the Mineralogical Record

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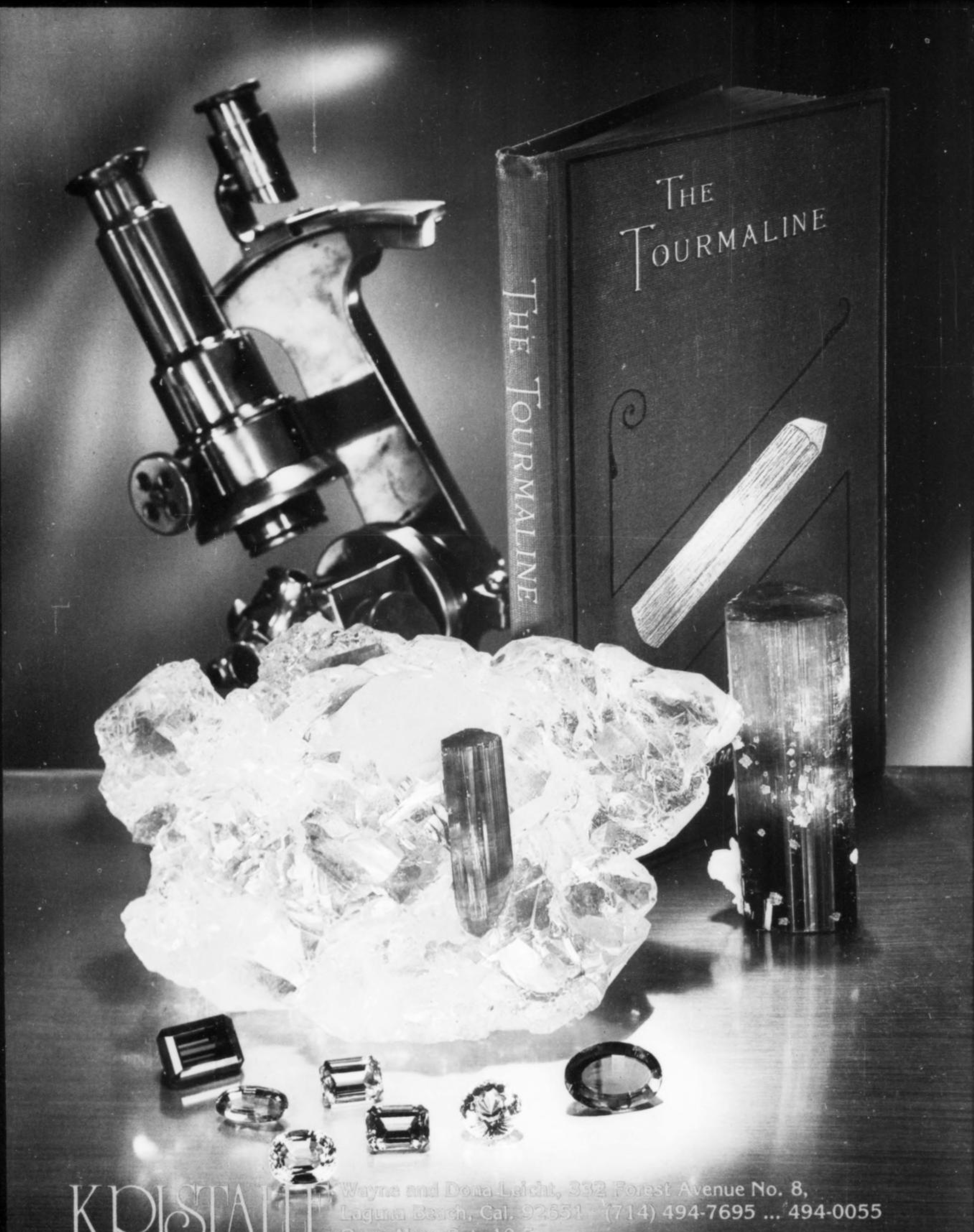

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November–December 1983
Volume Fourteen, Number Six

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COVER: SERANDITE, 3 inches tall, with analcime, minor natrolite and rhodochrosite, from Mont St. Hilaire, Quebec. The specimen is from the collection of the University of Delaware, a gift of Mrs. David Craven. See the article on this collection beginning on page 369 of this issue. Photo by Raymond Scheinfeld and Sharon Fitzgerald.

notes from the EDITOR

LIGHT ISSUE

Readers with a delicate touch will no doubt notice that this issue is a little lighter than usual. We have reduced its length by 16 pages so that our yearly total will come to the traditional 400 pages (the 1982 total was 412 pages due to extra financing for the Gold Issue). So there is no need to worry . . . it's nothing permanent. In fact, this issue marks a milestone for us: it is the fifth issue in a row to contain color photography, thanks to a grant.

It is also worth noting that four of our advertisers have chosen to present color ads inside the magazine for this issue . . . *Mineral Kingdom, Roberts Minerals, Western Minerals* and *Victor Yount*. This is in addition to the fine color ads provided on the covers by *Kristalle, Earth Resources* and *Pala International*. Needless to say, such attractive photographs of rare and remarkable specimens are difficult and expensive to produce. In my opinion they contribute significantly to the beauty and appeal of the *Mineralogical Record*. If you appreciate the effort, be sure to let them know.

MARKET TRENDS

Edward Brazeau is co-author of the *Standard Mineralogical Catalogue,* the only reference on mineral prices. His figures, periodically updated, are computer-compiled from many thousands of sale prices and appear, to me, to be surprisingly accurate. His intensive monitoring of the market over the last several years qualifies him to make learned commentary on trends. So I am pleased to be able to present his analysis here (before Louis Rukeyser snags him for a guest spot on *Wall Street Week*). He writes:

> The mineral specimen market has, in the last year, displayed an unexpected trend contrary to collectibles in general. New pricing has revealed that although the heated price rise trend of previous years has slowed, the trend is still up. This is contrary to other collectibles (such as stamps, speculative coins and diamonds) where the trend has been definitely downm in some case dramatically, due to the poor economy.
>
> Many minerals have actually dropped in price while others have continued to rise significantly. Rare minerals are mixed, with some falling and a few rising; overall the prices for these on the average have dropped slightly. Low-priced minerals and rocks have shown little price movement from previous levels. Average-quality material was more volatile, with many examples up and many others down. Overall, average-quality specimens rose very slightly in value.
>
> High-quality specimens have kept the overall price trend upward. The "gainers" have reduced in number from previous years but a few are still rising dramatically. Several of the "popular" minerals which gained dramatically in previous years have stopped rising and in a few cases dropped slightly. Aside from these, high quality/outstanding specimens have had a very good year. Lapidary materials, both high and low-quality, overall showed a slight trend upward. Premium material showed approximately the same gain as lower quality material.
>
> The continued upward trend of mineral prices has been something of a surprise to us, in light of what has been happening to other collectibles (which we monitor for comparison). The scarcity of high-quality specimens may be the answer, but in other collectible fields the best and rarest have frequently taken the worst price beating. Although it is debatable, we feel the relative lack of speculators and high dollar/quantity investors so commonly found in other collectible fields makes the mineral market more stable and predictable. The fact that mineral specimen buyers are mostly true collectors stabilizes the market and makes growth in value of specimens real and not an artificial result of speculation. It would be interesting to hear the thoughts of others regarding why the mineral market is the way it is.

E. Brazeau
1145 Foxfire Road
Kernersville, North Carolina 27285

Note: the sixth edition, Brazeau's 110-page *Standard Mineralogical Catalogue, 1983–1984,* is now available from the author for $5.85 postpaid. It contains 27,000 price listings. Write to Mineralogical Studies, 1145 Foxfire Rd., Kernersville, NC 27284.

ADVERTISING POLICY CHANGE

Because significant discounts apply, approximately 90% of our advertisers pay in advance for their advertising. The Board of Directors of the Mineralogical Record Inc. has decided that, in order to streamline our bookkeeping and eliminate collection problems, our policy as of January 1 will be that *all* advertisements accepted for publication in the *Mineralogical Record* shall be paid in advance of the closing dates. Discounts will apply when more than two ads are paid for at a time.

For convenient reference, our closing dates are now listed on the title page of every issue. These are the dates by which payment must be received and the exact space reserved. However, advertisers have an additional 30 days beyond these dates in which they may change the *contents* of the ad.

BACK ISSUES

We recently completed an inventory of our warehouse, and found a few copies of some issues we didn't know we still had. These are all from volume 3 (1972): numbers 3, 4, 5 and 6. Copies may be obtained for $6 each postpaid from the Circulation Manager, while they last.

MAGAZINES NEEDED

Donations of books and magazines to help build the *Mineralogical Record* library are much needed and are tax-deductible. Please write if you have items no longer needed. We can use, among other things, the following:

Lapidary Journal, 1947–1964
American Mineralogist, 1916–1960

Special thanks to Terry and Marie Huizing, Karl Brandl, Leonard Morgan, William Hunt and C. G. Nelson for recent donations of journals. W.E.W.

NOTICES

Died, Edgar T. Wherry, 96. During his long life, E. T. Wherry achieved distinction not only in mineralogy and crystallography, but also in chemistry, botany and ecology, and he played an important part in the establishment of *The American Mineralogist* and the Mineralogical Society of America. His biography and bibliography were published in the *American Mineralogist* (v. 60, p. 533–539, 1975), on the occasion of his election as Honorary Life President of the Mineralogical Society of America, and only a brief account of his mineralogical work will be given here. He was born and educated in Philadelphia, graduating Ph.D. from the University of Pennsylvania in 1909 with a thesis "Contributions to the mineralogy of the Newark Group in Pennsylvania." He taught at Lehigh University as assistant professor in mineralogy from 1908 to

(continued on p. 361)

Collector's Diary

Chuquicamata

and the Nitrate Pampa— Mark Chance Bandy, 1935

On July 17, 1935 Mark Bandy, the noted American mining engineer and mineralogist, left his home in Redfield, Iowa, to begin the long journey to Chile. The diary of his three-month expedition in search of mineral specimens for Harvard and the Smithsonian makes interesting reading.

Traveling to Chile in 1935 was a major undertaking, beginning with a bus trip across the U.S. to Boston, where Bandy met with Harvard Professors Harry Berman and Charles Palache. He also used his time in Boston to review Harvard's study collection of sulfates, borates, and nitrates – minerals that he would most likely encounter in Chile – and to obtain his passport and Chilean visa. From Boston, Bandy took a bus to New York City where he boarded the *Santa Rita,* a ship that was to take him through the Panama Canal to Callao and Lima, Peru and finally to Tocopilla, Chile. The voyage took from July 27 to August 10.

The entire collecting trip in Chile lasted from August 10 until his departure from Valparaiso, Chile, on November 7, a total of almost three months. During this visit Bandy collected at most of the important mineral localities in northern and central Chile. These included the famous copper mines at Chuquicamata, high in the Atacama desert, the nitrate pampa and the famous proustite locality of Chañarcillo. Bandy also spent a fair amount of his time looking at mineral collections, particularly in Santiago and Valparaiso. He was successful in obtaining some fine mineral specimens as well as meteorites, but he was frequently frustrated by the poor condition of many of the collections he visited.

Mark Bandy kept detailed diaries of his trips, which he bound for his personal use. To date, they have been seen by only a few fortunate people. His wife, Jean, a companion on many of his trips, recently consented to the publication of edited portions of his "Diary of a Mineral Collecting Trip Through Chile 1935." During the three-month trip, Bandy traveled a total of 16,564 miles and, as stated earlier, visited almost every notable mineral locality and museum in Chile.

We will begin the diary with Bandy's trip to Chuquicamata. He visited Chuquicamata soon after his arrival in Chile and spent nearly two months (from August 11 to October 1, 1935) visiting private collections and personally collecting at the mines in and around Chuquicamata and the nitrate pampa of northern Chile. Bandy knew Chuquicamata well and had many friends there, having worked there for five years, from 1929 to 1934; he used it as a base of operations for his many trips to the various localities. For this reason, we will see many entries referring to trips to or from Chuquicamata. Readers may wish to consult the article by Cook (1978) on Chuquicamata, which was published in the *Mineralogical Record* (vol. 9, no. 5, pp. 321–333).

It is important to remember that the diary has been heavily edited; his original entries are over 325 typewritten pages, many of which are of a nonmineralogical nature. Editorial comments are given in brackets. We begin with Bandy's arrival at Chuquicamata.

CHUQUICAMATA, CHILE

It seemed like old times to meet the bunch at the mine. Nothing had changed much. I met Bronkie and was glad to see Brownie again as well as Jerald. He seems to be having a lot of trouble with the equipment at the mine. So much of the equipment he doesn't know what it is for and the rest is about 50-50 in inability to use it. I showed him a lot. I told March a lot about the new dope on minerals from Chuqui [Chuquicamata], castanite being amarantite, hohmannite probably not a variety of amarantite, the so-called copiapite being sideronatrite, the so-called romerite being copiapite and the copiapite being triclinic not monoclinic. Also I gave them

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Figure 1. **Mark C. Bandy, Chile, 1935.**

all the dope on the new mineral lindgrenite. Likewise, quetenite being a variety of botryogen. March brought me down about 5:00 when Rene came for him. I stopped off at the club and looked it over and read a while before going to bed.

The next morning I was up a little after 7:00 and to the mine a little after 8:00. March suggested that I go up and see Julio Palacius about minerals. I did and the results were very gratifying. He has a number of good specimens. I didn't make a pass at them but will eventually. The climb to Santa Rosa was bad and I was well winded when I got there. Met a man named Wall who is evidently a real prospector. He offered me a piece of lapis from the south of Chile. Going up I collected a few good specimens, showy, of turquois. Coming down I found several good specimens of sideronatrite and one good specimen of sideronatrite and metavoltine. This was on the south end of C-2. There was a lot more sideronatrite but the rains had ruined it.

Walter brought me to the guest house and I got an airmail from Jean and the sun shone again. In the afternoon March took me to the mine and I covered Bench E-4 and found a little atacamite and a few specimens of chrysocolla. Coming out on E-3, at the north end I came across the much sought after and greatly desired lindgrenite. It was late so I left it for the next day. Home on the train; mailed some letters; tea, bath, writing and then Crocker came for me to go up for dinner.

The cocktails were good, the dinner was fine and the stock market up, especially utilities and American & Foreign Power. A fine evening. Home at 9:30 and to bed by 11:00.

Overslept as I wanted to get up at 7:00 and got up at 7:30. As soon as I got to the mine I went down and worked over the E-3 lindgrenite locality. Didn't work it long as they were drilling there and it was too dusty and bad. Tomorrow was a holiday so I put it off until then. One specimen was a fine one indeed. After taking the specimens in, I went up to Bench D-2 and found some good specimens of what I thought was scorodite or some iron arsenate, a dull, yellowish green mineral. Also found a good specimen in a vein of the colorless mineral that dehydrates so rapidly. I collected some for determination and in the afternoon it took me all the time available to determine it to be mirabilite. It dehydrated so rapidly that it was difficult to get a section made. Walked home with Bronkie and Jerald.

August 15th was a holiday and there was no one at the mine. I arrived and started in to clean out the lindgrenite locality. Made good progress and got about 75 good specimens. Made two trips and the last trip I had such a heavy load that I wore a great area on my shoulder into small blood blisters. Home about 12:00 and cleaned up for lunch and then sat and read and slept in the afternoon and wrote four letters. At 5:00 I went up to pay a duty call on Wheelers and they were in Tocopilla.

The next morning I didn't get to the mine until after nine as I waited for Vince to find the address of Al Millar in La Paz. He couldn't. An unsuccessful morning but I eliminated Benches E-2 and E-1 as mineral localities. I asked Mr. Sample [after whom sampleite was named seven years later] if I could get six boxes made to pack specimens in and he said that he would have to ask Mr. Wheeler first.

The next morning I went to Mr. Sample to see about the boxes and found that Mr. Wheeler had approved the order provided that I had enough money to pay for them. I was very indignant over the crack. Likewise, Mr. Wheeler wanted me to get a collection of specimens of lindgrenite to send to the States to the N.Y.C. office. I called on Julio Palacius and had a hard time giving him 20 pesos as a sort of retaining fee to collect minerals. He didn't want to take it but finally when I told him it wasn't my money he did.

I eliminated Benches C-3 and C-2 which only left the upper benches of the mine. At noon I cleaned up and then Dobbins and I went to Ballard's for lunch.

The next day, being Sunday, I wrote a while in the morning and then after the boys came down the hill from Montezuma (U.S. Weather Observation Station) we had soup and Delilah, Pres and I set out for Mina Quetena. Mina Quetena is being operated on a small scale by Mr. and Mrs. Fuss, formerly of Chuquicamata. At the time of this writing, Mr. F. was in Bolivia and Mrs. F. was operating the mine with indifferent success. The better botryogen, var. quetenite, locality had been covered up. However we obtained a number of good specimens of quetenite, salvadorite, coquimbite, fibrous, matted pickeringite, etc. The usual difficulty with sulfate dust and I left the mine with my throat sore and my eyes smarting and burning.

Mina Quetena lies about 5½ miles to the west and slightly north of Calama. It is reached by a very rough and twisting road. The altitude is about 9,000 feet. It was worked for some time during the war by a man named Green and is often called Green's mine. The ore mined has always been supergene sulfates. In the period of early working and in the recent attempt to reopen the mine, all the ore has been hauled down to the Rio Salvadore and treated by leaching in tanks. The resulting acid solution was run over scrap iron and the copper precipitated in this manner. A few areas of primary sulfides, almost entirely pyrite, have been exposed in the mine. Sooty

Figure 2. **An open pit at The Quetena mine; the walls are mostly rounded to tabular masses of iron sulfates.**

chalcocite in thin coatings is a common associate of the pyrite.

The mine is a network of veins of coarse comb quartz surrounding breccia fragments. No fracture pattern could be determined. Only a little copper was found in the limestone, and this in the form of malachite and possibly a little azurite. The limestone has been replaced by these hypogene copper minerals. The Chilean miners called such an irregular stockwork of veins a *rebosadero*. The veins now appear as cockscomb quartz lining the walls of the veins with a more or less open center occupied by limonite, often iridescent.

The supergene sulfates have replaced the volcanics to a great extent and bleached them white in many places. Due to replacement having taken place from the veins into the breccia fragments, the sulfates are often zoned and in the form of rough eyes or augens. The zoning is not always the same but commonly copiapite occurs in the center and botryogen, var. quetnite, occurs as an outside rim. Botryogen often rims limonite cores. Pyrite nodules are often rimmed by halotrichite. Pickeringite is commonly associated with botryogen and also with kroehnkite. Atacamite almost always occurs in the red, unbleached but somewhat altered volcanics. Coquimbite, light or purple in color, is usually close to sulfides and to the bleached volcanics. There is a very dark mineral commonly associated with it which may be coquimbite of a different color. Salvadorite [pisanite] occurs usually in round augens although it does occur in rims about other sulfates. Very commonly the soft, pulverent salvadorite has associated with it a great many other minerals. All are soft and incoherent and hard to collect and preserve.

Figure 3. **A caliche miner near Chuquicamata, standing beside his neatly stacked ore, 1935.**

A blue mineral, identified as a variety of spangolite, occurs on the north side of the pit associated with atacamite, kroehnkite (minor) and cupriferous gypsum. [This "spangolite" was later redescribed as bandylite. Unfortunately, it is unstable outside of the environment of the Atacama Desert of Chile.] The spangolite is a striking blue and occurs in flat, more or less skeleton crystals in many cases. It occurs along a heavy vein zone in a sort of chute, in red volcanics. The zone dips about 25 degrees to the east, away from the contact. Fine atacamite crystals are common in the upper part of the mine, in the red volcanics. It is apparent that the volcanics have oxidized to their red color due to the superposition.

OFICINA CHACABUCO

I arrived in Chacabuco on the night of August 29th. The trip from Antofagasta was made in the early evening and little was to be seen. I stopped and offered help to a stranded auto and just outside Antofasgasta I picked up a soldier for company. He was on his way to Pedro Valdivia so went the entire distance with me. In going through Baquedano I was stopped by the carabineros and had to show my carnet and driver's license. After he had recorded all the data I gave him a cigarette and drove on.

At Chacabuco I went to the General Manager's home and presented myself to Sr. A. de la Fuente. He was just eating his dinner and was surprised to see me as he had had no word that I was actually coming. He took me to the Casa de Huespedes himself and then ordered dinner for me. I hadn't intended to eat but he was so insistent that I did. I declined all varieties of liquor, much to his surprise. The guest house was a fine one with a very broad veranda with large tubs of plants. My room was large and spacious and the bathroom was all that could be asked for.

The meal was soon served and Sr. F. sat with me until the meal reached the course that he had been eating at his home and then he started in and finished the meal with me. He was a most engaging talker. He had worked at the San Jose mine at Oruro, Bolivia, and knew the camps in Bolivia quite well. He had a fair knowledge of minerals and could talk very intelligently about them. My mineralogical Spanish had been rapidly advancing so that the evening passed quickly in pleasant conversation and I only had to make use of a half dozen English words. A very engaging host and a very delightful evening. By 11:30 I was quite sleepy and he took his leave with an appointment for the next morning.

I had always heard of the famous hospitality that the nitrate oficinas were noted for but I supposed that during these times of depression this had been pushed to one side as so much else that makes life worth living. Yet here was an oficina, under Chilean management, extending a hospitality that had never been excelled in my experience of visiting mines, unless it was at Braden, Chile. The pampa of northern Chile has much in common with the moon in that it gets frightfully hot during the day when the sun shines on it and gets penetratingly cold at night when the sun withdraws its heat. At Sr. F.'s suggestion I took a blanket from another bed in the guest house and still I was none too warm.

Sr. F. was held up by business and did not come for me until about 10:00. He immediately took me to a certain pit in the pampa where I was able to get some caliche that contained a very high percentage of dietzeite, the sodium chromate that first came from the Oficina Louisa near Taltal. As we were returning from this place and looking for a purple caliche locality I asked Sr. F. how he told the percentage of nitrate in caliche or if he could tell it without an analysis. He said he had his laboratory with him and could tell within three percent the content as a rule. I was politely surprised and then he produced a fuse lighter and got it smoldering and then hammered on some caliche. Of course the nitrate burned, the ordinary non-hydrous salts didn't do anything and the hydrous salts boiled and formed an enamel. Any fool could have thought of that one but I was so dumb that such a testing apparatus had never occurred to me. Possibly if I had worked with nitrate any I might have but I doubt it. He stopped several times and showed me how it worked and each time it amused me as it was so simple in preparation.

We found the place where he had seen a beautiful purple caliche but there was none at that time. We worked around a lot and gave it up. I was interested to see what a large amount of agate was associated with the caliche sediments. The replacement of various types of sediments is self-evident and even he who runs can read that part of the history. I could not decide what type of sediment was most amiable to replacement and caliche development. Certainly the higher grades of caliche occurred in the finer sediments and I suspected the more arkosic varieties of fine sediments. I saw a large amount of course conglomerate that had been dug up. The pebbles had been more or less altered, some much more than others and the cement of the conglomerate had been replaced by the caliche. As a rule the coarse conglomeratic caliche only runs about 15 percent nitrate.

Fifteen percent nitrate was the lower limit of the shanks process ore while the process used at other oficinas, such as Pedro and Maria Elena, can use caliche down to 8 percent.

We stopped at one place that was working and he showed me some caliche ore than ran 35 percent nitrate and looked like a sort of coarse sandstone with a good percentage of some salt, certainly not like a rich caliche ore. The ore is all dug on contract. The men pile it up in rectangular blocks with straight sides and right angle corners and then they are paid by the cubic meter. The characteristic sight on the pampa is to see irregular, ugly, desolate looking holes with a trim pile of caliche near them.

Sr. F. was trying a system of leaching old dumps in place. Some of the old oficinas around Chacabuco, that were controlled and are controlled today by Lautaro, have large ripio piles than run 5 percent nitrate. Where the ground under them is solid and slopes in the right direction, Sr. F. has started leaching them. His recovery of water is remarkable when one considers the character of the general ground rock. His loss of water is from 10 to 37 percent. The water coming from the dumps is caught in a series of ditches and carried to central pumping stations and there pumped to evaporating tanks where he recovers a 40 percent nitrate salt. This is refined with the regular caliche. He took me to a set of the evaporating tanks and I was much interested in some beautiful, clear, octahedrons that crystallized on the sides of the tanks. They ran up to a quarter of an inch in size. I was sure they were salt crystals in spite of the octahedron shape and he was sure they were nitrate crystals. I knew that nitrate crystals were rhombohedral in shape and he didn't. We took some back to the car at his suggestion and tested it with his lighter. I was willing to admit that they were nitrate as he was the host. After he tested them and got a little flame from some admixed nitrates he was insisting that they were salt and I was trying to save his face by insisting that they were probably an impure nitrate.

We returned to the guest house with a number of ore specimens but no crystals of soda niter. Worse luck. I was thoroughly heated up when we got back and as I went into my room I said to Sr. F. that I would like to avail myself of the invitation to a gin and ginger that he had extended me the night before. He spoke to the servant who was just behind us and like the perfect servant he was he replied that two gin and gingers were awaiting us in the front room. They were and they were good. Afterwards, Sr. F. went home to lunch and apologized that I had to eat alone.

