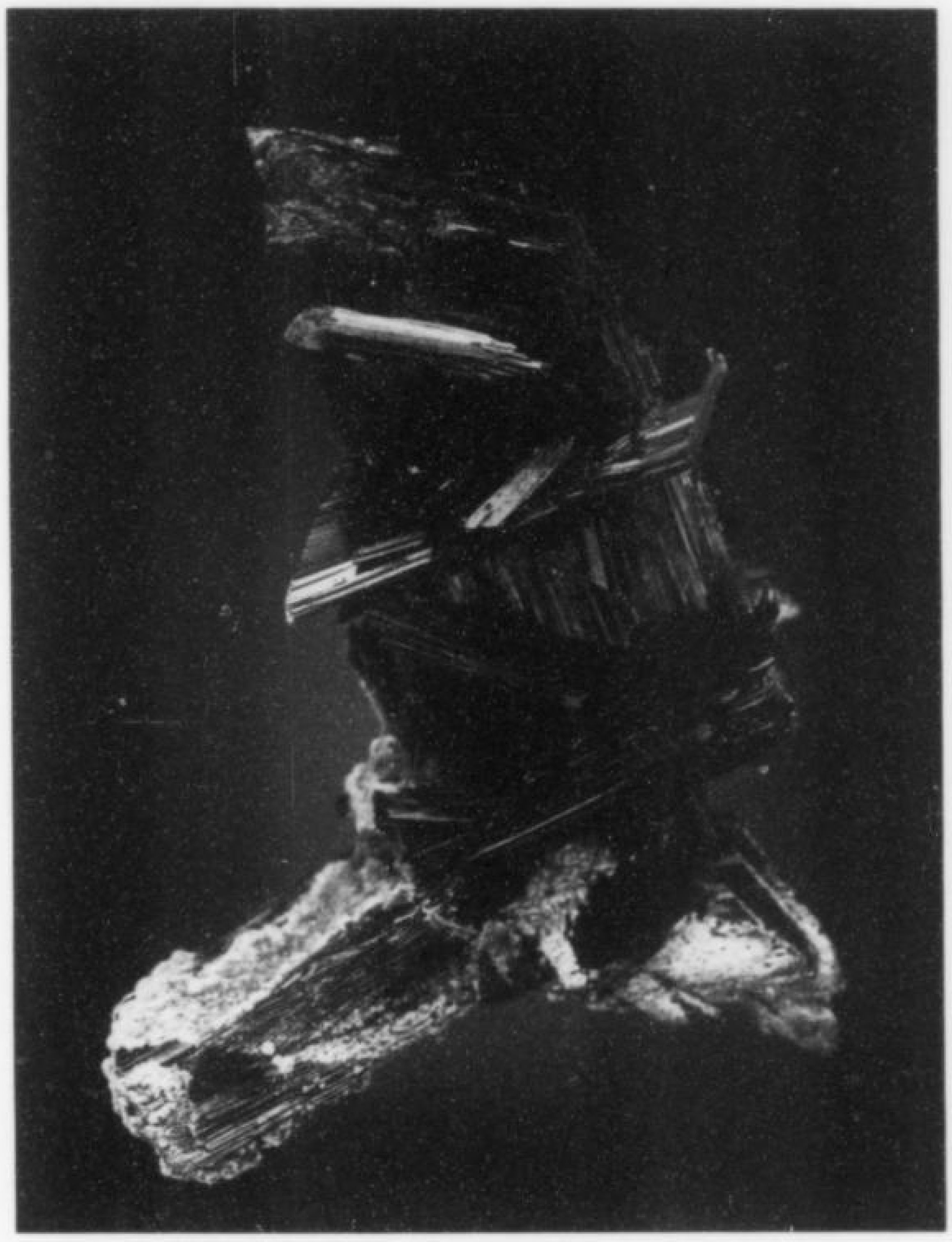
Dave Bunk played the Brazilian what's new/old game here, too, with some enormous and stellar, indeed world-class, specimens of **titanite** from a new strike last month at the long-famous locality of Capelinha, Minas Gerais. It seems I've hardly finished saluting Frank Melanson, from Springfield last month, for having some fine, small, old specimens of this material, but now here's Dave with lustrous, part-gemmy, deep yellow-green fishtail twins to *12 cm* long! The twins show very little damage, and sit regally on a matrix of white feldspar and dark green **epidote** crystals. There were 20 such dramatic specimens here, and they were among the biggest hits of the show.

European pickings were slim this time, but for rare-phosphate enthusiasts there's a new find of **scorodite** from the Hemerdon Ball mine, Sparkwell, Devon, England—an old mine now being combed for specimens. Uli Burchard had just five pieces on consignment with The Virtual Show, and in-the-know Ian Bruce says that only a handful of others so far exists. The scorodite crystals reach about 5 mm, tops, but are sharp and crisp, nicely translucent, and liberally sprinkled about in small vugs in a matrix of hard, massive iron-stained white quartz; these measure from 2 x 4 to 6 x 6 cm. The scorodite color ranges from bright blue to deep grayish bluish green, and this ranging happens moreover within the same crystals, depending on incident light. It's not Tsumeb or Mexican scorodite, but it is probably third-best in the world.

I come now to the show-stoppingest of the Denver show-stoppers, the one that had crowds of beauty-mesmerized seekers pressing continually into the two relevant rooms in the Holiday Inn. If you can remember the brief influx in the market, about 14 years ago, of electrically bright and lustrous, deep red to magenta **erythrite** from Bou Azzer, Morocco, you are also aware that these vanished quickly, no more such world-class specimens having been found since 1986. Well, recent workings between June and September of this year on the same drift of the cobalt mine that produced the old killers have now produced some 2000 to 3000 more specimens just as good, or better! Christine Gaillard, working with François Lietard in the latter's *Minerive* dealership, brought about ten flats of erythrite specimens of all sizes to Denver. Pawing through the flats, elbows constantly elbowing other seekers, I found that good thumbnails could be had for around $200, fine cabinet pieces for low four-figure prices. The scene was similar in the room of Horst Burkart (Dornheckenstr. 20 D-53227 Bonn,

Figure 5. **Erythrite crystal cluster, 4.5 cm, from Bou Azzer, Morocco. Marcus Budil collection; Jeff Scovil photo.**

Figure 6. **Erythrite crystal group, 3.5 cm, from Bou Azzer, Morocco. Christian Gaillard collection; Jeff Scovil photo.**



Germany), where average specimen qualities and prices were just a bit lower than at Lietard's, although, surely, utterly wonderful erythrites could be had in either room (and isolated fine pieces in a few other rooms). The erythrite forms as parallel sheaves of very thin crystals, the sheaves wedging at their tips to delicate points. These sheaves may be loose, or may make jumbled clusters without matrix, or may rise at all angles from a dense black matrix of ore sulfides and arsenides (recall that the world's best skutterudite occurs at Bou Azzer, too). The color, as I've said, is a brilliantly lustrous magenta; on some matrix specimens there is a dusting of much paler pink-purple microcrystals of erythrite and/or roselite. The only problem is that at least some damage is almost always present, and is poignantly conspicuous: tiny bruises, especially on the wedge-tips of sheaves, stand out because of their lighter color and micaceous scaliness. To pick the "best" specimens from so many closely similar ones is a complex matter of weighing variables: styles of specimens, angles of sheaves, variations of brightness, matrix aesthetics, and, most of all, the damage issue, i.e. how many pale little dings one is willing to tolerate on an otherwise fine specimen. We may be pretty sure, anyway, that now's the time to try to pick up one of these lovely things; they are world's-best for what they are, and mineral beauty outdoes itself in them. I'll add finally that a small number of specimens of the related but much rarer species **roselite**, **beta-roselite** and **wendwilsonite** were also found this past summer at Bou Azzer; these tend to occur as simple, flat crystal druses on matrix, deep pink to deep purplish red. Ernesto Ossola and Chris Wright were among a few dealers who had verified specimens of wendwilsonite, a member of the roselite group in which Mg exceeds Co (the reverse being the case for roselite). *Really* finally on this topic, did you know that, as François Lietard vouches, "Bou Azzer" is Arabic for "fig tree"?

Horst Burkart, François Lietard and a few others—most notably Brad and Star Van Scriver of *Heliodor*—offered also some wondrous specimens from a new strike of **vanadinite** at the ACF mine, Mibladen, Morocco, hit in the first week of June (I'm told that specimens were available at July's Ste.-Marie-aux-Mines Show). Thousands of pieces were dug in all; the best in Denver showed pristinely sharp, simple hexagonal crystals to 1.5 cm across (and, exceptionally, almost as thick), and as vividly orange-red and lustrous as vanadinite gets. The crystals form in great plates, mounds, waveforms and towers to 20 cm, either with or without the familiar matrix of bladed white barite and earthy brown gossan.

Moving southward in Africa now, we come to the pretty gem crystals of raspberry-red **elbaite** trickling out from a place "near Oyo City," Nigeria; Dudley Blauwet of *Mountain Minerals International* was offering a handful of these at the Main Show. They are clearly alluvial crystals, being all loose, slightly rounded and minutely chipped; dull of luster, they are nonetheless well terminated and of a lovely shade of red offbeat for elbaite. Dudley says that these have been "known to" (i.e. devoured by) the gem trade for several years, but this is the first offering of natural crystals.

