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COLORADO-III

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COVER: SPECIMENS from the collection of the Geology Museum, Colorado School of Mines. See page 242 for a full description. Photo by Harold and Erica Van Pelt.

notes from the EDITOR

COLORADO-III

Here we are with our third special issue devoted to the mines and minerals of Colorado. As most long-time subscribers know, the first in the series was volume 7, number 6 (1976), an issue which sold out immediately and now commands a price of about $200 on the out-of-print market. The second Colorado issue was vol. 10, number 6 (1979), and we still have a few of those left at this writing (copies may be obtained from the Circulation Manager at $5 each postpaid, while they last).

Colorado-I was the first special issue of any kind published by the *Mineralogical Record* (and only the fourth issue having your current editor at the helm). The main article is fairly spectacular: "Crystallized minerals of the Colorado Mineral Belt" by Richard Kosnar and Harold Miller. I enjoy looking back through this one even today; it's still the best collector's overview to the minerals of the state, and the color photography is excellent. Nevertheless, it is but an overview, leaving plenty of room for expansion on the many famous and prolific localities. One peculiarity which that issue contained, however, was a five-page article on Saint John's Island, Egypt . . . rather far from Colorado, I admit. Please remember, however, that in those days the *Mineralogical Record* could hardly ever afford to run color. When a 4-color page turned up available in that issue, and an article was on hand which had a color photo of one of those beautiful forsterite crystals . . . well, an editor has to be flexible. And, to this day, no one has complained about that little conceptual irregularity.

Colorado-II contained a follow-up on Colorado minerals in general by Richard Kosnar, plus two articles in the "famous locality" series: the Home Sweet Home mine and Mount Antero. A fine mineralogical study of amazonite from the Pikes Peak batholith, a historical review centering on the San Juan Mountains, a narrative regarding recent collecting at the Sunnyside and Idarado mines, and an index to important Colorado localities filled out the remainder of the issue.

In Colorado-III we present major reviews of the mines and minerals of two important districts, Leadville and Rico, plus a sort of collector's guide to the Pikes Peak area and a historical look at a fascinating occurrence: the famous Cresson Vug. Rounding out the collection is an in-depth report on the Geology Museum at the Colorado School of Mines.

There is a wealth of subject matter remaining for future Colorado issues. Cripple Creek, for instance, and the Gilman area, Creede, Breckenridge, the American Tunnel, and many more. So don't let your subscription lapse. We'll get around to them all sooner or later.

I'm sure that, whenever a special issue comes out, some subscribers will look at it and say to themselves, "Why don't they do a special issue on *my* state?" The answer is, we'll be glad to. We need just one thing first, though: authors willing to write. With the exception of the Arizona issues, all of our special state issues were initially someone else's suggestion made to the editor while volunteering an article which would fit in. I can think of a wide variety of topics which would make excellent special issues if we could get top-quality writing, but doing so is not always easy. I say this partly to encourage authors, but also to let all of our readers know that we are not discriminating against all of those states which have yet to be the subject of a special issue.

ROCKS & MINERALS

Over the years many people have told me that they love the *Mineralogical Record* and only wish it came out twelve times a year instead of six. My answer has always been that we have our hands full trying to get six issues out on time and that, as expansion became possible, we'd much prefer simply to add more pages and/or more color per issue rather than more issues per year. And this is what we've done.

Nevertheless, there is a way to get more interesting issues per year, and that is to subscribe to more than one magazine. *Rocks & Minerals* is a good choice for supplementary reading. Being in English, and also somewhat different in editorial slant from the *Mineralogical Record,* it makes a nice complement. For example, *R&M* gives more space to personality-oriented material such as their excellent series "Who's who in mineral names?" by Richard S. Mitchell (personality sketches of the people after whom minerals have been named). Another type of *R&M* article which has been a tradition for decades is the brief, non-technical overview of a particular species—Robert W. Jones readable treatment of dioptase in the January-February issue for instance.

Each issue contains something on fossils, and a coming events section. Other periodic features include the letters column, a question and answer column, book reviews, "World news on mineral occurrences" (similar to our own "What's new in minerals"), articles on various public collections and displays, and chatty, conversational reports on field trips, symposia and other events of interest.

Mineral localities are, of course, dealt with as well. Usually these articles don't go as far toward a comprehensive treatment as is typical for the *Mineralogical Record,* but there are notable exceptions. Localities chosen are sometimes of less international "significance" and virtually all are in North America, but quite often these are localities where people can actually go to collect.

Rocks & Minerals has been around since 1926, but fell on poor times when its long-time editor Peter Zodac passed away in 1967. Already somewhat dated-looking, it slumped further in quality with subsequent editorship. In 1975 it was acquired by Heldref Publications, a non-profit organization (specializing in the rescue and perpetuation of otherwise unprofitable magazines having some redeeming value). Under a new editor, Marie Huizing, the old magazine has been gradually modernized and is today quite a presentable journal.

In fact, *R&M* has had a number of special issues devoted to specific states in the Union, and these generally augment rather than duplicate the *Mineralogical Record*'s array of state issues. Wyoming, Pennsylvania, Florida, Arizona, Michigan, Kentucky, North Carolina and Minnesota have all been covered. One issue now sold out has come to be known as the St. Hilaire issue because of its major article (though it was not presented as a "special" issue), and now sells for $15 on the rare issues market. A complete set of *Rocks & Minerals,* like the *Mineralogical Record,* is considered to be worth about $1000.

Rocks & Minerals comes out six times a year, has about the same page size as the *Mineralogical Record,* averages around 44 pages per issue with rather little advertising, and even sports occasional color inside and an occasional Van Pelt cover photo. According to a recent Heldref survey, approximately 2000 *Mineralogical Record* subscribers are also *Rocks & Minerals* subscribers already. Sound pretty good? If so, send $19 ($25 foreign), to Rocks & Minerals, c/o Marie Huizing, 5341 Thrasher Dr., Cincinnati, Ohio 45247, and you'll have a one-year subscription—plus a new project to work on after completing your set of back issues of the *Mineralogical Record*!

MINERALOGICAL RECORD PINS!

Anyone who's been to a big mineral show in the last few years has observed the phenomenon: club pins of all descriptions. These are generally flat metal plates with the club logo printed in bright colors. Some people even collect these, and have special vests made to display their entire collection on their body . . . you'd almost think they were in danger of falling over forward from the weight of all those pins! No criticism intended, though; it's a nice way to let people know what you're interested in, what club you belong to, and where you come from.

American mining schools and professional organizations have long practiced a similar tradition, although their lapel pins and tie tacks tend to be more three-dimensional and considerably more expensive than the average club pin. A nice one that comes to mind is the Columbia School of Mines pin of 1908, made in the form of a tiny miner's candlestick with mother-of-pearl candle. Such pins serve a similar purpose: to be worn at conventions, symposia and shows as a way of proudly and yet discreetly saying where you come from and where your sympathies lie.

But what is there specifically for the mineral collector, to show where *he's* coming from . . . to identify himself to other mineral collectors worldwide? Unfortunately nothing. Until now, that is! Shown in the illustration is the Mineralogical Record pin. It is a cast-bronze, three-dimensional, miniature replica of our goniometer logo, copied directly from an antique goniometer in the Smithsonian Institution. The maker is Josten's, famous for the Super Bowl Ring and also just about everyone's gold class ring. This is unquestionably a high-quality pin and, we think, rather elegant. Our cost from Josten's is $10.25 each; our price to our readers is $12.00. Obviously we're not doing this to make a lot of money. We just like the idea, and think our readers may too.

Bronze goniometer pin, enlarged slightly to show detail. Actual height: 1.7 cm.

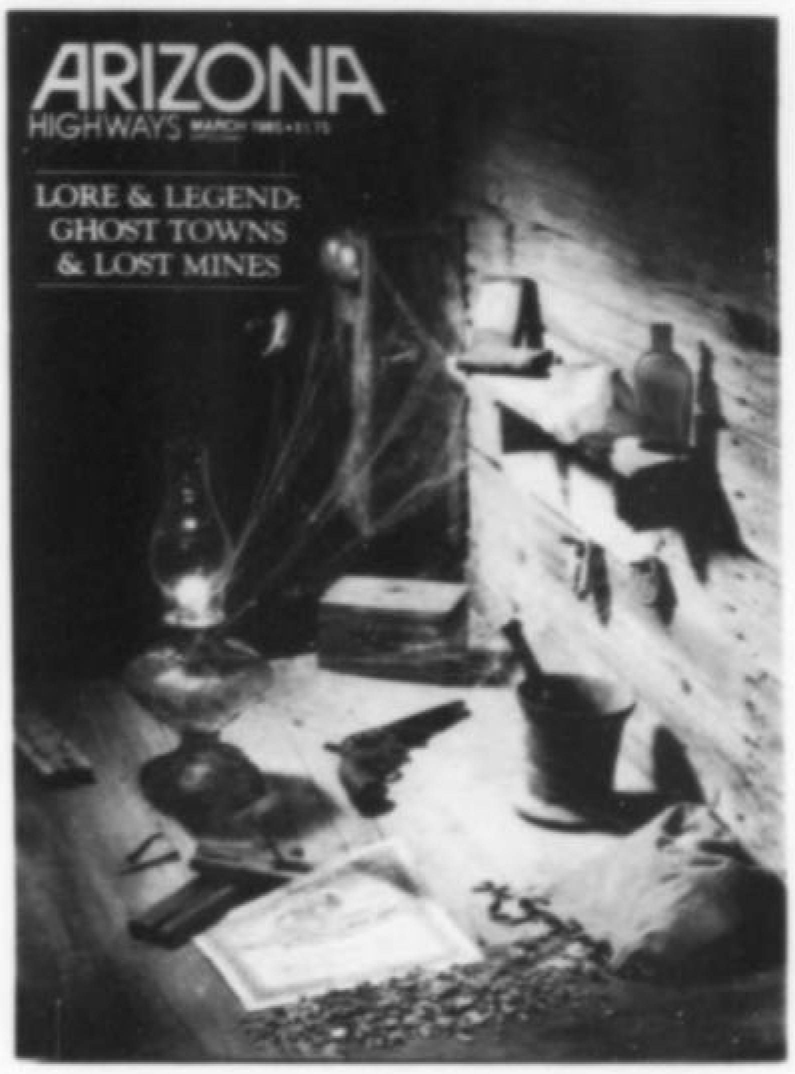
There are other versions of this pin. But, though you may see them around, they cannot be purchased. The gold version is awarded only to people who have served as associate editors, as directors, as foreign subscription agents or on our volunteer staff at mineral shows for at least five years. If you see a person wearing the gold one, shake his or her hand . . . these volunteers have done a lot of work to help keep our magazine going year after year, and they receive no payment in return.

The *crème de la crème* of Mineralogical Record pins is a gold goniometer with a small white stone inset into the center. At present there are only a few of these little beauties in circulation, awarded for a remarkable ten years of volunteer service. If you see someone wearing one, don't just shake their hand . . . take them out to dinner!

(Actually there *is* one other version: gold with a blue stone in the center. Catch me privately at a show sometime and I'll be happy to tell you what it signifies.)

Even the bronze pins should be worn with pride, however. We think that our readers and supporters are special people . . . well above average in taste, sophistication and intelligence, not to mention their passion for minerals and mineralogy. We really wish we could *give* a pin to every subscriber and advertiser – you all deserve it. But, since we don't have an extra $61,500 lying around, I guess we'll have to charge for them, and hope the cost is not too much of a deterrent. It didn't seem to be at the recent Tucson Show, where the pins made their debut and sold very well.

The bronze goniometer pin may be ordered for $12 plus 50¢ postage ($1 foreign) from the Mineralogical Record Book Department, P.O. Box 1656, Carson City, NV 89702.



ARIZONA MINES

The March issue of *Arizona Highways* magazine is a particularly nice one, centering on some of the nostalgic aspects of mining in Arizona and beautifully illustrated with paintings and drawings by Arizona artist Bill Ahrendt. Photography, of course, is superb as always. Articles include "Missing and presumed lost" by the well-known lost-mine author Kearney Egerton; "El Dorado's children" by Dana Cooper (about early prospectors); "They seldom get rich" by Dennis Farrell (also about prospectors); "Where the Old West still lives" by Allison Hodges (about the still-living old mining towns of Jerome, Oatman, Bisbee and Tombstone), and other features. Front and back covers show mining still life photos by Jerry Jacka which are worthy of framing.

Copies are available at $1.75 each ($2 each outside the U.S.) from Arizona Highways, 2039 West Lewis Avenue, Phoenix, AZ 85009.

CHECK OUT THE BOOK DEPT.

New titles continued to be added to our line-up in the Book Department, and many of them are difficult to obtain elsewhere. These books are carefully selected with the *Mineralogical Record* reader's eclectic tastes in mind, and we think you'll find them well worth adding to your library.

Even if you can find some of them at the corner bookstore, however, we hope you'll sit back in your easy chair and order them from us instead. Why? Because profits from the Book Department go directly to the *Mineralogical Record* magazine, buying more color photography and more pages for you to enjoy. So you'll be doing yourself a favor in two ways; you'll end up with good books *and* a bigger, better magazine to read from that easy chair.

the mines and minerals of Leadville

John M. Shannon and Geraldine C. Shannon
Colorado School of Mines
Geology Museum
Golden, Colorado 80401

The Colorado Mining Directory of 1883 called Leadville the "natural successor to Australia and California." In the century since that statement was made, interest has never waned and production has never entirely ceased. Not only valuable ore but also fine mineral specimens have been recovered and preserved from many of the nearly 2000 mines in the Leadville area.

INTRODUCTION

The town of Leadville is located on the western edge of the Leadville mining district, on the western slope of the Mosquito Range, in Lake County, Colorado, about 128 km (80 miles) southwest of Denver. Altitudes range from 3070 to 4000 meters (10,000 to 13,000 feet), and the mountain scenery in that area of Colorado is spectacular. Leadville is one of Colorado's great mining districts, with a long and complex history. Historical material gathered for this article gives preference to those mines of greatest mineralogical interest.

DISCOVERY

Gold!!!

The rush had begun.

Those who found themselves left out at Mountain City and other Gilpin mines continued to push relentlessly onward. Prospectors, their numbers fed by the thousands who flocked to the West in the aftermath of the terrible financial panic of 1857, pressed forward throughout the summer and fall of 1859. Into areas now known as Georgetown, Boulder, Gold Hill, Tarryall, Fairplay and over the low divide into the Arkansas Valley they drove, always in search of the yellow metal. When winter came they returned to Auraria and Denver to wait for another season to continue the search.

Finally, on February 15, 1860, A. G. (Al) Kelley (sometimes spelled Kelly) led 25 men from Auraria via Colorado City and Ute Pass across South Park, over the Mosquito Range to the west, probably via Trout Creek Pass, to the upper Arkansas River to a spot he had prospected the previous fall. This first group to work the Arkansas River chose a site that was approximately 32 km (20 miles) south of present-day Leadville; they called it "Kelley's Diggings," "Kelleysburg" or "Kelley's Bar" (Smiley, 1901; Blair, 1980).

Meanwhile, another miner who had also prospected the Arkansas Valley briefly that fall of 1859 told S. S. Slater in Mountain City (near what is now Central City) of a rich placer he had located. Although Smiley (1901) gives Currier as leader of the group organized to search out this placer, Slater seems to be the one who figured most prominently.

In any case, a small party from Mountain City journeyed down Bear Creek, up the South Platte and across South Park to the Mosquito Range. They did not cross Trout Creek Pass, the easiest access to the Arkansas Valley, but apparently entered the area via a pass immediately east of present-day Granite (Smiley, 1901; Griswold, 1951; Blair, 1980). Because their information indicated that they should continue north, this second party did not prospect at Kelley's Bar, but went on.

At this point there are discrepancies in the accounts of the Slater party and of how California Gulch and Iowa Gulch came to be discovered and named. The popular view is that at Cache Creek others threw in with them, and in Hayden Flats this larger Slater group encountered the Jones party. The latter had also heard of good prospects in the mountains and had also come from Mountain City (Blair, 1980).

The Slater party and the Jones party combined and agreed to divide "into three groups: (a) Iowans led by Jones would prospect the first likely gulch, (b) Slater's bunch (later called 'Stevens' group') from Mountain City would prospect the second likely gulch, and (c) a third group, which seems to have been made up of odd lots and led by a stranger named Johnson, would prospect the western side of the valley along the base of Mt. Massive" (Blair, 1980).

Iowa Gulch bears the name the Jones group gave it. Stevens' group prospected a gulch about 2.4 km (1½ miles) north of Iowa Gulch, and, finally, Abe Lee found "a pan that promised to make rich men of them all" (Blair, 1980). Soon thereafter this gulch was named California Gulch, from which "a number of the largest and most valuable nuggets known to the country were taken out" (Hall, 1889).

The reason for the name is also controversial. "Most old-timers claimed the gulch was so named from Abe Lee's memorial words, 'By God, I've got California in this here pan.' Others protested the gulch derived its name from the fact that the majority of the first prospectors had come from California (mining camps). A third group held that the name grew out of the early-comers' predictions that the 'diggings' would be as rich as those of California" (Griswold, 1951).

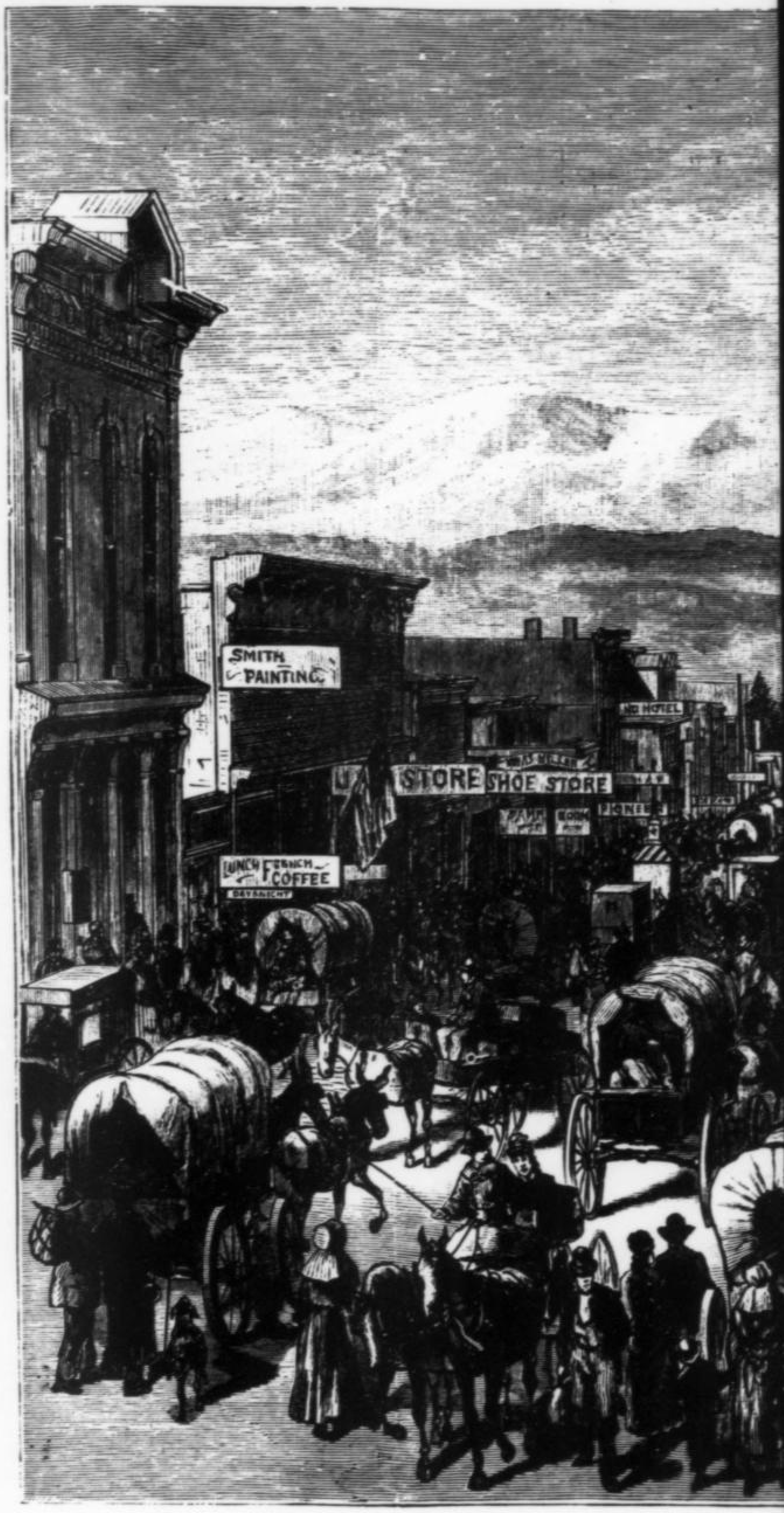
Even the date of discovery is disputed (Smiley, 1901; Griswold, 1951; Blair, 1980), but "They reported it at the Kelley Diggings – which in the meantime had not 'panned out' as well as had been expected – on the evening of April 25th" (Smiley, 1901). "The official 'Bylaws of California Mining District, California Gulch, Arkansas River' were adopted on May 12, 1860. They first outlined the extent of the district" (Blair, 1980).

The Johnson party, the third group prospecting, tried their hand in California Gulch, but soon returned to the gulch they had previously worked at the base of Mount Massive. Using a skillet to pan the dirt, they found gold there and named this creek opposite California Gulch, Frying Pan Gulch. (It was later renamed Colorado Gulch [Griswold, 1961].) The Colorado Mining District was formed by the Johnson party (Blair, 1980).

The following two reports are examples of the type of information that caused the rush to Leadville.

"Mr. H. A. Rogers has shown us some of the finest specimens of nugget gold we have seen taken out of the Mountains. . . . He had in his possession about $200 in nugget gold, varying in value from $5 to up to $33.10. It was taken from his claims, No. 2 and No. 4 in California Gulch. He also showed us over *four pounds* of fine gold taken from the same claims. Mr. R. was on his way to St. Joseph for goods, and will return in a few weeks. He gives a glowing account of the mining prospects in California Gulch" (*The Rocky Mountain News,* August 29, 1860).

"On Wednesday eve of last week two rough-looking individuals, sunburned and shaggy, entered the office of Pikes Peak Express Co., bearing sacks upon their shoulders which they deposited upon the counter like bags of corn. . . . Then causing door to be closed, they opened their pouches and emptied them of $27,000 in gulch gold. . . . The shining dust, whose luster had never been dimmed by any retorting process, glittered with peculiar brilliancy and abounded in nuggets, largest of which were twice the size of silver dollars. . . . Owners of the treasure are two miners just in from California Gulch. . . . Their names were J. M. Rafferty from Ohio and George Stevens from Philadelphia" (*The Mountaineer,* September 26, 1860).



"Following this period placer operations were carried on in a small way, the seasons' yields often being no more than about $20,000. It had been noticed, however, that certain heavy stones accumulated in the sluice-boxes to the annoyance of the placer

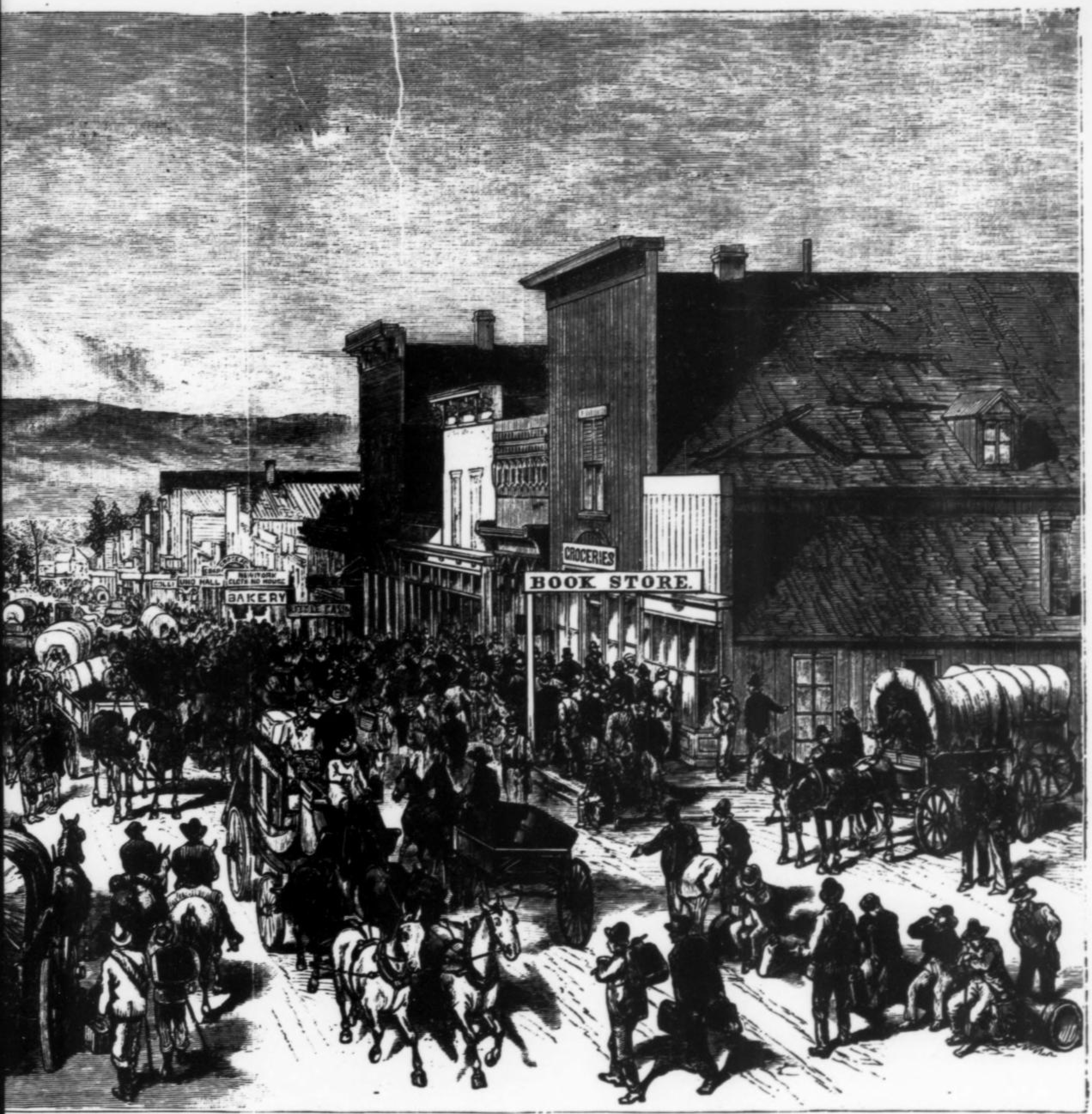


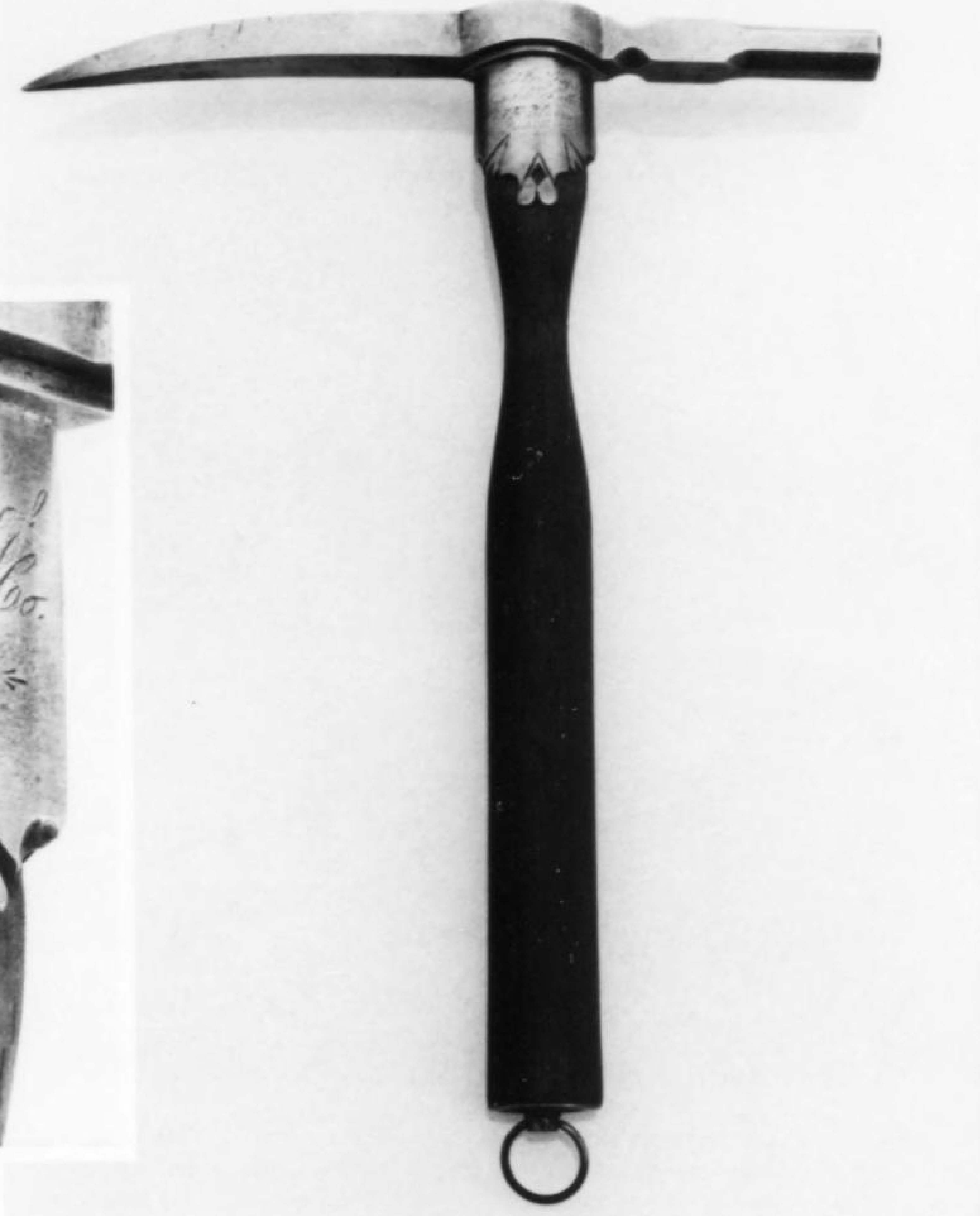
Figure 1. **Main street of Leadville in 1879, as depicted in *Frank Leslies Illustrated Newspaper* on April 12 of that year.**

miners. While it is true that many of the men were ignorant of the nature of these stones, it soon become more or less a matter of general knowledge that they were nodules of lead carbonate. Lead minerals, unless excessively rich in silver, were in the late sixties and early seventies of no value, owing to the distance from the few smelters at that time in existence west of the Mississippi. Men busy at placering could not afford to spend any time in saving or looking for deposits of such comparatively worthless minerals" (Warwick, 1905).