Figure 5. **Evaporating tanks at Chacabuco, Chile, 1935. Crystallized nitrate is shoveled to one side, and subsequently loaded into cars for transport to the stockpile.**

After lunch he appeared with a Chilean who was the plant superintendent. I never did get his name. Sr. F. then drove by his house and gave me a good crystal of calcite from near Taltal and two specimens of purple caliche and one very rare specimen shot through with blue. He thought that the blue color was due to cobalt. Possibly. At his office he turned me over to the plant man and we went through the plant. The Chilean had worked in the chemical lab at Chuqui when he was a student and remembered seeing me there. I didn't remember him but that didn't matter. We went through the unloading bins and the jaw and vertical Symmonds crushers and the belt transfers. Everything was frightfully dusty and one can go through such a plant and easily understand the pall of dust that marks every operating nitrate oficina. They size their crushed material into plus-1-inch, 1 inch to ±50 mesh, and dust. They load their tanks for leaching with a traveling belt. They put the coarse material on the bottom, then the finer material and finally heap up the tank with the powder. They leach it in vats with stronger and stronger solutions, finally wash them and draw the ripio out of the bottom of the tanks into cars. The solution, a deep orange from the chromium content, is run into evaporating tanks. When the solution is spent the mother liquor (agua madre) is run into tanks for use again. A little borax and salts of boron crystallize out early. This method of evaporation produces a 95–97 percent nitrate. If the mother liquor is allowed to crystallize to dryness 37 different salts form, the most prominent being, of course, sodium chloride and sodium sulfate.

I visited the iodine plant where enough iodine is produced from the circulating solution to fill the oficina's quota. The solution is drawn into tanks and then agitated by air as a sodium hyposulfite solution is added. This precipitates out the iodine in great clusters of crystals. The solution is run through burlap filters that take out all the iodine crystals. The iodine sludge from the filters is distilled or volatilized in iron cylinders and the vapors condensed in a line of 3-foot tiles.

Due to the value of the iodine, everything about the iodine plant is under lock and key; the stills, the filters and the kegs of iodine are kept in a vault. As they remove the iodine from the tiles they place it in small oak casks about 14 inches high and 10 inches across. These hold about 60 to 70 pounds of iodine. Two circles of a given size and a long strip of the correct size are cut from green cow hides and then sewn in the barrels, hair inside. The hide is branded on one end and data as to the oficina, the number of the cask, etc., are branded into the hide and then painted in. The casks are set aside to dry and when dry the hide shrinks greatly, thus binding the casks very securely and preventing theft. Certainly an odd way of doing up a commodity.

They make their own sodium hyposulfite in a spectacular manner. They take the dirty and somewhat impure nitrate and thoroughly mix it with charcoal. This mixture is shovelled into a basin 10 feet in diameter with a sloping floor and an open slit in the low side. A match is applied and the entire mixture flares up in a grand pyrotechnic display. The resultant soda ash (crude sodium carbonate) flows down and out of the basin into a second one where it forms a highly porous mass of light green color. The second basin is merely a hole in the ground. The soda ash is placed in tanks, under pressure and sulfur dioxide gas is introduced. This forms the sodium sulfite for the iodine plant. A crude but effective process.

I returned to the office of Sr. F. and got a specimen of fibrous caliche that was very good. I soon excused myself and returned to the guest house and passed the rest of the day reading and fixing up my specimens. In the evening I ate early, 8:00, and then walked over to the show with the servant. I offered to buy him a seat with me but he refused. The show was poor, Mandalay. The company owns the theatre and operates it at cost in order to give the workmen a cheap form of amusement. My seat, a box, cost me the equivalent of 8¢ gold.

A good night's sleep and an early breakfast. As I was eating Sr. F. came and apologized for not coming around the previous evening. We went to get the car and I found that he had had the mechanic go all over the car and put in oil and water and fix it all up for traveling. Such thoughtfulness. Good-byes were said with sincere regret on my part. And the marvelous part of it all is that they sometimes have as many as 165 guests in a single month at this oficina.

MONTEZUMA

After filling my car with gas, I met a fellow who asked to ride as far as the road to Maria Elena. I took him along and ate my can of tomatoes on the road. The entire trip was one lacking in events of any kind. I looked over the hill that was supposed to have a meteorite on it and I must confess that I doubt it greatly. I arrived at Montezuma at 5:30.

Sunday the first day of September dawned bright and clear; Maltby said so but I wasn't conscious to see it. I got up after he had the coffee on and finally dressed. A light breakfast and then after I washed the dishes or rather a few dishes, I left for Green's mine. Maltby had most of the dishes in the house dirty so they were left for the evening. At the mine I tried to get down the large quetenite-copiapite augen but only succeeded in getting myself thoroughly saturated with sulfate dust and hot and dry. I decided to use dynamite on it later. I got a few specimens and then in searching around came upon an odd looking blue mineral in peculiar crystals. I collected a number of good specimens and finally left about 3:30, thoroughly dirty and tired and hot.

The next day I drove over to Chuqui [Chuquicamata] to find out what the blue mineral was and to do different jobs there. I got a haircut and then couldn't find a mineral which would conform to the data on my other mineral listed. It belonged to the spangolite group I am sure, or a related mineral for the common habit was in basal, hexagonal plates, negative, No = 1.680±. Maybe it is a new mineral but I doubt it greatly. I picked up two of the new boxes I had made and left for Calama.

I stopped in Calama and made a date with Mrs. Fuss to go out to Green's mine the following day and see if she would let me blast down the specimen.

The following day I got breakfast and finished the dishes and met Mrs. Fuss just five minutes late. We went to the mine and I put in the two blasts but the cracks were large and I had no way of confining the action of the dynamite. As a result, since the sticks were too small, nothing happened. I did get some more specimens of the blue mineral and returned Mrs. Fuss to her home before noon. When I went for the mail for Maltby I found a telegram from Inch: "I have a specimen of crystallized cuprite and one of asbestos. Tell me where I can send them. Greetings, Inch."

The next day I got up and had an early breakfast and started out about 8:30 for the sulfate mine near Cerritos Bayos. I just knew that such a mine existed and that it was near the station on the west side of the road. I took the tank with me to get water at Du Pont for Montezuma.

From the station I soon came to a fork of the road and like a fool departed from my old time custom of always taking the left-hand turn. I saw some dumps in the distance on the right-hand turn and so went to them. Small, 2-foot barite-lead-silver veins. There were a lot of prospects on these little echelon veins in the Caracoles series of shales. Some massive barite on some of the dumps. I kept following the road much against my better judgment. I passed over a portazuelo and then ran down a canyon that evidently led to the Rio Loa canyon. I finally came to another fork and couldn't see that the road out of the quebrada was getting any place nor that the road down to the Loa would help me. I turned back and took a turn off of the road I had been on and soon came to a great pile of iron sulfate. No mine was in sight but a strong burro trail ran over the hills. I worked around on the dump for a while and found a lot of interesting material. I finally took all my hammers and moils and a box and started over the trail to the mine. It was a long up and down trail and a hot day. Finally I came to the area, a surprisingly large area of many pits and underground workings.

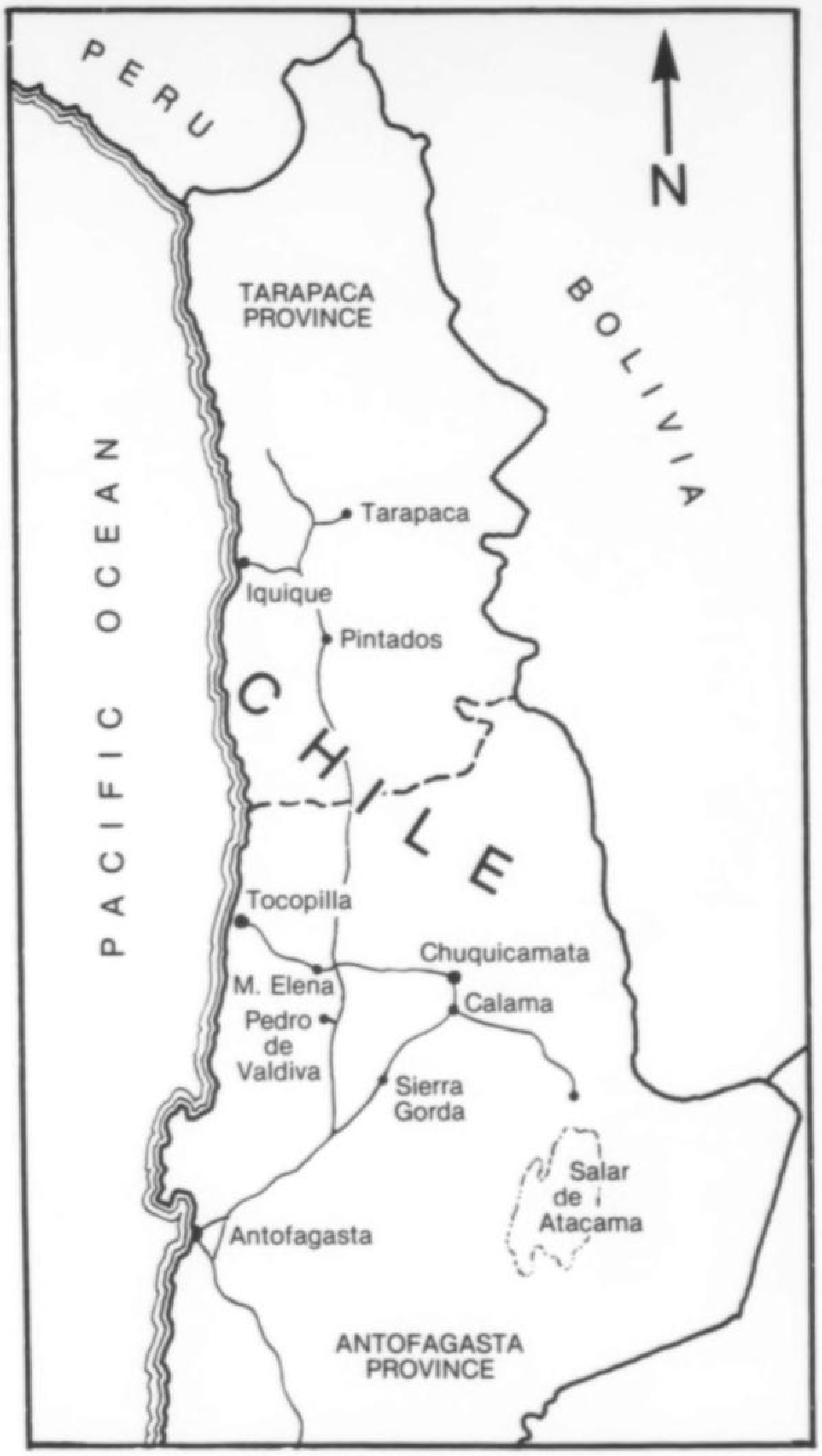
After a long and hard time getting out a number of specimens but most of all getting a great amount of iron sulfate dust in my eyes, nose and throat. I was almost frantic with the smarting of the sulfate in my eyes. Then came the long and hard job of carrying out about 100 pounds of specimens to the car. I made two trips and I was about all in. I carried my coat full of specimens and then carried a box on my shoulder. A hard grind and I felt it greatly.

When I arrived at Chuqui, I stopped at the Carmela and bought some supplies for Montezuma and then drove on over to the New Camp and to Dobbin's. I stayed for lunch and they had delicious fried albacore. After lunch I went up to the mine and looked up the one mineral I thought was darapskite. It was. I ran an optical index on it and proved it to be darapskite. I went up with Jerrall to get some kroehnkite that was supposed to be in the mine but there was none, only a couple of very inferior specimens. I went back to Dobbin's and packed my things in my suit case and took it down to the Guest House and left it with the girl there. I planned to go to the Guest House after I returned from Iquique.

The next morning I got a fairly early start for Mina Quetena. I arrived there about 10:30 and started in at once to try and blast out the large augen of botryogen and copiapite. The first stick shot out the rock underneath but didn't let the augen down. I poked around and poked around and all I managed to do was to get myself covered with sulfate dust again and get my eyes liberally filled with it. It was dangerous work. I went up on top of the quarry and tried to get down on top of it. All I succeeded in doing was to almost fall in the pit and then discovered some atacamite on the edge. I hung by a wire and got several specimens and then went back to poking around below. I broke off several specimens from the augen and had about resigned myself to those when I decided to clean out underneath the augen and place the other stick there and see if I could break off a large piece. I did and it worked. I had to pry it down but the piece broke out finally. The fall didn't injure it fortunately and I finally succeeded in getting it into the car. I collected a few more specimens of spangolite and called it a dirty and messy day. I was glad to end the work at Quetena and felt that I had a good suite of specimens.

After I arrived I started to pack the salt specimens from the Onyx mine. I dressed and shaved later and we arrived at the Pesches in due time, early in fact but it wasn't Maltby's fault that we didn't arrive even earlier. They had Fernie in for dinner. Gin and vermouth before dinner and I am none too keen on simple, un-iced cocktails before a meal. An excellent dinner and a pleasant evening of conversation afterwards. Pesches and Fernie were making plans to go to Iquina the following day, Sunday, to attend the famous religious festival. People had been leaving Calama for two days, walking the entire 40 or 50 miles as a sacrifice to atone for their sins committed during the intervening year. I would have liked to have gone but I couldn't take the time off.

Sunday dawned dull and cloudy. Maltby couldn't observe. And all this after I had got up at 6:30 and started the coffee so he could run a long method. I hadn't slept very well either as the cats kept me awake for some time. There was a hole in the roof and the two cats would get in under the roof each night and run about in the attic and thump on the thin ceiling and scamper around in a manner that couldn't help but keep a man awake. I straightened up a few things and then we both started for the sulfate mine near Cerritos Bayos. A nice trip and pleasant company. We went through every working and Maltby was greatly impressed by the thick efflorescence of halotrichite over many of the workings, "halotosite" he called it. A most successful day of mineral collecting.



I collected some interesting paragenesis specimens and some marvelous and large coquimbite specimens. Other specimens were very fine and too numerous to mention. We started back to the car with a crate between us containing about 150 pounds of specimens. We had to make numerous stops and both were glad to see the car. We loaded some of the specimens in the back and some of the more choice ones I carried on my lap in a box and in my hands and Maltby drove slowly and carefully most of the way back.

To be continued

NOTES *(continued from p. 354)*

1913. In 1913 Dr. G. P. Merrill, head curator in geology at the Smithsonian Institution, invited him to join the staff as assistant curator of mineralogy and petrology, succeeding Joseph Pogue, who had resigned to join the U.S. Geological Survey. During his time at the Smithsonian he published extensively on mineralogical topics. In 1917 he described merrillite as a new calcium phosphate mineral that Dr. Merrill had recognized as a meteoritic constituent in 1915 (it has since been identified as a significant mineral in lunar rocks). Among his important contributions at this time was the recognition that the South Dakota bentonite is an altered volcanic ash. He resigned from the Smithsonian Institution in August 1917 to join the Bureau of Chemistry at the Department of Agriculture as a crystallographer, to apply his skill in the use of optical techniques to identify crystalline compounds in such diverse materials as foods, drugs and insecticides – probably the first such application to practical ends. During his service at the Department of Agriculture he was still active in mineralogy, both as a researcher and as an editor of *The American Mineralogist* from its founding in 1916 until 1922. In 1923 he was elected the fourth president of the Mineralogical Society of America. In 1930 he was called to the University of Pennsylvania as professor of botany, and retired as emeritus professor in 1955.

Brian Mason
Smithsonian Institution

Microminerals

by **Bill Henderson**

Flat Twins, Fans and Balls

Shortly before it was closed, the nepheline syenite locality at Mont St. Hilaire, Quebec, afforded collectors a remarkable variety of habits of the rather common mineral rhodochrosite. The great majority of the crystals show the usual, simple, rhombohedral habit shown in Figure 1. The color varies from a pale brown with a slightly orange tint through a definite orange to red, deep red and red-brown. Some crystals, such as those in Figure 1, are in large part a pale color but have a skin or rind of much darker material. I will call these equant crystals *type I.*

Figure 1. **Equant rhodochrosite crystals, the largest 2.5 mm, from Mont St. Hilaire, Quebec. The crystals are color-zoned a pale orange-red with deep red-brown skins.**

Associated with the type I crystals are others of the same colors but of a completely different habit. These crystals, *type II,* are extremely flat, show a *c*-face, and are twinned! Figure 2 shows such a crystal on edge, flattened, and showing the reentrant angles indicating twinning. Most crystals (such as that in Fig. 3) do not show reentrant angles, but can still be recognized as twins since the bottom three faces of the rhomb are not rotated 60° out of phase with the top three but, rather, fall directly below them. Still another indication of twinning is that type II crystals show a trigonal outline (Fig. 3) while untwinned rhombs such as the type I crystals show a hexagonal outline when viewed down the *c*-axis.

Returning to the crystal in Figure 3, I have to admit that this one

Figure 2. **A flat, bright orange twin of rhodochrosite from Mont St. Hilaire, Quebec, 4.5 mm on edge. Re-entrant angles can be seen at the corners of the triangular crystal.**

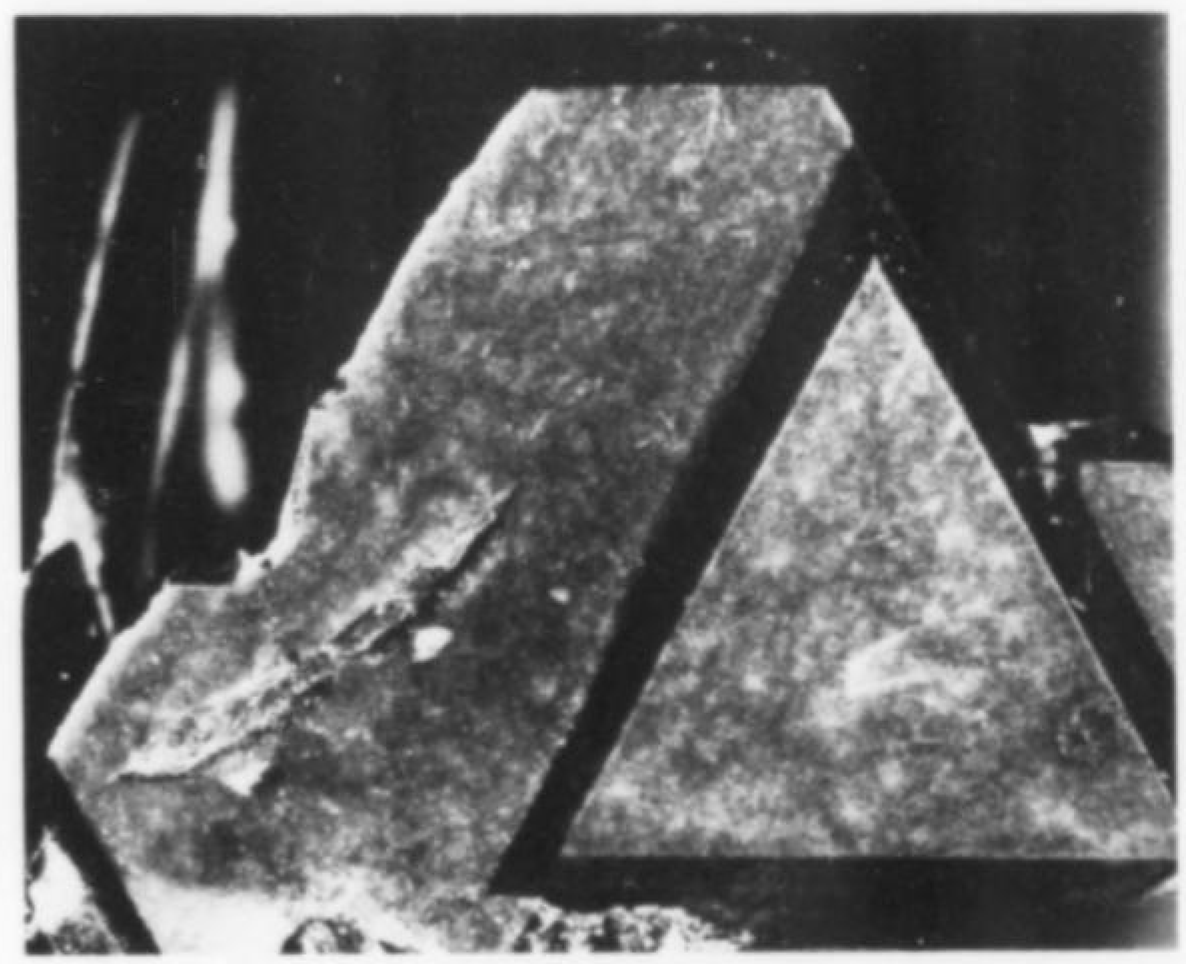


Figure 3. **A large (4.5 cm), extremely flat, twinned crystal of rhodochrosite from Mont St. Hilaire, deep red in color. Note on the left the mirror reflection of the same crystal viewed on edge.**

is a ringer and has no business in a column on microminerals. The crystal is 4.5 cm (not mm) on an edge, a very deep but still slightly transparent red, with lustrous rhomb faces but etched *c*-faces. The ghostly image to the left is a mirror reflection of the crystal viewed on edge, this to emphasize the extreme thinness of the crystal.

While this generalization of flat twins and equant singles held very well for the material collected at that time, I'm not trying to suggest that all twins are flat or that all flat crystals are twins. A clear exception is seen even in rhodochrosite from Mont St. Hilaire, some of which is paper thin (Fig. 4) and in saddle shape groups but

Figure 4. **Paper-thin, pale orange crystals, untwinned, of rhodochrosite; size of group is 3.5 mm, from Mont St. Hilaire, Quebec.**

shows no evidence of twinning. Still, a large number of rhombohedral carbonates show this tendency. Certain siderite crystals from Mont St. Hilaire show twinning and are moderately flattened. It should be mentioned, too, that a twinned rhomb cannot be flat relative to the untwinned rhomb unless it also shows another face such as the *c*-face. The siderite twins, like the rhodochrosite twins but unlike the siderite single crystals, do indeed show *c*-faces.

Calcite, another rhombohedral carbonate, also forms flattened twins, but the finest such crystals are twinned dolomites from the Lengenbach quarry, Binnatal, Switzerland. Such a twinned crystal, transparent as glass and colorless, is shown in Figure 5, while a sketch of such twins is shown in Figure 6. Again, the untwinned crystals of dolomite have an equant shape.

Figure 5. **Transparent, colorless, twinned crystal of dolomite from the Lengenbach quarry, Binnatal, Switzerland. Size of crystal, 2.0 mm.**

Peter Embrey, of the British Museum of Natural History, to whom I wrote about flat twins, pointed out another interesting thing about twinned crystals. He made the observation that twins are often larger than their untwinned brethren. As an example, he mentioned L-shape twins of calcite from Wheal Wrey, Cornwall, England. The twinned crystals are ten or more times the size of the untwinned ones. Note, too, that these twins are obviously of a different kind than those I have described which are twinned by reflection in the *c*-plane. The rhodochrosites at Mont St. Hilaire seemed to fit this rule. The largest crystals (such as that in Fig. 3) are an order of magnitude larger than the untwinned crystals associated with them. Similarly, Lengenbach dolomite twins are also larger than untwinned crystals.

Minerals need not be rhombohedral to form noticeably flattened twins. The diamond octahedron in Figure 7 is equant, while the twinned diamond in Figure 8 is flat. Note, again, the reentrant angles. These so-called *macle* twins of diamond are, as a rule, flattened. Interestingly, and unlike the rhombohedral crystals described earlier, a twinned octahedron need not show any faces other than octahedron faces in order to be flat. Two such octahedron faces take the place of the *c*-face required in the rhombohedral carbonates.

Many other isometric minerals are described in Dana as forming "flattened twins." Among them are galena, copper, uraninite, magnetite, spinel, fluorite, silver and gold. Flattened twins of magnetite, gold and copper taken from Goldschmidt are shown in the sketches in Figures 9–11.

Those readers who read carefully Robert B. Cook's article on Japan-law twins of quartz in the May–June 1979 issue of the *Mineralogical Record* will recall that they too are described as often being flat. Two such crystals are shown in Figures 12 and 13. The first of these is from a source for excellent micro Japan-law twins, Big Bug Creek, near Mayer, Arizona. The second is a superb, absolutely transparent twin from Denny Mountain, King County, Washington, a locality mentioned in Cook's article. Cook also states that Japan-law twins are often larger than untwinned crystals from the same pocket. Perhaps this is the reason Japan-law twins in micro size are not overly common!