Helmut Brückner of *Exclusive Mineralien* (Postfach 1342, D-79373 Müllheim, Germany) had the best specimens I have yet seen of **aegirine** from Mt. Malosa, Zomba District, Malawi: two deep flats with 17 pieces came with him to Denver. The best three of these specimens are also the biggest: majestic crossed-sword groups with individual lustrous black prisms to 18 cm long. The prisms are thick and sharply, complexly terminated, and they are lightly attached, making for an extremely dramatic effect. At the bases where the swords meet there are little helpings of 1.5-cm white **microcline** crystals and sharp, rich tan, 1-cm **zircon** crystals. The smaller aegirine specimens are nice too, but these three big ones are maxi-aesthetic. They were very recently mined; another shipment *may* make it to Helmut in time for Munich.

impressive but, unfortunately, all at least a little bit damaged as well. Further, Colin had a box of 3 to 5-cm specimens of transparent, lustrous, blocky **topaz** crystals to 2 cm individually, with schorl and feldspar, from the Erongo Mountains, Namibia (presumably somewhere near the aquamarine sites).

On to Asia . . . and up into the Himalayas, and back, predictably, to Dudley Blauwet's *Mountain Minerals International* booth again at the Main Show. A new prospect at Sabsar, Rhondu District, Northern Areas, Pakistan, has lately been giving up some fine little **hydroxylherderite** specimens: either sharp, lustrous, loose wedge-terminated prisms, essentially colorless but tinted yellowish gray by inclusions, or else, in a small minority of the specimens, pale green doubly terminated hydroxylherderite crystals to 2 cm lying flat on a matrix of white feldspar and black schorl, some with tiny gemmy colorless **topaz** crystals too. These latter, green hydroxylherderites have only a medium luster and are translucent at best, but are very sharp, and thumbnail matrix specimens are well composed and appealing.

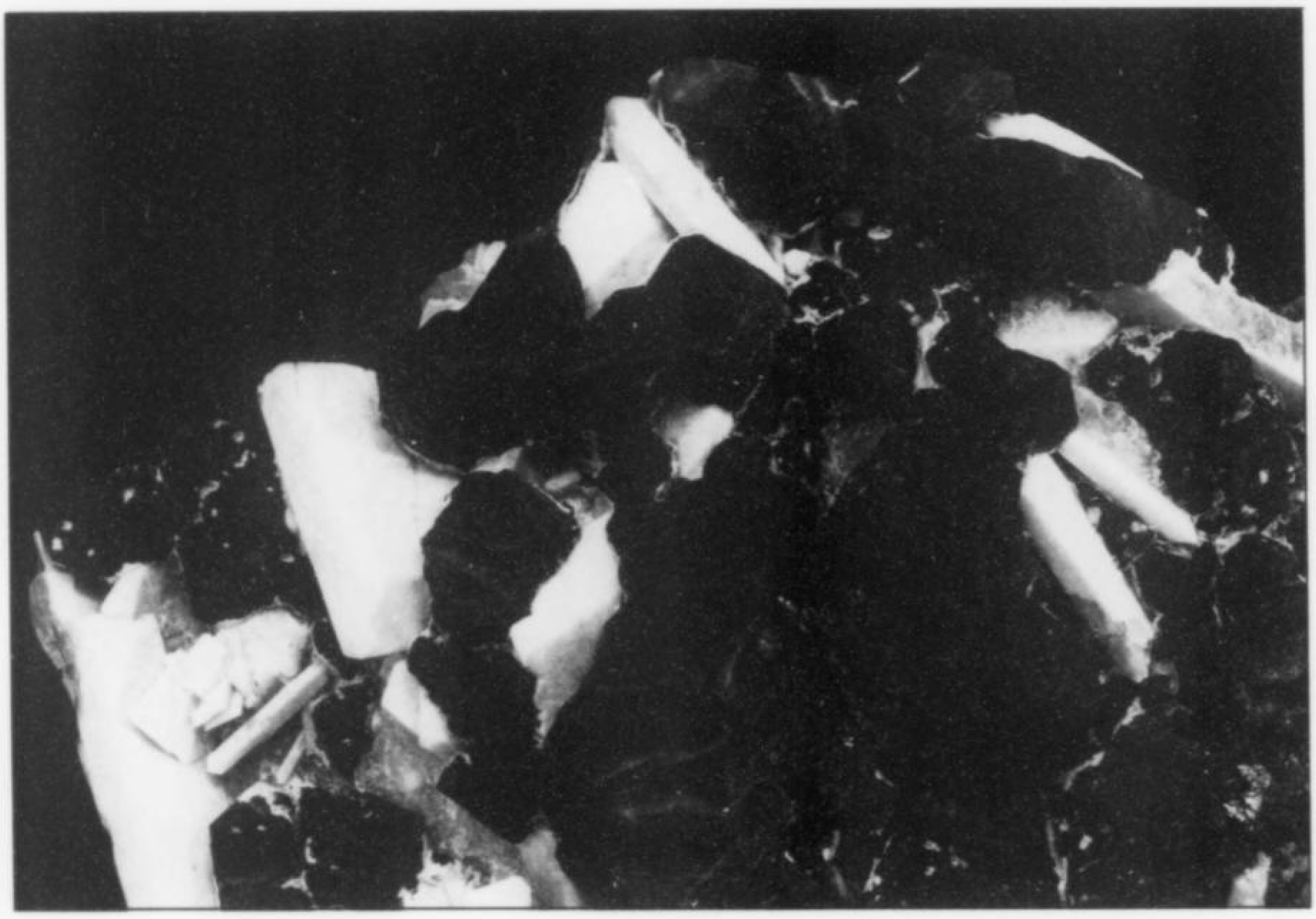


Figure 7. **Sodalite crystals (blue) to 2.9 cm with forsterite, from the Kokscha Valley, Badakhshan, Afghanistan. Herbert Obodda specimen; Jeff Scovil photo.**

Dave Bunk starred again with about 20 miniature and cabinet-sized specimens of **aquamarine** with **schorl** on feldspar from the fast-developing locality of Bergsig 274, Erongo Mountains, Namibia. These are real stunners (especially the matrix specimens), with medium to deep blue, gemmy, simple hexagonal prisms of aquamarine to 3 x 3 x 8 cm, either as loose loners or rising from, or cuddled up against, the sharp, lustrous black schorl or creamy white feldspar euhedrons. One terrific 10-cm specimen had a special surprise: a few 5-mm, sharp gemmy cubes of bright green **fluorite** perching petitely on the feldspar! These Namibian aquamarines have been gingerly coming out lately (see my last Tucson report and the report following this one by Bruce Cairncross), but now seem to be claiming a very high place in the aquamarine pantheon; work is ongoing in the granite pegmatite outbacks of Namibia from whence they come.

There is a new, quite beautiful **hematoid quartz** now being collected on both the Namibian and South African sides of an arid borderland region called the Goodhouse Area (in Namibia) and Warm Baths (in South Africa); I learned about it, in the always-interesting International Dealers enclave of the Main Show, from geologist Colin Comer (Fourways, Johannesburg 2055, Republic of South Africa). Local people discovered the huge crystal clusters about two years ago, but, Colin says, they're just now becoming a hot item in the South African mineral trade. The stout, tight groups of quartz prisms show individuals to 6 cm high and 4 cm thick; the transparent crystals have a bright glassy luster and are zoned in shades of pale to very deep brick red, with some amethystine areas. Here were about 20 specimens, from 5 to 20 cm across—all quite

I noted from Springfield that Dudley Blauwet had also come up with several thumbnail-size loose crystals of gemmy brown **bastnäsite-(Ce)** from a new find in Pakistan. At Denver, several more such world-class specimens of what's usually a dull, unattractive (if rare) complex rare-earth carbonate were escorted to market by Andreas Weerth (Hochfeldstr. 37, D-83684 Tegernsee, Germany), holding court as usual in the Holiday Inn. Andreas had six miniature matrix specimens with crude, opaque 3-cm bastnäsite crystals (possibly interlayered with synchisite) lying flat in them; but also he had a few more of the loose, 2-cm, gem crystals. The locality is given as Chuliani, near Jalalabad, Afghanistan. While we are with Andreas, please note also his big specimens with large, pale pink translucent **elbaite** crystals to 10 cm, surrounded, where they meet their smoky quartz and feldspar crystal matrixes, by **stilbite** in solid coatings of typical bladed white crystals to 2 cm (in some of these pieces there are gray transparent **spodumene** crystals and bright yellow microcrystals of **microlite** too).

As I intimated earlier, one of the most surprising and most excitingly promising debuts at this show was of a radically new sort of **sodalite** from Afghanistan; Andreas Weerth and Herb

Obodda share honors for these specimens (four of them with each dealer). The locality is the Kokcha Valley, Badakhshan: the place we've long known as the source of the world's only fine large lazurite crystals. Indeed, at first glance these new matrix sodalite specimens look much like the familiar lazurites, with rounded, bright blue isometric crystals embedded in massive white material. But in this new instance the white stuff seems to be forsterite, with opaque gray-white bladed forsterite crystals sometimes surrounding the blue blobs on these large (to 10 cm) pieces. The blue blobs, in turn, are sodalite, not lazurite, and the color in fact is a much paler shade of blue, and crystal edges may be quite sharp; a few are even translucent when backlit. The sodalite crystals reach up to 3 cm across, and there are up to 12 individuals on the largest of these specimens. For world-beating sodalite, these new ones easily rival—and look entirely different from—the quartz-encrusted crystals found several years ago at Ste.-Hilaire. Stay tuned!

Additionally, Herb Obodda had a couple of loose gemmy crystals of **danburite** from somewhere in Nuristan, Afghanistan. The prisms are 4 and 5 cm high, lustrous, gemmy throughout, and of a rich shade of orange such that they suggest the "Imperial" topaz of Ouro Preto, Brazil. One danburite is a blocky rectangular prism with a flat basal termination; the other is more rounded, with higher-order prism faces and a complex termination.