Sometime during the first five years of the 1860s, the first and one of the most famous lodes of the Leadville area, the Printer Boy, was discovered in California Gulch. Due to improper management, however, its full potential was not realized until 1868, when large masses of free gold were found.

Once these and other discoveries became known, men flocked in and a "camp" developed. The first unofficial, overall name of the settlement, which was scattered in a most unorderly manner for about 9.6 km (6 miles) up and down the gulch, was Boughtown, a name of "appearance" (Griswold, 1961). According to the *Daily Chronicle* of April 7, 1879, "Men in those days were in too much of a hurry to even build houses to live in; they contented themselves generally with erecting four posts and covering the tops and sides with green pine boughs."

Figure 2. **Miner's pick made by J. H. Murray, H. A. W. Tabor's blacksmith, probably as some kind of presentation piece. The inscription reads: "Made at the Shops of Chrysolite S. M. [Silver Mining] Co. by J. H. Murray, Leadville, Colo." J. Muntyan photos. Collection of R. Bowman.**



In this area grew "Oro City, as it was finally dubbed, (and it) became the social and economic hub of the area. It had one long main street that ran the length of California Gulch. . . . Oro City was one of the few communities that really served the needs of its citizens. It never required people to move to town; rather it followed the people. In its early years it was scattered up and down California Gulch; as the population diminished and those remaining clustered in the upper end of the gulch, that became Oro City. Then in 1868 the Printer Boy drew miners up the gulch and Oro City followed. In fact, in amoebic fashion, the town split into Upper and Lower Oro. The official site of Oro City was wherever the Post Office was located, and in 1868 that was Upper Oro, or Oro Number Two as it was occasionally called" (Blair, 1980).

The most productive years of placer mining in California Gulch were from 1860 to 1867; however, by 1871 placering continued there with decreased yield and a stamp mill treated ores from several lode mines. "In 1873 only a few placers were worked. Several rich gold strikes were made on lodes in California Gulch, and the Homestake mine (near Tennessee Pass) was reported to be shipping to Golden, ore that carried 30–60 percent lead and 200–500 ounces of silver. In 1874 there was little placer mining, and most of the old, lower ground was regarded as worked out, but many new ditches were being built to carry water to higher ground. The Homestake mine shipped some argentiferous galena containing nickel, but there was no market near at hand for silver ores" (Henderson, 1926).

A third period in the history of the area, the carbonate period, began around 1874, when William H. Stevens and Alvinus B. Wood formed a partnership in order to construct a 19-km (12-mile) ditch to transport water (from the Arkansas River) to California Gulch to assist with sluicing operations, in hopes of discovering new placers and veins. "The original plans contemplated applying the hydraulic process to the new ground now covered by the southwestern half of the city of Leadville" (Hall, 1889; Blair, 1980). The ditch "was an immediate success after its completion in 1875, except that Wood and Stevens were plagued with that same heavy black sand that had confounded placer operations in the gulch since those halcyon days of 1860." They collected samples from the gulch; an Alma assayer showed the ore "ran twenty-seven percent lead and fifteen ounces of silver to the ton" (Blair, 1980).

Keeping this new secret, "Wood and Stevens quietly prospected the upper slopes of the gulch until they located an outcropping in the area that Stevens had surveyed in 1865" (Blair, 1980). When samples showed it contained a high percentage of lead and 20 to 40 ounces of silver, they "did not make their discovery known until they were in a fair way to secure government titles to nine claims. These were taken up lengthways along what they considered the crest or apex of the lodes" and crossed the gulch, extending high up on the hills (Fossett, 1880). "By the fall of 1875 they controlled a considerable portion of California Gulch" (Blair, 1980).

The names of the principal locations commencing at the south were the Dome, Rock, Stone, Lime, Bull's Eye and Iron claims.

Figure 3. **Hydraulic mining at Leadville. W. Prosser collection, now in the collection of the authors.**

The ore was first found in place on the Rock claim, where it was over 10 feet thick. It was rich in lead, but carried only a small amount of silver (Fossett, 1880). Stevens was a promoter knowledgeable in mining matters, but Wood on the other hand was a mining engineer and trained metallurgist (Blair, 1980).

While they are given credit for the discovery of the Leadville carbonates that led directly to the silver boom in the late seventies, there is ample evidence that the presence of silver in the general area had been known for years, as previously mentioned. One source claimed that as early as 1871 it was not only known that lead existed on the site of Stevens's Rock mine, but also that the ore was put to a practical use – that of making bullets (Blair, 1980). That the miners were also well aware of the presence of silver is evidenced by this quote from the *Rocky Mountain News* of November 14, 1860: "We have been shown some beautiful specimens of pure silver ore, from the Washoe, Chicago and Paul's leads, which are situated about fifteen miles from California Gulch. Portions of the ore have been smelted, and globules of pure silver are attached to the fragments."

"Rather than discovery, [Wood and Stevens] were responsible for locating the first paying silver lode in California Gulch and having the financial resources and technical knowhow to develop their find" (Blair, 1980).

The successful establishment of lead smelters to treat Georgetown silver-lead ores, and the erection of smelters near Alma and at near-by Malta soon induced numerous other miners to look for the source of the lead minerals known from earlier years (Warwick, 1905).

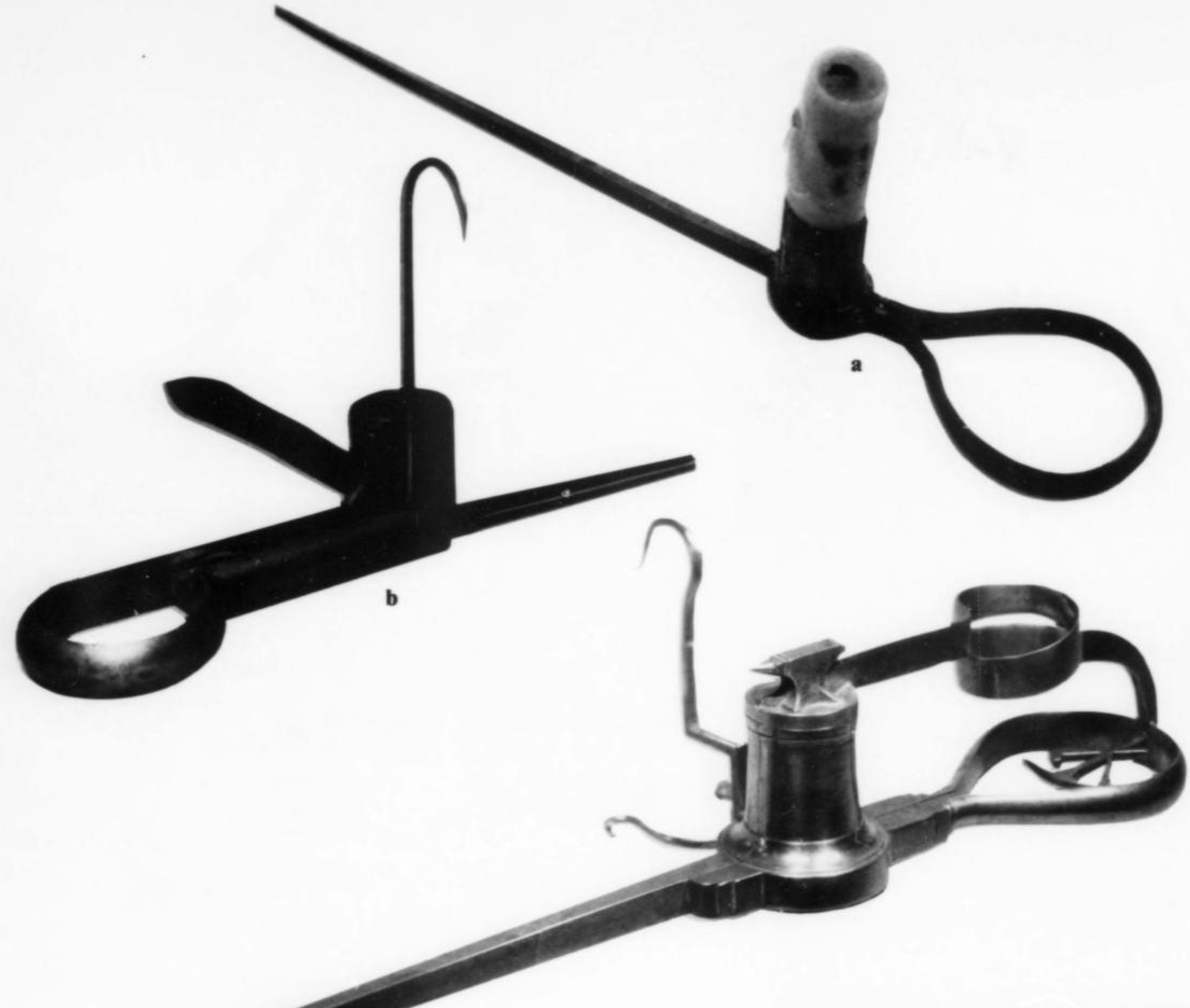
"In 1877–78 the greatest rush to any camp in the history of the state occurred, resulting in the building of a new town, called Leadville, seven miles below the old town of Oro" (Henderson, 1926). The name was derived from that decided upon when requesting a new post office for the area in 1877. "Naming the post office did not necessarily name the town, but by the fall of 1877 the name was in general use throughout Colorado. When the city framers met in January of 1878, they had either to approve 'Leadville' or come up with an acceptable substitute." Eventually "Leadville" was accepted unanimously and Governor Routt was petitioned "to allow them to establish a recognized city." This was accomplished by the spring (Blair, 1980).

It was also during this period that many of the mines which then and later produced superb mineral specimens were first staked: 1876, the Wolftone mine; 1877, the Moyer mine; 1878, the Matchless mine; 1879, the Little Jonny mine; 1880, the Resurrection mine; and 1881, the Tucson mine. (See section following entitled "About Some of the Mines.")

"North of the established mines of Iron, Breece and Carbonate hills lay an area that the experts claimed was barren. To this barren ground came George H. Fryer (in 1878)" (Blair, 1980), "who sunk a hole on a hill north of Stray Horse Gulch and found a deposit of carbonate ore that proved to be one of the most remarkable ore bodies ever discovered" (Henderson, 1926). "The mine was called the New Discovery to spite the experts" (Blair, 1980). Eventually this mine was sold to Jerome B. Chaffee.

MINING

Two poor German shoemakers, August Rische and George Hook, who had been grubstaked by Tabor (Blair, 1980), "happened to sink a hole where the 'contact' or the mass of the ore approached the surface and found the ore body on which was developed the Little Pittsburg mine, the foundation of the fortune of H. A. W.



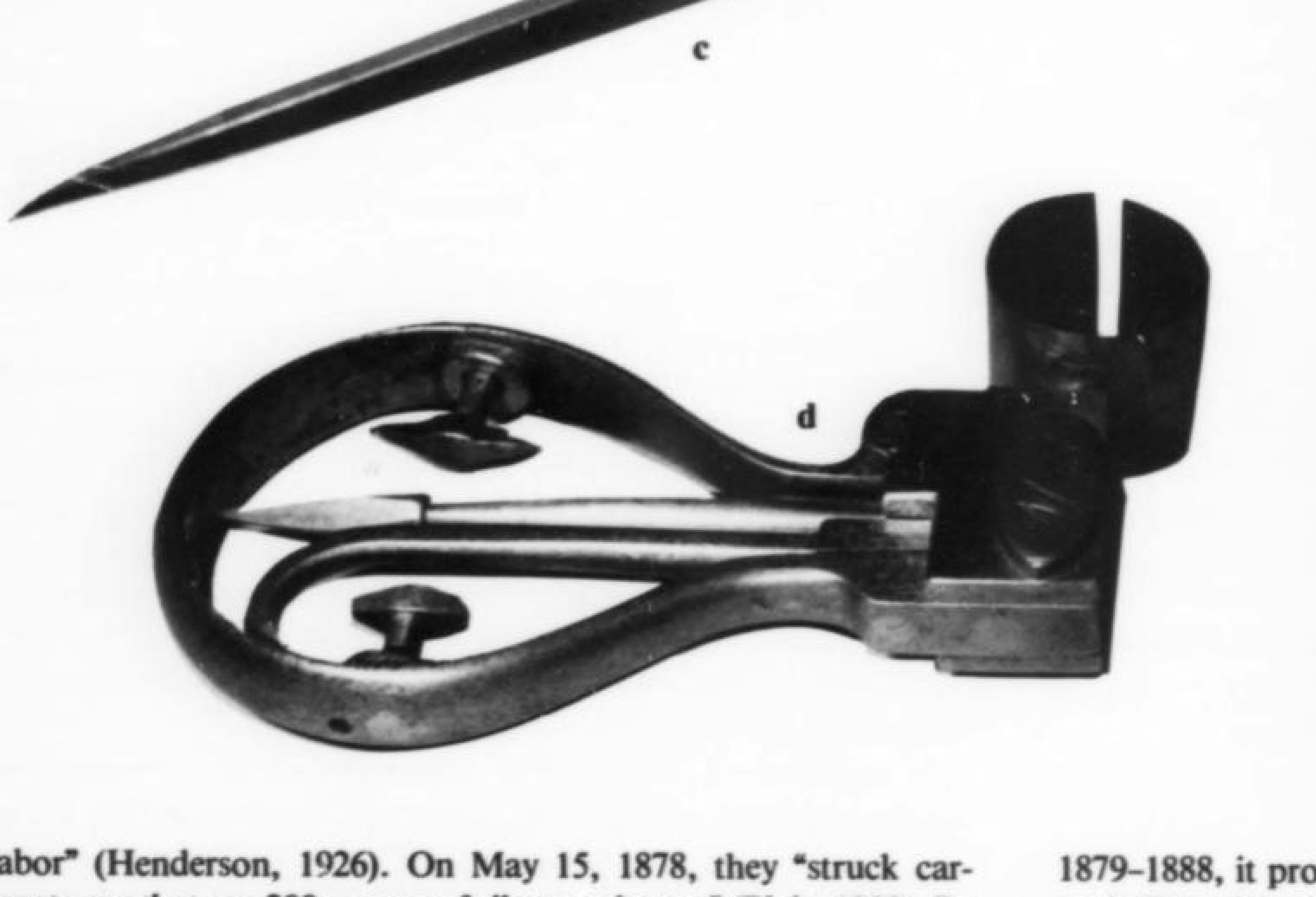


Figure 4. **Leadville miners' candlesticks, now valuable collectors' items. From top to bottom: (a) Model patented in 1906 by Joseph Kindelan of Leadville; steel, 28 cm; Jack Ramsdell collection and photo. (b) Folding model with knife blade for cutting fuse, patented in 1882 by Charles Des Moineaux of Leadville; steel, 16.5 cm unfolded; John Leahy collection; W. E. Wilson photo. (c) Fancy presentation piece with spring-loaded candle-snuffer; steel, 28 cm long; Ken and Betty Roberts collection; W. E. Wilson photo. (d) Folding model patented in 1882 by John Hume and Thomas Tate of Leadville; shown folded, 8.3 cm, steel with brass initials plate; Ted Bobrink collection; W. E. Wilson photo. (For more information on these and many other miners' candlesticks see Wilson and Bobrink, 1984.)**

Tabor" (Henderson, 1926). On May 15, 1878, they "struck carbonate ore that ran 200 ounces of silver to the ton" (Blair, 1980). By 1882 production had increased to an output valued at $10,139,765 (Henderson, 1926). This value was based on a per-ounce price of $1.14.

During 1883 "Iron Hill continued to be the largest producing district from the Iron Silver, A. Y., Minnie, Colonel Sellers, Tucson and other mines. The Little Jonny mine was actively worked, the product being silver-lead ores carrying some gold" (Henderson, 1926). "In the first decade of the carbonate era, 1879–1888, it produced $146,342,000 in silver, lead, gold and copper" (Warwick, 1905).

It was also in 1883 that a visitor to Leadville could see the Leadville Free Museum. "It is a rare treat, and one that every visitor to Leadville should avail himself of, to see the mineral and natural curiosities and the mercantile museum of Messrs. Westover and Fuller. They have every imaginable mineral wonder mounted and unmounted that is known to Colorado, which is the same as saying 'which was ever known to the world.' They also carry a large collection of petrified woods of every imaginable shape and unique-

Figure 5. **Sixty-five tons of silver bullion awaiting shipment at Leadville. Photo (one side of a stereo pair) by Gurnsey, printed by Kilburn Brothers, Littleton, New Hampshire; authors' collection.**

ness. . . . Messrs. Westover and Fuller have had many years valuable experience in their present line of business, and are continually adding new and rare specimens to their collections. They not only supply rare articles to residents for their own use or to send eastern friends and furnish every eastern visitor with souvenirs, but fill orders from metropolitan jewelers, colleges, private collectors, etc." (*Leading Industries of the West,* 1883).

"In 1890, a large deposit of copper ore was found in the Henriette and Maid of Erin properties. In 1893 Lake County began to produce considerable gold, chiefly from properties on Breece Hill." In that same year, "American Smelting and Refining Company organized and took over nearly all lead smelters of the Rocky Mountain States" (Henderson, 1926).

After the fall in the price of both silver and lead in the early 1890s and a disastrous miners' strike in 1896, it took a cooperative effort from the town of Leadville to revive mining there. The Down-Town Pumping Association was formed to assist with the financing necessary to drain the "downtown" mines, which had been flooded during the strike. The Home Mining Company, supported largely by Leadville merchants, was also organized. The success of these organizations encouraged miners and restored prestige to the district (Warwick, 1905).

During the period from 1899 to 1915, zinc became the important mining product of the Leadville area. Zinc mills were established and shipments of zinc sulfides became quite large. Numerous large bodies of zinc carbonate were found in 1910, many in the old workings.

In 1915 "output of gold from Breece Hill mines increased greatly and the placer industry was revived, after years of non-existence, by the installation of a dredge on the Arkansas River at the mouth of Box Creek, 12 miles above Leadville. In June, 1916, the downtown mines, which had been allowed to fill with water in 1907, were again unwatered and from 1917 to 1923, when they were again closed, they produced large quantities of lead oxide, zinc carbonate, iron-manganese and other ores. In August, 1923, unwatering by electric pumps was begun in the Carbonate Hill mines that had been closed in 1918–1919. The water was not completely removed until the spring of 1925" (Henderson, 1926).

The years between 1918 and 1940 saw many ups and downs in the mining at Leadville. Several small booms took place during these years, brought about by a demand for some of the metals or a chance discovery of a new pocket or small orebody, but these always seemed to play out, resulting in a period of inactivity.

Mining became active once again as a result of the demand for metals during World War II and on into the Korean conflict. In 1943 the government appropriated money for a 4-km drainage tunnel to drain the Leadville district. It was hoped the tunnel would open large deposits of lead, zinc and manganese ores for production, but the project was halted in 1952 because of rising costs and a decline once again in metal prices.

Figure 6. **An 1895 exhibit of crystalline gold, sponge gold, placer gold and gold bullion taken from Leadville mines. The specimens and bars, worth $150,000 then and at least $2.5 million today in bullion value alone, were assembled and exhibited by the Carbonate National Bank, Leadville. Courtesy University of Colorado Western History Collections.**

In recent years mining has been carried on with the discovery of a block of down-faulted ore near the old Black Cloud lode claim and is being worked through the new Black Cloud shaft. "The Hilltop mineral deposit and veins common to Park and Lake Counties are being worked through the Sherman Tunnel" (Holmes, 1983).

"In some respects, Leadville is the most remarkable city the world has ever seen" (Ingham, 1880). Certainly it has been able to survive the vicissitudes of fortune for more than a century, and it remains a working monument to mining in Colorado.

GEOLOGY

Ridge (1972) has summarized the geology of the Leadville area, and his report is the basis of the following synopsis.

The Leadville area is underlain by Precambrian granite, gneiss and schist which are essentially free of ore. Overlying Paleozoic sediments (quartzite, shale, dolomite, sandstone, limestone) all have been found to contain ore, although the Mississippian Leadville dolomote has been the biggest producer. A wide variety of intrusive rocks, mostly porphyries, have penetrated the sediments at one time or another. One unit, the Pando porphyry, forms extensive sills up to 300 meters (1000 feet) in thickness. Many of these intrusions were pre-ore, but some were post-ore, and dating of these rocks suggests that the Leadville ores were emplaced in the late Mesozoic or early Tertiary.

Most of the Leadville ore mined has come from an area bounded by Leadville on the west, the Ball Mountain fault on the east, Evans Gulch on the north, and Iowa Gulch on the south. Nevertheless, significant quantities have come from some outlying areas.

The primary ores at Leadville are of three types: (1) silicate-oxide deposits, (2) mixed-sulfide veins, mostly in siliceous rocks, and (3) sulfide replacement bodies in dolomite. Several periods of faulting prepared the way for introduction of the ore-forming solutions throughout the area.

The silicate-oxide deposits, of relatively minor economic significance, consist primarily of magnetite and hematite in a serpentine-manganosiderite gangue. Subsequent fracturing of this assemblage allowed the formation of gold-bearing pyrite veins.

The mixed-sulfide veins, most common in the eastern area because of the abundance of siliceous rocks there (which the veins seem to favor), consist of pyrite with interstitial chalcopyrite and gold in quartz gangue. Gold, silver and copper have been mined extensively from these deposits, particularly where the ore has undergone some secondary enrichment. In some areas the veins expand into sulfide replacement bodies.

The sulfide replacement deposits are more common in the western part of the district, where carbonate rocks suitable for replacement are more abundant. These bodies form mantos spreading out from fractures and sheeted zones under impermeable covers such as porphyry sills. The replacement ores consist primarily of sphalerite and galena with appreciable silver, all in a gangue of manganosiderite with quartz and barite. The most abundant sulfide was pyrite, its deposition beginning before and ending after the formation of sphalerite and galena. Only very small amounts of gold

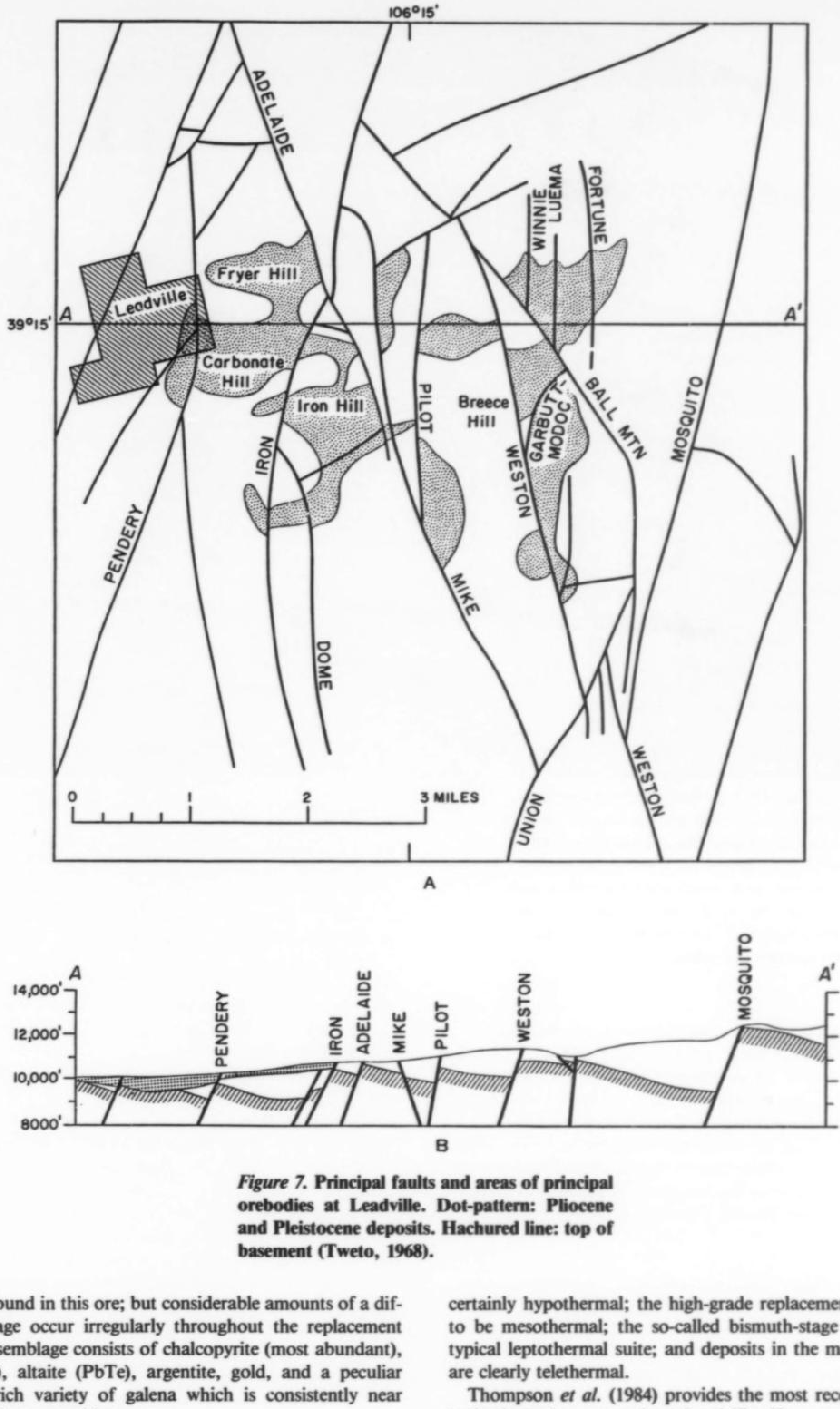


Figure 7. **Principal faults and areas of principal orebodies at Leadville. Dot-pattern: Pliocene and Pleistocene deposits. Hachured line: top of basement (Tweto, 1968).**

and silver are found in this ore; but considerable amounts of a different assemblage occur irregularly throughout the replacement bodies. This assemblage consists of chalcopyrite (most abundant), hessite (Ag_2Te), altaite (PbTe), argentite, gold, and a peculiar silver-bismuth-rich variety of galena which is consistently near $Pb_{11}Ag_2Bi_2S_{15}$ in composition.