Thus far, I have covered minerals in the isometric and hexagonal-rhombohedral systems which are normally equant but form flattened twins. Although minerals of the remaining systems may well do the same, clearcut examples do not come readily to mind. I can recall, however, one single occurrence of one of my favorite minerals where the reverse is seen. That is, bertrandite from certain pockets at the Strickland quarry, Portland, Connecticut, is found in flat *single* crystals but fat *twins*! In Figure 14 can be seen the normal, flat, untwinned bertrandite. Twinned crystals only a millimeter or so away form the fat crystals shown in Figure 15 and the fol-

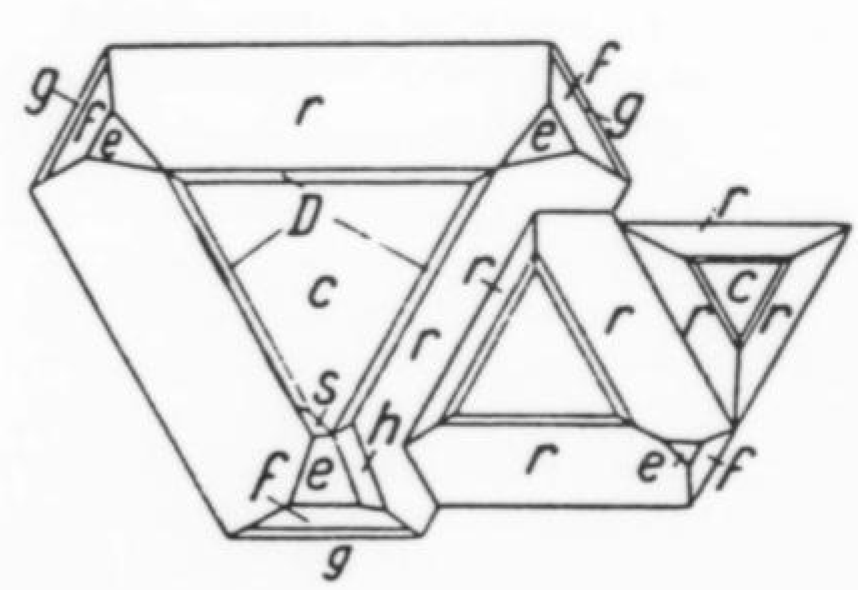


Figure 6. **Twinned crystals of dolomite from the Lengenbach quarry, Binnatal, Switzerland; after Parker, *Die Mineralfunde der Schweiz.***

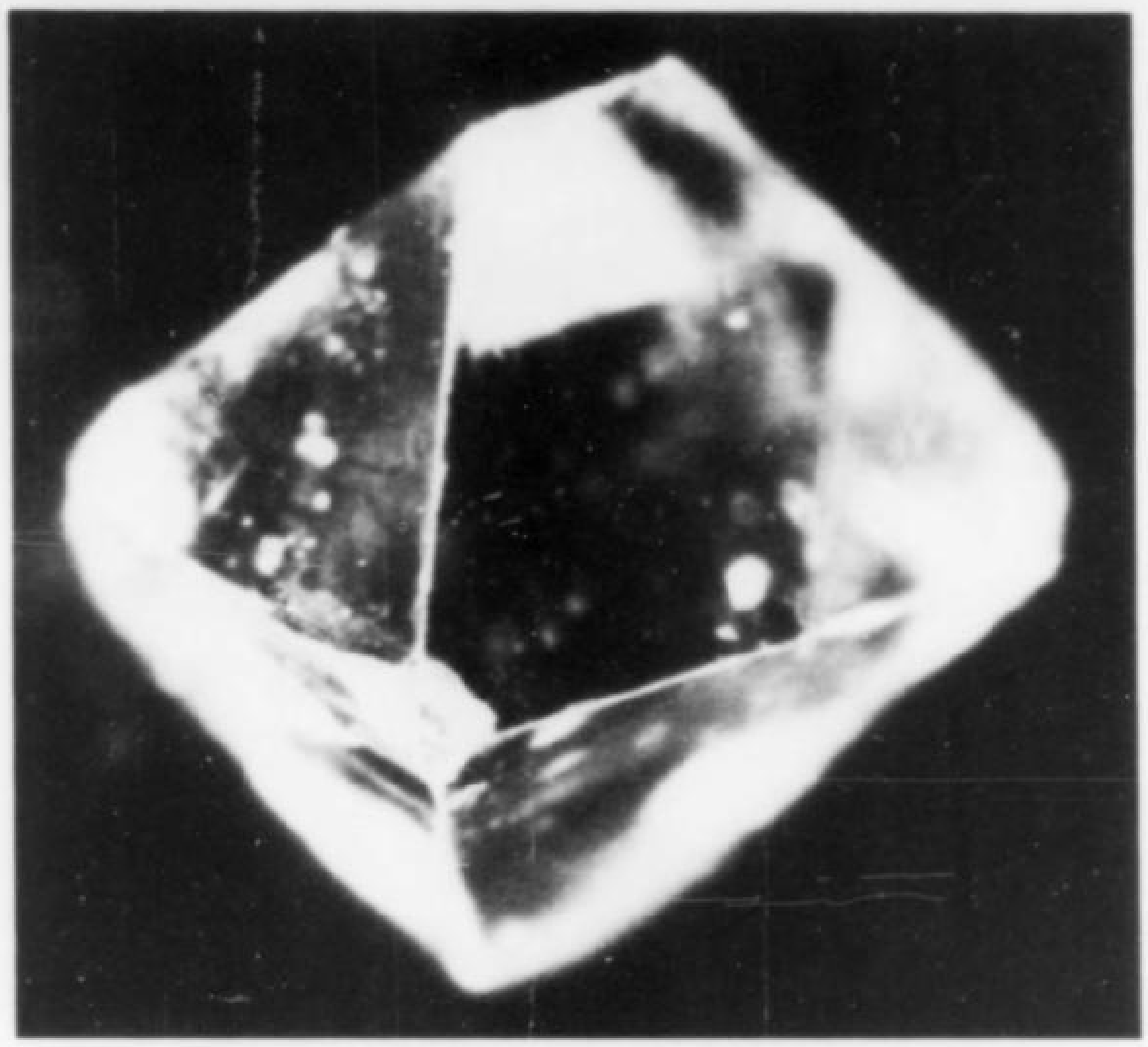
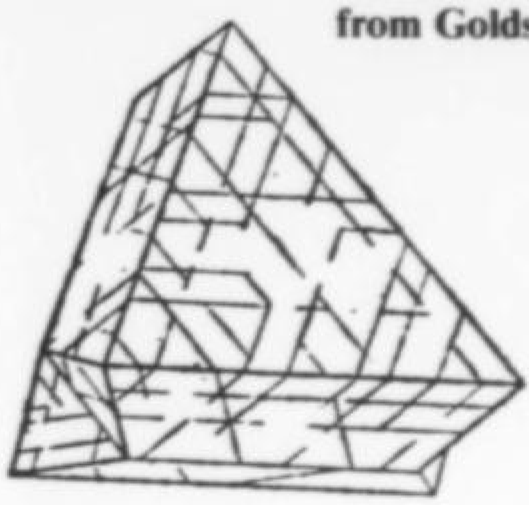


Figure 7. Equant, yellow, octahedral crystal of diamond from Kimberley, South Africa; 0.8 mm in size. A Neal Yedlin specimen.

Figure 9. Flattened spinel twin of magnetite from Goldschmidt's *Atlas der Krystallformen.*



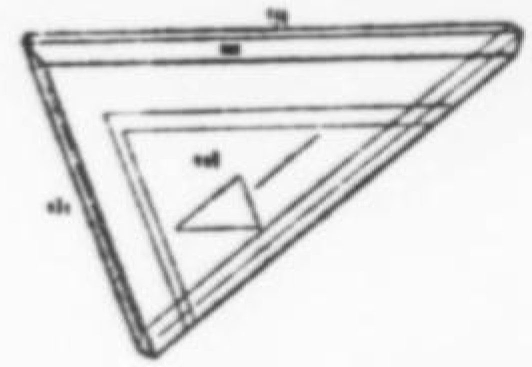


Figure 10. Tabular, twinned gold crystal; from Goldschmidt.

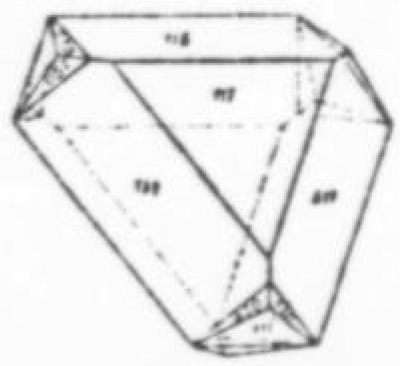


Figure 11. Twinned and tabular copper crystal; from Goldschmidt.

Figure 8. Colorless spinel or *macle* twin of diamond from South Africa. The 1.5-mm crystal is flattened parallel to the octahedron face and shows re-entrant angles.

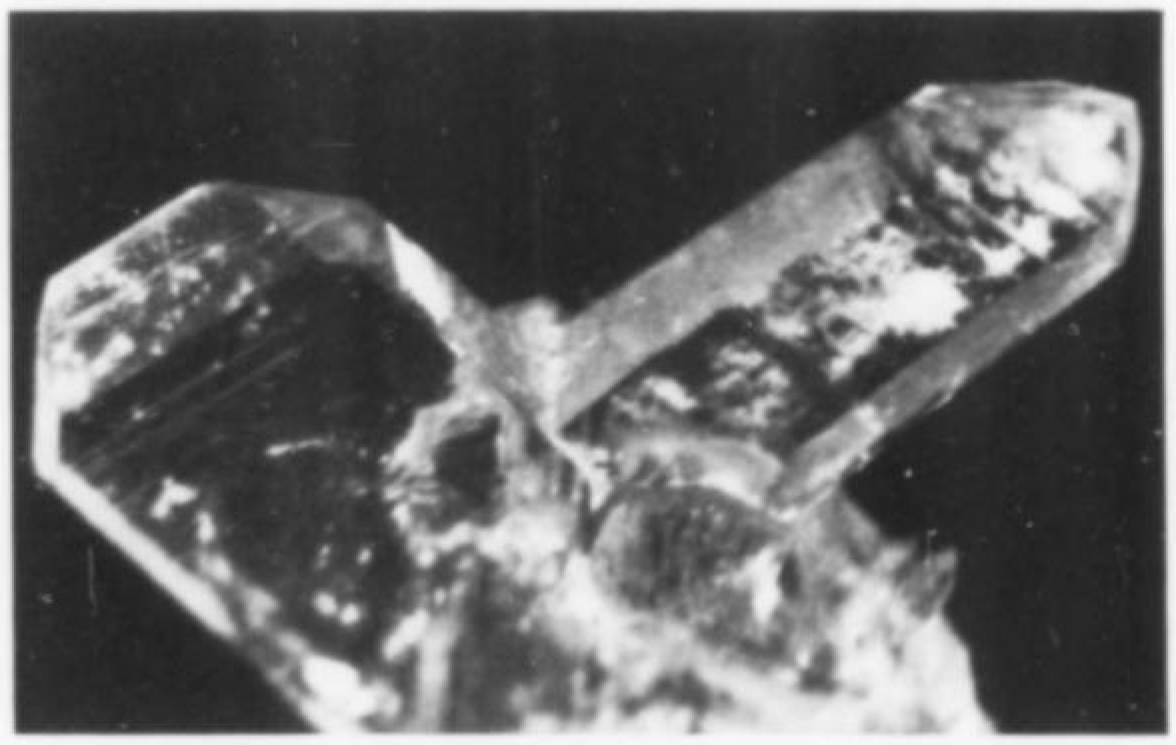
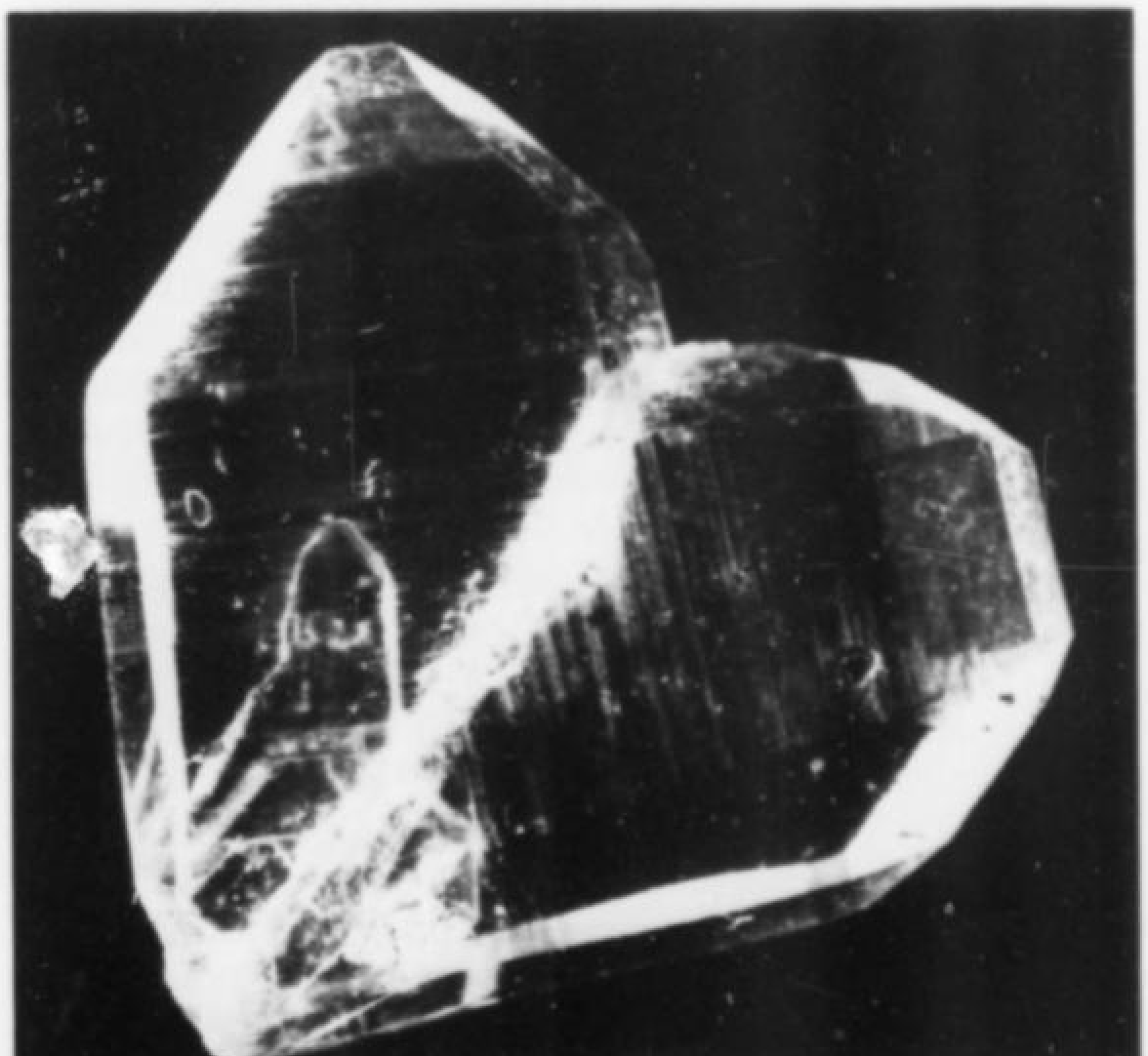


Figure 12. Colorless Japan-law twin of quartz, 3 mm in longest dimension and tabular. From Big Bug Creek, near Mayer, Arizona.

Figure 13. Colorless, very thin Japan-law twin of quartz, 12 mm across, from Denny Mountain, King County, Washington.



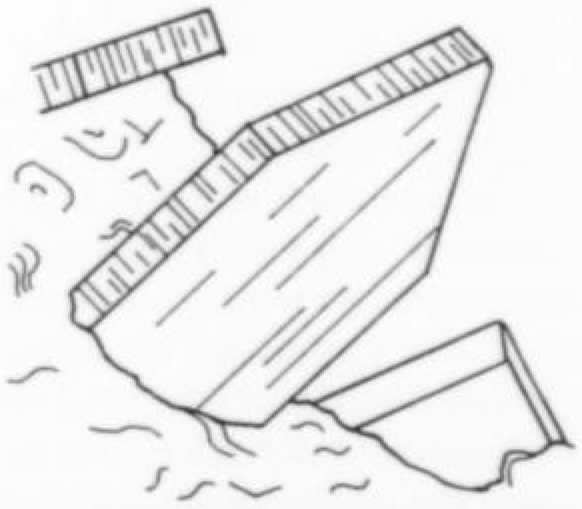


Figure 14. Colorless, untwinned, tabular bertrandite crystals from the Bierman quarry, Bethel, Connecticut. Largest crystal is 2.0 mm in length. Sketch by the author.

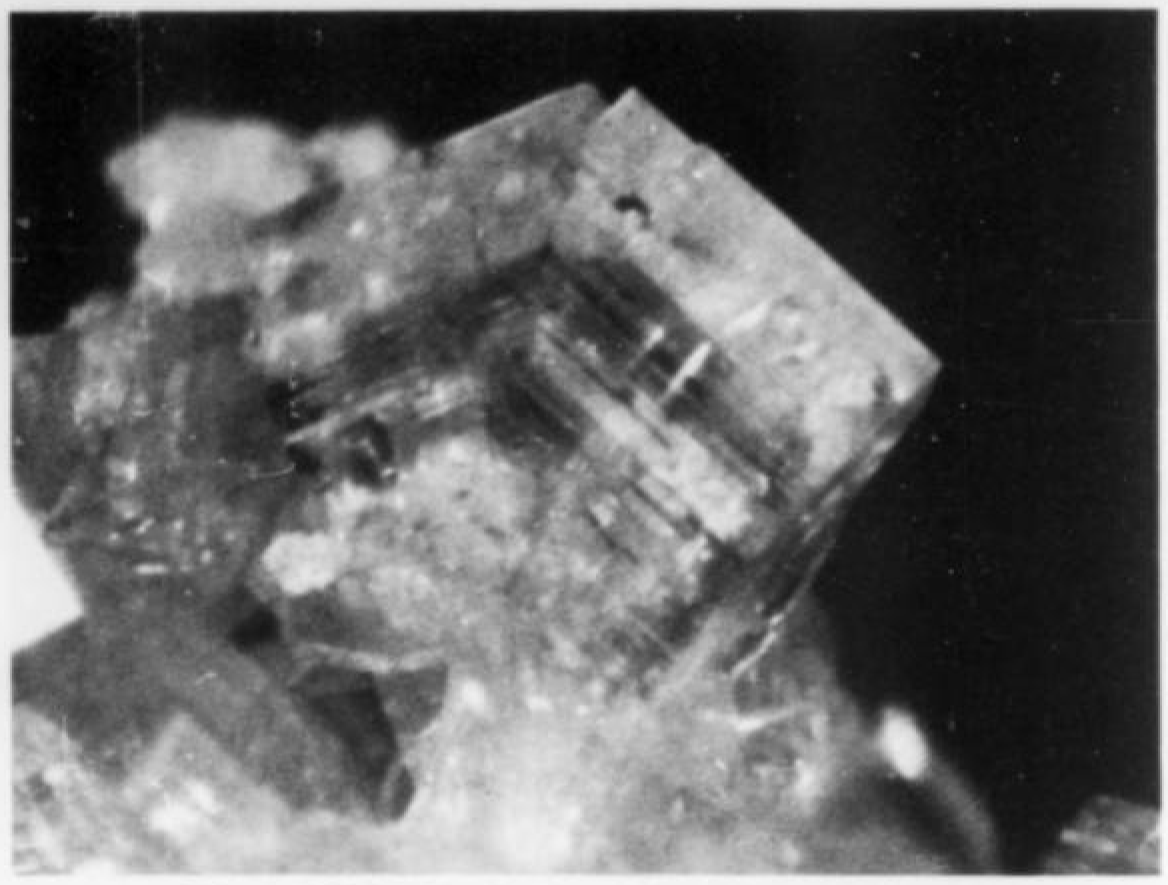


Figure 15. **Striated, fat twin of bertrandite, 1.5 mm across, from the Bierman quarry, Bethel, Connecticut.**

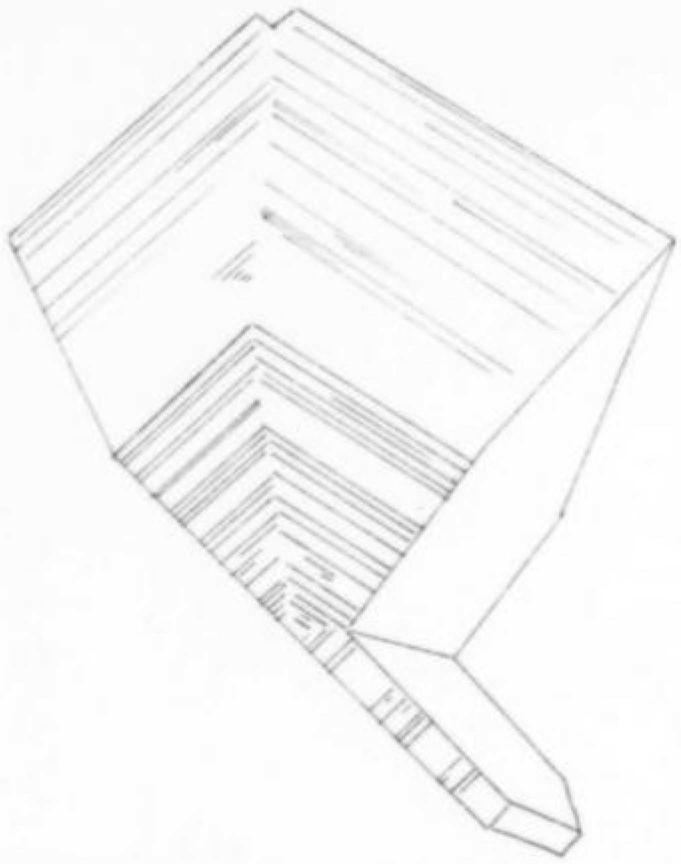


Figure 16. **Fat, twinned, 1.2-mm crystal of bertrandite from the Bierman quarry, Bethel, Connecticut. Bart Cannon sketch.**

lowing sketch (Fig. 16). Note the reentrant angles characteristic of twinning. The striations on the twinned and untwinned crystals used as a guide to see in which direction the crystal grows faster on twinning.

Now here is an interesting phenomenon, this business of flat twins of equant minerals. Still more interesting would be the answer to the question, why? I've pondered this one for some time, ever since I began searching my collection for examples other than the flat rhodochrosite twins from Mont St. Hilaire. I've also asked at least a dozen professional mineralogists why such a thing should happen. While a few have noticed it, not one has a good answer as to why.