Again here at Denver, as at the previous Tucson Show, the country that proved most prolific of all in fine new occurrences was, you guessed it, China. All of the Chinese items I raved about in Tucson were here again, with the pyromorphite reaching new heights of quality and abundance (see later)—yet still there were a couple of *new*-new things too.

One of these is a new type of **calcite** from the Shizhuyuan mine, Hunan Province—a place known also for super specimens of bournonite, bismuthinite and stannite. The loose calcite prisms and parallel groups of prisms are utterly colorless and transparent; and, since their terminations have rhombohedron faces of unequal sizes, they look at first glance like "rock crystal" quartz. But no, they are calcite, recalling the most beautifully pellucid of the old English calcites; some have feathery red hematite inclusions near their bases. Their escort in Denver was Dr. Guanghua Liu of *AAA Liu's Minerals* (Französische Allee 24, D-72072 Tübingen, Germany).

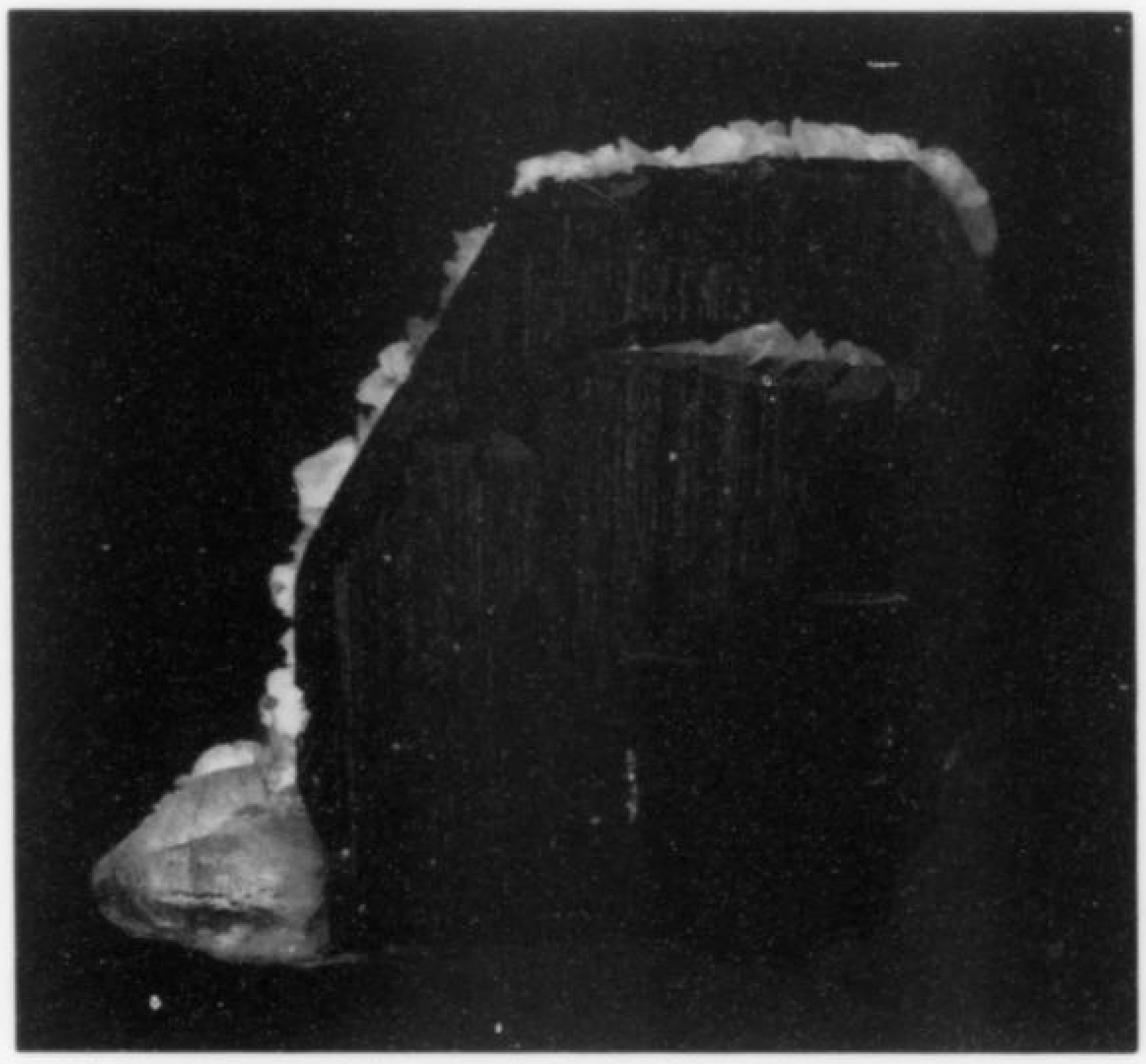


***Figure 8.* Wolframite crystal 8.2 cm, from the Yaogangxian mine, Hunan, China. *Collector's Edge Minerals* specimen; Jeff Scovil photo.**

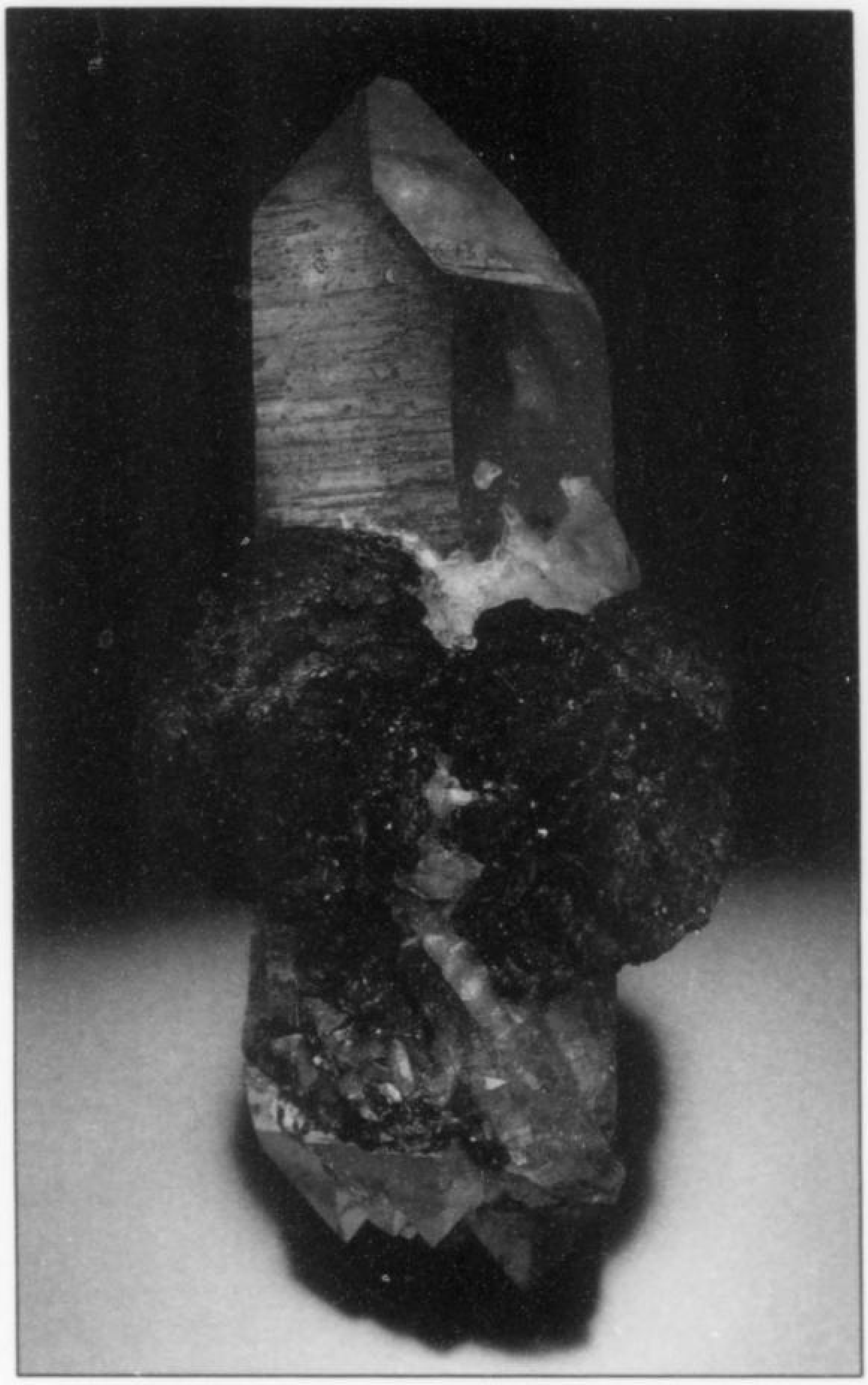


***Figure 9.* Stannite on quartz, 18.8 cm, from the Yaogangxian mine, Hunan, China. *Collector's Edge Minerals* specimen; Jeff Scovil photo.**

Bryan Lees' *Collector's Edge* crew—especially Ken Roberts—have lately been scouting around in China, and one result has been about 12 cabinet-sized, outstanding **wolframite** and two ditto **stannite** specimens from the Yaogangxian mine, Hunan. The better of the stannites, displayed in the *Collector's Edge* case at the Main Show, is probably the best stannite specimen in the world: two 6-cm, lustrous metallic gray, flattened crystals lying symmetrically on either side of the bottom of a transparent terminated quartz prism about 18 cm high.