Replacement bodies occur all over the district, but those in the outlying areas tend to be smaller and simpler in their mineralogy.

Deposition in the Leadville area as a whole spans a range of temperatures and pressures. The magnetite-hematite ores are most certainly hypothermal; the high-grade replacement bodies appear to be mesothermal; the so-called bismuth-stage assemblage is a typical leptothermal suite; and deposits in the more distant areas are clearly telethermal.

Thompson *et al.* (1984) provides the most recent discussion of hydrothermal ore genesis at Leadville. However, DeVoto (1984) proposes some alternative concepts by theorizing that pre-existing karst (cavernous) topography within the limestone units controlled ore deposition in a manner similar to that associated with Mississippi Valley-type lead deposits.

ABOUT SOME OF THE MINES

Considering that the Leadville area encompasses nearly 2000 mines, it would be impractical to discuss them all here. The following discussion touches upon some of the more interesting claims, with the understanding that there are many more stories left untold.

Printer Boy Hill

Printer Boy Hill lies at the southernmost extension of the so-called Leadville gold belt. In this area gold mineralization seems to be closely related to bismuth mineralization (Loughlin and Behre, 1934, 1937). Both sulfide replacement and vein deposits occur in the area.

Printer Boy mine

Locating specific information on many of the earliest mines is always extremely difficult, owing to the fact that no one at the time was especially interested in preserving for posterity any accounts of what actually happened. All energies were turned to producing precious metals and earning money, rather than to writing and recording.

Hardly any mine has presented such a challenge in research as the Printer Boy. Some few sources place its location in 1861 (Manning, 1895), while most say the date was 1868. Its low claim number certainly suggests the earlier date.

While it is true that the first discovery of gold in place was made at the Printer Boy in June, 1868, on the north side of Georgia Gulch by Messrs. Smith and Mullen, research suggests that it had been a claim long before that time and had been neglected for a while.

One source says that for a year very little attention was paid to the claim by anyone, and during the absence of the owners the claim was jumped and several thousand dollars in ore taken out. Attention of the owners was attracted and litigation ensued, bringing about the notice of the public (Raymond, 1872).

Since this mine, along with the Antioch, was opened to try to locate the source of the California Gulch gold, it appears odd that it would have been ignored for a while. If this occurred before 1868, however, when the lode was discovered, it surely might have taken place.

The notes of S. A. Safford, Surveyor, dated June 9, 1868, state that the claim contains "veins of ore from three to eighteen inches wide, composed of decomposed quartz containing some copper and very rich in free gold. The crevice usually carries a vein of dark gray cleavable talc on the west wall. Twenty-six ounces of gold have been taken from one pan of selected ore from this lode." It was "worked by shafts and hand windlass, also by a tunnel" and the ore assayed at $75 per ton. At that time there was no mill (Bureau of Land Management files).

Eventually the float of yellow iron-stained clay was followed (after 1868) until it turned down into the formation in place, which proved to be the vein. A shaft was then sunk and discovery was made of a large body of ore. The vein was only about 50 cm wide and the ore consisted of decomposed porphyry, clay and iron, in walls of pyritiferous porphyry (Emmons, 1886; Lakes, 1895).

In 1880, Dill (1881) described the workings as primitive, unsafe and haphazard.

Ingham (1880) states that the claim proved to be valuable enough that a stamp mill was erected to crush its ore, and that the mill produced about $250,000 in bullion from 1868 until 1874. He also says that the mill "was not very successfully managed thereafter." Monograph 12 asserts that the Printer Boy "produced a large amount of gold between 1866 and 1870, of which no record can be obtained" (Emmons, 1886).

Operated by the imperfect methods of that early period of mining, the Printer Boy produced, in the course of time, some extraordinary returns because the rich pockets lay comparatively near the surface (Hall, 1890; Griswold, 1951).

"Large bodies of decomposed quartz, soft and porous, were found, carrying great masses of free gold in nuggets, bunches of fantastically formed and matted wires, and beautiful crystallizations. Many large glass jars, such as are seen upon the shelves of drug-stores, were filled with these remarkable specimens, and exhibited, first at the national banks in Denver, and subsequently in Philadelphia and New York, where they excited much admiration, and for a time, revived the interest of speculators in the mines of Colorado" (Hall, 1890).

The Pilot fault divides Printer Boy Hill into two parts, and J. Marshall Paul is said to have made a fortune from the mine before finally selling the north half in 1868. Since that time it has been known as the Upper and Lower Printer Boy (Dill, 1881; Lakes, 1895).

Circa 1893, after sinking a shaft, running two drifts, and mining over $100,000 in value, a second shaft was started on the property. It was in this second shaft that two ore veins were found. From one of these "$4500 in gold nuggets were panned out from a single pan of dirt" (Dill, 1881); $4500 in gold computes to approximately 20 pounds troy of gold in a single pan, or about $74,000 at late 1984 prices! Nuggets of large size were taken from the mine, many exceeding 5 ounces, and one of 28 ounces (Dill, 1881).

"In the deeper workings considerable iron and copper pyrites and some galena and tennantite were found. Gold occurred in both pyrite and galena, and a piece of ore containing galena crystals, connected by a filament of wire gold, was one of the show specimens at the mine. Selected specimens are said to have contained 122 ounces of gold to the ton, and the average assay is given at three to four ounces" (Emmons, 1886).

In view of all the reports of fabulous finds, quite an exhaustive search has been conducted to locate specimens from the Printer Boy mine. To date no well-documented gold specimens have been found, after consulting the Harvard Mineralogical Museum, the Philadelphia Academy of Natural Sciences, the Smithsonian Institution, the Los Angeles County Museum of Natural History, the Denver Museum of Natural History, the Geology Museum at Colorado School of Mines and numerous private collectors. This leaves it open to conjecture as to whether or not the lavish reports were just a promotional scheme designed to encourage investment.

Lilian mine

The Lilian mine carries one of Leadville's most unusual mineral assemblages, in a sulfide replacement body. The mine is the discredited type locality for lillianite. But, in one of those peculiar twists of mineralogical history, even though the type specimens were discredited as mixtures, the species has remained valid. By coincidence, material matching the originally described (though erroneous) composition was subsequently found at the Sultan mine, Silverton district, Colorado, and in the White Cross–Hurricane Basin district, Colorado, so the species has been allowed to stand. The original author (Keller, 1889) therefore has the unique distinction of having described and named a valid species which he had never seen, at a time prior to its discovery.

California Gulch

Rock Hill and Iron Hill are here included in the California Gulch area. Orebodies begin on Iron Hill, to the north, and pass under California Gulch to Rock Hill, on the south (Loughlin and Behre, 1947). The upper portions of California Gulch intersect the gold-pyrite vein deposits radiating from Breece Hill and Printer Boy Hill. These were the veins which furnished most of the placer gold found in California Gulch in the early boom days.

The gulch is also the scene of the discovery of bonanza-grade silver-lead replacement bodies in limestone, where cerussite and chlorargyrite were the main ore minerals.

Figure 8. **Facilities of the Iron Silver Mining Company, including the Tucson mine shaft, the Iron mine, Luella mine and others. William H. Jackson photo, courtesy Denver Public Library Western History Department.**

Many well-known mines from this area probably produced fine specimens, but the early-day Leadville mineral specimens have had a low survival rate. The best-known specimen producers include the Tucson mine, Moyer mine, and the A. Y. and Minnie mine.

Tucson mine

It seems very likely that the Tucson mine, patented in 1886 by Charles J. Doud *et al.* (Bureau of Land Management files) was one of the claims purchased by Stevens and Wood as they developed the carbonates on Iron Hill. The Tucson, along with the Luella, was added to the Iron Silver Mining Company of W. H. Stevens and Levi Z. Leiter in 1881, Leiter having purchased Wood's interest (Dill, 1881; Ebbley, 1949; Blair, 1980).

In any event, the first operations were through the north and south incline by Stevens and Leiter, and the Tucson shaft was sunk to a depth of 338 meters (1,100 feet). At that time it was recognized as the best in the Leadville district (Ebbley, 1949).

In 1910 high-grade silver, one assay being as high as 2,000 ounces per ton, was mined in the lower levels. Considerable mining was carried on from 1912 to 1918, at which time lead and zinc sulfides were the main ores. A few attempts to reopen the mine between 1918 and 1926 were reported, but none was successful, and the property remained inactive until 1940 (Ebbley, 1949).

In that year the upper portion of the shaft was reopened by Axel Lind and Associates to gain access to a zinc carbonate (smithsonite) orebody known to have been left partly unmined by former operators. Production was discontinued after making five shipments of ore, because the minimum grade acceptable to the buyers was raised to 30% zinc. Low-grade lead carbonate (cerussite) ore was mined by the lessees and shipped to the local smelter until the mine was closed again in 1944 (Ebbley, 1949).

The upper workings of the Tucson mine intersect oxidized lead-silver ores in the Leadville limestone. A large specimen of jackstraw cerussite in the Colorado School of Mines collection is from this zone.

Many fine specimens have come from the Tucson mine. Chapman (1941) reports gold with hessite, altaite and galenobismutite. A material called "schapbachite" was found to be a mixture of hessite, bismuth-bearing altaite and gold; it occurred as a coating on 2.5-cm galena crystals.

A specimen of flattened galena crystals, apparently twinned on the spinel law, exists (ER collection); the crystals have a drusy gray coating ("schapbachite"?) and are associated with sphalerite and pyrite.

Fine, large, pyritohedral to octahedral masses of pyrite crystals have come from the Tucson mine, as well as siderite and botryoidal hemimorphite.

Vugs of twinned sphalerite crystals, some of which reached diameters of more than 1.2 cm and small well-developed crystals of arsenopyrite have also been reported (Emmons *et al.*, 1927).

"An unusual occurrence of drusy and stalactitic galena was noted on the sixth level of the Tucson mine. This galena had grown upon zincblende crystals in vugs in sulfide ore along the hanging wall of the Tucson fault. The stalactites were as much as half an inch in length and were distinctly later than the blende or the few crystals of chalcopyrite that accompanied it. The galena was coated with a dusty film that may have been argentite, as the ore at this place assayed 80 ounces to the ton in silver" (Emmons *et al.*, 1927).

Much of the sulfide material is associated with flattened rhombs of siderite.

Moyer mine

Patent was granted on January 30, 1880, to William Moyer and Judge Wells for the Moyer placer, which they had located in 1877, under a special Act of Congress passed in 1872. Although it straddled California Gulch, it also extended up the south slope of Iron Hill (Silversparre, 1882; *Denver Tribune,* 1899 and 1902; newspaper, name unknown, 1888).

On February 24, 1880, the upper or northern portion was sold to Stevens and Leiter as part of the Iron Silver Mining Company and holdings grew steadily under several different managers.

The Report of the Director of the Mint tells of a new strike reported in 1882. "Near the porphyry, or top of the orebody, the mineral is a fair galena ore, carrying some sulphate of lead, and only small quantities of iron pyrites and zinc blende" (Burchard, 1884).

Figure 9. **The Colonel Sellers mines No. 1, No. 2, and No. 3 (at top) and the Moyer mine (right foreground), ca. 1887. Richard Ronzio collection.**

In 1890 some 2.5 km of drifts had been run in the Moyer alone (Harper, 1890). This included two shafts: the lower or south shaft sunk in 1882 (described in the above-mentioned Mint Report) and the north shaft, sunk sometime later approximately 800 meters to the north.

The Moyer mine shipped the first zinc to Belgium via Galveston, Texas, in 1899 (Blair, 1980) and thus in its own way was responsible for some of the beginnings of one of the later periods of Leadville—that of the lead-zinc-silver-gold, or composite, era.

Aside from good ore, the Moyer's primary claim to fame is the multitude of ghosts which are said to inhabit it. Senator Gallagher of Silver Plume, who was killed in the mine, is said to have been seen wandering around, and the disembodied souls of twelve workers crushed to death in a cave-in have continued to occupy it (Blair, 1980).

The main ore shoot, a blanket-shaped sulfide orebody, measured 28 meters thick and 150 x 600 meters across (Emmons *et al.*, 1927). Some of the Moyer orebodies were pure, solid pyrite which was ultimately mined as flux for the Leadville smelters. These orebodies were usually replaced limestone blocks completely surrounding intrusive porphyry. In places alternating bands of pyrite and sphalerite appear to have preserved original bedding structure. Another Moyer orebody was composed of mixed sulfides thoroughly shot through with secondary cerussite and limonite (Emmons *et al.*, 1927).

The Moyer has produced lustrous, black, 2.5-cm sphalerite crystals on pyrite matrix (Henderson, 1926; Kosnar, 1976); hemimorphite; some very nice, although small (1.2-cm) modified crystals of galena; and some beautiful pyrite specimens showing combinations of the octahedron and pyritohedron (ER collection).

Carbonate Hill

Carbonate Hill lies between the Pendery fault on the west and the Iron fault on the east. The Tucson-Maid reverse fault passes through the hill and appears to have been a factor in the development of sulfide replacement orebodies at the Wolftone mine.

The mines on Carbonate Hill were the second major group developed on secondary lead-silver bonanza deposits in the early days. As in the California Gulch area, the orebodies occur mainly in the upper Leadville limestone. Just below and sometimes adjacent to these orebodies lay the oxidized zinc ores for which the area is best known; these were not considered economical in the early days of mining and were temporarily bypassed.

Common botryoidal smithsonite was reported from the Maid of Erin mine (Loughlin, 1918), and other mines in the area reported fine smithsonite druses and mixtures with iron and manganese oxides. When the district finally did begin to produce zinc, the result was significant: $43,000,000 worth from 1910 to 1916, most of it from Carbonate Hill.

Wolftone mine/A. M. W. properties

The Wolftone mine, named for Theobald Wolfe Tone, the spiritual father of modern Irish nationalism, was located in 1876 by Samuel Morgan and Aden Alexander. Situated on Carbonate Hill, California district, 1.6 km (1 mile) from Leadville, five shafts were sunk ranging from 9 to 25 meters in depth and the ore was said to have a value of $250 per ton (Corbett, 1879).

Malta Smelting and Mining Company was the claimant requesting a survey in 1880; patent was granted later that year (Bureau of Land Management files).

"At a depth of 633 feet ore was first struck, and a body of iron pyrites, mixed with galena, passed through, which is 7 feet in

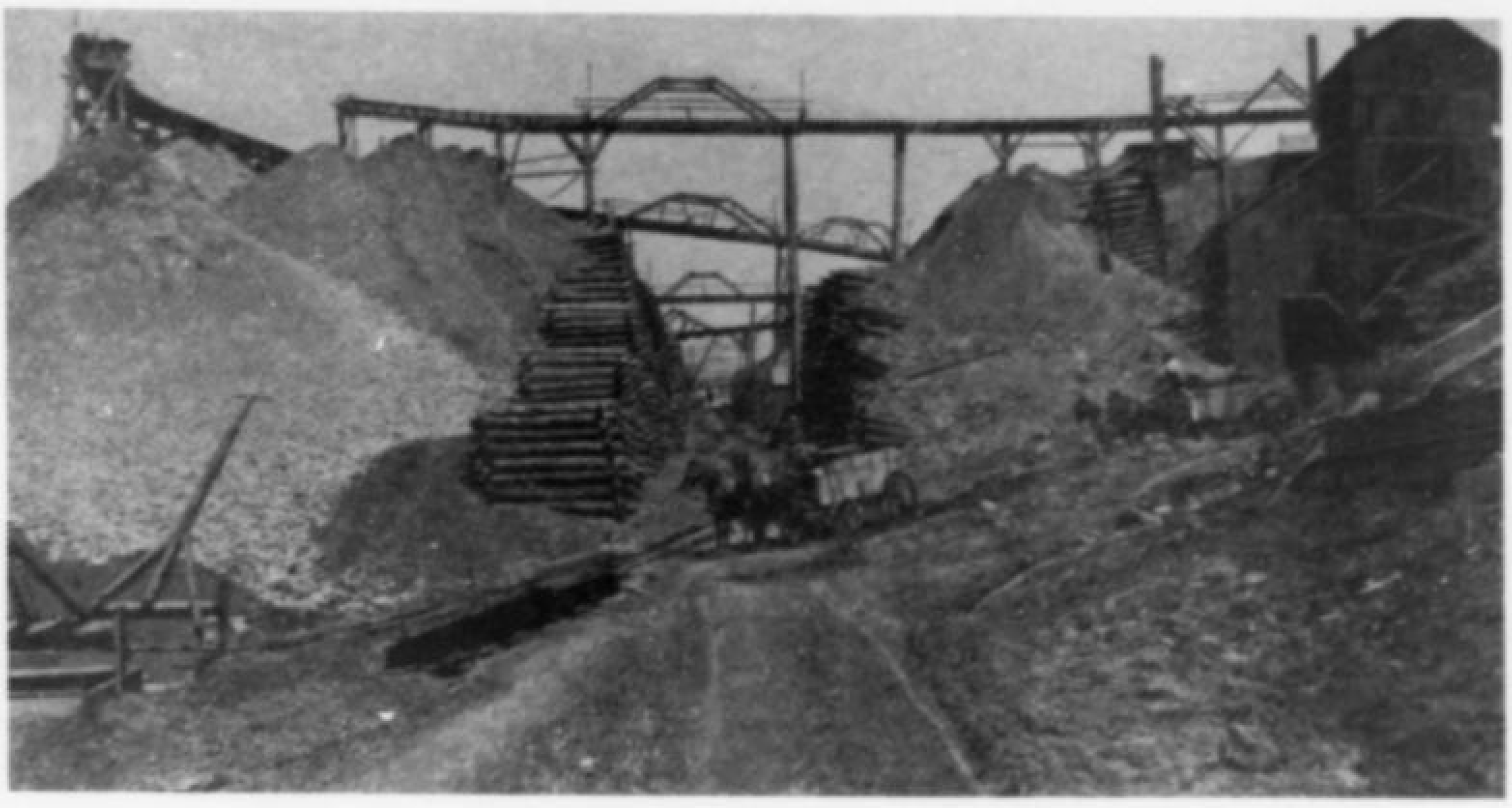


Figure 10. **Dumps of the Maid of Erin mine, ca. 1892 (from *Engineering Magazine*).**

Figure 11. **Headframe of the Wolftone mine, ca. 1899 (from *Engineering Magazine*).**

thickness. It is not similar to other ores found on the hill, and is believed by those who have examined it to be an overlying iron body, and that the regular ore contact is at a still greater depth. . . . The strike is one of the most valuable ones made about Leadville for a year past, and will add large territory to the productive mines of this camp" (Burchard, 1882).

The A. M. W. Company, made up of the Adams, Maid of Erin and Wolftone mines, was organized sometime prior to 1892. The President and General Manager of the A. M. W. was S. D. Nicholson (Blair, 1980; Holmes, 1983).

When in 1910 the first highgrade zinc ore, reported as calamine (hemimorphite), was discovered in the May Queen mine, Nicholson began a search for oxidized zinc ores in the old workings of the Wolftone and discovered the largest body of zinc silicate in the district (Loughlin, 1918).

In 1913 Nicholson sent an unidentified sample of zinc ore to the Colorado School of Mines, where G. M. Butler identified it as a zinc-rich variety of aragonite and named it *nicholsonite* after the man who had brought it to his attention (Loughlin, 1918).

As the development of the oxidized zinc ores intensified, what was believed to be another new mineral species was found in the Wolftone and named *wolftonite,* but further study suggested it to be hetaerolite. In 1913 Ford and Bradley described it as a rare vug-filling mineral, found with a radiating mammillary structure, whose outer surfaces were generally smooth and rounded. More chemical analysis showed a quantity of water in the formula, indicating the mineral was actually hydrohetaerolite.

In 1920 the Wolftone mine had been "developed by a shaft 1,120 feet deep, from which eight leads had been driven" (Hornor, 1920).

The Wolftone had produced hemimorphite, galena, sphalerite, and the other minerals already mentioned. Emmons *et al.* (1927) also reports "a considerable quantity of pyrite . . . with radiating structure suggestive of marcasite, but chemical tests proved it to be pyrite. The surfaces of many of the radiating pyrite crystals are coated with pyrite crystals of more ordinary form."

Yak tunnel

What has been and might still be considered one of the greatest undertakings in the Leadville camp is the development of the Yak tunnel.

In 1899, A. A. Blow, general manager of the Silver Cord Combination Mining Company, was instrumental in the construction of a tunnel. Its portal is on the south side of Carbonate Hill, about 1.2 km southeast of the Leadville city limits, halfway between Leadville and the former site of the most recent Oro City settlement.

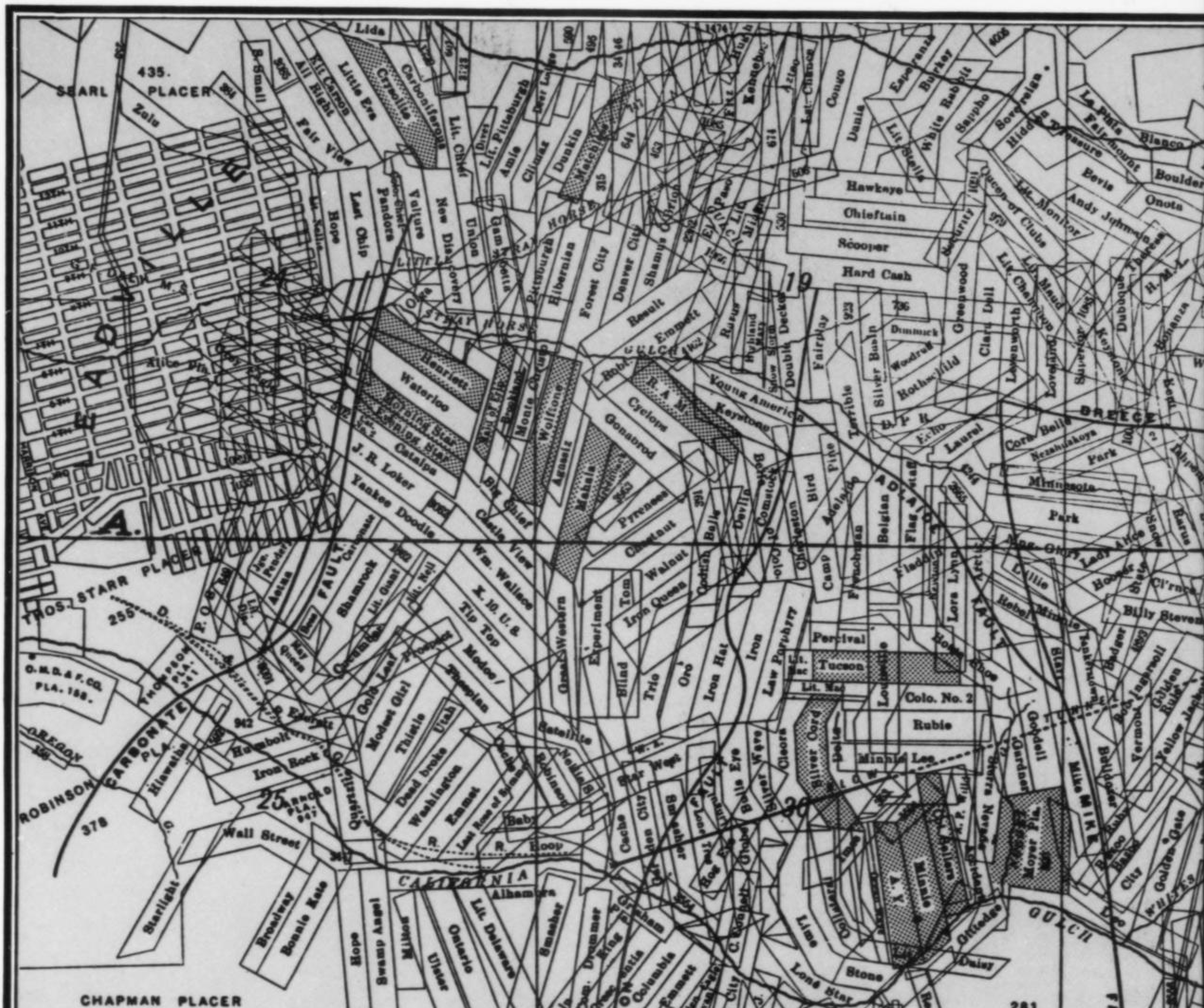
The Blow tunnel, as it was first called, was planned to reach the Silver Cord incline and was to be used for draining the mine and as a haulage-way.

Human power was the force behind the first haulage, but when the distance from the face to the portal made this impractical, mules came into use. By June 24, 1892, a distance of 910 meters (2956 feet) to the Imes station of the Silver Cord incline had been completed (Luke, 1971).

The tunnel had penetrated 1.2 km to the Colonel Sellers mine when the repeal of the Sherman Silver Act brought about cessation of the work in 1893.

Shortly after shutdown the two-year-old mill burned, causing Blow to recommend the formation of a new company for the purpose of driving the tunnel through Iron Hill to the area beneath Breece Hill (Luke, 1971). It was felt that the mines on Breece Hill, including the Ibex properties, could be unwatered and worked more effectively through a tunnel. In addition, there would no doubt be exposed a number of exciting prospects along the tunnel's route (Blair, 1980).

As a result, the Yak Mining, Milling and Tunneling Company was organized. In addition to Blow and other individuals, one of the organizers was John F. Campion. The Yak name probably was chosen by Campion, who named properties for large hoofed animals (Luke, 1971).


