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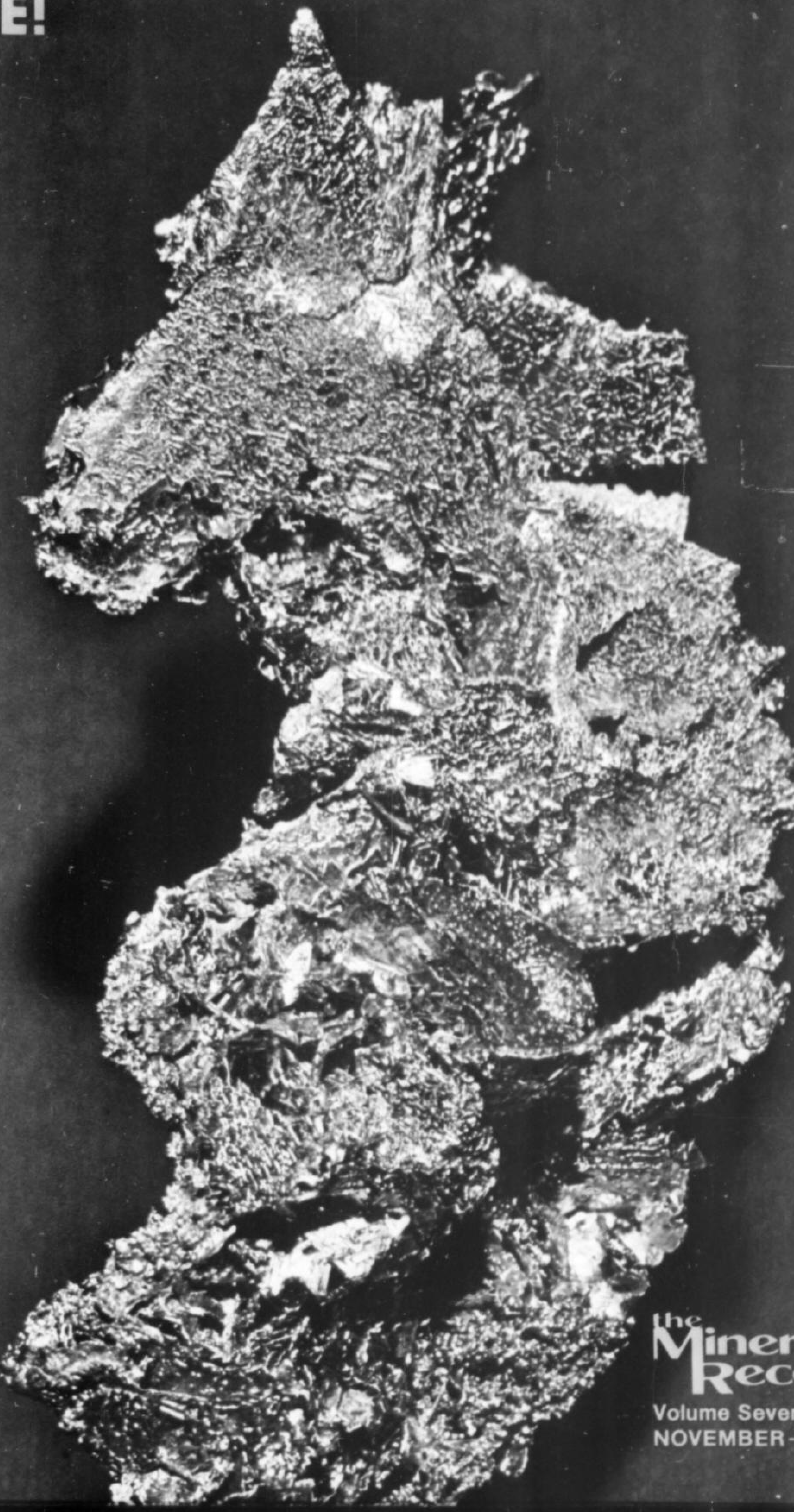

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publisher
John S. White
Division of Mineralogy
The Smithsonian Institution

editor
Wendell E. Wilson
Mineralogist

associate editors
written content:
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Mineralogist
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Supervisor, Division of Mineralogy
The Smithsonian Institution
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circulation manager
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COVER: GOLD, from the Wapiti mine, Farncomb Hill, Breckenridge, Summit Co., Colorado. The specimen is 1-1/2 inches (4 cm) wide. Specimen and photo: R.A. Kosnar.
note: the milarite on the cover of v. 7, n. 3, belongs to Gottfried Gunther, Barschwil, Switzerland.

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EDITORIAL

INVESTING IN MINERALS: NO GUARANTEES

Many collectors are offended whenever money and minerals are mentioned in the same breath, and feel the rising costs of minerals are taking much of the fun out of collecting; perhaps they are right. But there is still a large number of people who collect with the "silver pick", and who are concerned with getting their money's worth. One of the primary concerns of the average collector spending a significant (to him) amount of money on minerals is whether those expenditures will turn out to be good investments. In other words, can the buyer later resell a specimen for as much or more than he paid for it? Some people feel it is the seller's responsibility to make sure the item is a good investment at the price. If it turns out to be a loser when they try to resell it, they feel mistreated and taken advantage of by the dealer.

These people should stop blaming the dealer and start blaming themselves. The fact is that dealers can no more be held responsible than can the seller of stocks in the stock market. The buyer of stocks must live by the old saying, *"You pays your money and you takes your chances."* He must rely on his *own* understanding of (a) companies issuing stocks, and (b) the stock market, unless he wishes to put complete trust in his broker (and there is no counterpart to the stock broker in the mineral business, contrary to what some dealers will say). The mineral collector is in an analogous position. He must rely on his own understanding of (a) minerals, and (b) the mineral market. The person who pays too much for specimens out of carelessness or because he hasn't done his homework has only himself (his own lack of experience) to blame when he finds he cannot resell them at a good price. *Investing* in minerals is clearly not for the novice.

Do dealers have any responsibilities? Of course they do. For example, if a specimen turns out to have been labeled with the wrong species name they should be willing to take it back and give a refund. Certainly any kind of falsification is unethical, and a repaired specimen should be indicated as such, or a refund made available. I also feel they should honestly tell you how any specimen compares with the other pieces in the original lot. But the specimen price is a function of the market as they see it, and they cannot be held individually responsible in that area. Of course a collector who finds that a dealer's prices are consistently higher than other dealers, should leave that dealer alone. Refusing to buy is the only way to influence market prices.

There is no doubt that minerals can be an incredibly good investment. I know of true stories of people running a few hundred or a few thousand dollars into hundreds of thousands of dollars in just a few years. Many more people routinely make minerals a better investment than savings certificates or treasury bills, and an annual appreciation of over 15% is not uncommon for astute collectors. Even a few hundred dollars a year, spent wisely, can make a nice investment. Minerals are also a superb hedge against inflation. Of course many people lose money too, and the mechanics of liquidation are trickier than with stocks.

The mineral market can be perturbed by various factors centering mostly on the effect of new discoveries on past discoveries. For instance the discovery of superb Moroccan vanadinite a few years ago virtually destroyed the market for Old Yuma (Arizona) vanadinite, which was formerly the world's best vanadinite source. When the first trickle of specimens comes from a new find, no one can be sure if that will be all (resulting in rapidly rising prices), or if a huge load of specimens will come out next month, glutting the market and driving prices down. So there is always a gamble, but not nearly so much as in the stock market. Truly fine minerals will eventually perform very well even if their price is temporarily depressed. The market for Tsumeb dioptase, for instance, is currently depressed because quite a lot of extremely fine material has been coming out for several years. But when Tsumeb is cut off, which could be any time, prices for fine dioptase will go through the roof, and keep on going probably as long as people collect minerals. Good companies may go bankrupt and die through mismanagement (and their stock becomes worthless); but this cannot happen to fine minerals unless you drop them on the floor...their security is in your own hands and not the hands of company executives.

The success of minerals as an investment is largely dependent upon the buying philosophy of the investor-collector. If he wishes minerals to be an investment for him he must follow certain rules that not all collectors are willing to follow. **He must buy what *other* collectors want most, or, more importantly, *will* want most in the future.** Obviously this means that if his tastes are out of the ordinary he will be frustrated, because the specimens that please him will not prove to be good investments, and *vice versa*. Such a person, therefore, cannot expect to buy what pleases only him, and then be able to resell at a profit when tired of it; he must be content with the pleasure the specimen has given him, and let it go at that.

How to recognize a good investment piece? Minerals that are the best investments usually have certain features in common, provided of course that they are not grossly overpriced to begin with. But even an overpriced specimen that will gain consistently in value is better than an underpriced specimen that will *lose* value. The features: (a) clean, bright color, (b) good crystal form, size and luster, (c) freedom from damage, (d) matrix, (e) transparency when possible, (f) durability, (g) proximity to "the best" for that species or variety, (h) aesthetically pleasing "sculptural quality", (i) from 1-6 inches in size, and (j) high unit value (the higher the better). Many collectors find out too late that *most* pieces in the under-$50 range are poor investments (they're priced low because they're common, in one way or another, and common things aren't good investments); pieces in the over-$1000 range are demonstrably the best investments. Other characteristics can help too, such as clean and obvious twinning, doubly terminated crystals, or a species with intrinsic value such as precious metals or gem materials. Also, a crystal group should have what might be called a "prime crystal"...one crystal in the group which is larger and better than all the rest on the specimen, and pleasingly positioned. It must be remembered that features which can make a specimen "interesting" are often completely worthless in terms of dollar value, because another person may not be equally impressed. The important features are those with almost universal appeal...those which make a piece look beautiful and eye-catching in the display case...something of the kind many people want but not many people can have. A very quick glance at any display case will reveal the best investment pieces; your eye is involuntarily drawn to them first, even from a distance. (The first time I saw the famous Bancroft/ Wilber Alma rhodochrosite it snapped my head around from 40 feet away!)

The trend toward specimens of the above description is causing some serious and unfortunate problems, however. Dealers must almost always purchase minerals in large lots, and most of the specimens do *not* fit the above description. They therefore do not sell easily. This is a great pity because many are generally fine pieces whose only sin is being black or white, or having minor damage, or not being particularly flashy, or being smaller than people like, or not conforming with other of the "investment characteristics". They are often still very worthwhile pieces in many other, possibly more important, ways. Despite high prices for the "right" pieces, this trend works a hardship on the dealers and results in a loss to collectors who decide they will appreciate nothing but investment-type pieces. It might also be noted that investment-type pieces are often described as "competition quality"; and many people will buy nothing less even if they never compete! Some collectors I know have gone to mineral shows and not bought a single thing because they didn't come across a "perfect specimen" of "competition quality", etc., etc. They are missing a lot; I would like sometime to see a competition case of nothing but fine, well-formed and attractively displayed WHITE minerals. I wonder how it would be judged.

Getting back to investments, there is another more elusive feature of the market. With specimens there is the "upper class" and the "lower class". A specimen purchased as a lower class piece can be "discovered"; like a movie star, and elevated to the upper class where its value may immediately become 10-20 times higher. These are sometimes called "sleepers", and a finely tuned feeling for the division between the classes can allow the investor to repeatedly buy at a low price and ride them swiftly to a high price. Dealers are faced with this critical distinction every day, and must keep in mind the dual nature of the market. There is danger here too for investors because the dividing line drifts with time (usually upward in quality) and a piece on the lower limit of the upper class can fall out of favor and lose much of its value. The distinctions are devilishly subtle.

As mentioned, reselling even the best pieces is not always easy to do properly. If you sell to a dealer he will want to pay only 30-60% of the retail value, and then only if he thinks it will sell relatively soon. This is why dealers are not brokers...their cut is much larger because their whole financial structure and overhead are different. A very few dealers will accept specimens "on consignment", and keep 10-25% of the sale price, giving the rest to you when the piece is sold, but the practice is not common in the mineral market. Suppose a collector buys a piece for $100, and it appreciates to $150 in a year. He then may wish to sell it and take his profit, perhaps to invest in something else. **(Note: The goal of many "investment collectors" is not simply to obtain more dollars but rather to obtain finer *specimens* with which to improve their collection, at the lowest possible cost in "new" money.)** The dealer he bought it from can probably only give him $75 for it...resulting in a loss. Sold on consignment he might break even. So the collector can only claim all of the appreciation if he *sells it himself* to another collector at the retail price. Fortunately, any collector is free to do this, unlike the stock exchange where a "seat", entitling you to sell directly, can cost over $10,000 by itself! The only remotely analogous situation is selling at mineral shows where you must buy dealer space, but people circumvent that by selling from their motel rooms. Certainly it is more difficult for a collector without a shop to sell retail, and it may take longer, but it can be done.

Today the distinction between collector and dealer is becoming less and less clear. A few people make their living 100% through dealing in minerals, some 80%, some 50%, some 20%, and some 0.1%. Where do you draw the line between dealer and collector? Any attempt to draw that line must be based on arbitrary criteria. Dealers should not grumble about collectors selling on their own. The investment nature of minerals is the only factor which has allowed prices to go so high (and support so many dealers). The collector is forced to deal in order to keep going; if he can sell on his own and maintain the credibility of minerals as investments, dealers will continue to do good business. If the day ever comes when collectors cannot sell on their own, a crash of the mineral market would surely result.

As a new dealer himself, the collector must evaluate the question "what is the right price?" Notice the question was not "what is a *fair* price?" The "right price" is the highest price at which a piece will sell in a reasonable period of time, or after exposure to a reasonable number of potential buyers. You may complain to a dealer that a piece of his is priced way too high, but if he sells it to someone else, in a reasonable period of time, the price was right (and perhaps even too low). Given exposure to the same customers, that piece would have been just as easy for you to resell at retail. The right price is as much as the seller can get; it is the buyers as a whole who, in the end, determine the prices.

I'm not saying that the rise in prices is all good; the opportunity it presents for investment is better than none; and certainly high prices stimulate the search for more and finer material at the source (the earth), and through the liquidation of old collections that, if worthless, would have been thrown away. High prices do put a strain on the hobby by cutting off people who cannot keep up financially, and on academia by making it more difficult for researchers and learning institutions to obtain specimens. This is somewhat balanced by the fact that the frantic search for more specimens turns up a wealth of scientifically interesting discoveries that would not have been found during times of a low, sleepy market. In fact, so many new species have been found lately that the last few years have seen publication of a record number of new species, and yet crystallographers and mineralogists are falling behind the rate of field discoveries... many laboratories have sizeable backlogs of new species awaiting study and formal description.

Hobbyists are always free to return to (or continue in) the Old Way: self-collecting and trading. So no one need drop mineral collecting for lack of funds. And there is still an enormous array of specimens for sale in the under-$5 category, for people who are not too concerned with resale value. Not everyone must feel compelled to turn his hobby into an investment. But those who are to succeed at investing in minerals in the future will have to be more careful and more knowledgeable than they have ever been before, because more money is involved and there are no guarantees.

NOTICE!

Readers may have noticed the addition to the editorial board of a photographic section. These people are all famous, or worthy of being famous, mineral photographers who have volunteered their services to help *M.R.* maintain the highest standards in mineral photography. They are available to supplement articles with photos as the need arises; some authors are unable to provide photography so this is a very valuable service indeed.

However, these people should *not* be contacted directly. An article to be supplemented with photos must first be completely finished in all other respects, submitted to the editor, and approved for publication. *Then* the *editor* will make arrangements with the editorial board photographers for the photos. This is the reason why the addresses of the editorial board photographers are not published.

On behalf of *Record* readers I would like to thank these people for the time, expense, and unique skills they have contributed, and will continue to contribute, to the *Record.*

W.E.W.

FM friends of mineralogy

We continue here the publishing of reports on mineral preservation at specific localities written by FM members. Ed.

CALVIN MITCHELL FARM
DeKalb, St. Lawrence Co., New York
by George Robinson

This famous American locality has produced some of the finest diopside crystals ever found (Robinson, 1973). The crystals occur with tremolite, quartz and calcite in talc-filled pockets that have developed along joints and tremolite veinlets cross-cutting an interbedded quartzite and calc-silicate schist of the Grenville series.

The first crystals were probably found by Calvin Mitchell, who owned the property in the late 1800's (Kunz, 1892). By 1899, the locality had achieved considerable fame, and the right to mine diopside was obtained that year by George L. English. However, little work was done until Terry Szenics prospected there in 1967 (Szenics, 1968). The New York State Museum removed a few more crystals the following year, but collecting was prohibited by the landowner shortly thereafter.

In 1971 both the land and the right to mine diopside were purchased by the present owners, Schuyler Alveum, Robert Dow, and George Robinson. The mine is now being worked intermittently each year for specimen material by the present owners. No collecting by the public is permitted at this time.

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SZENICS, T.	(1968)	World-famous lost American diopside locality rediscovered, *Lapidary Journal*, **21**, No. 10, 1232-1239.
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ITALIAN MOUNTAIN, COLORADO
by M. M. Groben

Italian Mountain (elevation 13,378 Ft.) is the dominant peak in a spur extending south from the Elk Mountains which are located between Aspen and Crested Butte in western Colorado. Although probably visited by early miners, it was not until the 1880's that geologists in the mapping party of S. F. Emmons, Whitman Cross, and G. H. Eldridge investigated the locality and collected specimens. A summary of the geology and mineralogy of the Italian Mountain area was subsequently published by Cross and Shannon (USNM Proc., v. 71, art. 18, 1927; SI 3.6:2690).

The small range of peaks, of which Italian Mountain is a part, consists of quartz monzonite which intrudes a Lower Paleozoic sequence of sedimentary rocks. Limestones, which are particularly susceptible to contact metamorphism, reacted with hydrothermal solutions related to the intrusion, forming typical calc-silicate skarns. Diopside, epidote, grossular, and idocrase are abundant and can occur in excellent crystals, some of them twinned. The locality also produces many other species including the zeolites chabazite, scolecite and stilbite.

The Italian Mountain area is rough with none of the general amenities associated with popular collecting areas. The trail from the access road (strictly 4-wheel-drive) is a mile and half long, rises 1,500 feet and can be climbed in two and one-half hours.

Italian Mountain is currently being worked for mineral specimens by Alpine Exploration, which holds the mineral rights. Collecting by the public is not encouraged, but can be done under permit from the mine operators. Permits may be obtained by first joining the Friends of Mineralogy, then writing Alpine Exploration, Box 277, Crested Butte, Colorado 81224, for application. A fee of $6.00 is requested, half of which will be returned upon receipt of information describing the location and type of material collected.

The data for this resumé was supplied by Mr. Henry Truebe of Alpine Exploration.

LITTLE GREEN MONSTER VARISCITE MINE
by Peter J. Modreski

Description

The Little Green Monster mine is located in Clay Canyon near Fairfield, Utah. Nodules of gem-quality variscite occur in limestone here. Alteration products of the variscite include the phosphate minerals crandallite, kolbeckite, goyazite, dehrnite, hydroxylapatite, wardite, millisite, lehiite, lewistonite, davisonite, englishite, gordonite, overite, and montgomeryite; Clay Canyon is the type locality for the last nine of these. It is said to be the most important occurrence of gem-quality variscite in the world.

History

Variscite was first discovered in Clay Canyon in 1893, and small-scale mining for the semiprecious variscite nodules was conducted in subsequent years. Arthur Montgomery and Edwin Over took over the then-abandoned claims in 1936. They expanded the underground workings, searching not only for variscite, but for specimens of the rarer phosphate minerals that occur in the altered nodules. Many of their specimens were given to Harvard University for study by Esper S. Larsen III, which led to the discovery of several new mineral species. Montgomery and Over eventually converted the mine to a patented claim (granting complete ownership of the land), following a long legal dispute with "claim-jumpers". In the late 1950's interest developed in the deposit as a potential source of the rare metal scandium when the mineral kolbeckite was recognized to be a scandium phosphate, but mining for scandium did not prove feasible.

Preservation

Sporadic digging and high-grading in recent years have left the underground workings in poor condition. The adits are partially caved in and filled with rock waste, and access for collecting is very difficult. Arthur Montgomery and Clifford Frondel have recently transferred the ownership of the claim to A.R. McFarland, of Beehive, Inc., Sandy, Utah. The terms of the transfer specify that McFarland will clean out the mine and improve its accessibility so it can be appreciated by students and collectors. Some properly planned small-scale mining may be carried out to expose the areas rich in variscite nodules.

McFarland has made plans to clean rubble from the mine, mount a steel door at the entrance, cover some dangerous mine drifts, and plant 1000 pine seedlings on the property; the above is to be accomplished in 1976. Once the mine has been put in decent condition, McFarland may mine some variscite on a small scale to help pay for the costs of the reclamation work. McFarland has petitioned the Utah Preservation Planning Office to designate the mine a State Historical Site, and has offered to assist in constructing a plaque and monument near the site. This proposal is being considered by the Governor's Historic and Cultural Sites Review Commitee.

ZUNI MINE

Silverton, San Juan Co., Colorado
by M. M. Groben

The Zuni mine is located on Anvil Mountain approximately 3 miles north of Silverton, Colorado. This is the "type" locality for guitermanite, (species status uncertain) and zunyite. Other minerals that occur at this locality are galena, pyrite, anglesite, cerussite, sulfur, silver, quartz, cosalite and pearceite. The mine property consists of five patented claims covering more than 50 acres. Access at this time is only by a steep foot trail up the mountain.

The mine was first operated around 1884 in order to recover silver. Zunyite and several other unusual minerals that were found here about this time were identified by Schaller, Pearce and Guiterman. Exposed crystals of zunyite up to 2" in size are still visible in one drift which has caved-in at the portal during the past year. Many of the old dumps still show numerous signs of zunyite and other minerals of interest to collectors.

The Zuni mine, like so many others, has had a succession of owners. This mine was recently acquired by Allen Mining Co., who in turn sold it to a mining company in Washington. Because the present owner contemplates commercial operation, the Zuni mine is closed to public collecting. Allen Mining Company, however, retained the "exclusive" collecting rights for all mineral specimens. Allen Mining will endeavor to recover any specimen material that may be uncovered as a result of these new operations and make this material available to collectors. Despite the loss of public access to this locality, specimen preservation has been accomplished.

The data for this resumé was kindly supplied by Allen Minerals, McCoy, Colorado.

FRANKLIN

Sussex County, New Jersey
by M. M. Groben

The Franklin-Sterling Hill mining district is known thoughout the world for its mineral deposits and its wealth of more than 250 mineral species. Most of the ore bodies are zinc, iron and manganese oxides; the remainder of the deposits are primarily zinc, iron and manganese silicates. There have probably been more fluorescent species found here than at any other location in the world. The area is so well known for its fluorescent minerals that the New Jersey legislature has passed a resolution memorializing this area as the fluorescent mineral capitol of the world.

The first successful commercial operation to exploit the ore bodies was started by the New Jersey Zinc Co. in 1850. The area has continued to produce ore on a commercial basis ever since. In 1954 mining was discontinued at Franklin because the operations were no longer economically feasible, however mining at Sterling Hill still continues.

With the closing of the mine at Franklin, it was realized that a continuing interest in this historic and mineralogical area should be perpetuated. This interest originated with the Kiwanis Club and it was through the Kiwanis that the stimulus was provided for the formation of the Franklin Mineral Museum. Additional support came from the then newly formed Franklin-Ogdensburg Mineralogical Society and other individual collectors who recognized the interest in and the value of perpetuating the study of Franklin minerals.

The initial payment for the Franklin Mineral Museum was made by the Franklin Kiwanis Club from fees collected at previous mineral exhibits that had been sponsored at the "Neighborhood House Building" through the cooperation of the New Jersey Zinc Co. The remaining payments for the museum have been from the revenue obtained by the Franklin Kiwanis Club from both their annual October Mineral Festival and from admissions to the museum and the adjoining Buckwheat dump.

The Kiwanis Club is still responsible for the organization of the museum and has set it up as a non-profit, tax exempt corporation. The trustees for the corporation are elected by the Kiwanis, but the trustees are not required to be members of the Kiwanis.

The two historic dumps, Buckwheat and Trotter, are also available to the public for collecting purposes. The Franklin Mineral Museum was successful in arranging a lease for the Buckwheat dump from the town of Franklin. The income from collecting fees provides part of the necessary operating costs. The dump is bulldozed occasionally to expose new material. At present there is a limit of 25 pounds that may be removed by any one person. The entire area is fenced to protect it from unauthorized entrance. Authorized entrance is by admission through the museum. The Trotter dump is privately owned. This dump was purchased directly from the New Jersey Zinc Co. by a Mr. Phillips. The price of admission to both the Buckwheat and the Trotter dumps is kept to a modest amount to assure that the public will continue to visit and enjoy collecting minerals at Franklin in the future.

The data for this resumé was supplied by Mr. Fred Kraissl of Kraissl Associates, North Hackensack, New Jersey, a past president of the Kiwanis Club who was instrumental in the founding of the Franklin Mineral Museum.

THE HARDING MINE, DIXON, TAOS COUNTY, NEW MEXICO

by Peter J. Modreski

Description

The Harding mine is a lithium-and tantalum-rich pegmatite in Precambrian metamorphic rocks. It is located 6.5 miles east of the town of Dixon, in north-central New Mexico. The mine is noted for large flat crystals of spodumene, up to 6′ x 1′ x 1′ in size. An association of "rose" muscovite and albite (var. cleavelandite) makes strikingly attractive pink-and-white specimens. Fine-grained deep pink to lilac massive lepidolite found at the mine is suitable for carving and polishing. White beryl is also abundant. Tantalum (microlite, tantalite, and columbite) and bismuth (native bismuth, bismutite, bismuthinite, and beyerite) are among the rare metals found at the mine.

History

The pegmatite was discovered in 1910. It was worked as an open cut in the 1920's for lepidolite, used in glass-making. Arthur Montgomery, formerly professor of geology (now retired) at Lafayette College and one of the founders of the Friends of Mineralogy, played a major role in the subsequent development of the mine. He initiated the mining of lepidolite-microlite ore for tantalum during the second world war, during which time the Harding mine was the only domestic source of tantalum. Montgomery also operated the mine for beryl from 1949 until 1958 in partnership with Flaudio Griego of Dixon. During several years of this period, the Harding mine was the largest producer of beryl in the U.S.

Preservation

Although substantial low-grade lithium and tantalum reserves have been located in the pegmatite by diamond drilling, Art Montgomery has come to feel that the mine should be managed as an example of mineral conservation and hopefully also to benefit the local community. Scholarships for local students have been established from royalties collected from leasing of the mine to several companies during the 1960's. No extensive mining has been done since 1958, and Montgomery feels that the deposit should be preserved for educational, scientific, and public-benefit purposes. He has recently leased the mine property, one patented (title to the land owned) and twelve unpatented claims, to the University of New Mexico, with the hope of eventually seeing the University become the permanent owner of the mine. The Geology Department of UNM will be largely responsible for carrying out the preservation project.

The mine has been open to collectors in recent years, with permission to enter the property preferably having been granted to organized groups who collected under the supervision of a watchman. The university continues to allow mineral collecting at the mine; plans for the future include:

1) Posting signs inviting collectors to enter, but warning of possible hazards.
2) Possibly charging a small fee for collectors, to help defray the expenses of maintaining the property.
3) Making available to visitors copies of an article summarizing the geology and mineralogy of the mine. Such an article has been written by Dr. Rod Ewing and Dr. Richard Jahns and awaits publication in the *Mineralogical Record*. Dr. Jahns, of Stanford University, has had a long association with Art Montgomery and with the Harding Mine.
4) Arranging with a local store to distribute the articles, have collectors sign release forms, and possibly collect a fee.
5) Fencing off some dangerous mine adits; other underground workings would remain open to collectors.
6) Blocking the access road at a point several hundred feet from the mine, to limit collecting to amounts of material easily hand-carried.
7) Eventually establishing a sort of geologic nature trail around the mine area.

Those who desire to visit the Harding Mine should preferably contact Dr. Rodney Ewing, Geology Department, University of New Mexico, Albuquerque, N.M. 87131 (505 277-2030) for advance permission. Signs posted at the mine also direct visitors to Zellers Store in Dixon, where release forms and permission to collect may be obtained. No fee is charged, and collectors are asked to limit themselves to about ten pounds of specimens. Mr. E. Griego of Dixon, who has worked at the mine and served as caretaker of the property for Art Montgomery, will continue as a caretaker for the university and supervises the entry of collectors.

Art Montgomery found over-collecting of material by greedy or commercial-minded collectors to be a problem in recent years, and he was disturbed by the appearance of large quantities of Harding minerals in dealers' stocks. Collectors who visit the mine are encouraged to collect loose material, rather than removing specimens from the mine walls and rock exposures that would be better left in place to be seen by future visitors. The Geology Department of the University of New Mexico would welcome help from the Friends of Mineralogy or other groups in maintaining and preserving the mine.

MORDENITE AT WOLF CREEK PASS, COLORADO

by
Marvin E. Hanner
Box 579
Holbrook, Arizona 86025

Mineral County, Colorado, known for the mines at Creede and as the type locality of creedite, is also the home of what is possibly the finest mordenite in North America.

Extensive flows of basalt cover many square miles of southwestern Mineral County and adjoining Archeleta County. A small area 4 miles west of the summit of Wolf Creek Pass has long been known to produce agate nodules and natrolite (Pearl, 1958). Erionite (Ross Glenn, *Personal communication*) is also said to occur here. This area is a part of the San Juan National Forest.

Several specimens of a white mineral from this locality have been sent to the Arizona Bureau of Mines for X-ray identification. These samples all proved to be mordenite, which occurs in at least three different habits. The only other zeolites I have been able to identify are heulandite and analcime.

The minerals are found in amygdaloidal cavities in basalt. The cavities rarely reach 20 cm across. One tube, about 25 cm long and 4 cm in diameter, was opened. Most openings are much smaller.

Some of the larger cavities are completely covered by capillary needles and appear to be fur-lined. The "fur" resembles the okenite from India but cannot be petted as the needles are too brittle. Smaller cavities sometimes have tufts of mordenite associated with tiny (3mm) heulandite crystals.

Mordenite occurs in several forms. Some cavities appear to have been stuffed with cotton. Long white needles up to are not too uncommon in the larger cavities. In others short pinkish needles to 4 mm are found. Solid nodules of reddish fibers grading to white in the center appear to be mordenite but have not been analyzed. Creamy white or pinkish porcelaneous masses may be a mixture of quartz and mordenite.

Calcite, in crude rhombohedrons and scalenohedrons, rarely occurs with the mordenite. In several instances mordenite needles penetrate calcite crystals and in another tiny calcite crystals are perched on capillary needles of mordenite.

Sometimes heulandite and rarely mordenite are lightly covered with minute brown or black scales which may be biotite.

Some openings and nodules contain a soft black material. X-ray analysis by the Arizona Bureau of Mines has disclosed that these nodules contain minerals of the chlorite and montmorillonite groups in random, interlayered structures. These lumps may possibly have altered from biotite.

Analcime occurs massive and as crystals to 5 mm. Bands of white, intergrown fibers occur within massive analcime. Analcime is usually accompanied by small calcite crystals and has not been found with mordenite.

Nodules of agate are scattered through the basalt along with the mordentie. Agate nodules, quartz geodes, mordenite geodes and rarely amethystine quartz geodes can be removed in their entirety.

All specimens thus far collected have been removed from large, loose boulders. Some of the boulders are alluvial but most appear to have been removed during construction of U.S. Highway 160 a number of years ago. (I wonder how many prize specimens were used as road fill?)

The minerals occur *in situ* along U.S. Highway 160 between Wolf Creek and Treasure Creek. The zeolite outcrop is 800 meters uphill on the right from the pullout for Treasure Falls. (Be sure to see this scenic waterfall if you are in the area.)

A small area southeast of here near the road to Summitville along the East Fork of the San Juan river also contains agate nodules in basalt. Microscopic crystals of an unidentified rust colored mineral occur as a druse and as thin (3mm) radiated layers here. Small nodules, not over 5mm in diameter, of fire opal were found in a single boulder on Wolf Creek several years ago.

Inasmuch as this basalt-covered area is quite large, I feel it deserves further exploration and investigation by mineralogists. The high elevation, beautiful scenery, clean air and friendly people in any case make visits well worthwhile.

[1] Pearl, R. (1958) *Colorado Gem Trails and Mineral Guide 51-53*

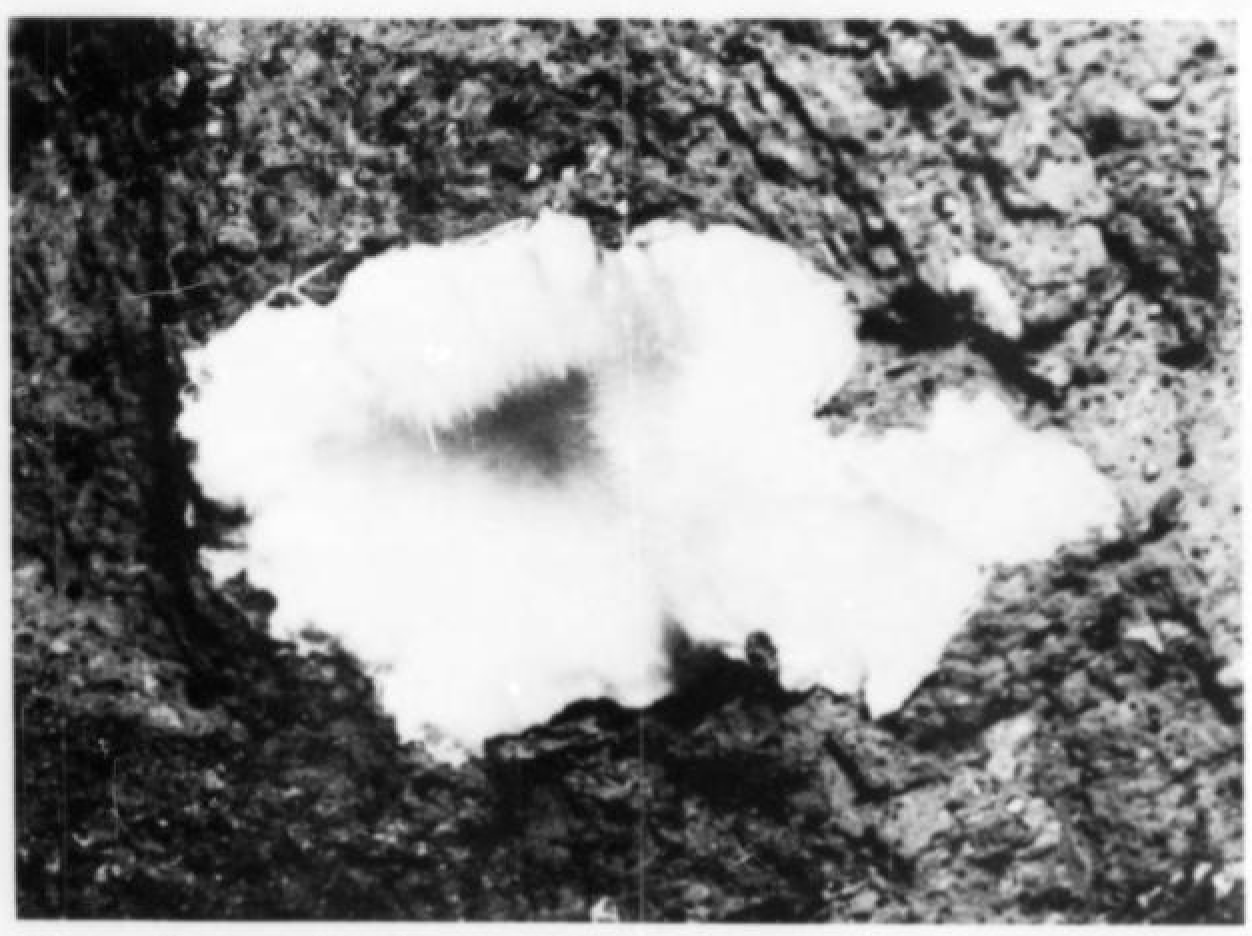

Figure 1. **A cavity lined with mordenite; the opening is about 9 cm across and contains capillary crystals of mordenite up to 2 cm in length. The "fur" is creamy white. Specimen and photo: Marvin Hanner.**

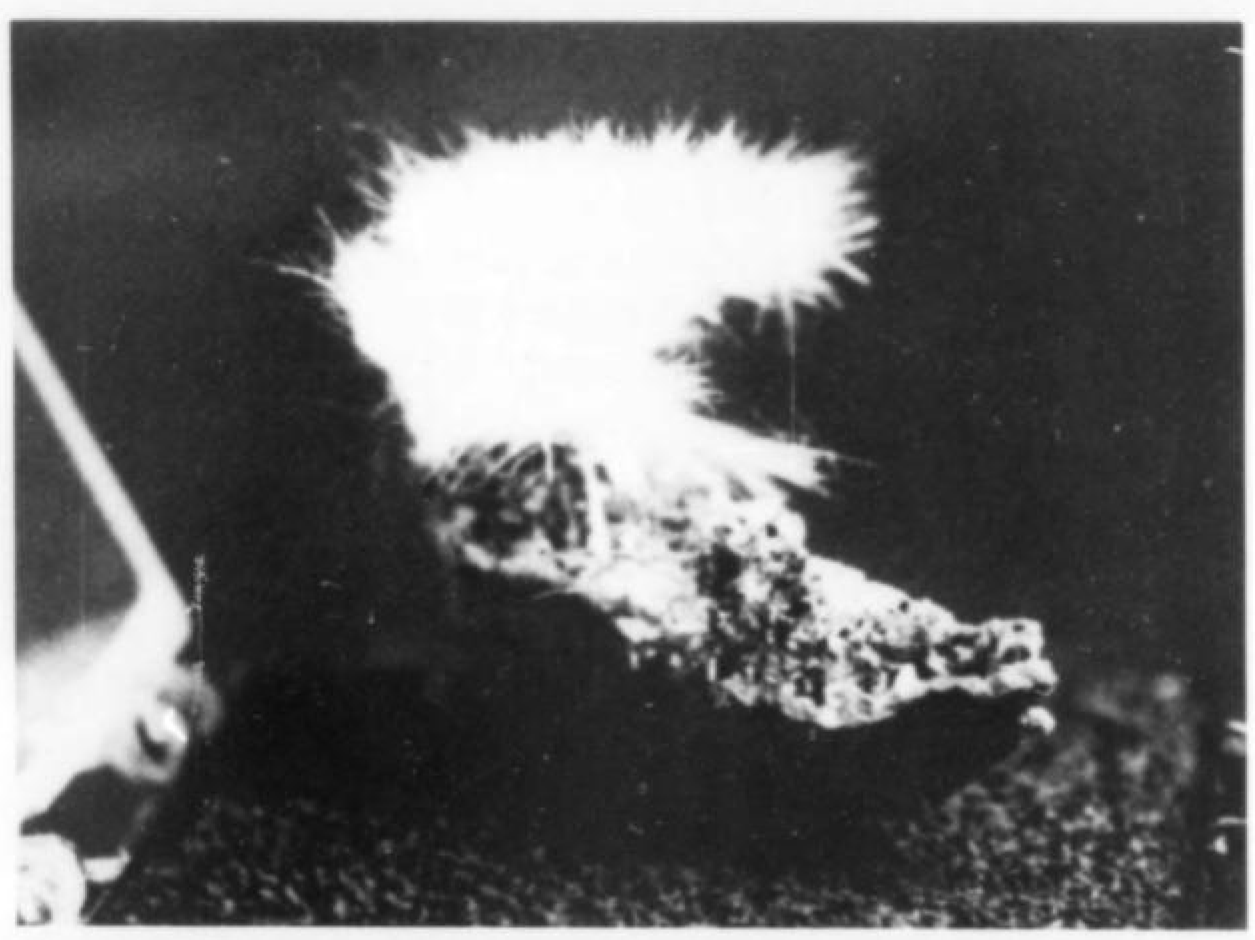

Figure 2. **Tuft of mordenite with minute heulandite crystals on basalt. The specimen is ¾-inch tall. Specimen and photo: Marvin Hanner.**

SOME ADDITIONS TO THE ORE MINERALOGY OF COLORADO

by

Donald Grybeck
U.S. Geological Survey
1209 Orca Street
Anchorage, Alaska 99501

INTRODUCTION

As a mining state, Colorado has had a long and eventful history, reflected in the great diversity of ore minerals that have been identified there. However, even though studies on these minerals began more than 100 years ago and have been pursued by generations of eminent mineralogists, new species and new localities continue to be found. This short paper describes some new Colorado occurrences and, in doing so, suggests that much additional work may prove rewarding to both amateurs and professionals alike.