For more humble seekers, though, the *Collector's Edge* folks also brought in about 100 excellent small specimens (mostly thumbnails and toenails) of the beautiful purple **fluorite** from the Shangbao mine, Hunan, occasionally seen before in scattered examples. All of the fluorite crystals are predominantly cubes, but with dodecahedron faces bevelling the cube edges; they are transparent, and range in color from pale lilac to deepest purple. Best of all, brilliant little pyrite cubes and little quartz needles are apt to be sprinkled on and included in many of the fluorites. A top-class, aesthetically dramatic thumbnail will run you around $100.

I have a strong finish this time, involving what must be many thousands of the new Chinese **pyromorphite** specimens, in all sizes and qualities, which were seen everywhere around both Denver shows: a great green gushing specimen flood, with the promise of still more waves to come. Let's first address the issue of

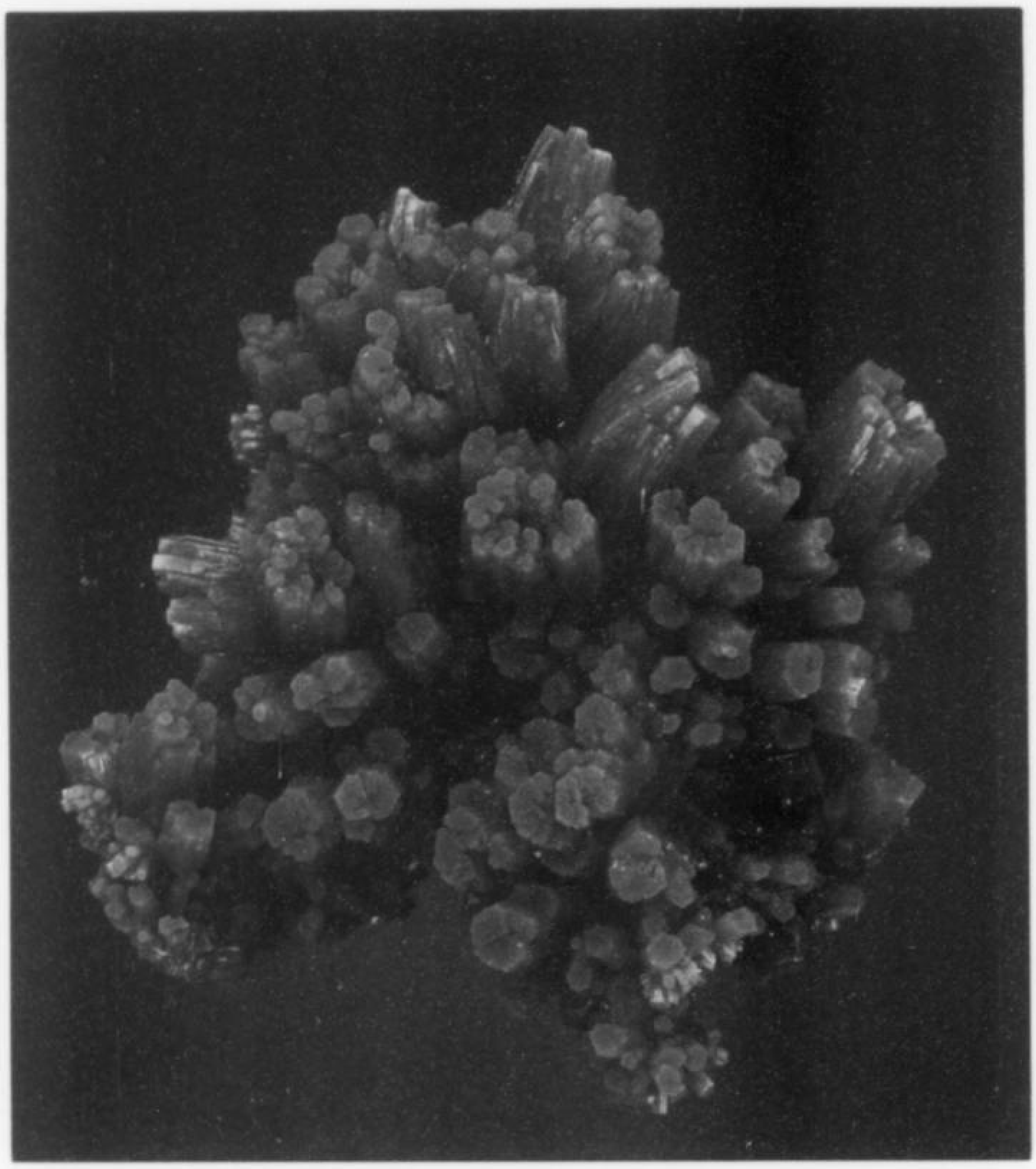


Figure 10. **Pyromorphite, 6 cm, from Yangshu, Guangxi, China.** ***Collector's Edge Minerals*** **specimen; Jeff Scovil photo.**

the locality, the confusion about which I mentioned in my Springfield report. Several people claim authoritative knowledge regarding the place, and there are some apparent contradictions, but since all informants are surely at least partly right, the overlap-summary of data I gleaned is as follows. A mountain near the town of Yangshuo, near the city of Guilin, in the province of Guangxi, contains an old lead mine now being worked both for ore and specimens, with two main adits coming in from opposite sides of the mountain; the mine is called the Daoping. As we know, pyromorphite specimens from here have been trickling out for the last two or three years, and now, with so many different dealers' lots to look at, it's clear that the pyromorphite has varied from pocket to pocket, or perhaps zone to zone. The first major lot, taken out about two years ago, has the palest colored crystals with the brightest luster: these are brilliant, Spanish-style, yellow-green hexagonal barrels to 2 cm or so, or, more rarely, milky pale green spikes and barrels and sheaves, sometimes on white quartz matrix. As mining has gone on, the color has darkened, the luster has decreased, and specimen sizes have greatly increased: here we are talking about huge, lush plates of medium-green crystals, suggesting thick lawns in rainy summers—and some specimens reach 25 cm across. In the very latest batch, mined two or three months ago, the crystals are a paler yellow-green again, may reach 3 cm long, and are faintly zoned, and actually translucent: backlit, they glow gorgeously in lime-green throughout the prisms. In general the best of this pyromorphite is turning out to be among the world's finest, and new lots may well continue to hit the market. To credit all of the Denver dealers who had this material is tricky, as dozens of dealerships had at least some of it, so to name names is really to talk about specialties: e.g., Wayne Thompson and *Collector's Edge* had the biggest and most dramatic green-lawn specimens, while the *Rocksmiths* at the Main Show had diversities of nice little thumbnails. But I must say that the most generally impressive—and, on the whole, lowest priced—array was to be found in the Holiday Inn room of Mike Bergmann. Here was a large glass case simply flaming with about a hundred top-class pyromorphite specimens of every style (though Mike is especially proud of having scored so many of the newest, translucent kind). As a postscript I'll mention that the only place where I saw any specimens of *other* species from this locality was at the Rocksmiths' stand, where two small clusters of iron-stained white **cerussite** crystals hid out. These are nothing special for cerussite, but may dimly promise that the Daoping mine will turn out, in time, other lead-bearing things besides pyromorphite in noteworthy specimens.

And that concludes the tour.

Of course, some mighty fine things were to be ogled in the display cases at the Main Show this year, but first a word about a fine small collection of silver minerals on show at one of the stands, and about the collection's creator. Jack Schissler of Bisbee, Arizona, was a mineral collector, mining engineer, gold prospector, World War II fighter pilot, mayor of Bisbee from 1982 to 1984, and, I gather from the front-page article about him in the *Bisbee Daily Review*, a much-beloved southwestern "character" whose death in March of this year was a sad event for many good people. Gene and Jackie Schlepp of the Tucson dealership of *Western Minerals* now have the job of selling Jack's silver-species collection, but before doing so they wanted to show it off to the Denver crowds, and what a show it was: about 50 smallish but outstanding specimens mounted on black styrofoam bases in the rear area of the Schlepps' booth. Highlights included wonderful thumbnails of Příbram proustite and polybasite; thumbnails of Peruvian proustite and pyrargyrite; amazing miniatures of Romanian hessite and nagyagite; acanthites from everywhere; and, best of all (to my taste anyway) a 4 x 6-cm cluster of loosely joined, brilliant spheres of miargyrite crystals from the Little Anna mine in Colorado. (Miargyrite from Colorado?? But this has to be one of the finest miargyrites from anywhere.) Many thanks to the Schlepps for sharing this exquisite little collection with everyone before selling it off.

Naturally, many of the display cases presented Colorado themes. Among these were a casefull of self-collected Colorado pieces by Robert Stoufer of Ouray; the Ouray County Historical Society's case of fine Colorado specimens recently donated by John Marshall of Dedham, Massachusetts; and Harvard's case of manganese-bearing Colorado minerals. The San Juan Mountains (being the show theme) came in for lavish treatment in several more cases: one by the Colorado School of Mines, one by Benjy and Liz Kuehling, and three by Dave Bunk, in a partial reprise of his Colorado-collection performance at Springfield. And there was much, much else in the way of Colorado minerals too.

Among the displays on other themes that grabbed me were show-stopping specimens from the Houston Museum and from the Rice Northwest Museum; new Nevada minerals from the Los Angeles County Museum; old Franklin, New Jersey, pieces from the Pennsylvania State University Earth and Science Museum; four magnificent specimens from *Collector's Edge* (including that Chinese stannite); minerals (and geology) of the Mogok District, Burma, from the American Museum of Natural History; and the Smithsonian's millennial/antiquarian case showing specimens that have reposed in the U.S. National Collection since 1900, with a bit of their histories explained. Irv Brown and Wendell Wilson let us look at some of the best of their terrific specimens (large ones and small ones, respectively). The Society of Mineral Museum Professionals, under the heading "Minerals Under 40," displayed really *good* specimens purchased by various people over the last two years for under $40 (it *can* be done!).