MAP OF
THE MINING CLAIMS
OF
LEADVILLE, COLO.
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W
E
CHAPMAN PLACER
2364
OSCAR PLACER
2362
PEASE PLACER
T. S. WELLS & WM. MOYER
PLACER
1014
MACKENZIE
PLACER
OLSON PLA.
2719
SEARL PLACER
435.
ROBINSON
CARBONATE
THOS. STARR PLACER
CALIFORNIA
IOWA
GULCH
MOUNT
YALE PLAC
3976
281
Wall Street
Mac Gregor
Reconstruction
Robin Hood
Cornucopia
Hawkeye
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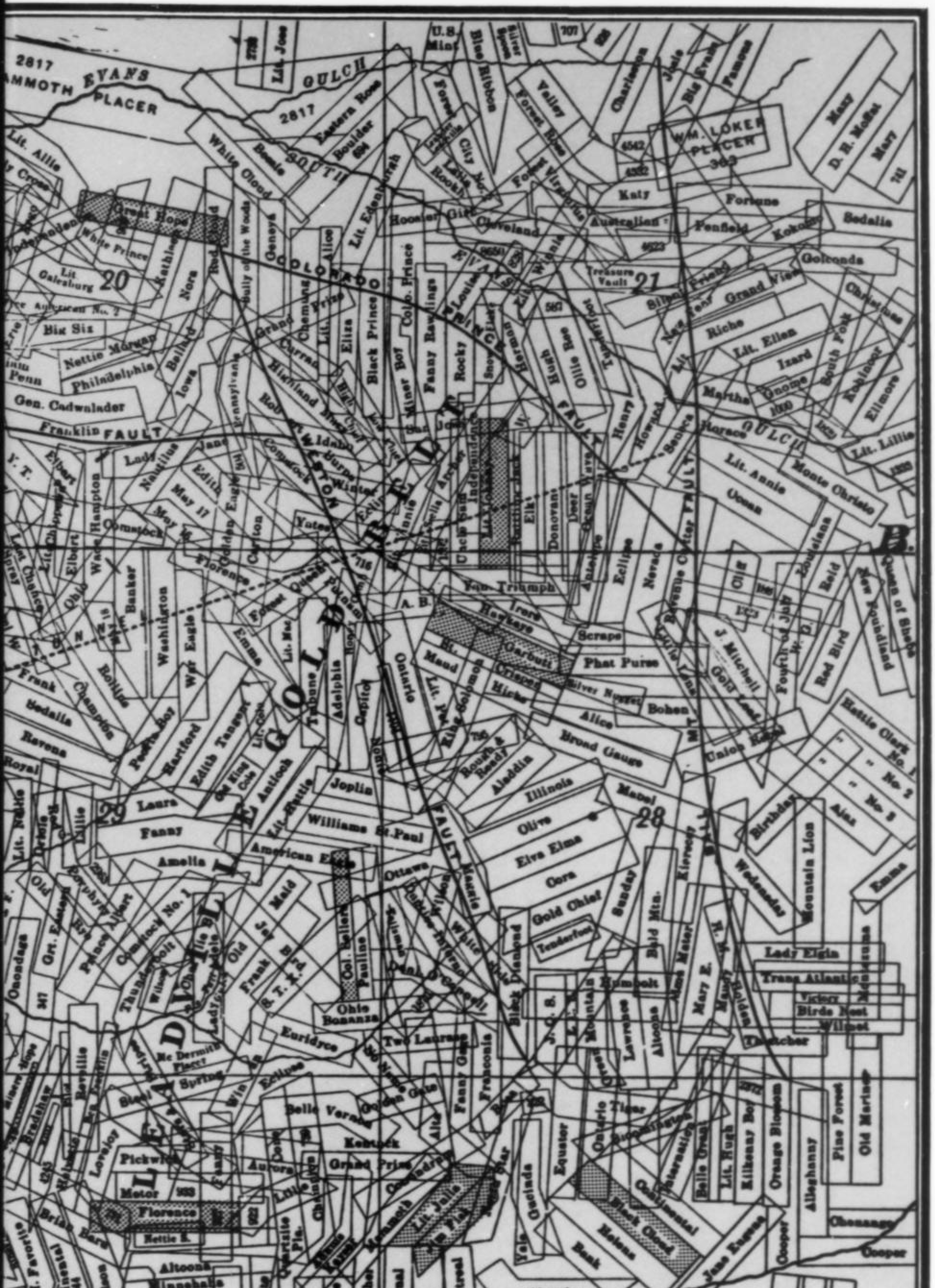

Figure 12. **Surface map of the Leadville area in 1908, showing claims and major faults (Miller, 1908). Sections are 1.6 km (1 mile) on a side. Some mines mentioned in the text are shown shaded.**

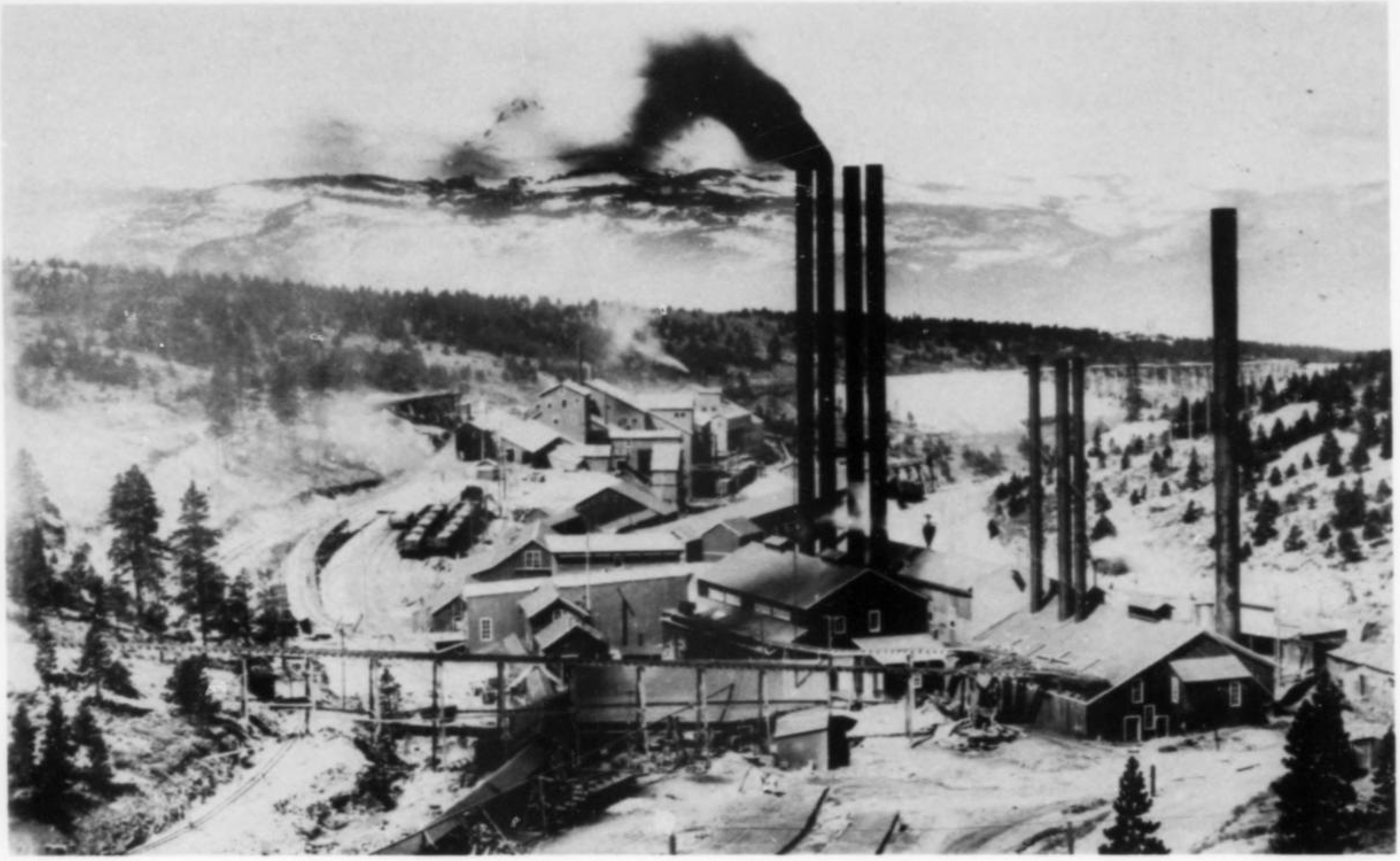

Figure 13. **The Yak tunnel complex. Richard Ronzio collection.**

Work on the new project began in March, 1895, and by the end of 1899 the tunnel had been driven 2.5 km to a depth of 400 meters below the Forest Queen on Breece Hill (Luke, 1971).

At the turn of the century attention shifted from gold and silver to increasing amounts of lead-zinc ore, with over 1000 tons per year being shipped by way of the Yak. It was at this time that consideration was given to continuing the tunnel under the Mosquito Range and emerging into Park County (Luke, 1971). However, this plan never came to fruition.

The Yak workings reached the Resurrection #1 mine in 1908. By January 1, 1909, it extended 4.8 km into the hills, and October 30 of that year saw the Resurrection #2 included in the networks of laterals, shafts and raises. During this time the work continued to the accompaniment of numerous improvements, including electric locomotives, a new electric generating plant and a new magnetic separator mill (Luke, 1971).

The terminus of the Yak was reached in October of 1912, approximately 6.4 km (4 miles) from daylight, "in the vicinity of the Diamond and Vega properties, approximately one mile northwest of Little Ellen Hill" (Luke, 1971).

Mines all along the route of the Yak were unwatered, a benefit for which owners paid the Yak Mining, Milling and Tunnel Company. "Many of the mines along the route were worked through the tunnel and for that privilege they also paid. The Company owned a considerable number of claims outright; others they leased and paid royalty on; still others were held in 'perpetual contract,' which gave the Yak an easement through the property and allowed the owner to work his own mine if he desired" (Blair, 1980). Of course, there were fees and royalties charged for this privilege, also.

In 1917 ASARCO purchased an undivided half interest in the Yak, but activity slowed drastically after World War I and through the depression of the 1930s. Abandoned workings filled with water; some have never been pumped dry. In 1938 Newmont Mining Corporation and Hecla Mining Company purchased interests and joined ASARCO in the Resurrection Mining Company, which included the Yak properties (Luke, 1971).

Production flourished during World War II, but slowed considerably afterward. A fire in 1956 destroyed most of the surface facilities of the Resurrection, resulting in a mine shut-down in 1957. ASARCO's smelter closed in 1961, and in 1963 the tracks to the portal of the Yak were removed.

The Yak tunnel provided its owners with a steady income for nearly half a century, and it was still a part of local mining operations in 1980. It enabled several marginal properties to operate profitably by lowering overhead costs; it provided drainage, transportation and ventilation to numerous mines; it extended the growth and production of the Leadville district for many years (Blair, 1980). By 1971, only the Black Cloud mine (ASARCO) maintained access to the Yak; all other operations had ceased.

It is difficult to say for certain where mineral specimens marked "The Yak" came from. Specimens could have originated in the Silver Cord, which consisted of "vuggy veinlets of pyrite and quartz cementing the quartzite fragments and partly replacing them, practically pure pyrite to practically pure zinc blends (or sphalerite), and barite in small crystals" (Emmons *et al.*, 1927). They might also have come from any of the mines worked through the 6.4 km of the tunnel system. Well-formed galena crystals have also been labeled "The Yak."

Fryer Hill

Fryer Hill is easily the most famous of the early lead-silver bonanzas. Orebodies were found in the anticline under the hill, and in the syncline under adjacent Fairview Hill. Mineralization was so intense that virtually all of the upper Leadville limestone became replaced by sulfides.

The oxidized lead-silver ores on Fryer Hill consisted predominantly of remnant galena with cerussite and minor anglesite and pyromorphite, chlorargyrite and iodargyrite (Emmons, 1886).

The first secondary zinc ore (smithsonite) produced in all of Leadville came from the Robert E. Lee mine on Fryer Hill; though no detailed description of the ore has come down to us, it was probably similar to Carbonate Hill material.

The Matchless mine

According to Gordon L. Hall in his *Two Lives of Baby Doe,* the Matchless was discovered on Fryer Hill in July, 1878, by seven poor prospectors and named for Lorillard's chewing tobacco. A year later a survey was granted to Tim Foley, A. P. Moore and T. B. Wilgus. Although they extracted a considerable amount of ore from the mine, they had no idea of the riches it contained (Dill, 1881).

The mine was patented in 1879 (*Colorado State Mining Directory,* 1898), and H. A. W. Tabor in September of that year "claimed he wanted a mine to call his own," after being involved very profitably in a number of other mining ventures, "and spent $117,000 to clean up the various lawsuits against the property" (Blair, 1980).

Of three shafts on the property, only one with a small vein of galena ore showed promise. The shaft was sunk to a depth of 77 meters (250 feet) when it became flooded and work was soon halted (Dill, 1881). Lou Leonard took over as Mr. Tabor's manager in July, 1880, and reopened the mine (Blair, 1980). A new shaft was sunk to "a depth of 148 feet, and from this a drift 42 feet long has been run. . . . (L)ater yesterday afternoon a fine body of [silver] chlorides . . . was struck. It is 8 feet high and 10 feet were passed through. The chlorides were mixed with flint and iron, and will run high in the thousands. An assay was made from some of the ore late this afternoon resulting in 1,434 ounces in silver to the ton" (*The Denver Tribune,* November 25, 1880).

Mr. Tabor was realizing a net profit from the Matchless mine of over $2000 per day by 1881 (Dill, 1881).

United States Mint Reports for 1882 stated of the Matchless: "The ore is for the most part chloride, crystalline particles of which are studded all through the masses of ore, and sometimes specimens are obtained which assay many thousands of ounces."

In 1888 another rich vein was struck, assaying 125 ounces of silver per ton (*Colorado Graphic,* n.d.).

"It was leased about 1918 by Dr. Bailey; again in 1937 by Tom Palmer," who turned it into "Leadville's major attraction. It is the Mecca which is daily attracting tourists, scores of cars carrying visitors from every state in the Union to the cabin that has now become almost a shrine. . . . (T)he visitor can select his specimen of argentiferous iron," and Tom "impressed the visitors with the belief that a fortune, coy and concealed, still lurked within the depths of the old mine." Tom arrived in town with a lease from the Shorego Mining Company "just when the cabin was becoming the prey to the pillagers" and restored the place. "It seems to be Tom Palmer's ambition to make a mine out of the Matchless. He has at least made it Leadville's most popular showplace" (*Carbonate Weekly Chronicle,* August 16, 1937).

"In 1964 the owner was (still) Shorego Mining Company, Denver" (Gilfillan, 1964), "which is in turn owned by the heirs of J. K. Mullen, who was a contemporary of the Tabors" (*The Rocky Mountain News,* May 28, 1969).

This mine, situated on Fryer Hill in Little Stray Horse Gulch, adjoining the Robert E. Lee, California district (*Colorado State Mining Directory,* 1883; Burchard, 1883), produced some very fine wire silver with pink rhodochrosite (Miller, 1971). Pyrite, galena, sphalerite, cerussite and siderite have also been reported (Muntyan, 1979).

One of the Matchless silver orebodies had the peculiar distinction of being almost entire lead-free, and consisted of finely disseminated chlorargyrite in a sandy-textured ocherous mass.

Breece Hill

Breece Hill is the center of the main intrusive complex at Leadville. Both vein deposits and replacement orebodies exhibit some zoning concentric to Breece Hill. Over 100 precious metal-pyrite-quartz veins have been discovered extending outward from the complex. Pyrite-gold ores occur in fault breccias, and tungsten mineralization is also present (Behre, 1953; Loughlin and Behre, 1947).

Contact-related magnetite-serpentine-carbonate skarns formed during the intrusion of the Breece Hill stock, and magnetite was mined from these in the 1880s to the 1920s as a smelter flux. Most of this production came from the Penn mines and carried small values of gold and silver in zones where pyrite and chalcopyrite had replaced magnetite (Thompson *et al.,* 1984).

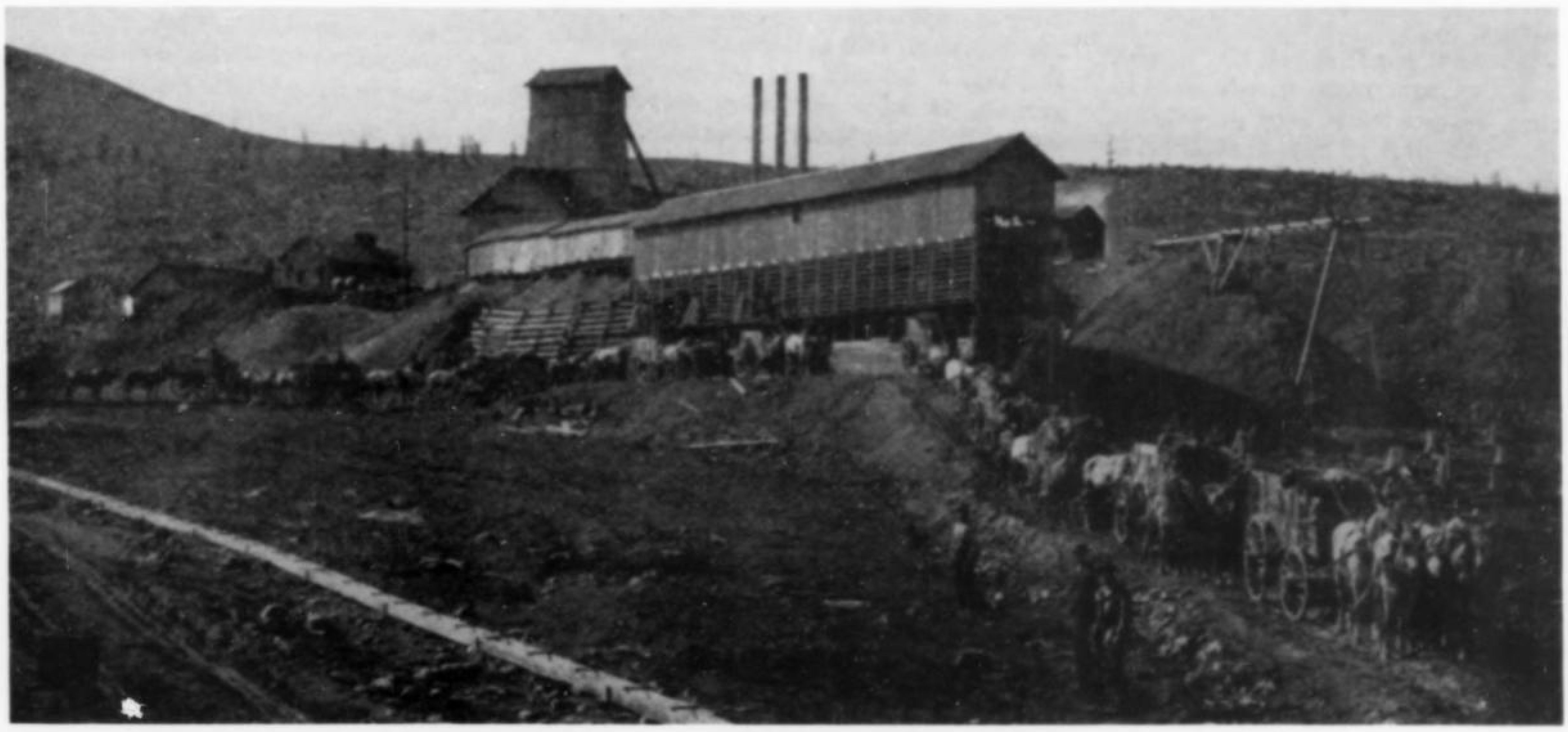

Figure 14. **The Little Jonny mine, ca. 1899. Courtesy Colorado Historical Society.**

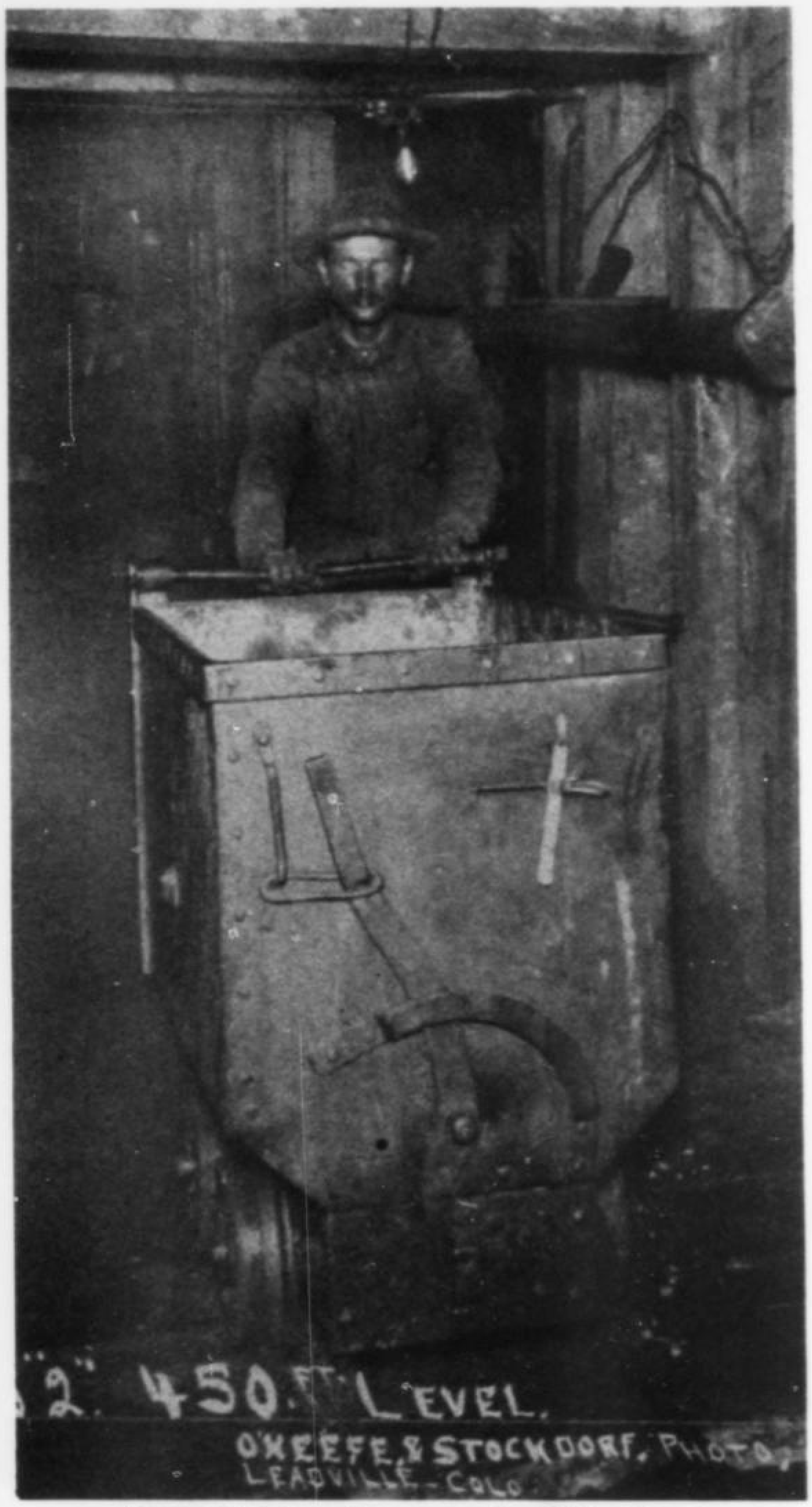

Figure 15. **Tramming ore on the 450-foot level of the Ibex mine, 1894–1897. Courtesy Amon Carter Museum, Fort Worth, Texas.**

Lead isotope studies suggest that convection cells of circulating meteoric water leached metals and sulfur from the Breece Hill stock and redeposited them in faults and as replacements in limestone (Thompson *et al.,* 1984).

The Little Jonny/Ibex mine

The Little Jonny is another mine of the California district whose beginnings are somewhat uncertain.

One story is that in the winter of 1879 three young men – John Curran, Thomas Kelly and James H. Donovan – left Galena, Illinois, and went to Leadville, where they dug away 2 meters of snow on Breece Hill to put up a cabin. In this they lived and starved all winter. Kelly died from illness brought on by exposure and privation, and was soon followed by Curran, after whom the mine was named. They knew nothing about mining and had located their claim in haphazard fashion. Kelly's heirs are said to have sold their interest for $1000 and the Currans for $2500. The amount Donovan received is unknown (*The Denver Times,* February 19, 1899; Blair, 1980).

Another source indicated the Little Jonny was surveyed August 21, 1879, for A. F. Ozmond *et al.* (Bureau of Land Management files).

Of course, Hollywood has erroneously insisted that Leadville Johnny Brown located it for his wife, the Unsinkable Molly Brown.

John Campion, who was so prominent in developing the Ibex properties, came to Leadville in 1879 and did quite well buying and selling claims. After a short period of time, he had amassed enough capital to begin working the properties, instead of continuing to trade them. This enabled him to organize the Elk Consolidated Mining Company, when he inaugurated his practice of naming properties for cloven-hoofed animals, and shortly thereafter he "took a lease on the Little Jonny, which had been abandoned after Captain Jack McCarthy had sunk 159 feet to the sulfides, which were then worthless" (*Dawson Scrapbooks*; Blair, 1980).

Eventually Campion and his associates were able to purchase the Little Jonny and a number of adjacent claims. In 1891 the Ibex Mining Company was formed under Colorado laws as a closely-held corporation. It owned 150 acres of land on Breece Hill and was comprised of a consolidation of the Little Jonny, Uncle Sam, Archer and Titan claims, and the old Glengarry and Queen consolidations (Canfield, 1893; Manning, 1895).

Soon after Campion's arrival in Leadville, James Joseph Brown reached Colorado. Following a short stay in Denver and a period of working the mines in Aspen, Alma, Fairplay and other camps, Brown moved to Leadville and got a job at the Maid and Henriett mines. By 1893 he had gained enough experience that he was made superintendent of the Ibex properties. Because of Brown's assistance in solving the problem of caving dolomite sand and his general work as superintendent, the owners gave him 12,500 shares of Ibex stock (Blair, 1980), which may have amounted to as much as three-sixteenths interest in the Ibex Company (Coquoz, 1965).

"During Campion's days, miners found the 'golden stairs' and 'millionaire's chamber' on the third level between Numbers 1 and 2 shafts of the Ibex (Number 1 was the Little Jonny). The stairs – a step fault – had wire and sheet gold; the chamber – a cave – was similarly inlaid. 'It (the gold) could be pried off with a chisel or screwdriver,' said one observer" (Gilfillan, 1964).

Emmons (1927) describes another find as follows: "Wire and leaf gold occurred very abundantly in a seam of sulfide which was found on the sixth level of the Ibex about 200 feet south of the Big Four shaft and which was associated with certain highly siliceous ores interbedded with black 'Weber shales.' Some of the richest ore found in the Ibex mine was taken from this locality. The oxidized siliceous ore in one of the stopes above the third level of the same mine contained a small but remarkably rich seam of leaf and wire gold mingled with decomposed silicified porphyry. Sixteen sacks mined from this seam carried more than 50 percent of gold. In a specimen from this locality, seen in the office of the Ibex Mining Co., the gold occurs in a seam of compact jasperoid between limestone and porphyry. The jasperoid is stained deep brown by iron, has a conchoidal fracture, and contains sheets of gold in the joints. Some of these sheets are from 1 to 2 inches across. The gold is pure yellow and 860 fine. Another specimen in the company's office, from the sixth level of the Ibex mine, shows a large cluster of zinc blende and pyrite crystals which form a coating half an inch thick on a quartz seam. The quartz, partly stained by oxidation, shows many irregular openings which contain free gold, mostly in long wires but partly in leaf-like plates."

Native gold was also found in the oxidized zone in some of the lodes penetrating porphyry. In the Number 7 vein of the Ibex mine, on the tenth level, at the junction of the oxidized and the sulfide ores, it was discovered as thin leaves on sheeting planes in the porphyry (Emmons *et al.,* 1927).