Most of the specimens described were studied in the collections at Colorado School of Mines while I was a graduate student there. Those collections, which now include the large collection formerly housed at the Colorado State Historical Society Museum in Denver, preserve a unique accumulation of ore specimens from many old and almost forgotten mines. Most of the mineralogical identifications (or original misidentifications) were based on studies of polished sections under the reflecting microscope. In all cases, however, the mineralogy given here has been verified by x-ray diffraction with the powder camera and is considered certain and unambiguous unless otherwise noted. The species noted were not necessarily present in microscopic amounts; most of the minerals identified were in masses at least 5 mm and commonly more than 5 cm in size. Admittedly, one might have difficulty in identifying some of them in hand specimen—particularly the sulfosalts—but a few have easily discernible properties. Unfortunately, little is known about most of the specimens other than what is on their labels, and I was unable to visit most of the localities.

Rather than attempt to fully document these species and localities through the very extensive literature that applies to many of them, I used *Minerals of Colorado* by E. B. Eckel (1961). One can assume that otherwise unsupported statements in this paper are documented there. The chemical composition indicated for the various minerals is given as a convenience following Fleischer (1975) and does not imply any chemical analyses on these specimens.

MAUCHERITE

Nickeline has been known since prior to 1900 from the Gem mine northwest of Silver Cliff and two specimens, about 4 cm long, so labeled were found in the C.S.M. collections. In both cases, they proved to be mainly **maucherite**, $Ni_{11}A_{8}$, a mineral not unlike **nickeline**, NiAs, in appearance but new to Colorado and even more uncommon. Both specimens consisted of rosette-like masses of nickel arsenides in quartz which has irregular, lacy masses of chalcocite intergrown with the gangue. The main body of the rosettes is composed of maucherite, but in one specimen it is rimmed by a layer of nickeline about 1 mm thick that is succeeded by a microscopic layer of another unknown arsenopyrite-like mineral. These specimens almost certainly came from the Gem mine, which Eckel places in Fremont County although one is labeled "Silver Cliff, Custer Co., Colorado." The exact location of this mine is obscure because of the very early period of mining there and lack of detailed references to it for a long period. A cursory search for part of a day was made to find it, but without success; however, without any details of the ore minerals at the mine, Parker and Sharp (1970) pinpoint its location at the north end of Gem Park in a gabbro-pyroxenite body.

SILVER CLIFF, CUSTER COUNTY

Silver Cliff is one of the early bonanza gold-silver camps that has largely escaped modern detailed work on its ore minerals. Apparently there is no previous reference to bismuth minerals there. At least three occur. A small specimen from the "Twenty-six mine, Rosita, Custer Co., Colorado" produced a definite **aikinite**, $PbCuBiS_3$, x-ray pattern.* In addition, a small portion of it was also furnished to B.F. Leonard who found that portion to contain **cuprobismutite**, $Cu_{10}Bi_{12}S_{23}$. In 1964, D.M. Brown provided a tour of the Revell #1 mine north of Silver Cliff, which he was then working at a depth of about 85 feet in partially oxidized silver ore that ran up to $1100 a ton. The ore consisted of fine-grained galena intimately intergrown with abundant sphalerite and pyrite; the galena contained approximately equal proportions of **matildite**, $AgBiS_2$, which was undoubtedly the Ag-bearing mineral.

Neither are tellurides well documented from the Silver Cliff area although **hessite** was possibly present. A specimen from the "Bassick mine, Custer Co., Colorado" contained abundant **sylvanite**, $AgAuTe_4$, in a banded specimen. The layers consisted of one about a centimeter thick of intergrown sphalerite. chalcopyrite, and galena; followed by another about a centimeter thick that contained the sylvanite as columnar aggregates of tiny crystals oriented perpendicular to the layering in about an equal quantity of tetrahedrite; and then a layer of botryoidal sphalerite about 1/2 cm thick against altered wallrock.

PAVONITE

Pavonite, $Ag_2Cu(Bi,Sb,Pb)_9S_{16}$(?), was defined from Bolivian material that was originally identified as the now discredited species "**alaskaite**" (Nuffield, 1954). At least two specimens that were labeled "alaskaite" from its supposed type locality in the San Juan Mountains were also mainly pavonite with subordinate chalcopyrite, tetrahedrite, and pyrite. One is labeled "Alaska mine, San Juan Co., Colorado," and the other "Poughkeepsie Gulch, Ouray Co., Colorado"; as the Alaska mine is in upper Poughkeepsie Gulch, these may be from the same locality.

Another specimen from the "Geneva district, Park Co., Colorado" labeled "schirmerite" is also probably pavonite although it could better fit the standard pavonite x-ray pattern. The mineral is certainly not schirmerite, $AgPb_2Bi_3S_7$, although this is the district in which it was originally found.

PYROSTILPNITE AND MCKINSTRYITE

Pyrostilpnite, Ag_3SbS_3, or at least a member of the pyrostilpnite-xanthoconite series, was identified in a single specimen from the Maine mine, Silver Plume. In the course of a study of the ore deposits there, many hundreds of samples were examined, but only one contained pyrostilpnite. The pyrostilpnite end-member is suggested by the chemistry of its dimorph pyrargyrite and polybasite, which are relatively common there. It

*Ed. note: there are several other minerals, in the aikinite group, with virtually identical powder patterns.

is quite distinctive even in tiny grains and occurs as scattered orange to yellowish-orange crystals less than 1 mm in diameter in barite with a variety of other sulfides including galena, chalcopyrite, sphalerite, and polybasite.

Mckinstryite, $(Ag,Cu)_2S$, has been identified previously, from Silver Plume, in a few microscopic grains associated with **jalpaite**, Ag_3CuS_2, (Grybeck and Finney, 1968). However, another nearby mine, the Colorado Central mine near Georgetown in Clear Creek County, furnished a nice specimen that was mainly mckinstryite associated with pearceite, chalcopyrite, and minor galena, covellite, and pyrite. The mine produced some rich silver ore, and many spectacular pyrargyrite-rich specimens are in the C.S.M. collections, but it has long been inactive and the workings are inaccessible.

There are numerous dumps in the Georgetown-Silver Plume area and I have spent many, many hours combing over them, particularly at Silver Plume, without exhausting the possibilities. Most dumps yield specimens with a relatively simple mineralogy: galena, sphalerite and pyrite. However, arsenopyrite is not uncommon in certain localities and specimens with visible pyrargyrite, polybasite, and tetrahedrite can be found occasionally, particularly in the smaller dumps derived from near-surface workings.

The long tunnels at Silver Plume, notably the Mendota, the Burleigh and the Diamond, offer some excellent exposures of the veins in place but little in the way of good ore mineral specimens, and they are not generally open to the public. An interesting aspect of these tunnels is the occurrence of inconspicuous, friable, white to gray coatings, clots, and encrustations on the rocks and timbers. I ignored them for a long time but some x-ray work indicated that at least 10 minerals are involved: **calcite**, $CaCO_3$; **hydromagnesite**, $Mg_5(CO_3)_4(OH)_2 \cdot 4H_2$); **hydrozincite**, $Zn_5(CO_3)_2(OH)_6$; **smithsonite**, $ZnCO_3$; **anglesite** $PbSO_4$; **bianchite**, $(Zn,Fe)SO_4 \cdot 6H_2O$; **epsomite**, $MgSO_4 \cdot 7H_2O$; **goslarite**, $ZnSO_4 \cdot 7H_2O$; **gypsum**, $CaSO_4 \cdot 2H_2O$; and **kaolinite**, $Al_2Si_2O_5(OH)_4$. All probably formed subsequent to mining. Even more unusual is the occurrence of **gunningite**, $(Zn,Mn)SO_4 \cdot H_2O$, which was originally discovered in the Yukon Territory (Jambor and Boyle, 1962). It apparently does not occur naturally at Silver Plume but formed a powdery coating up to 1 mm thick on numerous, fresh spalerite-pyrite-galena specimens after they were stored at Golden, Colorado, for a few months. Gunningite is soluble and rinsing with tap water immediately restored the fresh surfaces. However, the gunningite continued to reappear, although in decreasing quantity, through at least three cycles of washing. The appearance of gunningite is probably related to the original moisture content of the samples and the change in humidity from the underground workings, which are damp, if not wet, and cool, to the environment at Golden, which is hot with periods of very low humidity. One may debate whether this gunningite is a natural occurrence at all, but the phenomenon should probably be considered when dealing with gunningite—and perhaps similar soluble secondary minerals—in specimens when their original appearance is unknown.

BROBDIGNAG PROSPECT

This prospect has long been known as a zinkenite locality—the first authenticated occurrence of it in the United States. Several specimens so labeled were found in the C.S.M. collections, and one did indeed prove to be mainly **zinkenite**, $Pb_6Sb_{14}S_{27}$. The other was **guettardite**, $Pb_9(Sb,As)_{16}S_{33}$, one of the eight new Pb-Sb-As sulfosalts that were recently discovered at Madoc, Ontario, by Jambor (1967, 1968). Subsequently Colorado "zinkenite" that probably came from this location was purchased from Allen Minerals and Mining Company, McCoy, Colorado, and the prospect was visited personally as well. Guettardite and some zinkenite were also identified from this material, as well as **boulangerite**, $Pb_5Sb_4S_{11}$, **semseyite**, $Pb_9Sb_8S_{21}$, and **jordanite**, $(Pb,Tl)_{14}As_6S_{23}$. Microscopic enargite is ubiquitous in the material, and barite is present in quantity as gangue. Most of the material is fresh and distinctive in that it appears as the typical Pb-Sb-As sulfosalt—medium-gray, soft, without a good cleavage, a tendency to appear somewhat fibrous, and between galena and tetrahedrite in brightness or reflectivity. However, in general, it appears massive and without any noteworthy characteristics indicative of the individual species. It is probable that even more Pb-Sb-As sulfosalts are present here, possibly more of the Madoc-type suite, but most are almost indistinguishable under the reflecting microscope and in hand specimen. At a minimum, x-ray diffraction work is needed to identify most of these minerals, and electron microprobe work will probably be necessary for a completely unambiguous identification.

The prospect occurs about 5 km northwest of Silverton. It is not shown on most modern maps but was easily found in a small gully at an elevation of about 11,400 feet following Ransome's (1901) map. The prospect is marked by two small dumps, less than 10 m in maximum dimension, derived from short adits driven in the sides of the gully. The one to the south is caved, the one to the north could just barely be entered over a pile of debris at the portal. There were almost no ore minerals on the dump but massive gray specimens were abundant along the back of the north adit about 3 m past the portal.

Other prospects in the area might also be examined for these sulfosalts. The Brobdignag prospect is just northwest of the Zuni mine, which was the type locality of another discredited Pb-As sulfosalt, "guitermanite," which has been found to be at least partly jordanite. A sample from the Zuni mine in the C.S.M. collection consists of fine-grained galena and a distinctive sulfosalt (or sulfosalts), disseminated through the gangue, whose x-ray pattern most closely matched **sartorite**, $PbAs_2S_4$. Ransome also indicates that there are additional prospects of the Zuni mine type in the vicinity although he does not show their location.

MATILDITE

Eckel suggests that **matildite**, $AgBiS_2$, which was reported from only one locality in Colorado, is probably related or identical to **schapbachite**, which was more widespread. Present usage indicates that they are identical although schapbachite is the preferred European designation. In its usual occurrence as a microscopic intergrowth with galena, it may escape notice even under the microscope, but it is surprisingly common in Colorado silver ores. Among some additional new localities where it formed a major part of at least one specimen are: (1) the May Day mine, La Plate Mountains, (2) the Alaska mine, Ouray Co., where it was labeled "galenobismutite, var. alaskaite", (3) the Tucson mine, Leadville, where it occurs with varying amounts of hessite, (4) the Yak tunnel, Leadville, (5) the Silver Wing mine, Silverton, and (6) the Old Lout mine, Ouray Co., where it was labeled "beegerite". The last is a Dana locality (Palache, Berman and Frondel, 1944) for this now discredited species. However, the chemical analysis cited for it has exactly the Ag/Bi ratio of matildite in addition to major lead and minor copper, and it is likely that the Dana analysis represents a mixture of matildite and minerals that contain lead and copper.

MISCELLANEOUS LOCALITIES

The following represent some additional specimens on which little more than an uncertain location or association is known:

(a) **Joseite**, $Bi_3Te(Se,S)$, was identified intergrown with galena in a specimen labeled "Summit County, Colorado." The x-ray pattern indicated the Joseite-II variety as given by Berry and Thompson (1962). Eckel indicates a locality for the similar mineral **tetradymite**, Bi_2Te_2S, at Kokomo in Summit County that may be related.

(b) **Stibnite**, Sb_2S_3, was identified from two localities. One from the C.S.M. collection was labeled "4th of July mine, Eagle River Canyon, Eagle Co., Colorado", and the other was furnished by H. S. Miller who attributed it to the Revenge mine, Grand Island mining district, Eldora, Colorado. Both are large monomineralic specimens.

(c) **Kobellite**, $Pb_5Bi_8S_{17}$, was found in a large specimen from the Comstock mine, La Plata County" with an equal quantity of intergrown chalcopyrite. The x-ray pattern did not match kobellite exactly, as given in Berry and Thompson (1952), in the intensity of some of the lines, but their position was sufficient to indicate it as the most likely mineral species.

(d) **Semseyite**, $Pb_9Sb_8S_{21}$, forms a layer about a centimeter thick in a specimen from the "Mary Ann Lode, near Argentine Pass, Clear Creek Co., Colorado" associated with galena and botryoidal sphalerite. The mine is not mentioned in Lovering (1935), nor did personal inquiries in the area reveal its location.

(e) **Tetradymite**, Bi_2Te_2S, is present as a rim about 5 mm thick surrounding chalcopyrite from the "Jonathan mine, Ouray, Co., Colorado". Hessite and native gold fill in the areas between the tetradymite-rimmed chalcopyrite.

One mineral that is well represented in the literature and on the labels of many specimens was surprisingly rare. **Stephanite**, Ag_5SbS_4, is commonly cited, but in looking at hundreds of polished sections and x-raying many questionable minerals, none was ever found in any of the C.S.M. collections in spite of a persistent effort to document it. It does occur in Colorado however; M. N. Greeley produced an old specimen from the Gilman mine, Eagle County, that contained a tiny grain of it associated with copper-silver ore that was with some difficulty isolated and x-rayed. I have the impression that the term "brittle silver," which is commonly thought to mean stephanite, was used much less specifically in the past by miners and collectors but taken narrowly when the specimen reached the hands of more knowledgeable mineralogists. Most of the so-called "stephanite" turned out to be tetrahedrite or tennantite, or less commonly, polybasite or pearceite.

ACKNOWLEDGEMENTS

I would particularly like to thank Joseph J. Finney of Colorado School of Mines who actively encouraged me in my work in the collections there. He and B. F. Leonard, U.S. Geological Survey, were also exceedingly helpful in discussions of various aspects of the mineralogy of these minerals. We are all perhaps even more indebted to the hundreds of often unnamed collectors and miners who had the foresight to save these specimens for posterity.

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CRYSTALLIZED MINERALS OF THE COLORADO MINERAL BELT

BY **RICHARD A. KOSNAR**
2749 S. Lakeridge Trail
Boulder, Colorado

AND **HAROLD W. MILLER**
Mine & Mineral Services, Box 1092
Boulder, Colorado

INTRODUCTION

The Colorado Mineral Belt, a region of intense mineralization about 300 miles long, traverses the highest and most rugged mountains of Colorado in a northeast-southwesterly direction (Fig. 4). There are, of course, a few outlying mineralized areas, such as the gold deposits of Cripple Creek, the thorium and gold-silver deposits near Westcliffe, and the uranium-vanadium deposits of the Colorado Plateau, but in general the mineral belt is considered to run diagonally across the state from Boulder County in the North to La Plata County in the south.

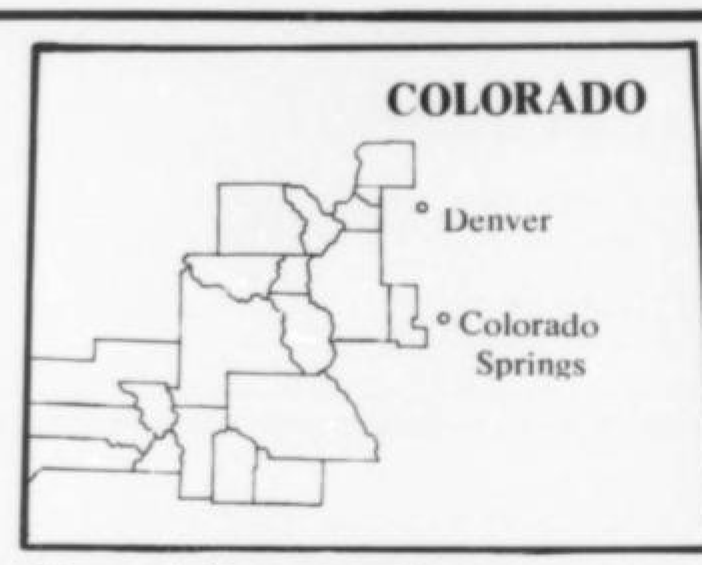


Figure 1. **Location Map**

It is not the authors' intent to cover such an area of several hundred square miles and of countless thousands of mines and prospects comprehensively, but merely to provide a guide and an introduction for collectors to the fabulous mineral wealth of the state. Only mines which have produced good specimens of crystallized minerals will be mentioned. Undoubtedly, many crystal areas will not be mentioned, either because the authors are unaware of them or because neither of the authors has personally examined specimens from these localities.

Frequently a mine is known for fine specimens of only a few minerals but also contains unnoteworthy specimens of many other species. Consequently a thorough discussion of the mineralogy will not be given, and only the well-crystallized minerals will be discussed. Many mines have undoubtedly produced numerous fine specimens in the past, glowing descriptions of which can be heard in the mining camps today or gleaned from the literature, however, those specimens and species which the authors have not seen will not be covered here.

Due to the immensity of this task, two further omissions will be made. None of the fine crystals

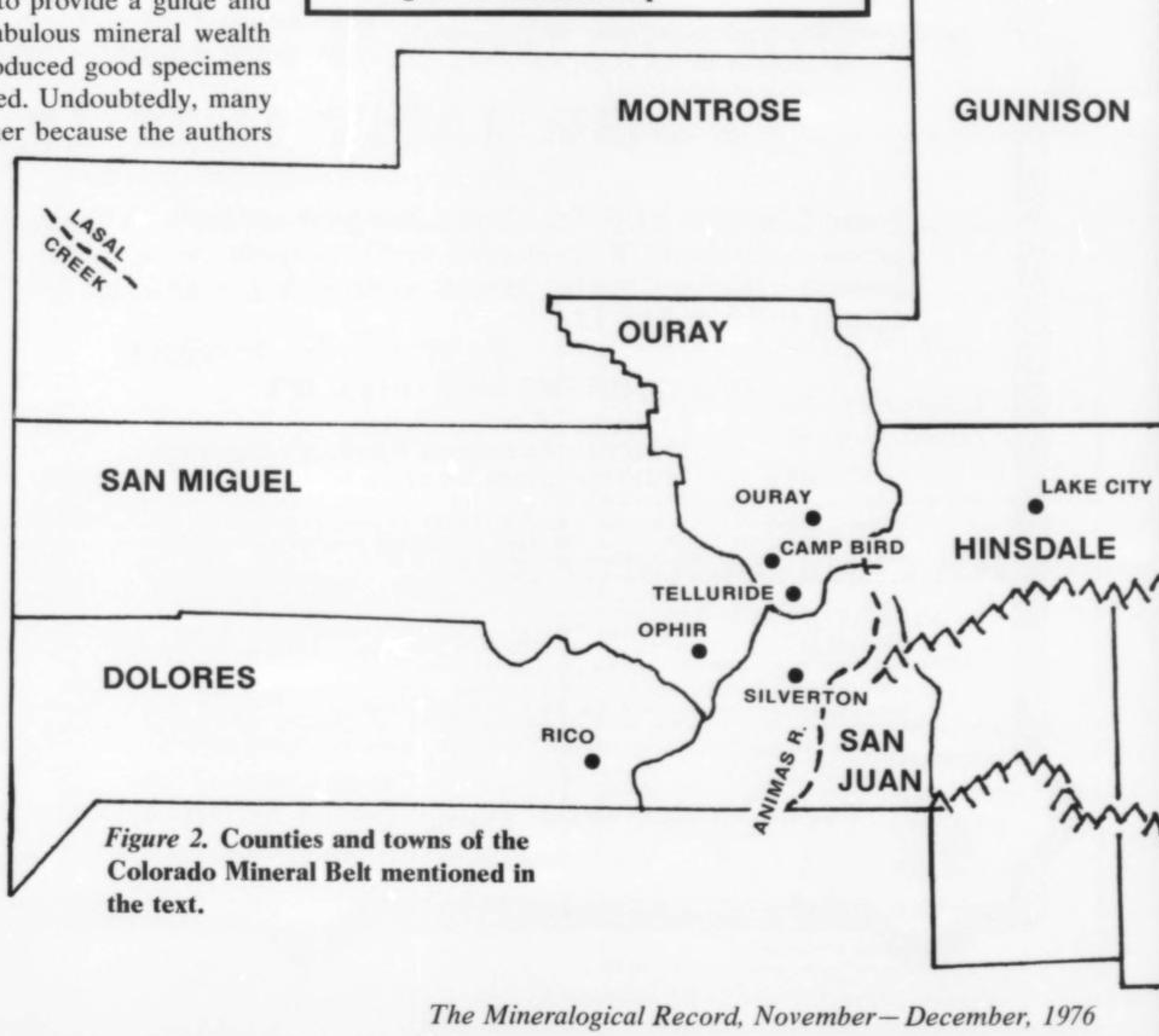
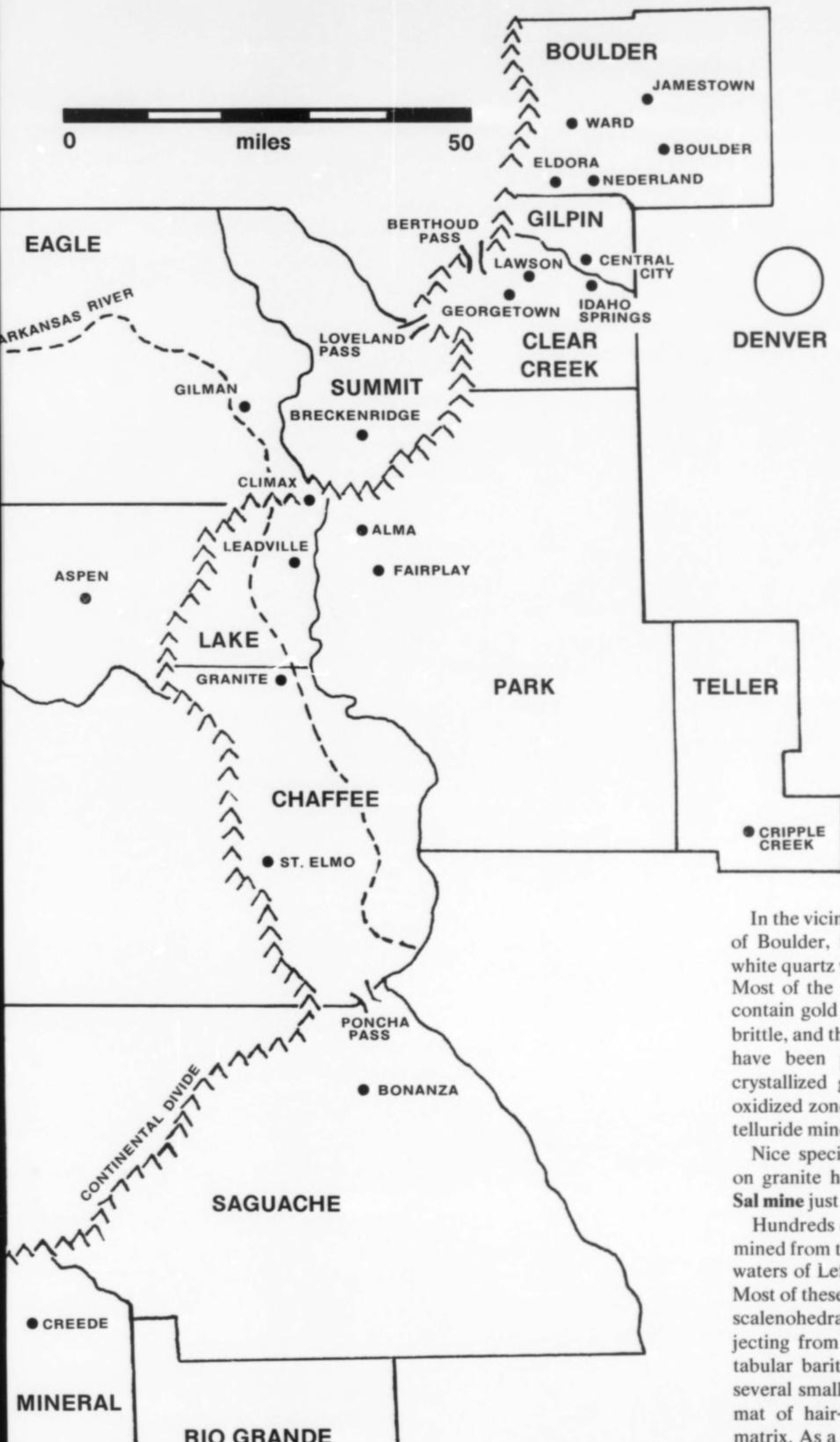


Figure 2. **Counties and towns of the Colorado Mineral Belt mentioned in the text.**



obtained from pegmatites nor from the uranium-vanadium deposits of the plateau region will be described.

Since mining is still a major industry in Colorado, it is well to bear in mind that this is only an interim report. Many surprises are still in store for the mineral collector and as this paper is being written a vug containing fine crystals of either a common or rare mineral not previously found in the state may be in the process of being opened.

The mineral localities are described by county, starting at the northern end of the mineral belt and proceeding across the state to the southern end. It should be remembered, however, that counties are political, not geological subdivisions and that many mining districts and mines span more than one county.

BOULDER COUNTY

Boulder county represents the northern most extension of the Colorado Mineral Belt. The geology of the area consists of Precambrian granodiorite, schists, and gneisses intruded by numerous Tertiary stocks and dikes. Mining is carried out at elevations from 7000 to 11,000 ft. above sea level.

In the vicinity of Jamestown, about 9 miles northwest of Boulder, fine specimens of wire and leaf gold in white quartz were obtained from the **Golden Age mine.** Most of the gold mines in Boulder County, however, contain gold tellurides. Since the telluride crystals are brittle, and the vein rock very hard, few good specimens have been produced. However, fine specimens of crystallized gold were frequently obtained from the oxidized zones as a result of the alteration of the gold telluride minerals.

Nice specimens of autunite and torbernite crystals on granite have been found in the vicinity of the **La Sal mine** just west of Jamestown.

Hundreds of fine specimens of wire silver have been mined from the **White Raven mine** situated at the headwaters of Lefthand creek, about one mile from Ward. Most of these specimens consisted of a matrix of brown scalenohedral siderite crystals about ½ inch long. Projecting from this matrix were numerous, pure white, tabular barite crystals up to 1 inch on an edge with several small, highly modified galena crystals. A dense mat of hair-like wires of silver covered the siderite matrix. As a rule the wires were tightly curled and less than an inch long but specimens with wires up to 6 inches long were not unusual. Unfortunately most of this material was shipped to the smelter. The neighboring **Blackjack mine** has also produced wire silver specimens but not in the quantity nor of the quality of those from the White Raven.

High on a mountain south of Lefthand creek and near the town of Gold Hill is the famous **Slide mine**. This mine has produced very fine crystallized gold specimens, probably formed as the result of the alteration of petzite, and a few nice specimens of small, well-crystallized calaverite. Altaite and hessite crystals have also been reported from this mine.

Another interesting deposit is located about two miles south of Gold Hill on Fourmile creek. A vein crosses the creek in a north-south direction which exhibits an interesting example of horizontal zoning. Two mining locations were staked on this vein; the **Krakajack No. 1** and the **Krakajack No. 2.** The Krakajack No. 1 is located on the north side of the canyon. The ore was primarily gold but the finest pyrite crystals found in Boulder County came out of this mine (Fig. 17). The crystals measured up to 2 inches in diameter and were all of a very unusual habit. Unfortunately a truck load of these fine specimens went to the smelter for their gold content. The Krakajack No. 2 mine was located on the south side of the canyon but was considered to be a silver mine. This mine produced fine specimens of bright chalcopyrite crystals nearly an inch on an edge. Tabular barite crystals and argentite were associated with most of these specimens.

Placer operations were carried out about 1/4 mile downstream from the Krakajack mines and several nuggets weighing about an ounce were obtained.

The **Orphan Boy mine** is located high on the slopes of Bald Mountain about a mile upstream from the Krakajack mines. The oxidized zone of this mine produced very fine specimens of wire and crystallized gold which resulted from the alteration of petzite and other gold tellurides. Of particular interest to the collector were the nice specimens of cubic pyrite from which gold wires protruded.

The **Dolly Varden mine**, which is located farther upstream and about 3/4 mile southwest of Sunset, in Pennsylvania Gulch, has produced fine specimens of 1/2 inch chalcopyrite crystals and molybdenite crystals on a matrix of glassy white quartz. This was also a gold mine, however no free gold specimens were obtained from the Dolly Varden as the gold was contained in the chalcopyrite.

If the old narrow-gauge railroad grade is followed from Sunset up to Sugarloaf Mountain and then southward down into the drainage of North and Middle Boulder Creeks, the richest tungsten district in the world is reached. The Tungsten district can also be reached by travelling due west of Boulder, 4 miles up Boulder Canyon. The Tungsten district lies on each side of the canyon and extends about ten miles in a westerly direction to the town of Nederland.

The ore is different than that of other tungsten districts in the world in that it consists of the mineral ferberite. To the south, in the **Magnolia district**, a little hübnerite was mined and to the north, in the **Ward district**, a little wolframite and scheelite were mined but the production was not significant nor were any crystals obtained.

To describe all of the crystal-producing mines in this area is not feasible. In contrast to most mines, crystals in the ferberite mines were the rule, not the exception. The farther west one proceeds along Boulder Creek, the higher grade the ore and the better the crystals. The crystal area begins at the waterfalls where North Boulder creek joins Middle Boulder Creek. **The Eureka mine** is situated just off the highway and at creek level. The **Good Friday mine** is located several hundred feet above the Eureka. Both of these mines have produced fine specimens. Characteristically they consisted of a matrix of quartz or granodiorite completely covered with brilliant, shiny, black, wedge-shaped crystals about 1/8 inch long. Higher up the cliff, above the Good Friday mine, is the **Tip Top mine**. This mine produced unusual specimens in that the matrix consisted of milky quartz crystals up to 2 inches long. Small black ferberite crystals of a pseudocubic habit were scattered about on the quartz crystals. No other mine produced specimens similar to these. The only other mine that produced ferberite crystals of a pseudocubic habit was the **Georgia A. mine** near Nederland and these occurred on a matrix of quartz crystals.

About three miles up North Boulder Creek, above the falls, and across from Peewink Mountain are **the Iowa** and **the Miser's Delight mines**. Both of these mines produced specimens of 1/8 inch black, wedge-shaped ferberite crystals but they were unusual in that scheelite crystals, in a pseudo-octahedral habit, were interspersed among the ferberite crystals. The scheelite crystals ranged from 1/8 to 1/4 inch on an edge and for the most part were milky white, although several crystals ranged in color from water clear to green, blue, red, and brown.

In the vicinity of Nederland the crystals became more common and of much higher quality. In mines such as the **Conger, Cold Spring, Vasco No. 6, Lone Tree, Cross, Spider Leg**, etc., brilliant, black, shiny, wedge-shaped crystals from 1/4 to 1/2 inch long formed dense coatings over a matrix of massive ferberite or quartz. The finest crystals of all, however, came from the **Manchester mine** and the **Phillips Extension-Hoosier mine**. The best crystals were again, brilliant, black, wedge shaped crystals but they measured 1 x 1 x 1/2 inch thick. Occasionally these crystals would twin to produce fan shaped crystals 2 inches long.

About 3 miles west of Nederland, near the towns of Eldora and Hessie, is another gold telluride district. The **Revenge mine**, in this district, produced one fine matrix specimen consisting of white quartz upon which was perched a bright cubic crystal of altaite about 3/4 inch on an edge. This mine also produced crude stibnite crystals about 2 inches long.

Finally, about six miles to the northwest of Nederland and at an altitude of over 10,000 ft. lies the famous silver camp of Caribou. The **Caribou mine** was for many years the leading silver producer in the United States. The ore was very rich and mineralogically very complex but unfortunately most of the mining was carried out in the 1860's and few specimens are available for inspection. Those which have been examined are matrix specimens of 1/2 inch red proustite crystals, 1/2 inch black pearcite crystals and several wire silver specimens. The wires were very attractive in that they were bright in luster, about 1/8 inch thick and 3 inches long. Each wire was terminated by a silver crystal giving the wires the appearance of small spears.

GILPIN COUNTY

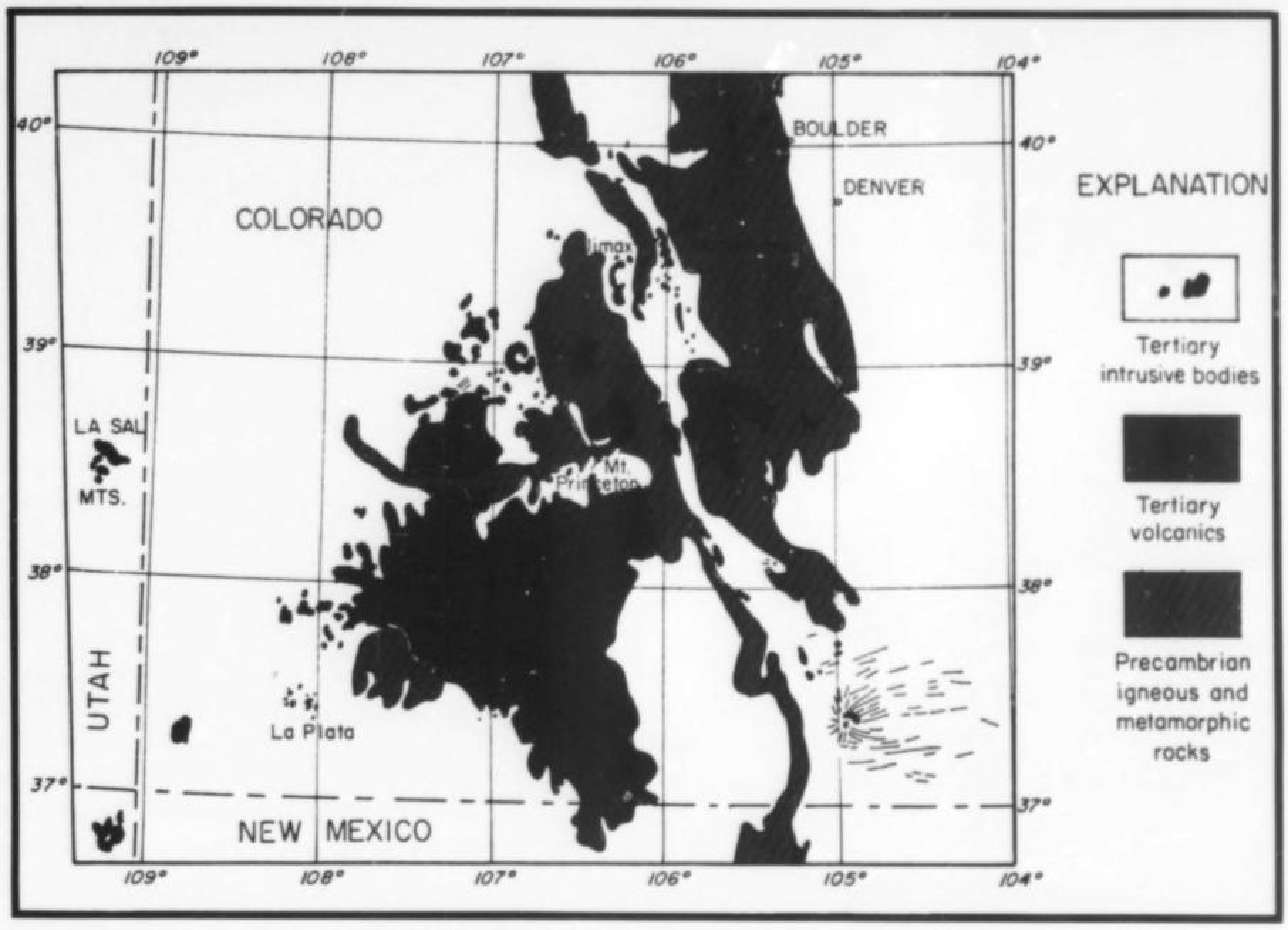
The geology of Gilpin County is similar to the of Boulder County with perhaps more Precambrian schists and gneisses. The ores fill fissures in the Precambrian rocks but are related to Tertiary intrusives.

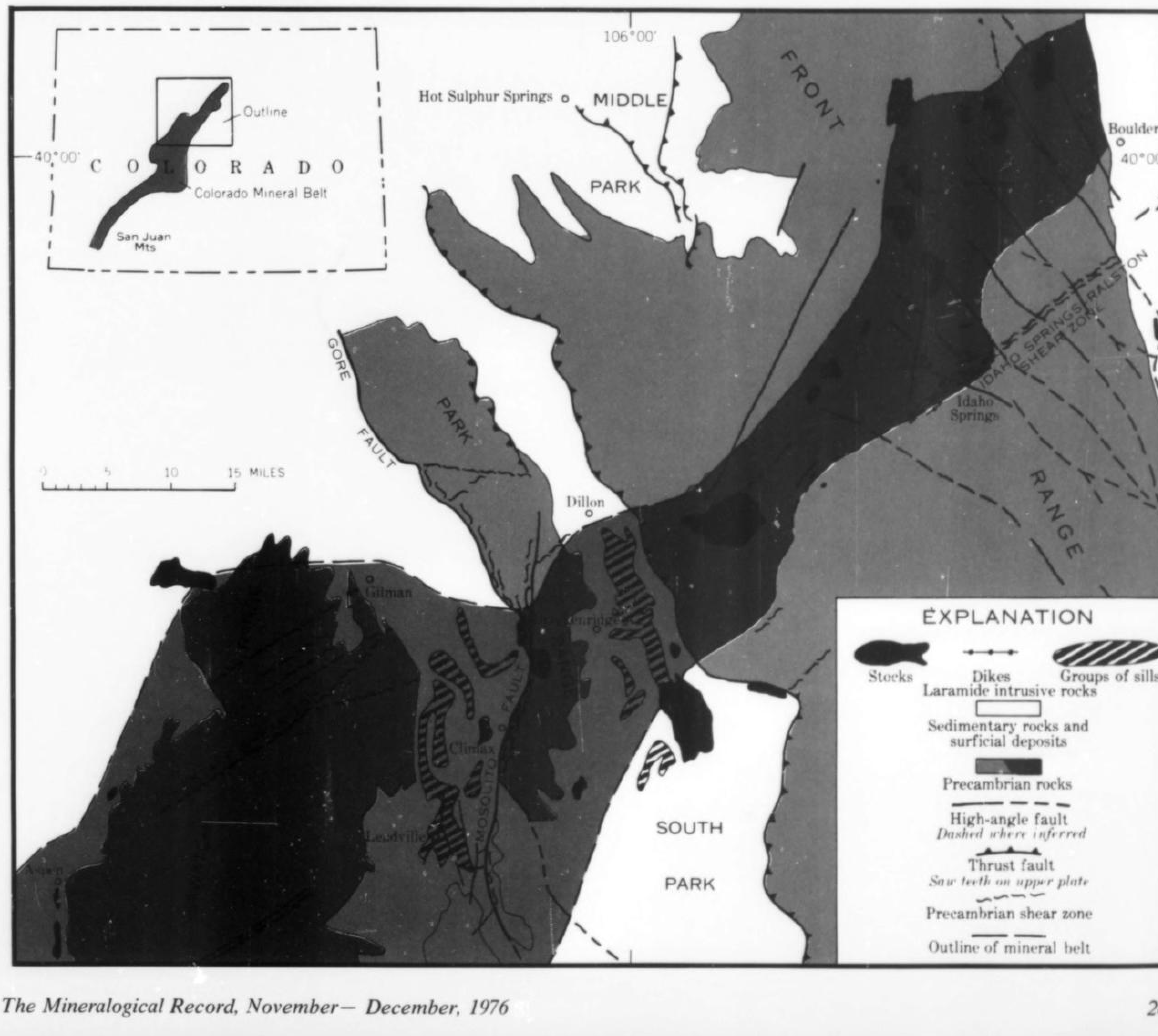
Gilpin County is known for its gold placers and gold and silver veins. Nice specimens of wire and leaf gold have come from many of the mines in this district. Unfortunately most of the mining was done so long ago that the specimens which are still available are of questionable origin. Many fine pyrite and quartz groups, with pyrite cubes up to 3 inches on an edge, have come from the numerous gold mines in the Central City area. Again it is difficult to ascertain from which mines most of the specimens originated, that are still available for examination.