But I've saved my most elaborate gushings for an amazing and creative case by Bill and Carol Smith called "A Good Day at Black Rock," wherein about 40 black "rocks" spoke of top quality and highest taste. I have seen the Smiths' collection a couple of times, yet many of these pieces were unfamiliar to me, and are thus, I guess, very recently acquired. Among the standouts of standouts here were a huge Ilfeld, Germany, manganite; two likewise huge bournonites, from Peru and Cornwall; two kingly South African hematites and a major Swiss "Eisenrose" hematite; an insanely bright cluster of Dal'negorsk sphalerite crystals; a 3.5-cm Swedish native lead with truly sharp 1-cm crystals; and even a black Tsumeb smithsonite, with sharp elongated rhombohedrons to 3 cm. Who says black minerals can't be exciting?!

On opening day of the Main Show, every grownup is always a bit unnerved by the dense crowds of boisterous schoolchildren set loose, careening, about the show floor; but some of them are tomorrow's great collectors, and must be lovingly encouraged and tolerated. I can think of nothing else even faintly negative to say about the pleasure and thrill of this great show (and yes, Marty, I mean the hotel show too).

I am finishing this report just in time; dusk again is coming in at the fourth-floor window, and I must be packed and ready to leave the hotel tomorrow at 7:00 A.M. Let me invite anyone who has not yet made it to Denver to do so soon . . . it's a wonderful tour through the World According To Minerals. See you next year.

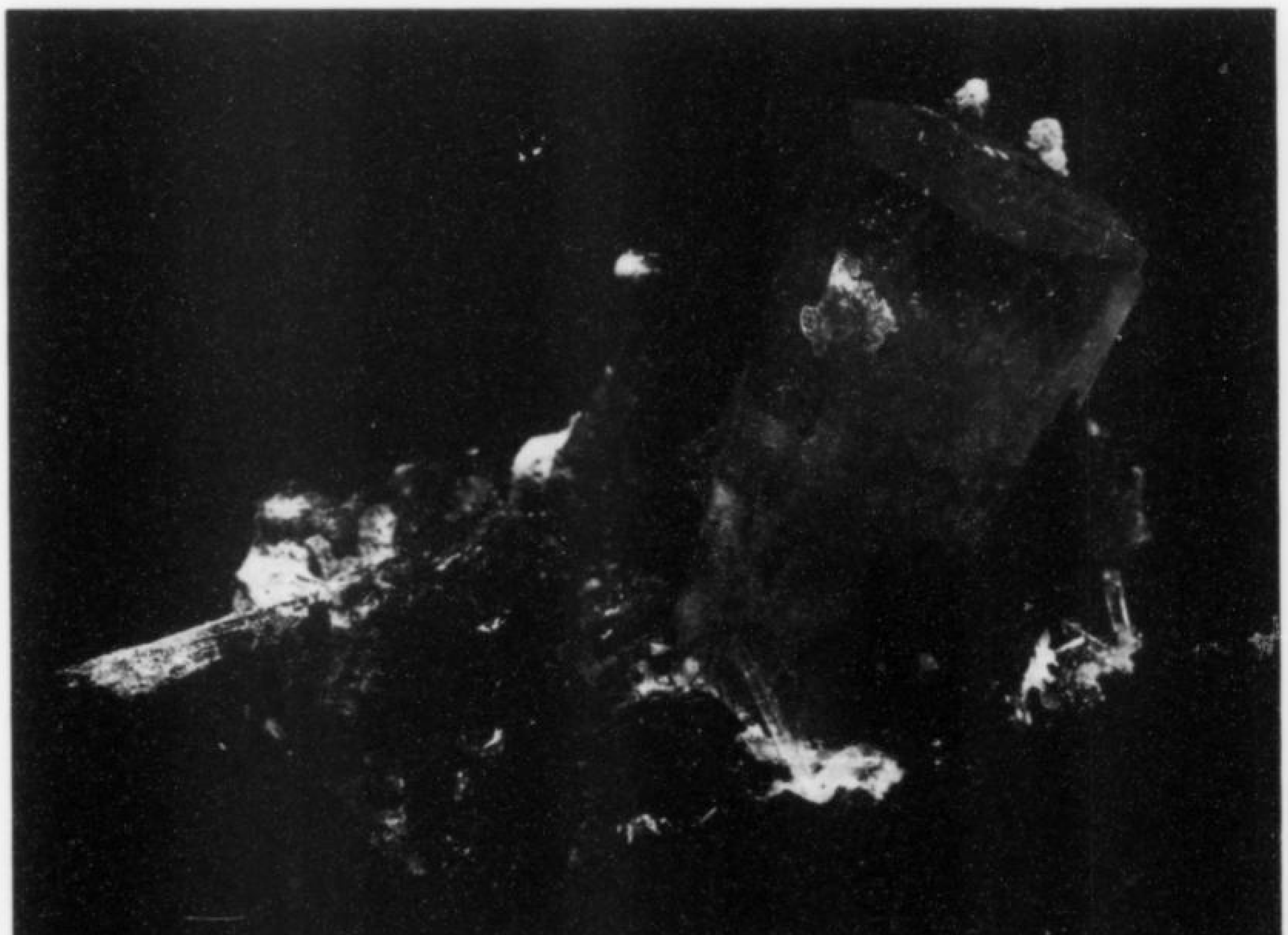


***Figure 11.* Aquamarine beryl with schorl, 9.2 cm, from Erongo Mountain, Namibia. Desmond Sacco collection; Bruce Cairncross photo.**

Aquamarine from Erongo Mtn., Namibia

by Bruce Cairncross

During the first half of 2000, a major discovery of aquamarine was made at Erongo Mountain in Namibia. Geographically, this locality is a prominent, semi-circular mountain, about 30 kilometers in diameter, located approximately 20 km due north of Usakos and 25 km northwest of Karibib in Damaraland, Namibia. Mineral collectors usually refer to the Erongo as a "granite" mountain, but there are actually several different rock types found there, and geologists who have researched the region have called this feature the Erongo Volcanic Complex. The rocks are late-Jurassic in age and consist of a mixture of older mafic and felsic lavas (basalts, rhyodacites, tuffs), intrusive sills and dikes, and younger intrusive granite. Pegmatites are fairly common at Erongo Mountain and

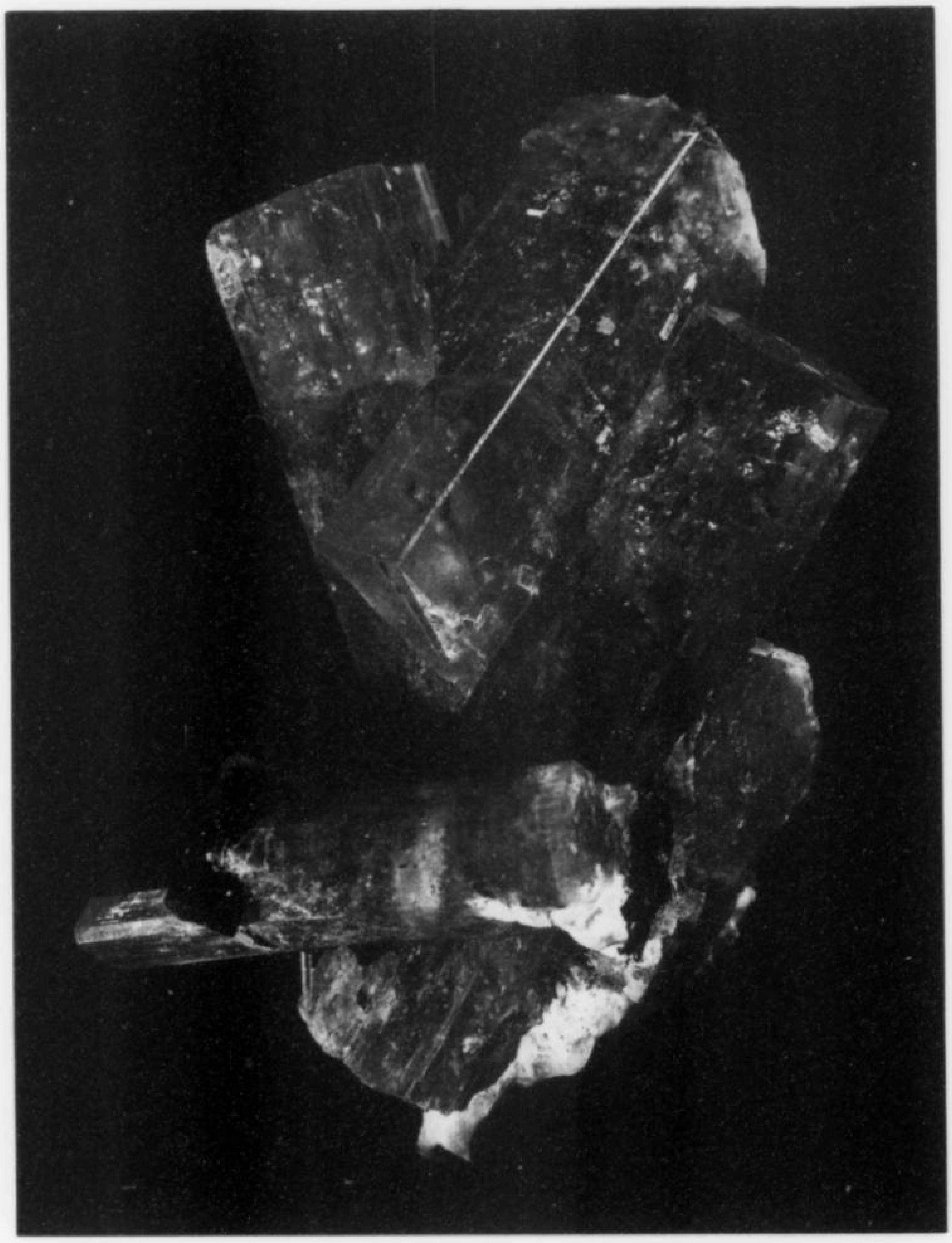


Figure 12. **Aquamarine beryl with schorl, 9 cm, from Erongo Mountain, Namibia. Desmond Sacco collection; Bruce Cairncross photo.**

several of these have economic deposits of tin, tungsten, beryllium, fluorine and even small amounts of gold. The Krantzberg tin-tungsten mine is one of the largest in this region.