In the ornate prose of Arthur Lakes (1895), writing on the collection of the Colorado State Mining Bureau exhibited in the Capitol

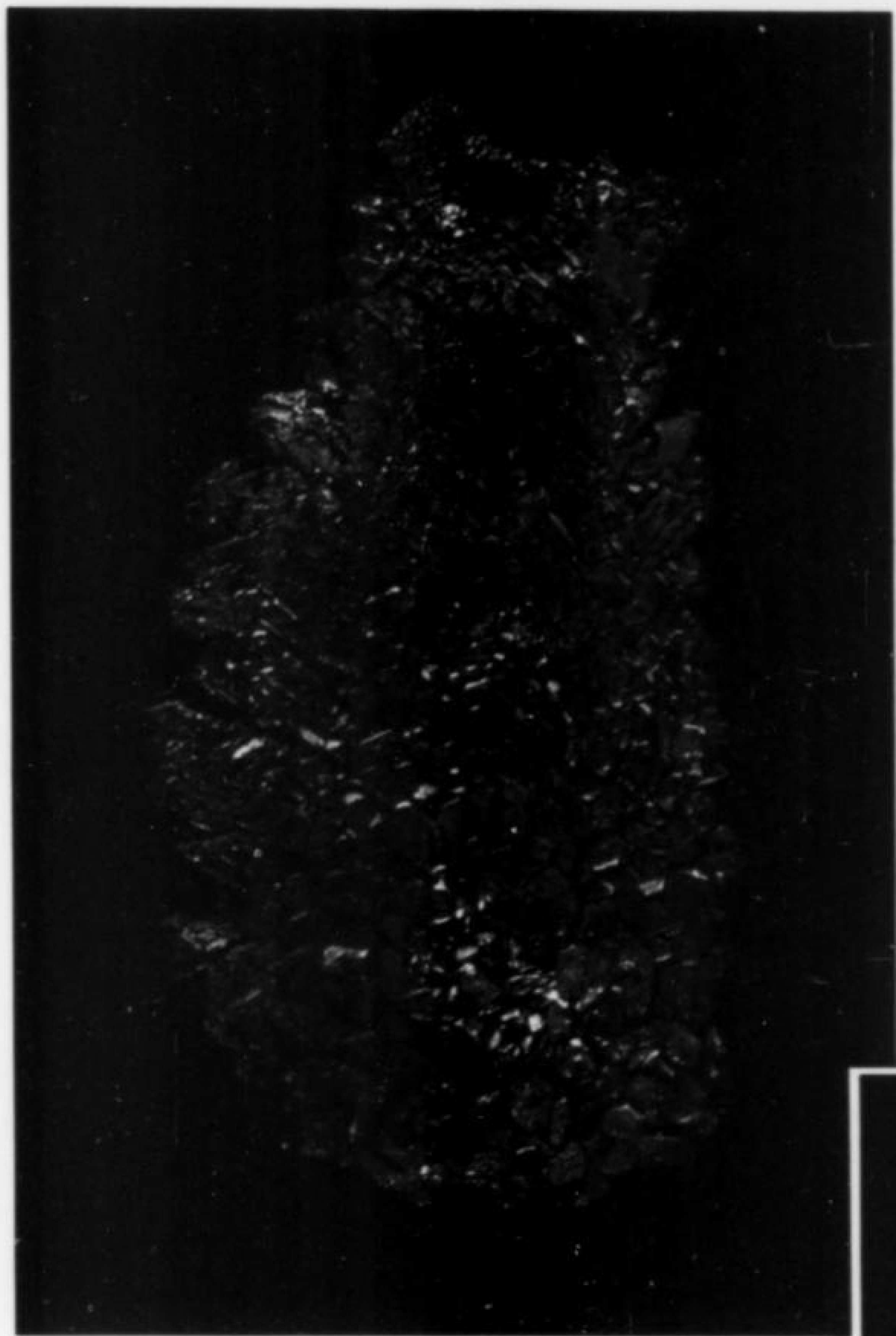

Figure 16. **Gold, 2.2 cm long, from the Lilian mine. Ed Raines specimen and photo.**

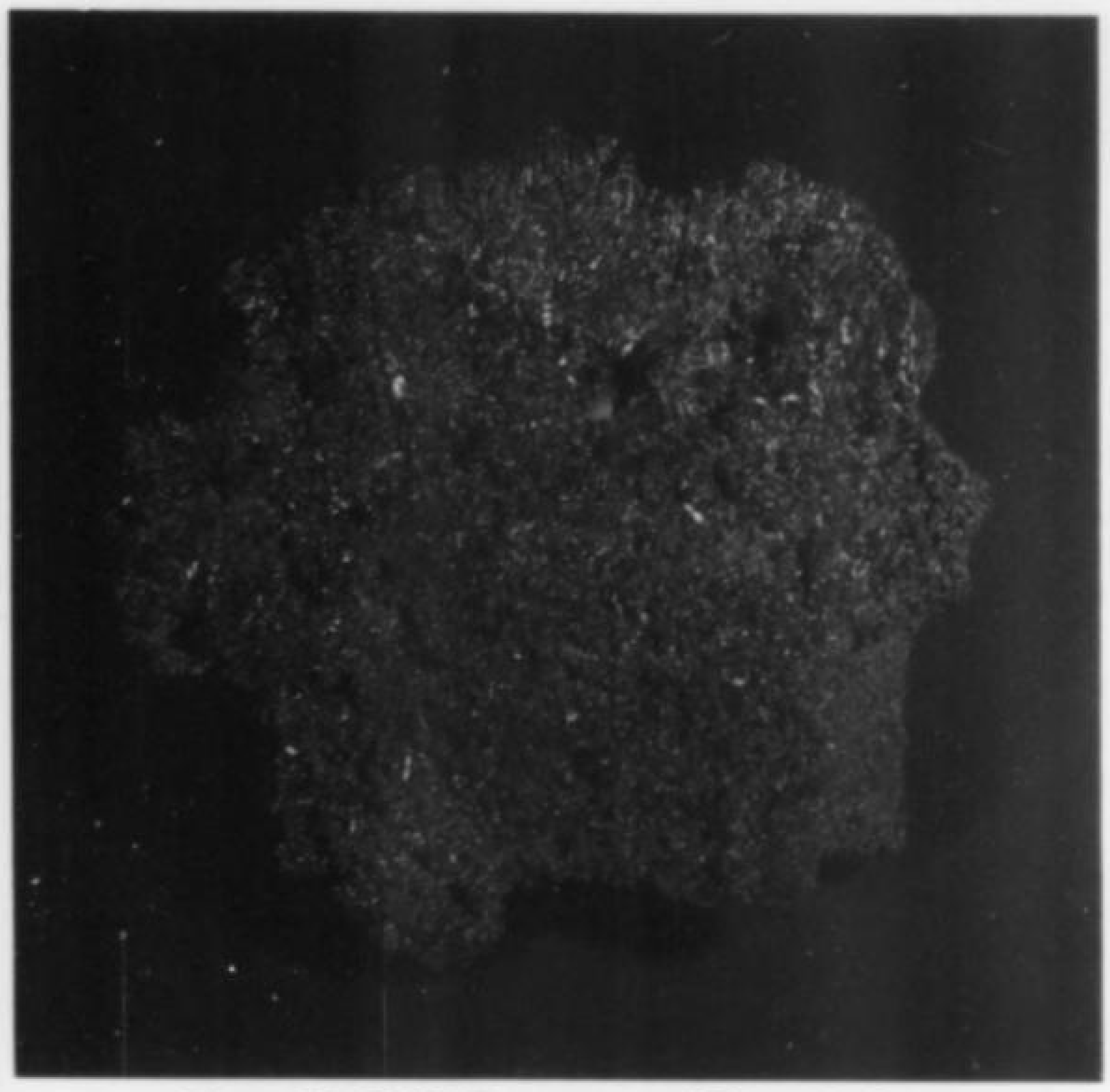

Figure 17. **Gold, 7 cm across (23½ oz.), from the Little Jonny mine. Richard Bowman specimen originally collected by a Mr. Madron in 1892; J. M. Shannon photo.**

Figure 18. **Dolomite on blue quartz crystals from the Black Cloud mine. The view is 3.5 cm across. Ed Raines specimen and photo.**

Figure 19. **Scheelite crystals to 2.5 cm, from the Garbutt shaft on the Ibex mine property. Ed Raines specimen and photo.**

building: "A specimen from the Little Johnnie [*sic*] mine, Leadville, is like a number of golden caterpillars or snakes crawling out from a mass of brown moss of iron oxide. This free gold is not always a pure, bright, golden yellow. Sometimes it is so tarnished or covered with rust that it might readily be taken for blotches of yellow ochre or common mud."

Gold was also reported to have occurred in much of the ore containing considerable sphalerite. In the early days a specimen of ore in the office of the Ibex Company contained crystals of sphalerite coated with films of gold (Emmons *et al.,* 1927).

It was also during Campion's time that a solid mass of copper ore 3.7 meters (12 feet) in thickness was found (Dill, 1881). This yielded some large, well-crystallized sprays from the fifth level (Emmons *et al.,* 1927).

In 1914 and 1915 another type of orebody was recognized and studied by the U.S. Geological Survey. It was one of gold-bearing quartz-pyrite veins containing the tungsten minerals wolframite and scheelite. This ore was primarily from Ibex properties and adjoining properties on the south and east sides of Breece Hill (Fitch, 1916).

Between 1894 and 1922 the Little Jonny produced close to $50,000,000, with a net profit of $12,000,000. Ore ran from $15 per ton in gold and copper values, to $60 per *pound* in the gold vugs (unknown newspaper, December 3, 1922). In 1925, Ibex workings aggregated 80 km (50 miles) and in 1938 they produced about 300 tons per month (Gilfillan, 1964).

On the south side of the Ibex properties quartz occurred mostly in typical colorless crystals up to 5 cm in length, which lined cavities and also penetrated pyrite crystals. Pyrite was well-distributed throughout the veins, occurring mostly in groups of rather large crystals. Single crystals of cube form were found with edges 12.7 cm long. An interesting phase of the pyrite crystals was the repeated development of narrow pyritohedron faces on a large cube face giving, especially where corroded, a "Gothic window" shape of marking (Fitch, 1916; Emmons *et al.,* 1927).

In addition to the aforementioned gold and scheelite specimens the Ibex group has also produced good black sphalerite crystals. Fine specimens of vivianite have also been found; one specimen which can be seen in the Denver Museum of Natural History consists of 5-cm blue-purple vivianite crystals on matrix. Emmons *et al.* (1927) note vivianite also occurred as solid aggregates, single crystals and crystalline druses lining cavities on masses embedded in loose infiltrated clay.

Dull brownish black masses of wolframite occurred in the South Ibex stockwork. "These masses contain many small cavities, where some faces and angles of wolframite crystals have developed, but these are generally so corroded that no adequate idea of the crystal form can be gained. In one specimen, however, there is an isolated crystal over half an inch long, projecting into a small vug" (Emmons *et al.,* 1927).

In addition to those mentioned above, several other interesting species were found in the Ibex mine. Jackstraw cerussite, chlorargyrite, minium intergrown with cerussite, hemimorphite, vivianite in fine prismatic crystals (some to 8 cm), pyromorphite, and Leadville's only occurrence of aurichalcite.

The central portion of the No. 4 vein was the location of huge pyrite cubes measuring 15 to 25 cm on an edge (Holmes and Kennedy, 1983). Many fine gold wires and leaves were also found there.

All of the Ibex veins connect with sulfide replacement bodies and were most likely the solution channels which fed the replacements (Emmons *et al.,* 1927).

Garbutt mine

The Garbutt vein fills the Garbutt fault, with intrusive porphyry on one wall and Cambrian shale on the other; no limestone or dolomite are intersected. Also within the mine is the South Ibex stockwork, found on the second level about 8 meters from the Ibex No. 4 vein. Here quartz has been found in crystals to 5 cm, along with large pyrite cubes to 12 cm on an edge. Wolframite and scheelite occur irregularly scattered in vugs. Crystals of scheelite are deep red-orange dipyramids occasionally reaching 1 cm on an edge (ER collection). Wolframite and pyrite have been observed as pseudomorphs after scheelite (Emmons *et al.,* 1927).

Iowa Gulch

The Black Cloud shaft

The Black Cloud shaft on the north side of Iowa Gulch that most know of today takes its name from the original Black Cloud lode claim. Smith (1983) indicates this original lode claim was staked by R. D. Elder, while Silversparre (1882) points out that claim survey number 903, Black Cloud, was granted to R. W. Officer, *et al.* in 1880 (Bureau of Land Management files).

In 1880 a Philadelphia merchant and tailor spent $5000 in meeting notes of a friend and business associate. In this fashion Meyer Guggenheim became half owner of the A. Y. mine, and subsequently he and his partner bought the Minnie mine. This modest beginning eventually led to the Guggenheims' involvement in the

Figure 20. **Garbutt shaft on the Ibex property. Courtesy American Heritage Center, University of Wyoming.**

American Smelting and Refining Company (now ASARCO, Inc.), which in time came to own the Black Cloud mine (Blair, 1980).

As early as 1927, Emmons, Irving and Loughlin had alluded to the possibility that replacement ore might be found in a down-dropped block of ground bordered by the Ball Mountain, Weston and Garbutt faults. From this date extensive evaluation was carried on in this area.

In 1942 W. R. Landwehr reviewed the Leadville district for geologically favorable ground which might be leasable. Findings in 1968 revealed an ore reserve of 2,080,410 tons averaging 0.089 ounces gold, 2.48 ounces silver, 5.05% lead, 9.42% zinc and 0.19% copper.

As a result a new shaft was sunk on R. D. Elder's old Black Cloud lode and it became a producing mine in April, 1971 (Smith, 1983).

"In 1973, the Black Cloud shaft produced 11,350 ounces of gold, ranking third in the state for gold production. It was second in lead production and sixth in silver production" (Holmes, 1983).

The Black Cloud has produced nice specimens of splendent black sphalerite crystals sprinkled with 6-mm galena cubes, other galena crystals to 2.5 cm, white dolomite crystals on black sphalerite, wurtzite on stalactitic dolomite, golden barite, galena, and Japan-law twinned quartz crystals (Kosnar and Miller, 1976; Muntyan, 1979; Holmes and Kennedy, 1983). Also reported from the Black Cloud are pyrite, siderite, cerussite, small blue (!) quartz crystals to 4 mm, and rare greenish barite crystals to over 3 cm.

The Julia-Fisk mine

The Jim Fisk claim was located in 1880 and patented in 1881 by Raphael Marcott (Bureau of Land Management files; Corregan, 1883), and the Little Julia was patented by Joseph Frazer *et al.* in 1881 (Bureau of Land Management files).

It is unclear just how it came about, but it was decided to locate the first shaft of the Julia-Fisk mine at the southernmost tip of the Fisk claim, on the north slope of Iowa Gulch and the east slope of Printer Boy Hill, about 150 meters from a shaft near the north end of the adjacent First National claim. Eventually the claims became part of the First National Gold Mining and Leasing Company, which was formed to sink the shafts deeper in order to locate a second and richer contact. Mining in the Julia-Fisk was carried on chiefly between 1900 and 1910, when the shaft was sunk to 185 meters (Manning, 1895; Behre, 1953).

At a depth of 126 meters a small bedding plane deposit of silver-bearing galena was found between quartzite and Dyer dolomite, and ore valued at $20 a ton was mined; "near the bottom of the shaft a gold-bearing fissure was discovered, assaying 1.0 ounce gold and 40 to 50 ounces silver to the ton, but organizational difficulties and heavy pumping costs compelled the company to stop operations" (Behre, 1953). Although the shaft was reopened in 1957, a decline in metal prices curtailed most activity (Holmes and Kennedy, 1983).

Most of the recent activity in this area centers around the Black Cloud shaft, which has intersected some of the Julia-Fisk orebody, as well as other orebodies in the general area.

"The large dump in 1932 yielded many specimens of primary minerals, including galena, dark brown sphalerite, a little chalcopyrite and considerable manganoan siderite. Most of this siderite occurs as very thin rhombohedrons forming rosettes, under which arsenopyrite commonly appears in short prisms up to 1 mm in length" (Behre, 1953). Also "pale pink (rhodochrosite) scalenohedra about one-quarter inch long" have been found (Miller, 1971).

Horseshoe Area

The Horseshoe area, sometimes called East Leadville, is on the eastern frontier of the Leadville district about 11 km (7 miles) from the town of Leadville. Although the area is separated from Leadville by a high range of peaks, the geology was long thought to be identical (Leadville Lead Corporation, 1947). Thompson *et al.* (1984) point out, however, that the circumstances are quite distinctive; the orebodies appear to be confined to sediment filled karst paleotopographic features underlying shale beds in the Leadville limestone, and also to a few small faults. Silver values come from tetrahedrite and minor acanthite.

Sherman tunnel/Hilltop mine

Although the Hilltop mine is actually in Park County, many, if not all, of its mineral specimens arrived through the Sherman tunnel in Lake County.

The Hilltop mine actually saw its beginnings with the staking of the Last Chance claim in 1869. Progress on the claim continued during the ensuing years and in 1877 the Last Chance was supplying ore to a new smelter erected at the town of Horseshoe, about 9.6 km to the east. The mill was apparently unsuccessful; in 1884 the Last Chance began shipping ore to Fairplay and construction was started on a mill at a site that was later to become the town of Leavick (Leadville Lead Corporation, 1947).

In 1886 a mine cook, discharged by Last Chance operators, located three claims – the Hilltop, the Ptarmigan and the Leslie De; these were just north of the Last Chance endline and represented the beginning of the Hilltop mine. The Hilltop Incline shaft, sunk to a depth of 37 meters, resulted in highly profitable production (Leadville Lead Corporation, 1947).

"The Hilltop produced heavily and profitably from 1886 to the silver decline of 1893" (Leadville Lead Corporation, 1947). Felix Leavick and associates acquired control in 1892. Immediately they built a narrow gauge railway spur from Fairplay to Leavick and constructed a 5-km aerial tramway from Leavick to the main Hilltop shaft. In light of these large expenditures, the silver price drop of 1893 was disastrous to the Leavick group and operations were suspended.

A number of different lessees operated the mine from 1893 to 1923 with varying degrees of success. "A drop in the price of silver occurred in 1923 with the expiration of the Pittman Silver Purchase Act, and essentially all mining activity in the Horseshoe district was terminated for a period of around twenty years" (Bloom, 1965).

The Horseshoe Zinc Company started work in the area when in 1943 it leased the mine claims of the Hilltop group and in 1945, after consolidating properties in the Four Mile Amphitheater, the company was reorganized to form the Leadville Lead Corporation.

In 1946 this corporation started driving the Sherman tunnel on the side of Mount Sherman and planned to go under the old Hilltop workings to evaluate lower level veins (Leadville Lead Corporation, 1947). From this tunnel and the Hilltop workings have come a variety of fine collectible mineral specimens.

Plates of small hemimorphite crystals, crystalline quartz and white mamillary smithsonite have come from the Hilltop.

The Sherman tunnel has produced large, thick, golden barite crystals up to 5 cm on an edge, hemimorphtie, crystalline azurite and malachite, calcite, smithsonite and native silver.

MINERALS

The following discussion centers on those species of most collector interest. All of the species reported from Leadville are listed on Table 2, and a few are also described in the preceding section on mines.

Aragonite $(Ca,Zn)CO_3$

A variety, named *nicholsonite* and containing up to 10% zinc, was found at the Wolftone mine (q.v.) It was typically found as diverging or spherical radiating crystal aggregates having individual crystals to 2.5 cm in length (Butler, 1913; Loughlin, 1918).

Barite $BaSO_4$

"Some white crystals in vugs in sulfide ore supposedly were found in the Yak tunnel" (Emmons *et al.*, 1927).

Calcite $CaCO_3$

"Large and very handsome rhombohedrons [of calcite] on cerussite occur in the Evening Star. Much of it occurred in a cave found in the workings of the Boarding-house shaft" (Ricketts, 1883).

Cerussite $PbCO_3$

"There are few mines in the Leadville district which do not contain at least a small portion of this mineral in their oxidized ores, especially the iron and manganese oxides, in which the crystals may be visible or may be detected only by chemical analysis. Cerussite occurs in three well-recognized forms—as large crystals; as aggregates of small crystals, generally loosely bound together and known as sand carbonate; and irregularly disseminated in masses of dense silica, which are usually termed hard carbonate. The large crystals of cerussite are found either embedded in manganese and iron oxides or in clay, and occur at many places as radiating clusters or as drusy linings in cavities in the harder ores. Some crystals are white and glassy; others are discolored by minute inclusions of darker minerals, some of which have been proved to be the silver sulfide argentite. Occasionally minute crystalline specks of silver chloride are found coating the crystals of cerussite. It has been shown by many assays and analyses of the Leadville cerussite that this mineral always carries a little silver, which is generally believed to be present either in the form of minute argentite inclusions or minute scattered specks of silver chloride or bromide" (Emmons *et al.*, 1927).

A fist-size chunk of jackstraw cerussite is known [ER collection] in which crystals 1 mm by 1.5 cm are complexly intergrown. The specimen is from the Stone mine, one of Wood's and Stevens's original 1874–75 claims in California Gulch.

"It is reported that in the Morning Star and Evening Star mines there were numerous cavities in the galena which were lined with large transparent crystals of cerussite having the form of long prisms capped by the pyramid" (Emmons *et al.*, 1927).

***Figure 21.* Copper, 8 cm tall, from the Ibex mine. Colorado School of Mines specimen; J. Muntyan photo.**

Copper Cu

Flat, dendritic masses of copper occurred in the Ibex mine and as small thin flakes in the mines on Iron Hill. Although occasionally found in other localities, none was of sufficient size or form to collect (Emmons *et al.*, 1927).

Dolomite $CaMg(CO_3)_2$

Dolomite occurred "as white rhombohedrons lining vugs in sulfides" in many of the mines of the area (Emmons *et al.*, 1927).

Galena PbS

"Galena occurs mostly in granular masses, and to a minor extent as well-developed crystals lining cavities. . . . Where the galena is pure the largest crystals attain an inch in diameter.

"Large fractures lined with galena crystals were observed in the Moyer, Tucson, A. Y. and Minnie, Wolftone and many other mines.

"Another variety of galena in peculiar crystal form occurs in considerable quantity in nearly all the mines, and is especially abundant in the mines of Iron and Carbonate hills and Graham Park. These crystals are brilliant and in places occur in great profusion as linings in the cavities of the ores. Many of the cubes are twinned, and some of the faces are built up by peculiar rounded irregular and incomplete accretions. Many of these accretions consist of smaller and smaller superposed layers. These layers are similar in origin to those giving the 'Gothic window' effect to pyrite crystals. Some portions of the crystals, usually on the under sides next to the wall on which they are attached, are rounded and irregular, resembling semi-fused material. This appearance is not due to fusion, however, but may be interpreted as a variation of the accretionary growth

***Figure 22.* Galena group, 6 cm tall, from the South Moyer mine (2nd level, 63 stope). Colorado School of Mines specimen; J. Muntyan photo.**

Figure 23. **Galena group, 8 cm across, from the Helena mine. Fred Meissner specimen; J. Muntyan photo.**

Figure 24. **Galena group, 14 cm across, from the Julia-Fisk mine; collected in 1945. J. Muntyan photo.**

just described, in which the decreasing size of the successive layers is so gradual that no lines of division can be seen between them" (Emmons *et al.*, 1927).

Some galena contains silver and bismuth (Chapman and Stephens, 1933).

Gold Au

"Native gold has been found in varying quantity in many of the Leadville ores. Although most of the ore classed as gold-silver or gold-copper ore, whether primary or altered, contains gold only in microscopic or submicroscopic grains, gold in coarse flakes and wires has been seen in the enriched parts of several of the lodes and closely associated blanket orebodies in the eastern part of the district, notably in the Ibex, Garbutt, Winnie-Leuma, Big Four, Colorado Prince, Great Hope, Printer Boy and Lilian (Florence) mines" (Emmons *et al.*, 1927).

In the Winnie-Leuma lode "some of the ore ran as high as 100 ounces to the ton in gold, and leaf and wire gold occurred in considerable quantity. The blanket ores of the Florence (Lilian) mine carried large quantities of native leaf gold on a narrow contact between the limestone and the overlying white porphyry." Specimens of crystalline gold composed entirely of flattened octahedrons in parallel growth, associated with alaskaite (a discredited species) were reported (Emmons *et al.*, 1927).

Hemimorphite $Zn_4Si_2O_7(OH)_2 \cdot H_2O$

According to Heistand, the Henriett and Maid of Erin mines produced specimens of hemimorphite (Heistand, n.d.).

"Calamine (hemimorphite) occurs typically in fine to coarse druses of white to colorless bladed crystals, or in aggregates of diverging crystal groups, which may partly or completely fill cavities. In one exceptional specimen, found . . . on the dump at the Adams shaft, . . . calamine crystals are coated with minute quartz crystals. The calamine crystals have grown upon both massive and drusy smithsonite and on red and brown iron oxides and black manganese oxides" (Emmons *et al.*, 1927).

The Field Columbian Museum of Chicago reports that some Maid of Erin ores received after the World's Columbian-Exposition in 1893 contained an ocherous substance thickly coated with long, slender crystals. The crystals, determined by testing to be calamine or hemimorphite, occur in groups which were partly radiated and partly joined. The average length of the crystals is about 10 mm; they are transparent to translucent and colorless to white (Farrington and Tillotson, 1908).

In the Little Jonny hemimorphite crystals were found as diverging groups of blades associated with Leadville's only occurrence of aurichalcite.

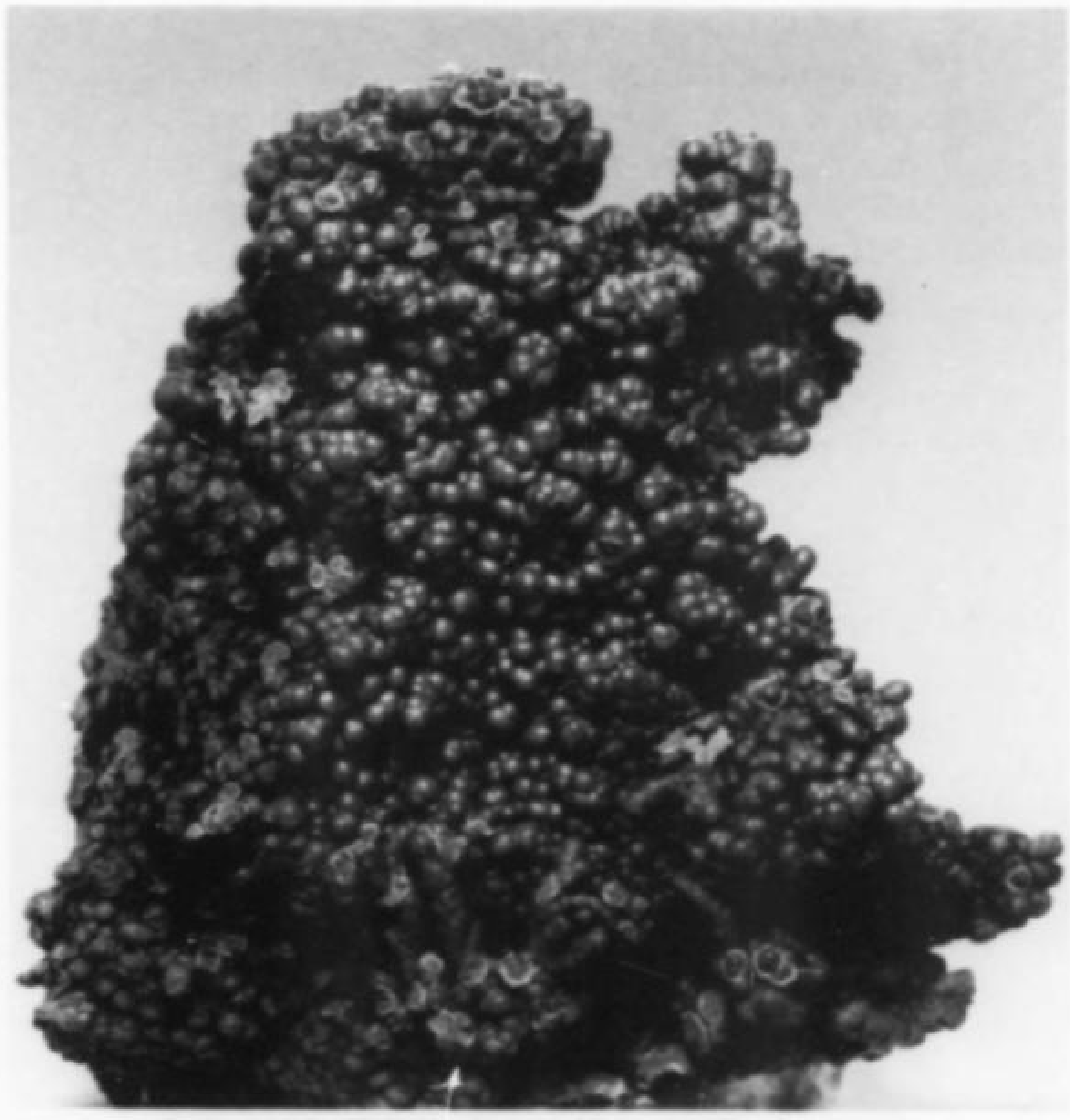

Figure 25. **Psilomelane, 10 cm tall, from an unknown mine at Leadville. Colorado School of Mines specimen; J. Muntyan photo.**

Psilomelane Mn oxides

Manganese oxides ("psilomelane") occurred in both stalactitic and mammillary forms and one fine specimen can be seen in the accompanying photographs. Unfortunately, the only locality given is "Leadville."

Pyrite FeS_2

Pyrite is found in some form in the majority of the mines in Leadville, and in a number of cases occurs as fine crystals. "Some of these well-formed crystals are 12-faced (pentagonal dodecahedrons), and some are cubes. All have characteristic striated faces" (Emmons *et al.*, 1927). Pyrite was found in the Adelaide, Black Cloud, Capitol, Garibaldi, Garbutt Shaft (Little Jonny/Ibex), Greenback, Mahala, Maid of Erin, Matchless, Moyer, R. A. M. Resurrection, Silver Cord, Tucson and Wolftone mines and in the Yak tunnel.