At one time, I thought that perhaps the existence of the "other half" of a twin promoted faster growth of the twin in a direction intersecting the angle between the two halves of the twin (see Fig. 17). It is well known that a crystal has a hard time beginning a new growth layer, probably because attaching the first few weakly bonded atoms of a new layer is awkward in terms of surface energies. Perhaps, I thought, the already-present other half of the twin provides a preformed, albeit imperfectly oriented, corner in which to begin a new growth layer, thus making rapid growth on both reentrant faces of the twin possible. Returning to the apparently anomalous case of the fat twins of bertrandite, note that

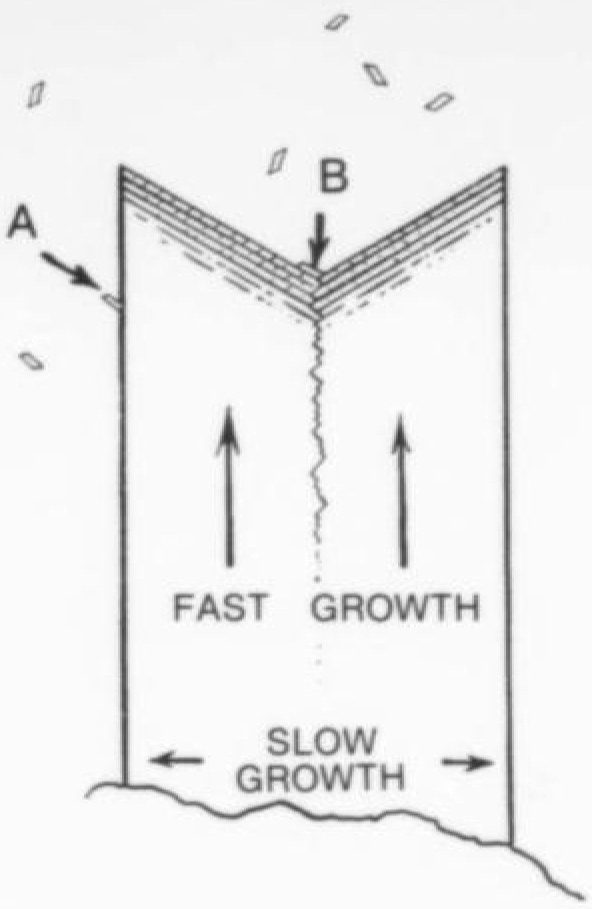


Figure 17. **A possible explanation for differential rates of growth of two crystal forms which, in untwinned crystals, have similar growth rates: Molecules in solution must attach to a single surface at A in order to establish the next growth plane, whereas molecules may attach more firmly to two surfaces at the twin reentrant point, thus more easily getting a start on the next growth plane there.**

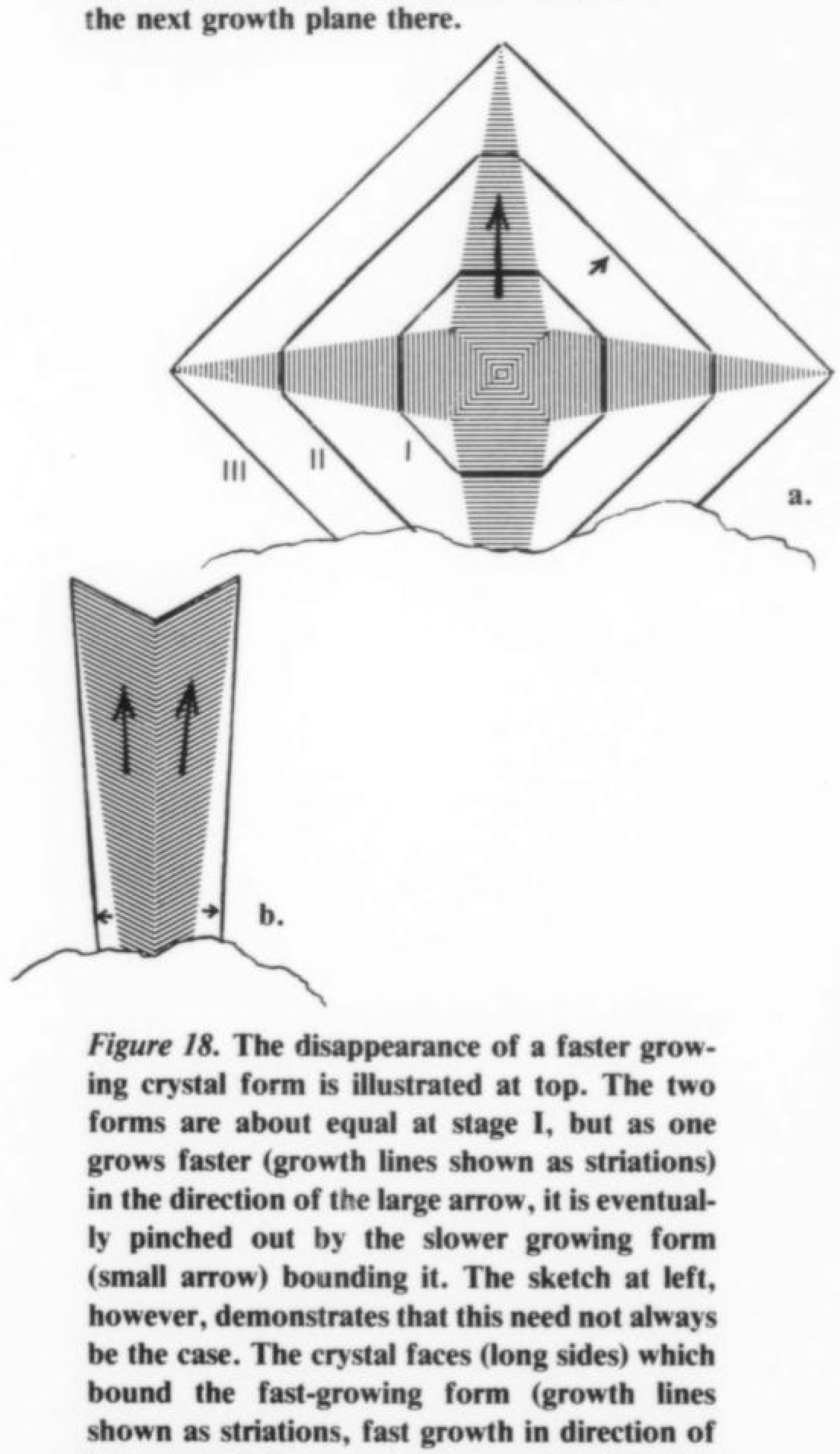


Figure 18. **The disappearance of a faster growing crystal form is illustrated at top. The two forms are about equal at stage I, but as one grows faster (growth lines shown as striations) in the direction of the large arrow, it is eventually pinched out by the slower growing form (small arrow) bounding it. The sketch at left, however, demonstrates that this need not always be the case. The crystal faces (long sides) which bound the fast-growing form (growth lines shown as striations, fast growth in direction of large arrow) do *not* converge, and so the fast-growing form cannot pinch out.**

rapid growth within the reentrant of the twin would fill out the twin and make it fat. Perhaps too this is the explanation for "filled in" butterfly twins of calcite as well as for filled-in Japan-law twins of quartz.

One possible objection to this argument is the old axiom that fast-growing faces will die out in favor of slower growing forms, as shown in Figure 18a. However, this is clearly true *only* when the faces bounding the fast-growing one converge. If they are parallel (like two opposing *c*-faces) or if they diverge, there is nothing to stop the fast-growing face, even if the bounding faces do not grow at all (Fig. 18b).

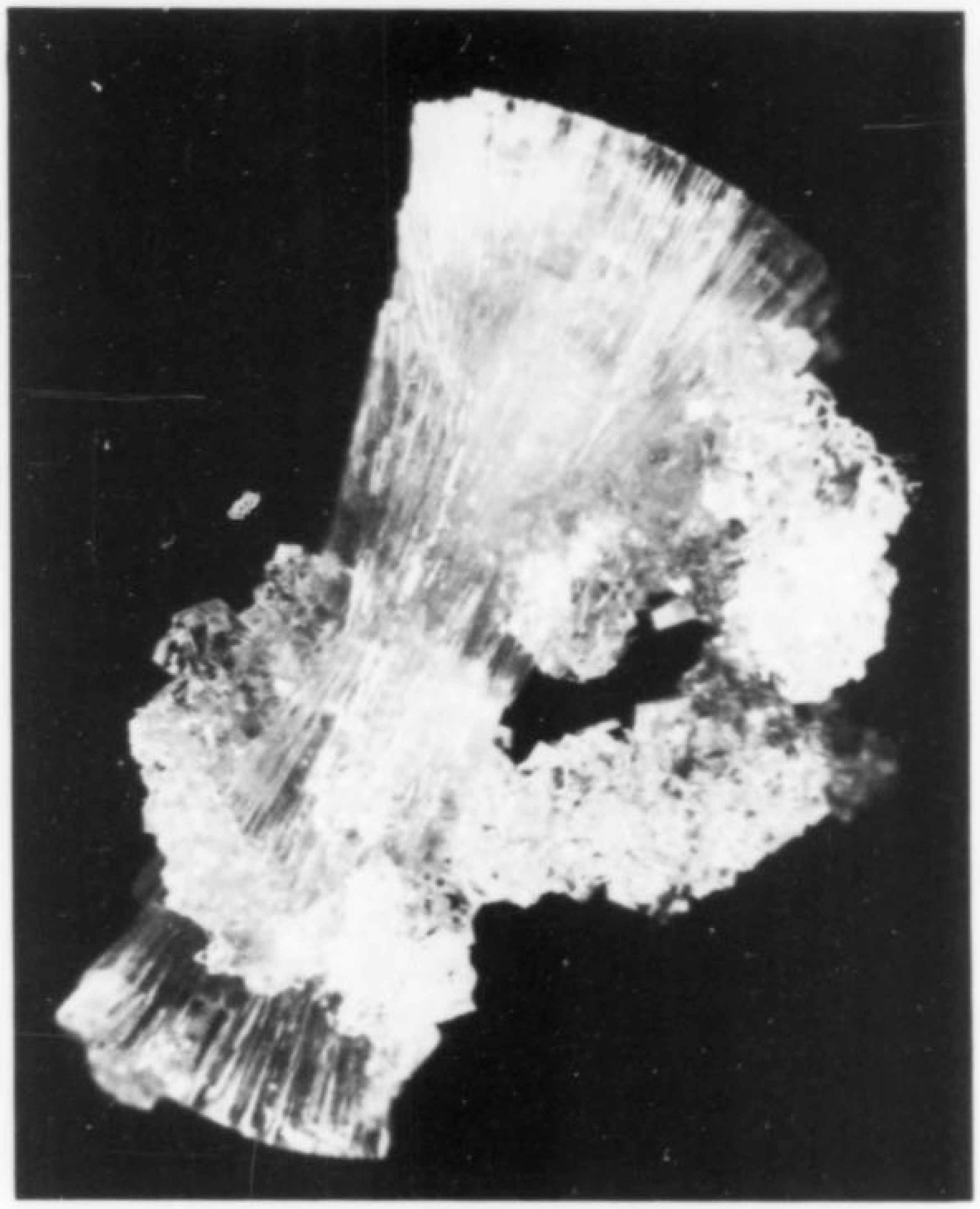


Figure 19. **Fan of stellerite crystals encircled by chabazite, from Lost Creek Dam, Douglas County, Oregon. Size of crystal group, 12 mm.**

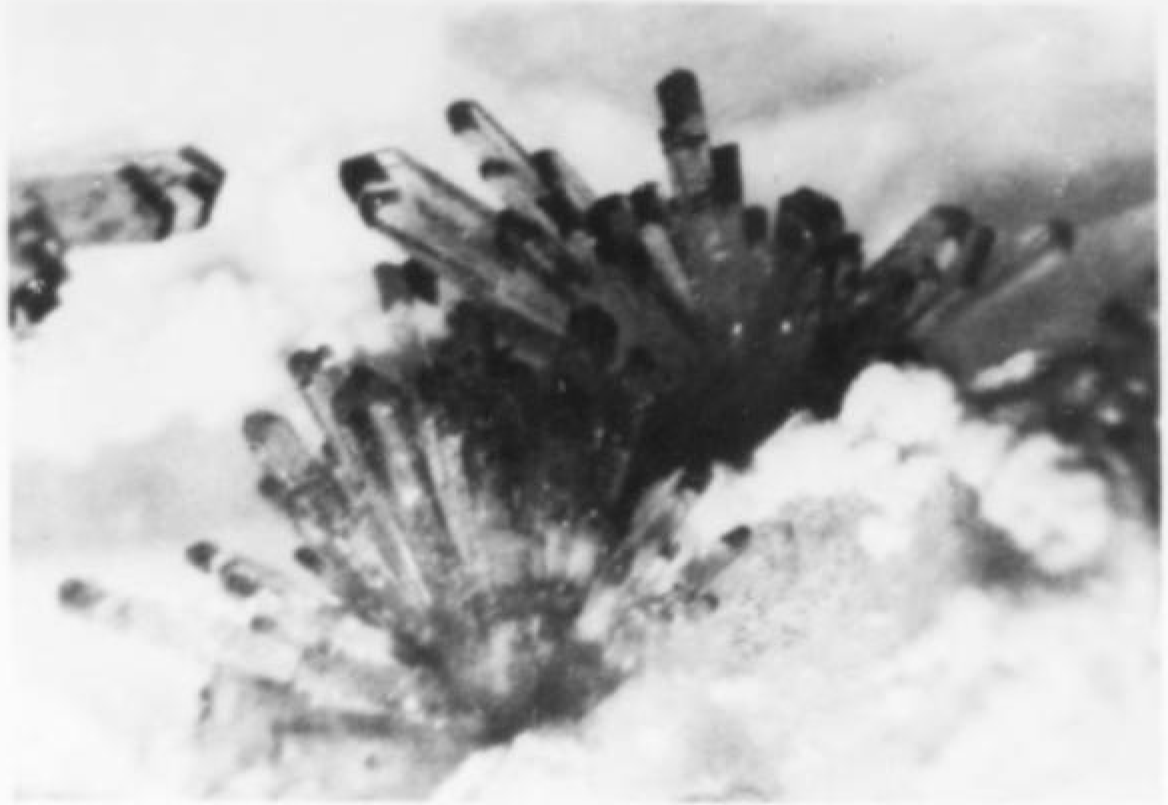


Figure 20. **Fans of transparent, tan eosphorite crystals, largest crystals 1.5 mm long, from Black Mountain, Rumford, Maine.**

Figure 21. **Esophorite crystals from Newry, Maine, to 3 mm, opaque and honey-brown in color. Bart Cannon sketch.**

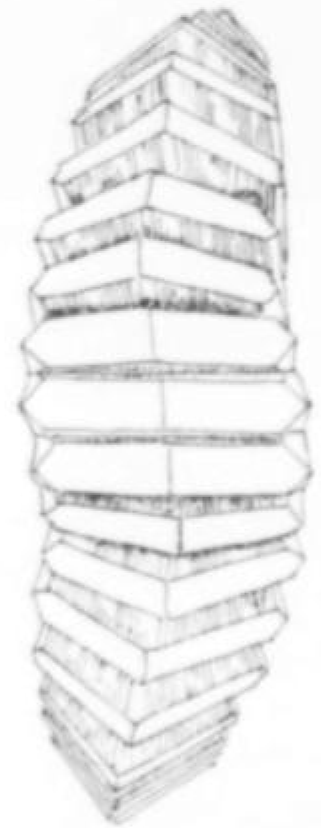


Figure 22. **Fan of colorless, transparent hemimorphite crystals with flat directions of crystal terminations parallel to each other. Crystal size, 2–3 mm. From Sweetwater, Tennessee. Bart Cannon sketch.**

The remainder of this column will be filled out with some observations on fans and balls of micro crystals. The clear and colorless stellerite from Lost Creek Dam, Oregon, shown in Figure 19 is partially encircled by smaller crystals of chabazite. They make a truly outstanding combination.

Of more interest are the eosphorite crystals from Black Mountain, Rumford, Maine, in Figure 20 and from Newry, Maine, in the following sketch (Fig. 21). The crystals in these two groups form in two-dimensional fans, but within each fan, the crystals are not randomly oriented. In the first case and, more obviously, in the second, it can be seen that the wide dimensions of the crystals are all parallel or almost parallel to the axis about which each fan of crystals is arranged. This orientation is much like that of the pages of a book when they are fanned open. It is not limited to the species eosphorite, either. Many other minerals which form fans of crystals do the same. Some examples are stilbite, adamite, ashcroftine (to name a rare one), aurichalcite and hydrozincite. Still another such mineral is hemimorphite, an example of which is shown in Figure 22.

In addition to fans, balls of lath-like crystals also often show a similar orientation about the axis of rotation. The ferrierite in Figure 23 is such a mineral. Close inspection will show that here also, many groups or sub-groups of crystals making up the crystal ball have the long dimensions of their terminations parallel. These ferrierite crystals vary in color from a light cream to orange or orange brown. For my money, they are the world's finest micro ferrierites. Another example of such parallel or sub-parallel terminations on radiating crystals forming botryoidal groups are the stilbites from Newtown, Connecticut, shown in Figures 24 and 25. These crystals are colorless and glassy clear, and occur with other stilbites arranged in fans. With them is found fine chabazite of a deep golden yellow color, often showing color zoning and two types of twinning, a nice combination.

Again, why are the crystals making up these fans and balls not randomly arranged? Unlike the case for twins or crystals in parallel growth, there is no recognizable and consistent relationship between the atomic planes of one individual and another. For that matter, why do so many minerals form fans and balls at all? Clearly, during the very early stages of growth, there is some mechanism which causes a multitude of crystals to begin growing at a single point. Further, that mechanism causes the crystals to grow as though rotated about a single crystallographic axis. Perhaps some day I'll know the reason why.

The mineralogical world is full of little curiosities such as those covered in this column. Micromineral collectors are in a unique

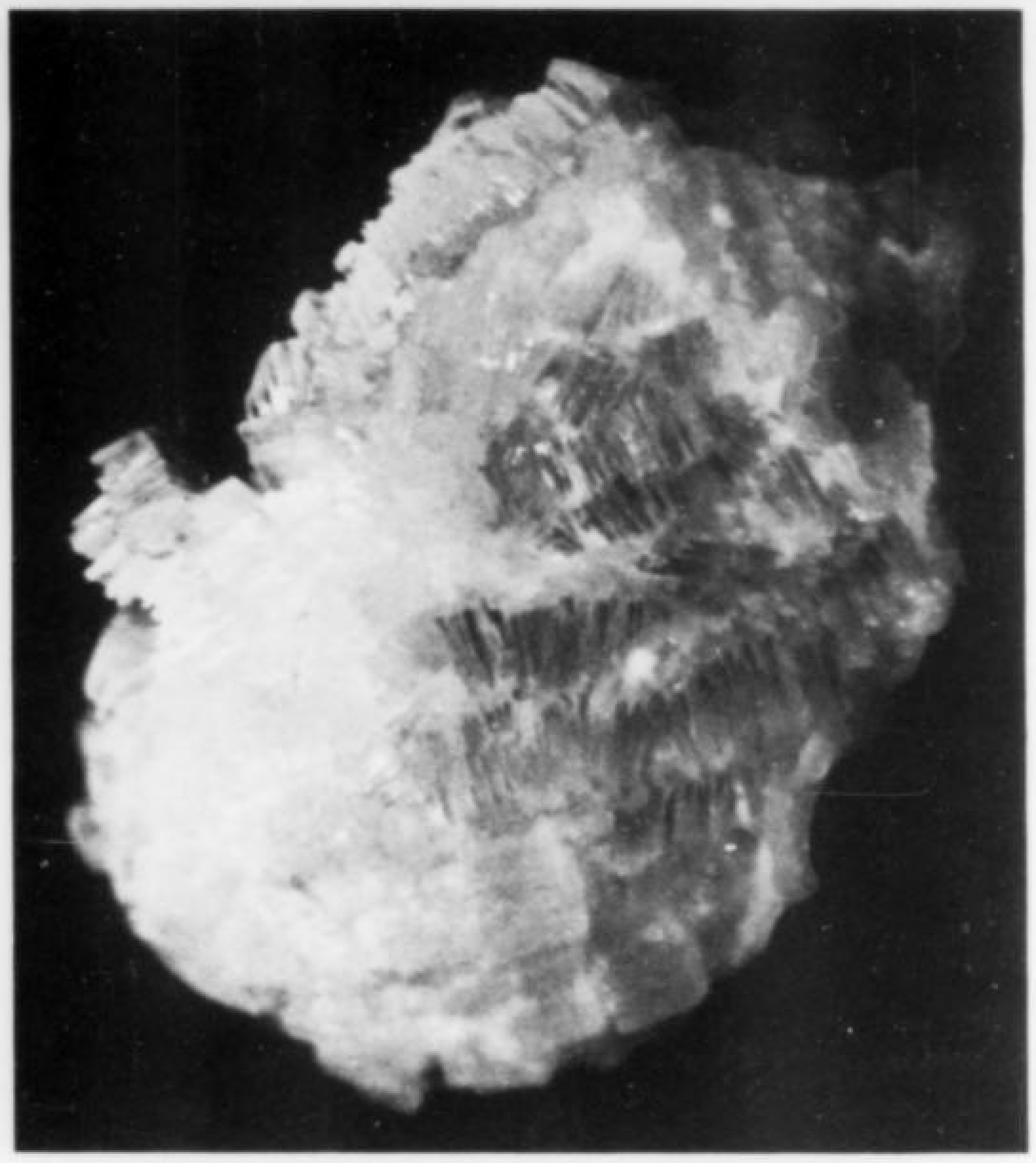


Figure 23. **Ball of radiating, salmon-color ferrierite crystals, 7 mm across, from Kamloops Lake, British Columbia.**

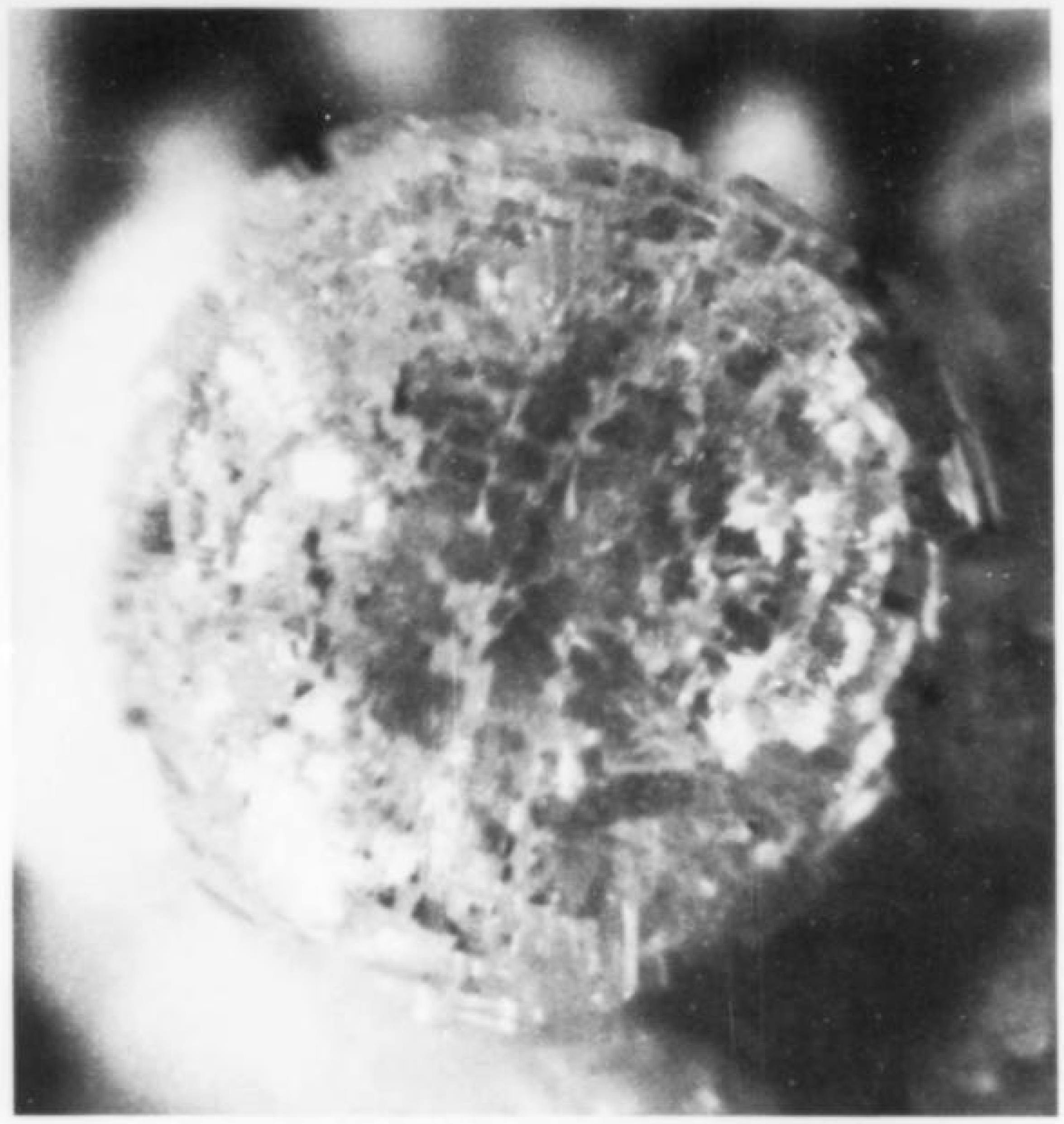


Figure 25. **Stilbite ball of colorless, radiating crystals, 5 mm across, from Newtown, Connecticut.**

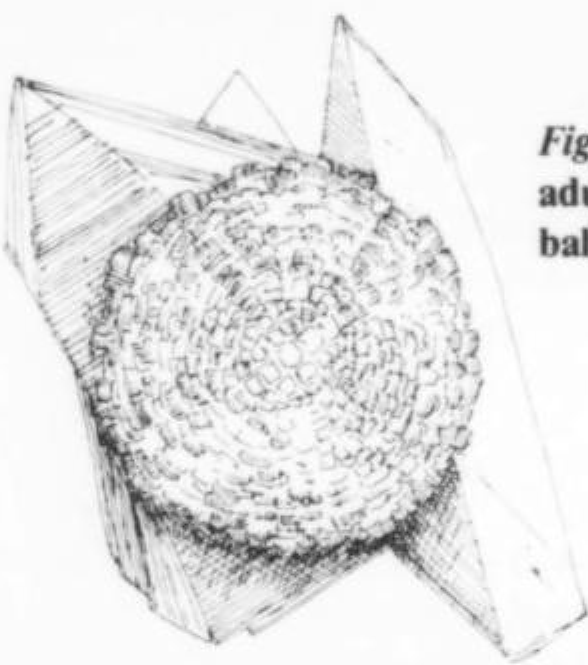


Figure 24. **Radiating ball of stilbite crystals on adularia from Newtown, Connecticut. Crystal ball 4 mm across; sketch by Bart Cannon.**

position to observe them, since so many such phenomena are only to be seen in small crystals or through the microscope. I hope this column will inspire readers to seek out and ponder other such curiosities on their own.

Happy hunting!

Wm. A. Henderson, Jr.
174 East Hunting Ridge Road
Stamford, Conn. 06903

The University of Delaware Mineral Museum

by **Peter B. Leavens**
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Department of Geology
University of Delaware, Newark, Delaware 19711

Photography (except as noted) by
Raymond Scheinfeld
and Sharon Fitzgerald

The late Irénée duPont was an enthusiastic mineral collector. His collection, accumulated between the years 1919 and 1933, was subsequently donated to the University of Delaware, where it has formed the core of an ever-growing collection of superb display pieces and study specimens.