Large, crude, quartz-coated crystals of enargite were obtained from the **Powers mine** in Russel Gulch. Very nice, deep red crystals of rhodochrosite one inch in diameter and in association

Figure 3. **The distribution of Tertiary plutons, Tertiary San Juan volcanics, and Precambrian rocks in the area of the Colorado Mineral Belt. (Modified by A.F. Buddington [1959],** ***Bull. Geol. Soc. Am.*****, 70, from** ***Geologic Map of the United States*****, U.S. Geol. Survey, 1932)**

Figure 4. **Location of Precambrian shear zones and other structural features of the northern portion of the Colorado Mineral Belt. (From O. Tweto and P.K. Sims [1960],** ***U.S. Geol. Sur. Prof. Paper*****, 400-B.)**





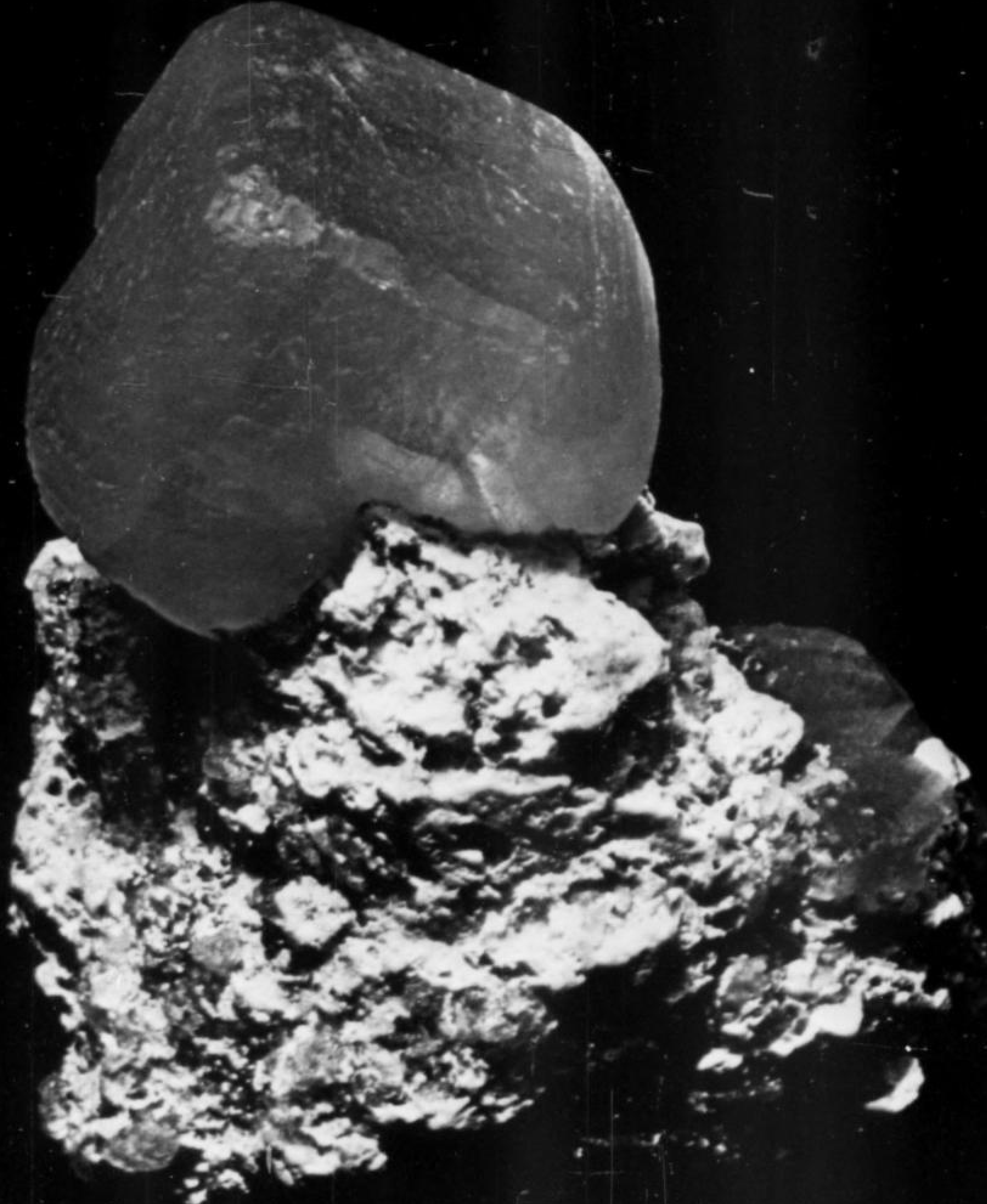


Figure 5. **Rhodochrosite on quartz with molybdenite; 1 X 1¼-inch specimen, ¾-inch crystal; Urad mine, Berthoud Pass, Clear Creek Co., Colorado; specimen, R.A. Kosnar.**

with purple fluorite were abundant in the **Moose mine** about 1 mile south of Central City in Willis Gulch. The **Bellman** and **Gem mines** were also known for deep red crystals of rhodochrosite.

In the northern part of Gilpin County, just south of Nederland, fine crystals of ferberite occur in the **Nugget mine** (Fig. 19). These crystals are of a pseudo-rhombohedral habit and frequently occur up to ¼ inch in size. This is probably the only location for crystals of this habit.

CLEAR CREEK COUNTY

Clear Creek County has long been known for its gold placers and veins. As a matter of fact, Colorado's first gold strike was on Clear Creek itself. The geology of the county is similar to that of Gilpin County: Precambrian schists and gneisses cut by numerous Tertiary intrusives.

Many fine specimens were taken from the mines of this district but most have been scattered far and wide over the years. A few are still available for inspection and renewed mining activity will undoubtedly produce more.

Pyrite crystals were common in this district and groups of pyrite cubes with crystals up to 3 inches on an edge were common in the **Princess Alice vein**, which is located on the east side of Silver Creek. One interesting specimen from the Alice mine is a group of 1½-inch chalcopyrite crystals sprinkled with ¼-inch pyrite cubes.

In the vicinity of Idaho Springs, the **Freeland mine** produced fine ¾-inch chalcopyrite crystals, usually on a

Figure 6. **Rhodochrosite on quartz; 2½ X 1½ inches; American Tunnel mine, Gladstone, San Juan Co., Colorado; specimen: R.A. Kosnar.**

Figure 7. **Rhodochrosite with quartz and pyrite; 4-inch crystal; Sweet Home mine, Alma, Park Co., Colorado; specimen: David P. Wilber, photo: Wendell E. Wilson; generally acknowledged to be the world's finest rhodochrosite and, some say, the finest mineral specimen of any kind.**

matrix of tennantite: The **Dixie mine** is located 5 miles south of Idaho Springs and 1 mile up Ute Creek. This mine has produced, and is still capable of producing, very fine gold specimens. The gold occurs as leaves, wires, and crystals on a gray quartz matrix, occasionally associated with sphalerite and galena.

West of Idaho Springs, in the vicinity of Lawson, many mines produced good crystals. The **Little Giant mine** is located on the east side of the gulch leading north from Lawson. This mine produced nice specimens of green, transparent to translucent sphalerite crystal groups. The crystals measured in excess of 1 inch in diameter. On the other side of the gulch is the **Red Elephant group of mines.** One of these mines produced large groups of sooty black, quartz-coated enargite crystals. The crystals on one group measured ¼ x ½ x 2 inches long. The **American Sisters mine** is located less than a mile south of Lawson and has produced matrix specimens of ½-inch cubes of argentite and ½-inch pearcite crystals.

Continuing west from Lawson to Georgetown and Silver Plume one enters a very rich silver district. Numerous specimens of wire silver and proustite crystals were obtained from this area; most of them from the **Pelican-Bismark** and the **Seven-Thirty vein** systems.

Some very fine specimens have been obtained recently

Figure 8. **Fluorite (pale blue) on rhodochrosite and quartz; 2½ X 2½ X 1½ inches; Climax mine, Alicante Gulch, Lake Co., Colorado; specimen: R.A. Kosnar.**

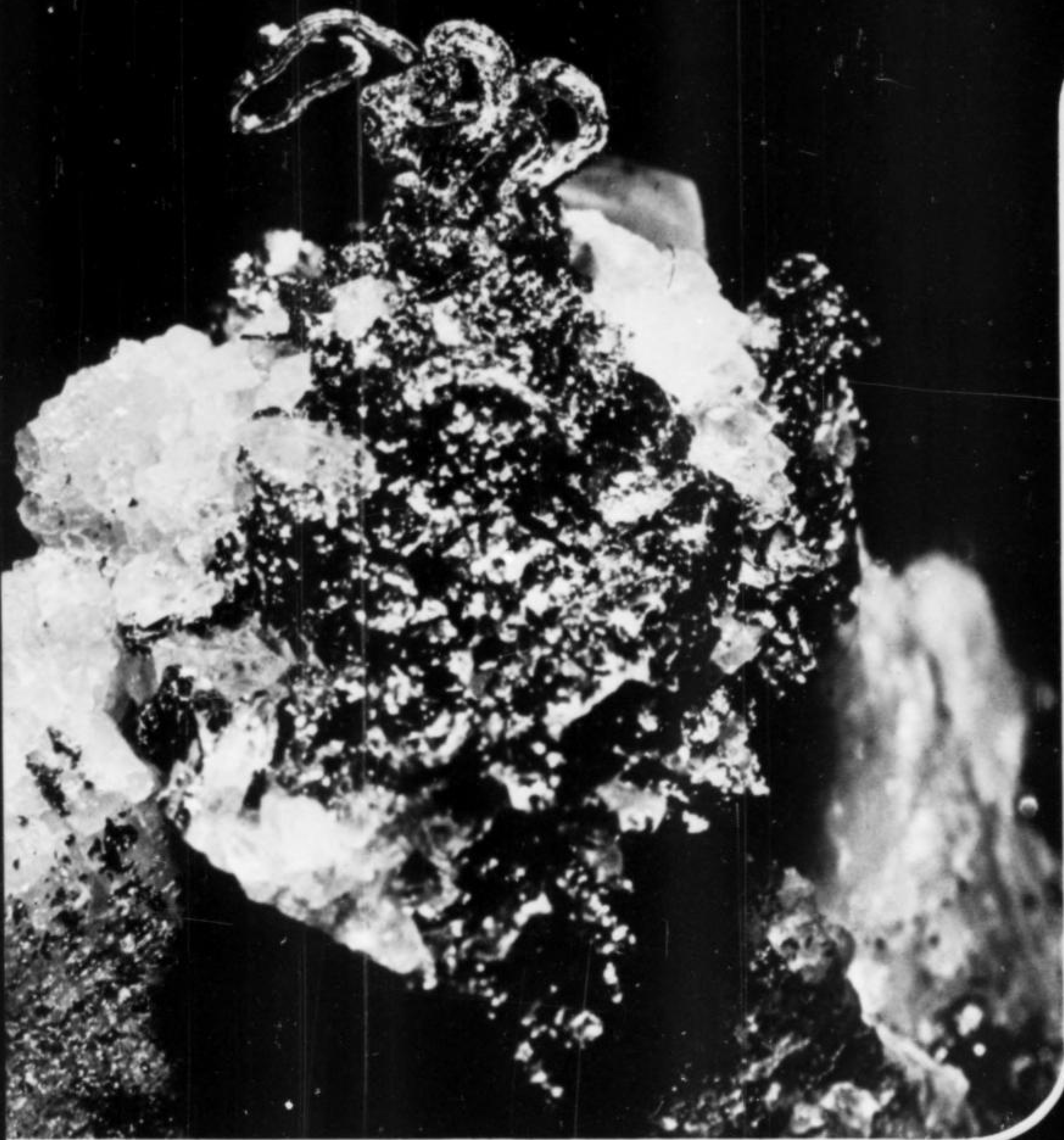


Figure 9. **Gold on quartz with petzite; 2150 drift, 1430 stope, Belle Creole vein, Standard Metals mine, American Tunnel, Gladstone, San Juan Co., Colorado; specimen: R.A. Kosnar.**

from the **Urad Molybdenum mine**, which is located about 18 miles west of Idaho Springs. Among these are superb, large, deep red rhodochrosite crystals (Fig. 5) associated with molybdenite crystals and blue-green apatite crystals. Fine, sharp, green, octahedral crystals of fluorite on matrix (Fig. 16) have also been obtained from this mine.

SUMMIT COUNTY

Summit County is entered as one proceeds west over the Continental Divide at Loveland Pass. The rocks of the area are predominantly quartzites, shales, limestones, and Precambrian gneisses and schists. Although the mineralization is related to numerous Tertiary intrusions, the various rock types played a significant part in controlling and localizing ore deposition.

The silver mining **district of Montezuma** is located at the foot of Loveland Pass and can be reached by taking the first road, for about 10 miles, to the south. This is an area of high, rugged mountains and glacial valleys.

Most of the mining activity took place in the 1860's but sporadic mining has continued to the present. In general the mines are shallow, very rich, and of a complex mineralogy.

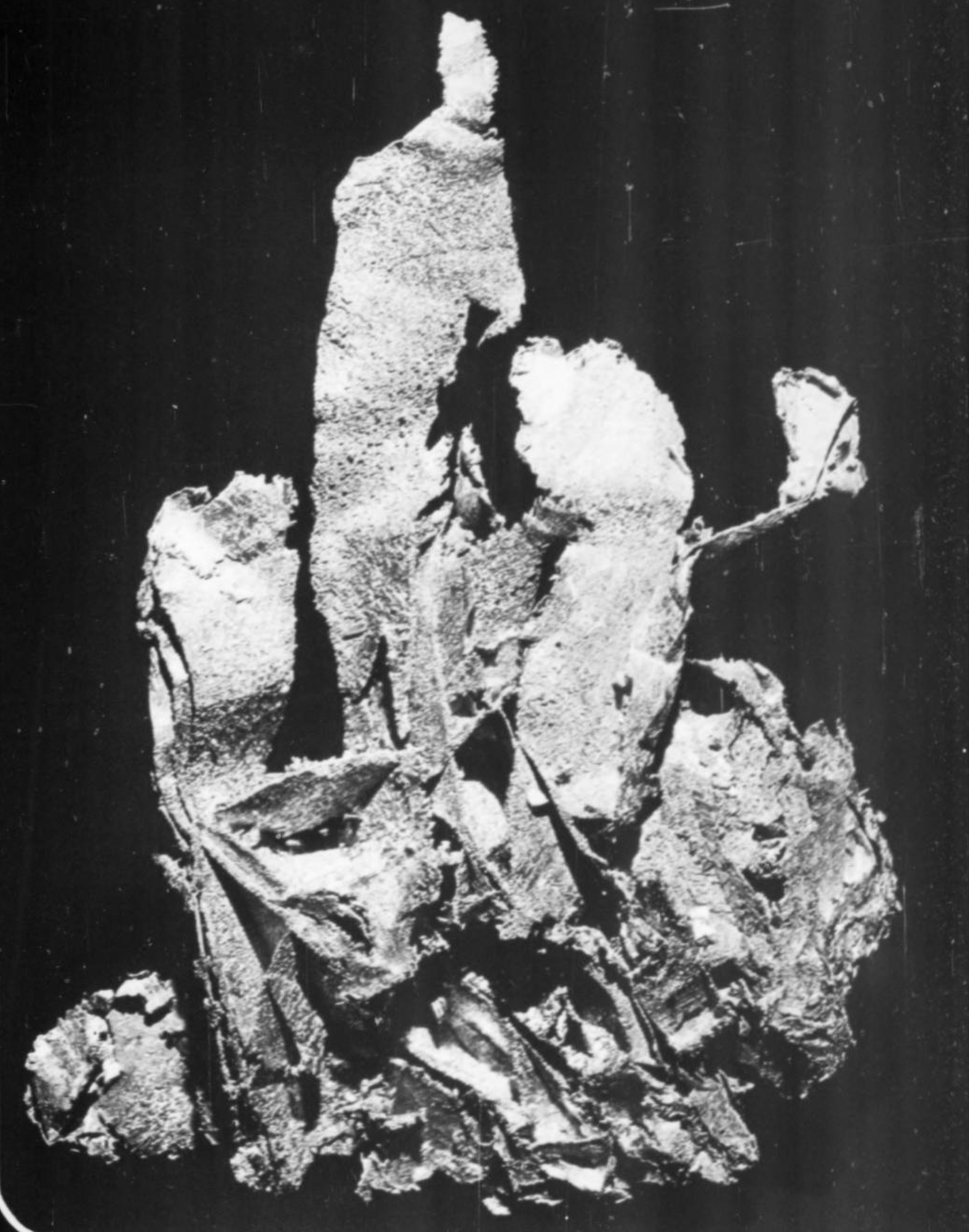
Only three good specimens from this area were examined: a specimen of matildite (Fig. 21), a specimen of ¼-inch alabandite crystals on massive alabandite from the Argentine Pass area, and a specimen of small, red rhombohedra of rhodochrosite on massive alabandite from the **Queen of the West mine**, Argentine Pass.

To the west lies the famous **Breckenridge gold district**. This area is known for its placers and large specimens of leaf and wire gold. Most of the famous gold specimens were obtained from the veins of Farncomb Hill. The veins were very narrow but contained pockets of large masses of crystallized native gold in a limonitic matrix. Among the mines which produced fine native gold specimens were the **Wire Patch** (Fig. 69), the **Wapiti** (Fig. 11), and the **Ontario mines.**

The **Wellington mine** is situated on the north side of French Gulch, 2 miles east of Breckenridge. Fine 1-inch, black crystals of sphalerite and small, brilliant galena crystals were abundant in this mine. Probably the best sphalerite crystals from Summit County, however, came from the **Big Four mine**. This mine is located above the north

Figure 10. **Gold on matrix; 3 X 2½ X 1½ inches; Ground Hog mine, Battle Mountain, Gilman, Eagle Co., Colorado; specimen: Denver Museum of Natural History.**

Figure 11. **Gold (crystallized leaf type); 8 X 6¼ X 2 inches, weight: 17.01 oz. troy; Wapiti mine, Farncomb Hill, Breckenridge, Summit Co., Colorado; specimen: Denver Museum of Natural History.**



bank of Green Mountain Reservoir on the Blue River. The sphalerite crystals obtained were frequently as large as 4 inches in diameter. Many crystals were a dark, opaque green but some were a lighter green color and were transparent.

EAGLE COUNTY

The Gilman district, also known as the Battle Mountain district, is on the northeast flank of the Sawatch Range about 20 miles northwest of Leadville. The rocks of the area consist of a basement of Precambrian granites and schists overlain by sandstones, quartzites, limestones, and dolomite. Fissure veins in the quartzite produced considerable gold and silver; some of the ore consisted of telluride minerals, mostly hessite. Most of the lead-zinc mineralization occurs in large replacement bodies in limestone.

The **Eagle mine** has produced a fantastic number of fine crystallized mineral specimens. Fine plates of brilliant pyrite pyritohedra have been mined by the thousands. Galena has formed in nice specimens of bright, modified, ½-inch cubes scattered about on a brown matrix of scalenohedral siderite crystals. Sphalerite crystals are common in the mine. One area of the mine produced excellent, modified, tabular barite crystals which are of a beautiful transparent golden color (Fig. 13). Specimens consisting of large, sharp, pure white rhombs of dolomite, up to 2 inches on

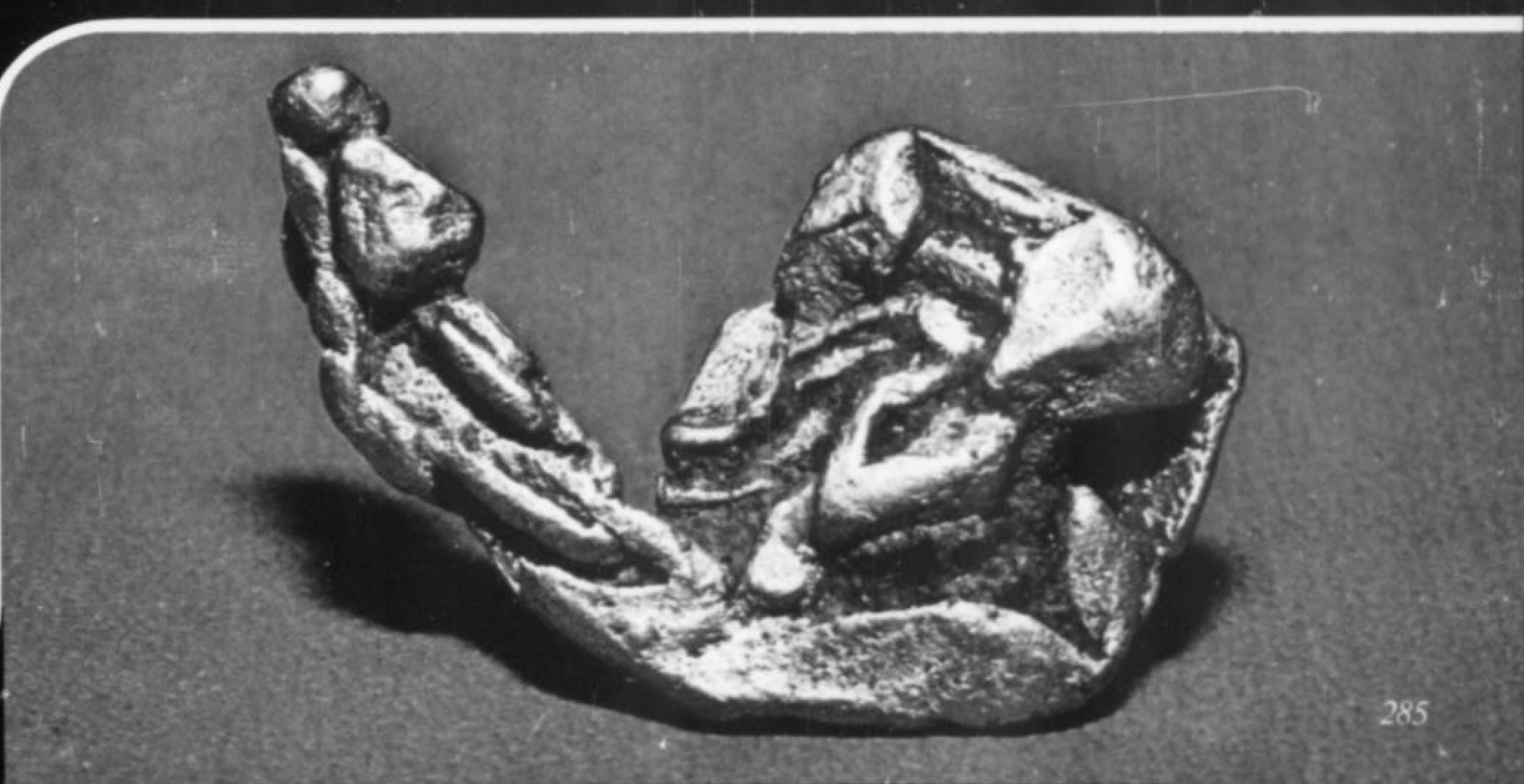


Figure 12. **Gold (crystallized nugget); ¾ X ½ inch, 2.66 grams; Wall Street district, Boulder Co., Colorado; specimen: Denver Museum of Natural History.**

Figure 13. **Barite on siderite; 2½ X 3¼ inches; Eagle mine, Gilman, Eagle Co., Colorado; specimen: R.A. Kosnar.**

an edge, and sometimes sprinkled with minute pyrite crystals, were common. Brassy chalcopyrite crystals ½-inch on an edge, fine green apatite crystals to ¾-inch, and dendritic sheets of native copper up to 3 x 3 inches have been produced. The rarest find in the mine has been a splendid ⅝-inch pyrrhotite crystal on matrix (Fig. 24). One of the most recent discoveries, however, has been rhodochrosite (Fig. 26, 70). The mine has only produced six or seven specimens which were all removed from the same vug. All of the specimens but one consist of beautiful, ¼-inch disc-shaped, pink crystals scattered about on a brilliant black sphalerite matrix; one crystal is also partially covered with clear quartz crystals. One superb specimen of a group of curved, rhombohedral rhodochrosite crystals about 1 inch on an edge is shown in figure 26.

The ***Ground Hog mine*** has produced spectacular wire gold specimens, single wires of which weigh several ounces. One such specimen with a wire 3 inches long is pictured (Fig. 10).

LAKE COUNTY

A large number of mining districts, clustered around the rugged Mosquito Range, and encompassing portions of Lake, Summit, and Park counties, might be considered as one unit. The Leadville district, Climax, and hundreds of scattered mines including the gold placers of Breckenridge, Alma, Fairplay, Granite, Penn Hill, and California Gulch are in close proximity. The geology, and means by which the ores were deposited, of course, vary to a considerable extent.

The **Climax mine** (Fig. 27) is located on the northernmost crest of the Mosquito Range (summit of Fremont Pass). This is the largest known molybdenum mine in the world. The deposit is probably best described as a greisen. The major ore mineral is molybdenite but considerable quantities of wolframite, cassiterite, and brannerite are recovered as byproducts due to the enormous size of the mining operation. (70,000 tons of ore processed per day).

Many superb crystallized mineral specimens have been procured from this mine; none, however, of molybdenite. Perhaps the finest fluorite specimens in Colorado are mined at Climax (Fig. 29-32). Among the specimens examined are purple octahedra, purple dodecahedra associated with blue apatite crystals, blue fluorite cubes on large, red, rhodochrosite rhombs (Fig. 8), and finally green

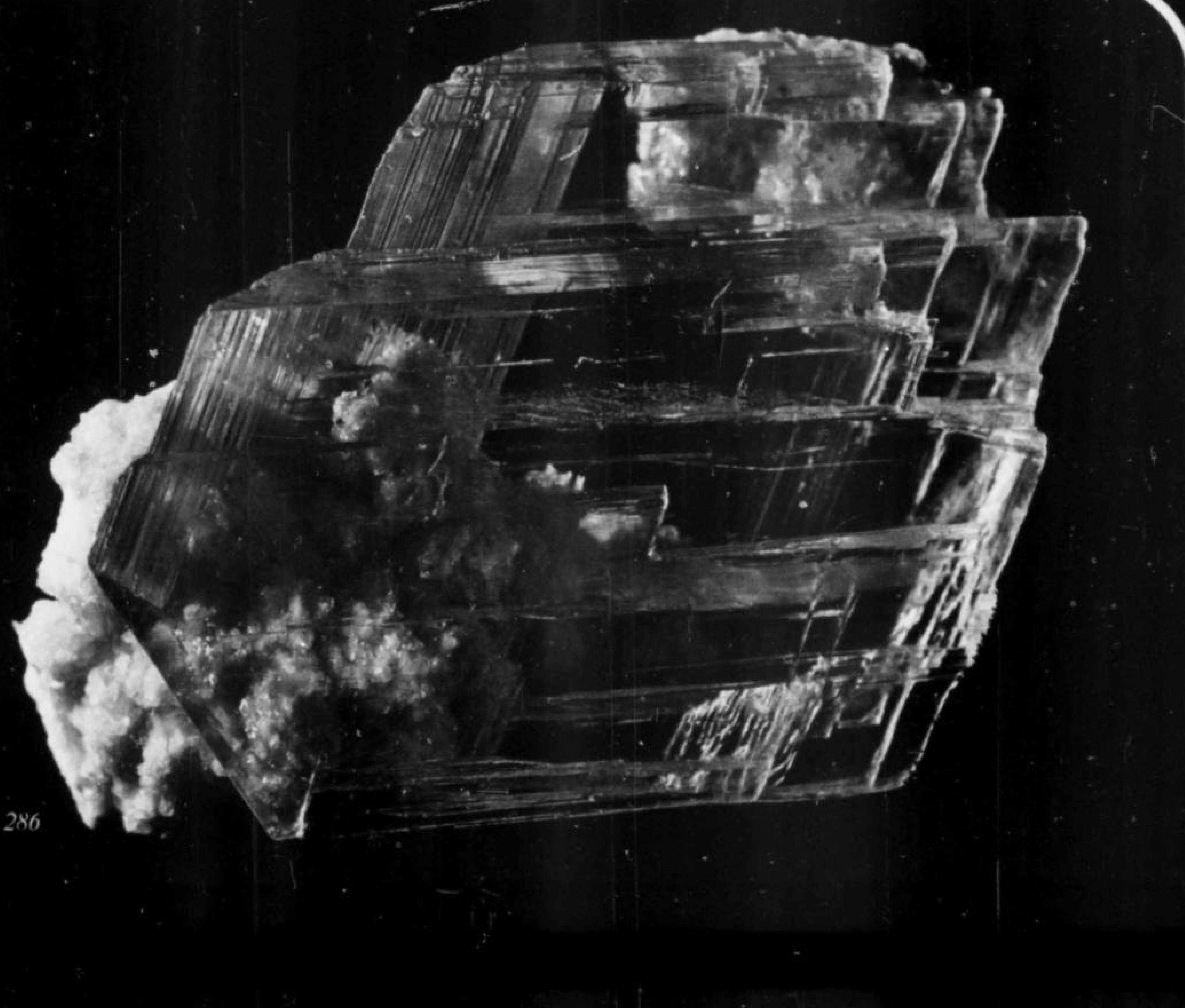


Figure 14. (left) **Gypsum with rhodochrosite; 2 X 2½ inches; American Tunnel mine, Gladstone, San Juan Co., Colorado; specimen: R.A. Kosnar.**

Figure 16. (right) **Fluorite on rhodochrosite with pyrite; 4½ X 2½ inches (largest octahedron is 1¼ inch); 830 Level, Urad mine, Berthoud Pass, Clear Creek Co., Colorado; specimen: R.A. Kosnar.**

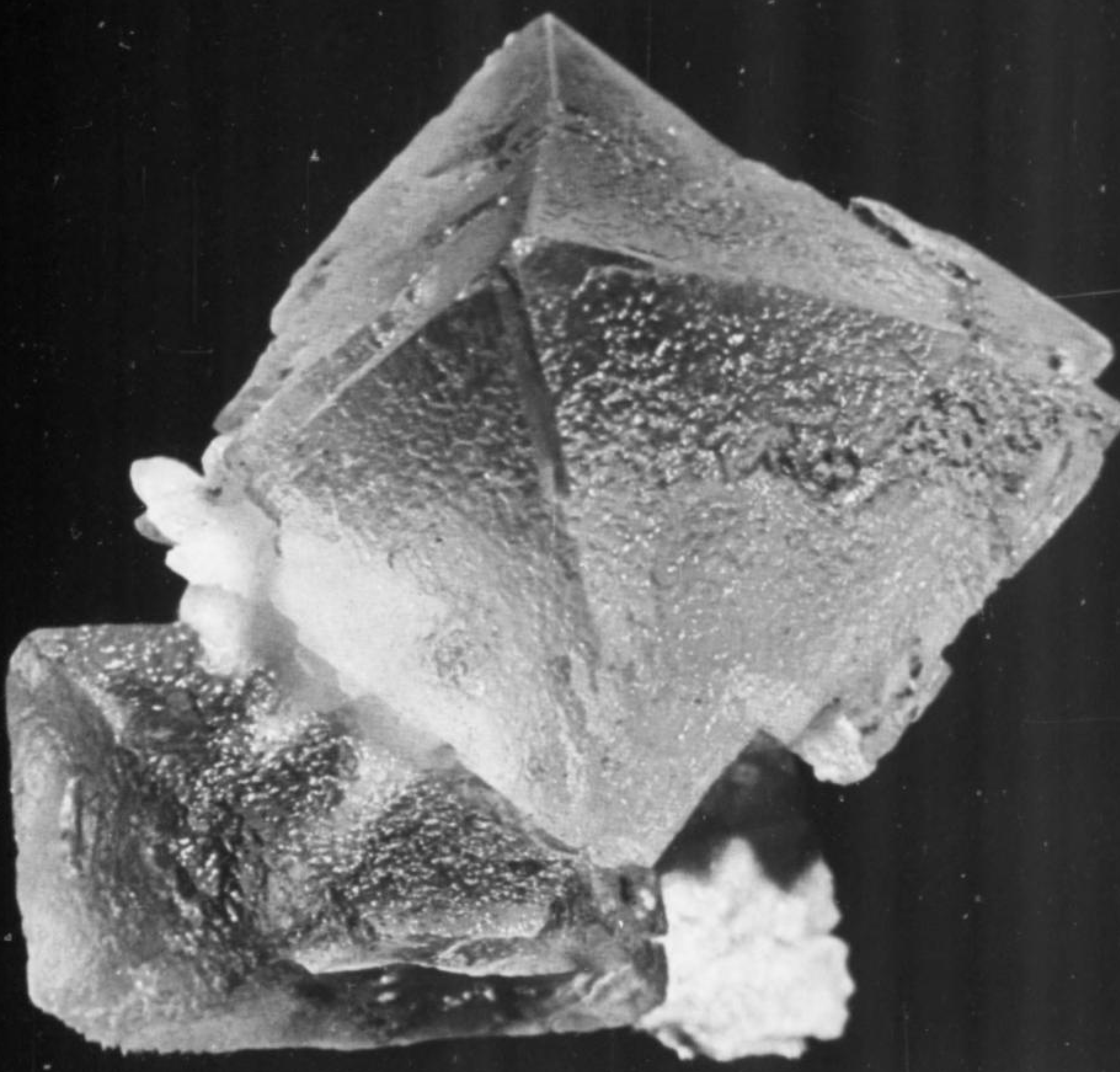


Figure 15. **Fluorite with rhodochrosite and quartz; 1¾ X 1¾ X 1½ inch; Sunnyside mine, Eureka Gulch, San Juan Co., Colorado; specimen: Linda Kosnar.**

red, rhodochrosite rhombs (Fig. 8), and finally green and purple bicolored cubes. Sphalerite occurs as ½-inch black crystals, topaz as ½-inch clear crystals, apatite as ¼-inch blue-green crystals, and wolframite as ½-inch sprays on quartz. Brilliant, sharp cubes of pyrite, occasionally up to 12 inches on an edge, have been mined over the years. The finest specimens of all, however, are the deep red rhombs of rhodochrosite frequently scattered about on a matrix of milky quartz crystals. The best specimen examined was a very deep red, transparent 2 x 3 inch rhombohedron of rhodochrosite perched on a matrix of drusy white quartz.

Another source of deep red rhodochrosite rhombs has been the **John Reed mine**, which is located a mile south-

Figure 17. (left) **Pyrite (octahedra+pyritohedra; 3 X 4 inches; Krakajack mine, Wallstreet Canyon, Boulder Co., Colorado; specimen: Hal Miller.**

Figure 18. (below) **Pyrite; 1 X 1⅜ inches; Saratoga mine, Central City, Gilpin Co., Colorado; specimen: R.A. Kosnar.**

Figure 19. (bottom) **Ferberite; 1½ X 2½ inches; Nugget mine, Gilpin Co., Colorado; specimen: R.A. Kosnar.**

west of the summit of Fremont Pass and about ½ mile up Alicante Gulch. This mine, however, has not been in operation for several years.

The **Leadville mining district** is situated on the western flank of the Mosquito Range, at the head of the Arkansas Valley. The district was first known for its gold placers in California Gulch, later for its rich silver deposits and finally for its lode gold deposits. The geology is very complex; the basement rocks are composed of a complex of Precambrian granites and gneisses. This complex is overlain by various sedimentary rocks, the most important of which is the Leadville dolomite which was subject to extensive replacement by enormous lead-zinc-silver deposits. The sediments were cut by numerous Tertiary dikes and stocks of various porphyry rocks which were probably the source of the mineralizing solutions.

If one travels east on 7th Street, from Leadville, for about 1 mile, the famous **Matchless mine** (Fig. 33) can be seen on the north side of the road. From this mine fine specimens of pink, saddle-shaped, rhombohedral rhodochrosite perched on and pierced by wire silver have been obtained in quantity. Proceeding up Evans Gulch, the **Mammoth mine** is encountered. This mine produced attractive ¼-inch, violet, saddle-shaped groups of rhombohedral rhodochrosite. Another 6 or 7 miles brings one to the **Resurrection shaft**. Fine black sphalerites and groups of bright, 1-inch pyrite cubes have been obtained here. About 3 miles to the southeast and upon the slope of Breece Hill are located the **Little Jonny**, **Ibex**, and **Irene mines.** All have produced good black sphalerite crystals and a few modified galena cubes, but they are better known for the fine groups of bright pyrite cubes (Fig. 34), usually associated with quartz crystals and occasionally with small scheelite and wolframite crystals. The Little Jonny mine has produced brilliant, sharp, pyrite cubes up to nearly 12 inches on an edge. Large, spongy masses of wire gold, weighing several ounces, and fine specimens of gold consisting of numerous 1-inch wires protruding from massive black sphalerite have also been mined from the Little Jonny. Fine specimens of vivianite have been taken from the Ibex mine. One specimen consisted of 2-inch blue-purple vivianite crystals on matrix.

Travelling westward about 7 miles, until 5th Street in Leadville is reached, the **Wolftone mine** can be seen to the south near Carbonate Hill. This mine has produced fine lustrous, black, botryoidal groups of hydrohetaerolite. Returning eastward about 2 miles and proceeding southward another 2 miles down into

Figure 20. **The London mine near the top of Mosquito Pass, Colorado; photo: Hal Miller.**

California Gulch, several good crystal localities are encountered. The **Julia Fisk mine** is located eastward about 3 miles up the Gulch. This mine has produced nice groups of pink to violet, 1/4 inch, saddle-shaped rhodochrosite rhombohedra, and fine bright 1 inch galena cubes modified by octahedrons in groups and scattered about on a matrix of tan, 1/4 inch siderite crystals. **The Moyer mine** is located about 1/4 mile to the west down California Gulch. This mine has produced black, lustrous, 1 inch sphalerite crystals on a pyrite matrix (Fig. 36). About 1 mile farther downstream is the **Yak tunnel**, located at an altitude of 10,340 feet. This tunnel was driven to Breece Hill as a drainage tunnel and cut many ore bodies. Nice groups of modified, 1 inch pyritohedra came from this tunnel. This crystal habit is not common at Leadville but even rarer are the groups of octahedral pyrite crystals which have been obtained from this district. The neighboring **Black Cloud mine** has produced nice specimens of black sphalerite crystals sprinkled with 1/4 inch galena cubes and lustrous white dolomite crystals (Fig. 37). On the south slope of California Gulch is the **A.Y. and Minnie mine**. Attractive groups of pink, 1/4 saddle-shaped rhombohedra of rhodochrosite have come from this mine as well as at least one matrix specimen of cerussite with beautiful radiating clusters of cerussite crystals up to 6 inches long.