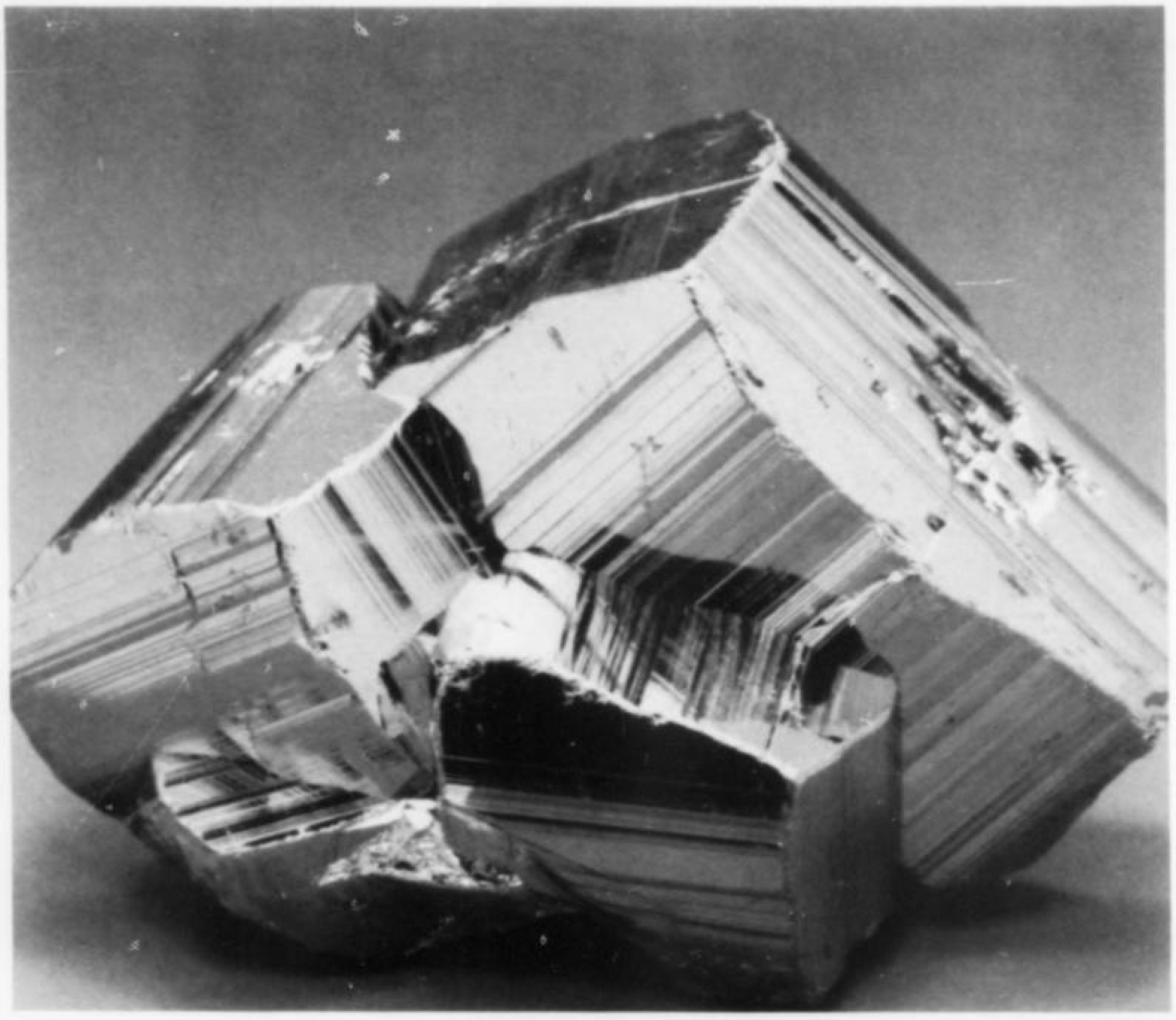

Figure 26. **Pyrite group, 9 cm across, from the Yak tunnel; collected around 1900. J. Muntyan photo.**

Figure 27. **Pyrite group, 10 cm across, from the Black Cloud mine. J. Muntyan photo.**

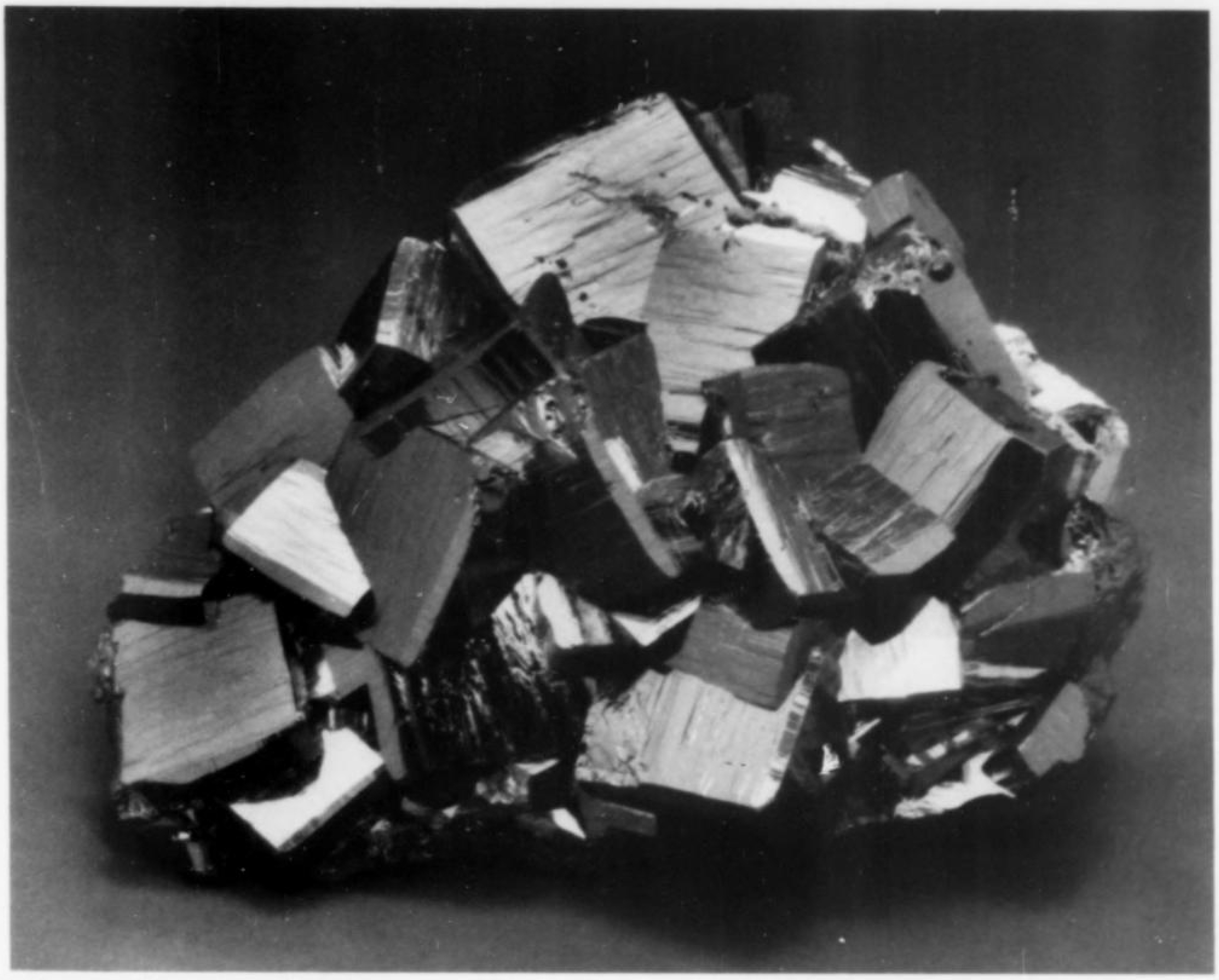

Figure 28. **Pyrite group, 8 cm across, from the Ibex mine; collected in 1964. J. Muntyan photo.**

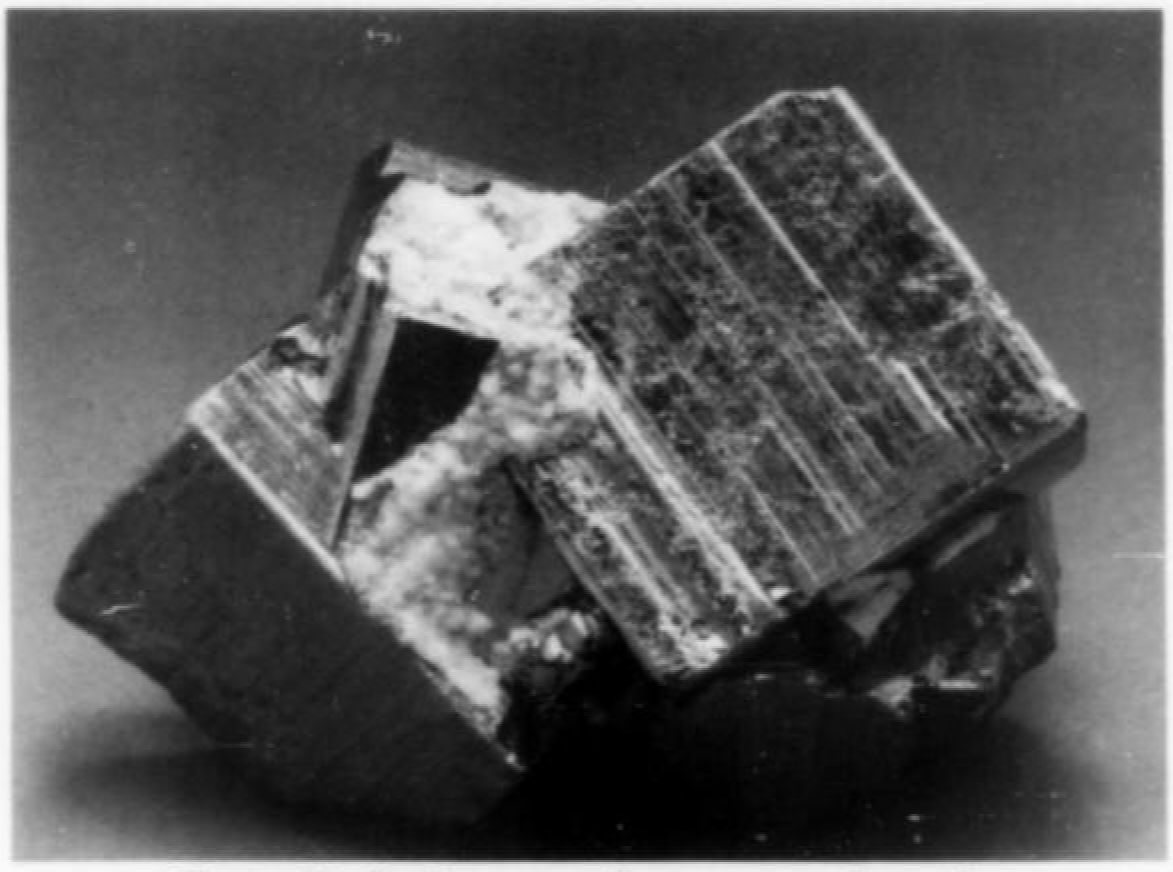

Figure 29. **Pyrite group, 9 cm across, from the Little Jonny mine. J. Muntyan photo.**

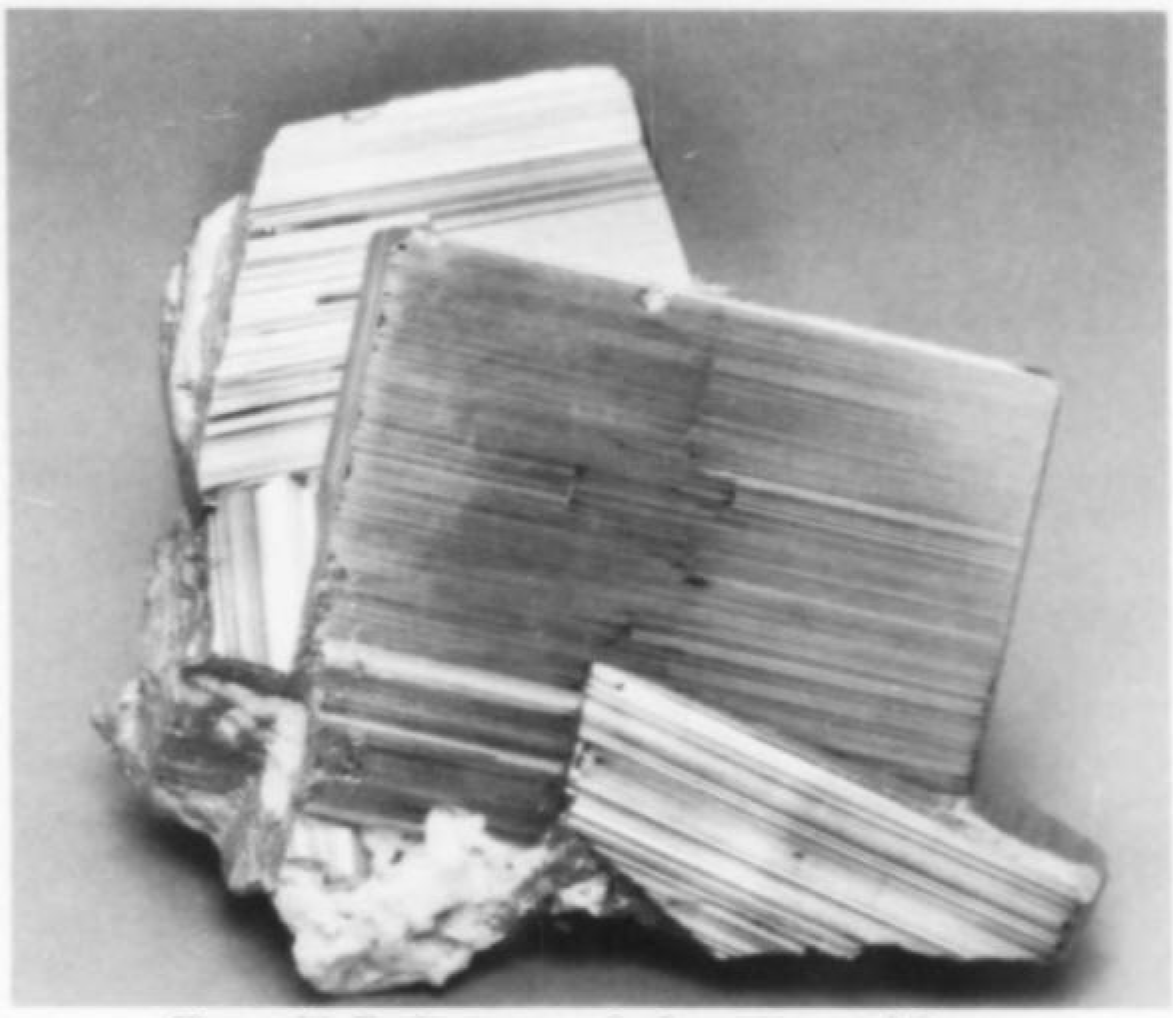

Figure 30. **Pyrite group, the largest crystal 6 cm on an edge, from the Black Cloud mine; collected in 1980. J. Muntyan photo.**

Pyromorphite $Pb_5(PO_4)_3Cl$

"Slender, tapering, yellowish green crystals of pyromorphite, as much as an inch long, are frequently found, single and as radiating clusters, in the linings of cavities in the oxidized ores of both blanket orebodies and lodes.

"Pyromorphite was also observed in the Evening Star mine" and was also reported from the Great Hope mine (Emmons *et al.*, 1927).

Quartz SiO_2

"Very fine colorless crystals of quartz have been found coating calamine (hemimorphite) crystals in low-grade oxidized zinc ore from the old Mikado dump" (Emmons *et al.*, 1927). Many fine specimens of blue quartz crystals with dolomite are known from the Black Cloud mine.

Scheelite $CaWO_4$

Scheelite has been found in the Golden Queen mine, and also in the Garbutt shaft as excellent, deep red-orange, pseudo-octahedral crystals.

Siderite $FeCO_3$

Both the pure siderite and siderite containing significant

Figure 31. **Siderite crystals with sphalerite on matrix, 8 cm tall, from the Tucson mine (5th level). Colorado School of Mines specimen; J. Muntyan photo.**

Figure 32. **Leaf silver on matrix, 7 cm tall, from the Coronado mine. Colorado School of Mines specimen; J. Muntyan photo.**

manganese occur at Leadville. The pure variety generally occurred as flat rhombs of a pale to dark brown color, ranging in size from 1.5 mm up to 12 mm in diameter. The manganosiderite usually occurred in very small grains and crystals, almost always gray but sometimes with a pink cast. The Black Cloud, Julia-Fisk, Matchless and Tucson all contained siderite (Emmons *et al.*, 1927).

Silver Ag

"The native silver occurs both as wire silver and as small plates, scales or flakes scattered through the gangue or country rock. It is found in cavities in sulfides, where it has probably been precipitated by reaction between the sulfides and descending waters. The wires are generally small, but some attain lengths of half an inch or more, with striations parallel to their elongations. Some specimens of siliceous ore are formed of bluish cavernous jasperoid in which plates of native silver from 3 to 10 millimeters in diameter are profusely disseminated. To a minor degree the scaly silver is partly coated with thin bluish tarnish, presumably due to the presence of a small portion of sulfide on the outside of the mineral" (Emmons *et al.*, 1927). These plates of native silver occurred in the Coronado mine.

Note the interesting, ornate description by Arthur Lakes of specimens from the Colorado State Mining Bureau collection, at one time housed in the Capitol building: "A sample from the Colonel Sellers mine glistens with large galena crystals, amongst which are dark little caverns lined with perfect quartz crystals, and clinging to the crystalline walls and roof of these Aladdin grottoes, are trailing mosses and vines of silver with tufts and tussocks of moss-like silver from which depend black silver rootlets. One from the A. Y. and Minnie, Leadville, is a black rock covered with black, wriggling serpents. These silver forms are doubtless tarnished with manganese" (Lakes, 1895). Lakes' "manganese" was probably acanthite.

Lakes also describes another beautiful silver specimen "from the Maid of Erin which is a mass of black manganese traversed by narrow seams of quartz from which issue beautiful leaves of silver foil. Another specimen shows wire silver issuing from crevices and tiny caverns lined with quartz crystals resembling tangled rootlets of moss, colored almost black, these rootlets being curled like celery stalks. Another rock is gray and black with silver sulphurets in which are many little caverns lined with quartz crystals, on the bottom of which appear clusters of wriggling snakes of silver like the locks of Medusa" (Lakes, 1895).

Silver Halides

"The prevailing varieties [of silver halides present in Leadville] are the green chlorobromide embolite, Ag(BrCl) [bromargyrite], and the colorless chloride cerargyrite, AgCl [chlorargyrite], each of which contains a very small amount of the iodide molecule. Brilliant yellowish crystals along joints in lead carbonate ore were found in the Weldon mine but were not analyzed" (Emmons *et al.*, 1927). Emmons stated that the chloriodide was also present in less quantity and mentioned minute yellow crystals of iodargyrite (AgI), in the Chrysolite mine. These were also found in the Evening Star and Morning Star mines (Ricketts, 1883).

"The mineral embolite is invariably light greenish, soft, and sectile and does not change color on exposure to light. It occurs in scales and plates, as single grains or aggregates of such grains, and as rough crystalline coatings on the walls of crevices. The crystalline structure can be seen through a magnifying glass" (Emmons *et al.*, 1927).

***Table 1.* Mines of the Leadville area producing mineral specimens (miniature or larger).**

Adelaide mine
Pyrite
Adams shaft
Hemimorphite
A. Y. and Minnie mine (See Black Cloud)
Galena, Sphalerite
Big Four mine
Gold
Black Cloud mine (See History of mine)
Sphalerite, Dolomite, Wurtzite, Barite, Galena, Quartz, Pyrite, Siderite, Cerussite
Capitol mine
Pyrite, Quartz
Chrysolite mine
Iodyrite and other secondary silver minerals
Colonel Sellers mine
Silver
Colorado Prince mine
Gold
Coronado mine
Silver
Evening Star mine and Boarding-house shaft
Pyromorphite, Calcite, secondary silver minerals
First National mine
Wire Silver and "Ruby Silver"
Florence mine (See Lilian)
Garibaldi mine
Pyrite
Garbutt shaft (See Little Jonny/Ibex)
Scheelite, Quartz, Pyrite
Golden Queen mine
Scheelite
Greenback mine
Pryite
Great Hope mine
Pyromorphite
Henriett mine
Hemimorphite
Ibex mine (See Little Jonny/Ibex)
Julia-Fisk mine (See History of mine)
Galena, Sphalerite, Chalcopyrite, Manganoan Siderite, Arsenopyrite, Rhodochrosite
Lilian (Florence) mine
Caledonite, Kobellite, Lillianite, Bismutite, Gold
Little Jonny/Ibex mine (See History of mine)
Gold, Pyrite, Copper, Wolframite, Scheelite, Quartz, Sphalerite, Vivianite, Aurichalcite
Mahala mine
Pyrite
Maid of Erin mine (See Wolftone/A. M. W.)
Hemimorphite, Silver, Quartz, Pyrite
Matchless mine (See History of mine)
Silver, Rhodochrosite, Pyrite, Galena, Sphalerite, Cerussite, Siderite
Mikado mine
Quartz, Hemimorphite
Morning Star mine
Oxidized silver minerals
Moyer mine (See History of mine)
Galena, Pyrite, Sphalerite, Hemimorphite
Printer Boy mine (See History of mine)
Gold, Galena
R. A. M. mine
Pyrite
Resurrection mine (See History of mine)
Sphalerite, Pyrite, Galena
Sherman tunnel/Hilltop mine (See History of tunnel/mine)
Barite, Hemimorphite, Azurite, Malachite, Calcite, Smithsonite, Silver, Quartz
Silver Cord mine (See Yak tunnel History)
Pyrite, Quartz, Barite, Sphalerite
Tucson mine (See History of mine)
Pyrite, Siderite, Hemimorphite, Manganoan Siderite, Sphalerite, Galena, Chalcopyrite, Arsenopyrite
Weldon mine
Secondary silver minerals
Winnie-Leuma mine
Gold
Wolftone/A. M. W. mine (See History of mine)
Pyrite, Galena, Quartz, Wire Silver, *Nicholsonite* (Aragonite), Hydrohetaerolite, Hemimorphite, Sphalerite
Yak tunnel (See History of tunnel)
Galena, Pyrite, Sphalerite, Barite

Sphalerite (Zn,Fe)S

"With the exception of pyrite, sphalerite was the most abundant mineral in the Leadville ores" (Emmons *et al.*, 1927). Most commonly it was associated with pyrite and galena and ranged from a dark brown color to an almost metallic black. Some of the coarse orebodies contained vugs of twinned sphalerite. Crystals up to 13 mm were found in the Moyer, Tucson, A. Y. and Minnie and other mines on Iron Hill. The Julia-Fisk, Little Jonny, Matchless, Resurrection and Wolftone also produced sphalerite crystals.

Vivianite $Fe_3(PO_4)_2 \cdot 8H_2O$

Another mineral which was found at least in small quantities in all the oxidized ores of Leadville is vivianite. It usually occurred as "indigo-blue to bluish green flat prismatic crystals" with striated faces. It occurred both as single crystals and crystalline druses (Emmons *et al.*, 1927).

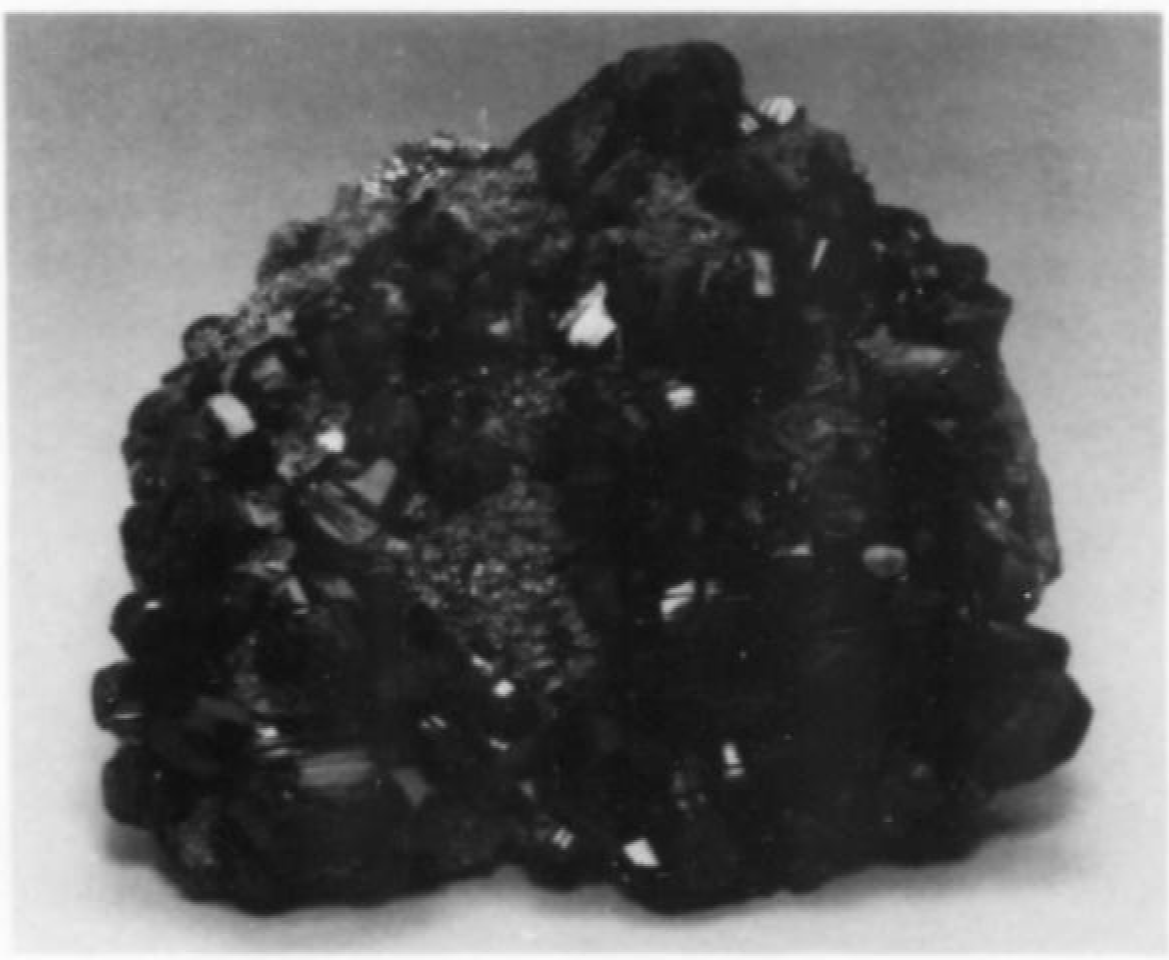

***Figure 33.* Sphalerite group, 9 cm across, from the Moyer mine; collected in 1945. J. Muntyan photo.**

Table 2. **Minerals reported from Leadville, compiled from Chapman and Stevens (1929), Emmons *et al.* (1927), Eckel (1961), Holmes and Kennedy (1983), and Muntyan (1979).**

Aikinite	$PbCuBiS_3$
"Alaskaite"**	mixture
Altaite	PbTe
Anglesite	$PbSO_4$
Ankerite	$Ca(Fe,Mg,Mn)(CO_3)_2$
Aragonite*	$CaCO_3$
Argentite	Ag_2S
Arsenopyrite	FeAsS
Aurichalcite	$(Zn,Cu)_5(CO_3)_2(OH)_6$
Azurite	$Cu_3(CO_3)_2(OH)_2$
Barite*	$BaSO_4$
Bismuthinite	$Bi_2(CO_3)O_2$
Bromargyrite	AgBr
Calcite*	$CaCO_3$
Caledonite	$Pb_5Cu_2(CO_3)(SO_4)_3(OH)_6$
Cerussite*	$PbCO_3$
Chalcanthite	$CuSO_4 \cdot 5H_2O$
Chalcocite	Cu_2S
Chalcophanite	$(Zn,Fe,Mn^{+2})Mn_3^{+4}O_7 \cdot 3H_2O$
Chalcopyrite	$CuFeS_2$
Chlorargyrite*	AgCl
Chlorite	group, monoclinic silicates
Chrysocolla	$(Cu,Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$
Copper*	Cu
Descloizite	$PbZn(VO_4)(OH)$
Dolomite*	$CaMg(CO_3)_2$
Epidote	$Ca_2(Al,Fe)_3(SiO_4)_3(OH)$
Galena*	PbS
Gold*	Au
Goslarite	$ZnSO_4 \cdot 7H_2O$
Hematite	Fe_2O_3
Hemimorphite*	$Zn_4Si_2O_7(OH)_2 \cdot H_2O$
Hessite	Ag_2Te
Huebnerite	$MnWO_4$
Hydrohetaerolite	$Zn_2Mn_4O_8 \cdot H_2O$
Iodargyrite*	AgI
Jarosite	$KFe_3(SO_4)_2(OH)_6$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Kobellite	$Pb_5(Bi,Sb)_8S_{17}$
Lillianite (?)	$Pb_3Bi_2S_6$
Litharge	PbO
Magnetite	Fe_3O_4
Malachite	$Cu_2(CO_3)(OH)_2$
Matildite	$AgBiS_2$
Mimetite	$Pb_5(AsO_4)_3Cl$
Minium	Pb_3O_4
Proustite	Ag_3AsS_3
Psilomelane*	Mn oxides
Pyrargyrite	Ag_3SbS_3
Pyrite*	FeS_2
Pyromorphite*	$Pb_5(PO_4)_3Cl$
Pyroxene	group, silicates
Quartz*	SiO_2
Rhodochrosite	$MnCO_3$
Rhodonite	$(Mn,Fe,Mg,Ca)SiO_3$
Rosasite	$(Cu,Zn)_2(CO_3)(OH)_2$
Scheelite*	$CaWO_4$
Selenium	Se
Siderite*	$FeCO_3$
Silver*	Ag
Smithsonite	$ZnCO_3$
Sphalerite*	(Zn,Fe)S
Tennantite	$(Cu,Fe)_{12}As_4S_{13}$
Tetrahedrite	$(Cu,Fe)_{12}Sb_4S_{13}$
Turquoise	$CuAl_6(PO_4)_4(OH)_8 \cdot 5H_2O$
Vivianite*	$Fe_3(PO_4)_2 \cdot 8H_2O$
Wollastonite	$CaSiO_3$
Wulfenite	$PbMoO_4$
Wurtzite	(Zn,Fe)S

* See text.