The University of Delaware at Newark enrolls about 13,000 undergraduates, including about 150 undergraduate majors and 30 graduate students in geology. Directly inside the front door of Penny Hall, the geology building, is the Irénée duPont Mineral Room, which houses the mineral collection of the University. The collection contains about 6000 minerals, gems and carvings; about 1000 of the most beautiful and interesting specimens are on display.

The late Irénée duPont assembled what is now the core of the collection. He was born in 1876 and served as president of the Du Pont Company from 1919 to 1926. He had been interested in minerals for a number of years when, in 1919, he purchased the remarkable mineral collection put together by George Kunz, which Tiffany & Company displayed in their Fifth Avenue showrooms in New York City. DuPont paid the then very substantial price of $27,000 for the collection of about 2000 specimens. Among the outstanding pieces in the collection are crystals of kunzite, including one illustrated in Kunz's 1905 book, *Gems, Jewelers' Materials, and Ornamental Stones of California*. Other pieces in-

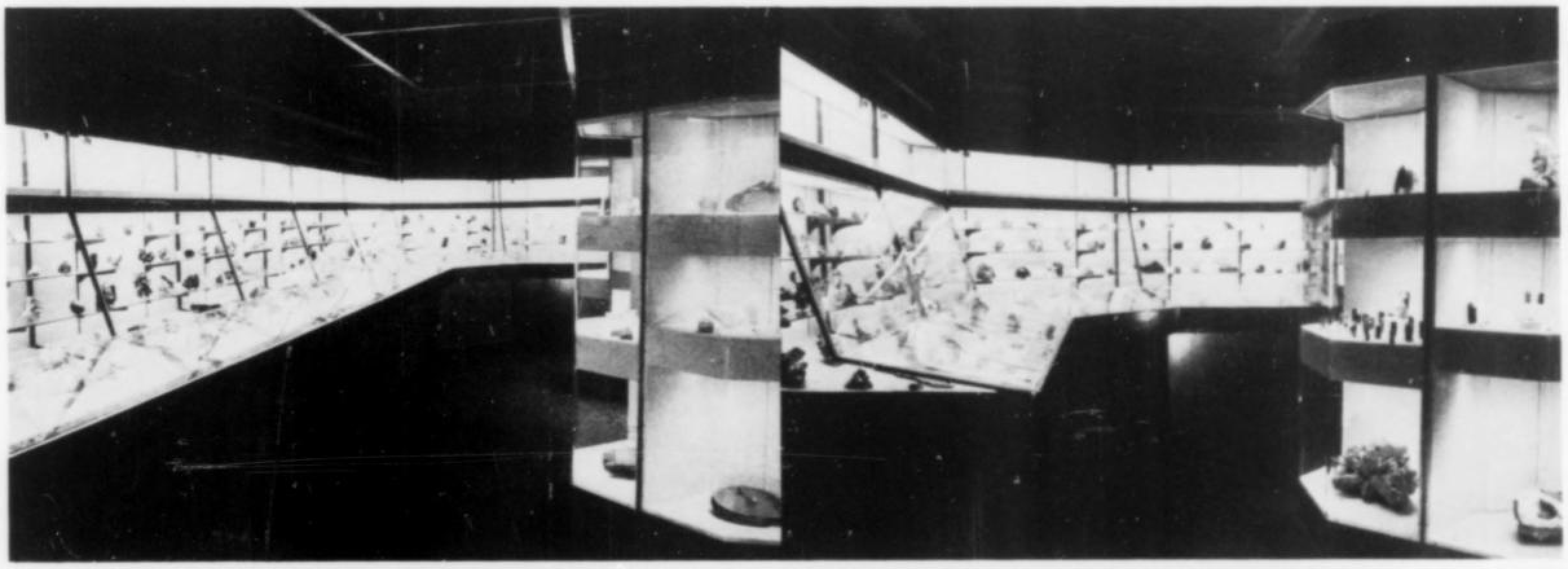

Figure 1. **Two views of displays in the Irénée duPont Mineral Room at the University of Delaware. The cases are lit with Westinghouse Ultralume 5000 fluorescent lamps, which have a color temperature of 5300° K and a spectral distribution which approaches that of daylight through a north-facing window.**

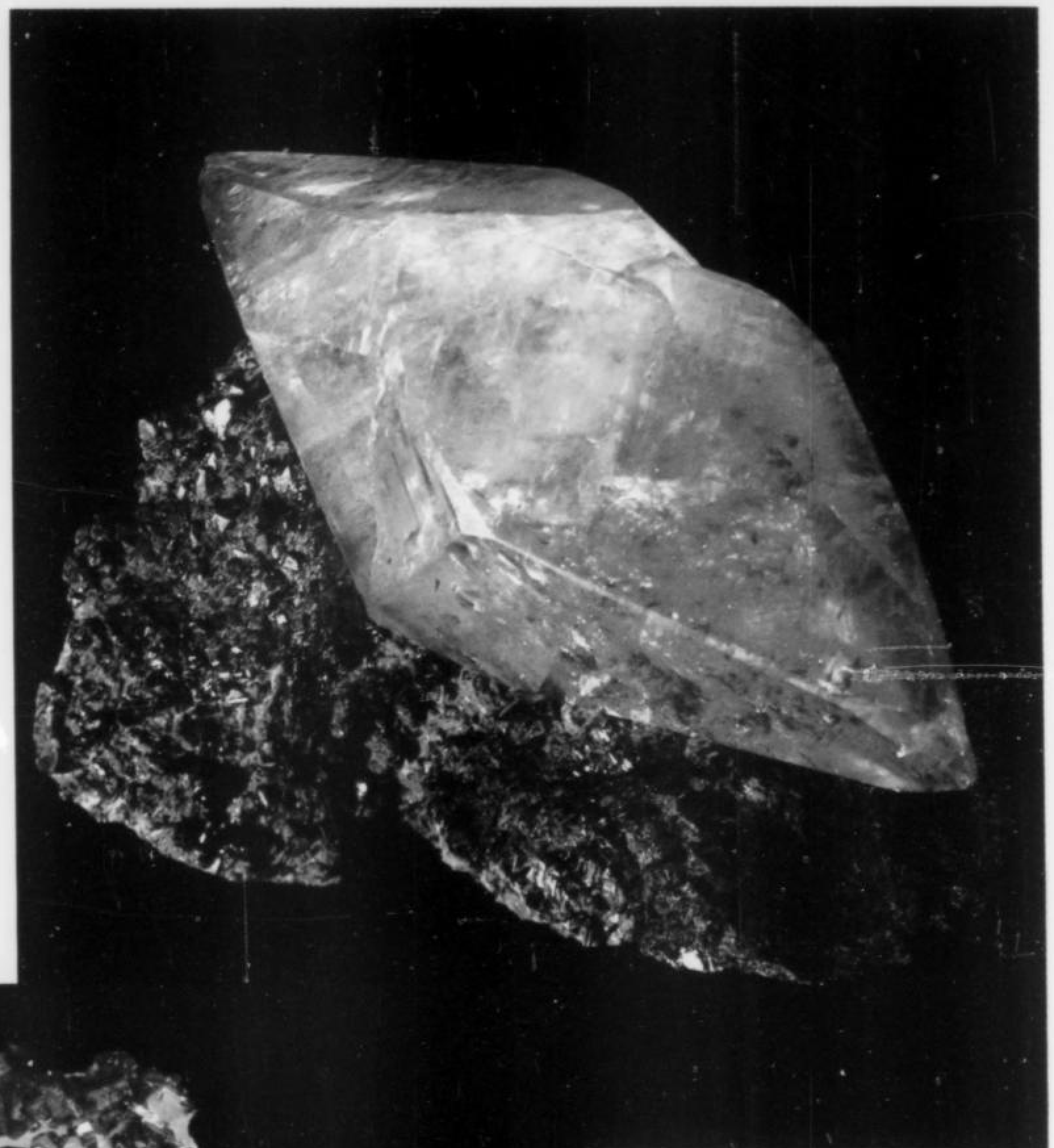

Figure 3. **Calcite crystal 8 inches (20 cm) long, on sphalerite, from Elmwood, Tennessee. Gift of John M. Martin.**

Figure 2. **Vanadinite on barite, 5¾ inches (14.5 cm) high, from Mibladen, Morocco. Gift of Mrs. David Craven.**

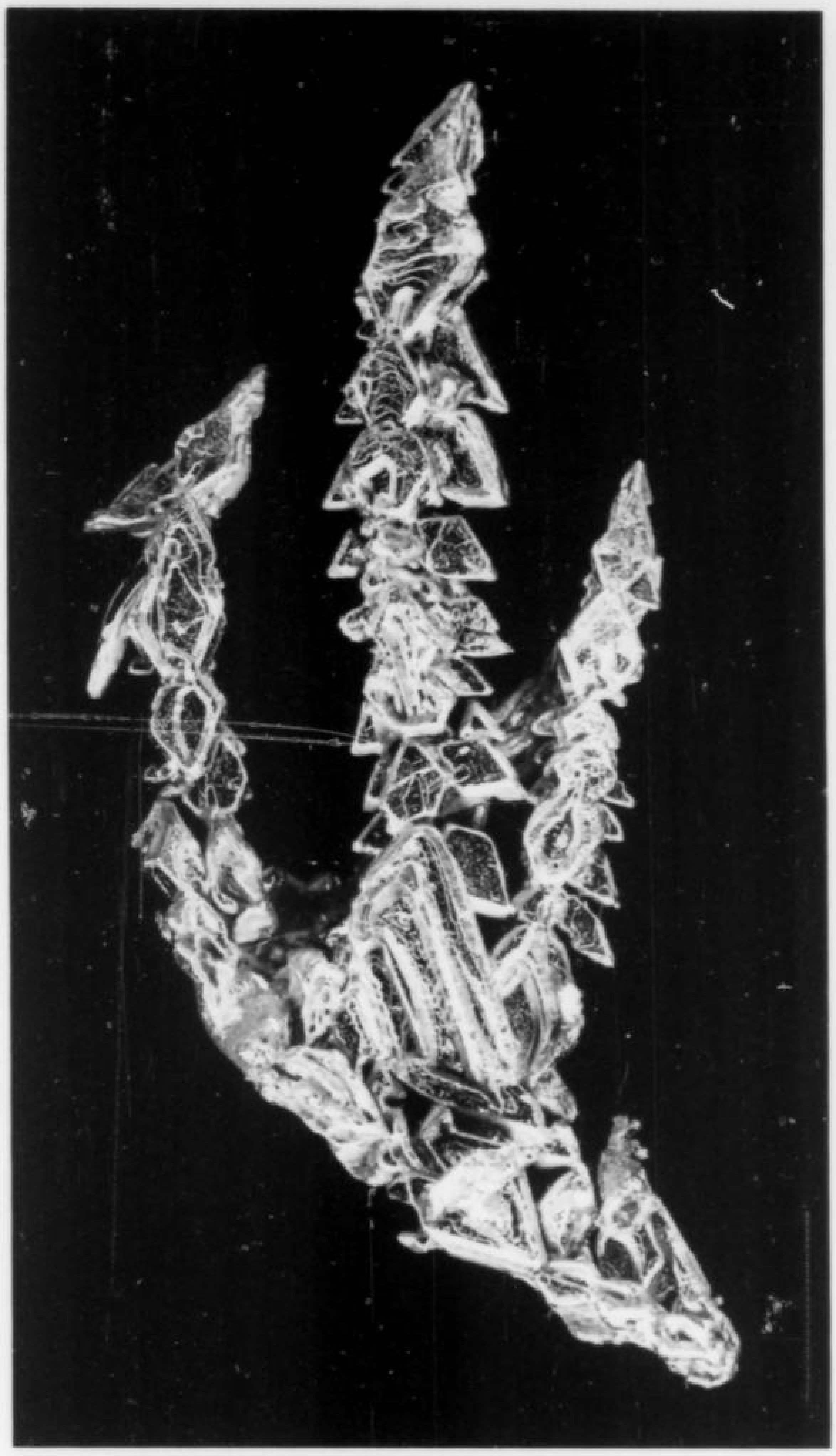

Figure 4. Gold, 1¼ inches (3.2 cm) in maximum dimension, from California. Gift of Cdr. Kurt O. Runge.

Figure 5. Spodumene (kunzite), 5½ inches (14 cm) long, from the Sickler mines, Heriart Mountain, Pala, California. Illustrated by Kunz, in *Gems, Jewelers' Materials and Ornamental Stones of California* (1905). Photo by Harold and Erica Van Pelt, Los Angeles.

Figure 6. Beryl (aquamarine), 3 inches (7.5 cm) high, Minas Gerais, Brazil. Purchased by Irénée duPont from George Kunz ca 1927.

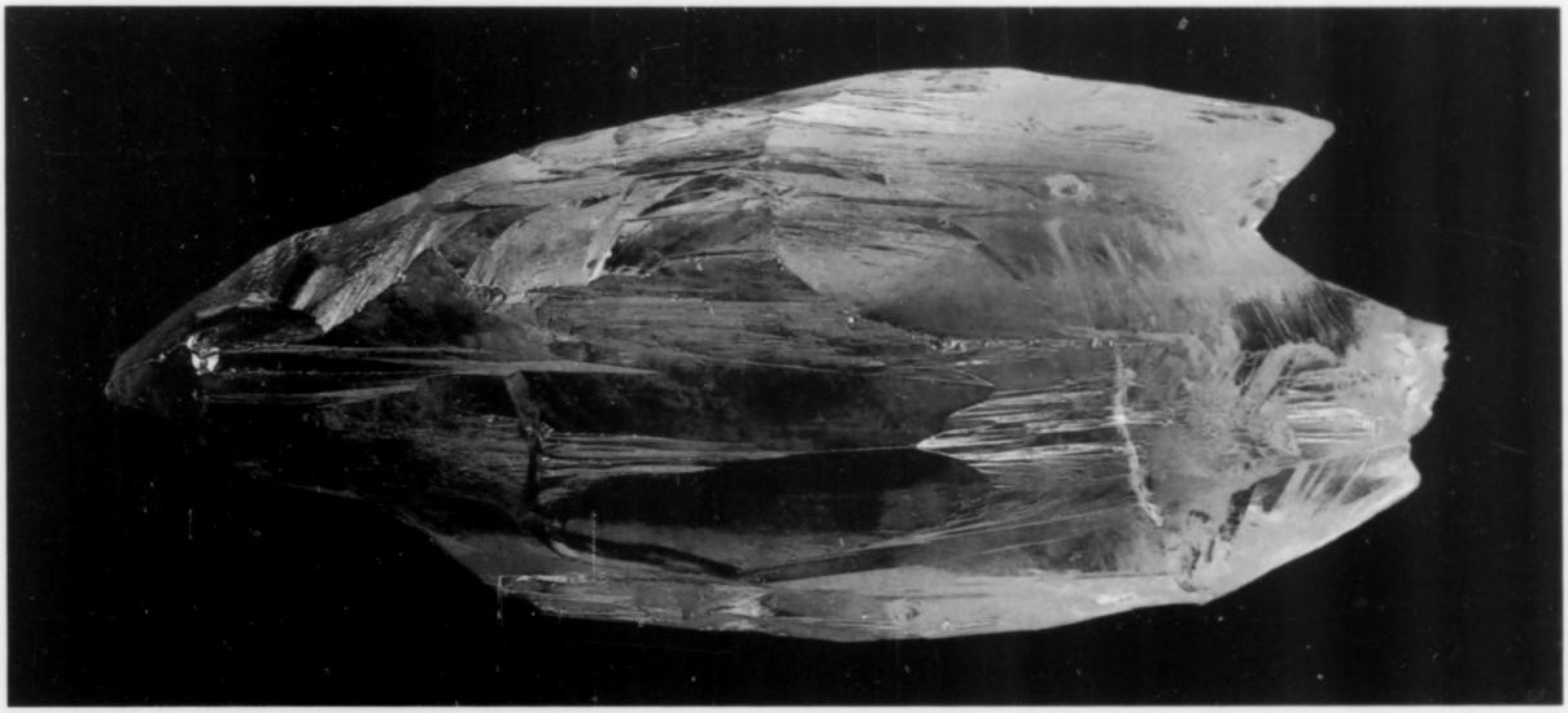

Figure 7. Cassiterite from Nuristan, Laghman Province, Afghanistan. A complex twin 4 inches (10 cm) across. Gift of Mrs. David Craven.

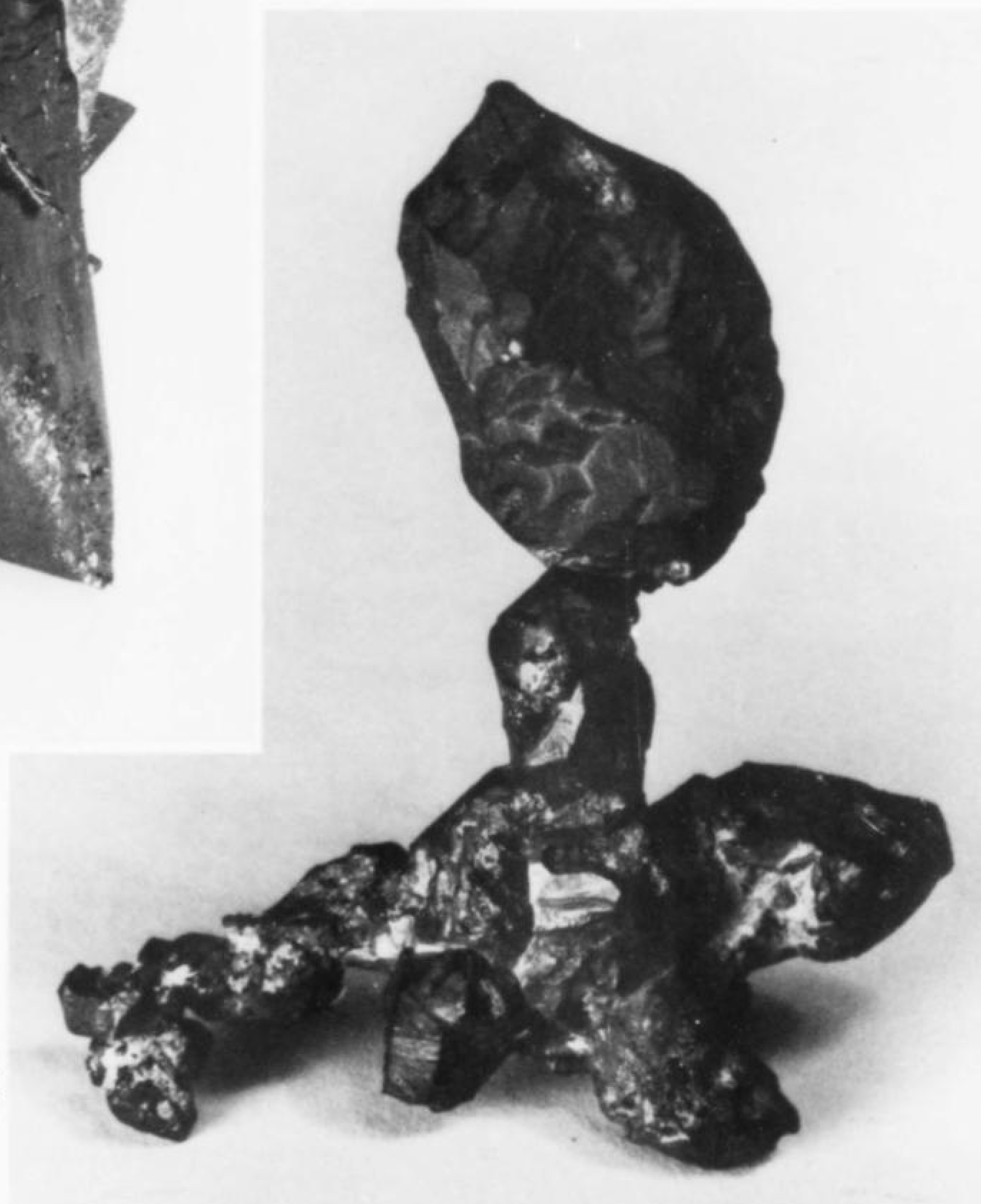

Figure 8. Copper, from the Keweenaw Peninsula, Michigan; 2¾ inches (7 cm) high. Gift of Mr. A. B. Stiles.

clude crystals of gem tourmaline on matrix from California, emerald on matrix from Colombia and Russia, an assortment of pyrite crystals from Leadville, Colorado, and sceptre amethyst crystals from Montana.

DuPont constructed a museum room in his estate at Granogue, near Wilmington, Delaware, and throughout the 1920's he continued to buy fine specimens, particularly from Kunz at Tiffany's and from George L. English of Ward's Natural Science Establishment. By 1929 or 1930, however, additions to the collection had more or less ceased. Perhaps the last major specimens duPont acquired are three pieces of crystallized gold from Breckinridge, Colorado, which he purchased in 1933 from Professor Charles E. Locke of the Massachusetts Institute of Technology. The three totalled 7.1 ounces and cost $200 – gold prices have changed since then!

Before duPont died in 1963, he specified in his will that the collection was to go to a university. Because he had taken an interest in education and educational institutions in Delaware for many years, his family offered the collection to the University of Delaware; the offer was accepted. For several years a portion of the collection was displayed in the University Library. In 1970 the Crystal Trust, established by Irénée duPont to aid educational projects in Delaware, made a grant to the University for a museum room to display the collection in Penny Hall, which was being rebuilt to house the Department of Geology.

The Irénée duPont Mineral Room provided a suitable housing for the collection. Not only was it valuable to the University as a teaching and study tool, it also attracted the attention of the general public. Elementary and secondary school classes from around northern Delaware visited the room, as did many scout groups. Mineral clubs from Delaware and adjoining states organized field trips to see the display. A number of mineral collectors became interested in the collection and have donated specimens for display and study.

In 1976 Mrs. David Craven, a niece of Irénée duPont, became interested in the mineral collection. She began purchasing display specimens for the University and then gave a substantial cash donation for mineral specimens. This generous gift made it possible for

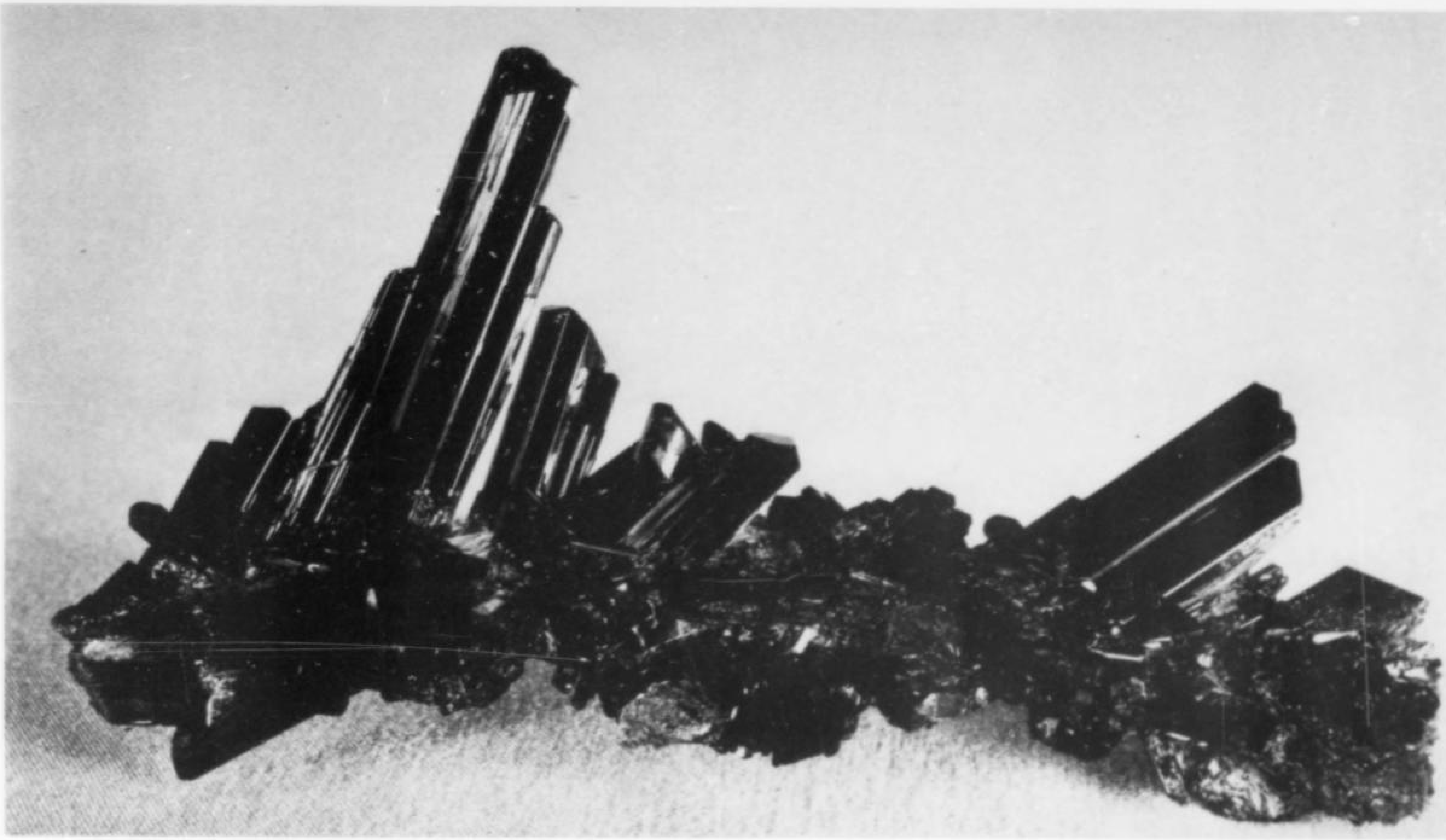

Figure 9. **Epidote, 5 inches (12.7 cm) long, from Knappenwand, Untersulzbachtal, Austria. Gift of A. B. Stiles.**

the collection to acquire a number of major pieces. Mrs. Craven made another gift in 1977 and in 1978 established a lifetime endowment for the collection. She continues to be active in approving the specimens purchased with these funds.