PARK COUNTY

Spectacular specimens of rhodochrosite have been mined on the east slope of the Mosquito Range. The **Sweet Home mine**, near Alma, located in Buckskin Gulch, produced the most sought after specimens (Fig. 7). Similar specimens were obtained, however, from the **Tanner Boy mine** on the southwest side of the gulch and from the **Russia mine** at an altitude of nearly 14,000 feet on the east face of Mt. Lincoln. All of these mines have produced deep red, gemmy rhodochrosite rhombohedra, frequently associated with pink, blue, or green fluorite octahedra.

A little to the north is **Penn Hill**, near Mosquito Pass and just above timberline. Nuggets of gold weighing several pounds have been found here. Across the valley is the **American mine**, a small

Figure 21. **Matildite with quartz; field of view about ½ X ½ inch; Sullivan Mountain, Montezuma, Summit Co., Colorado; specimen and photo: John M. Shannon.**

Figure 22. **Apatite (pale green) on pyrite; 1¾ X 2 inches; Eagle mine, Gilman, Eagle Co., Colorado; specimen: R.A. Kosnar.**

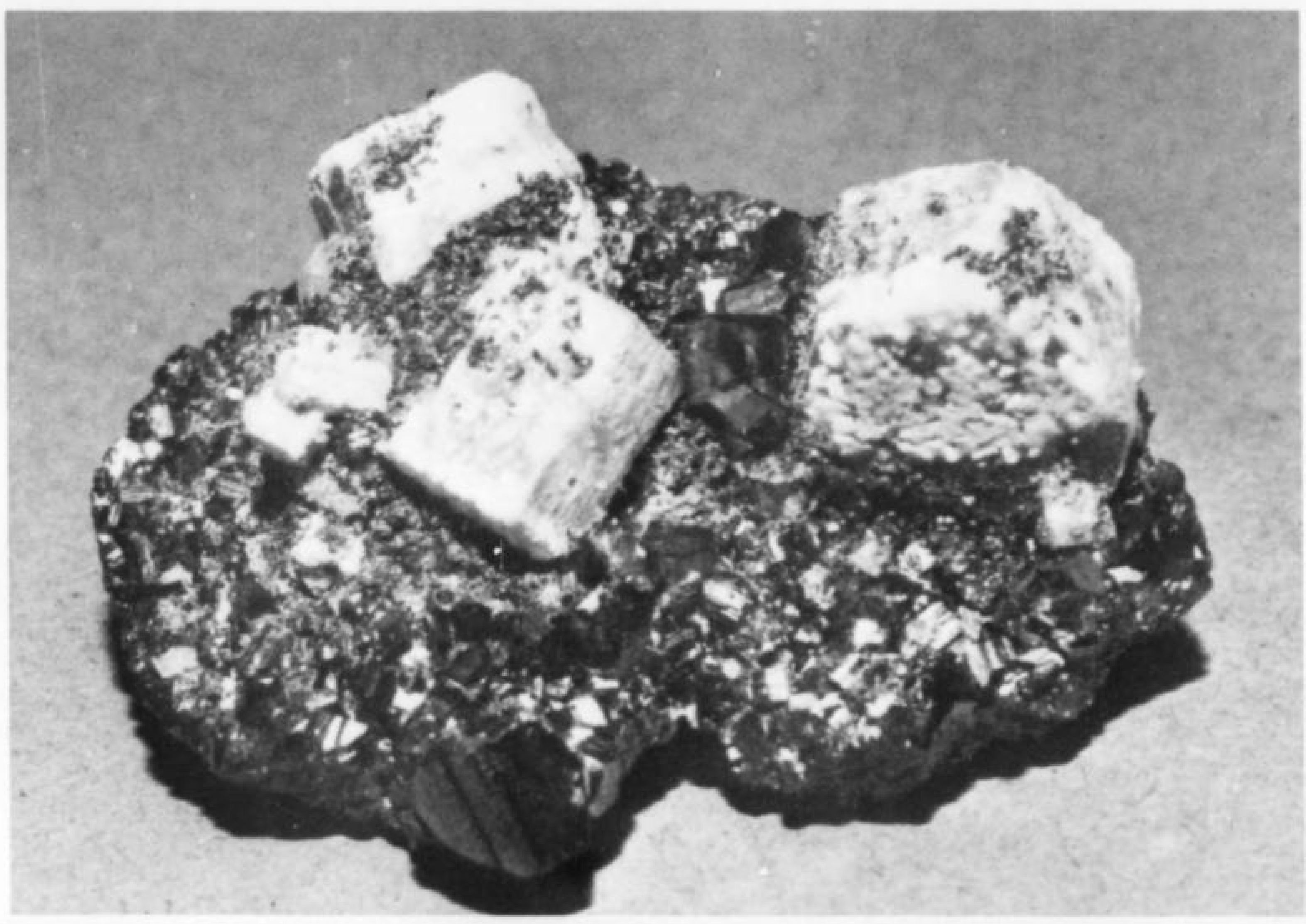


Figure 23. **Siderite (greenish-brown) on sphalerite ("marmatite"); 1¾ X 2¼ inches; Eagle mine, Gilman, Eagle Co., Colorado; specimen: R.A. Kosnar.**

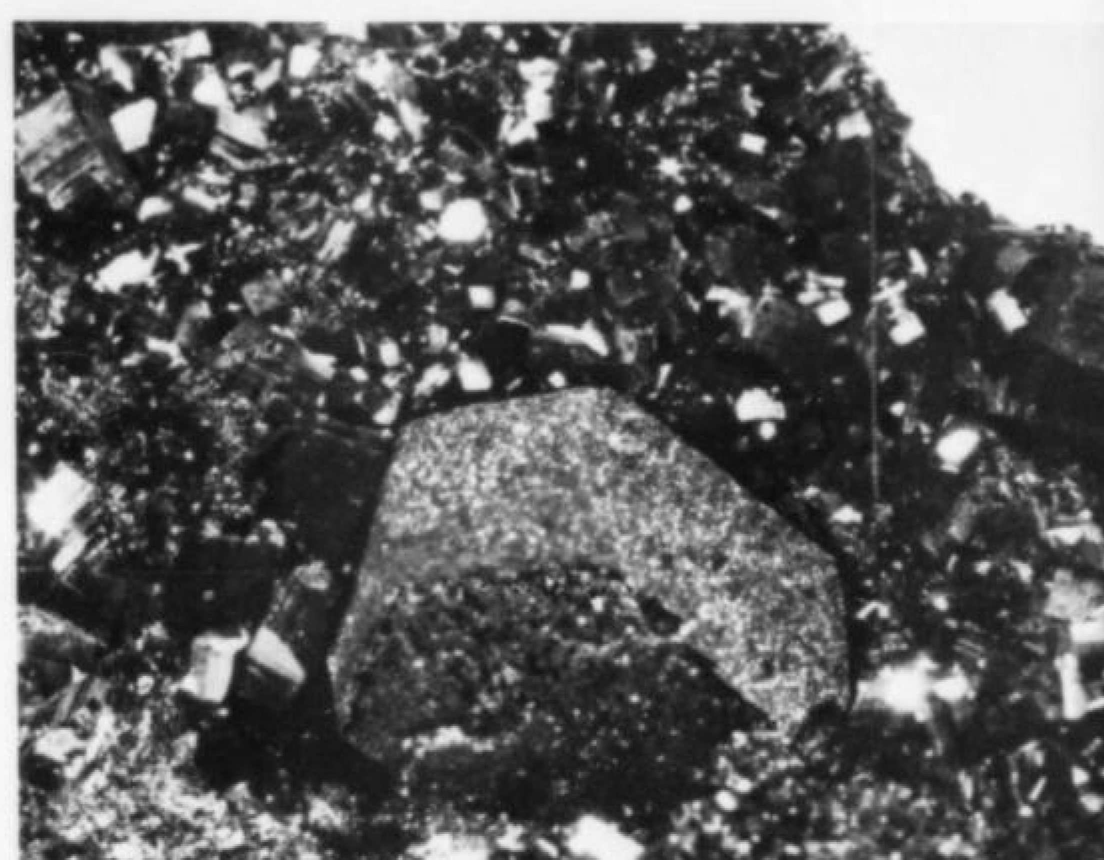


Figure 24. **Pyrrhotite coated with a druse of pyrite crystals, on pyrite; 2½ X 3 inches (pyrrhotite crystal is ⅝ inch); Eagle mine, Gilman, Eagle Co., Colorado; specimen: R.A. Kosnar.**

mine on one of the claims in the London vein system at London Mountain. It has produced over 100,000 ounces of gold, much of which formed attractive specimens of leaf gold in quartz.

The **Andes mine** in the same district has produced deep red gemmy crystals of hübnerite 3 inches long.

PITKIN COUNTY

To the northwest of Leadville lies the silver mining district of Aspen. Paleozoic sedimentary formations (shales and limestones) rest on Precambrian granite and schists of the Sawatch Range.

This area is famous for its rich silver production; much of which occurred as wires, leaves, and masses of native silver (Fig. 38, 39). Good argentite crystals were found here as well. The best specimens came from the **Molly Gibson** and the **Smuggler mines**.

Large white barite roses were common on the black sphalerite and galena ore from the **Midnight mine**.

CHAFFEE COUNTY

To the southwest of Leadville lies the **Chalk Creek mining district**. The veins in this district are in the quartz monzonite of the Mount Princton Batholith, of Tertiary age. The **Mary Murphy mine**, which was the chief gold and silver producer in the district, is located on the southwest side of Chrysolite Mountain about 2 miles south of St. Elmo. This mine has produced small, 1/4 inch pink rhombs of rhodochrosite of gem quality.

TELLER COUNTY

About 100 miles east of the Chalk Creek district is the famous **Cripple Creek gold telluride district**. Most of the good producing

***Figure 25. (above left)* Pyrite; 2 X 2¼ inches; Eagle mine, Gilman, Eagle Co., Colorado; specimen: R.A. Kosnar.**

***Figure 26. (left)* Rhodochrosite; 3 X 4 inches; Eagle mine, Gilman, Eagle Co., Colorado; specimen: R.A. Kosnar.**

***Figure 27. (below)* The climax mine, Alicante Gulch (near the summit of Fremont Pass), Lake Co., Colorado; 1976 photo.**

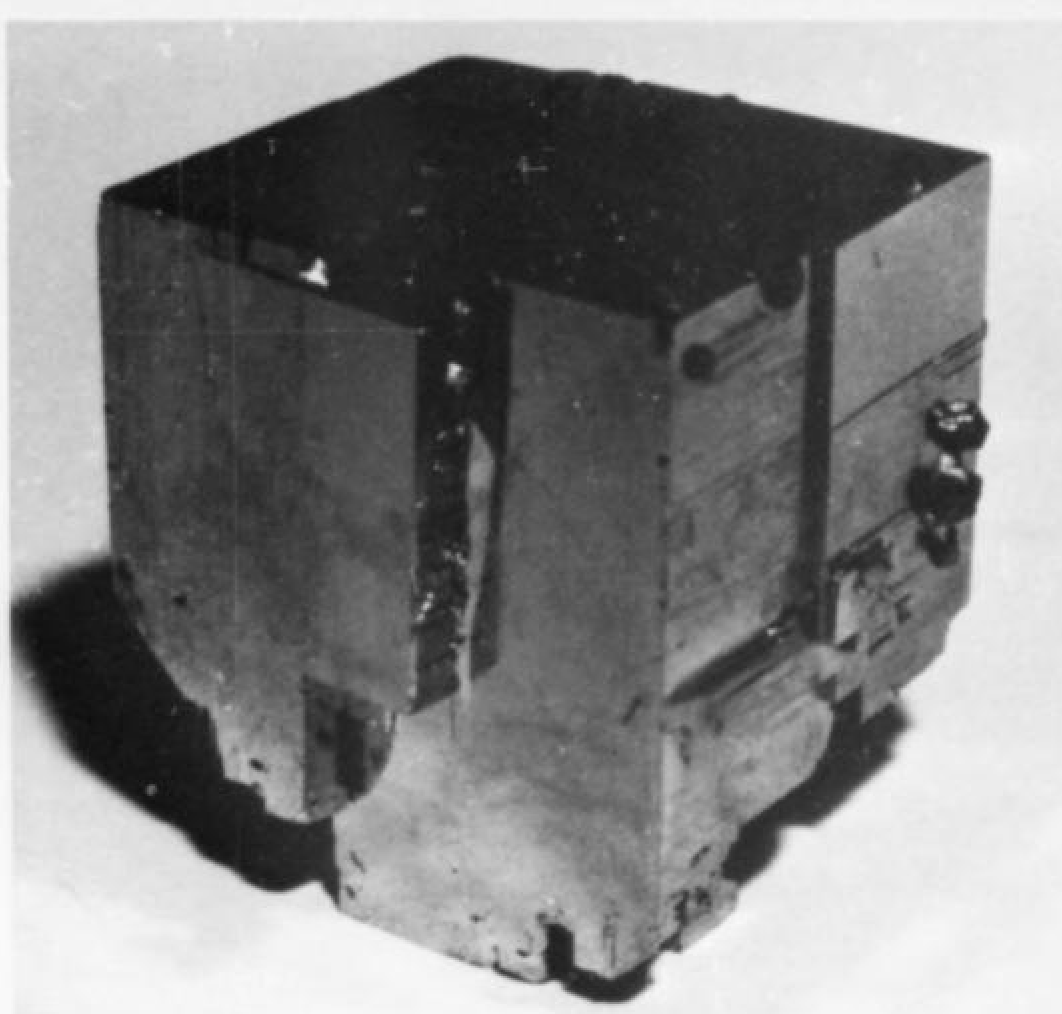


Figure 28. (above left) **Pyrite "floater" (no point of attachment); 2 X 1½ inches; Climax mine, Alicante Gulch, Lake Co., Colorado; specimen: Bert and Ellen Myer.**

Figure 29. (above right) **Fluorite (purple) on quartz; 1¼ X 1½ inches; Climax mine, Alicante Gulch, Lake Co., Colorado; specimen: Linda Kosnar.**

Figure 30. (left) **Pyrite with minor sphalerite; 1½X 1¼X 1¼; Climax mine, Alicante Gulch, Lake Co., Colorado; specimen: R.A. Kosnar.**

Figure 31. (left) **Fluorite (purple) with apatite (blue) on sericite; Climax mine, Stork level, Alicante Gulch, Lake Co., Colorado; specimen: Linda Kosnar.**

Figure 32. (below) **Fluorite (pale purple) with sphalerite (spinel law twin); 2½X 3 inches; Climax mine, Stork level, Alicante Gulch, Lake Co., Colorado; specimen: R.A. Kosnar.**

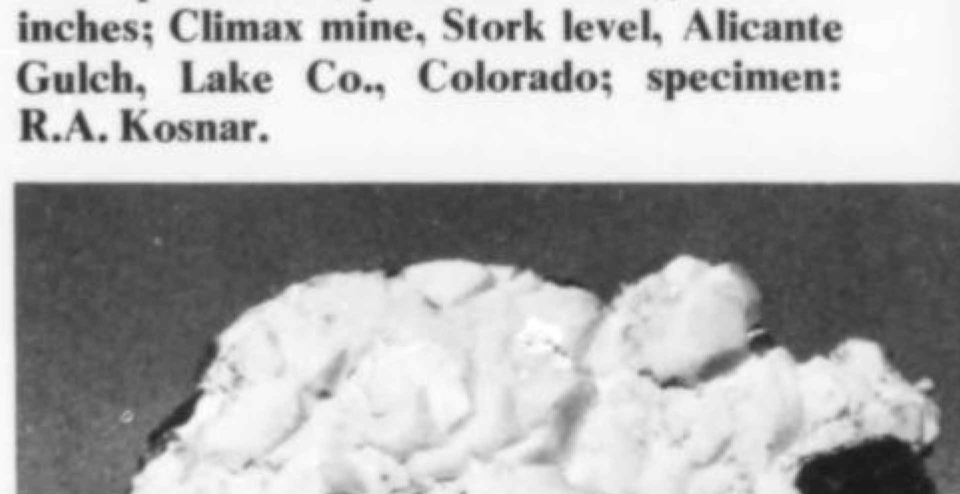
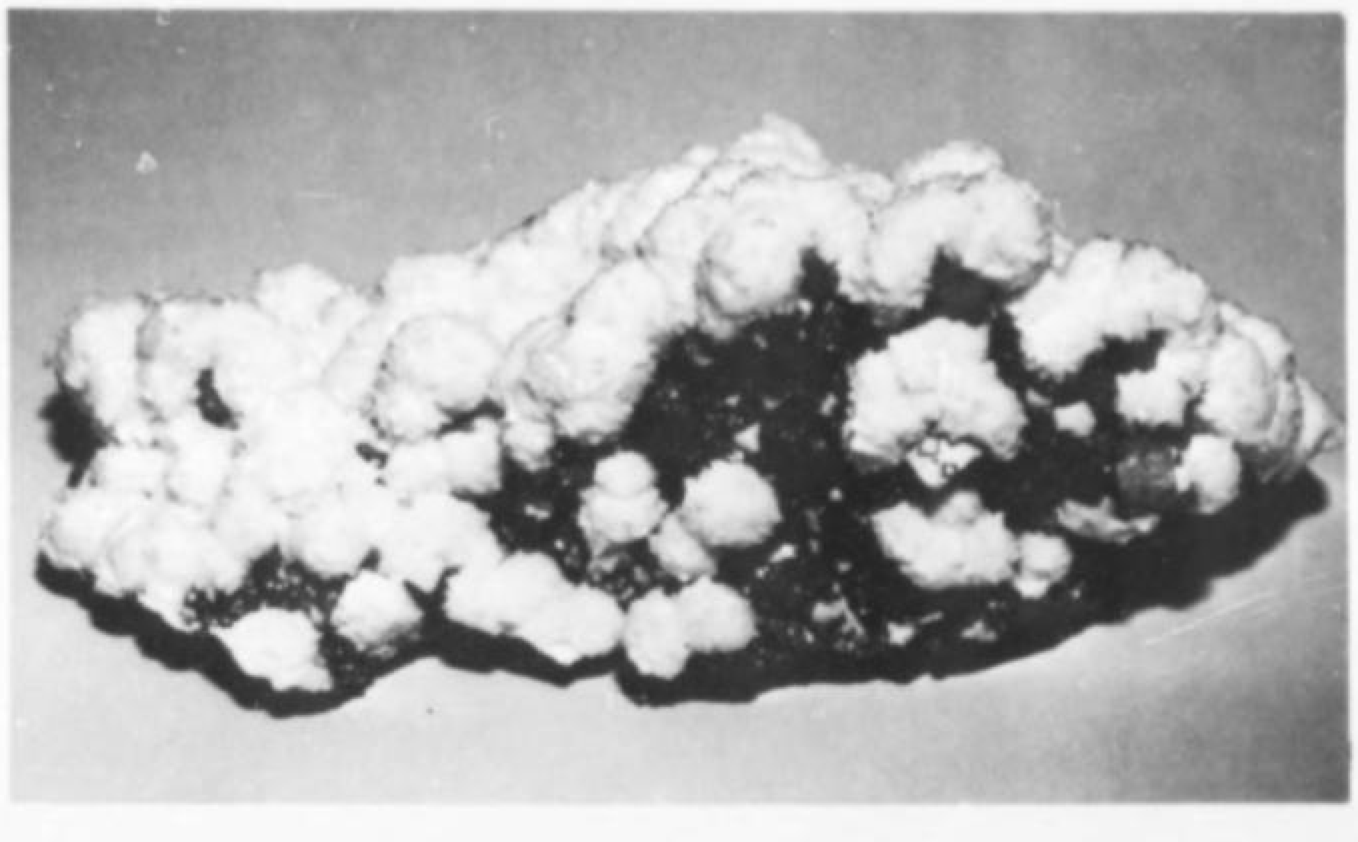
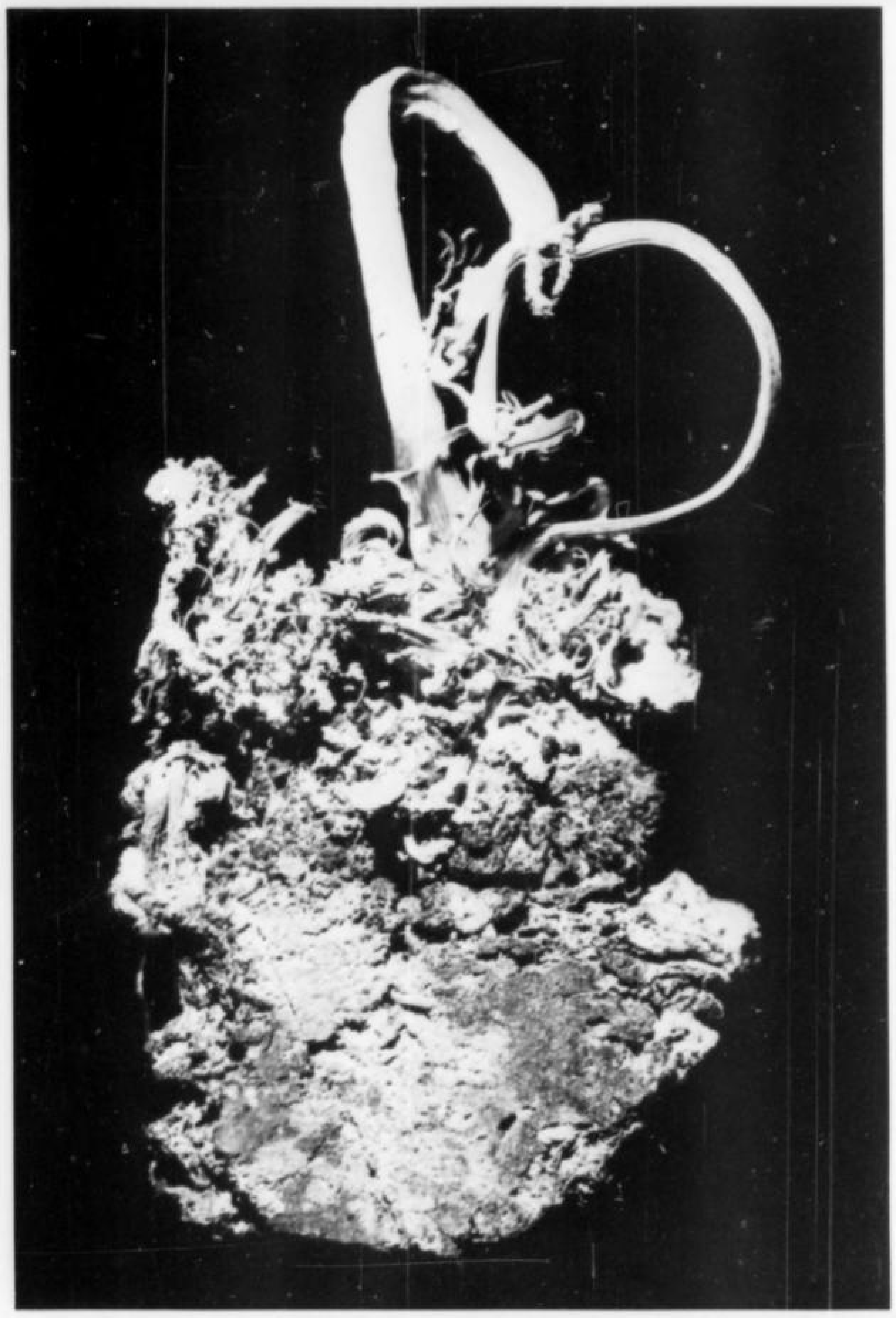
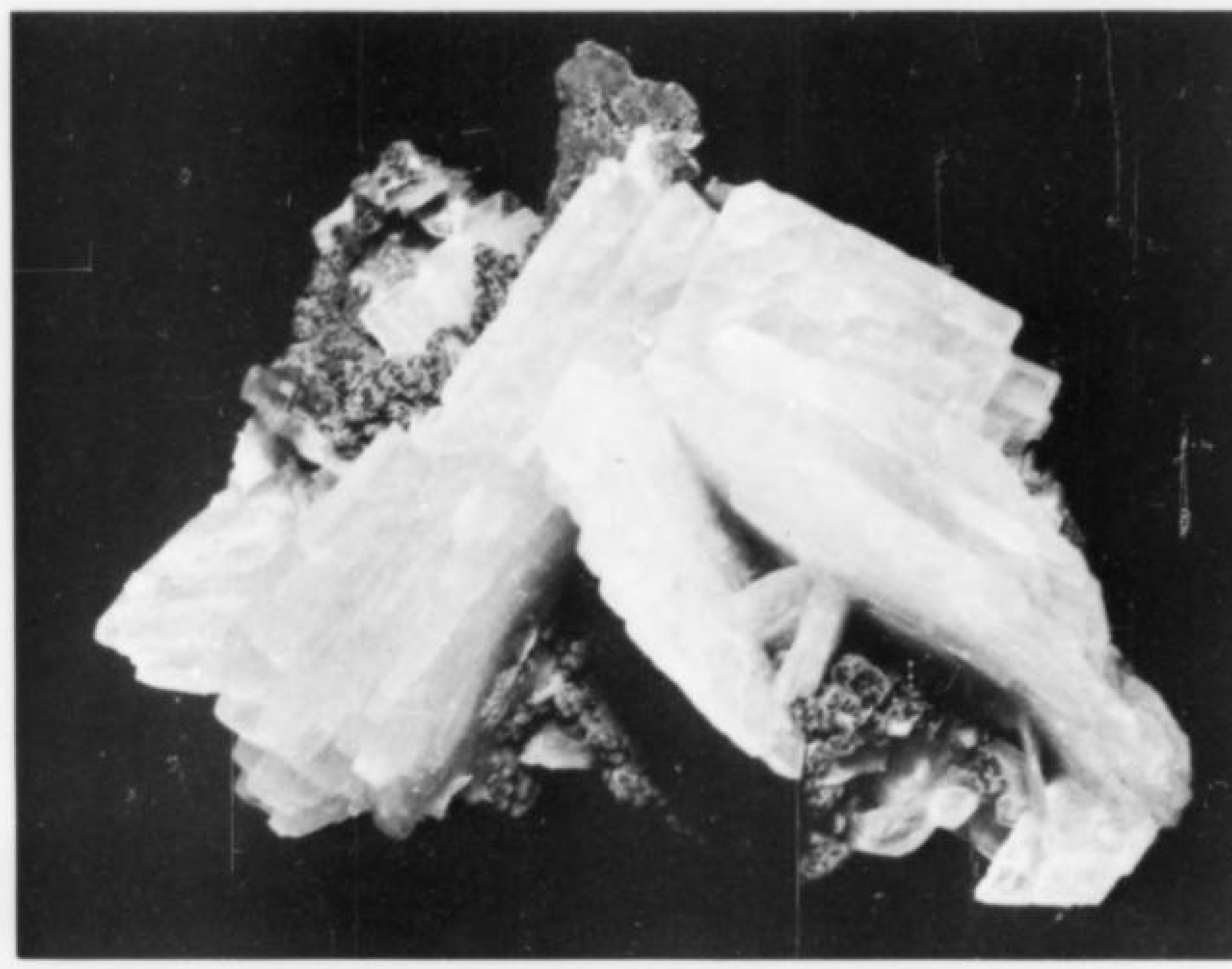


Figure 33. (above) **The Matchless mine, Lake Co., Colorado.** *Figure 34. (below left)* **Pyrite; 3 X 3½ inches; Ibex mine, Leadville, Lake Co., Colorado; specimen: Hal Miller; photo: Gordon Sweeney.** *Figure 35. (bottom left)* **Siderite with galena; 3½ X 4 inches; Julia Fisk mine, Leadville, Lake Co., Colorado; specimen: Hal Miller; photo: Gordon Sweeney.** *Figure 36. (below right)* **Sphalerite on pyrite; 4 X 4 inches; Moyer mine, Leadville, Lake Co., Colorado; specimen: Hal Miller.** *Figure 37. (bottom right)* **Dolomite on sphalerite with galena; 6½ X 3 inches; Black Cloud mine, Leadville, Lake Co., Colorado; specimen: Hal Miller.**







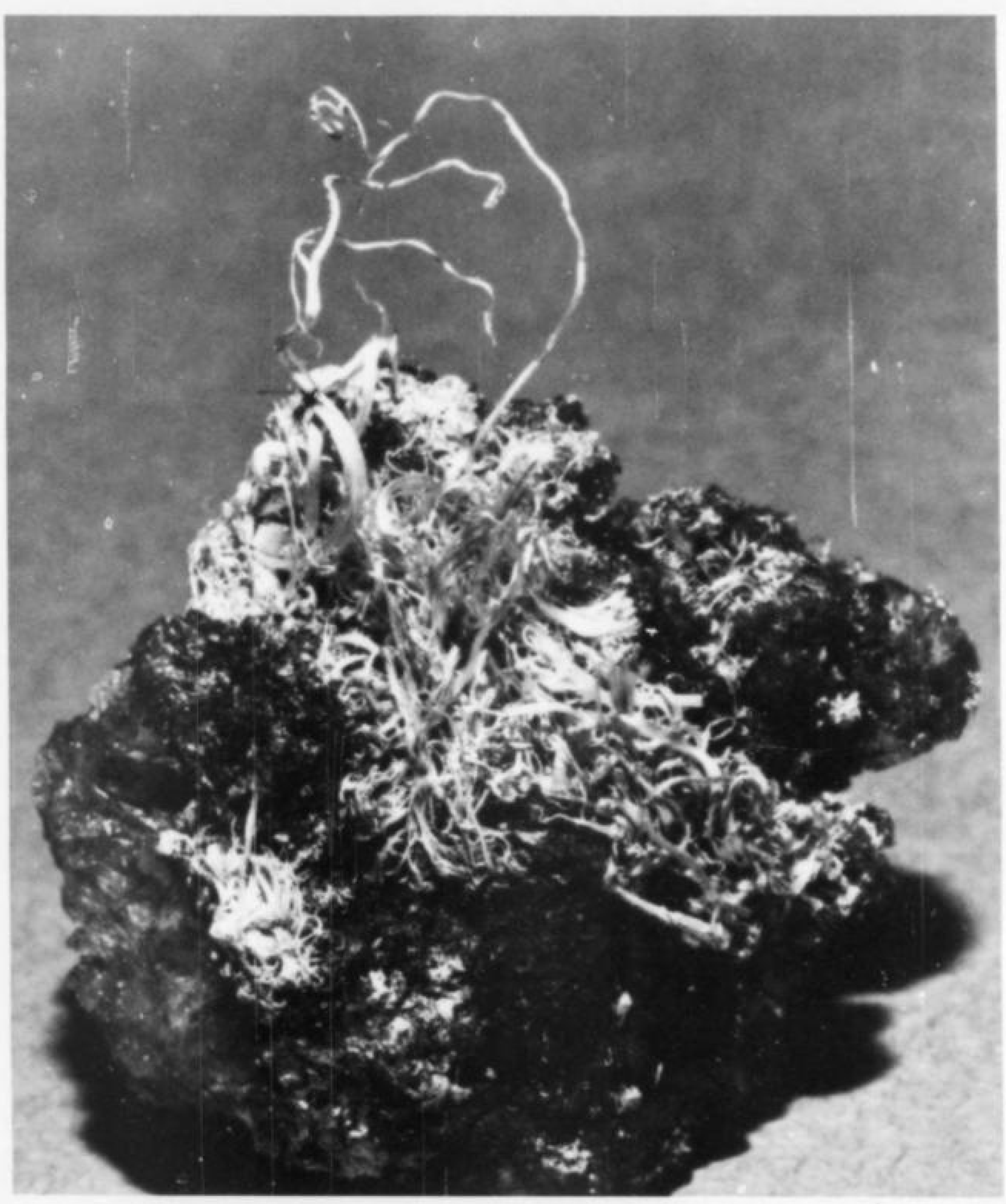


Figure 38. (above) **Silver; 2½ X 1¼ inches; Molly Gibson mine, Aspen, Pitkin Co., Colorado; specimen: Denver Museum of Natural History.**

Figure 39. (above right) **Silver; 4 X 5½ X 8 inches; Smuggler mine, Aspen, Pitkin Co., Colorado; specimen: Kurt Bresnitz.**

Figure 40. (right) **Barite on quartz; 7 X 10 inches (largest crystal is 6 inches, doubly terminated); Bulldog mine, Creede, Mineral Co., Colorado; specimen: R.A. Kosnar.**

Figure 41. (bottom right) **Silver on pyrargyrite and quartz (amethyst); 2 X 2 inches; Bulldog mine, Creede, Mineral Co., Colorado; specimen: R.A. Kosnar.**

mines are located within a volcanic caldera in Precambrian rocks. Many mines produced splendid crystals of gold, silver, and nickel tellurides. The famous Cresson vug produced fine crystals of calaverite, krennerite, sylvanite, and some melonite along with a few other telluride minerals.

GUNNISON COUNTY

A few small mining districts in northern Gunnison County produced crystallized mineral specimens. Gemmy blue, 1 inch crystals of anatase have been obtained from the Cebolla gold district. The **Vulcan mine** was the principle gold producer in the area.

At Crested Butte the **Keystone mine** produced large plates of 5/8 inch pyrite cubes.

SAGUACHE COUNTY

Returning to the Arkansas Valley and proceeding southward over Poncha Pass into South Park one approaches the extreme northeastern part of the San Juan volcanic region. The Bonanza mining district is located in a caldera in this area; most of the rocks are a quartz latite porphyry or rhyolite.

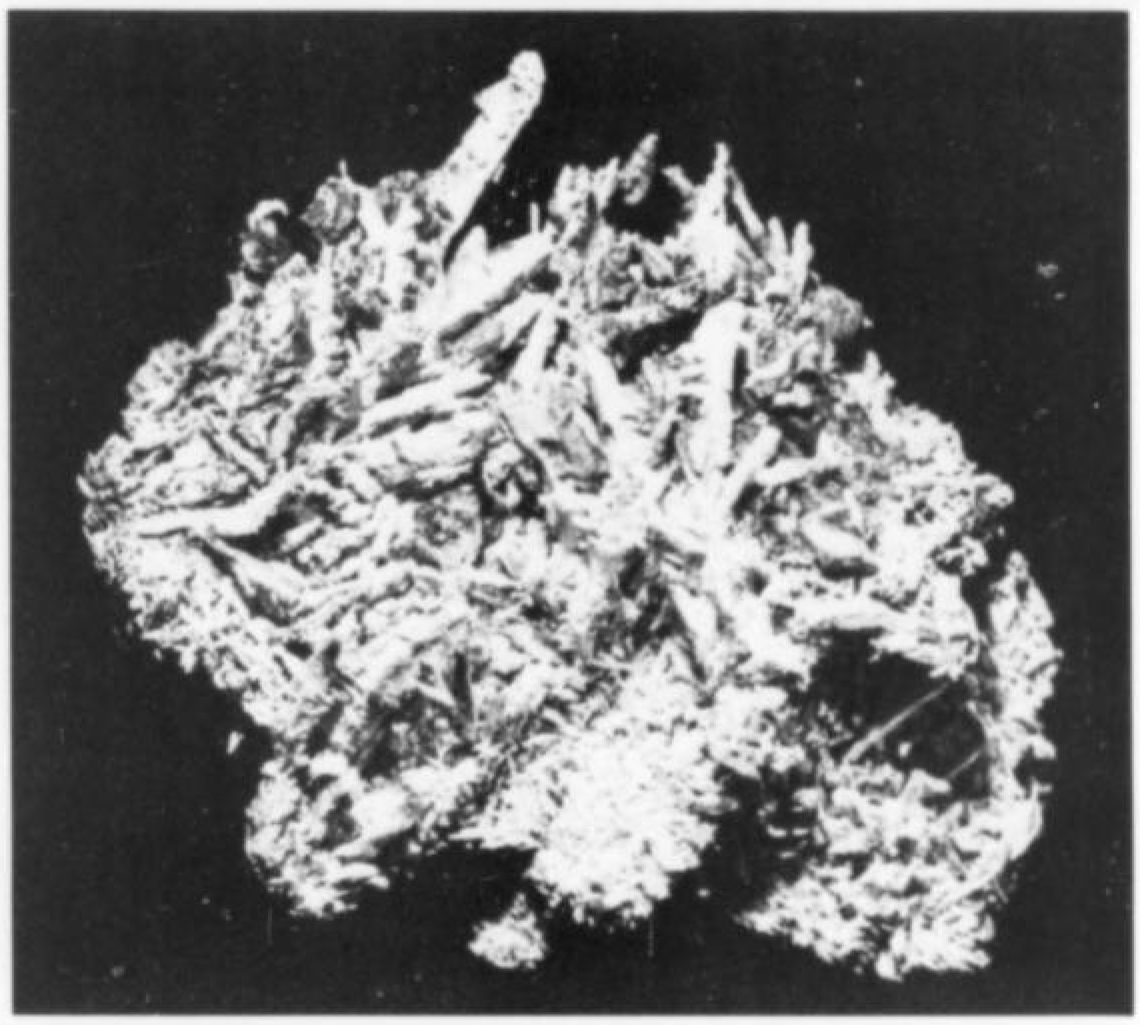


Figure 42. (above) **Galena with sphalerite (gemmy); 3 X 4½X 7 inches; OH vein, #18 raise, 5th level, Commodore mine, Creede, Mineral Co., Colorado; specimen: Hal Miller; photo: Gordon Sweeney.**

Figure 43. (left) **Silver; 3 X 4½ X 5¼ inches, 47.71 oz. troy; Commodore mine, Creede, Mineral Co., Colorado; specimen: Denver Museum of Natural History.**