Specimens of schorl, smoky quartz and quartz have been collected at Erongo Mountain for decades; some examples in South African collections date back to the 1930's, so the locality is not really new in the sense of being recently discovered. However, during the past few years, there appears to have been an intense resurgence in informal diggers exploiting the pegmatites for mineral specimens (*see March–April 2000, page 193–194; Jan.–Feb. 2000, page 99; Nov.–Dec. 1999, page 471*). In fact, at the neighboring Spitzkoppe Mountains, where minerals can be purchased from local diggers, more and more specimens are being sold that are actually being dug from Erongo Mountain, not the Spitzkoppe. Both localities produce topaz and aquamarine, so caution is needed to determine the exact locality for one's purchases! Large, shiny black schorl, sometimes associated with transparent, euhedral topaz and green fluorite, has recently been the most attractive and sought-after specimens from Erongo Mountain. There has been some hint of aquamarine and some good specimens have previously been collected, most being pale blue or pale green.

The latest discovery of aquamarines from the Erongo pegmatites is stunning. (I have personally seen several dozen pieces that came from one particular discovery. There are however, more specimens available, of varying size and quality.) These range in size from miniatures through cabinet-size to a few museum-size plates; all were carefully collected, as can be seen from the minimum amount of damage present. The bulk of the specimens are small-cabinet to large-cabinet size. On the matrix specimens, the predominant (and most striking) species is aquamarine beryl. It is associated with euhedral black schorl, deep green, cuboctahedral fluorite (up to 1 cm), orthoclase and minor quartz. Several specimens are single, stand-alone crystals of aquamarine. The color of the aquamarine is one of the most appealing aspects of these crystals. It is an intense blue, of a color variety not previously found in the Erongo pegmatites. Many crystals are zoned perpendicular to the *c*-axis, from the base to the top of the crystal. The lower section is somewhat opaque and deep blue; this passes upwards into a termination that is a transparent, gemmy, paler blue. Single crystals are up to 9 cm and were probably broken off from their matrix. There are also some free-standing, interlocking clusters of crystals. Matrix pieces, some over 20 cm, consist of a mixture of large, euhedral, prismatic schorl, some squat, terminated crystals 10 x 5 cm, and masses of smaller interlocking schorls, with the aquamarine nestling in amongst the schorl. The blue-black color combination makes for striking specimens. The specimens have been cleaned, but a few still have overgrowths of fluorescent, globular hyalite that has previously been reported as an associated species. The orthoclase is a pale creamy white; when the blue aquamarine occurs on this crystalline matrix, these two minerals together produce very attractive color contrasts.

Letters

FREILICH ISSUE REVISITED

It was surprising to see some negative feedback in response to the Freilich Issue. Let's face it: mineral collecting is not among the most popular hobbies. So we should all be grateful when a successful businessman dedicates a portion of his wealth and time to the hobby, and is willing to share his passion with the rest of us. That he had the humility and good sense to hire an expert to help him in his pursuit of excellence is further evidence of his dedication. It is true that "just having money does not make a person one of the great mineral collectors." But spending that money to acquire the very finest mineral specimens available just might. One thing the *Mineralogical Record* should be about is "showing off" newly acquired minerals and giving credit to their owners. Please keep up the good work.

And thank you for the article about the Millington quarry. I live nearby and was therefore quite excited to see a local site grace the pages of your magazine.

Richard Blackman
Randolph, NJ

I must take the opportunity to echo J. Roger Mitchell's letter of complaint about the Freilich Issue. It struck me as a blatant attempt to raise the value of his collection and promote the "good old boys" dealer network. Are you publishing for the likes of such people, or do you care about the real collectors that make up most of your audience?

Rick Dillhoff
Redmond, WA

Regarding J. Roger Mitchell's letter about the Freilich Issue: Posh my foot! Wouldn't most of us like to be able to hire Mr. Mineral [Dave Wilber] as our personal curator? I cannot begin to convey the depth of admiration I have for Dave's ability as revealed in the many displays he has mounted over the years. He is the first and greatest mineral collector of recent times. That Mr. Freilich chose to hire him speaks volumes about ability, not to mention trust. MR can be the show-off vehicle for any future acquisitions. The Freilich Issue has what should always be among the focal points of the mineral hobby's chief publication: excellent photographs and fantastic specimens. Bravo!

P.S. John [White], thank you for your articles and your curatorial insight. Few readers possess such acumen.

James L. Bleess
Tucson, AZ

Some interesting developments have taken place since the publication of the Freilich Issue. Mr. Freilich began thinking last year that it was time for him to leave his em-

ployer and establish his own jewelry design and manufacturing business. Consequently he began having second thoughts about going ahead with the Freilich Issue, because it appeared that the valuable mineral and book collections might have to be liquidated in order to raise working capital for his new venture. In December 1999 he asked me if it was possible to cancel *the issue, but by then we had already gone to press and it was too late. So Joe decided to make the best of it, and had a good time exhibiting his collection at the Tucson Show and fielding nice compliments on the collection and the issue.*

Since that time Joe has indeed gone ahead and started his own business, Joe Freilich Designs. He held onto the collections as long as possible. But finally it was necessary to liquidate them, a year after publication of the Freilich Issue. In January of this year the mineral and book collections were scheduled to be put up for public auction at Sotheby's in New York, just as this issue was being mailed. So the beautiful assemblage of minerals that he put together in such a short time is no more, the individual pieces dispersed to other lucky collectors at the market price.

We have no regrets about publishing the Freilich Issue, even though the collection proved to be short-lived. It is something Joe can always be proud of; it documents what was possible to do if you sought out the best specimens on the market during the years 1998–1999. In the future that issue will stand as a sort of time capsule representing those years, even though (like so many other historical collections) it no longer exists as an entity. And the issue was a fine opportunity to feature David Wilber, who has long deserved public recognition for his life-long achievements in mineral collecting. We are very grateful to Joe for funding that issue, and we wish him the best in his new business, and in building a new collection.

Will we change the way we deal with proposals for special collection catalogs in the future? Probably not substantially, although we will go back to our usual format of presenting them as outside-funded supplements to, rather than replacements of, a regular issue. That way there will always be plenty of science in every issue, and the collection catalogs will be a bonus. The readership will be the beneficiary, receiving once again for free something that will be a treat to the eyes, while our regular complement of articles and columns will continue uninterrupted. *Ed.*

VALZERGUES MINE BOOK

I have just received the July-August issue and found in it what you wrote about my book, *La Mine de Fluorine de Valzergues*. I just want to tell you "thank you." You wrote a beautiful commentary that gives happiness to me. So now I have enough energy to think about writing another book!

Etienne Guillou
Le Perray en Yvelines, France

Go for it! *Ed.*

CARNEGIE AWARD RECIPIENT

Regarding your "Tucson Show 2K Winners" announcement (vol. 31, no. 5, p. 379), you designated the "Franklin-Sterling Hill Mining Museum" as recipient of the Carnegie Mineralogical Award. Although "Franklin-Sterling" is a common phrase locally (as in the Franklin-Sterling Gem and Mineral Show), there is no Franklin-Sterling Hill Mining Museum. There is the Franklin Mineral Museum in Franklin, and the Sterling Hill Mining Museum about two miles away in Ogdensburg. Both are worthy institutions, but they have not yet merged; it is the latter which was honored by the Carnegie Mineralogical Award. If you are willing to admit a mistake was made, we fans of the Franklin-Sterling Hill area will consider it merely an editorial wilber in the customarily flawless finish of your estimable publication.

Richard C. Bastwick
New York, NY

GROWING WIRE SILVERS

There has been some conjecture regarding the origins of some very fine wire silver specimens which have appeared on the market during the last three years. These purport to be from Freiberg in Saxony, but some people have suggested that the natural origin of many, if not all, of these specimens must be in doubt because they are 99.9% pure silver and have no matrix. Whilst there are numerous questions which need to be addressed in this matter, the major one, to my mind, was: *HOW* could such specimens be artificially produced?

I looked through the literature I possessed on the subject of silver and found in Dana (*System of Mineralogy*) a reference to a paper on the formation of wire silver (A. Beutell, Centralblatt für Mineralogie, Stuttgart, **14**, 1919). I assumed this would be of a conjectural nature and would have done no more about it, had I not mentioned its existence in an e-mail to my very good friend and colleague, Dave Crawford of Rockford, Illinois. Dave replied shortly afterwards saying that he had obtained a copy of the paper (in German) and had put it in the mail to me. When it arrived I skimmed through it and rapidly realized that what I had in front of me was not in the least bit conjectural, but was, in fact, a detailed blueprint for the production of typical wire silver specimens in a laboratory environment!