Expanded quarters were needed to house and display the growing collection. Late in 1978 Mrs. Craven donated funds for a major reconstruction and expansion of the mineral room. Work was finally completed, and the room opened to the public, on April 4, 1981.

The new Mineral Room features walnut paneling and custom-built walnut cases, including two free-standing columnar cases for gem crystals, cut gems and carvings. These two cases each separate into four units which roll apart to provide access from the back. They have fixed shelves which are covered with an off-white, burlap-textured vinyl against which specimens display well.

The 13 wall cases for mineral specimens are lined with the same material as the gem cases, and have Plexiglas fronts. These cases have glass shelving because the collection is growing and changing; the shelves can be installed or repositioned relatively easily as the needs of the collection dictate.

A collection must have a philosophy of acquisition if it is to be anything more than a random accumulation. Mineral museum collections may be specialized in a number of different ways. Most have public displays, though a few do not. Displays may be technically oriented or primarily esthetic. Some collections focus on the minerals of a particular region or district, some serve as teaching tools, and others as comprehensive research and study collections. A few museums, such as the Smithsonian and the Harvard Mineralogical Museum, are able to fulfill several of these functions, but most other museums must specialize in some way if they are to effectively utilize their individual resources.

The University of Delaware's display collection emphasizes esthetic specimens. A number of factors influenced the development of this orientation. Of course, the original duPont collection has many fine display pieces. In addition, the financial support for the museum has come from private collectors who are most interested in esthetic specimens. The University of Delaware and the Department of Geology, though not providing direct financial assistance for the collection, have enthusiastically supported its growth and display, and have treated it as one of the showpieces of the university.

The collection does not emphasize minerals of the region. Although the museum has a collection of minerals from Delaware, it amounts to only a couple of hundred specimens, and the state has no notable mineral localities. Counties in adjoining southeastern Pennsylvania do have a number of famous mineral localities, but the majority have been unproductive for at least 50 years, and specimens are difficult to obtain, either from the dumps (many now paved over) or from dealers. A number of the older museums in Pennsylvania, such as the Academy of Natural Sciences in Philadelphia, already have outstanding regional collections which would be impossible to emulate.

Although the focus of the collection is the display specimens, these account for only about 1000 of the roughly 6000 specimens in the museum. Most of the collection is stored in cabinets of drawers under the display cases, and is used for research, study and teaching. Research specimens are considered to be those which have provided published data. Because mineralogy is a descriptive science depending on actual objects to study, the careful documentation of research specimens is vital, even though they may compose only a small minority of any collection. Study specimens make up a broader and more general category; they include specimens from localities that have been studied, or examples of the kind of material that has been used in research. Study specimens are obtained in many ways – by field collecting, exchanging with other museums and private collectors, and by direct purchase from dealers. Study specimens provide X-ray standards, help to calibrate analytical tools, and provide specimens which may be required for future research projects.

The last group of non-display specimens are the teaching specimens used in the instructional programs of the university. Although there are separate teaching collections in use for courses in general geology and mineralogy, the Mineralogical Museum

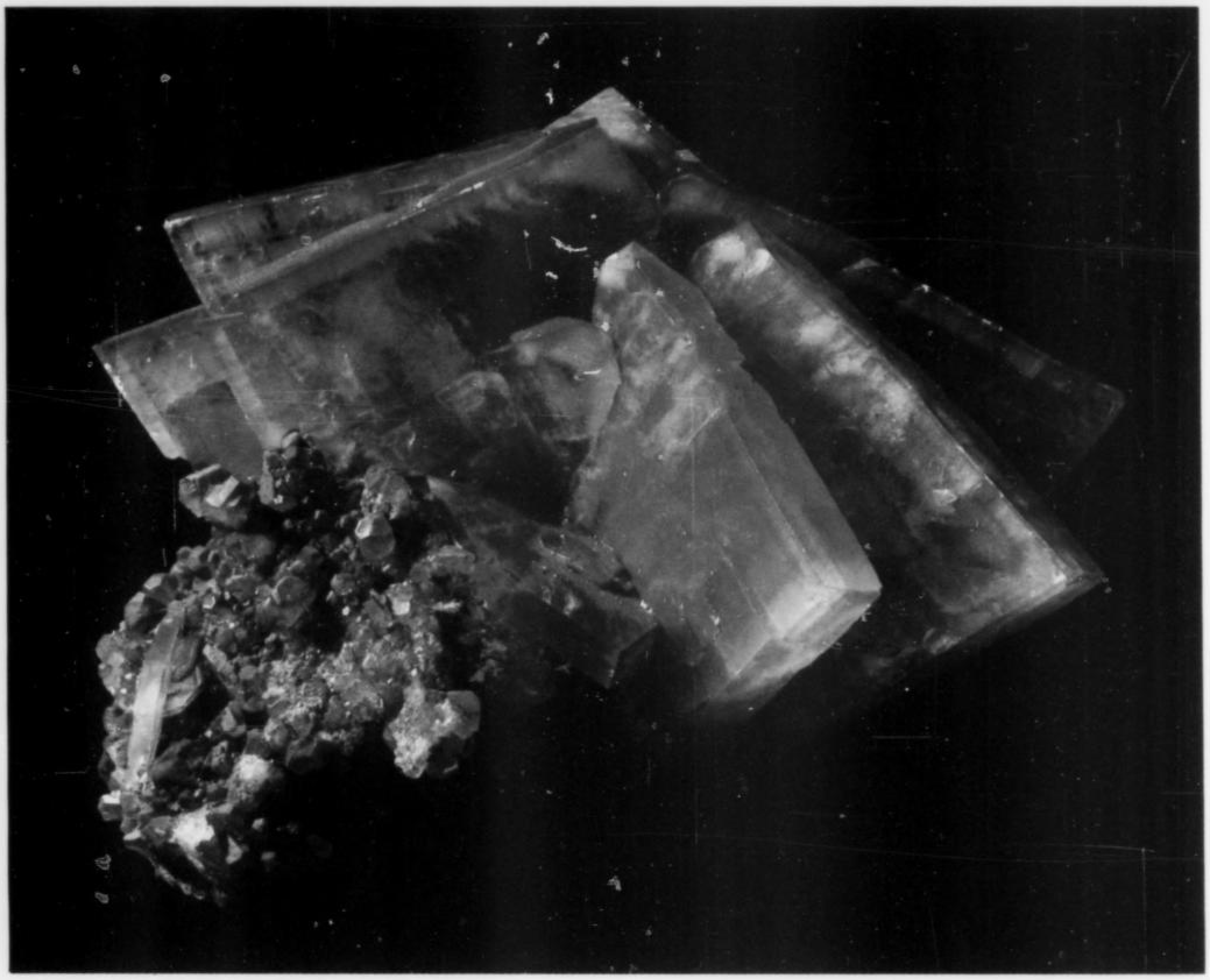

Figure 10. **Barite cluster 3 inches (7.5 cm) across, with minor calcite, from Cumberland, England. Irénée duPont collection. On the back of the specimen is an old Ward's price label: $3.50!**

display collections can prove useful as well. In fact, many of the display specimens make fine teaching tools, and the display is heavily used to provide examples of crystal morphology, habit, physical properties (but not cleavage!), pseudomorphism, association and occurrence. In many cases display specimens are the best examples we have showing important mineral properties; their esthetic values make them interesting and encourage students to study them much more thoroughly than they would a mediocre piece or broken fragment in the teaching collection, even though the display specimens cannot be touched or handled. A piece like the Elmwood calcite pictured here demonstrates morphology, twinning, color zoning and association in a clear and dramatic manner.

With the museum's limited financial resources, it is necessary to make decisions about which specimens to buy, and gradually we have evolved the philosophy of buying only a few specimens a year. Each new specimen is chosen to make a significant difference in the collection, rather than selecting many lesser quality specimens which individually would contribute much less. The philosophy forces us to pursue the same kind of specimens which competitive private collectors seek, not only in quality but also in size. The museum does not have the space to store or display large "museum size" specimens. Almost all of our purchases are of medium to small cabinet size. Size is important because the display space is currently full, and for every new specimen put out, something must be removed to make space for it.

Dealers are absolutely necessary to the growth of any collection, whether it be of artworks, mining antiques or mineral specimens.

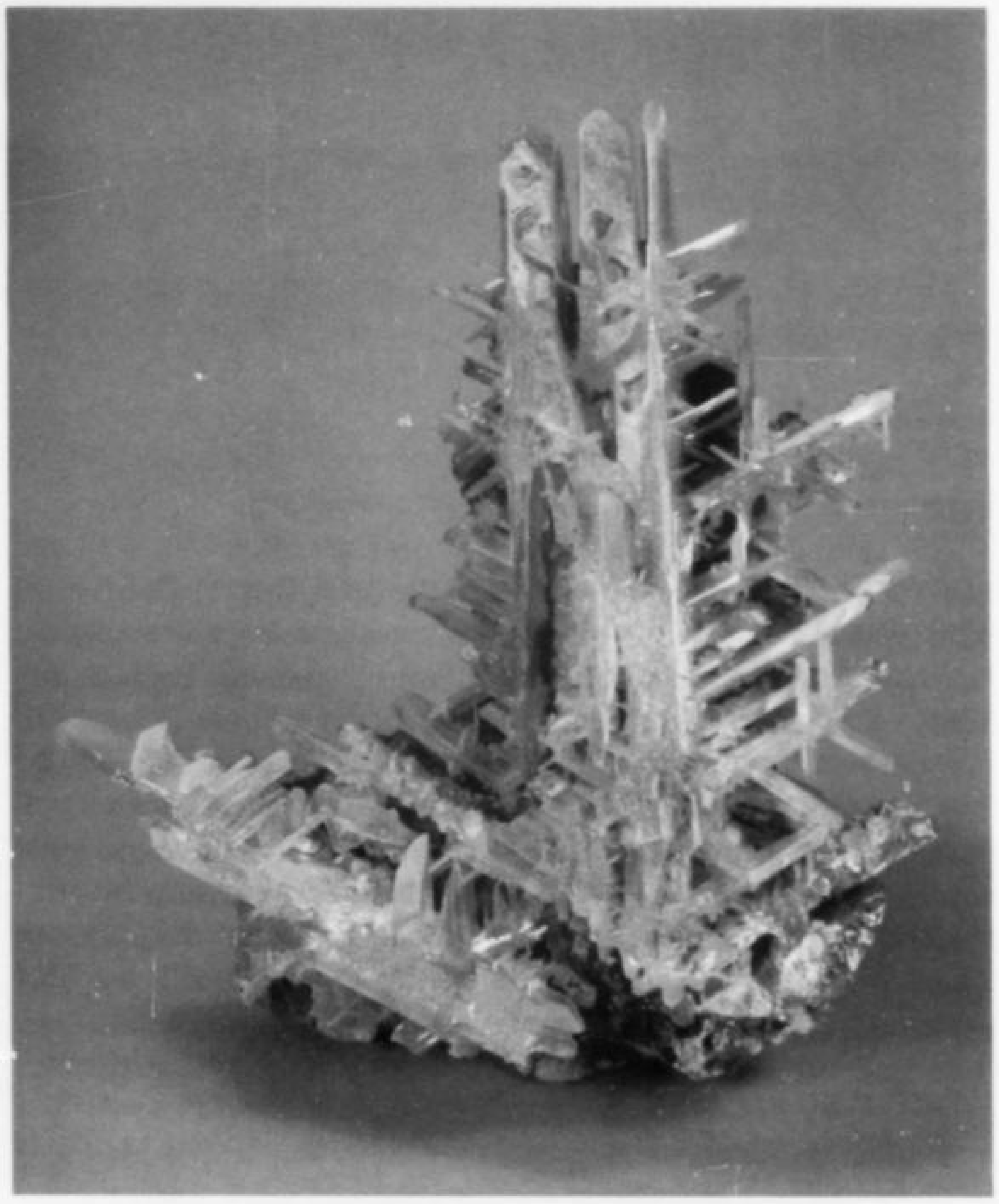

Figure 11. **Cerussite with minor smithsonite, 8½ inches (21.5 cm) high, from Tsumeb, Namibia. Gift of Mr. and Mrs. William M. Ryan.**

Figure 12. **Stilbite with pale green apophyllite, 6¾ inches (17 cm) across, from the Pashan Hills, Poona district, India. Gift of William A. N. Severance.**

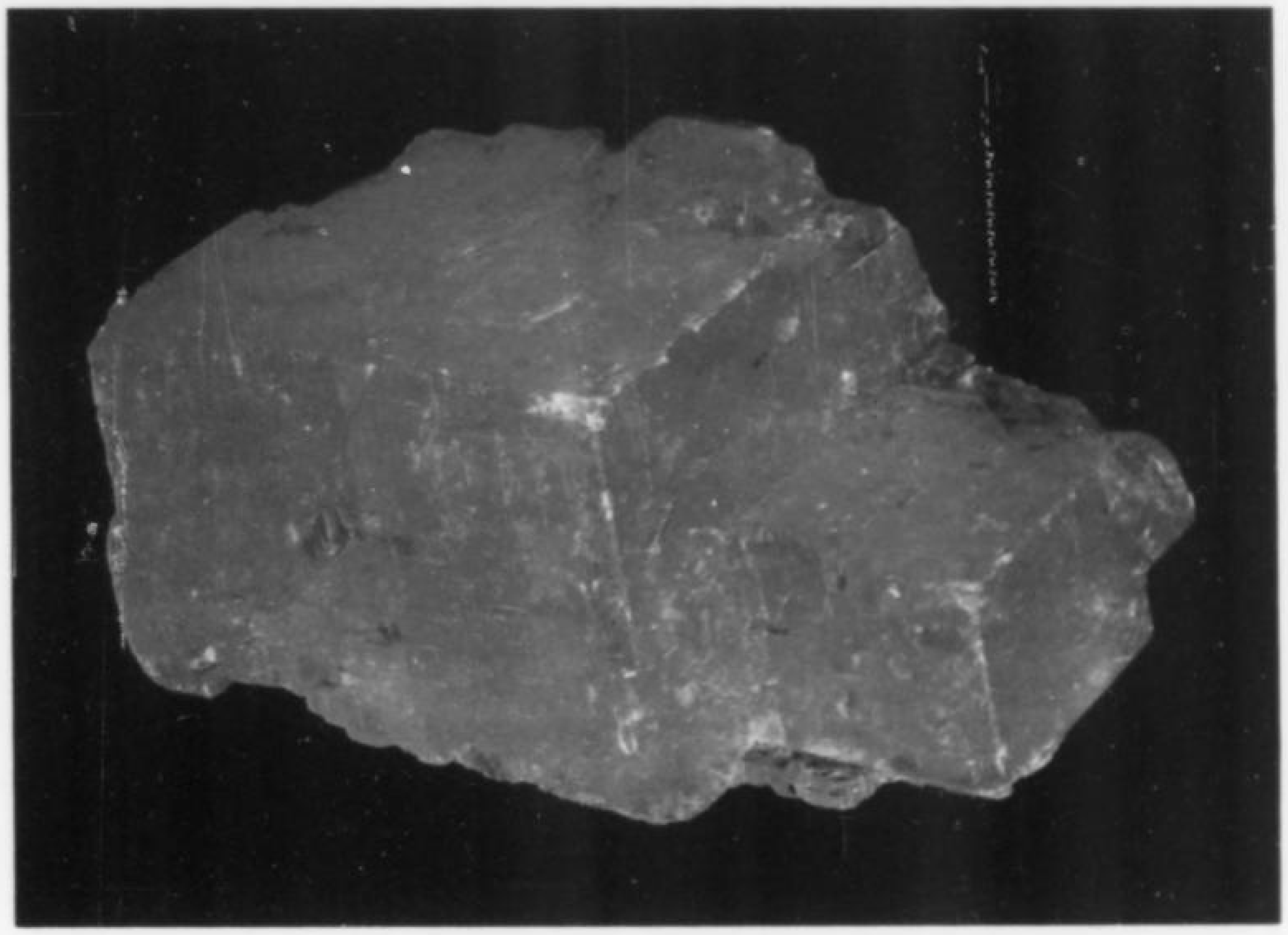

Figure 13. **Rhodochrosite, 4¼ inches (10 cm) across, from the Santa Isabella vein, Huallapon mine, Pasto Bueno, Peru. A floater, with a thin calcite overgrowth etched off. Gift of Mrs. David Craven.**

We have enjoyed invaluable support from dealers who have steered fine specimens to us and provided useful information and advice. But not everything comes from dealers . . . serendipity occasionally plays a role. The miniature gold shown here in Figure 4 was given to the museum by a local resident whose father had been a mineral collector 50 years ago. He thought we might appreciate it, and he was certainly right. Two years ago an alumnus of the university called. He was moving, and wondered if we wanted his grandfather's rocks. Grandfather had been a mining engineer in the 1890's, and had worked in Australia, South America and Mexico. "Well, what are the rocks like?" we asked.

"Several of the Mexican ones are silver," he replied, "and one silver looks like toothpaste coming out of a tube."

"Be right there," said the curator.

The silver specimen turned out to be a superb wire silver on matrix which will be illustrated in the *Mineralogical Record*'s forthcoming Silver Issue. A splendid and generous gift.

As the figure captions here show, many of the museum's specimens have been donated by individuals, most of whom are collectors living nearby. Their interest and support are additional factors which help to make the museum a success. In fact, without support from many directions – the University administration, Mrs. David Craven, mineral dealers, private collectors and the general public – the museum could not succeed. Every mineral museum depends on this complex web of support and enthusiasm. What are you doing to help a museum?

Penny Hall houses the Irénée duPont Mineral Room, the Department of Geology and the Delaware Geological Survey. It was named after Charles L. Penny, first Professor of Mineralogy and Chemistry at Delaware College (now the University of Delaware). The Mineral Room is open to the public without charge. Hours are 9 a.m. to 4:30 p.m. on weekdays, and at other times by appointment. An illustrated summary catalog of the collection was published in 1981 and is available on request.

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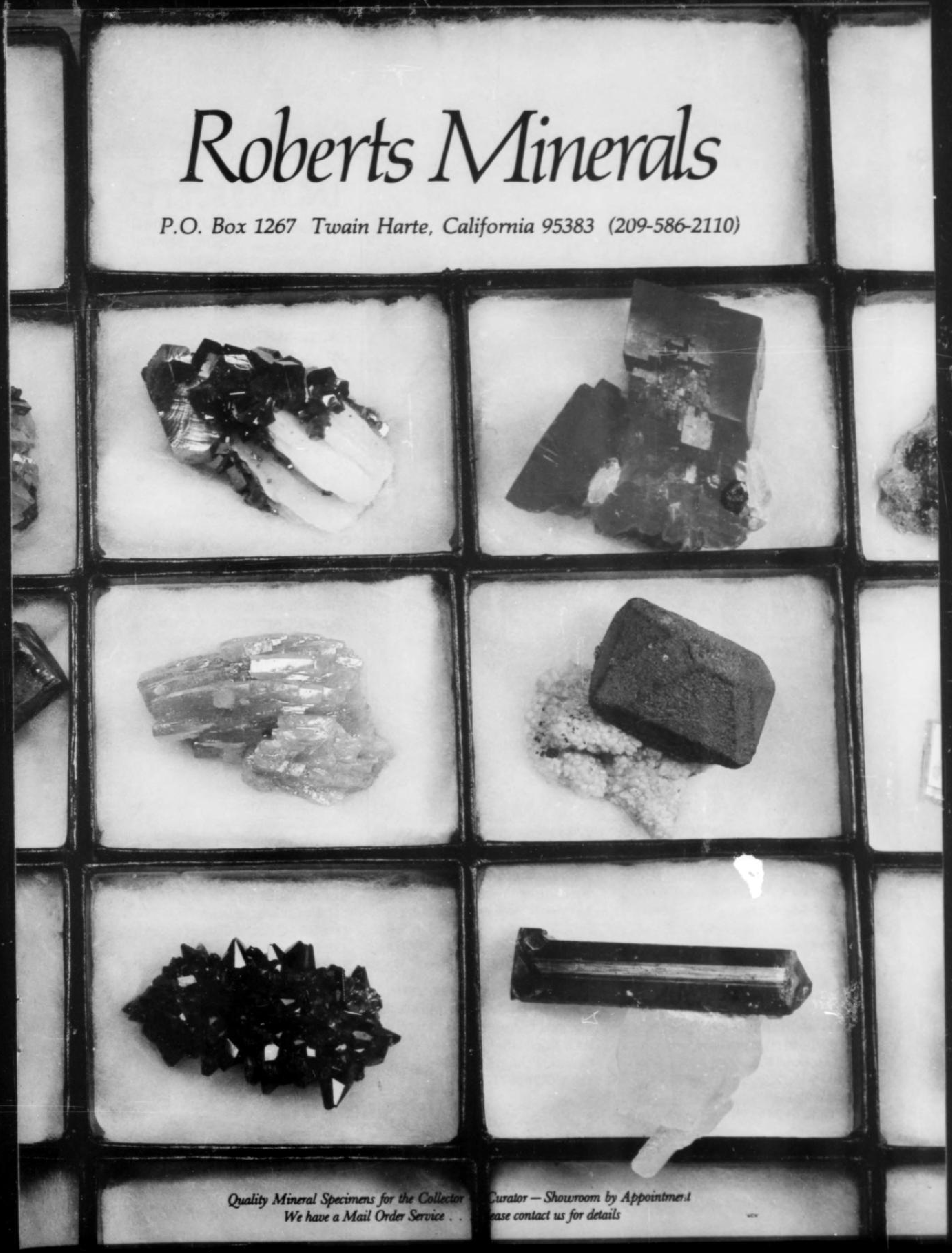
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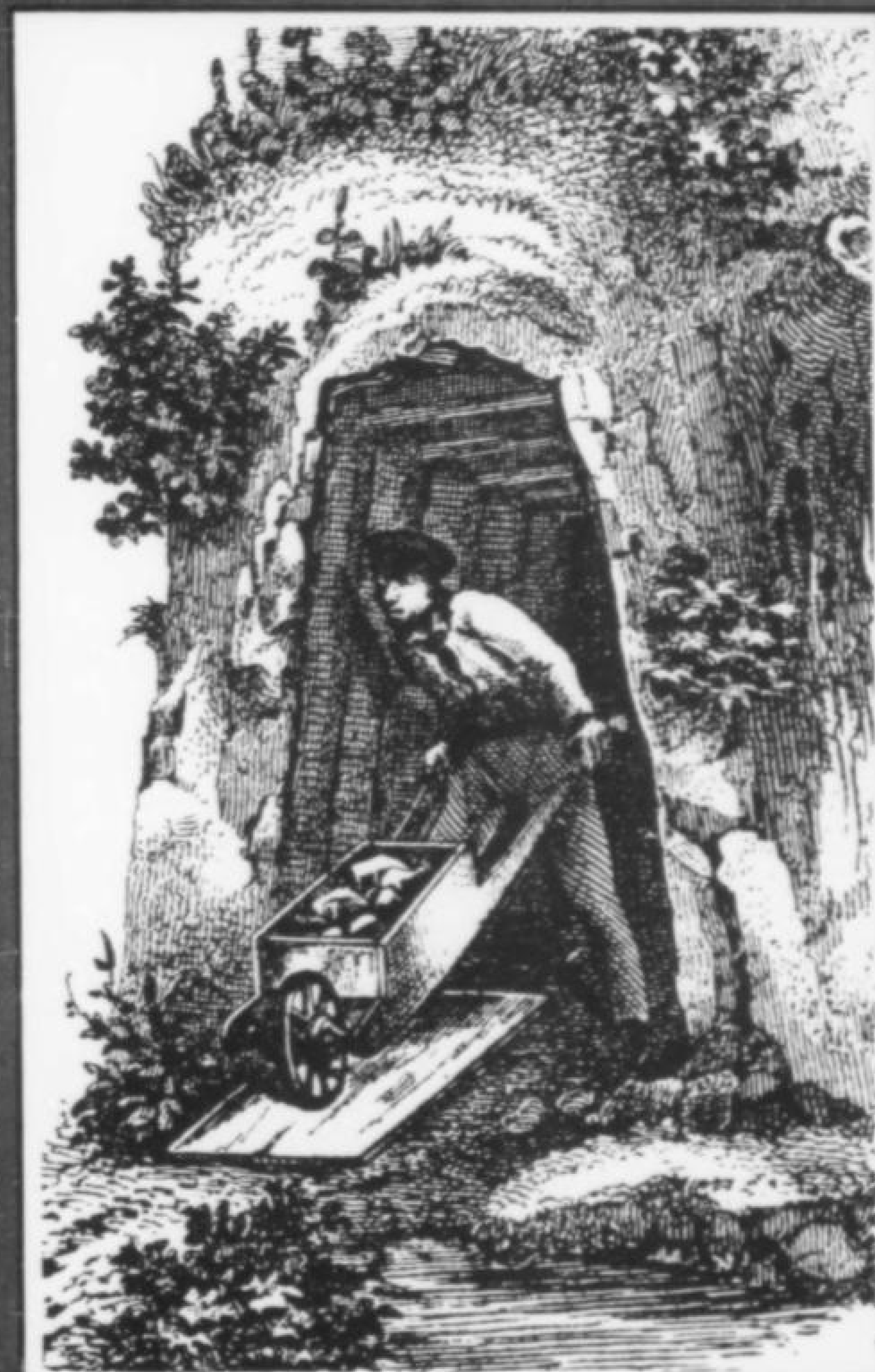