Figure 44. (below) **Creede, Mineral Co., Colorado; photo: Hal Miller.**

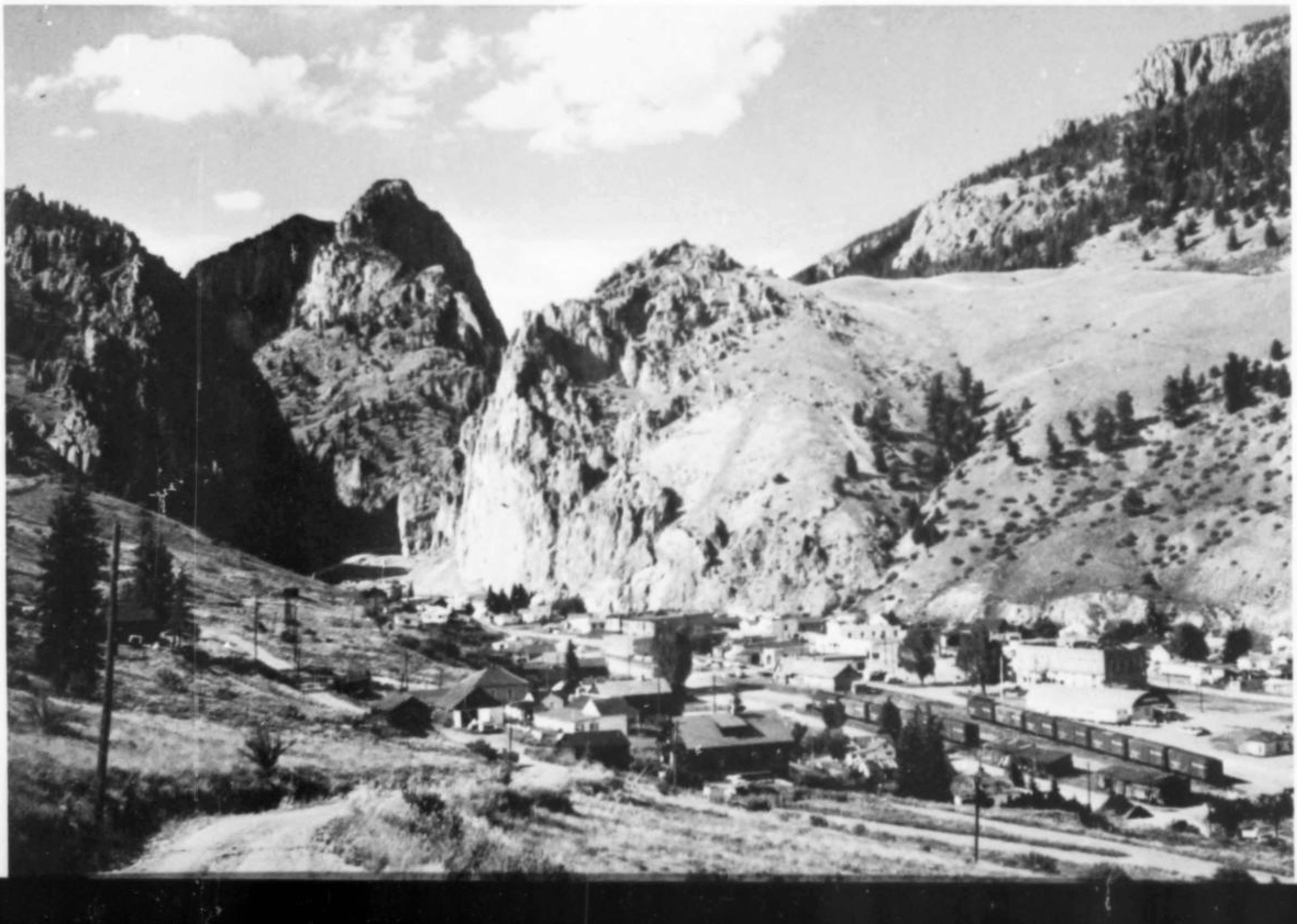
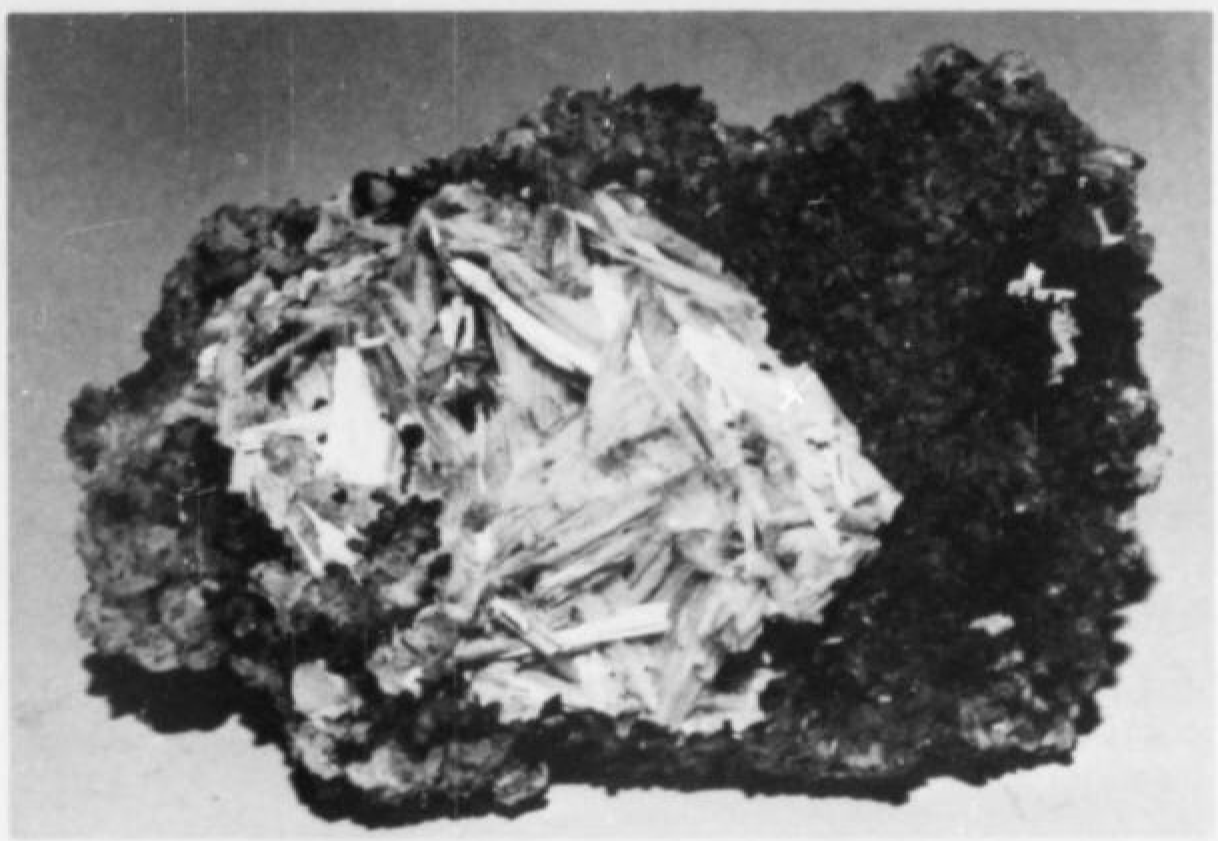


Figure 45. (right) **Cerussite on quartz; 3 X 4½ inches; Amethyst lode, Creede, Mineral Co., Colorado; specimen: R.A. Kosnar.**

Figure 46. (below right) **Covellite (pseudomorphs after chalcocite) on latite breccia; covellite crystals are ⅝ inch; Little Annie vein, Summitville, Rio Grande Co., Colorado; specimen: William Bird; photo: Gordon Sweeney.**

Figure 47. (bottom) **Silverton, San Juan Co., Colorado; photo taken from the mouth of Cement Creek, looking southeast; photo: Hal Miller.**



This area is known for the occurrence of the rare telluride minerals, rickardite and empressite, as well as for rhodochrosite. Slightly warped rhombohedra of deep pink or rose color are found only in some of the veins in the southern part of the district. In both the Eagle vein and the Rhodochrosite vein of the **Express mine**, green octahedral fluorite crystals are commonly associated with the rhodochrosite. In the Clark vein of the **Rawley tunnel** nearly pure rhodochrosite occurs associated with manganocalcite. Occasional small vugs in the ore of the **Eagle mine** contain many small prismatic crystals of red pyrargyrite perched on rhodochrosite crystals. Wire silver also occurs with the rhodochrosite.

RIO GRANDE COUNTY

Proceeding in a southwesterly direction to Del Norte and from there about 30 miles south, over unimproved roads, the **Summitville district** is reached. The major mines are located in the Summitville caldera; the rock type there is a quartz latite. Summitville was a large producer of gold. Placers in the area produced nuggets up to 2 ounces in weight and recently a 150-pound rock was found alongside the road which contained about

350 troy ounces of native gold. The region has produced small, bright blue covellite crystals on a latite matrix, covellite pseudomorphs after chalcocite crystals, and small enargite crystals.

MINERAL COUNTY

Returning to Del Norte and thence 40 miles in a north-westerly direction, the silver camp of **Creede** is reached, Creede is also located in a caldera; the rocks for the most part are rhyolite ash flows and tuffs.

Many fine mineral specimens have been taken from this area. Spectacular specimens of wire silver are common. The most recent specimens were obtained from the **Bulldog mine**. Frequently the wire silver specimens occur with argentite and are on a matrix of amethyst quartz crystals. Fine white cerussite crystals on a quartz crystal matrix came from the amethyst lode, and a superb matrix specimen of doubly terminated barite crystals up to 6 inches long (Fig. 40) have been mined recently from the Bulldog mine. Pyrargyrite crystals (Fig. 41) have also been mined from the Bulldog vein. Very fine, large groups of 1 inch cubic galena crystals were common in the **Bachelor mine**. The finest specimens of galena and sphalerite mined so far in the state of Colorado came from the No. 18 raise of the OH vein in the **Commodore mine** (Fig. 42). One fine specimen consists of galena cubes up to 2-1/2 inches on an edge and mirror bright, sharp, black sphalerite crystals to 2 inches. The Commodore mine has also produced matrix specimens of bright green, trans-

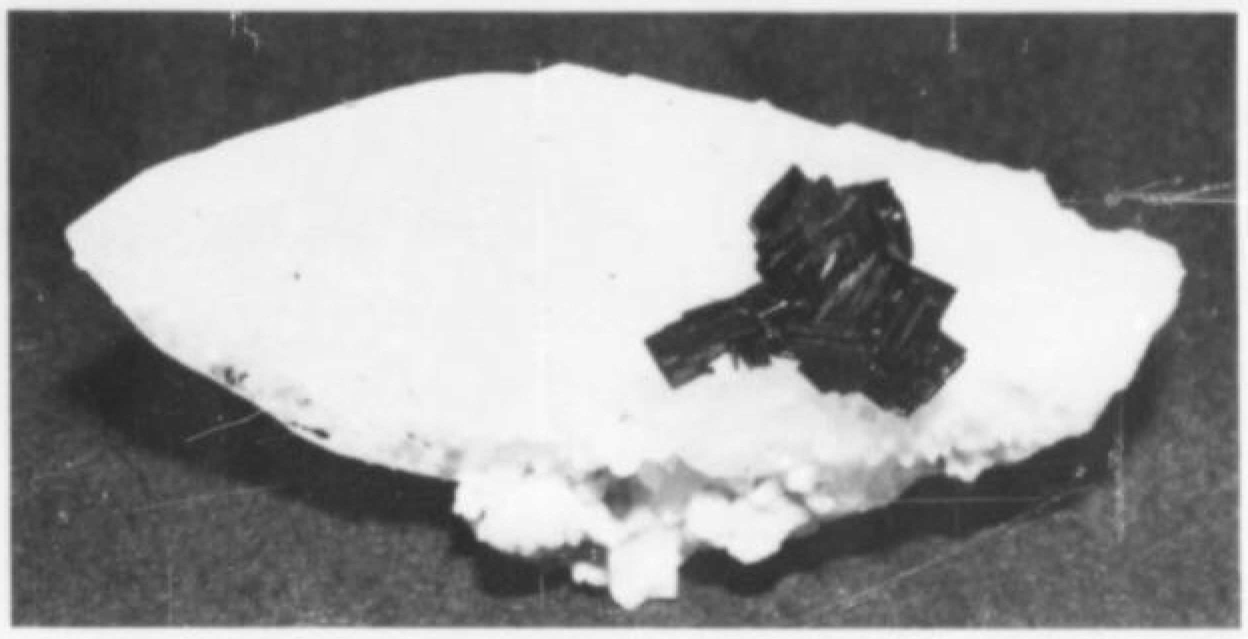
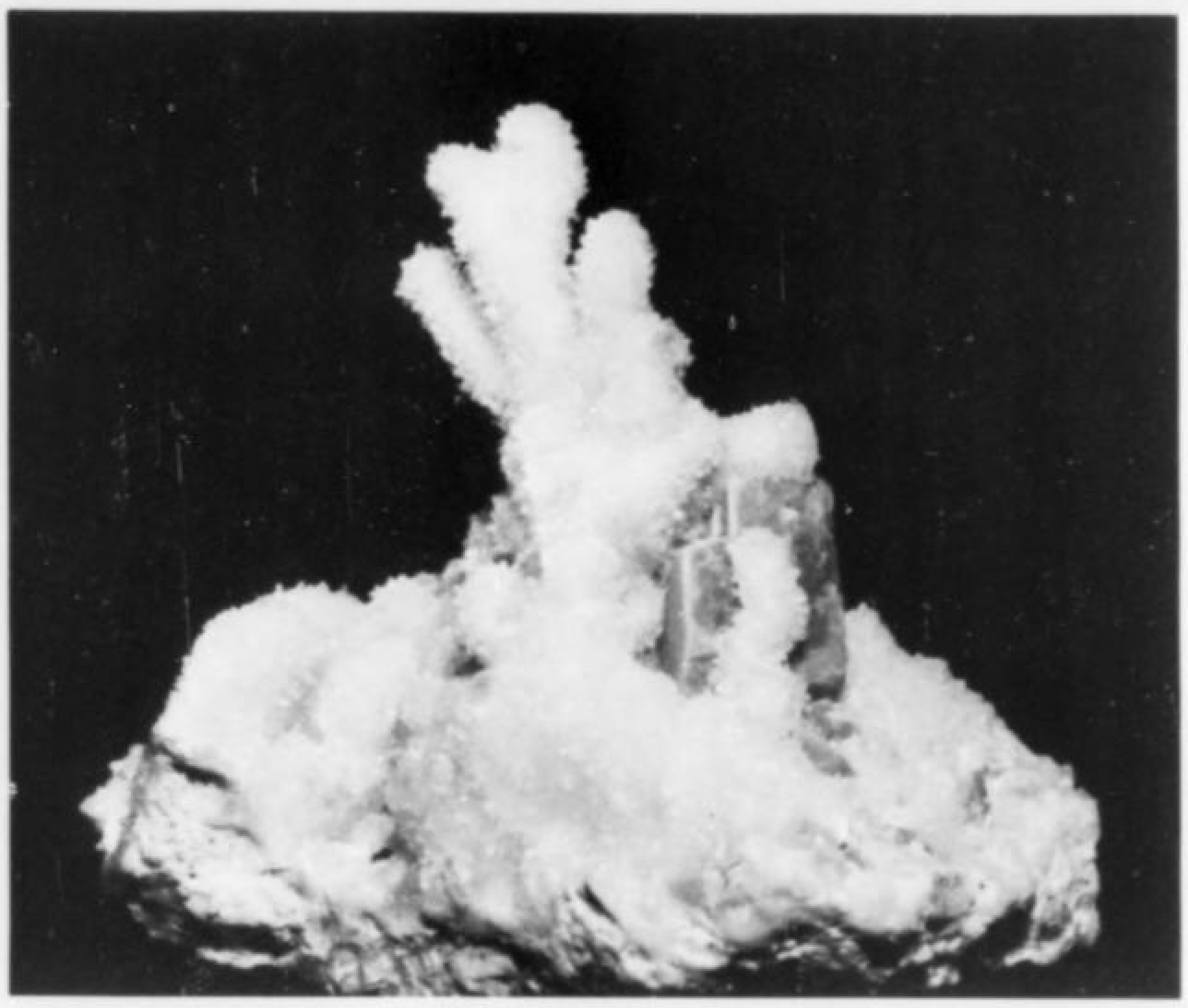


Figure 48. (above right) **Wolframite on quartz; 1 X 2 inches; Kitti Mack mine, Middleton, San Juan Co., Colorado; specimen: R.A. Kosnar.**

Figure 49. (above) **Chalcopyrite with galena (cubo-octahedrons) and sphalerite (spinel law twins); 2 X 2 inches; "B" drift, Osceloa mine, Cunningham Gulch, San Juan Co., Colorado; specimen: R.A. Kosnar.**

Figure 50. (below) **American Tunnel mine near Gladstone, San Juan Co., Colorado; photo: Hal Miller.**



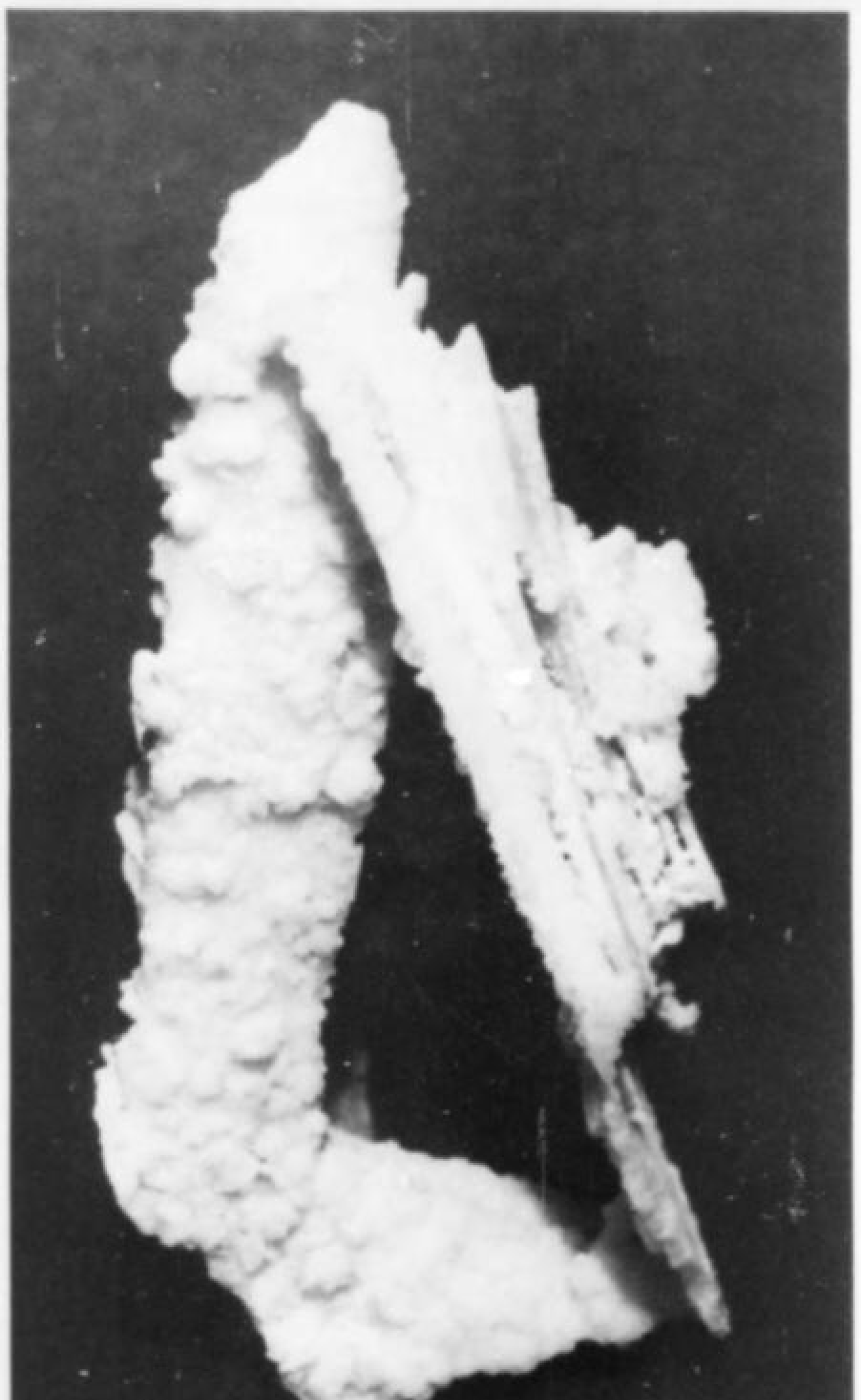


Figure 51. (above left) **Quartz (drusy) coating pyroxmangite, with rhodochrosite; 3 X 3½ inches; American Tunnel mine, Gladstone, San Juan Co., Colorado; specimen: Linda Kosnar.**

Figure 52. (left) **Quartz molds of dissolved anhydrite crystals, with small crystals of rhodochrosite and fluorite; 1¾ X 3¾ inches; specimen: Linda Kosnar.**

Figure 53. (bottom left) **Hübnerite in quartz; 4 X 5 inches; Adams mine, Bonita Mountain, Gladstone, San Juan Co., Colorado; specimen in the collection of Hal Miller at the time photo was taken, but later sold to Martin Ehrman; photo: Charles McMullen.**

Figure 54. (above right) **Fluorite (lilac) on tetrahedrite with enargite; 1½ X 2¼ inches; North Ore Body, Longfellow mine, Red Mountain Pass, San Juan Co., Colorado; specimen: R.A. Kosnar.**

parent sphalerite crystals up to ½ inch in diameter. Atractice amethyst quartz crystals in large groups are common. The district is also known for groups of ½-inch, white creedite crystals, and is the type locality for creedite.

HINSDALE COUNTY

The **Lake City mining district** is located about 40 miles to the northwest of Creede and at the foot of Slumgullion Pass. This mining district is entirely within the Lake City caldera; the rock types are primarily rhyolites and latites. Most of the mines are at altitudes of about 11,000 feet on the lower slopes of the mountains.

The ore of the **Golden Fleece mine** contained krennerite, sylvanite, and petzite as well as free gold. Fine, ½-inch blue-gray crystals of hinsdalite occurred on a galena matrix. Pale pink rhodochrosite rhombohedra, up to 1 inch on an edge, frequently associated with freibergite, occurred in the **Hidden Treasure**, **Ute and Ulay**, **Monte Queen**, and **Black Crook mines**. Unfortunately, the rhodochrosite from this area bleaches on exposure to sunlight.

SAN JUAN – SAN MIGUEL – OURAY COUNTIES

For the sake of convenience the **Silverton mining district**, located in the western portion of the San Juan mountains, will be considered to include portions of San Juan, San Miguel, and Ouray Counties. This intensely mineralized area encompasses the most rugged mountain topography in the state of Colorado. The San Juan volcanic region contains 12,000 square miles of precipitous mountains with 14 named peaks above 14,000 feet and hundreds above 13,000 feet.

The shortest distance between Lake City and Silverton (Fig. 47) is by way of Cinnamon Pass to Animas Forks. The road is steep and dangerous, requiring four wheel drive, and rises to an altitude of over 13,000 feet at the pass.

Figure 55. (left) **Enargite on quartz with pyrite; 1⅛ X 1⅜ inches (large crystal is ½ X ⅝ inches); North Ore Body, Longfellow mine, Red Mountain Pass, San Juan Co., Colorado; specimen: R.A. Kosnar.**

Figure 56. (below) **Campbird mine, 4.5 miles south of Ouray, Ouray Co., Colorado; 1976 photo.**

The **Silver Wing mine** is about 2 miles south of Animas Forks, downstream on the Animas River, in Burns Gulch. This mine has produced spectacular specimens of large bright tetrahedrite crystals. Continuing south for another 2 miles, Minnie Gulch is reached. The **Kittie Mac mine** is located at an altitude of about 12,000 feet, about 2 miles up the gulch. Fine specimens of 1/2 inch, brilliant black wolframite crystal (Fig. 48) sprays on white downstream on the Animas River, in Burns Gulch. This mine has produced spectacular specimens of large bright tetrahedrite crystals on a matrix of milky white quartz and black sphalerite quartz and often associated with yellow, needle-like crystals of tungstite have been mined here. Another mile down the Animas River and Maggie Gulch can be seen to the east. The **Ruby mine** is about 1 mile up Maggie Gulch. This mine has produced nice, 1/2 inch, gemmy red hübnerite crystal sprays on white quartz. At the ghost town of Howardsville, which is another 2 miles downstream, a fork in the road to the southeast leads to Cunningham Gulch. About 2 miles up the gulch a four wheel drive traverses the precipitous slopes of Galena Mountain and dead ends at the **Buffalo Boy mine**.

A specimen of 1/2 inch thick crystals, tentatively identified as pyrargyrite, was seen recently in the office of the Buffalo Boy mine. The vein system contains high grade areas of proustite, pyrargyrite, and polybasite and although no large crystals have been produced as yet the potential of breaking into a crystal-lined vug is very good. Crystals seen in micromount size in the ore have been: brilliant black dodecahedra of argentite, bright red proustite and pyrargyrite, bright hexagonal polybasite and also native gold and wire silver.

The **Osceola mine** is about 1/2 mile farther up Cunningham Gulch. This mine has produced nice groups of galena, sphaler-

Figure 57. (above right) **Chalcopyrite and sphalerite with quartz; 1½ X 2 inches; 400′ stope, 2100′ level, Campbird mine, Ouray Co., Colorado; specimen: R.A. Kosnar.**

Figure 58. (right) **Chalcopyrite with sphalerite and calcite; 2 X 2 X 2 inches (largest crystal is 1¼ inches); 600′ stope, 2100′ level, Campbird mine, Ouray Co., Colorado; specimen: R.A. Kosnar.**

Figure 59. **Galena with chalcopyrite and quartz; 1¼ X 2 inches; 2100′ level, Campbird mine, Ouray Co., Colorado; specimen: R.A. Kosnar.**

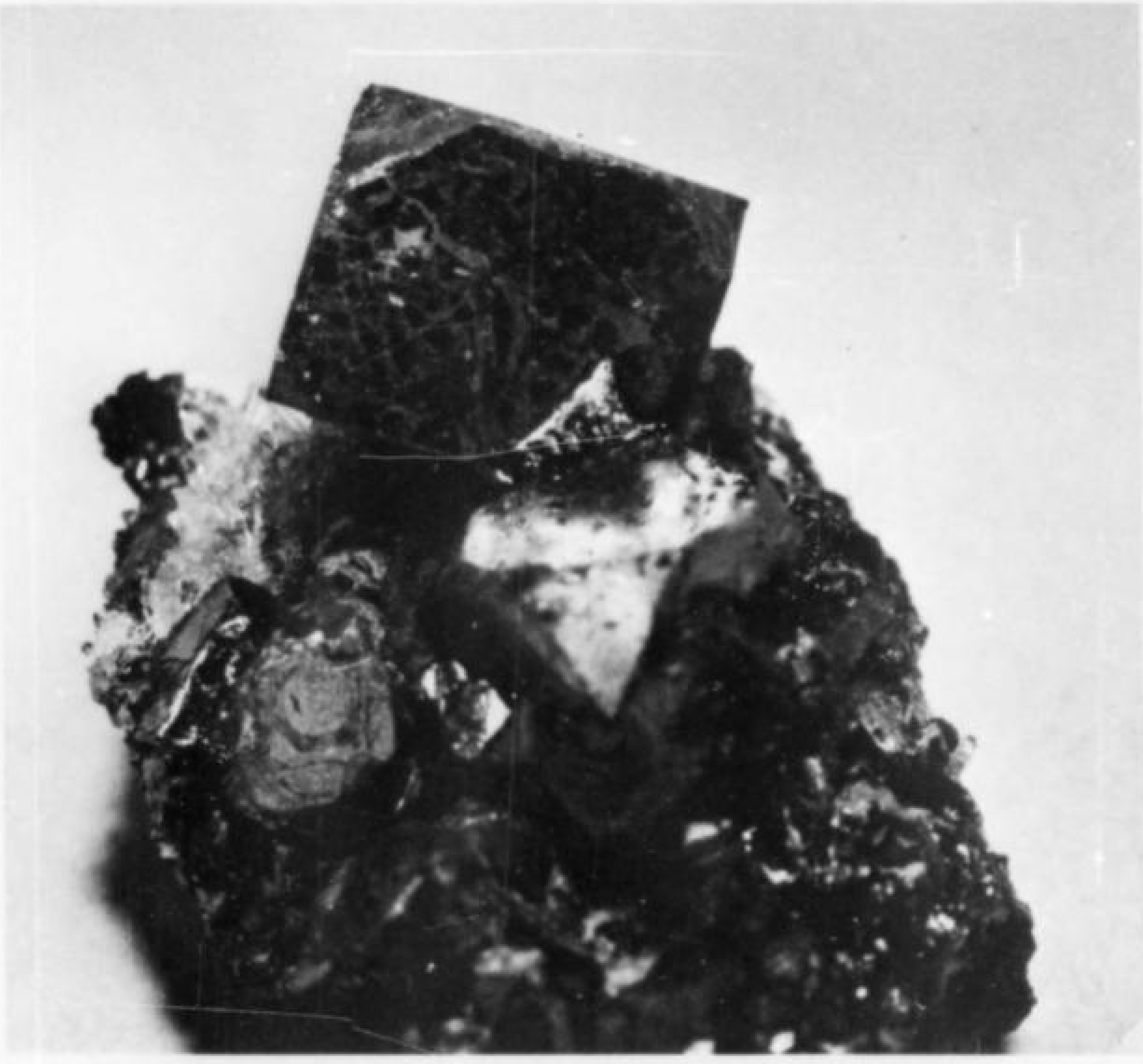


Figure 60. **Pyrite with calcite; 1¾ X 2¾ inches; 400′ stope, 2100′ level, Campbird mine, Ouray Co., Colorado; specimen: R.A. Kosnar.**

ite, chalcopyrite, and quartz crystals (Fig. 49).

Returning to the Animas River canyon and proceeding another 4 miles downstream, the city limit of Silverton is reached. A right turn and a 6 mile drive up Cement Creek brings one to the **Galena Queen mine**. This mine has produced groups of bright, 3 inch galena cubes on a matrix of milky white quartz crystals.

About 1 mile farther up Cement Creek, near the old ghost town of Gladstone, is the portal to the **American Tunnel mine** (Fig. 50). This mine has been a producer of much spectacular specimen material.

Thousands of rhodochrosite specimens have been mined from the lower workings. Nearly all of the specimens of rhodochrosite are on a matrix of drusy milky white quartz, but occasionally the matrix is sphalerite or rhodochrosite. The crystal forms observed include various types of rhombohedra; the colors range from pale pink to a deep gemmy red (Fig. 6, 71, 72), and the sizes of the individual crystals range from 1/8 inch to 3 inches. Occasionally green fluorite cubes or octahedra are associated with the rhodochrosite. Specimens of rhodochrosite associated with 1/2 inch chalcopyrite crystals and even with tetrahedrite crystals have also been found. This mine has been, without doubt, the most prolific producer of good rhodochrosite specimens in Colorado. (For more information on Colorado rhodochrosite see the article by one of the authors [H.M.] in *M.R.* **2**, p. 105. *Ed.*)

Large groups of 1 inch, green fluorite cubes, associated with quartz crystals, were also common in the lower workings, however, splended octahedra and dodecahedra have also been encountered. Rarely, good, gemmy red hübnerite crystals, bright yellow helvite crystals on pink pyroxmangite, gemmy red pyroxmangite crystals, and friedelite crystals are obtained from the workings. The upper workings of the mine are producing many specimens of free gold and although they represent very rich ore they are hardly of interest to the discriminating collector. Occasionally, however, an unusually fine gold specimen is encountered. One such specimen consists of bright gold wires protruding from a group of gold crystals pseudomorphic after petzite (Fig. 9). The crystals are quite large and very sharp; the specimen was obviously formed by the alteration of rich petzite ore to native gold.

About 1 mile north of the American Tunnel portal and on the west slope of Bonita Peak are the **Red Bonita** and the **Adams mines**. These mines have produced large beautiful groups of mahogany-red hübnerite crystals up to 6 inches long and standing upright from a matrix of hübnerite and white quartz (Fig. 53).

Other mines in the area that have also produced good hübnerite crystals are the **Yukon**, the **Anglo Saxon**, and the **North Star mine**, which is on the north slope of Sultan Mountain just southwest of Silverton.

Zuni Gulch is located about 3 miles out of Silverton on the road to Ouray. The **Zuni mine** is located a mile or so up the gulch at an altitude of 12,000 feet. This mine has produced nice groups of small bright enargite and pyrite crystals as well as colorless, tetrahedral crystals of zunyite up to 1/2 inch on an edge.

The **Longfellow mine** is located at the top of Red Mountain Pass between Silverton and Ouray. Fine enargite and tetrahedrite crystals occur here (Fig. 55). Occasionally specimens of crystallized tetrahedrite will be associated with blue fluorite cubes (Fig. 54).

The famous **Campbird gold mine** (Fig. 56) is located a few miles up Canyon Creek from the town of Ouray. This mine has produced many fine crystallized specimens (Fig. 56-62), among which are: quartz, both amethyst and milky, groups of pink

Figure 61. **Chalcopyrite; 1½ X 2 inches; 700′ stope, 2100′ level, Campbird mine, Ouray Co., Colorado; specimen: R.A. Kosnar.**

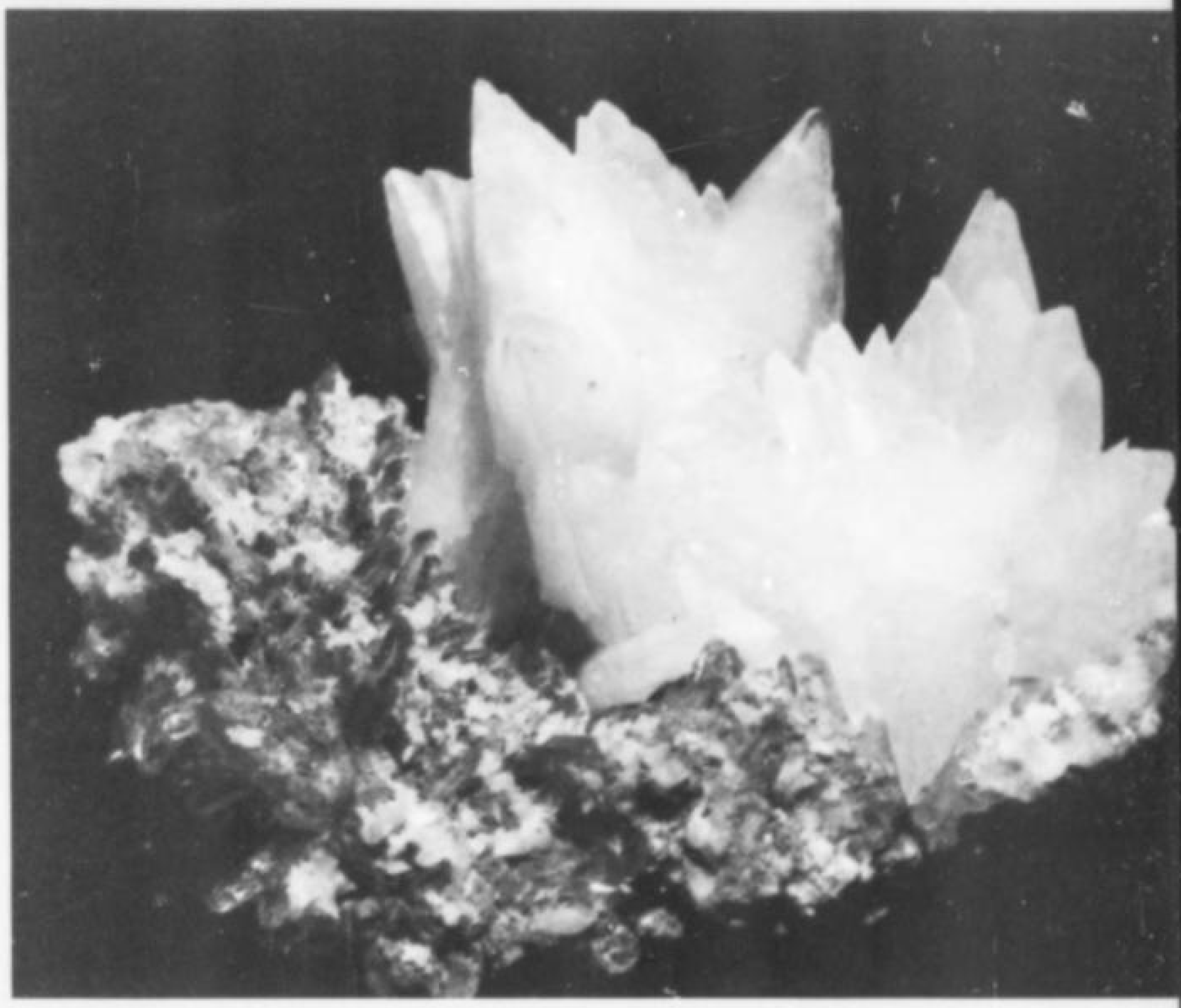


Figure 63. **Manganese-rich calcite ("manganocalcite") on quartz (amethyst); 3 X 4 inches; Idarado mine, Telluride, San Miguel Co., Colorado; specimen: R.A. Kosnar.**

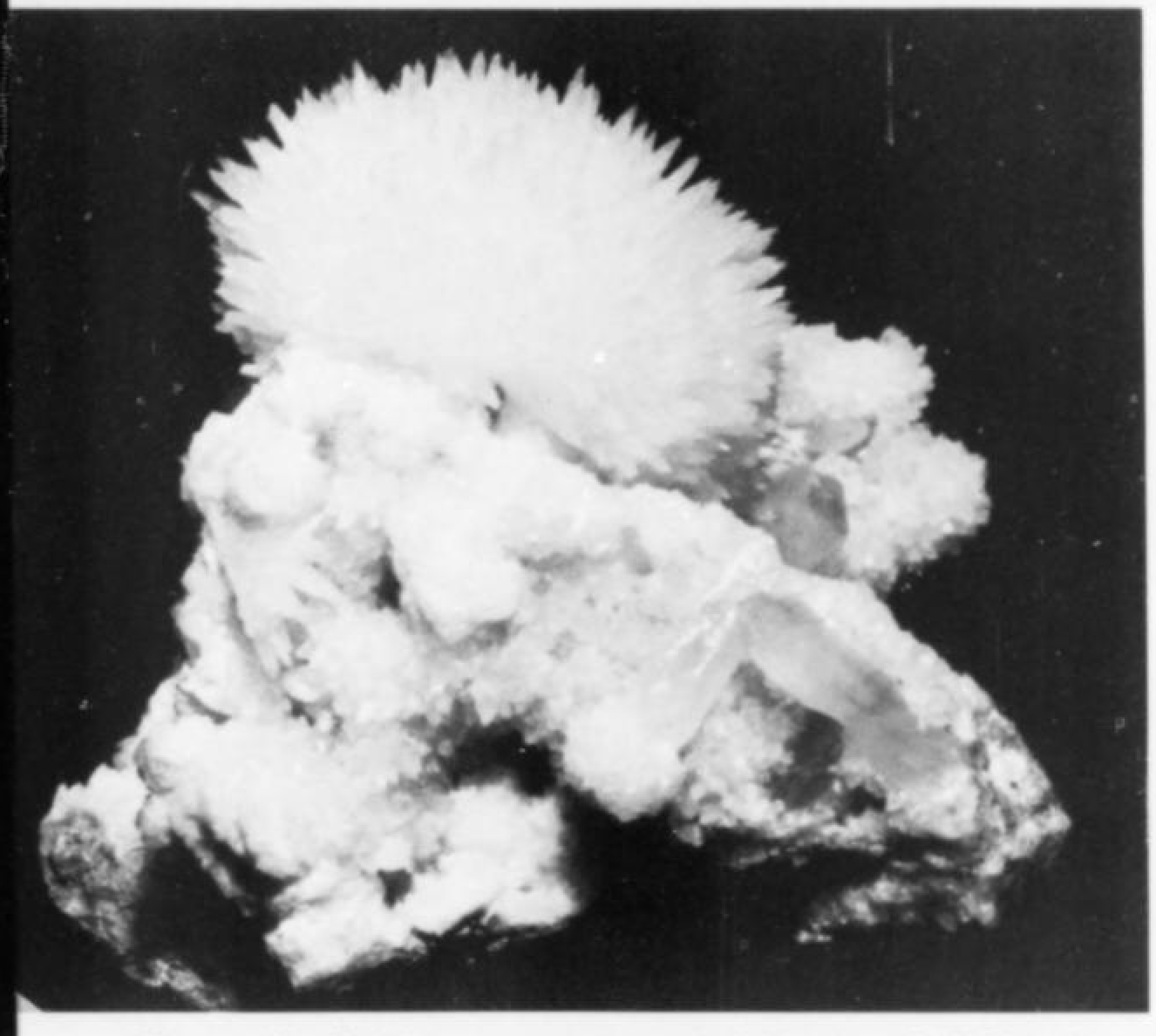


Figure 62. **Calcite on quartz and dolomite; 2 X 2 inches; 2100′ level, Campbird mine, Ouray Co., Colorado; specimen: Linda Kosnar.**

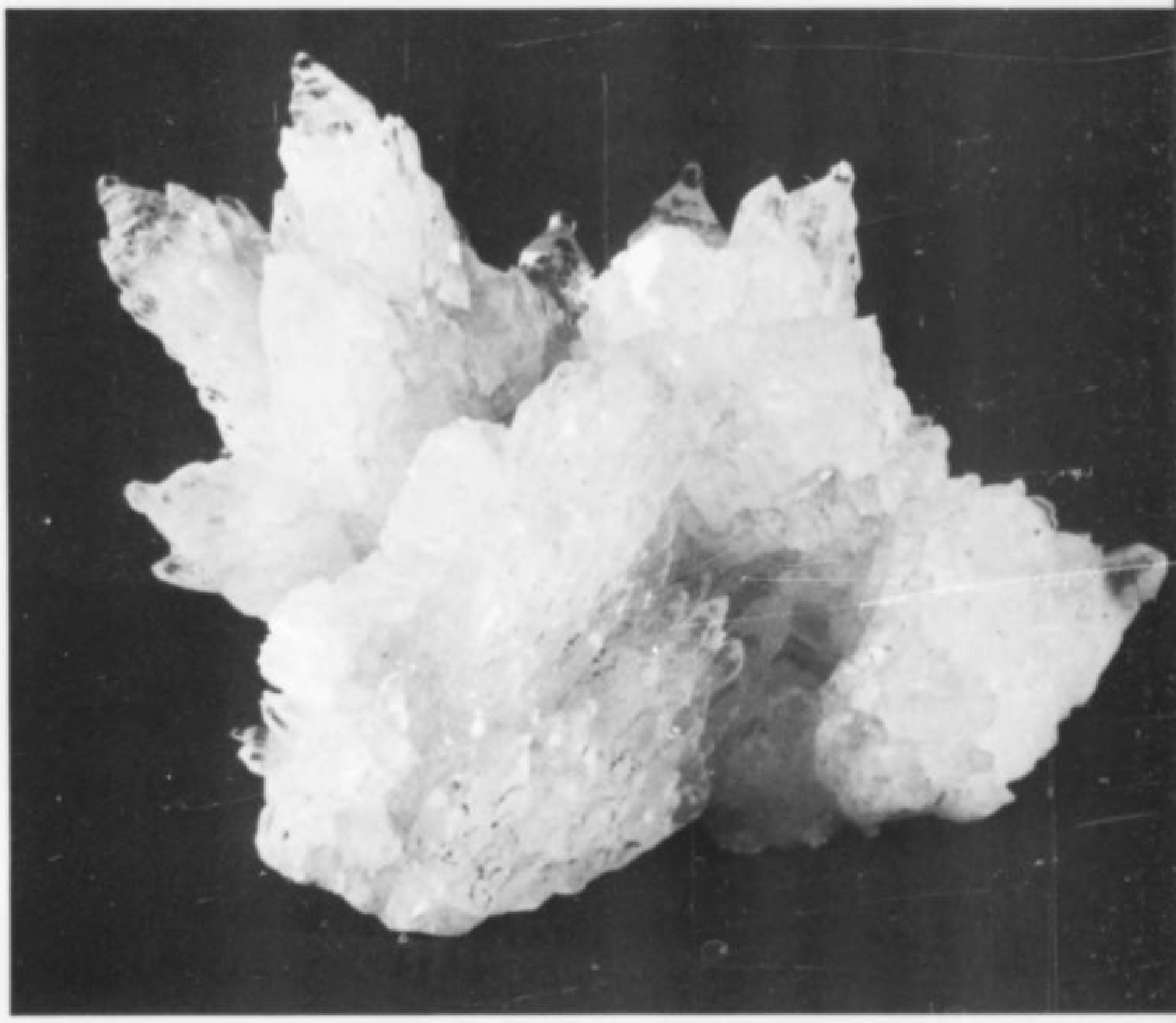


Figure 64. **Quartz ("cathedral" type); 3½ X 4½ inches; Idarado mine, Telluride, San Miguel Co., Colorado; specimen: R.A. Kosnar.**

manganocalcite, dolomite, siderite, pink saddle-shaped rhodochrosite crystals, bladed barite, 2 inch pyrite pyritohedra, 3 inch crude chalcopyrite crystals, 1-1/2 inch galena and sphalerite crystals, and small crystals of argentite, tetrahedrite, gold, epidote, zoisite, and greenockite.