** Alaskaite, originally described from the Alaska mine, Silverton district, San Juan County, Colorado, was discredited by Karup-Moller (1972). Re-examination of type material showed it to be a mixture of pavonite [$(Ag,Cu)(Bi,Pb)_3S_5$], gustavite [$PbAgBi_3S_6$], tetrahedrite and sphalerite. Whether Leadville "alaskaite" also contains these minerals is not known.

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the mines and minerals of

Rico

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Once heralded as "the New Leadville," Rico never lived up to that lofty expectation. However, it did become a major producer of silver, zinc and lead, leaving behind a colorful history and numerous fine mineral specimens.

INTRODUCTION

Located in the southwestern corner of Colorado, the town of Rico (elevation 2700 meters/8800 feet), is situated near the center of the Rico Mountains, which are an isolated branch of the San Juan massif. Once the county seat of Dolores County, Rico now is home to a summer population of only about 200. Rico is approximately 40 km (25 miles) south of Telluride, and is served by state highway 145. Rico is in the Pioneer mining district (commonly referred to as the Rico mining district), and is found on the *Rico, Colorado* 15-minute quadrangle.

The picturesque area surrounding Rico is characterized by rugged 3,700-meter (12,000-foot) peaks, cut by deep canyons and gulches. The lower slopes are typically smooth and rounded due to alluvium left by ages of landslides. This condition limits rock outcrops, and severely impeded the pioneers first efforts to prospect the area. Rico itself rests in a narrow valley on the east bank of the Dolores River at its confluence with Silver Creek. The winters are long and often harsh, with much snowfall; while the summer season is short, it is characterized by mild days and cool evenings. The mountain slopes surrounding Rico are forested with aspen, blue spruce, Englemann spruce and fir. In the spring and early summer the meadows are ablaze with wildflowers.

HISTORY

The earliest recorded history of the Rico area begins with the Spanish explorers. There is some evidence that the Spanish made limited attempts at mining in the Dolores River Valley. However the large scale mining and prospecting efforts of the late nineteenth century argonauts either destroyed or largely covered over most of the work done by the Spanish. The real evidence of Spanish influence in this part of Colorado may be noted in the local place names, such as the San Juan Mountains, Dolores River, Cortez, Durango and Rico.

In 1833 a group of trappers from St. Louis under the command of William G. Walton spent the summer trapping along the Dolores River, near Trout Lake (19 km north of Rico). This group, believed to be the first Anglos in the area, reported the presence of numerous Indians and the remains of crude Spanish furnaces (smelters). In 1861, a group of men led by a Lieutenant Howard prospected the Dolores River Valley. This contingent was part of the Jim Baker Party (Baker Park fame) which was prospecting an area to the east that later would come to be known as Silverton. In 1864 Robert Darling led a small band of army officers and Mexicans to mineral outcrops along the banks of the Dolores River. Sheldon Shafer and Joe Fearheiler staked the first claim in the area in 1869. Their claim was called the Pioneer, from which the district drew its name. The Pioneer claim was later developed as the Shamrock and Potter mines.

It is noteworthy to mention that prospecting in the San Juan Mountains was a dangerous undertaking in the 1860s. The elements took a terrible toll and the Ute Indians also made their presence felt in a rather ominous way. Joe Fearheiler became one of the many victims of the Utes, killed shortly after staking the Pioneer claim. Also in the year 1869, seven men including a Captain Bennett, Lieutenant Ford, J. French and Robert Darling staked the Atlantic Cable claim on the east bank of the Dolores River. In 1870 Gus Begole, who had first explored the region in 1860, returned with John Echols, Dempsey Reese and Pony Whitmore. They located the Nigger Baby and Dolores claims (later called the Yellow Jacket and Aztec). Because the ore grade was low and transportation costs high, the claims were abandoned.

Figure 1. **Southern approach to Rico, snow-capped peak of Telescope Mountain on the right. Photo by the author.**

In the summer of 1870, Robert Darling located some claims near Shafer and Fearheiler's, and built a cabin (the first permanent structure in Rico) beside Silver Creek. Darling Ridge, a spur of Expectation Mountain, was later named in his honor. Darling and others continued to intermittantly work the Atlantic Cable, Aztec, Yellow Jacket and Phoenix claims. By 1872 they had constructed a smelting furnace and produced three bars of gold bullion. The claims were all abandoned in the winter of 1872–73. In October of 1873, by way of the Brunot Treaty, the Ute Indians ceded to the United States the mineral-rich land in the Dolores River Valley. Just when it was becoming safe to prospect, the panic of 1873 curtailed development for several years.

The Hayden Mineral Survey, which came through in 1874, provided the first accurate maps of the area and also gave names to many of the local topographical features. Colorado gained statehood in 1876 and, with the 1873 economic problems behind them, a steady stream of prospectors again found their way into this isolated part of the San Juan Mountains. In 1878, John Glasgow, Charles Hummeston and Sandy Campbell began to develop carbonate ore in the Phoenix, Yellow Jacket and Atlantic Cable prospects. The group cleared out with the coming of the winter snows; however, throughout the winter and spring (1878–79) word of the carbonate ores spread like wildfire. There was much cause for optimism; after all, greater mineral rushes had been started on much less fact. Soon people were talking about a "new Leadville," and the little tent village by the Dolores River began to grow.

The year 1879 brought three important silver discoveries. The first occurred when Simon Ransom and J. C. Haggerty discovered oxidized silver ore on Nigger Baby Hill. Nearly all of the major discoveries of the 1880s were centered around Nigger Baby Hill. Charles H. Carpenter discovered ore on the lower slopes of Telescope Mountain (just north of Nigger Baby Hill). Later this area would be called C.H.C. Hill, in Carpenter's honor. The third major discovery was made on Newman Hill, just southeast of Rico. Harry Irving located the silver-rich Chestnut vein; however, nearly ten years would pass before the importance of this discovery was to be felt.

The new discoveries on Nigger Baby and C.H.C. Hills served to further heighten the rush to the area from neighboring camps. On October 11, 1879, the camp was incorporated. Having been previously called Carbonate City, Dolores City, Doloresville and Lead City, the name Rico (meaning rich in Spanish) was decided upon. The new town had a population of 12,000. The new finds necessitated the need for a smelter. In the fall of 1880 the Grand View smelter was blown in, under the supervision of Messrs. Endlich and Arnold. T. A. Rickard (1896) remarked, "That smelter afforded many well known metallurgists their early and hard bought experience. Its history would present an amusing commentary on the struggles of ill-digested enterprises." In 1881 the Rico Mining and Smelting Company built Rico's second smelter. In the same year up on Newman Hill, David Swickheimer, Patrick Cain and John Gualt began work on a claim they called the Enterprise, and A. A. Waggener sank a shaft on the adjoining Songbird claim. The goal of both of these operations was the previously mentioned Chestnut vein. However, owing to disappointing results, both claims were abandoned. Swickheimer traded the Enterprise to George Barlow in 1883 for an unknown quantity of lumber. Hindsight proved this to be a very unwise transaction.

On February 10, 1881, Dolores County was formed from Ouray County, with Rico being established as the county seat. In the years following 1881, Rico's future looked bright as a blossoming silver queen. However, the high cost of shipping, and the lack of good

Figure 2. **Rico City Hall, built in 1892. Photo by the author.**

transportation continued to plague the isolated camp. In 1883 silver was discovered along Silver Creek, which opened up a new area to prospectors.

In 1884, Larned and Hackett, while working the Swansea mine on Newman Hill, found that the vein earlier sought by the owners of the Songbird and Enterprise claims was not absent, but merely displaced. In 1886 Barlow and Waggener relocated the Enterprise and Songbird claims. In December of the same year, David Swickheimer, who had been working at the Swansea mine, bought out Waggener, thereby gaining control of the Songbird. In 1887, Swickheimer purchased the Enterprise from George Barlow, regaining ownership of the property he had traded away four years earlier. Swickheimer immediately began resinking the Enterprise shaft and on October 6, 1887, the fabulously rich Enterprise blanket orebody was intersected. This discovery was followed shortly by a similar one at the nearby Rico Aspen mine. The discovery of the blanket ore deposits on Newman Hill not only saved Rico from an early demise, but fed new spirit into the camp, and inspired renewed interest throughout the district. In 1890 the Enterprise and Songbird properties were merged under the name, Enterprise Mining Company.

Rico came to another milestone in 1890 when famed Colorado railroad man Otto Mears brought his Rio Grande Southern Railroad into town. Finally cheap, dependable transportation was available, and Rico truly began to prosper. By 1892, 59 mines employing nearly 2,000 miners were operating. In less than a year the number would double to 4,000. Rico had finally made the transformation from a roaring frontier camp, populated by rowdy prospectors, to a very civilized community catering to women and family life. This metamorphosis was manifest all around. The first permanent church building, the Congregational, was erected in 1892 (the same building still stands today). By 1895, Rico had passed an anti-gambling law, plus an obscure catch-all ordinance dealing with "offences against public morality." The Old West refused to die totally however, as several brothels managed to survive, with or without the blessings of the community. In an effort to save face, town officials (no doubt men), stated that keepers of houses of ill repute would be responsible for any rowdy conduct. If this rule was not obeyed, then the ordinance prohibiting such houses would be enforced (Smith, 1982).

Nearly 3 million ounces of silver were produced in 1893, an all-time high. However, 1893 brought trouble to most of the silver mines of the American West, and Rico was no exception. The repeal of the Sherman Silver Purchase Act nearly crushed Rico's future. The price of silver fell from $1.29 an ounce to 50¢ an ounce. This drastic drop in price, coupled with rapidly dwindling high-grade deposits (Newman Hill blanket deposits) dealt Rico a staggering blow. One by one the mines which had prospered only a year earlier began to close and a mass exodus took place. By 1900, the population had fallen to 811.

World War I and the demand for copper, lead and zinc brought some life back to Rico, with the reopening of the Wellington and Mountain Springs mines up on C.H.C. Hill. Some renewed activity took place along Silver Creek, and 1915 proved to be the peak year for production of the base metals during the war years. However the end of the war brought the closure of more mines and in 1923 the population stood at 212. In the mid-1920s, with new advances in zinc processing, a mild economic surge was felt as the Atlantic Cable, Union Carbonate, Argentine, Shamrock & Potter, Silver Swan, Pro Patria, Revenue, Yellow Jacket and Falcon mines reopened. The Falcon mine alone boasted a work force of 500 men. Good times had at last come back to Rico. Between 1925 and 1929 the activity around Rico was much like that experienced in the 1890s. The International Smelting Company built a mill to process zinc in 1926. Base metal production peaked in 1927. But the stock market crash of 1929 brought all mining activity to a halt.

In 1930, in the depth of the Depression, the St. Louis Smelting and Refining Company drove the St. Louis tunnel from the east bank of the Dolores River into C.H.C. Hill. The goal of this work was to explore the Devonian-Mississippian limestones deep beneath C.H.C. Hill for lead-zinc replacement beds long thought to exist. Failing to find any ore, the St. Louis tunnel project was abandoned in 1932.

In 1938 the Rico Argentine Company began production from its holdings on Silver Creek (most notably the Argentine mine), and in 1939 completed work on a new flotation mill. This initiated a period of continual mining in Rico which lasted more than 30 years. Gradually the small, independent operations were replaced by large

Figure 3. **Dumps and old workings of the Jones mine, Dolores River in the foreground. Photo by the author.**

companies, with the Rico Argentine Company becoming the major producer in the district. The Rico Argentine Company continued to grow, purchasing numerous inactive properties surrounding their own and bringing them into production. The Van Winkle shaft was sunk in 1942 to exploit some of the newly acquired property, and soon became the Rico Argentine Company's biggest World War II producer of lead-zinc. The 1940s also saw the Mountain Springs and Wellington mines come back into production.

The end of World War II brought a slack demand for base metals and hastened the closure of several properties. Notable among these were the Van Winkle (1948) and the Mountain Springs (mid-1950s). In spite of the depressed conditions the Rico Argentine Company continued to purchase properties, proving that through consolidation mining could still be an economic venture. In 1955 the old St. Louis tunnel was driven to the Argentine shaft, opening up new ground for development and exploration.

In spite of the stable conditions which were brought about by the Rico Argentine Company, Rico was removed as county seat of Dolores County in 1946. A greater blow was received in 1951 when the railroad ceased to service Rico, after which all concentrates had to be trucked to another railhead for shipping to the smelter.

The mines of the Rico Argentine Company continued to produce lead and zinc throughout the 1950s and 1960s, with final closure coming in 1971. Anaconda Minerals Company (Rico Project) now holds controlling interest in nearly all property of past importance. There is currently no mining activity in the Pioneer mining district.

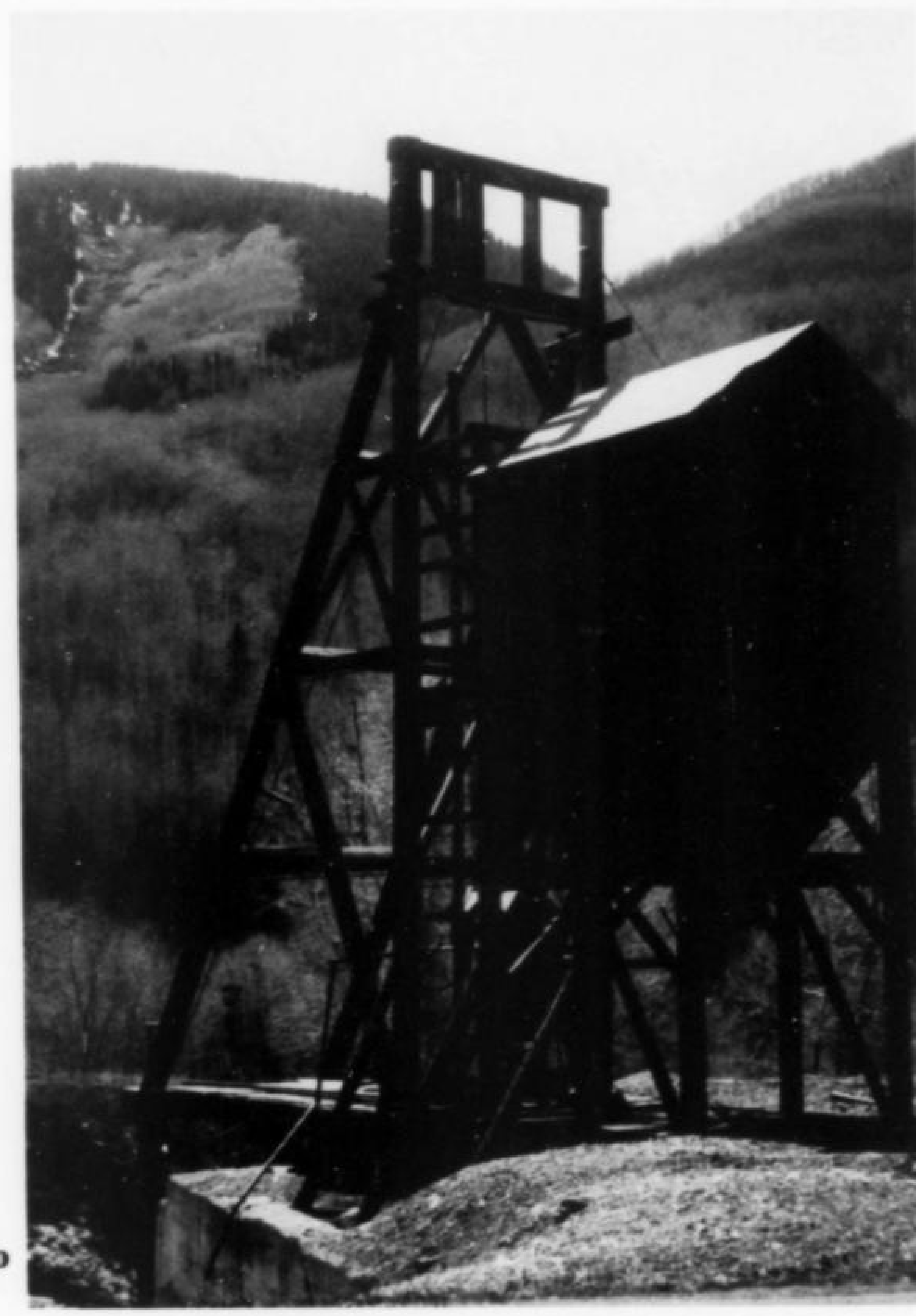


Figure 4. **The Atlantic Cable mine today. Photo by the author.**

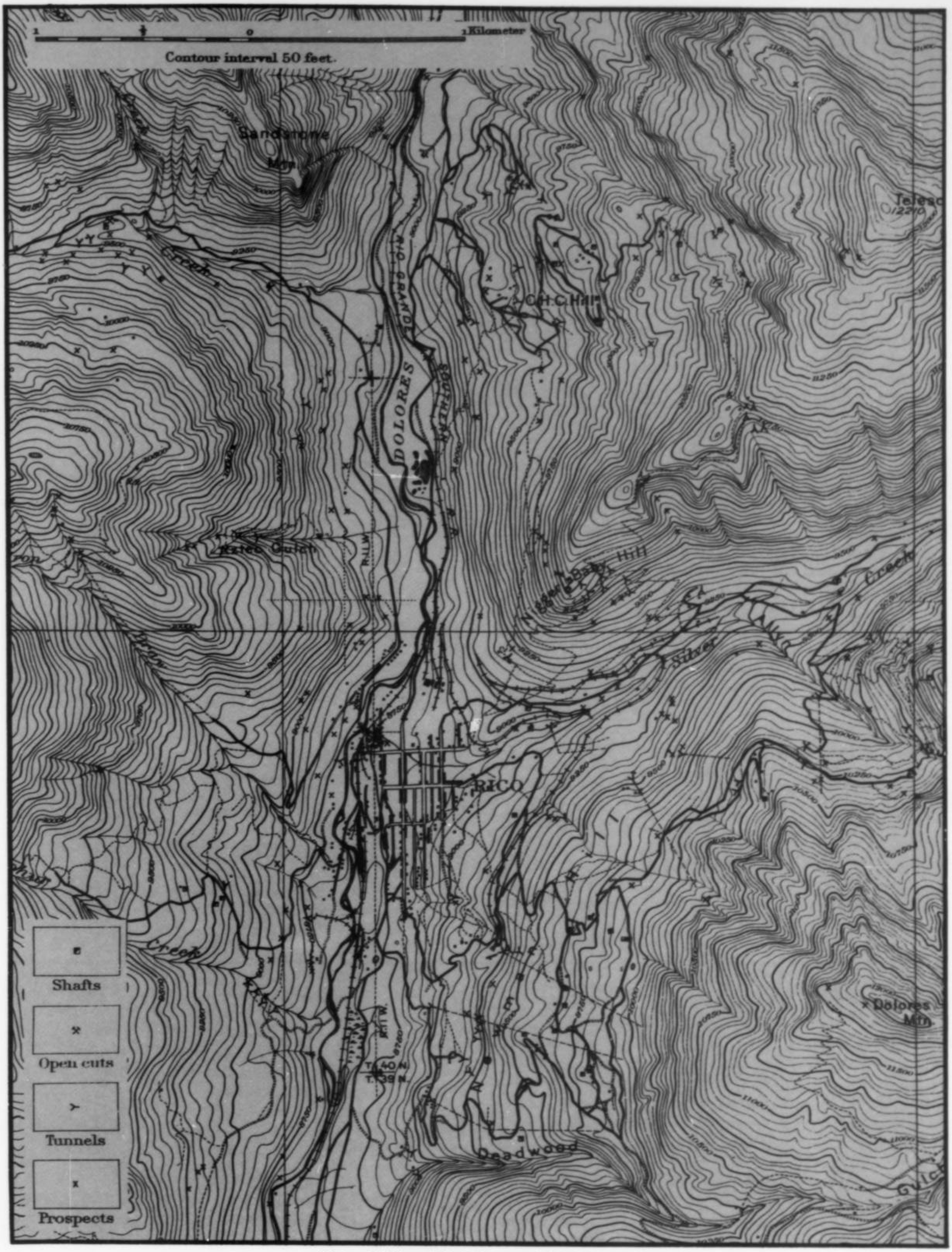


Figure 5. **Map of the Rico area (after Cross and Ransome, 1905). Courtesy University of Arizona Library Map Collection.**

If any one word could characterize the history of the district, it would be instability, with Rico being a virtual barometer of economic conditions throughout the country. It has fallen prey to every economic setback which the country has suffered over the past hundred years. In spite of this, Rico has exhibited an amazing resiliance. Gold spurred the first interest in the district, to be followed by the rich silver mines of Newman Hill. When the silver crash brought things to a halt, lead-zinc-copper came to the rescue, with lead and zinc continuing to be the backbone of the district until its final days. Even pyrite played a part in the history of Rico. The 1970s ushered in a new gloom for Rico; depleted ore reserves and poor base metal prices have apparently brought mining to an end in the district. Many of Rico's more substantial buildings were constructed in the 1880s and 90s. Those old buildings give the impression of having witnessed a lost era. Walking through the streets of Rico today brings to mind the words of T. A. Rickard: "Mines are short lived; they yield a harvest that is gathered only once."

GEOLOGY

The area in and around Rico was first mapped by Whitman Cross and numerous associates between the years 1897–1908, and later by Edwin McKnight and associates in 1930–31, 1955–58 and 1967. Other than the two reports resulting from these studies, very little comprehensive work has been produced on the geology of the Rico quadrangle. The scope and excellence of these reports has left little room for improvement. For those interested in an in-depth look at the geology of the region, *The geology of the Rico Mountains, Colorado* by Cross and Spencer (1900), and *The geology and ore deposits of the Rico District, Colorado* by McKnight (1974) are highly recommended.

A brief synopsis of the geologic history of the Rico area should suffice for the purposes of this article. Rico is located near the center of a local tectonic structure known as the Rico dome. The Rico Mountains, owing existence to this laccolithic dome, are composed of a thick sequence of Paleozoic and Mesozoic sedimentary rocks sharply tilted from their gentle southwesterly regional dip. A monzonite stock (late Cretaceous–early Tertiary) and Precambrian quartzites and schists, bounded by faults, occupy the central part of the uplift. The effects of dikes and sills (quartz monzonite of Tertiary age), accompanied by extensive faulting yielding displacements exceeding 300 meters contributed greatly to the eventual elevation of the Rico Mountains. The dome has since been bisected and deeply eroded by the Dolores River, exposing approximately 3400 meters (11,000 feet) of Precambrian to Cretaceous strata. Recent geologic history has been that of continued erosion and extensive landsliding. The Rico Mountains tower 1200 meters (4000 feet) above the surrounding plateau.

In the interest of brevity, only a short account of the ore deposits and mineralization of the Rico area will be presented here, in the hope that the reader will gain at least a general understanding of them. Four major types of deposits, all considered Tertiary in age, were mined at Rico: (1) fissure veins, (2) blanket deposits, (3) massive sulfide replacements, and (4) contact metamorphic deposits. Areas of mineralization are centered around Newman Hill, C.H.C. Hill, Nigger Baby Hill, Silver Creek, Horse Gulch and Expectation Mountain. The earliest deposits worked were fissure veins. In the late 1870s and on into the 1880s, much oxidized silver ore (cerussite-anglesite) was mined from the veins on Nigger Baby, C.H.C. and Newman Hills, as well as Expectation Mountain. It was the mining of fissure veins that led to the discovery of the fabulously rich silver blanket deposits of Newman Hill. Originally thought to be veins that ran parallel to the bedding planes, the blanket deposits were actually found to be replacements of thin gypsum beds in the lower Hermosa formation.

From the blanket deposits came the wealth of silver to which Rico owed its early fame. Native silver, acanthite, proustite, pyrargyrite, pearceite, polybasite, stephanite and argyrodite were among the minerals recovered from the mines of Newman Hill. Unfortunately, by 1900 these rich deposits were all but exhausted. Extensive exploration brought about the discovery of massive sulfide replacement deposits in the Hermosa formation. The replacements were rich in sphalerite, pyrite and galena, with locally abundant chalcopyrite and silver-bearing tetrahedrite. Traces of gold were quite common also. Mines exploiting the replacement deposits were centered in the Silver Creek area. Of minor importance were the contact metamorphic deposits, the most notable of which was worked through the Atlantic Cable mine, just north of downtown Rico. Sphalerite, galena and specular hematite were the most common minerals found in the contact metamorphic deposits.

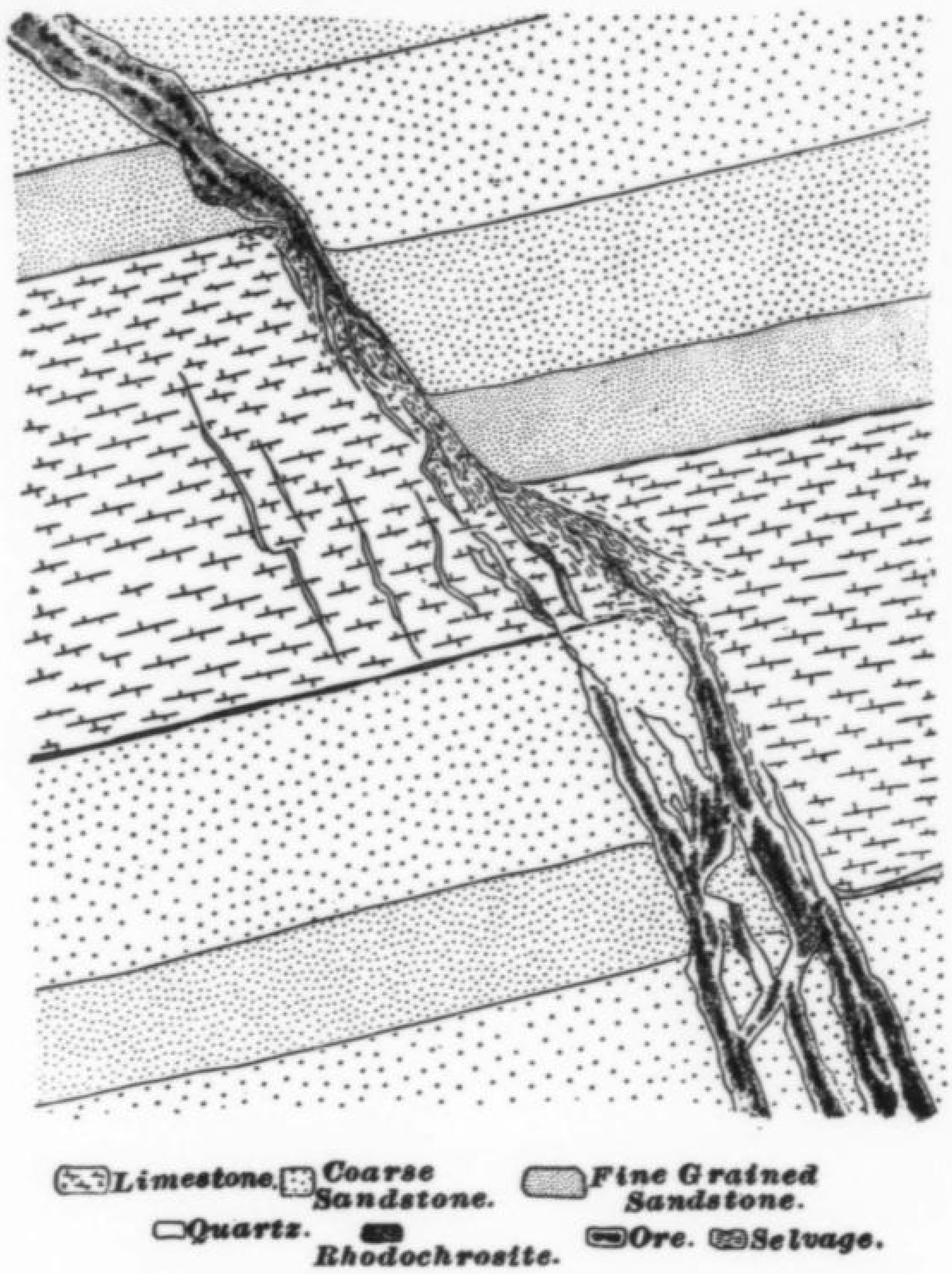


***Figure 6.* Mineralized vein in a fault zone, Newman Hill (Lakes, 1905).**

THE MINES

The mines of Rico are far too numerous to be treated individually. Save for a few weather-worn dumps, many of the mines have left no evidence that they ever existed. This fact, complicated by little written history, makes detailed descriptions impossible. Nevertheless, the author has attempted to present as near a complete listing of Rico's mines as possible.