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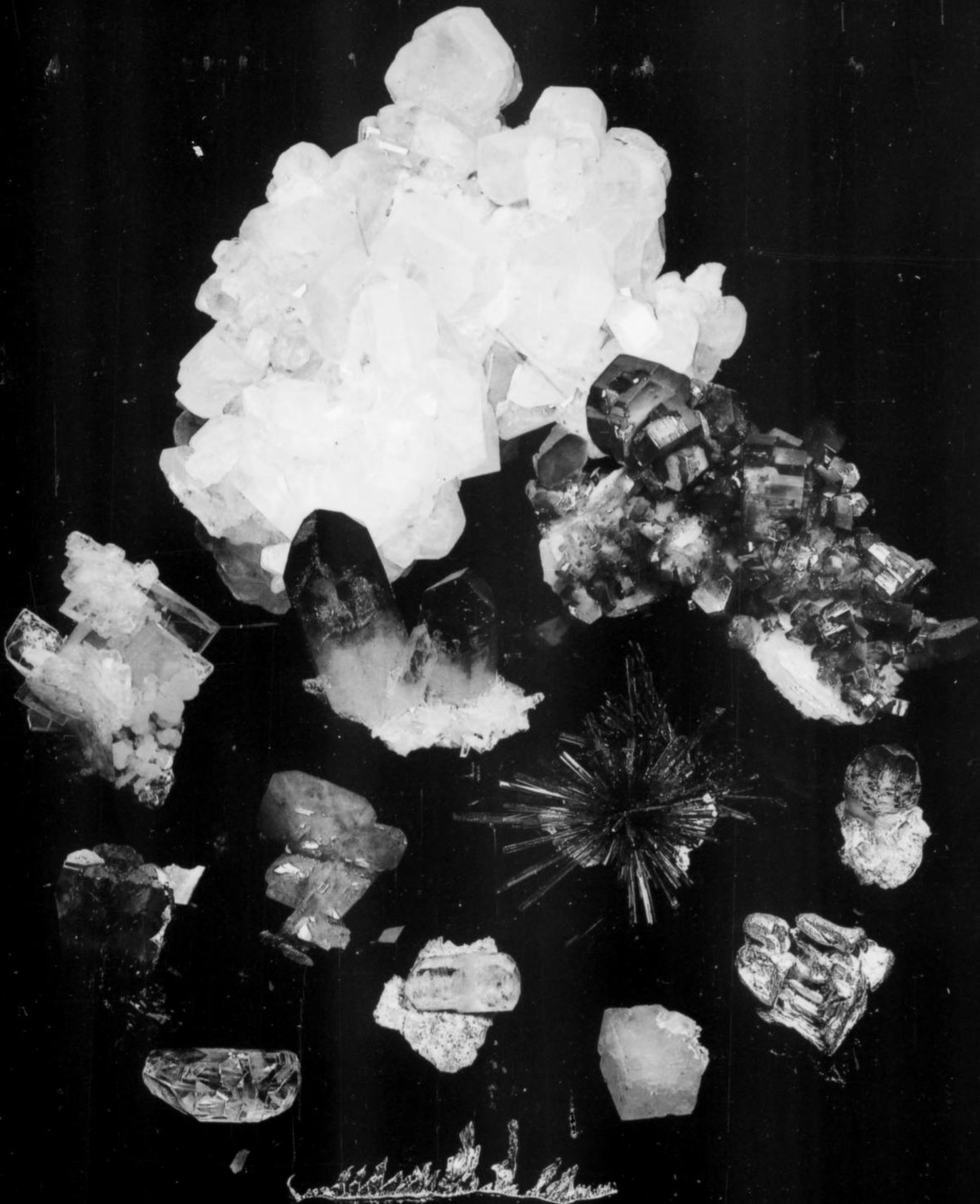

Notes from Mexico

by **Bill Panczner**

Figure 1. **Yellow smithsonite from the San Antonio mine. The large specimen is 5 inches across.**

Over the past four months the output of mineral specimens from Mexico has been on the steady decline. Nevertheless, several of the old, well known locations have produced on a limited basis and, in three cases, have yielded noteworthy mineral discoveries.

SANTA EULALIA

The San Antonio mine in the Santa Eulalia mining district, Chihuahua, is still continuing to produce mineral specimens. A large mass of smithsonite was uncovered in a newly developed area of the mine which contained small vugs; these proved very difficult to collect properly. Since this was an ore-producing area, no time was allowed for collecting and most of the smithsonite went to the mill as ore. The smithsonite is botryoidal with most of the specimens exhibiting the sparkling surface caused by thousands of tiny rhombohedral crystal faces. The color ranges from gray to various shades of green, orange, yellow and cherry-red. Most of the specimens are flat sheets but over two dozen heads, some reaching 6 to 8 inches, were recovered.

The most spectacular specimens are the yellow smithsonite, which is colored by greenockite, and is the best "turkey fat" smithsonite presently available from Mexico (and probably the best ever produced from this or any other area within Mexico). About two dozen specimens of the "turkey fat" were saved from the jaws of the crushers.

Also from the San Antonio mine, a basketball-size pocket of brilliant hemimorphite was uncovered. The crystals range in size from ½ to just over 1 inch and are snow-white with a high luster. They look very similar to the best hemimorphite from the Ojuela mine, Mapimi, Durango. Many of the pieces are very large and quite showy. This material is being held by the mining company, and will be disposed of later.

The San Antonio mine, as you may recall, has produced some remarkable mineral discoveries in the past several years. This output of mineral specimens is partly due to expansion of the mine through an orebody which contains exceptional crystallized minerals. Production should continue for some time as the mine continues to develop; the mineral world has not heard the last of the San Antonio.

Also from the Santa Eulalia district, red calcite reappeared from the Buena Tierra mine at Francisco Portillo, Chihuahua. This occurrence was a massive "cave" on the 19th level of the mine and produced several tons of specimens! It took about a week to mine and one entire shift to hoist it out of the mine.

NAICA

The mines of Naica, Chihuahua, over the past months have been producing fine gypsum. The color ranges from reddish brown to green with crystal size varying from 1 to 4 inches. The color appears to be from the iron content of the water in which the gypsum developed. The crystals are found on the sides, pipes and pumps of the sumps within the mine. This accumulation eventually causes the pumps to malfunction. The sumps have to be stripped of their shiny crystal coatings several times a year. This growth is dependent on the sulfate content of the hot mine waters within the sumps. At present (August) the water conditions have changed and the sumps are staying relatively free of gypsum growth. The miners find it great fun to hang nuts, bolts and even rock hammers into the sumps by a wire. Usually within about 4 to 6 weeks, with good water conditions, a coating of gypsum crystals 1 to 2 inches long will have developed on the items.

A number of fine specimens of sphalerite, brilliant galena, and fluorite have been recovered from the mining operations at a newly developed mine on the Naica fault. The sphalerite occurs as very lustrous black crystals, occasionally twinned. The galena specimens, which contain a very high silver content, are among the most brilliant dodecahedral crystals ever found at this mine. The fluorite occurs associated with sphalerite and galena. Color ranges from colorless to a pale green, but several small pockets were mined in which the fluorite has a deep blue color. Perched on a few of these specimens are small, ½ to 1-inch crystals of bournonite. A limited number of anhydrite crystals were also brought to the surface. These are associated with bright, crystallized pyrite, a most attractive combination!

MAPIMI

The summer rains took their toll on mineral collecting at this famous location in the state of Durango. Because many of the bet-

Figure 2. **An exceptionally large pyrargyrite crystal (2¾ inches) from the Santo Niño vein, Fresnillo.**

Figure 3. **A 2½-inch group of pyrargyrite crystals on matrix from the Santo Niño vein, Fresnillo.**

ter producing mineral specimen areas in the Ojuela mine are at or just below the water table, any increase in the water level causes the collecting areas to be flooded. As of August, this was the case in several of the areas which had produced adamite.

Because of the economic problems within Mexico and the present poor collecting conditions at Mapimi, several of the crystal collectors have left for work north of the Rio Bravo (Rio Grande). But still collecting goes on and several pockets of adamite and one fine scorodite vug were uncovered. Some of the adamite crystals are of a medium purple color, but most of the specimens are yellow or white. The crystal size averages around ½ to 1 inch, but one crystal is almost 2 inches in length, and is on matrix.

The scorodite is of good blue color and exceptional crystal size, reaching upwards of ½ inch! About two dozen specimens were produced, but only about half a dozen are exceptional. Three specimens rank as among the best to have come out in the past few years.

FRESNILLO

This famous old Spanish silver camp located in the state of Zacatecas is still producing silver. Several years ago, a new discovery gave added life to the mines on Proano Hill. From the Santo Niño vein, outstanding specimens of pyrargyrite have recently been mined. The crystals reach 2¾ inches, though most are less than an inch. Most of the crystals from the small vug average about ¾ inches. Only about 12 specimens came out of this find, but many are on matrix. This occurrence has added some exceptional crystal specimens to the shelves of collectors. Over the next several years, as this massive vein is mined, specimens should continue to come out.

GUANAJUATO

A few of the mines from this 437-year-old camp are still in operation and frequently produce fine specimens. The operators of mina de San Juan de Rayas (better known today simply as the Rayas mine), in order to increase the silver content of its lower-grade ore, mine occasionally in one of the older areas rich in high-grade silver. When this happens, specimens usually appear. Such was the case in July, when a large lot of acanthite surfaced. Three of the specimens have over 1-inch crystals, though the average is ½ inch or less. All are bright and shiny and fine specimens. Calcite and quartz (amethyst) continue to occasionally reach the surface as well.

As old mines expand and modernize and new mines develop, mineral specimens will continue to come from south of the border. In future columns I will describe a few of these newer locations which should, in the future, grace many collections with minerals.

William D. Panczner
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Tucson, Arizona 85745

What's New in Minerals?

by **Wendell E. Wilson**

The general view among many dealers and collectors during the current late-summer doldrums is that there is nothing new under the sun, mineralogically. Happily, this is not totally true, as a number of unusual finds have come to light.

SOUTH AFRICAN "ETTRINGITE"

A few months ago a major discovery was made in South Africa, reportedly near Kuruman (though initial reports are sketchy). What they found was a large pocket or series of pockets which have yielded several hundred very fine specimens. Specimens of what? Well, no one's quite sure yet. At least some of the crystals appear to be partially composed of ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12} \cdot 26H_2O$), although the crystals are zoned and the other portions *may* be related to the new minerals charlesite and sturmanite. Then again, they may not. Species determinations in this group are extremely difficult, and there may yet be undescribed new species lurking about, for all anyone knows. Detailed analyses are still being conducted at the University of Stellenbosch, and a comprehensive article for the *Mineralogical Record* has been promised.

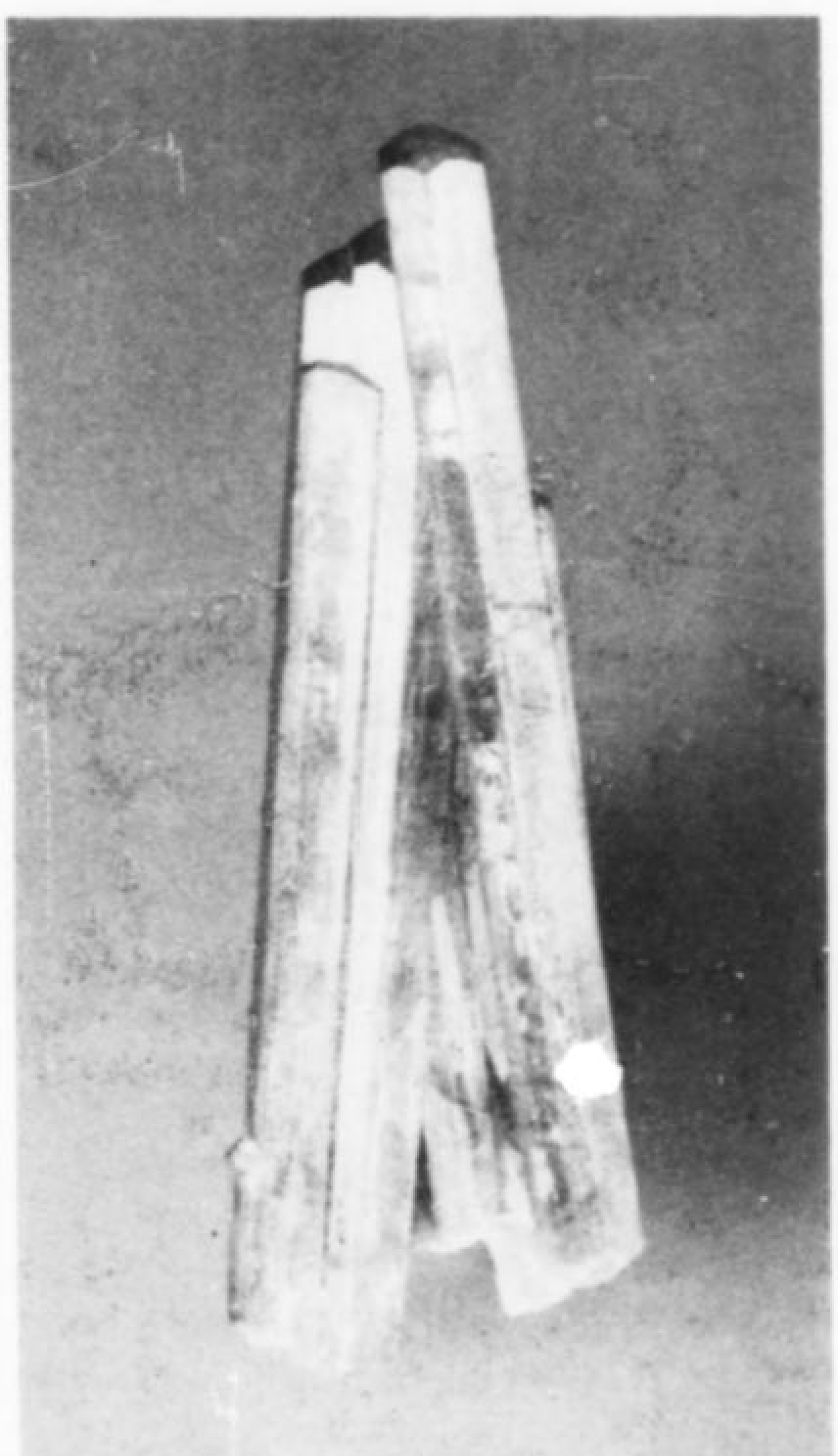


Figure 1. **Ettringite-like mineral, gemmy yellow, in hexagonal crystals 2⅜ inches long from South Africa. Cal Graeber specimen.**

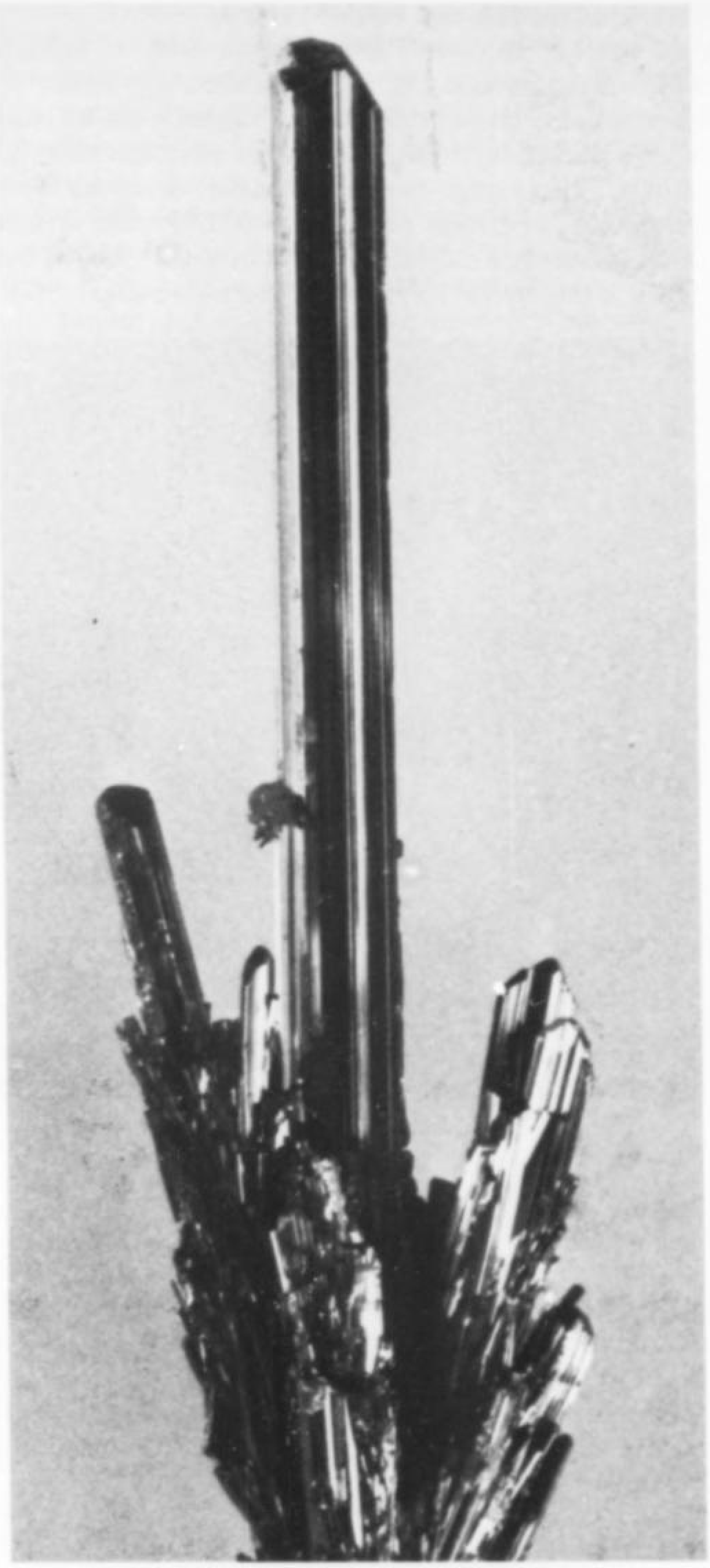


Figure 2. **Brilliantly lustrous stibnite crystals to 5½ inches from Hunan province, China. Russ Behnke specimen.**

Nevertheless, specimens are already trickling into the American market, and hundreds will probably appear for the Tucson Show this coming February. The crystals are very attractive, resembling the famous gemmy yellow mimetite found at Tsumeb in 1972. They consist predominantly of the same forms: the elongated hexagonal prism capped by a pinacoid modified by a pyramid. Apparently the best specimens have crystals in the neighborhood of 3 inches long and about ¼ to ½ inch wide, and in groups, and in some cases on matrix. The crystals range from gemmy, pure yellow throughout to a combination of a gemmy yellow outer layer and milky white core. Other crystals are gemmy yellow but are darkened by granular black inclusions, possibly of some manganese oxide.

There is no doubt that this discovery is of the highest significance, and will be remembered as one of the few truly great finds of 1983.

CHINESE STIBNITE and TOURMALINE

Russ Behnke has come through again with 15 remarkable Chinese stibnite crystals. The crystal pictured here is very bright and measures 5½ inches, though other singles in the lot reach 10 inches! The locality in Hunan province has been mined for stibnite since 1895, when foreign mining companies, concerned with the depletion of the Japanese deposits, opened the area to mining. Precise information is difficult to obtain from the Chinese, but the best guess is that the mine is near the town of I-yang.

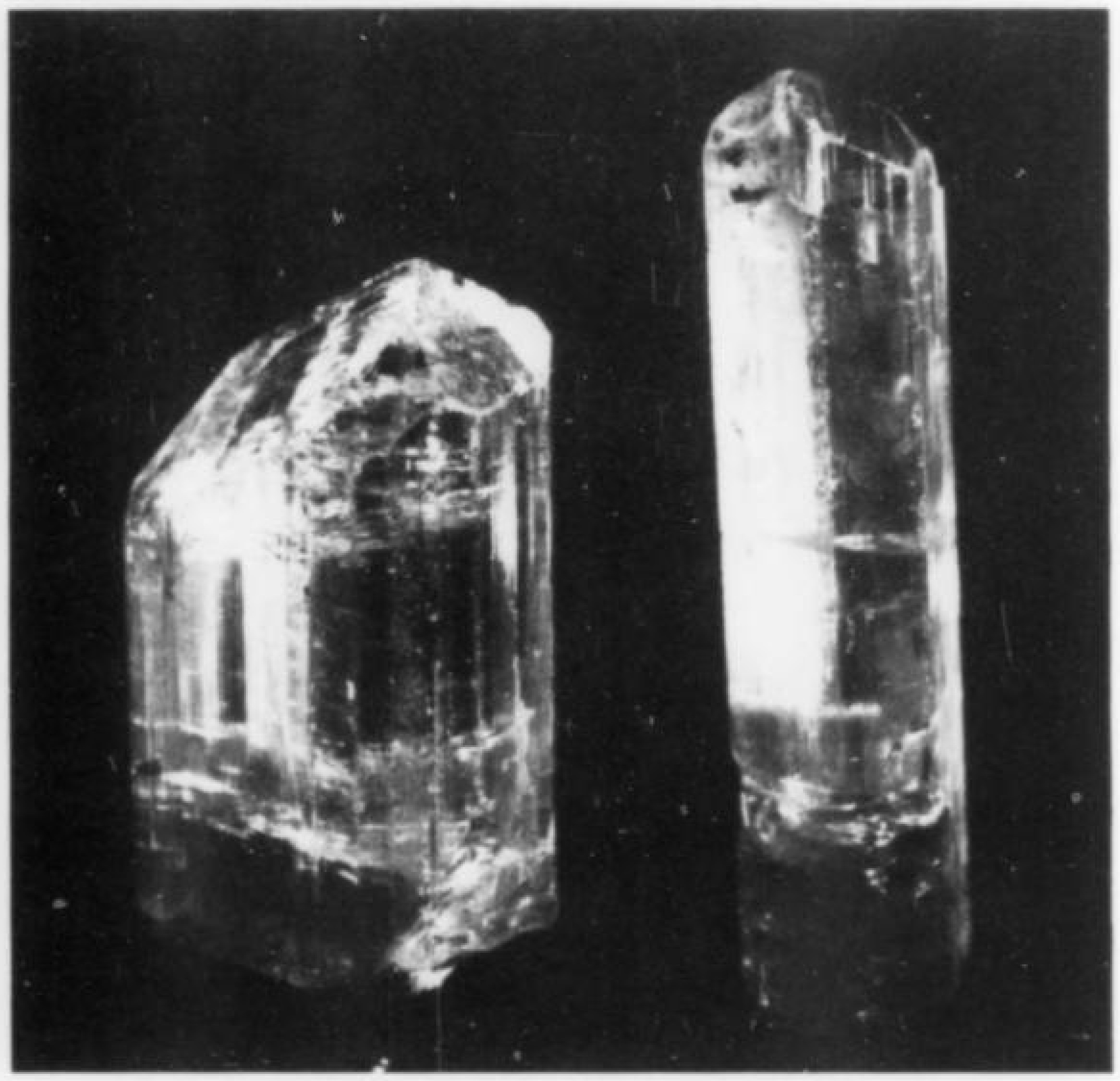


Figure 3. **Bicolored pink and green tourmaline to 1¾ inches from the Altai Mountains, Xinjiang Uygar, China. Russ Behnke specimens.**

Figure 4. **Pale blue celestite crystal 3⅓ inches tall, from Marada, Libya. Russ Behnke specimen.**