Other mines in the area that have produced good specimens are: **The Mineral Farm** which produced at least one group of brilliant black enargite crystals 3 inches long, and the **Mountain Monarch** and **Silver Bear mines** which have produced gemmy, rose-red, 1/2 inch rhodochrosite rhombohedra.

Figure 65. Calcite (yellow, iron stained); 1¾ X 2½ inches; Idarado mine, Telluride, San Miguel Co., Colorado; specimen: Linda Kosnar.

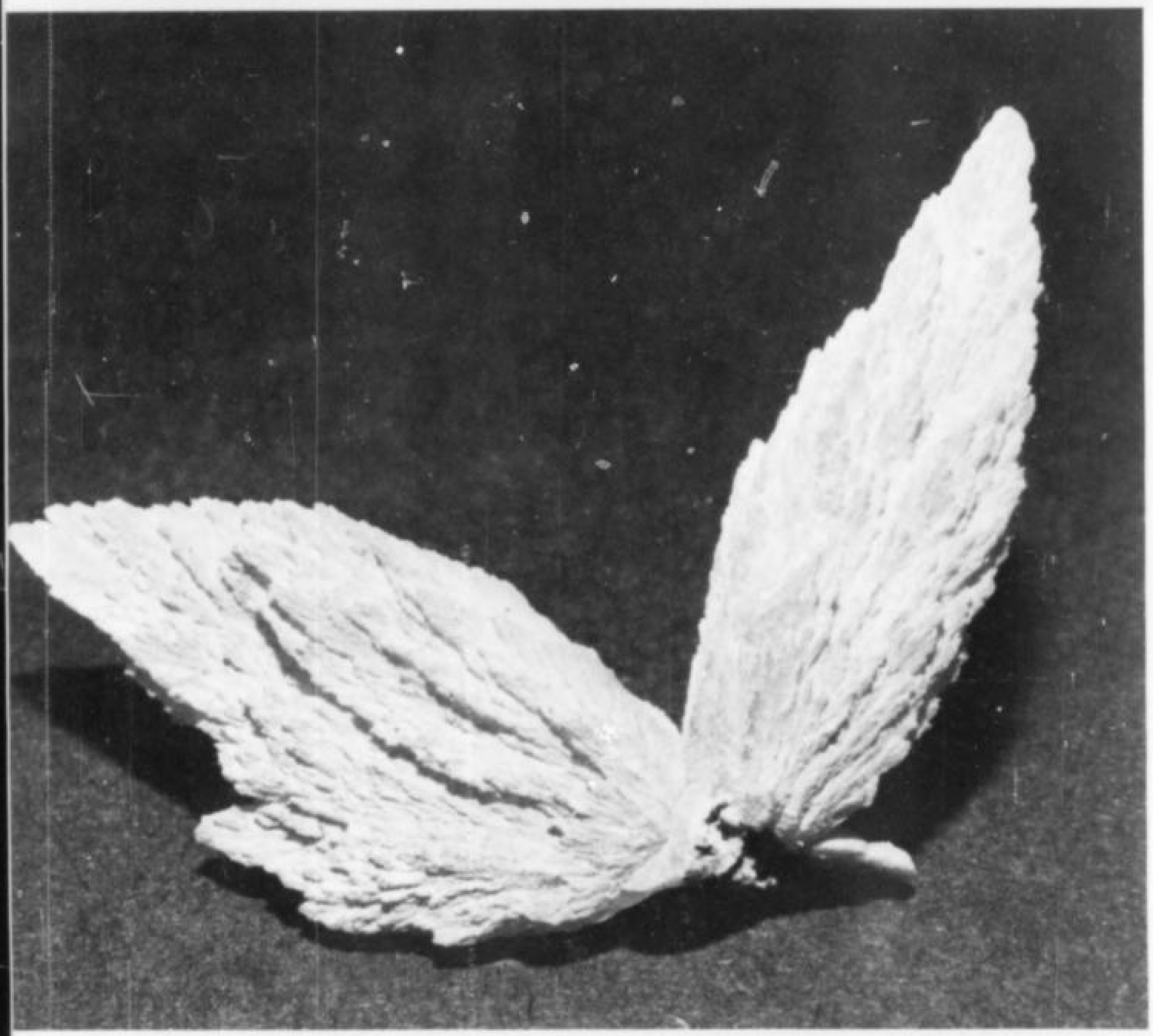
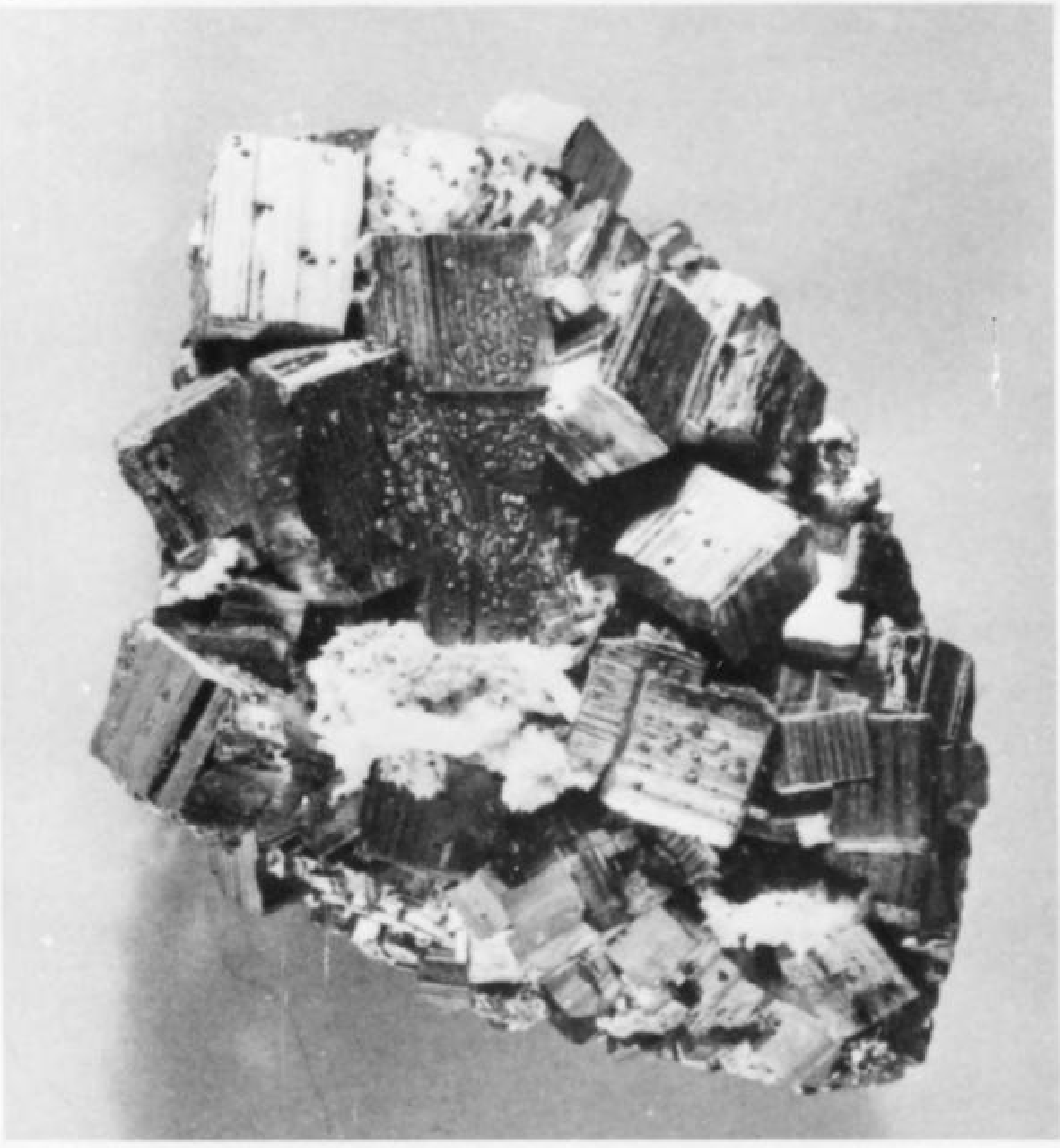


Figure 66. Pyrite with quartz; 3 X 5 inches; Rico Argentine mine, Rico, Dolores Co., Colorado; specimen: Hal Miller; photo: Gordon Sweeney.



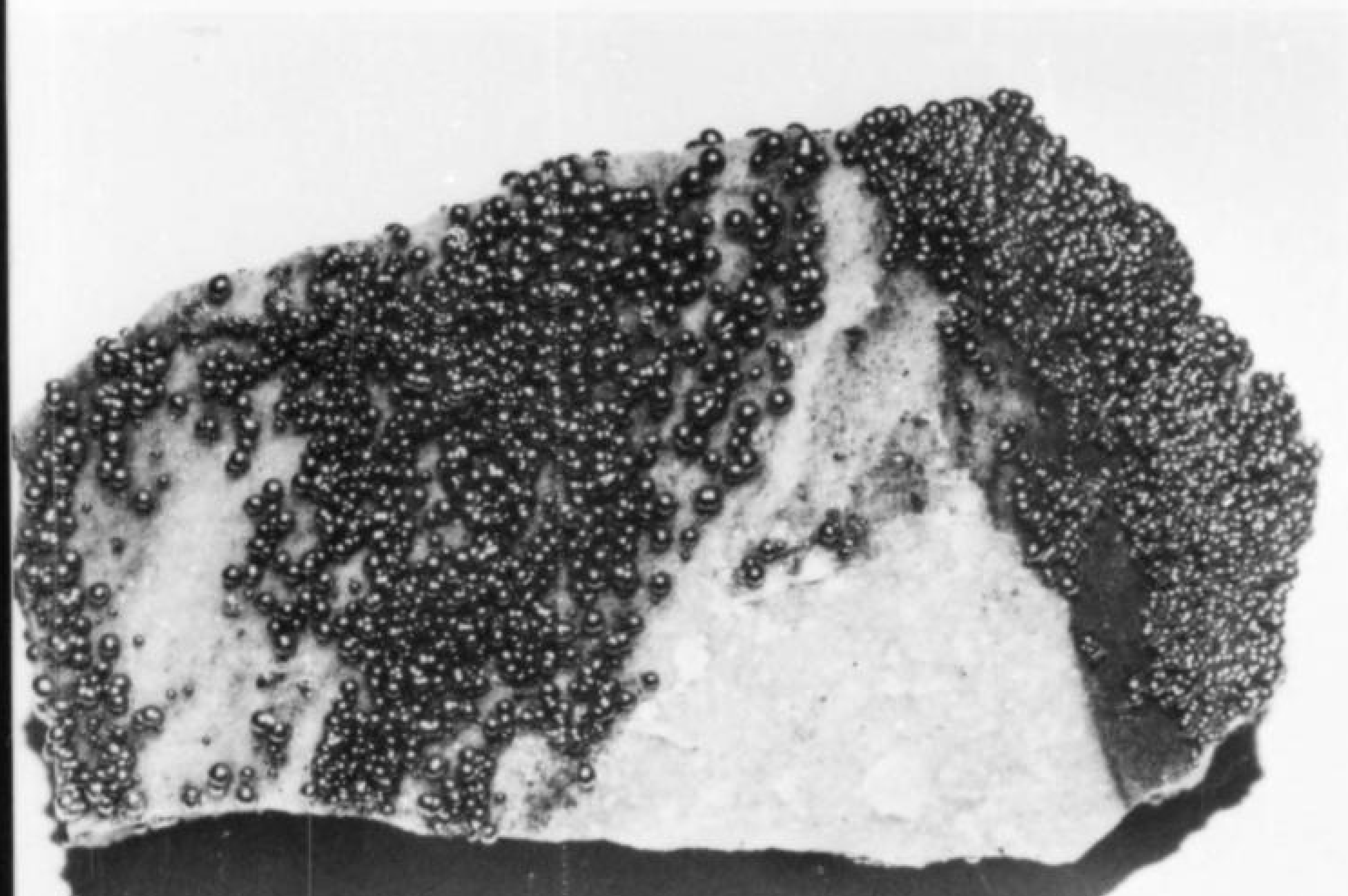


Figure 67. Pyrite (irridescent spheres) on quartz; 1½ X 2½ inches; Mountain Springs mine, Rico, Dolores Co., Colorado; specimen: R.A. Kosnar.

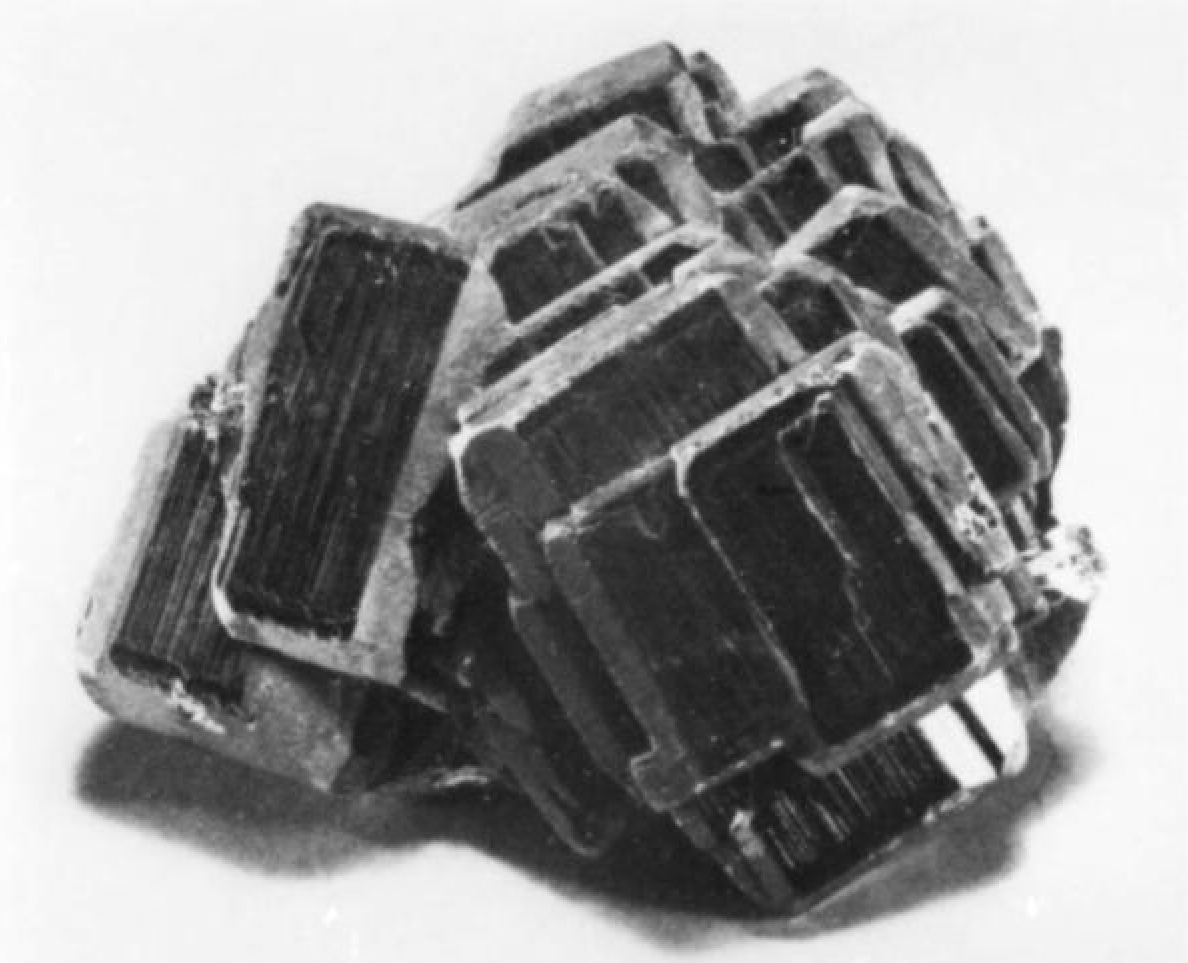


Figure 68. Pyrite; 3 X 3 inches; Mountain Springs mine, Rico, Dolores Co., Colorado; specimen: Hal Miller; photo: Gordon Sweeney.

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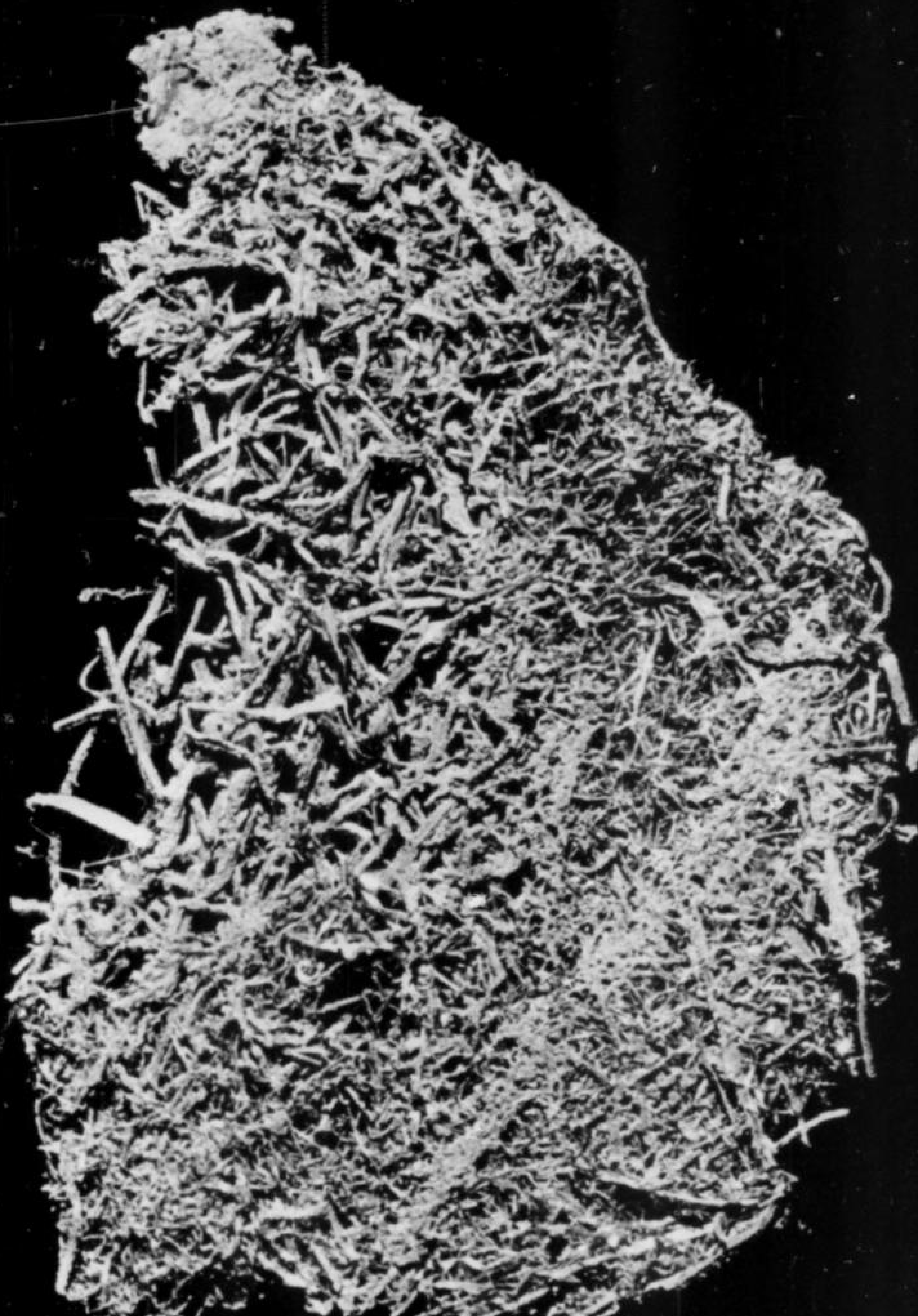


Figure 69. Gold; 3½ X 2¼ inches; Wire Patch mine, Farncomb Hill, Breckenridge, Summit Co., Colorado; specimen: R.A. Kosnar; (purchased at the *Mineralogical Record* Auction, Tucson Show, 1976).

The mining camp of **Telluride** may be reached by proceeding from Ouray to Ridgway, over Dallas Pass to Placerville and thence up the San Miguel River about 20 miles. It is of interest to note that tellurides occur in nearly every mining district in Colorado with the *exception* of the mines in the immediate vicinity of Telluride.

The **Idarado mine** is an excellent producer of crystallized specimens. Specimens which have been obtained in good crystal groups are: quartz, both milky and amethyst, large groups of calcite and pink "manganocalcite" (Fig. 63), good crystals of chalcopyrite, galena, and pyrite, gemmy green epidote crystals on a matrix of quartz and pyrite crystals, dolomite, siderite, and gold as crystals and leaves on white quartz. The mine has also produced a few rhodochrosite rhombohedra on a quartz matrix.

Probably some of the best gold specimens from the San Juan mountains came from the **Tomboy mine** and the **Smuggler mine**, both high above Telluride. The best of these specimens consists of very thick leaves of gold on quartz. The Smuggler mine also produced small, red rhombohedra of rhodochrosite with quartz and sphalerite.

Proceeding from Telluride south towards Lizard Head Pass one comes to the mining camp of Ophir. Nice, ¼-inch, black wolframite crystals on white quartz have been obtained from the **Silver Bell mine** in this district.

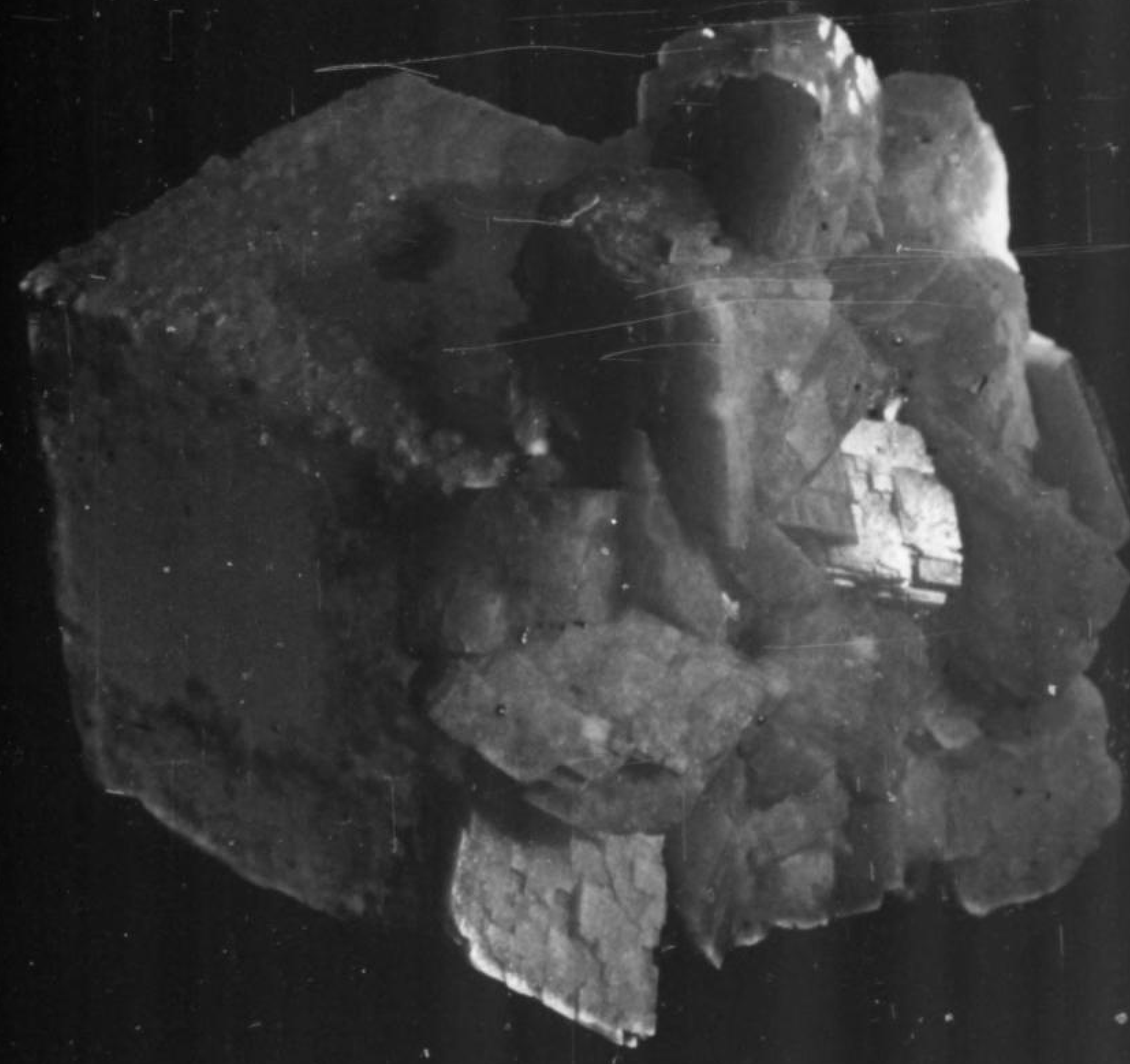
DOLORES COUNTY

The mining camp of Rico is located about 10 miles southwest of Lizard Head Pass. The Rico mining district is in a small group of mountains which are isolated from the main San Juan Mountains to the east. The major mines are in replacement bodies in limestone which have been intruded by a stock of quartz monzonite.

Native silver specimens have been obtained from the **Enterprise mine** as well as from many others. The main specimen value of the district, however, is from the thousands of the fine pyrite groups of cubic, octahedral, and pyritohedral habits along with nu-

Figure 70. **Rhodochrosite on sphalerite; 2½ X 4¼ inches; 1700 level, Eagle mine, Gilman, Eagle Co., Colorado; specimen: R.A. Kosnar.**

Figure 71. **Rhodochrosite, second generation crystals on large rhomb; 2 X 2 X 2¼ inches; American Tunnel mine, Gladstone, San Juan Co., Colorado; specimen: R.A. Kosnar; backlit to show the interior color of the crystals.**



merous modifications of these habits. The **Rico Argentine mine** and the **Mountain Springs mine** were probably the best producers of pyrite specimens (Fig. 66-68).

Many pyrite specimens from this district, coated with a thin blue-gray film, have been sold for years as bravoite on pyrite. Emission spectrographic analysis of this material, however, indicates the presence of copper only. The "so-called" bravoite coating is most probably chalcocite.

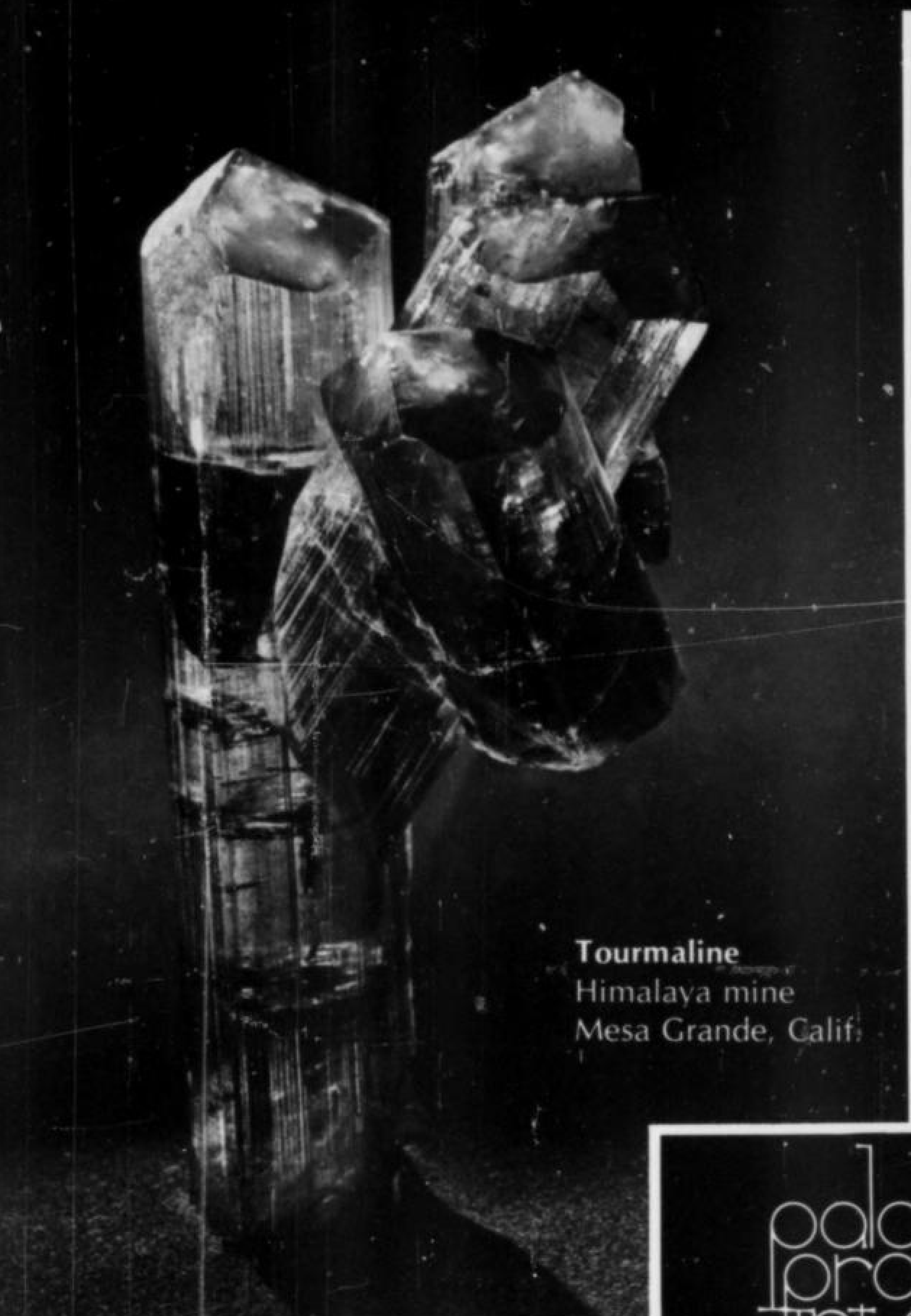
MONTROSE COUNTY

The **Cashin mine**, on La Sal Creek, a tributary of the Dolores River, is worthy of mention. This district is about 50 air miles northwest of Rico. The Cashin is situated high on the sandstone cliffs above La Sal Creek. The ore body is primarily chalcocite but fine large specimens of native copper, native silver, and copper-silver half-breeds have been mined here.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to Jack Murphy of the Denver Museum of Natural History whose enthusiastic cooperation contributed greatly to R. A. Kosnar's ability to examine and photograph a number of important and unique mineral specimen from Colorado. A debt of gratitude is also in order for the research efforts of John Shannon of Northglenn, Colorado, on behalf of R. A. Kosnar. Without these efforts it is conceivable that some of the data herein would not have been available for this report.

Figure 72. **Same specimen as in figure 71; front-lit to show surface color of the crystals.**



Tourmaline
Himalaya mine
Mesa Grande, Calif.

Topaz
Virgem da Lapa
Brazil

What's New in Minerals?

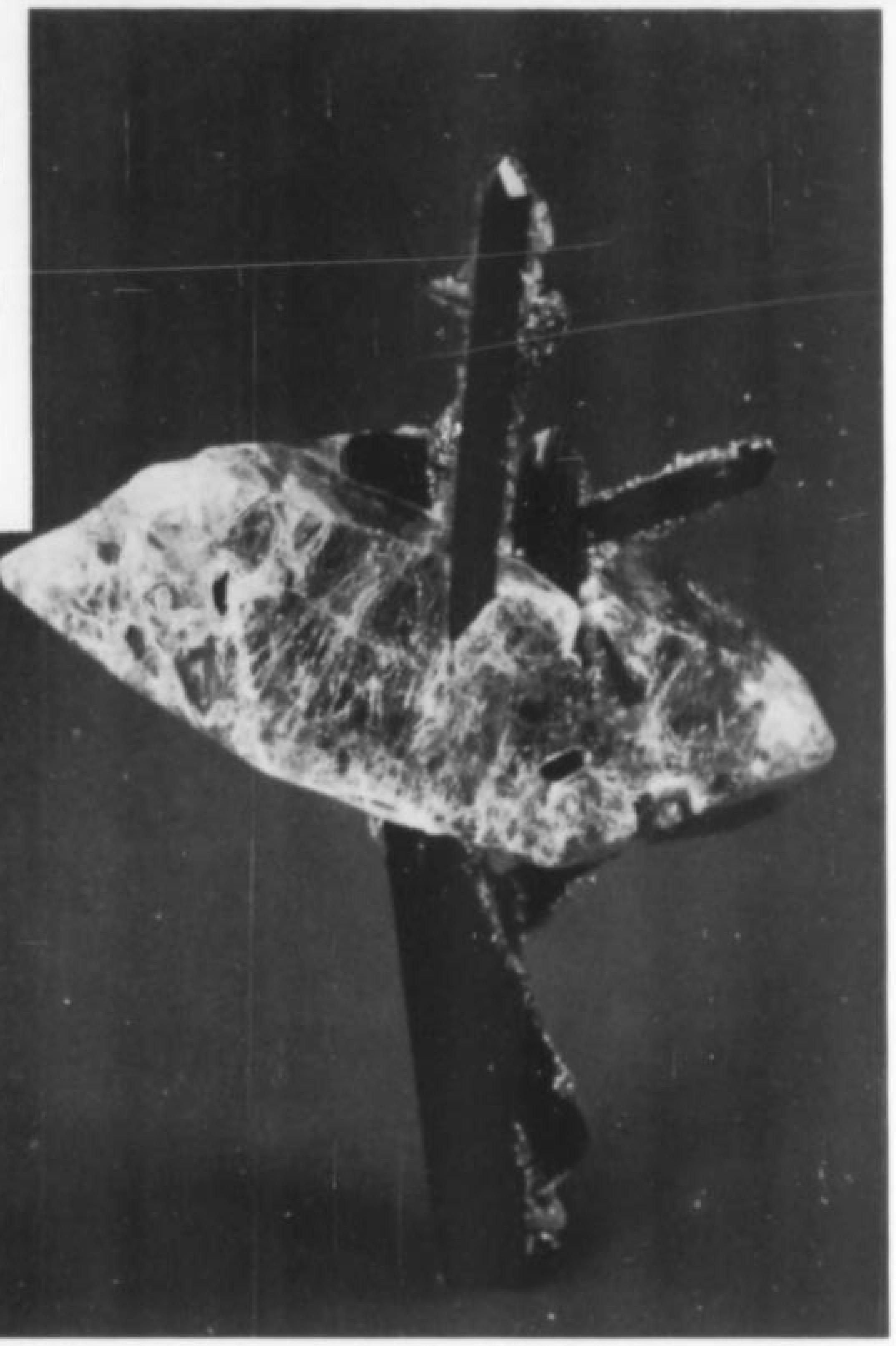
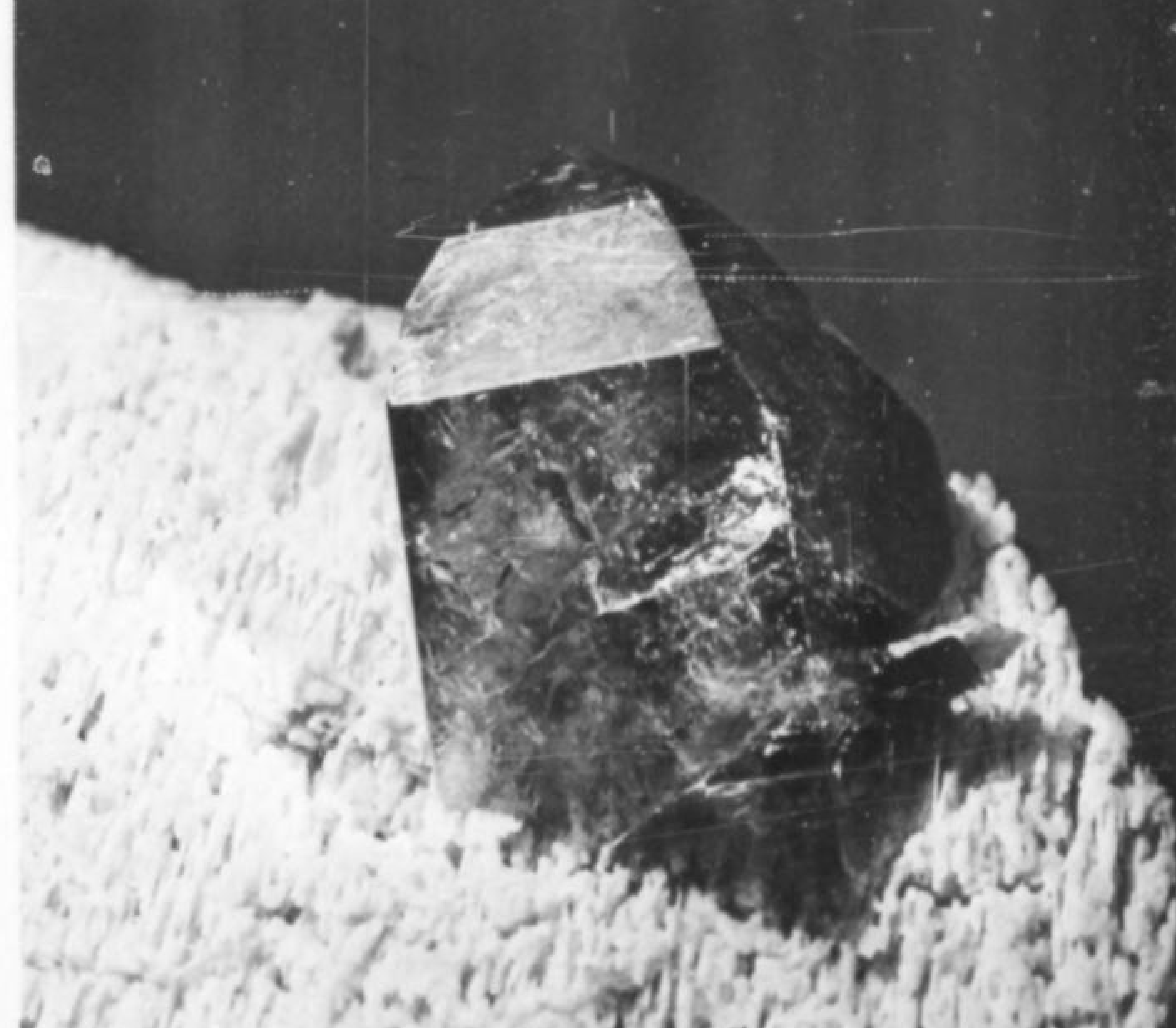


Figure 1. **Doubly terminated herderite crystal, light violet to light blue in color, two inches long, pierced by greenish-blue tourmaline crystals, one of which is also doubly terminated. From the Virgem da Lapa pegmatite, Minas Gerais, Brazil. Jack Lowell specimen and photo.**

Figure 2. **Herderite (2½by 1½inches), rich purple to rich blue in color, with tourmaline on microcline. From the Virgem da Lapa pegmatite, Minas Gerais, Brazil; imported by Jack Lowell, now owned by Richard Kosnar. Photo by Richard Kosnar.**



GREATEST HERDERITE EVER!