Originally Beutell had been experimenting with the synthesis of argentite and had noted the development of growths of pure silver on the synthetic sulfide he was producing. He discovered that if pieces of silver sulfide (synthetic or natural) were wrapped in a little metallic silver foil and heated, a beard-like growth of silver hairs appeared. He obtained the same result if a solid silver bead with a superficial sulfide coating was heated. He concluded that these curious growths were initiated by some property of the contact between sulfide and metal. He discovered also that the phenomenon was sensitive to a temperature *gradient*: he conducted most of his experiments at a fairly modest 450°C in evacuated glass tubes, and noted that the silver hairs grew from the hotter end of the tube towards the cooler end. Finally he used a tube which, although it had been drawn out into a capillary, was not evacuated and not sealed, and he found that the hair-like silver growths developed even better in the presence of air.

As well as the details of his experimental work the paper also had some illustrations of his results and these were unambiguous. Beutell had grown silver wires which, although small, were similar in all respects to natural specimens.

I resolved to repeat his experiments! I did not have any argentite (or, at least, none that I was prepared to sacrifice) but I had ample stocks of silver scrap, mostly the Sterling alloy of 92.5% silver, 7.5% copper. I suspect that this would not influence the outcome of the experiments and this, in general, proved to be the case. I melted some pieces of silver into beads of various sizes. To coat these beads with a suitable layer of sulfide I prepared some crude sodium sulfide by heating washing soda (sodium carbonate decahydrate) in a crucible. The solid crystals rapidly dissolved in their own water of crystallization, at which point I stirred in a couple of spoonfuls of powdered roll sulfur and continued heating until all the water had been driven off and the sulfur fused with the residual sodium carbonate (now, if I recall correctly, the monohydrate). Any silver beads warmed in this crucible rapidly gained a jet-black outer skin of silver sulfide.

I firstly tried using a temperature-controlled kiln at the temperature (450°C) which Beutell had selected and developed some small wire growths. These were sufficient to inspire, but were on a fairly microscopic scale, and I really wanted to generate something more sizeable—a thumbnail at the very least!

I read the paper again, and was struck by the importance Beutell attached to the temperature gradient. In my kiln there would be little variation in temperature between the bottom and the top of the crucibles I was using. Beutell had used what he called a "tube oven" which allowed him to have one end of his reaction tubes in the "oven," the other end outside, and thus there was a considerable temperature differential between one end of a tube and its opposite counterpart. I was about to modify my own kiln when I suddenly wondered if a kiln was even necessary. If temperature gradient rather than temperature was the critical factor, perhaps I could just heat a crucible over a Bunsen burner?

I was concerned that, outside the kiln, there might be too much air in the crucible which, even though it had a close-fitting lid, was relatively large (about 8 cm x 5 cm), so I added a little additional sulfur before putting on the lid and placing it on the Bunsen.

This time I got much better growths, with wires up to 5 mm long. I tried varying the amount of sulfur added to the crucible and noticed that, as the amount of sulfur increased, wire development increased up to a point where it was gradually sacrificed to the formation of rather fine acicular crystals of acanthite. With a substantial excess of sulfur no wires at all formed, and the silver bead was completely covered with twinned crystals of synthetic acanthite.

As regards time-scale, I found that, in general, most development involving wire silver seemed to have finished within two hours and that no further growth occurred, even if heating was continued for 24 hours.

But I was still only producing mircomounts, albeit some rather nice combinations of shiny wires and lustrous black acanthites. Finally it occurred to me that maybe I was in error trying to reduce the amount of air available in the crucible. If Beutell found better growth in an almost sealed tube with only a little air, and that presumably not replenished, maybe growth would be yet better in a completely uncovered crucible. And, of course, this would make for a more pronounced temperature gradient as well.

By this time I was getting more interested in the potential for growing some really stunning acanthites, and it was with some reluctance that I resolved to break off the series of trials I had been undertaking (it was all very well having spurned the kiln, but I only had one Bunsen burner) and try the simple procedure of heating a sulfide-coated bead of silver in a completely open crucible.

That afternoon I had been at my shop and was a little late returning home, so it was 6 p.m. when I went out to the building at the end of the garden which serves me as a workshop and laboratory. After ten days of heating innumerable crucibles of silver and sulfur it was beginning to smell like some antechamber to the Pit of Hades! I took the crucible with the latest batch of acanthite crystals off the Bunsen and prepared for the new trial by half submerging a nugget of oxidized silver (again, Sterling, 92.5% Ag, 7.5% Cu) weighing in the region of 15 gm in powdered clay at the bottom of another crucible. I sprinkled a little extra sulfur on the surface of the nugget (I had noted, previously, that a little sulfur was beneficial for wire growth) and set the crucible over the Bunsen burner.

I prepared dinner for my daughter and myself and when this was in the oven and cooking I went out again to look at the trial which had now been heating for 45 minutes. Already it had grown a few minute wires, barely perceptible to the naked eye but quite visible under low magnification. By the end of dinner there were three distinct groups of silvery white wires growing from the blackened nugget and clearly visible to the naked eye.

My daughter had some complicated math for homework; by the time we worked through this the trial had been running for three hours. The original wires were continuing to grow and new wire groupings were appearing. I broached my first can of beer and watched an interesting documentary about a mutiny which had occurred in the 70's on board a Soviet warship. Back in the workshop wires were sprouting everywhere!

I discussed life, the universe and everything with my wife, as we often do at the end of a day. Which took us to midnight, by which time the nugget had developed some splendid growths with individual wires reaching well over 5 mm. This nugget had become by far the best specimen I had prepared, and I was presented with something of a dilemma. In some previous trials, promising wire growths had subsequently been consumed as other reactions came into play so . . . should I stop the current trial and be satisfied with the degree of success now achieved? I decided against that course of action. I would leave the crucible heating overnight, just taking (with some difficulty) a few digital photos to record the development at that time.

I had been right. By morning the nugget in the crucible had a really quite superb growth of wires, the longest now well over 1 cm in length. I took some further photographs and resolved to allow the trial to continue until no further growth was observed.

After 24 hours growth was still continuing and individual wires had reached 2 cm in length. After 48 hours I stopped the trial, by which time the longest individual wire had reached a length of some 3.5 cm (1⅓ inches)!

The process of formation was (and still is) as surprising to me as it was to Beutell.

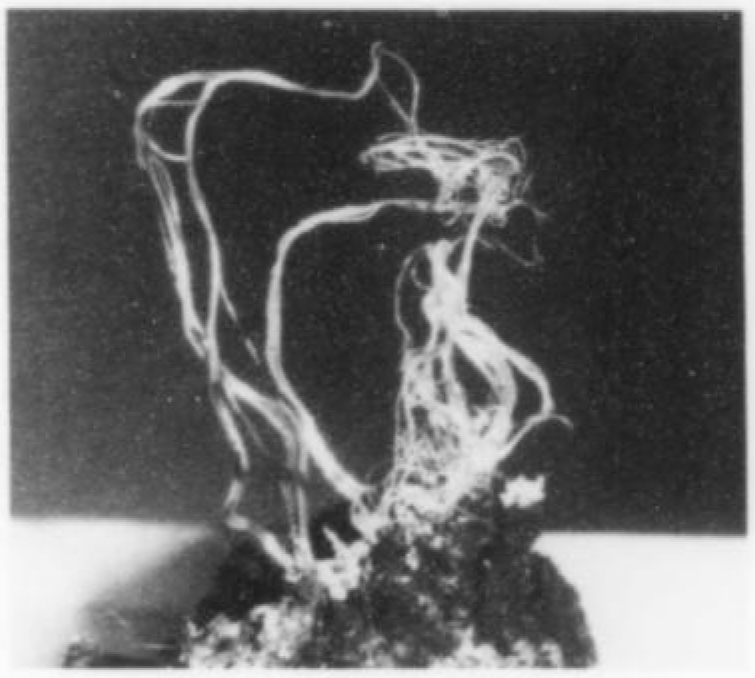


Figure 1. **Homemade wire silver with wires to 3.5 cm.**

What is also surprising is that this amazing process can be provoked so easily and with such modest equipment. There is more work to be done: I would suspect that even better growths could be produced in an open crucible using argentite and silver foil rather than sulfide-coated silver. But whatever else might grow in the future over that Bunsen burner at the bottom of the garden I am already convinced that sizeable specimens of wire silver to match those from Freiberg can be fabricated, and fabricated with equipment more reminiscent of a domestic kitchen rather than a modern research facility.

Don Edwards
Tideswell, UK

RETIRED AND READY TO ROCK

I was once a subscriber (1980's) but due to job demands found it difficult to pursue my mineral collecting interests. My collection was put on hold until the day I retired. That day has finally arrived and I now can put my time and energies back into the mineral collecting field. And, as in the past, your fantastic magazine will allow me to take those dreamed about mineral excursions as well as giving me numerous hours of sheer reading enjoyment.

Jim Ray
Troy, NC

The index and/or table of contents has been removed and photographed separately within this volume year.

For roll film users, this information for the current volume year is at the beginning of the microfilm. For a prior year volume, this information is at the end of the microfilm.

For microfiche users, the index and/or contents is contained on a separate fiche.