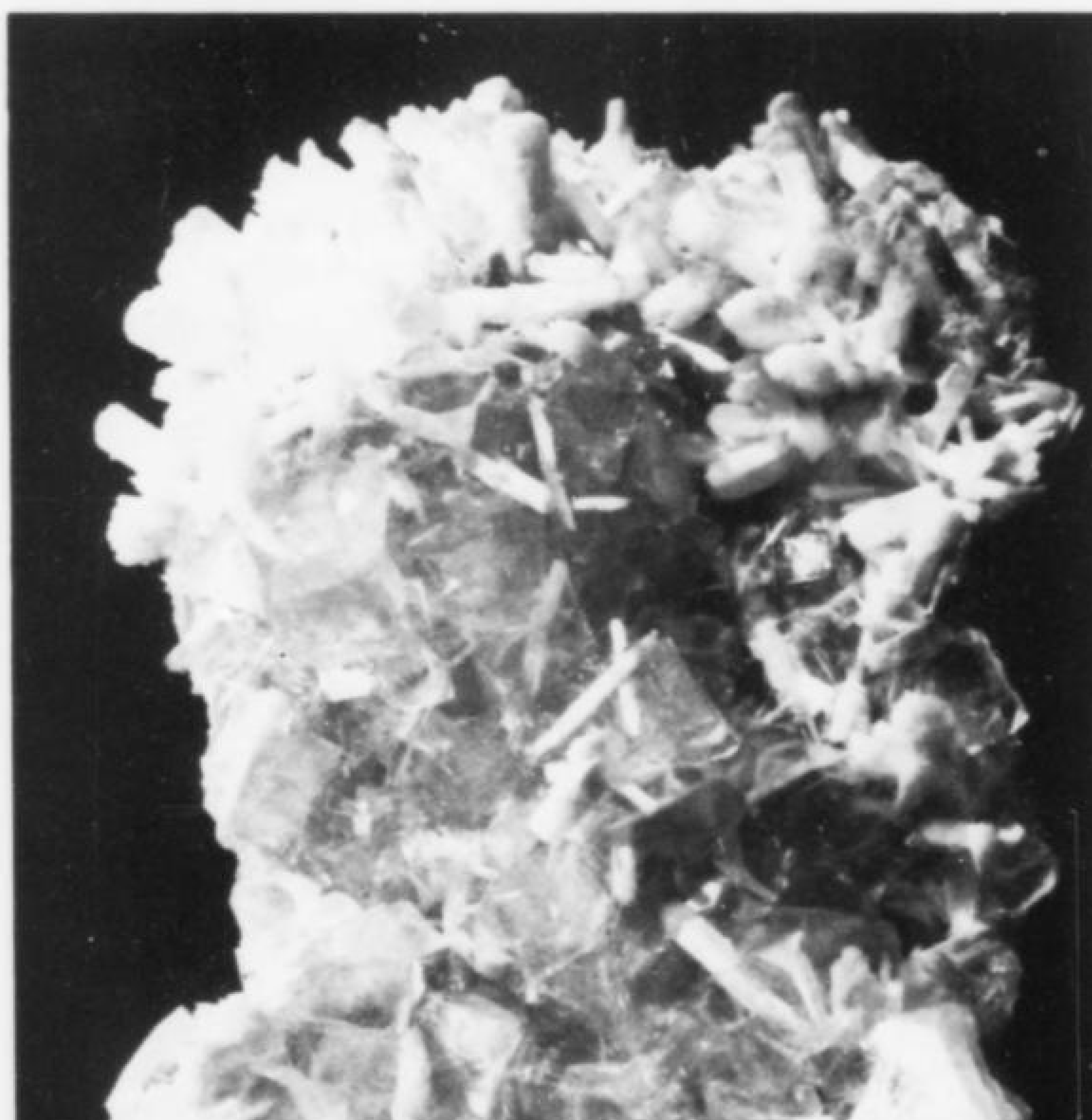


Figure 5. **Apophyllite and mesolite, 3½ inches across, from the Palabora open pit, Transvaal, South Africa. Russ Behnke specimen.**

Another lot Russ obtained from his Chinese sources consists of 10 tourmaline crystals (no matrix) from the Altai Mountains, Xinjiang Uygur autonomous region, very near the Russian border. The largest crystal is just over 2 inches, and the color ranges from pastel pink to pastel green, sometimes bicolored. Relatively few good crystals came out of the locality.

Russ became justly famous a few years ago for being the first person in many decades to get twinned cinnabar crystals out of China, and now he has a new lot of about 10 specimens. These consist of the classic twinned crystals to about ½ inch on matrix, from Tongren, Guizhou (Kweichow) province.

Russ seems to be specializing in strange localities. For example, who else is getting minerals out of *Libya* these days? From the Marada area he obtained about a dozen large crystals of celestite, pale blue to cream and white in color, translucent and of typical celestite form. A few are very lustrous, all are well formed, and size reaches about 4 inches.

Finally, from the Palabora open pit in Phalaborwa, Transvaal, South Africa, Russ obtained a lot of mesolite with apophyllite that strongly resembles the well known Indian material. The locality, a copper mine containing a number of interesting species, is the subject of an article in preparation for a future issue of the *Mineralogical Record.*

BOLIVIAN MINERALS

Jack Lowell (Colorado Gem and Mineral Co.) recently obtained some superb vivianite specimens from a new locality in Bolivia. The mine, located at the town of Morocoala, near Huanuni and Llallagua, is apparently known as the Santa Fe mine (although this needs confirmation). It is operated for cassiterite which, thus far, has not been of specimen grade. The only collectible specimens to come out since the mine opened are the 40 or so vivianite specimens in the present lot. Excellent thumbnail specimens are available for $20 to $150, and the small cabinet pieces are priced accordingly higher. Most have some pyrite or siderite in association. According to Jack, this mine has good potential as a future specimen producer.

From the famous San José mine at Oruro, Bolivia, have come

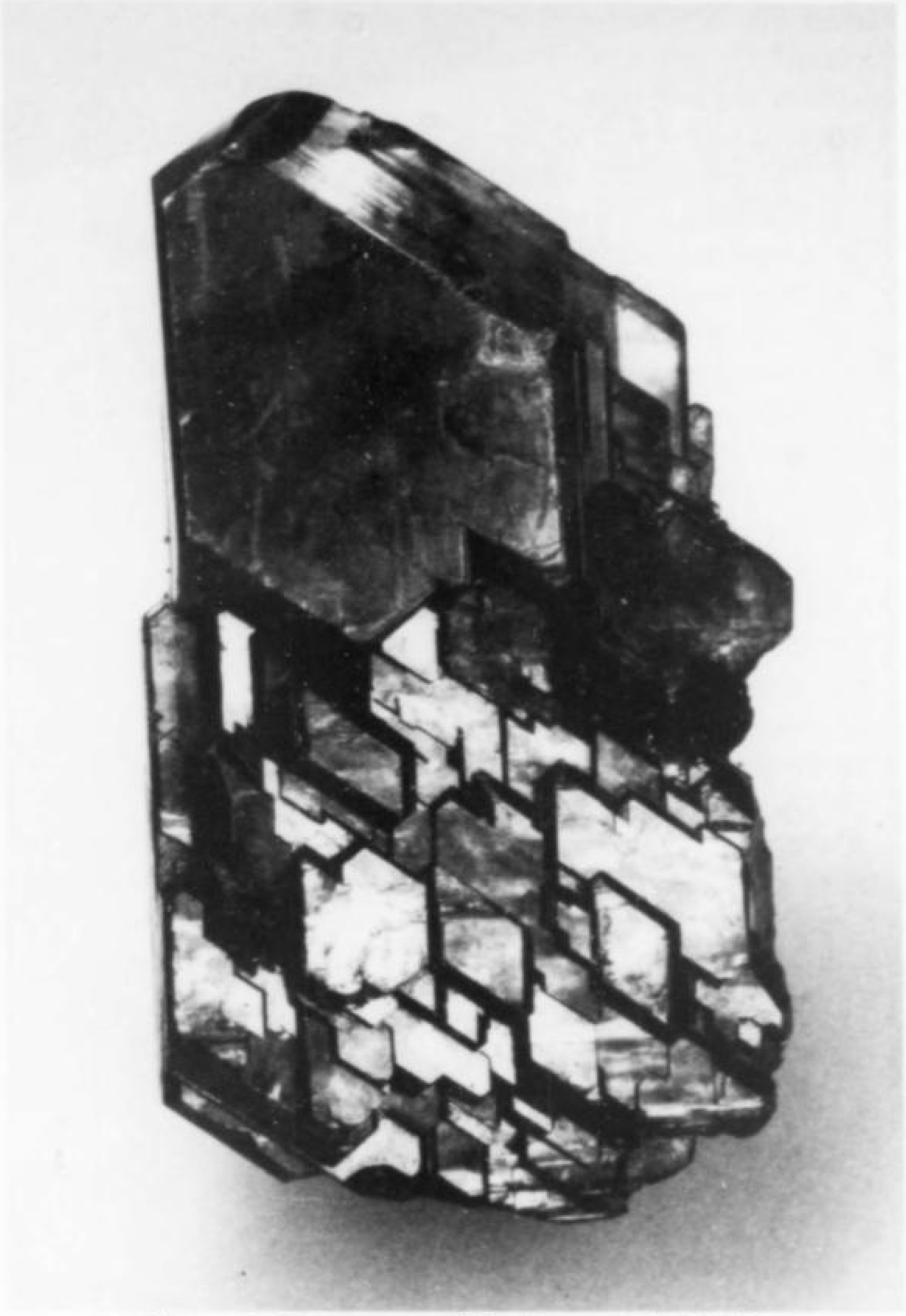


Figure 6. **Deep green vivianite crystal, 3 inches tall, from Morocoala, near Huanuni, Bolivia. Jack Lowell specimen.**

Figure 7. **Andorite crystals averaging about ½ inch, in pyrite vug from the San José mine, Oruro, Bolivia. The specimen is 4¼ inches across. Jack Lowell specimen.**

some excellent specimens of stannite and andorite. The stannite forms confused, spherical aggregates of twinned crystals penetrated by brilliant, acicular zinkenite crystals. The stannite balls, which reach 1¼ inches across and are available as somewhat smaller and very fine thumbnails, occur as floaters in the vugs. Luster is dull to metallic, apparently varying selectively with crystal form. Some arsenopyrite is associated as well. Jack received about 20 specimens in the latest lot.

The San José andorite continues to be found, although better specimens came out about 4½ years ago. The large vug pictured here is one of the earlier specimens and has crystals averaging about ½ inch. Singles to 2 inches came out about that time too, and crystals over an inch have been known from there since 1897. The San José mine is the premier locality for andorite. (Readers may wish to review the excellent article on Oruro by Cook which appeared in vol. 6, no. 3, p. 125–137).

Figure 8. **Greenish yellow andradite garnet from the C-thon prospect, Graham Mountains, Arizona. The specimen if 3½ inches long, and has associated green diopside. Chris Wright specimen.**

Figure 9. **A 3½ inch cassiterite crystal, probably the largest ever found in North America, from the Herbb No. 2 mine near Flat Rock, Powhatan County, Virginia. Lawrence Conklin specimen.**

ARIZONA ANDRADITE

A new locality in Graham County known as the C-thon prospect has produced approximately 800 very good specimens of dark greenish yellow andradite. The crystals are the typical dodecahedron with good luster and size up to ¾ inch. Many excellent thumbnails and miniatures turned up, as well as a few nice cabinet pieces. Some specimens are floaters, and some are associated with green diopside crystals, quartz and calcite. Wright's Rock Shop obtained the lot, and the occurrence has been pretty much gutted.

GIANT CASSITERITE

What is perhaps North America's largest cassiterite crystal, 3½ inches, was removed from the Herbb No. 2 mine near Flat Rock, Powhatan County, Virginia. The mine has also produced an 11-inch, 9-pound topaz crystal, as illustrated in a recent article in *Lapidary Journal* by Peter McCrery, one of the collectors (July 1983 issue, p. 586–594). The Herbb No. 2 mine is one of three important pegmatites in Virginia. In 1944 it yielded the largest Virginia beryl crystal ever found . . . 5 feet long. A smaller beryl (only 20 x 14 inches and weighing 300 pounds) from the same find is on display at the Virginia Division of Mineral Resources in Charlottesville. Good crystals have been rare because Virginia pegmatites are not typically vuggy.

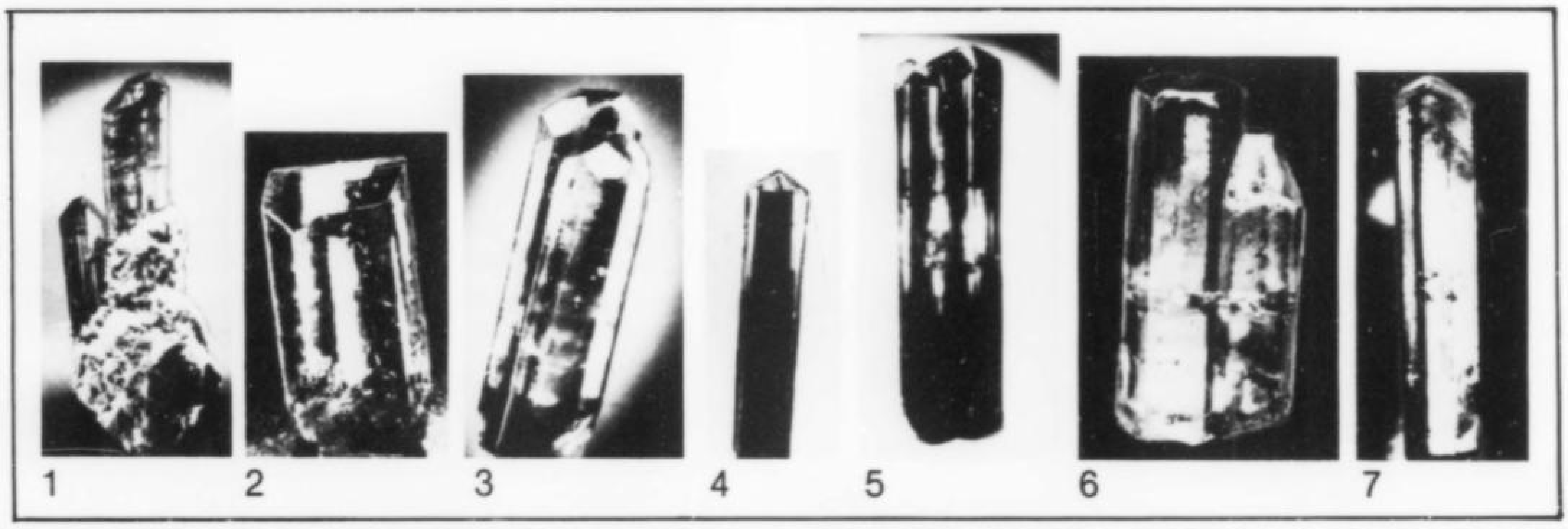
STOLEN CRYSTALS

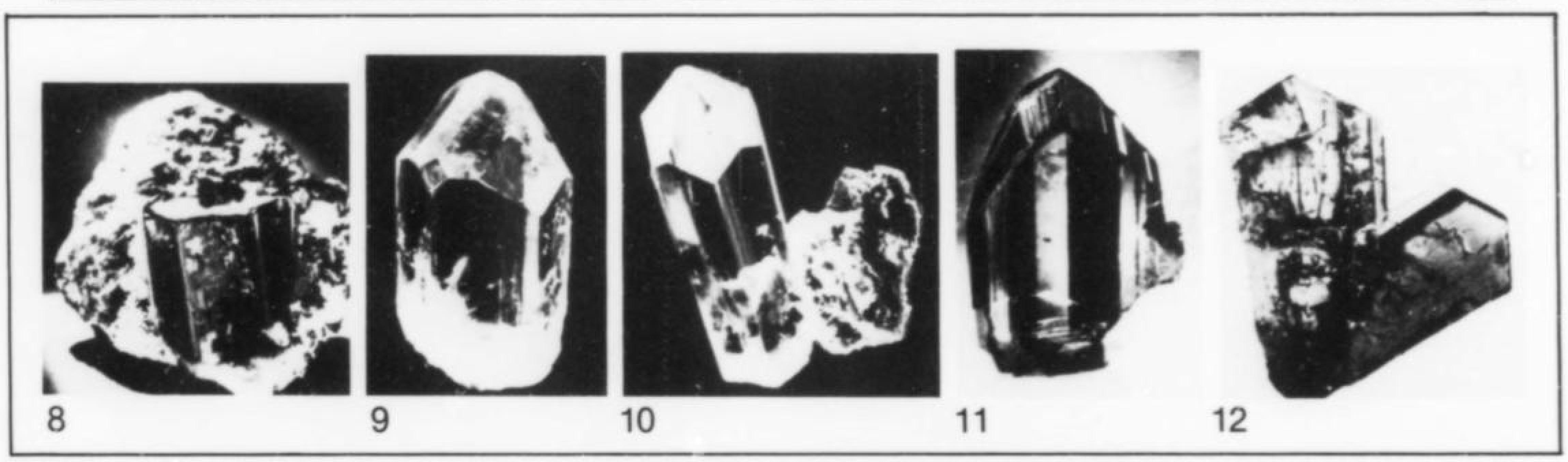
In May of this year, on Friday the 13th, 23 specimens were stolen from Keith Proctor at the Astrohall in Houston, Texas. There is a $20,000 reward offered for information leading to their return. If you are contacted and offered any of these crystals for sale, obtain as much information on the seller as you can and contact the nearest FBI office. The case is identified under the name "Keith Proctor." Or call Keith Proctor directly (303-598-1233), and no questions will be asked.

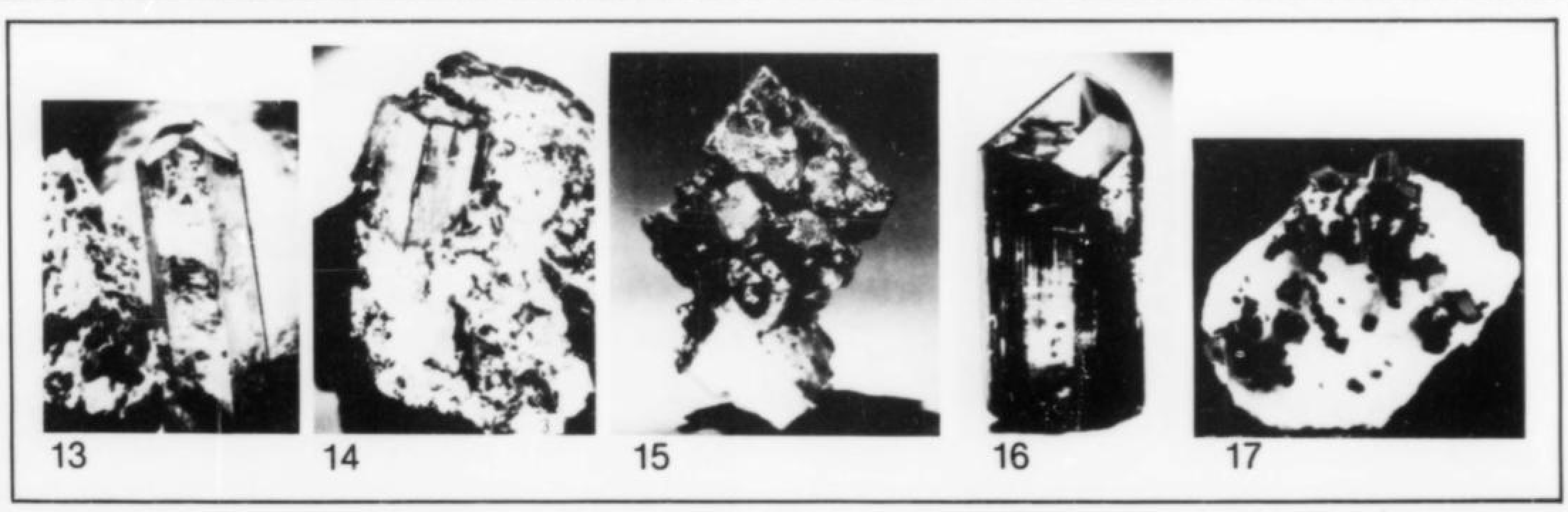
Pictured here are 17 of the stolen specimens:

1. Pink tourmaline with green tips, 3 inches.
2. Yellowish green beryl, 2⅜ inches.
3. Green Russian beryl, complex termination, 3 inches.
4. Blue/green bicolored tourmaline, 3½ inches.
5. Deep green tourmaline, 3 inches.
6. Lime-green beryl, two parallel crystals, 2⅜ inches.
7. Yellow-green beryl, pointed termination, 4½ inches.
8. Emerald in calcite matrix, 2½ inches.
9. Green beryl, 3¼ inches.
10. Sky-blue aquamarine with matrix, 3½ inches.
11. Bluish purple tanzanite, 1¾ inches.
12. Olive-green chrysoberyl, 2 inches.
13. Sky-blue aquamarine on matrix, 2 inches.
14. Emerald in calcite, 1½ inches.
15. Silver crystals on calcite, 3 inches.
16. Reddish Mozambique tourmaline, 2¾ inches.
17. Dioptase on calcite, 4 inches.

Also stolen were a ¾-inch octahedral diamond crystal, a 1-inch gold from Breckenridge, Colorado, a 2½-inch quartz gwindle and a 6-inch imperial topaz crystal.







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11. I certify that the statements made by me above are correct and complete. Wendell E. Wilson, editor.
12. In accordance with the provisions of this statute, I hereby request permission to mail the publication named in item 1 at the phased postage rates presently authorized by 39 U.S.C. 3626. Wendell E. Wilson, editor.

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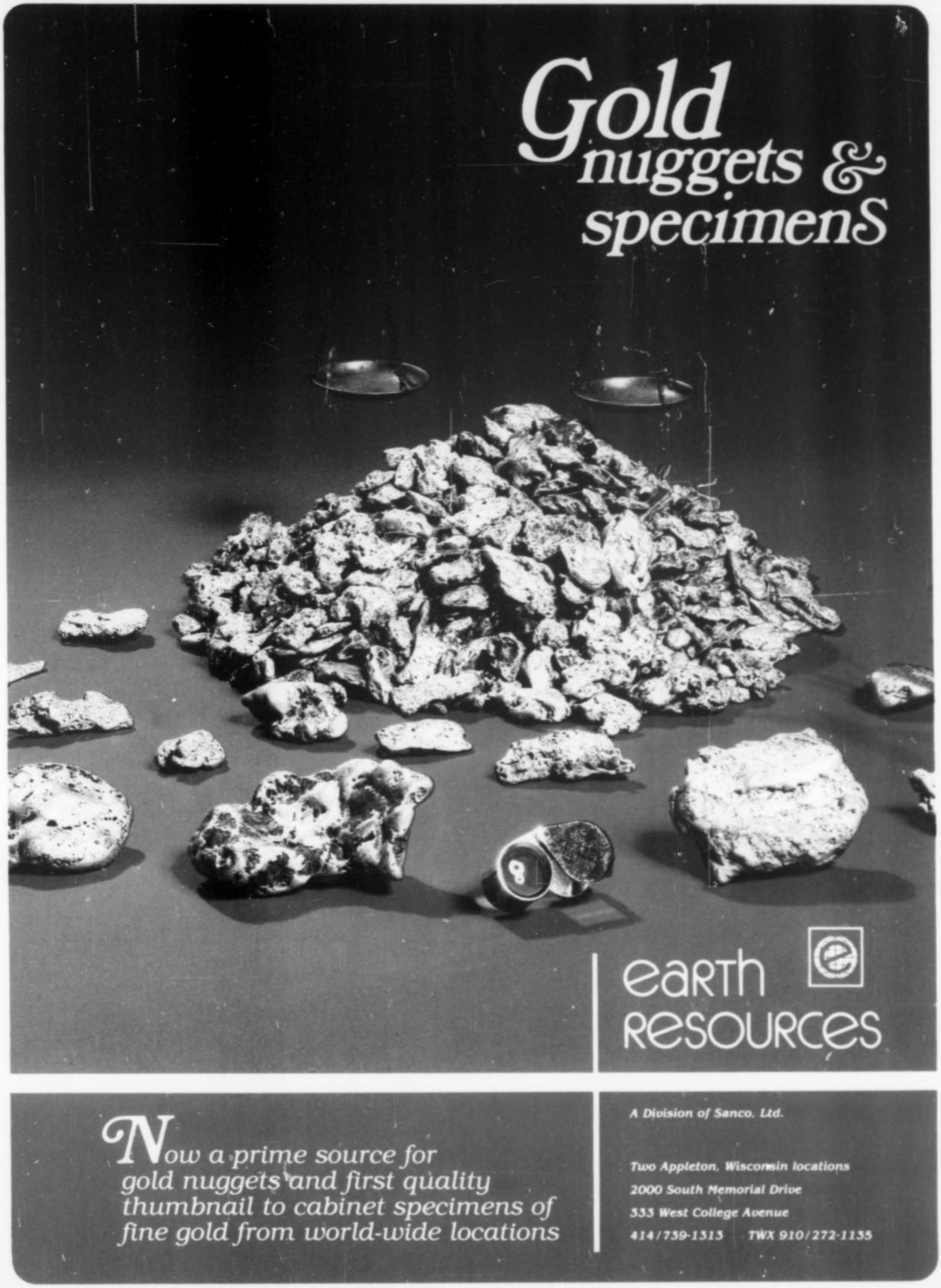
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