It appears that the blue herderite pictured in this column before (v. 7, #3, p. 131) was only the tip of the iceberg. A major strike of herderite, undoubtedly the finest specimens of this mineral ever found anywhere, have recently been brought into this country from Virgem da Lapa, Minas Gerais, Brazil. A sizeable number of specimens are now known. Crystals are often highly fractured but with gemmy areas, well-formed, commonly on a matrix of "honeycomb" microcline, bluish or greenish-black tourmaline crystals, purple lepidolite, or green muscovite. The herderite crystals are often doubly terminated, and range in size from a few millimeters to over 18 cm (7 inches)! Most are under 5 cm in size, however, and the biggest are sometimes not the best colored. Their color ranges from colorless to straw-colored to purple and blue. Crystals in the ½ to 3-inch size are usually the most deeply colored; crystals larger or smaller than that tend to be white or straw-colored. An extraordinary feature of many of these herderite crystals is an alexandrite-like color change: in incandescent light they are pale lavender to violet, and in daylight they are rich blue or greenish blue to a light, celestine blue. These are almost exactly the same colors shown by *synthetic* "alexandrite"! Prices for the larger crystals range up to several thousand dollars, but many miniatures and thumbnails are priced within the reach of the average collector. Jack Lowell is the principle importer of these pieces, but Pala Properties has recently brought in a selection (nothing smaller than cabinet pieces), and Richard Kosnar has a few more, some quite remarkable. The Sklars (Oceanside Imports) also have some, and more were recently (Sept. 15) seen ready for sale in Brazil. See Jack Lowell's ad in the last issue (Colorado Gem & Mineral Co.) for photos of two more of the best pieces.

STEWART MINE REOPENED

Pala Properties has closed the Tourmaline Queen mine in Pala, California, and turned their attention to the equally old and illustrious Stewart mine in the same area. Already pockets have been struck, the first one yielding 50 pounds of tourmaline crystals. The best piece from this pocket was an exceptional six-inch, fine red crystal which ranks as the second best ever found at the mine in its long history. A large number of small pieces should be available, and the last word was that two more pockets had been entered but not yet mined.

Pala Properties associates working Thomas Mountain, Utah, continue to produce very fine topaz crystals, red beryl, pseudobrookite crystals to 1½ inches, and bixbyite crystals to ½ inch. Al Buranek and others are doing the mining. But a more astounding find now in the hands of P.P.I. is a perfect octahedron of nearly flawless diamond (from Sierra Leone) weighing *57 carats* and valued at $100,000. There is a possibility that it will be purchased and donated to the Smithsonian, and then we'll *all* own a piece of it! A similar but smaller Sierra Leone diamond crystal (in John Barlow's collection) was pictured in M.R. 7, n.3, p. 113.

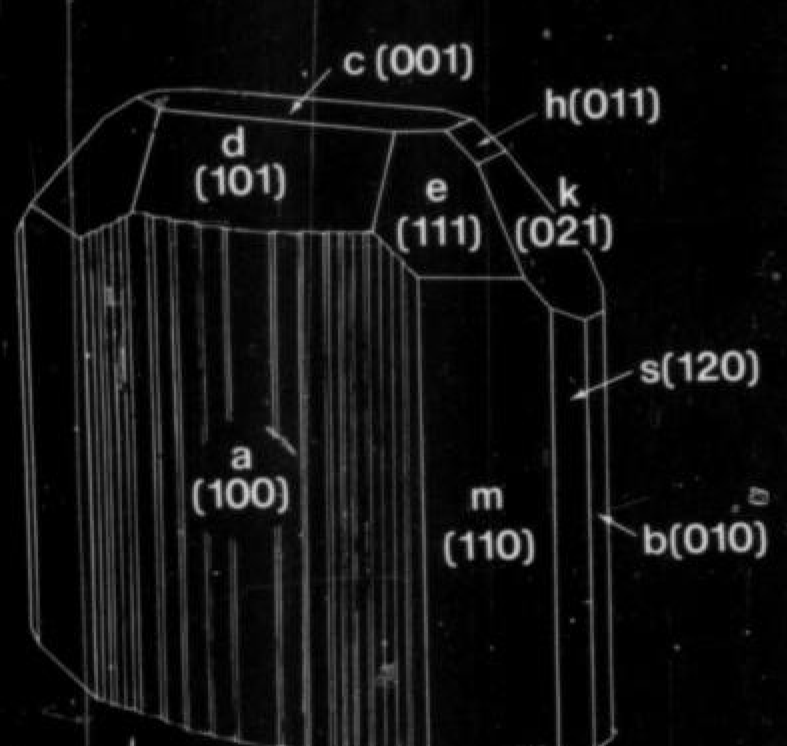
W.E.W.

Famous Mineral Localities:

SAINT JOHN'S ISLAND, EGYPT

by Wendell E. Wilson, P.O. Box 783, Bowie, MD 20715

Figure 1. Forsterite, St. John's Island.



PINACOIDS: a, b, c
PRISMS: d, h, k, m, s
DIPYRAMID: e

Figure 2. Transparent forsterite crystal, 4.6 cm tall, St. John's Island, Egypt. Keith Proctor collection.

INTRODUCTION

For almost every mineral dear to the hearts of collectors there is a "best locality". For olivine that locality is St. John's Island in the Red Sea, off the coast of southern Egypt. Although crystals are very scarce on the market today, tens of thousands of crystals, at the least, have been mined there since ancient times, the bulk of which have undoubtedly been cut and faceted long ago. Nevertheless, uncut crystals represent the ultimate in olivine specimens, and are the prizes of many collections throughout the world. Their fine form, luster, color, clarity, size and hardness make them highly desirable as specimens.

LOCATION AND DESCRIPTION

St. John's Island, also known as Zebirget* (Zeberged, Zabarjad) is located off the Ra's Banas (peninsula) in the Red Sea. The precise location (Fig. 7) is latitude 23° 36' 16" N, longitude 36° 11' 42" E, and is just 15 km north of the Tropic of Cancer (Ball, 1912). No fresh water is available on the island and there is very little life of any kind; the island is a barren desert supporting a few extremely sparse shrubs, a large species of sea-turtle, and a few birds (Moon, 1923). The island is about three kilometres long and covers an area of about four and a half square kilometres. The principal topographic feature is "Peridotite Hill", the highest point on the island (235 m). Charts of submarine topography indicate that St. John's Island is part of the submerged extension of the Ra's Banas promontory (Moon, 1923).

HISTORY

Specimens typical of olivine crystals from St. John's Island have been found in archeological excavations in Alexandria, Egypt, and carved specimens are known dating from the time of the Ancient Greeks (Anon., 1922). The "Serpent Isle", in the Red Sea, was stated by Agatharchides (150 A.D.) to be the

*Arabic for "peridot", the name for gem-grade olivine.

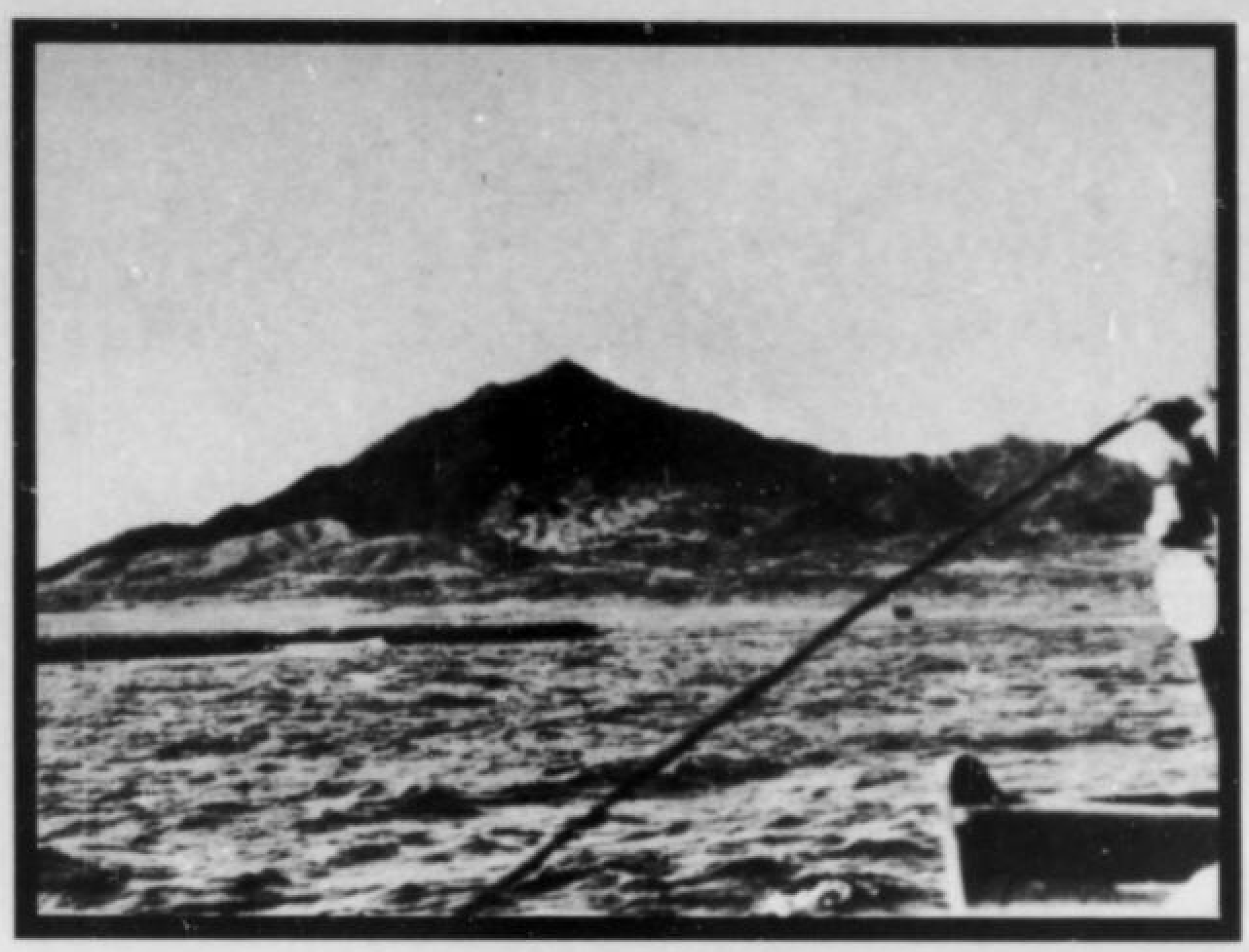


Figure 3. **View of the main peak from the Northeast, looking toward the workings shown in Fig. 4. Photo from Moon (1923).**

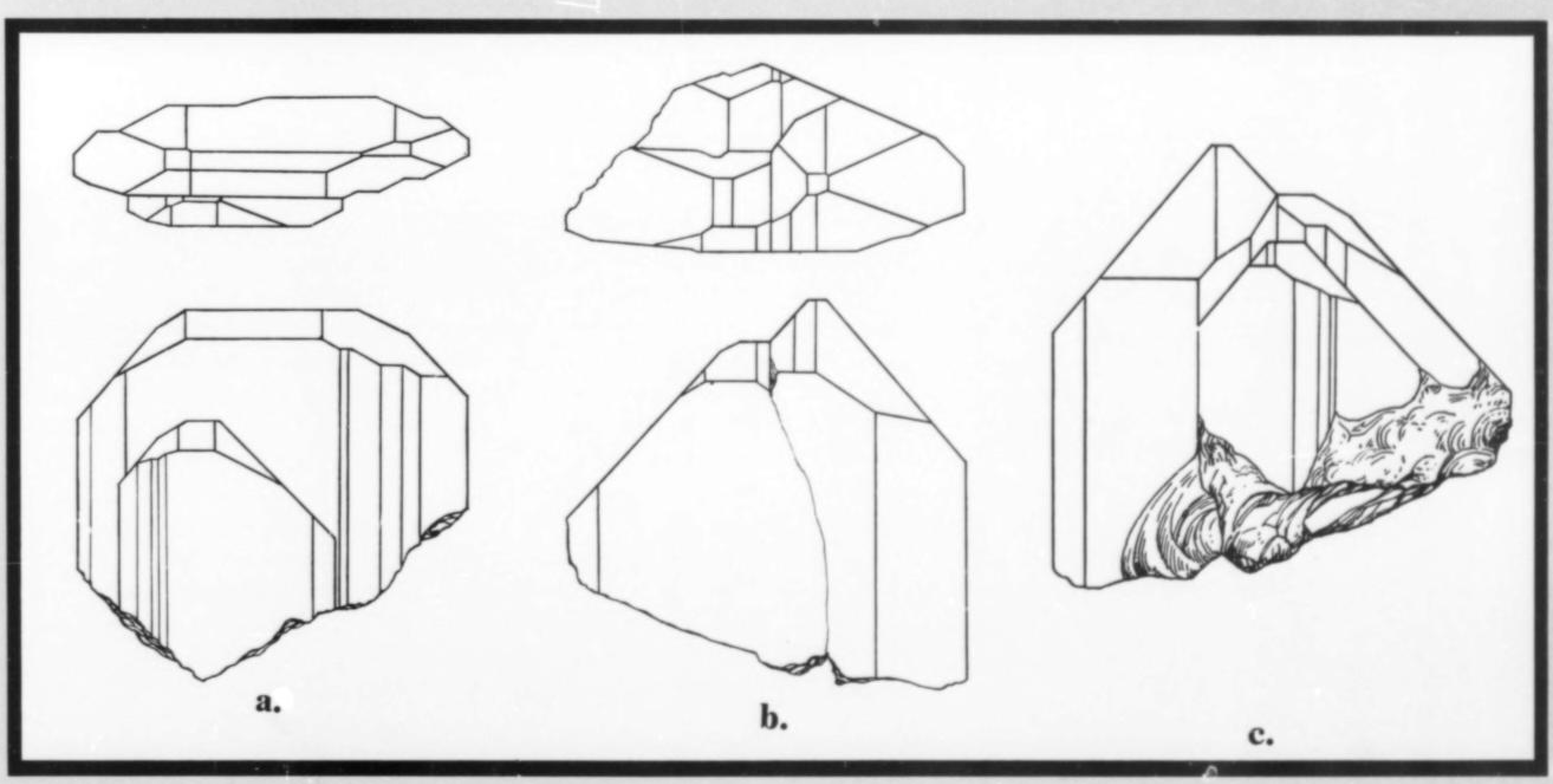
Figure 4. **View of the main Peridotite Hill from the North showing dump-heaps from the peridot workings (see Fig. 6). Photo from Moon (1923).**

source of peridot (gem olivine) for the Egyptian Kings. The Romans called the island "Topazius" (or "Topazos") from which "topazion", the ancient name for peridot, was derived (Pliny, 70 A.D). In fact, the peridot of the famous lost breastplate of the High Priest of Jerusalem (Moses, 1400 B.C.) was almost undoubtedly from St. John's Island (Desautels, 1970); the peridot mentioned as adorning the King of Tyre (Ezekial, 586 B.C.), was also probably from St. John's Island (Desautels, 1970). According to Pliny (70 A.D.), Philemon the Procurator collected a fine crystal at St. John's Island which he gave to Berenice, the wife of Ptolemy I (367-283 B.C.), King of Egypt. The Ancient Egyptians occupied and defended the Island (forcing slaves to mine it, and killing anyone else who came too close); pirates later held it, and its location was no doubt often a closely guarded secret for centuries or even millenia. The island has probably been lost and rediscovered many times. The deposit itself is so unique that, until its rediscovery around 1900, archeologists could not even speculate upon the origin of the peridot used by the ancient Egyptians, Romans and Jews.

Nothing is known about the locality from Biblical times to about 1300 A.D., and mining was largely dormant in Egypt from 1300 A.D. to about 1800 A.D. Europeans, most of them searching for gold, began investigating old mines in Egypt during the 19th Century (Anon., 1922).

It appears that the locality was rediscovered around 1900. Bauer (1904), in a discussion of peridot localities, noted that, at that time, specimens of transparent, green gem crystals labeled as being from Egypt were often seen in (European) mineral collections, but the exact locality was unknown. In several turn-of-the-century publications the locality is given only as "Levant" (generally the Eastern shores of the Mediterranean Sea anywhere from Western Greece to Western Egypt), and the stones at that time where known as "Levantine peridots" (Whitlock, 1945). They were nicknamed "evening emeralds"

Figure 5. **Sketch of forsterite crystals from St. John's Island. Smithsonian specimens. (a) Top and front view, specimen R7887, 2.5 cm in width. (b) Top and front view, specimen C6476, 3.0 cm in width. (c) Back view, specimen C6476.**



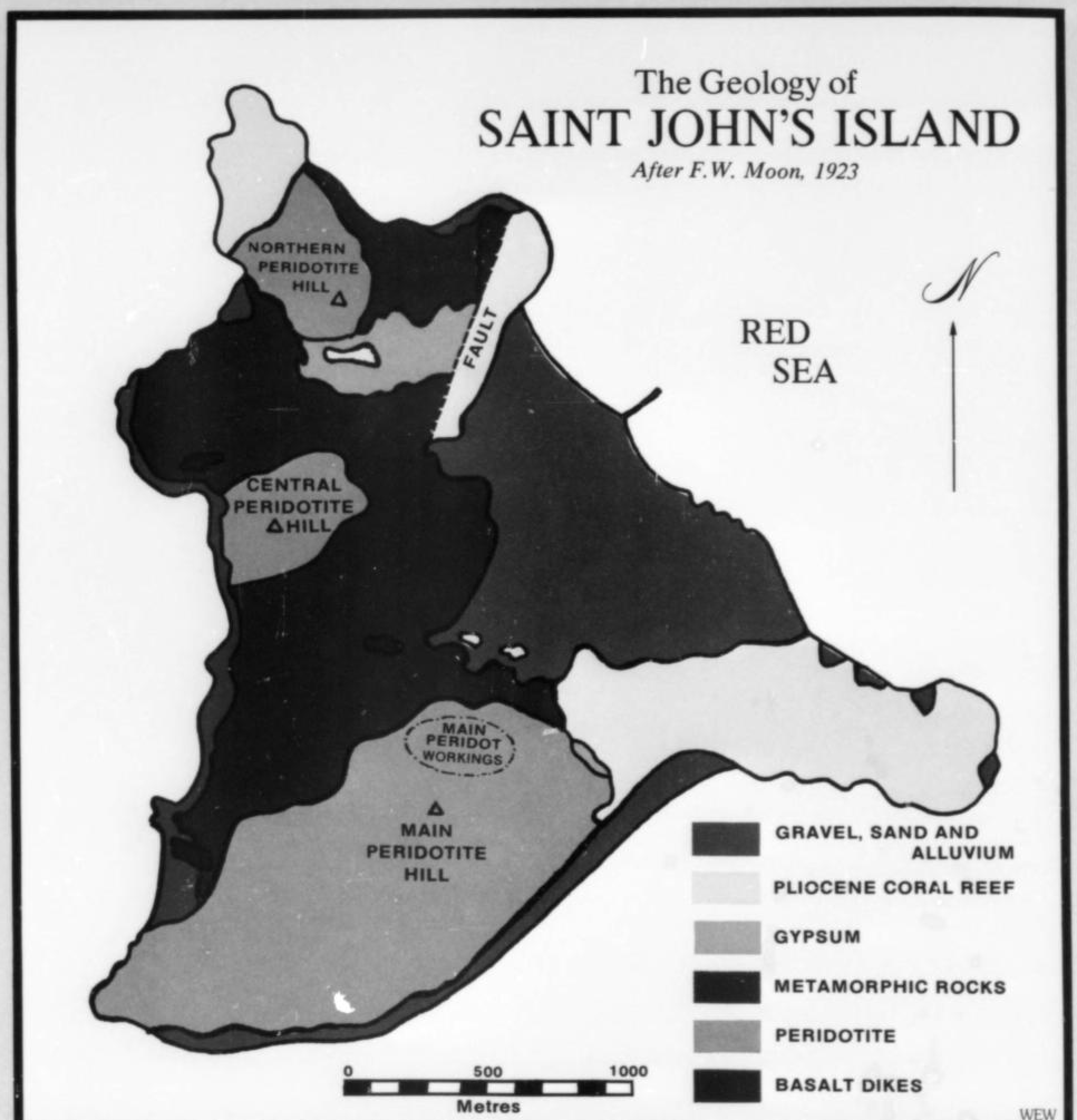


Figure 6. **Geology of St. John's Island.**
Figure 7. **Location map.**

by the gem trade to stimulate their popularity (Spencer, 1971). By 1906, however, the locality was made public (Michel, 1906).

From 1910 to 1914 gem mining on St. John's Island was the monopoly of the Khedive (Turkish Viceroy) of Egypt, during which time about £ 55,000 (about 1 million of today's dollars) in gem material was removed and sent to France for cutting and polishing (Anon., 1922). During this time a gasoline-powered condenser supplied about a ton of fresh water a day to the miners (Moon, 1923).

In 1922 the mines were being held on lease from the Egyptian Government by the Red Sea Mining Company, but to that date no production by the company had taken place (Moon, 1923). The Red Sea Mining Company began production around 1924 and produced sizeable amounts of gem material until the operation was shut down at the beginning of World War II. Specimens were always sent to France for cutting and/or distribution (Mel Strump, oral communication).

Illicitly collected gem material is continuing to appear on the market even today. Faceted St. John's Island stones can be distinguished by their sandy, reddish inclusions of biotite, whereas Burmese crystals have clouds of microscopic brown hematite inclusions. The finest peridot, in 10-15 carat cut stones, sells for about $80/carat on today's gem market. Therefore specimen crystals are quite expensive.

The mines were nationalized by Gamal Abdel Nasser shortly after he took power in 1958, and as often happens when mines are nationalized, operations broke down and production ceased. The fact that production ceased because of political/management reasons, rather than lack of peridot, suggests that there is more to be found.

GEOLOGY

The rocks of the island (see Fig. 6) consist of two general types: sedimentary or metamorphosed sedimentary rocks, and intrusive igneous rocks. The Red Sea is the result of a tectonic spreading center or "rift zone" running its length, along which mafic, igneous rocks are intruded and extruded. The ocean floor and nearby continental land masses move slowly away from the rift zone as more rock is emplaced in the center. The spreading takes place very slowly...only a few cm per year. The sedimentary rocks of St. John's Island were probably originally part of the African-Arabian continental land mass before the rift zone formed and opened up the Red Sea. They later "spalled off" to form a partially submerged promontory into the Red Sea, but while they were located directly over the rift zone they were intruded by mafic and ultramafic rocks coming up along the rift zone. Such rock types are thought to be derived from the Upper Mantle region, just beneath the earth's crust (Badgley. 1965).

The intrusions metamorphosed the sedimentary rocks to varying degrees, resulting in a suite of granulites, schists and slates containing garnet, epidote, quartz, titanite, plagioclases, amphiboles and mica (Smith, 1923).

The intrusions are silica-deficient (the only conditions under which olivine can form) and consist of dunite, peridotite diorite, pyroxenite, dolerite and basalt. The intrusive rocks which form the bulk of the island are peridotite and dunite, and they are intruded by minor dikes of basalt and other mafic rock types. The principle minerals of the major intrusions are plagioclases, amphiboles, olivine, pyroxenes, and minor magnetite. Spinel and biotite are present locally (Smith, 1923).

Deposits of alluvium, gypsum and coral reefs were formed after formation of the Red Sea.

MINERALOGY

General

All of the minerals thus far recognized from St. John's Island are listed on table 1. Most of these are major or minor rock-forming minerals, the occurrence of which is not unusual or noteworthy. Some species (other than olivine, which is covered in the next sub-section) are worthy of passing mention.

Aragonite is described as follows by Moon (1923): "Numerous cracks in the (dike basalt) mass are filled with beautifully radiating, and in places striped, aragonite."

Davyne, or a davyne-like mineral, is described by Spencer (1923) as occurring in hexagonal prisms several cm long, white, vitreous, and partly transparent. The chemical analysis resulted in a formula not precisely in agreement with the accepted davyne composition:

St. John's Island material: $(Na,Mg,Ca,K)_8(Al_5Si_5)O_{22}(Cl,SO_4,CO_3)_1 \cdot 2H_2O$.

Davyne (Fleischer, 1975): $(Na,Ca,K)_8(Al_6Si_6)O_{24}(Cl,SO_4,CO_3)_{2\text{-}3}$.

Wet chemical analyses of the time (1923) were subject to greater errors than would be allowed today, but there nevertheless appears to be Mg and H_2O not normally present in the davyne composition.

Tourmaline has been reported by Smith (1923) as occurring on the walls of fissures in diorite. The crystals are small, brilliant, blackish brown, short prisms exhibiting the forms $\{10\bar{1}1\}$, $\{02\bar{2}1\}$, $\{11\bar{2}0\}$, $\{12\bar{3}2\}$ and $\{0001\}$.

Olivine

Nomenclature

In ancient times gem olivine was known as *topazion* or *topaz*, after the ancient name for St. John's Island. The name is after the Green word *topazos*, meaning "to seek", apparently in reference to the difficulty ancient sailors had in finding the island. For more than 3000 years olivine was called *topaz*; in 1737 Henckel applied the name *topaz* to what we know as topaz today. Inexplicably the name stuck, and a new name had to be invented for olivine. The name *olivine* was given by A. G. Werner in 1790, after its typically olive-green color, and the name was used thereafter by English and German mineralogists. The French called it *peridot*, and this term is still in use today to signify green to lime-green, gem-grade olivine, although the name itself is not

TABLE 1. MINERALS OF SAINT JOHN'S ISLAND*

ELEMENTS	*Pyroxenes*
Sulfur	Augite
Platinum	Enstatite
	Hypersthene
OXIDES	Diopside (?)
Magnetite	
Corundum	*Feldspars*
Spinel	Labradorite
Goethite	Bytownite
	Andesine
SULFIDES	
Pyrite	*Other silicates*
	Biotite
CARBONATES	Clinochlore
Calcite	Cordierite (?)
Aragonite	Davyne (?)
Dolomite	Epidote
Zaratite	**Forsterite (olivine)**
PHOSPHATES	Garnet (colorless)**
Apatite	Garnet (brown)**
SULFATES	Garnierite**
Gypsum	Muscovite
	Pyrophyllite (?)
SILICATES	Quartz
Amphiboles	Scapolite
Tremolite	Serpentine**
Actinolite	Titanite
Hornblende	Tourmaline**

*compiled from Moon (1923), Smith (1923) and Spencer (1923).

**more precise identification not available.

of French origin. The name *peridot* is from the 13th century English *peridota* or *peridote*, which is analogous to the name *epidote* (Spencer, 1971). Therefore, the "t" should be pronounced. American mineralogists used the term *chrysolite*, for a period of time, but this name has fallen into disuse in recent years. The chemical end-members of the olivine series are *fayalite*, (Fe_2SiO_4), and *forsterite*, (Mg_2SiO_4). Pough (1960) used the term *chrysolite* to mean an intermediate composition between the two end members, but the common convention is to use the end member name corresponding to the dominant metal (Mg or Fe), and to use the term *olivine* when the exact composition is unknown. The term *peridot* is used here strictly in the commercial sense to avoid confusion by distinguishing the gem crystals from rock-forming olivine of no value.

Chemical and physical characteristics (St. John's Island material)

Crystals of a rich green or yellowish green color, and of gem quality, contain 8-10% FeO (Spencer, 1971) and are therefore *forsterite* (FeO+MgO equals roughly 64%). Brun (1921) writes: "Frequently they (the peridots) are well-formed, large, but sometimes broken. They are at times doubly terminated." Pough (1960) reports that crystals to 10 cm (four inches) in each direction have been recorded, but crystals from around two to four cm (one to one and a half inches) are more common. The largest cut stone is in the Smithsonian Institution (Washington, D.C.) and weighs 310 carats.

The crystals are orthorhombic and tabular in habit (Fig. 1), flattened along the *a* axis, making the $\{100\}$ pinacoid faces the largest. The *a* faces are striated parallel to the *c* axis because of oscillatory combination with prism $m\{110\}$. The wedge-shaped terminations usually have lustrous faces of the prism $d\{101\}$, and frosty faces of the prism $k\{021\}$ (Sinkankas, 1966). Some crystals are etched all over.

Mode of occurrence

Small peridots may be found at several places on the peridotite outcrops of the island, but the finest, largest stones have only been found on the eastern end of Peridotite Hill, where they occur in small veins in an area of serpentinized peridotite (Fig. 3, 4, 6). The veinlets, which run in all directions, form a kind of stockwork covering an oval area several acres in size. The method of mining was to mine by hand along each vein separately, downward from the surface, until it became barren or pinched out (Anon., 1922). The peridot crystals are not found in the position in which they crystallized; they are feebly attached and easily removed (Brun, 1921). I know of no bona fide matrix specimens.

It appears that the crystals formed on the walls of open fissures, and then were broken from the walls and deposited with debris at the bottoms of the fissures. It is unlikely that the peridot crystals were once imbedded and later weathered out of rock because olivine is relatively unstable in a weathering environment and would not be expected to remain clean and fresh while other mafic minerals decompose. The crystals, therefore, must have originally lined the fissures which were similar, perhaps, to miarolitic cavities. The difficulty with this interpretation is that much of the peridotite (which is mostly olivine) has been altered to serpentine, but the gem crystals in the fissures are fresh and unaltered, or at most, lightly etched. Furthermore, the peridot crystals are located in fissures which are natural conduits for weathering solutions, and are in a position to be most susceptible to near-surface weathering. This suggests that the serpentinization was metasomatic in origin, and took place before formation of the gem crystals. The gem olivines may then have been formed by late-stage magmatic fluids or gasses. The existence of open fractures at the time of peridot crystallization suggests that deep burial at the time of crystallization could not have been possible, and that the peridots formed under *relatively* near-surface conditions, i.e. after intrusion of the peridotite. However, as the island has not been thoroughly investigated by mineralogists and petrologists, this is only speculation. Needless to say, the deposit is deserving of further study and renewed investigation for specimens.

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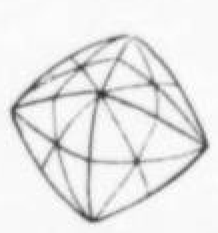


The Record Bookshelf

Mineral-Fundstellen **("Mineral Localities").** ***Tirol, Salzburg, Südtirol*, by L. Fruth, 207 p., hardcover, (DM 28.50).**
***Baden-Würtemberg*, by M. Glas and H. Schmeltzer, 197 p., hardcover, (DM 28.50).**
***Skandinavien*, by H. J. Wilke, 369 p., hardcover, (DM 48.00). Published by Christian Weise Verlag, 8 München 43, Postfach 667, West Germany. (In German)**

Each of these three books (and another soon to be published) consist of nothing but descriptions of mineral localities; the first two are German provinces and the third deals with Scandanavia (Norway, Sweden and Finland). They are meticulously illustrated with small-area maps, color and B&W mineral photos, locality photos, and an occasional geologic cross section diagram. Each description contains data on location, minerals, geology, collecting possibilities, and the nearest lodgings available. The Scandanavia volume even gives the nearest camping and gasoline stops. These books are highly recommended to (a) people keeping a file on foreign mineral localities, and (b) anyone who may have the opportunity to actually tour these areas. They are thorough, practical guides to mineral localities and mineral collecting in the areas covered.

W.E.W.

***Minerals of Virginia*, by R. V. Dietrich, Research Division Bulletin 47, Virginia Polytechnic Institute & State University, Blacksburg, Va., 1970. Paperback, 325 pages, 30 black and white plates, $4.00.**

Minerals of Virginia is Professor Dietrich's eighth publication since 1953 in a series entitled *Virginia Mineral Localities*. It is a comprehensive report on the state's minerals in which more than two hundred species are described. This compilation is based on data communicated by collectors, generated by Dietrich, and drawn from the literature. The broad coverage reaches beyond the "collectable" species to the rock-forming and ore-forming minerals, making the book useful to both the amateur and professional segments of the mineralogical community. Besides the main text of two hundred fifty-nine pages, the book includes some three hundred references which document mineral occurrences in Virginia. This book is not a field guide, but a state mineralogy which compares favorably with the better-known titles *Minerals of Arizona* by Galbraith and Brennan and *Minerals of Connecticut* by Sohon. It may be obtained from:

Cooperative Extension Service
Virginia Polytechnic Institute
& State University
112 Landsdowne Street
Blacksburg, Virginia 24060

Carl Francis

***Mineralogy of Llallagua, Bolivia*, by Mark Chance Bandy. The Tucson Gem and Mineral Society Special Paper 1, 69 pages, softcover, published by the Tucson Gem and Mineral Society Inc., P.O. Box 6363, Tucson, AZ, 85733, ($2.00), 1976.**

This book is a reprint of the 1944 edition published originally for the Patino Mines and Enterprises. Additions have been made to round out the work; these include an appendix of defined terms, a brief sketch of the author by his wife, a short history of Llallagua based on a lecture given by the author to the Mineralogical Society of Southern California in the late 1940's, and photographs of several fine Llallagua specimens from the author's collection.

The paper itself covers the geologic history, metallization, and ore solutions briefly, and the remainder is devoted to descriptions of the minerals found at Llallagua, one at a time. Many of the descriptions are highly detailed, giving information on the precise areas of the mine where vugs and pockets of minerals were found, the size, color and quality of the specimens from various areas, and the associations. Clearly written with the mineral collector in mind, *Mineralogy of Llallagua, Bolivia* is the ideal collector's reference for this famous locality.

W.E.W.

***Geochemistry of Beryllium and Genetic Types of Beryllium Deposits*, 401 pages, hardcover ($2.50);**
***Beryllium: Evaluation of Deposits During Prospecting and Exploratory Work*, 161 pages, hardcover ($1.50), both books by A. A. Beus, published by Freeman & Co., translated from Russian by The Geochemical Society.**

These two well-known books by A. A. Beus, probably the best available on these aspects of beryllium, may be purchased at the extraordinarily low prices quoted above from:

Geochemical Society, books
c/o Earl Ingerson
Dept. of Geological Sciences
University of Texas
Austin, TX 78712

Together the books may be purchased for $3.50, which includes fourth class postage.

***Minerali Alpini e Prealpini*, C.M. Gramaccioli: 2 vols., 473 xxiii pages, 1975. Instituto Italiano Edizioni Atlas S.p.A., 24100 Bergamo, Via Crescenzi 88, Italy.**

These handsome volumes exhaustively cover the minerals of the Alps and "pre-Alps." Geographically, this corresponds to south-central Switzerland, far northern Italy, and adjacent France and Austria. Therefore its coverage includes, but is broader in area and mineralogy than, several somewhat similar predecessor works (Wiebel; Stalder and Haverkamp) on the Alpine fissure minerals or on Switzerland alone.

The introductory chapter covers the types of occurrences of minerals in the area, beginning with the all-important alpine fissure minerals. It continues with minerals associated with the granitic in-

trusive rocks, dolomites, serpentinites, metamorphic schists, extrusives, metallic mineral deposits and pegmatites. Exemplar localities are discussed.

A short mineralogy and crystallography follows in chapter 2-4 and 6. Prominent collections of these minerals are discussed in chapter 5, including the major museums complete with addresses and visiting hours.

The second part, the bulk of the volumes (265 pages), is a systematic mineralogy. This follows Dana's system closely, but departs towards the end with chapters on rare-earth minerals, beryllium minerals, and radioactives. The third and last part of about 100 pages is devoted to 17 specific classic localities.

The beauty of these books, and perhaps principal value to the English-speaking reader, is in the lavish use of color illustrations. It is difficult to find a pair of pages without at least one color illustration. Almost 800 mineral species are treated, with 340 color pictures of 120 of these. Additionally, about 100 species are represented in colored crystal line drawings.

Maps are in abundance, beginning with the end-papers which are a reproduction of an 1817 mineralogical locality map of Switzerland, showing Cantons Uri, Granubundten, Wallis and Tessin. Twenty-four modern topographic maps, with an index map, show principal access roads and prominent localities. These localities are shown in about 50 color photos, featuring alpine meadows and lots of snow.

I met Carlo Grammaccioli nearly ten years ago while he was at Cal Tech, shortly before his return to Italy. In the interim, he has obviously been very busy. The localities discussed are in a rough arc about Milan, his present residence. The books show ample evidence of his first-hand field experience, including many specimens "coll. e foto Autore." Mineralogical Italian is not too much of a drawback with the mineral names for the most part following IMA nomenclature, rarely with localized varietal names. In summary the book is well recommended, and what ardent collector could read it without wanting to plan a trip to "La Val di Binn, Il San Gottardo, La Val d'Ala, or Val Malenco?"