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Required by 39 U.S.C. 3685)

1. *Publication Title:* Mineralogical Record
2. *Publication Number:* 0026-4628
3. *Filing Date:* September 30, 2000
4. *Issue frequency:* Bimonthly
5. *Number of Issues Published Annually:* 6
6. *Annual Subscription Price:* $47 (U.S.), $51 (foreign)
7. *Complete Mailing Address of known Office of Publication:* 7413 N. Mowry Place, Tucson, Arizona 85741-2573
   Contact Person: Mary Lynn Michela
   Telephone: 520-297-6709
8. *Complete Mailing Address of Headquarters or General Business Office of Publisher:* Same
9. *Publisher and Editor:* Wendell E. Wilson, 4631 Paseo Tubutama, Tucson, AZ 85750
   Managing Editor: none
10. *Owner:* The Mineralogical Record Inc., 7413 N. Mowry Place, Tucson, Arizona 85741-2573
11. *Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages or Other Securities:* none
12. *Tax Status:* Has not changed during preceding 12 months.
13. *Publication Title:* Mineralogical Record
14. *Issue Date for Circulation Data Below:* September-October 1999
15. *Extent and Nature of Circulation:*

		Average No. Copies Each Issue During Preceding 12 months	Actual No. Copies of Single Issue Published Nearest to Filing Date
A.	Total Number of Copies (Net Press Run)	8067	7836
B.	Paid and/or Requested Circulation		
	(1) Paid/Requested outside—County Mail Subscriptions	5931	6037
	(2) Paid in-County Subscriptions	0	0
	(3) Sales Through Dealers and Carriers, Street Vendors and Counter Sales (not mailed)	0	0
	(4) Other classes mailed	180	185
C.	Total Paid and/or Requested Circulation	6111	6222
D.	Free Distribution by Mail	119	109
E.	Free Distribution Outside the Mail	0	0
F.	Total Free Distribution	119	109
G.	Total Distribution	6174	6285
H.	Copies Not Distributed		
	(1) Office Use, Leftovers, Spoiled	1893	1505
I.	Total	8067	7790

Percent paid/requested circulation: 99%

16. *Publication of Statement of Ownership: Publication Required. Will be printed in the* January-February 2001 *issue of this publication*
17. *Signature and Title of Editor, Publisher, Business Manager, or Owner:* Mary Lynn Michela, business manager. *Date:* 9/12/00. *I certify that the information furnished on this form is true and complete.*

Mineralogical Record Inc.
Board of Directors
Art Soregaroli (Pres.)
1376 W. 26th Ave.
Vancouver, BC V6H 2B1
Marshall Sussman (Vice Pres.)
618 Hartrey
Evanston, IL 60202
Patricia A. Carlon (Secr.)
1110 E. Emerson
Bloomington, IL 61701
104764.1245@compuserve.com
Thomas M. Gressman (Treas.)
7753 Emerald Peak
Littleton, CO 80127
tgressman@aol.com
Anthony R. Kampf
Mineral. Section,
Natural History Museum
900 Exposition Blvd.
Los Angeles, CA 90007
akampf@nhm.org
Mary Lynn Michela
7413 N. Mowry Place
Tucson, AZ 85741
staff@minrec.org
George W. Robinson
Seaman Mineral Museum, MTU
1400 Townsend Drive
Houghton, MI 49931-1295
robinson@mtu.edu
Bill Smith
1731 Daphne
Broomfield, CO 80020
Wendell E. Wilson
4631 Paseo Tubutama
Tucson, AZ 85750
staff@minrec.org

Volunteer Coordinators
Eastern U.S.
Charles & Marcelle Weber
1172 West Lake Ave.
Guilford, CT 06437

Advertising Information
All advertising in the Mineralogical Record must be paid in advance of the closing date. Telephone orders not accepted. Write to the editor for rates.

Closing dates:

Jan.-Feb. issue	Oct. 15
March-April issue	Dec. 15
May-June issue	Feb. 15
July-Aug. issue	April 15
Sept.-Oct. issue	June 15
Nov.-Dec. issue	Aug. 15

An additional 20 days past the closing date are allowed in which advertisers may make changes (excluding size changes) in ads already paid for.

Design
Wendell E. Wilson

Graphic Production
Capitol Communications
Crofton, MD

Printing
Cadmus Journal Services,
Easton, MD

Color Separations
Hollis Phototechnics
Tucson, AZ

Circulation
P.O. Box 35565
Tucson, AZ 85740
520-297-6709

Editing, advertising
4631 Paseo Tubutama
Tucson, AZ 85750
520-299-5274

Foreign Payments
Remittance may be made in local currency, at *prevailing exchange rates,* without surcharge, to the following people:

Belgium
Paul Van Hee
Marialei 43
B-2900 Schoten

Great Britain
Paul Lowe
"Endsleigh"
50 Daniell Road
Truro, Cornwall TR1 2DA

Italy
Renato & Adriana Pagano
P.O. Box 37
I-20092 Cinisello Balsamo MI

Japan
Bon Earth Sciences
Tsukasa Kikuchi
Nagata Bldg. 201
19-10 Kitaotsuka 2-chome
Toshima, Tokyo 170

Netherlands
W. J. R. Kwak
Kabeljauwallee 23
6865 BL Doorwerth (Gld)

Norway & Sweden
Geir Wiik
N-2740 Roa
Norway

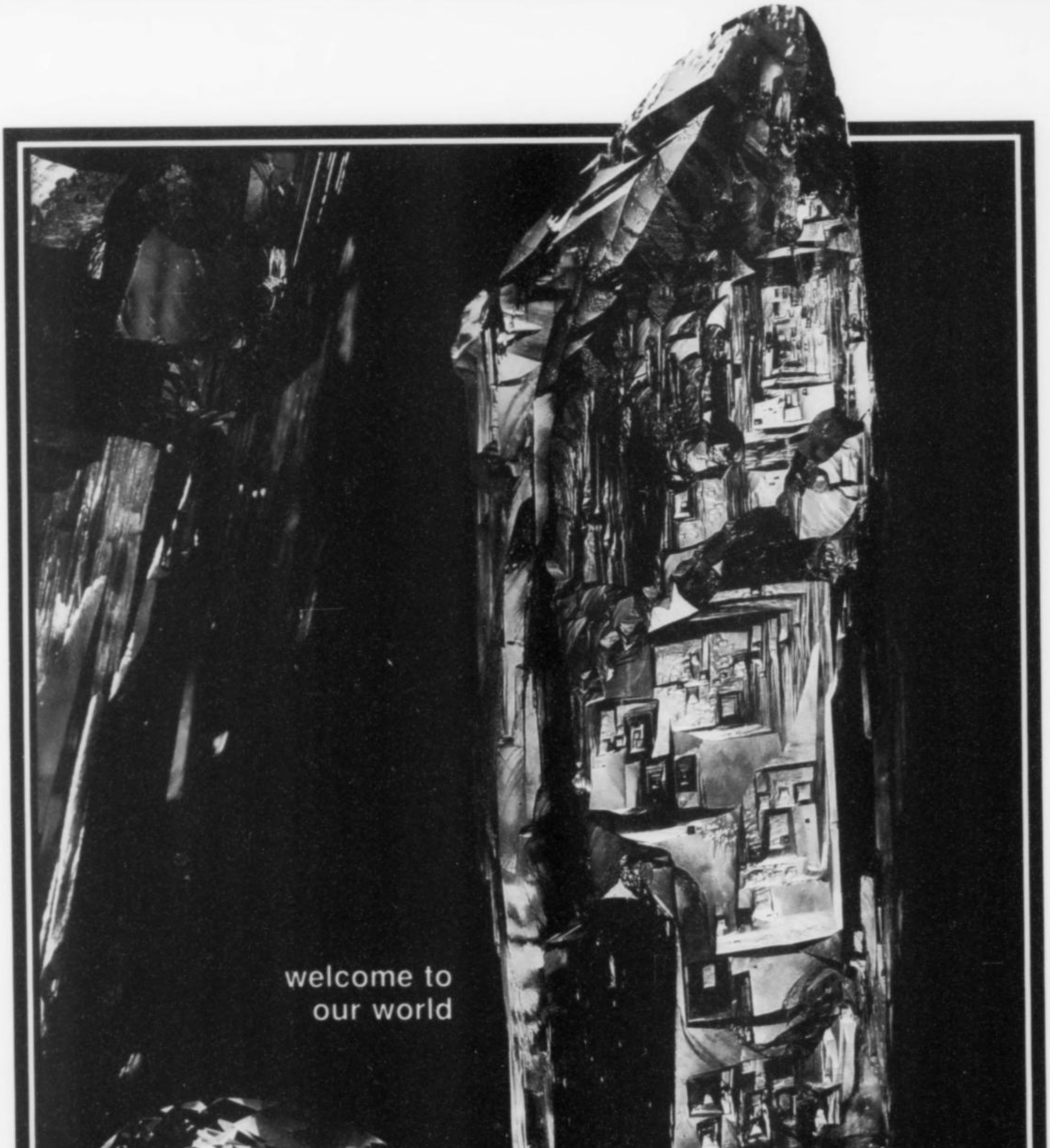
South Africa
Horst Windisch
30 Van Wouw Street
Groenkloof, Pretoria

Germany
Christian Weise Verlag
Oberanger 6
D-80331 München 2

Affiliated with the Friends of Mineralogy, an independent, non-profit organization devoted to furthering amateur and professional interests in mineralogy. For membership information contact
Roland Bounds, Treasurer
315 Stamford Drive,
Newark, DE 19711-2723

Opinions expressed
are those of the authors and do not necessarily reflect those of the Mineralogical Record Inc., its editorial staff or directors.

Advertisers Index



Russian Heliodor