R. A. Bideaux

***The Great Metal Mines of Wales (Number One): Dylife*, 1975, softcover, 32 pages, (90p);**
***The Old Metal Mines of Mid-Wales, Part 1: Cardiganshire—South of Devil's Bridge*, 1974, softcover, 52 pages, (90p);**
***Part 2: Cardiganshire—The Rheidol to Goginan*, 1975, softcover, 52 pages, (90p);**
***Part 3: Cardiganshire—North of Goginan*, 1976, softcover, 72 pages, (£1.20). All four books by David E. Bick, published by The Pound House, Market Square, Newent, Glos., GL18 1PS, England.**

Wales has been mined intermittently since the Romans first discovered metal deposits there; the enormous number of deposits kept miners busy for centuries, the peak of activity culminating between 1845 and 1900. The ruins and relics of this long mining history are slowly crumbling to dust now, but interest has recently been renewed by historians, industrial archeologists, and mineral collectors. These four books represent loving accumulations of data on nearly all of the mines in Mid-Wales for which records still exist in the English archives. Bick has added to this data through "countless visits to the sites themselves", and includes many fascinating old photographs, mine maps, and mining trivia of every sort. Although these mines could have been prolific specimen producers in their day, relatively little has been preserved; nevertheless, collecting activity there is on the increase, and perhaps soon the judges at mineral shows will be confronted with specimens labelled Twll Y Mwyn, Mynydd Gorddu, Llawrcwmbach, Cefngwyn, Penrhyngerwin, Llywernog, Cwmbrwyno, and Pwllrhenaid! Bick's books make good reading for anyone with an interest in mining lore and history, even though specific minerals are not discussed.

W.E.W.

***Metallogeny and Global Tectonics*, edited by Wilfred Walker. Dowden, Hutchinson & Ross, Inc., 523 Sarah Street, Stroudsburg, PA, 18360. 1976, hardcover, 413 pages, ($27.00).**

This volume (no. 29 in the Benchmark Series of Papers in Geology) contains facsimile reprints of 31 significant papers from professional journals which deal with metallogeny and global tectonics. The papers range in date from 1900 to 1974 with nearly all having been published since 1960. The editor comments on each of the papers in a preface to each section, discussing their concepts in relation to the development of current theory; this gives the book its only value beyond that of a stack of xeroxes. The papers, however, seem well-chosen to give a view of the subject directly from the original research. Casual students of ore mineralogy and geology may find the book difficult to work from; it is not arranged in the standard textbook style in which the work of many authors is assimilated together and boiled down to just the most salient conclusions. It is more appropriate to the serious student, already reasonably well trained in economic geology and plate tectonics, who wishes to deepen his background through a study of the more important original research. Because such papers were, of necessity, written for other professionals, the book borders on the graduate level.

W.E.W.

***World treasury of Minerals in Color; Le Monde Merveilleux des Mineraux* ("The marvelous world of minerals"); text by Pierre Bariand, photography by Nelly Bariand. Distributed by: Editions Minerva S.A., 1, rue Robert-de-Traz, 1206 Geneva, Switzerland; Galahad Books, New York, New York, (in English)($12); Presses de la Cité, 97-97 Tolhurst, Montreal, 357 PQ, Canada (in French); also a German Language edition (write to Swiss distributor for details). (1976). 128 pages, 160 plates, all in color.**

There are only a few truly masterful mineral photographers. Some of them have had at least one book published which is a compendium of their finest work, and which demonstrates their particular artistic style, technical mastery, and taste in minerals. Lee Boltin, for instance, has *Mineral Kingdom* (among others), Werner Lieber has *Kristalle unter der Lupe* (among others), and Julius Weber has *Encyclopedia of Minerals*. Now, happily, one more member of that select fraternity checks in with a *tour de force* of mineral photography: Nelly Bariand. Americans probably first became aware of Mme. Bariand several years ago when 13 of her photos appeared in Volume 3 of *Mineral Digest*. Seeing those photos was a consciousness-raising experience for many; she demonstarted how dramatic and wildly beautiful mineral photography really could be. Her photos have also appeared in the *Record* (**6**, 237-249). With the publication of *World Treasury of Minerals in Color* we now have over 150 new examples of the work of Nelly Bariand in full color, 60 of them full page size! All of the essential caption information is included: species, locality and specimen size. Eighty-eight of the more common (and more spectacular!) species have been photographed from the Sorbonne collection. One problem, however, is that it is not always clear which caption refers to which photo.

About a fourth of the book is devoted to text by Pierre Bariand, her husband. Pierre Bariand is curator of the Sorbonne collection (Paris) and a specialist in mineralogy-crystallography. The Bariands routinely collaborate in this fashion (her photos accompanying his text, as in the

Mineral Digest and *Record* articles); the result has always been a superior piece of work. In the current case the text consists of a brief, non-technical introduction followed by short discussions for each mineral species pictured. The discussions touch upon typical items of interest such as approximate composition, common associations, best-known localities, etc., and occasionally pass into interesting notes on color, crystal forms, and conditions of formation. The common feature of the comments is that they are all of some interest to collectors. Conditions of formation, for instance, are not discussed in every case, but only where they happen to be especially interesting. None of Bariand's remarks force the technical side of mineralogy; he works through the various species with the easy assurance of a curator and mineralogist of long experience. Primarily his comments seem designed to complement the *photographs*, rather than the reverse, and this approach sets the book apart from most others. And why not? Certainly enough has already been written about mineralogy so that current authors can be liberated from the old, traditional format: copious quantities of mineralogy and non-technical information with a few photos to compliment the text. The old standards (Sinkankas' *Mineralogy for Amateurs*, for instance) are excellent and no collector should be without them; but with the textual information so well covered in older books there is now a place for books with the primary accent upon the visual nature of minerals. The Bariands obviously recognize this and have produced an exceptionally beautiful and satisfying book unencumbered by any preconceived ideas of what a mineral book "should" be. Despite some translational problems (we should be happy there *is* an English version!) and somewhat less than excellent print quality, this book receives my highest recommendation.

W.E.W.

***Encyclopedia of rocks and minerals*, author anonymous (but probably Herbert S. Zim), Cracker Jack Division, Borden Foods, Borden Inc., 32 pages, 53 illustrations, 4.4 by 3.2 cm, soft cover, volume 15 of a series. (no date)**

For those desiring a truly pocket-sized reference on rocks and minerals this volume (1-¼ x 1-¾ inches) is unsurpassed. For field use it easily fits within a compass case (along with the compass), in a matchbox, or even clipped to your sunglasses. Subjects discussed include copper minerals, gold, silver, graphite, quartz, feldspars, garnets, sandstone, shale, limestone, slate and marble. Over 50 illustrations, plus the color cover, admirably supplement the text. Though somewhat sparse in its coverage for an encyclopedia, this book deserves to be an integral part of even the smallest libraries; those who accumulate mineralogy books as a hobby can hardly consider their collection complete without one. Micromineralogists* in particular should find it easy reading, and thumbnail collectors will appreciate it because, with just a little bending, the book itself will fit within a one-inch cube! The book has the further advantage of being sold surrounded by a box of Cracker Jacks (which comes at no additional charge); all too few textbooks these days come complete with snack.

W.E.W.

*a mineralogist so small that he must be viewed through a microscope to be fully appreciated.

Thanks to John Tetrick for loaning us a copy of the above rare work for review.

STRUCTURE-PROPERTY RELATIONS by Robert E. Newnham, Springer Verlag, 1975 ($31.00).

This volume attempts to deal with the way in which particular crystal structure characteristics influence the physical behavior of materials. Despite the author's protestation to the contrary in his prefacing remarks, it is eminently successful. Complex as the subject matter may be, concepts are developed in a direct and lucid manner with a minimum of elaborate mathematical treatment. For those readers who see in this a lack of rigor, there is an excellent list of references to the original literature at the end of each chapter. The seven chapters are titled as follows: 1) Symmetry and Crystal Physics, 2) Electronic Transport in Materials, 3) Thermal Properties and Ion Transport, 4) Ferroelectric and Other Ferroic Materials, 5) Optical Materials, 6) Magnetic Materials, and 7) Materials with Useful Mechanical Properties.

For the teacher of mineralogy or any other area of materials science this volume can serve as an excellent source book. The level of treatment is adequate to any general course, and the bibliographic material allows an easy expansion of any desired topic. Magnetic and electrical properties, so important in contemporary technology, are given considerable attention, but the more familiar properties of color, hardness, cleavage etc. are not neglected. In no mineralogy text has this reviewer seen better treatment of these topics. Such properties as toughness and grinding and polishing characteristics are very neatly presented.

On the debit side we have the high cost of the book. Many who would benefit from it may hesitate to pay the price, but the investment of a few hours at the library would be well worth their time. There are many typographical errors, but they are generally self-evident.

Throughout the text one senses the author's competence and familiarity with his subject. But more importantly, one becomes aware of Professor Newnham's great love for his field, and that he wishes to communicate and share that love and interest with the reader.

Abraham Rosenzweig

OTHER TITLES RECEIVED:

***Metamorphic Processes, Reactions, and Microstructure Development* by R. H. Vernon. Halsted Press, a division of John Wiley & Sons, Inc., 605 Third Avenue, New York, NY, 10016. 1976, 247 pages, hardcover, ($18.50).**

***Geology of Petroleum*, edited by Heinz Beckmann; *Vol. 2, Geological of Petroleum Engineering* by Alfred Mayer-Gürr. Halsted Press, a division of John Wiley & Sons, Inc., 605 Third Avenue, New York, NY, 10016. 1976, 183 and 208 pages respectively, softcover, ($6.95 each).**

***Structure and Classification of Paleocommunities*, edited by R. W. Scott and R. R. West. Dowden, Hutchinson & Ross, Inc., 523 Sarah Street, Stroudsburg, PA, 18360. 1976, 291 pages, hardcover.**

***Geochemistry of Boron*, (Benchmark Papers in Geology, V. 23), edited by C. T. Walker, Halsted Press (a Division of John Wiley & Sons, Inc.) 605 Third Avenue, New York, N.Y. 10016 (1976). 414 pages. ($35.00).**

***The Rift Zones of the World Ocean* by A. P. Vinogradov and G. B. Udintsev, Editors, Halsted Press (a Division of John Wiley & Sons, Inc.), 605 Third Avenue, New York, N.Y. 10016 (1975), 503 pages. ($55.00).**

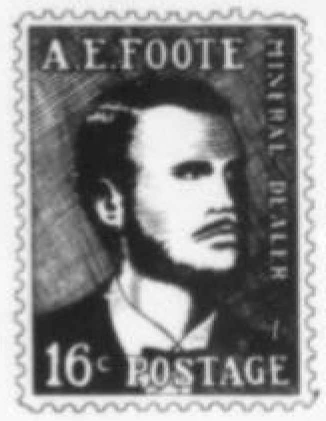
ERRATA

A photo of diaboleite in *Encyclopedia of Minerals*, by Roberts, Rapp and Weber, was erroneously labelled as being from Laurium, Greece (instead of Tiger, Arizona). This error was repeated in the article by W. Kohlberger, Minerals of the Laurium mines, Attica, Greece, in *Min. Record*, Vol. 7, #3, p. 114. Diaboleite has yet to be reported from Laurium.

Vol. 7, #4, pg. 168, figure 13 caption: Freiberg is not in the Harz Mountains; it is in Saxony.

Vol. 7 #5, pg. 226 and 228, figures 5 and 10 (the German phosphophyllite and prehnite) were inadvertently switched.

Letters



SETTING THE *PHOTO RECORD* STRAIGHT:

Dear Sir,

Yesterday arrived the new MR issue, which is "meaty" and delightful! And I enjoyed your photo essay very much - what a good idea to show some of the less well-known collections and some of the "old time" minerals. Yes, I too wonder sometimes where all those gorgeous specimens went that I saw in the Fifties and Sixties— and yes, in the Sixties still, one could get very good things for just a few dollars! I always feel sorry for the beginners; I mean those who are just starting to collect seriously. When we purchased a specimen so many years ago, if we made a "mistake" it cost us a few dollars—nowadays, it is a week's wages! But, on the other hand, we did not try to compete for blue ribbons right off the bat, without really knowing much about minerals - it is the competition for "blue ribbon material"—and only "super" pieces, that drives the prices up. The fact is, that even a less perfect piece can teach as much or more about mineralogy. It is the same old thing; there are two groups of collectors, really: (a) the "show" collector who wants to beat anybody at any price, and (b) the collector who is really interested in the mineral and what it has to say for itself and can teach, and the beauty of the specimen is an added benefit. It always amuses me at the shows, how many people will walk past a superb specimen of great rarity, only because it may be black and the label does not spell out why it is so good, particularly if the price is low. But change the price to a "whopper" and put it in front, and there will be ten people fighting over it! My limit per specimen was set many years ago, at $35.00 (which does not mean I can't spend a lot at a show, because it is "per piece"). It has been very healthy, because I have had to learn and observe - and you would be amazed at the things I can still find within my limit! A big budget does not necessarily mean a great collection; it may mean a wonderful display of exceptional pieces, but that is not a "mineral collection" in the old sense. For this reason I am very happy that you stressed the fact that these collectors did not spend huge sums to bring together a very fine collection, each with real value to himself and mineralogy in general.

The acanthite on page 168 (Vol. 7)— and I love the crystal drawings!—Freiberg is misplaced in the description. There are three major silver mining districts in Germany: (1) Saxony, (2) Harz Mountains, (3) Baden. The latter is the least well known, but all collectors are familiar with the first two. Freiberg is in Saxony. The Harz Mountains are in the center of the country, and now are divided between the East and West Zones. The border runs along the old demarcation line between Niedersachsen (Lower Saxony - nothing to do with Saxony!) and Thuringia. The Andreasberg silver district is in the West German, Niedersachsen part. The old mines at Eisleben, Ilfeld etc., are in the Eastern, Thuringian part, now in East Germany. And ALL of Saxony and the Ore Mountains, are in the East Zone; the Ore Mountains are the demarcation line with Bohemia, Czechoslovakia.

For people like me who don't have the time for many of the bigger shows, the "What's new in minerals" column is a boon - and even when I have seen the things, you still give a lot of back-ground information for which I am very grateful.

Kay Robertson
Los Angeles, California

Your comments are, by chance, pertinent to the editorial in this issue as well. As readers have no doubt noticed by now, the Photo Record will not always deal with collections per se; the reason is I've received some contributions out of that format (such as the one in the last issue) which are just too good to pass up.

Ed.

MORE ON ST. HILAIRE

Dear Sir,

Unfortunately, the case history of Mont St. Hilaire prepared by John and Louise Stevenson for the FM column of the May-June 1976 Mineralogical Record is incomplete in one important respect. This is the role of Professor Guy Perrault and his former colleagues in the Department of Geological Engineering, Ecole Polytechnique, Université de Montréal, in keeping the location open to collecting.

Professor Perrault was responsible for some of the earliest mineral identifications at Mont St. Hilaire, including the serandite found in 1963. He maintained a keen interest in the locality, and described two of the new species (lemoynite, yofortierite). When in 1974, Demix Ltee. decided to close the quarry completely to collecting (as a result of which the Montreal Gem and Mineral Club was turned down in its request for a field trip in May), it was the determined effort of Professor Perrault and his colleagues which succeeded in convincing the company to allow collecting on a restricted basis. Ecole Polytechnique undertook to act for Demix in handling requests for field trips, subject to the conditions which are again in force in 1976, as outlined on page 128 of the May-June Mineralogical Record.

Another aspect which should also be mentioned in the case history, is that both Ecole Polytechnique and the National Museum of Canada have negotiated special collecting privileges whereby their designated representatives have free access to the quarry. This at least increases the chances that no major mineral finds are lost to mineralogy, and insures the further growth of two of the major institutional collections of St. Hilaire minerals.

Finally, I would like to point out that the locality should not be listed as Mont St. Hilaire, Montreal, Quebec. Montreal is about 20 miles to the west. The nearest town to Mont St. Hilaire is called St. Hilaire, and is, like the quarries, in Rouville County. The correct location is then: Mont St. Hilaire, St. Hilaire, Rouville County, Quebec.

Peter Tarassoff
Quebec, Canada

WALT

Dear Sir,

One of the most unfortunate things ever to happen to the rock and crystal industry in our memory is the death of Walt Lidstrom. My wife and I have known Walt and his family since 1946, and have had a very close relationship with them all since that date. We have hunted rock with Walt and his family, have seen him in the lumber business, in the sliced rock business, then the opal business along with farming. We encouraged Walt to go into the mineral business. We considered him one of the top, if not *the* top, mineral dealer in the world, and one of the best friends we ever had. Through thick and thin he was a man you would always pick to ride the river with. Above all else Walt was a success, as no one but he and Liz could have raised a family such as the Lidstroms have raised.

Dale and Ila Hammersley
Patagonia, Arizona

ON REPAIR

Dear Sir,

The following statement by John K. Howat (Curator of American Paintings and Sculpture, Metropolitan Museum of Art, New York) in the introduction to *A Bicentennial Treasury: American Masterpieces from the Metropolitan* seemed pertinent to the recent editorial on repairing specimens (Thompson and Richards, v. 7, n. 4).

> "But the greatest must be judged on their intrinsic quality—and if quality is there, any amount of tears, scratches, scrapes, fading, breaks, patches, and even additions can be surmounted or be of less concern."

Carl Francis
Blacksburg, VA

Dear Sir,

The guest editorial was great...long overdue.

Pete Dunn
Lanham, MD

Dear Sir,

In defining the terminology of mineral repair no effort was made toward the *condemnation* of those practicing *manufacture* of mineral specimens. This was no doubt an oversight, but I submit that those practicing this technique are doing a great disservice to mineralogy, the mineral business, and the educational community.

The editorial alluded to values in such a way as to suggest that the only value of a mineral specimen is its dollar value. We all tend to do this sometimes, probably because most of us acquire specimens with the "silver pick" and find it easy to relate specimens to dollars. However there are many other forms of value to consider, and it would do us well to remember the educational, historical, cultural and scientific value of minerals when discussing money.

I cannot agree with the assumption that mineral specimens are comparable to great works of art, for two reasons: (a) works of art are created by Man and therefore have a much larger audience because they delve into the "Inner Man"; they are finite in number; (b) to compare minerals and art treasures on a one-to-one basis is a misunderstanding in magnitude. Simply compare the number of works by Michaelangelo to the number of wulfenite specimens you've seen. In all other respects I agree heartily with the editorial.

Jeff Kurtzeman
Phoenix, AZ

I must offer a rebuttal to your last paragraph. (a) he who restricts his interest to the works of Man, and ignores the works of Nature, is severely restricted indeed. Art may be a reflection of Man, but it can never be more than a second-rate reflection of nature...compare a painting of a rose to a real rose for example. (b) I would prefer to compare the number of fine Red Cloud wulfenites to the number of Michaelangelos. Or if not, the number of fine matrix Alma rhodochrosites, or Mexican scorodites. The numbers are comparable. The difference is that Man is constantly creating more art, but Nature creates fine mineral specimens infinitely more slowly, more carefully, and more perfectly.

Ed.

Dear Sir,

Your recent editorial in the *Mineralogical Record* on minerals and repair brings up a related topic which I believe also merits a more positive attitude on the part of collectors. This is the question of mineral specimens which have been trimmed with a saw.

Specimens collected in the field often require trimming to remove excess matrix, to improve their aesthetic appeal, or to make them sit up better in a display cabinet. Many specimens are destroyed or damaged in the process. As collectors know all too well, crystals may shatter or pop off the matrix, or the matrix may have planes of weakness in the wrong direction, e.g. the schistous rock of Alpine clefts. In striving for a "natural" look, which usually means the use of a hammer and chisel, or a breaker, the probability of disaster is greatly increased. Yet, a specimen trimmed with a saw, a much less destructive method, often meets the same response as a repaired specimen.

If, as in the case *for* repaired mineral specimens, the primary objective should be preservation, then I submit that specimens judiciously trimmed with a saw should also be acceptable. The saw cuts should not be obvious, and preferably should form the back or base of the specimens. Aesthetics, not some preconceived notion, should determine what is or is not acceptable. A specimen with a sawn base should not have any less merit than one which has been secured to an artificial base.

Peter Tarassoff
Quebec, Canada

Dear Sir,

First, my kudos to guest editorial writers Wayne A. Thompson and Grant W. Richards for their comments on "Minerals and Repair". It's about time knowledgable collectors such as these gentlemen spoke out on this important subject.

I wholeheartedly agree that it should be all right to repair a specimen. However, if a specimen is restored, the restoration should be indicated to potential buyers. I also believe reinforcing is a valuable technique for the sophisticated collector, but again, prospective buyers should be informed. Some deliquescent minerals would never last a year in a cabinet unless reinforced with a coating of Elmer's gule, shellac, or Krylon plastic spray. This technique is not so much reinforcement as it is "preservation by coating with an impervious substance". Unfortunately even a coating of clear laquer to prevent splitting of vivianite crystals has been frowned upon by certain purists. It is a well-known fact that, with time, Cameroon vivianite crystals split to pieces unless treated; Bolivian, Mexican and Idaho vivianites are nearly as unstable.

I faced this general problem of repair-restoration-manufacture not too long ago when I acquired a fabulous cluster of silver dollar-sized covellite crystals without matrix. Turning over the specimen, I noted that it had been reinforced; but the old, yellowing "horse-glue" was not visible from the front. I kept the specimen for years, showing it in competition, not bothering to note on the label that it had been reinforced or repaired (it was impossible to tell which). Then one fine day a friend pointed out that perhaps it was really two covellite specimens glued together to manufacture one super specimen. Eventually my doubts forced me to dissolve the glue and take the specimen apart. I traded off the smaller piece to a friend who had skillfully pointed out "Who would really want a *repaired* specimen?", "It shouldn't have been shown in competition", and "The judges should have taken off points for repair". I myself felt somehow that it was valuable and desirable with that old horse glue underneath; the glue seemed to block out the breath-taking beauty of this irridescent marvel from Butte, Montana, even though it was invisible from the front. Then a high-powered, fast-talking dealer traded me out of the other piece ("It doesn't really fit in with the rest of your collection."). Looking back, I wish your editorial had appeared several years ago, before I made these errors in judgment. I would undoubtedly have have kept the piece, which I now believe was the best covellite around for size, and you all would see it in my case at the Tuscon Show, competing for the McDole Trophy (and after all, it was probably McDole who collected it and glued it together in the first place). In fact, the original purchase price ($78.58 in 1961, for 4 X 1½ X 1½ inch specimen) was probably so low because the dealer was also influenced by that yellowing glue. The dealer who talked me out of the second half told me "If that covellite hadn't been repaired it would have been worth $6000"...maybe, maybe not.

My attitude about repaired specimens changed radically since I parted with that covellite. Don't let a fine (even though repaired) specimen slip out of your hands because some fast-talking dealer or sophisticated collector puts it down. He"ll only take it home and put a fancy price on it — laughing at your stupidity. Remember the Venus de Milo's value, even with the arms missing!

Paul F. Patchick
Pacific Grove, California

EXCHANGES:

Dear Sir,

I would like to exchange minerals with some of your readers; is it possible for you to publish my address in your magazine?

I will exchange mineral specimens (T/N or micromounts) from Italy for same from USA, Canada, Mexico, etc.

I thank you very much for your kindness. Ciao from Italy.

GIANNI PORCELLINI
via GIARABUB, no. 6
47037 RIMINI
ITALY

MYSTERY OF THE LOST ISSUES

Dear Sir,

We in the Everett/Seattle area have not as yet received the last issue of M.R. Our neighbors in Oregon got theirs about a month ago. What seems to be the problem? This is not by far the first time we have experienced this problem.

Gordon Leroux
Everett, Washington

We are experiencing persistent problems in obtaining delivery of the ***Record*** *throughout the Pacific Northwest (especially with v. 7, no. 2); other publications are having the same problem in that area of the country. Subscribers everywhere are urged to let us know whenever an issue is missing and we will replace it without charge. At the same time we would appreciate it if you would register a complaint with the Post Offic… your area.*

Ed.

Dear Sir,

I have not received the Mar.-April issue of the *Mineralogical Record* and the May-June issue arrived late. A check of other subscribers locally seems to indicate a similar problem. What is the explanation for this continued lack of deliveries to the Northwest?

On the plus side I did have a chance to review the missing issues during a trip to the East when I visited another subscriber and found them to be extremely interesting. The "What's New in Minerals" column is invaluable for the education of those of use who can't make the "show circuit" on a regular basis.

N. John Kilian
Edmonds, Washington

NOTE TO SUBSCRIBERS

Following the advice of an independent publications analyst, we will no longer send issues to readers whose subscriptions have expired and not been renewed. Rather we will send additional renewal reminders. If you miss an issue before renewing, we will be pleased to send it if you will indicate the last issue received when you renew. Check your mailing label for your expiration date; why not renew for 2 years ($19) and save trouble?

In any event, please help us by renewing with the first notice (sent with your next-to-last issue) or before, and save us the expense of additional reminders.

Ed.

yedlin on micromounting

THE OLD ORDER CHANGETH: Kristalle of Laguna Beach, and Mineralogical Research Company of San Jose, both in California, are no longer purveyors of micromounts. Both Dona Leicht of the former and Sharon Cisneros of the latter have found that they cannot devote adequate attention to the distribution of the minute minerals, for they have never supplied other than ideal specimens, and their primary duties with cabinet specimens do not afford them the time and opportunity to select and supply suitable material. Of course their catalogs, in describing minerals available, should be read with care. Descriptions reading "Lined with minute crystals in vugs and seams" are clues to desirable micromount material.

YIELDING PLACE TO THE NEW: Two other dealers have come forth. Micromounts International, P.O. Box 649, Gatlinburg, Tennessee 37738, with H. Allan Mitchell as its head, is presently supplying the micromount fraternity (and sorority) with material from all over the world. "Mitch" is an old-time collector, who, in the course of visiting mine and mineral producers throughout the country during his business life, acquired superb specimens, and furnished such material to all his friends. His retirement, some years ago to Tennessee, provided him with opportunity to do so professionally. Presently he has confined his activities to micromounts.

The other new dealer, Micro World (Fred and Joyce DiVito) P.O. Box G, Idyllwild, California 92349, advises that it has taken over the micromount stock of Kristalle, and has coupled it with the material from its own collecting, begun in 1953 in the trap rocks of New Jersey. "Much of our present stock," says Joyce, "was collected underground, with the help of carbide lamps and 15 X hand magnifiers. We visited many of the 'classic localities' of the west, and collected solely for minerals with micromount potential". List number 1 is presently available. A couple of stamps brings it.

The issue of May-June, 1976, of the *Mineralogical Record* had a fine article by William Kohlberger on the minerals of Laurium, Greece. On page 121 of the issue he cites diaboleite as one of the minerals of the locality, and he states that his only reference is a photograph in the Encylopedia of Minerals, 1974, by Roberts et. al.

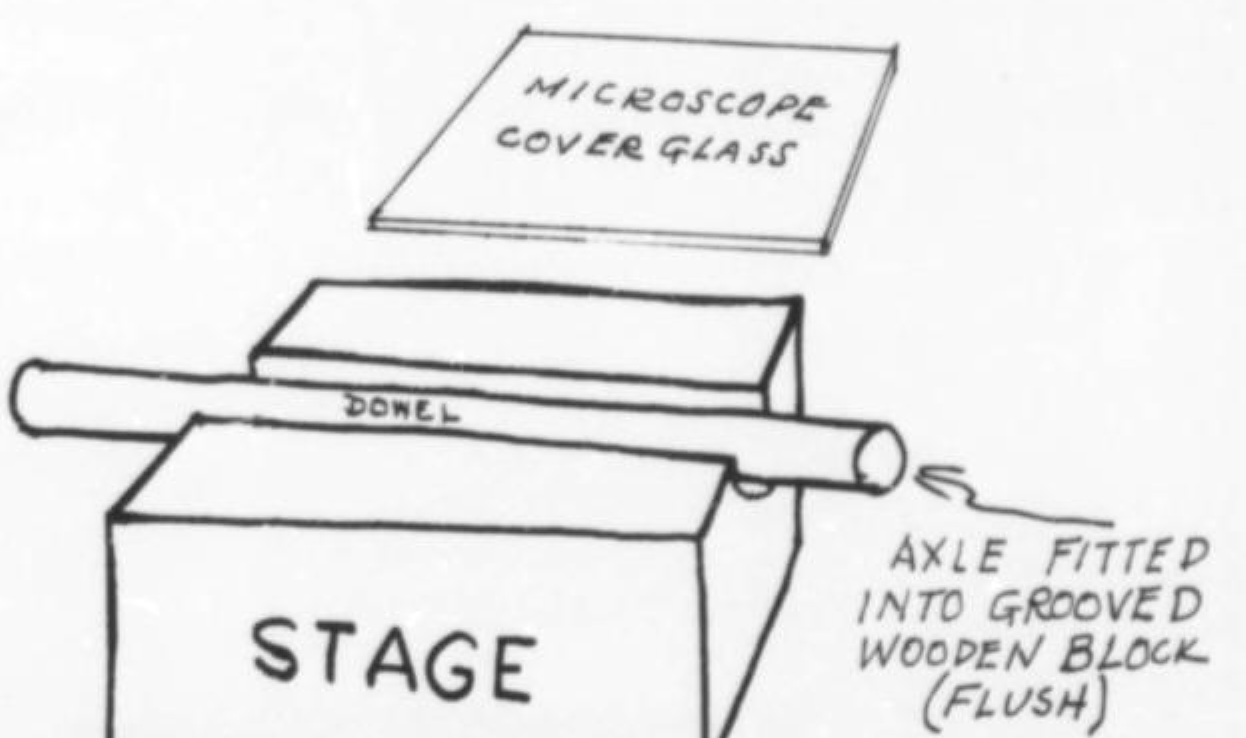
It has always been our conclusion that an error once published remains in the public domain forever, It becomes part of the litature, and as with all printed apologies for slander and libel, and corrections of other errors, such ammendments never reach all the people who have read the originals.

The diaboleite specimen shown in the Encyclopedia of Minerals is *not*, repeat, *not* from Greece. It is from the Mammoth-St. Anthony mine, Tiger, Pinal County, Arizona. It was mislabeled in the book, and will be corrected in the second printing. The specimen is ours, and is presently in our collection, associated with yedlinite (not shown in the photograph), and has been since we obtained it with an assortment of Arizona material some ten years ago from Schortmanns' Minerals. The original source of those Tiger minerals was Montgomery and Over. Bill Kohlberger probably has a memorandum about the diaboleite in this issue of the *Record.*

A note of warning. The last issue of the *Record* illustrated a method of converting a machinist's vise to a breaker. It indicated that a square file might be used as a cutter. Marty Plotkin reminds us that a file is made of high carbon steel, tempered to its hardest, and thus quite brittle, prone to chip and fragment, with the shrapnel flying in all directions. Right, but a retempering may resolve the matter. After the cutters have been made heat 'em to a glowing red, and let 'em cool slowly. This anneals the steel and pulls the temper. Reheat the bits, and let 'em cool to a dull red. Then plunge 'em into cold water. Bill Yost's breakers have had such bits for years. No trouble with ours, though so much depends on what you cut—its toughness and hardness. If there are any doubts use regular cold chisels, formed as bits. Most quarrymen use a rather soft steel for their chisels. Bob Mercer, superintendant of the New Street quarry at Paterson, New Jersey, when it operated as such, and produced some of the world's most famous zeolites and their associated minerals, once scoffed at the highly tempered chisel we were using to crack trap rock. He presented an old beat-up hunk of tapered, rusty iron. We have it yet, and have gotten more mileage out of it than all the other steels combined.

Bill Ulrich, 404 McNulty Place, New Hyde Park, New York 11040, a member of the Nassau Mineral Society and an ardent and ingenious collector, has created a tool which will assist in identification by means of external morphology. Measuring interfacial angles of minute crystals has always been most difficult, and normally requires a goniometer of precision and high cost. He's come up with a workable model which may be assembled by anyone. Let him detail it. He's included a number of photographs, which should aid in fashioning the instrument.

"The optical goniometer I have constructed is used to measure the angles between the crystal faces and is employed when the crystal is too small to permit the use of a contact goniometer. Crystals smaller than a half inch lend themselves readily



to this instrument, and very small ones can be checked, depending upon the developed skill of the operator. I can obtain readings within half a degree (30') of the published figures of any given crystal, which should be adequate for most identifications and checking tentative determinations.

"The ***microscope*** *that I use is an old B&L stereo. Only one of the eyepieces is employed. A monocular microscope could be substituted. The basic stage of the 'scope is removable. An aluminum stage of the same dimensions has been substituted. The goniometer is mounted to the aluminum stage.*

*"****The light source*** *is a B&L illuminator. This isn't critical, for I often use a Tensor lamp when making measurements.*

"The ***rotating stage*** *(see sketch) is about an inch in diameter and is made of hardwood. A groove has been hollowed out to provide a* ***friction fit*** *for the axle. A microscope cover glass is cemented over the shaft onto the block, and the shaft is thus visible for proper crystal orientation. The stage may be rotated independently of the shaft. I use 'double stick' tape to fasten the micro box or crystal to the stage.*

"The ***vernier*** *is a dual dial taken from an obsolete gear train. One revolution of the outer dial equals 360 degrees; the inner one encompasses 0 to 60 degrees, in half degree increments. This dial should be readily obtainable from manufacturers of electronic equipment, and surplus stores carry it.*

*"****Operation:*** *A mounted or (preferably) unmounted crystal is placed upon the stage in the proper orientation. The vernier dial is set at zero and locked. The light source is focused upon the crystal, about 4 inches away from, and above the specimen.*

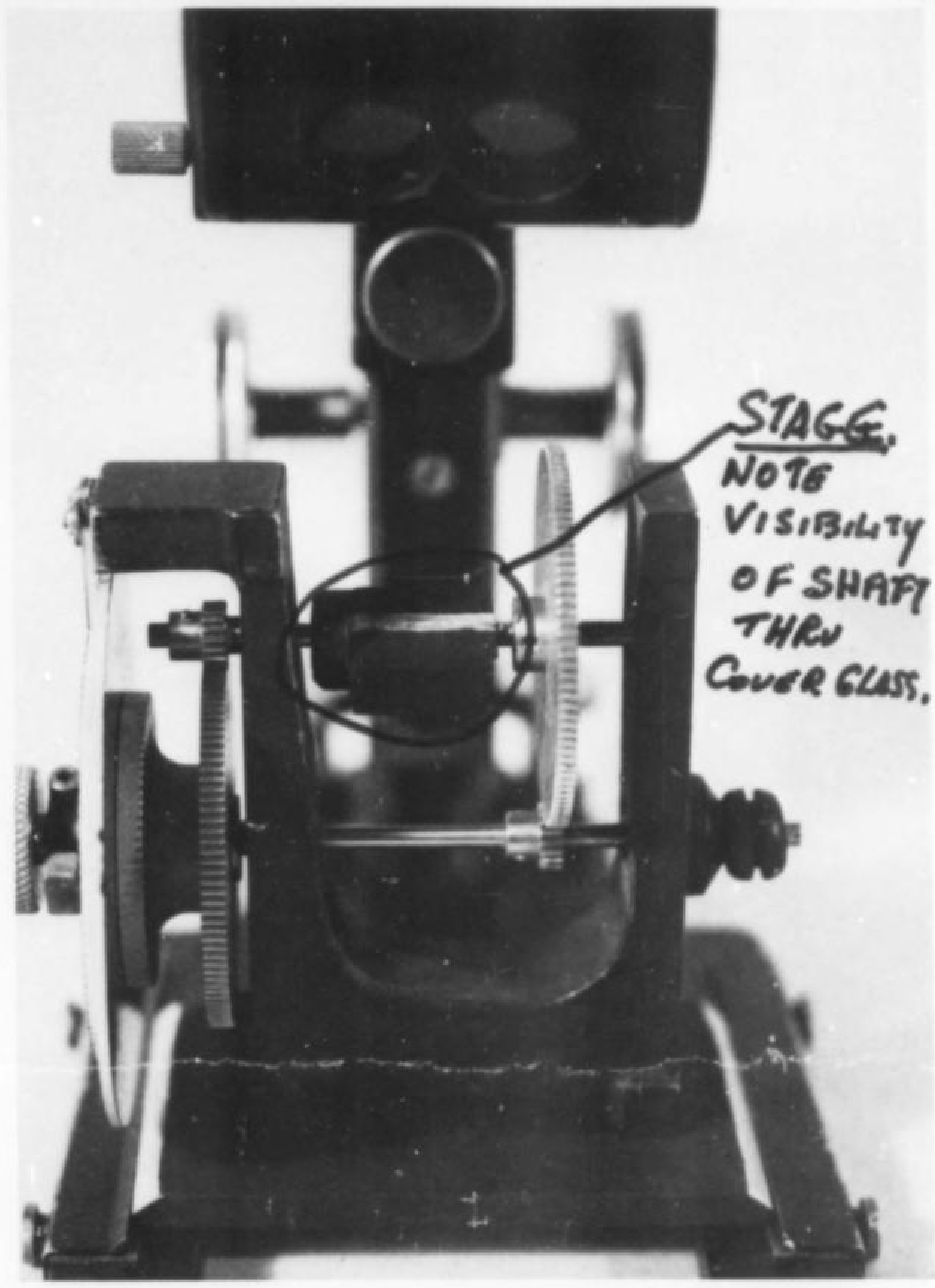


Figure 1. (left) **Bill Ulrich's self made goniometer for measuring interfacial angles of small crystals.**
Figure 2. (above) **Frontal details**
Figure 3. (below) **The vernier attachment**

The rotating stage is turned until one of the faces to be measured reflects light through the 'scope. The vernier dial is unlocked, and the dial turned until the light reflects from the second face to be measured. The angle is read directly from the dial. That's it. Repeat on other faces as needed."

From time to time we've discussed the vagaries of locality identifications as offered by some dealers and collectors who have made finds in the field. Too often are we confronted with deliberate misinformation, so that a finder's cache could be preserved from the inroads of others. This is a personal greed, and the perpetrator of such acts cares not for his associates, his customers, posterity or the permanent records of science. It is regrettable, but some areas of mineral collecting have deteriorated to a mere money-gathering affair, to the detriment of serious collectors, those who study the science and art, and ultimately to the ones guilty of such transgression.

There are situations, too, where carelessness rather than intent prevails, where the collector neglects to label his finds immediately, covers more than one locality before later unloading his car, trusts to memory, and is subsequently wrong by the hypothetical distance between hither and yon. His mislabelings are not deliberate, but result from a faulty memory, a haphazard mixing of gleaned materials, and a long period of storage without adequate locality identification. Again the mineralogical world suffers.

But what of the well-meaning individual who tries his best and whose best is so remote from reality that his information had better be left unsaid? The exact locality cannot be established adequately and a mere casual approximation of the site data ensues. To many collectors this is adequate, but to the student of mineralogical environments the loss of the exact *situs* is a fatal thing; the mineral cannot be studied completely.

Now this isn't new. Harry H. W. Stilwell wrote an article for the *Mineral Collector* in December, 1902, entitled "A Once Noted Prehnite Locality" Stillwell *tried* to give the details of the find. He wrote: "Some of the finest prehnites ever taken from the bosom of Mother Earth have come from the mountains surrounding the beautiful little village of Farmington, Connecticut, situated about fifteen miles from Hartford.....For the benefit of those who might wish to visit this place....I will give directions...as near as I can remember.

"When you leave the trolley at Farmington take a road running north (I cannot say just which road), follow this road for 5 miles. At a cross road turn to your left and go 5 miles further, then turn - well I am not sure which direction it is, but I think it is either north or south; follow this road for 5 miles and then cut across the fields for 5 miles more. If you do not discover any prehnite or deep excavations, which were dug by the ancient mineralogists, then you may be in the wrong place, and the best way out of it is to go back and start over again."

How about that! Go off for 20 miles, backtrack for 20, and start again. On foot, mind you. Guess they don't make men like they used to at the turn of the century. And Friends of Mineralogy take note. This is one of the best ways of preserving mineral localities - from everyone!

So buy and use a good mineral book, and wait for the new edition of *Dana's Textbook of Mineralogy*, (last issued in 1932) being done by Winchell, Skinner and Gaines, and due some time in 1977.

Neal Yedlin
129 Englewood Drive
New Haven, Connecticut 06515

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