Mining in Rico can be divided into several centers of activity. The following is a brief description of the mines which made Rico a major mining center, arranged according to major groups or areas.

Nigger Baby Hill

Named from the numerous outcrops of manganese, the term has been dropped from modern maps and literature. However, it has been retained here in the interest of historical accuracy. Ore was first discovered on Nigger Baby Hill in 1878. This led to much activity around the Rico area. Bounded on the north by C.H.C. Hill and on the south by Silver Creek, Nigger Baby Hill was literally honeycombed with adits, inclines, shafts and drifts. This myriad of workings led to much confusion, with a continual pattern of abandonment, relocation, and unending legal battles.

The Grand View group

This is a group of mines originally consisting of the Grand View, Major, Phoenix, Pelican and Yellow Jacket (formerly filed as the Nigger Baby claim, 1870) claims. The story of these mines is essentially the story of Nigger Baby Hill. Sandy Campbell and John Glasgow staked the claims in late 1878 or early 1879 . . . the record is a little unclear on the exact year. One thing is clear however, that the discovery of carbonate ore on the property sent shock waves through the mining communities of the San Juan Mountains. In 1879, Senator Jones of Nevada and John Mackey of Comstock fame purchased the Grand View from Campbell for $60,000 and the Phoenix and Yellow Jacket from Glasgow for an undisclosed sum. This represented the first major sale of mining property in the district. By 1880 all five claims had been acquired by the Grand View Mining and Smelting Company, with patents filed in 1881. The Grand View mine was developed by a shaft and several adits. The ore consisted mainly of cerussite which averaged over 50 ounces of silver per ton. The Phoenix and Yellow Jacket mines were operated as one, and worked the same vein as the Grand View. The ore consisted of cerussite, argentiferous galena and chalcopyrite. The mines were developed by two shafts and extensive drifting. The Pelican and Major never amounted to more than prospects. By 1900 most of the upper workings of the Grand View group had caved and were inaccessible. In 1923, Robert Pellet of the Pell-Eyre Company reopened the Yellow Jacket and Falcon mines. Five years of prosperity followed before the crash of the stock market in 1929. During the war years of the 1940s the Rico Argentine Mining Company gained control of and operated the properties of the Pell-Eyre Company.

Mines of Nigger Baby Hill

Grand View	Little African
Pelican	B. F. Butler
Phoenix	Ah Joyey
Major	Little Joe
Yellow Jacket	Little Leadville
Falcon	Little Queen
Hope & Cross	Montana
Alma Mater	Pacific
Nellie Bly	Silver Wedge
Iron	Rico No. 2
Last Chance	Silver Glade
Nora Lily	N & B
Arctic Cliff	Uncle Jess

C.H.C. Hill

Named for Charles H. Carpenter, C.H.C. Hill is located north of Rico and forms the lower western slope of Telescope Mountain. The rocks are badly broken and brecciated, and covered by landslide material. This unconsolidated material caused serious problems in keeping the portals of the various mines open. By the turn of the century most of the mining on C.H.C. Hill had been concluded. As one drives north out of Rico, the weathered buildings of the Rico Argentine acid plant may be seen at the foot of C.H.C. Hill.

Mountain Springs mine (Mountain Springs Claim, located in January 1881)

With C.H.C. Hill being literally a labyrinth of shafts, drifts, adits and raises, it was nearly impossible to define the bounds of one mine from those of another. Because of the situation the mines were often worked cooperatively as groups. The Mountain Springs mine was a member of the Wellington group. The group was originally worked by way of the Wellington shaft. However, when the shaft collapsed, the Mountain Springs tunnel became the main haulage level and eventually the group was referred to as the Mountain Springs mine.

The ore occurred as blankets of argentiferous galena, cerussite and anglesite. Above the ore blankets large bodies of pyrite were present. It is reported that pyrite was present as both loose granular deposits and as solid masses up to 15 meters thick. It was in these beds that some of Colorado's finest crystallized pyrites were recovered.

By the early 1890s most of the group was inactive. The Mountain Springs mine was reopened in 1913, and produced large quantities of copper from newly discovered lead-zinc-copper-iron replacement beds in the limestone. The mine continued to produce copper until 1919, when it was again closed. The outbreak of World War II stimulated mining on C.H.C. Hill one last time. The Mountain Springs mine was brought back to life and continued to produce copper, zinc and lead until final closure in the 1950s.

Mines of C.H.C. Hill

Wellington		Democrat
Zona K.		Clan Campbell
C.S. & H.H.		Governor
Maid of Australia	} Wellington Group	Gunshot
Lottie		Illinois
Mountain Springs		Iron Vault
		Little Laura
General Logan		Mayflower
General Sheridan		Melvina
General Howard		Niagara
General Sherman	} Logan Group	Paymaster
Little Casper		Premier
Goliath		Silver Plume
		Lily D.
C.H.C.		Iron Giant
Athlena		Amanda J.
Limestone		Gold King
Princeton	} C.H.C. Group	Pay Boy
Crebec		Silver Wing
Pigeon		Undine
		Wabash

Newman Hill

Located directly southeast of Rico, Newman Hill forms the lower western slopes of Dolores Mountain. It was on Newman Hill that the blanket deposits were first discovered, and where some of Rico's richest silver mines were located. The slopes of Newman Hill are covered by several meters of float, concealing the true nature of the rock formations found beneath. This overburden of landslide material hid the veins and blankets, causing the development of Newman Hill to lag behind other areas.

Enterprise mine (Enterprise claim, located in 1879)

Located 2.4 km (1.5 miles) southeast of Rico, the Enterprise shaft was sunk to a depth of 11 meters in 1881 by David Swickheimer and associates. Disillusionment soon led to the trading of the claim for a few hundred dollars worth of lumber. Due to the success of neighboring claims (Swansea and Songbird), Swickheimer repurchased the Enterprise and at once began resinking the shaft. On October 6, 1887, at a depth of 81 meters, the first flat orebody (blanket deposit) known to exist was encountered (Farish, 1892). The first assays from the newly discovered deposit ran 519 ounces of silver and 2.1 ounces of gold per ton (Farish, 1892).

In 1891 the Enterprise mine was sold to interests in London for $1.25 million. With the rich orebodies depleted and the price of

Figure 7. **Newman Hill above Rico, Enterprise mine is at right (Lakes, 1905).**

silver very low, the Enterprise was closed in 1901. It was reported (Farish, 1892) that massive bodies of pyrite averaging 8–10 ounces of silver and a trace of gold were left behind because they could not be profitably mined. The Enterprise produced over $4 million worth of precious metals. In 1905 Cross and Ransome reported that most all of the openings into the Enterprise had collapsed.

Rico-Aspen mine (Jumbo claim, located in 1879 on the southwest slope of Newman Hill, just north of Deadwood Gulch)

Access was gained by 5 shafts, the Aspen, Jumbo, Vestal, Montezuma and Silver Glance, and by 2 adits, the Syndicate and Stephanite tunnels. The name of the Stephanite tunnel makes one wonder about the specimens that might have been seen there. While not as large a mine as the Enterprise, the Rico-Aspen was the highest grade silver producer of all the mines on Newman Hill. The Rico-Aspen was contiguous with the Enterprise and the Newman mines, and many of the same veins and blankets were mined by all three. This led to many disputes and lengthy court battles. In 1892, seventy-five 10-ton cars of high-grade silver were being produced in a month (Engel, 1968). However in 1895, due to depressed silver prices, the Rico-Aspen was closed.

Union Carbonate mine (Carbonate claim, located in August of 1879)

This mine is situated high on the northwest spur of Dolores Mountain, about 1.6 km due east of Rico. It was the highest in elevation of all the mines located on Newman Hill. In 1879, two tunnels, driven by separate interests, intersected the same orebody. The Carbonate property spent the next seven years in litigation, with the opposing parties finally agreeing to work together; hence the name Union Carbonate. The workings consist of the Union Carbonate shaft and four adits, the Fickle Goddess being the most noteworthy of the group. The Union Carbonate exploited the blanket type orebodies previously mentioned. However the ore grade was not as high as in either the Enterprise or the Rico-Aspen and, despite extensive development, the Union Carbonate was closed in 1894. In 1924 the property was reopened, but operated profitably for only 5 years, falling victim to the 1929 stock market crash. Very little remains today that would hint at the activity found on Newman Hill 100 odd years ago. The hill is now totally reforested and one must look closely to find any evidence of mining activity.

Mines of Newman Hill

Enterprise	Eliza Jane
Rico-Aspen	Eureka No. 2
Union Carbonate	Fort Wayne
Lexington Tunnel	Franklin
Golden Fleece	General McPherson
Forest-Payrole	Governor Crapo
Mediterranean Tunnel	Guthrie
Sun Flower	Juniata
Laxey	Newman
Pro Patria Tunnel	Chestnut
South Park	Carbonate Queen
Hibernia	Melvin Clarence
Onamo Tunnel	Mountain Monarch
Isabella	Omaha
Swansea	Orphan Girl
Songbird	Dawn of Day
Laura	Wild Cat
Revenue	Pearl
New York	Raven
Belaire	Rico Muldoon
Black George	Robert E. Lee
Camp-Bird	Slide
Don Pedro	Waltham

Silver Creek

The area referred to as the Silver Creek mining area is found approximately 1.6 km up Silver Creek, and just east of Allyn Gulch. The mines are largely located on the south side of the east-west flowing creek. The Blackhawk mine was the most profitable early mine. However the Argentine mine and a group of later tunnels were to become the center of mining activity in Rico for nearly 40 years.

Rico Argentine mine

The Rico Argentine group or, as it later became known, the Rico Argentine mine, is found on Silver Creek, approximately 2.4 km northeast of Rico. The workings of the Rico Argentine are by far the most extensive of any of the mines found in Rico. In the 1930s, the Rico Argentine Mining Company began acquiring old properties and developing new ones. By the end of 1938 the Rico Argentine mine was in production. Eventually the holdings came to include the Argentine, 517, and Van Winkle shafts, as well as the St. Louis, Blaine, Rico Consolidated, Argentine, Blackhawk and Blacksmith tunnels. Most of the mines comprising the Rico Argentine were originally silver mines. The wealth and fame that eventually came to the Rico Argentine was gained by exploiting replacement deposits of sphalerite, galena and chalcopyrite in the Hermosa formation. Gold and silver were also recovered as by-products. The Rico Argentine continued full production throughout the war years. However the post-war years brought a slack demand for base metals and in 1948 the work force was cut to 50 men.

The uranium boom of the 1950s brought renewed prosperity to the Argentine. Massive pyrite replacement deposits of no previous economic value were mined and used in the production of sulfuric acid, which was vital to uranium processing. An acid plant at the site of the St. Louis Tunnel was completed in 1953, and enlarged in 1956. Pollution of the Dolores River and harmful effects on local vegetation brought about the closure of the plant in 1964. Production of base metals continued sporadically through the 1960s, with final closure coming in 1971. Leaching continued for a few more years. The mine, now idle, is owned by Anaconda Minerals Corporation.

Mines of Silver Creek

Argentine Shaft	Rico Argentine	Good Hope
Argentine Tunnel	Rico Argentine	Jersey Belle
517 Shaft	Rico Argentine	Sonica
Van Winkle Shaft	Rico Argentine	Little Maggie
St. Louis Tunnel	Rico Argentine	Parole
Blaine Tunnel	Rico Argentine	Orphan
Rico Consolidated Tunnel	Rico Argentine	Lead Year
		Paymaster
Blackhawk Tunnel	Rico Argentine	Richmond
Blacksmith Tunnel	Rico Argentine	Albany
Alleghany		Ella D.
Leila Davis		South Park
Privateer		Tuf Nut
Uncle Ned		Highland Mary
Worlds Fair		Little Mamie
Annie Proctor		Harvey
Avalanche		Wood & Sheivley
D.P.		

Expectation Mountain

As one stands in Rico and looks toward the west, the view is dominated by Expectation Mountain. The lower slopes of Expectation Mountain dip steeply down to the west bank of the Dolores River. While being the site of numerous mines, none of Rico's famous producers were located on Expectation Mountain.

Jones mine (St. Louis Claim, located in July of 1879)

This claim was developed by a tunnel just above the Dolores River. The Jones mine, while not a major mine by any measure, was unique nonetheless. For it was the Jones mine which produced the best native gold specimens ever to be found in Rico. Through the years much confusion has arisen regarding the Jones mine. The St. Louis claim, upon which the Jones mine is located, has often been confused with the properties of the St. Louis Mining & Smelting Company. During the 1920s and 30s, S.L.M. & S.C. developed much property in the area of C.H.C. Hill, most notably the St. Louis tunnel (later owned by the Rico Argentine Company). Many specimens coming from the Jones mine have doubtlessly been attributed to the St. Louis tunnel.

All the gold found at the Jones mine was free gold. It occurred in isolated vugs and pockets along the footwall of small irregular veins. Overall the mine was never totally an economic success. The individual gold pockets were quite often isolated, with much barren rock in between. However each newly revealed pocket produced enough gold to offer new hope and justify more development (McKnight, 1974).

Mines of Expectation Mountain

N. A. Cowdrey	Jones	Minnie
Tomale	Expectation	Modoc
Argonaut	Blue Bell	Mohegan
Potter Tunnel	Argenta	Stranger
Bancroft	Belle of Rico	Monitor
Silver Swan	Burwick	North Star
Little Maggie	D. and R.G.	Perhaps
Ironclad	D.K.D.	Radigan
Whim	Denver	Sixty-Six
Little Leonard	Edith D.	Lowell
Montezuma	Fair Valley	Shamrock Tunnel
Calumet	Gem of Beauty	Sunrise
Aztec	Keystone	Whale
Sambo	Liberty	Smuggler
Zulu Chief	Little Rico	Riverside
California	Lucy P. Brown	

Horse Creek

Located north of Expectation Mountain and running east-west, Horse Creek Gulch was the location of Rico's richest gold mines. The area was heavily assaulted by prospectors, however there was little ore to be found. Most promising claims were eventually deserted with only a few prospect holes left to mark their existence. However a few prospectors did find their dreams in Horse Creek. One such instance was exemplified by the Johnny Bull mine.

Johnny Bull Mine (Johnny Bull claim, located in June of 1880 in Horse Creek Gulch)

Gold was never the life blood of the Rico district; however, in 1880 a rather significant gold strike was made near Horse Creek. Two groups of prospectors claimed the property, and it is reported that gun battles actually took place in the struggle for ownership. The fight was finally settled in court, and for the lucky winners the Johnny Bull produced a million dollars in gold.

Ore at the mine occurred as a stock or chimney which proved good down to the 37-meter level. The Johnny Bull orebody was very much like those which were found near Red Mountain Pass in San Juan County, and is the only source of enargite in the Rico mining district. Two other Horse Creek mines which produced varying amounts of gold were the Puzzle and Gold Anchor. Both mines exhibited the same type of orebody as the Johnny Bull, however only the Puzzle produced gold economically. The Gold Anchor returned assays as high as 90 ounces of gold per ton, but the grade was spotty and on the whole not profitable. The mines of Horse Creek were, with few exceptions, closed by 1890.

Mines of Horse Creek

Puzzle	Kalamazoo
M.A.C.	Little Maud
Mohawk	Little Wink
Great Western	Lucky Boy
Lackawanna	Parlin
Johnny Bull	Query
Gold Anchor	Rico
Belzora	Rocky Point
Bull of the Woods	Silver Heels
Diamond	Colorado Boy
Dutchman	Stephen B.
Eclipse	Utah
Flying Fish	Venus No. 2
Garfield	Victoria
Heavy Spar	Vulcan
K.P.	

Miscellaneous

A few of Rico's mines could not geographically be placed into any of the well known mining areas, hence the above heading. Though referred to thusly, the most notable of these mines was anything but miscellaneous.

Atlantic Cable mine (Atlantic Cable claim, located in 1869)

Located at the confluence of the Dolores River and Silver Creek (downtown Rico on Main Street), the Atlantic Cable claim was first worked in the winter of 1869–70. The Atlantic Cable, along with the Shamrock (originally known as the Pioneer claim, the first claim located in Rico, 1869) which is located just across the Dolores River, were among a group of claims which first attracted attention to the Rico area. The Panic of 1873 brought work to a close at the Atlantic Cable, not to be resumed until 1878. The Dolores Silver Mining Company restaked the Atlantic Cable claim in May of 1878, and it was patented in March of 1883. It had long been known that much zinc was present in the mines along the Dolores River, however it was not until around 1900 that the extraction of zinc began.

It is thought that one of the earliest methods for the separation of non-magnetic iron sulfides from zinc was developed at the Atlantic Cable mine. Access was gained by way of three shafts, the Atlantic Cable 1 and 2, and the Gas shaft. The Gas shaft owes its name to the presence of carbon dioxide, caused by the seepage of river water onto carbonate rocks in the mine. The Atlantic Cable operated sporadically up to the time of World War II. The flooded mine was dewatered by the Rico Argentine Company during World War II, with much lead, zinc and silver being produced (ore averaged 15–20% lead, 16 ounces of silver per ton). The headframe of the Atlantic Cable mine may still be seen on the west side of the highway as one drives north out of Rico.

Miscellaneous Mines of Note

Atlantic Cable	Eighty-Eight
Iron Dollar	Burns

THE MINERALS

In a state which boasts such mineral producing giants as Leadville, Ouray, Silverton and Telluride (the list could go on and on), it is no wonder that an isolated mining camp like Rico has been relegated to near obscurity, mineralogically speaking. However, before the turn of the century, the mines of Rico produced a large suite of crystallized silver minerals, as well as numerous other species. By 1900 most of Rico's mines were shut down and inaccessible. Because of this lack of supply, and also natural attrition, precious few specimens have endured the 80–100 years which have elapsed since the time of those closures.

Through the 1940s, 50s and 60s a steady, though never abundant, flow of fine material was produced by the Rico Argentine mine. However with all mining activity ceased, very little Rico material ever sees the market these days. The few specimens which do surface are quickly gleaned off by "Colorado locality" collectors. It has been my experience that very few groups of collectors rival the Colorado collectors in their passion to acquire specimens. Fortunately, it is through this passion that we are afforded a sampling of the fine minerals that were at one time available.

The following descriptions are of those major crystallized species having significance to collectors. The descriptions are based in part on specimens actually viewed by the author in museums and private collections and in part on descriptions recorded in the literature by Ransome, Rickard, Farish, McKnight and others. Special effort has been made to note the individual mines where the minerals were collected. A list of most of the species found at Rico is included at the end of this section.

Elements

Silver Ag

In a district which achieved its fame from silver, it seems rather shocking that so little specimen material has survived to the present. Factors contributing to this shortage undoubtedly include the early closure of Rico's bonanza mines, mislabeling of existing silver specimens, and the ordinary attrition which sooner or later befalls nearly all older specimens.

Silver from the Rico district is widely reported in the literature. It seems, however, that the Enterprise mine was by far the most prolific source of crystalline material (Farish, 1891; Rickard, 1896; Ransome, 1901). Numerous fine, delicately crystalline silvers from the Enterprise have survived the years. Rickard (1896) reports native silver at the Rico Aspen mine. The Puzzle mine, which was the source of many silver-bearing minerals, also produced some native silver (Ransome, 1901). Other mines which have produced crystalline native silver include the Atlantic Cable (Lakes, 1905) and the Aztec (McKnight, 1974). In recent times the Rico Argentine mine infrequently was the source of some rather nice wire silver, associated with galena and sphalerite.

Gold Au

Though Rico was never known as a famous gold district, nearly all the ore produced contained gold, at least as a minor constituent. By far the finest gold specimens have come from the Jones mine. Leaf and ribbon gold set on yellow to red limonitic matrix make for some truly stunning specimens. The Rico Argentine mine occasionally produced native gold specimens. The mines of Newman Hill produced ore containing as much as 0.5 ounce per ton gold (McKnight, 1974); no doubt some excellent individual pieces existed at one time. Ransome (1901) reported free gold associated with rhodochrosite at the Enterprise mine. Other mines in the district which have reportedly been the source of native gold include the Gold Anchor, Puzzle, Uncle Remus and Johnny Bull (Ransome, 1901). The Johnny Bull is also credited with producing the only gold tellurides in the district (Ransome, 1901), although specific species were not mentioned.

Sulfides

Pyrite FeS_2

If you were to ask the average mineral collector to name a mineral found at Rico, nine out of ten would say pyrite. Such a response would be well founded, as some of Colorado's most attractive pyrites have come from the mines at Rico. Cubes, octahedrons and pyritohedrons are the most common crystal forms represented. The Rico Argentine mine was, over the years, the most steady source of good pyrite. Unfortunately the actual shaft or tunnel that so many of these beautiful pyrites came from has been lost or totally neglected. Most specimens are simply labeled Rico Argentine mine. Looking past the labeling problems, the Rico Argentine mine has produced literally thousands of lustrous groups of pyritohedral crystals. Many of these groups are covered by a silvery gray mineral, long thought to be bravoite. However X-ray analysis has revealed no nickel, only copper. This would suggest that the coating is perhaps chalcocite (Kosnar and Miller, 1976). Lovely groups of sharp octahedral pyrites associated with quartz were also found at the Rico Argentine. Another attractive variety consists of generally small cubes stacked one upon another, often giving the impression of some tiny futuristic city.

The mines of C.H.C. Hill, most notably the Mountain Springs mine, produced gorgeous groups of pyritohedral and modified cubic crystals during the 1950s. The Mountain Springs mine also was the source of some very unusual spherical pyrite specimens (see Kosnar and Miller, 1976, page 304).

At one time, though many years ago, some fairly nice pyrite specimens could be collected on the dumps of the Uncle Ned mine. Other mines which have produced good pyrites include the Johnny Bull, Gold Anchor, Enterprise, Puzzle, Shamrock, Pigeon and Wellington.

Sphalerite ZnS

History has been cruel to sphalerite in the Rico district. Until the turn of the century the presence of zinc was considered a detriment (because of smelting penalties) to an orebody. For this reason little mention of sphalerite was made by the early writers.

The mines of Newman Hill have produced some very nice sphalerites. Black to rosin-colored crystals, associated with quartz, galena, chalcopyrite and rhodochrosite were quite common in the blanket deposits of the Enterprise mine. One specimen labeled only as Newman Hill consists of gemmy green sphalerite with native silver and quartz (Ed Raines, personal communication, 1984). Other Newman Hill producers of sphalerite include the Rico Aspen and the Union Carbonate mines.

In 1901 the Atlantic Cable and the Bancroft mines became the first commercial producers of zinc in Rico. Farish (1891) mentioned the occurrence of sphalerite at the Atlantic Cable, however it was Ransome (1901) who first described dark brown crystals and nodular masses of sphalerite associated with specular hematite, chalcopyrite and galena at that locality. During World War II Rico became Colorado's second largest producer of zinc. The bulk of this production came from the Rico Argentine mine, most notably the Van Winkle shaft. The replacement beds of the Rico Argentine produced thousands of well crystallized specimens of sphalerite in constant association with galena and often quartz. This association was responsible for some very attractive pieces. The Lily D., the Sambo, and the previously mentioned Bancroft mine all were reported to have produced some nice sphalerite specimens.

Galena PbS

Galena was present in nearly all of Rico's mines. It was most commonly associated with chalcopyrite, sphalerite and pyrite. Ransome (1901) reports galena, associated with argentite, tetrahedrite, proustite and polybasite in the Newman Hill mines, and abundantly in the Enterprise mine. Unfortunately few good galenas from the old days exist today. The best galena in the district was extracted from the workings of the Rico Argentine mine. Cubes and cuboctahedrons combined with sphalerite to form some very attractive specimens. Some of the best of these pieces came from the Van Winkle shaft, but very few actually are labeled as such.

Other mines in the district which produced nice galena in varying amounts include the Mountain Springs, Wellington, Yellow Jacket, Falcon, Aztec, Nora Lily, Pro Patria, Revenue, Forest Payrole, Iron Clad and Atlantic Cable (McKnight, 1974).

While much of Rico's silver has come from argentiferous galena, the very richest areas in the orebodies were commonly highlighted by the presence of one or more of the following six minerals. These minerals were among the last to form (Ransome, 1901), and as often as not were found beautifully crystallized. As the high grade pods of ore were the first to be mined, the rich silver minerals became more scarce with the passing of time. By 1900, pockets of these minerals were indeed a rarity.

Argentite-Acanthite Ag_2S

Farish (1891), speaking in general of the minerals of Newman Hill, reported argentite associated with stephanite and polybasite in vugs and vein centers. Farish went on to note that many of the vugs were completely lined with argentite and quartz crystals. Ransome (1901) reported black rounded crystals of argentite at the Enterprise mine. Crystallized argentite also occurred at the Puzzle mine (Ransome, 1901). Some of these old-timers still may be found in the collections of today. One example consists of acanthite on pearceite (both crystallized), labeled simply Newman Hill (Ed Raines, personal communication, 1984). The Rico Argentine has been the source of some nice acanthite specimens, sometimes associated with native gold.

Sulfosalts

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

While not a silver mineral by definition, much of the tetrahedrite found in the mines of Rico was highly argentiferous in composition. So much so, in fact, that the presence of tetrahedrite became an indicator of highgrade ore. Though present in many mines, it seems to have been abundant only in the blanket deposits of Newman Hill. Often associated with galena, sphalerite, polybasite, rhodochrosite and quartz, fine crystals of tetrahedrite were reported at the Enterprise and Rico Aspen mines (Ransome, 1901). Ransome also mentions crystallized tetrahedrite at the Gold Anchor, Johnny Bull, Aztec and Iron Draw mines. At the Rico Argentine much silver was recovered from tetrahedrite, and occasionally nice crystals were found associated with sphalerite (McKnight, 1974).

Proustite-Pyrargyrite $Ag_3AsS_3 - Ag_3SbS_3$

The "ruby silvers" were constant companions, when present, in the mines of Rico, and in much of the early literature were doubtlessly mistaken for one another. Farish (1891) reports ruby silvers on Newman Hill associated with argentite, polybasite, stephenite and native silver. In 1894, Chester described black crystals from the Enterprise mine with brilliant metallic luster, sharply terminated, in association with stephanite, polybasite, tetrahedrite and common sulfides all set in bright pink rhodochrosite. Chester thought these crystals to be argentite, but more likely they were proustite or pyrargyrite. Ransome (1901) refers numerous times to beautiful crystals of proustite and pyrargyrite found in vugs associated with stephanite, polybasite, native silver and quartz. Though these gorgeous minerals were common in Rico at one time, the real tragedy is that so few of them survive today. The ruby silvers were most prevalent in the blanket deposits of Newman Hill, chiefly from the Rico Aspen and Enterprise mines. Pyrargyrite crystals up to 6 mm, associated with argyrodite, were reported from the Iron Clad mine (McKnight, 1974).

Stephanite Ag_5SbS_4

Stephanite was often found as crystals in vein centers associated with quartz (Farish, 1891), and in vugs in massive material (Ransome, 1901). Though found in many of the Newman Hill mines before 1900, stephanite was most prevalent at the Enterprise mine and in the Stephanite tunnel at the Rico Aspen mine. Chester (1894) reports that stephanite was quite common in the rich blanket ores, however he makes no mention of crystals. The Enterprise mine is

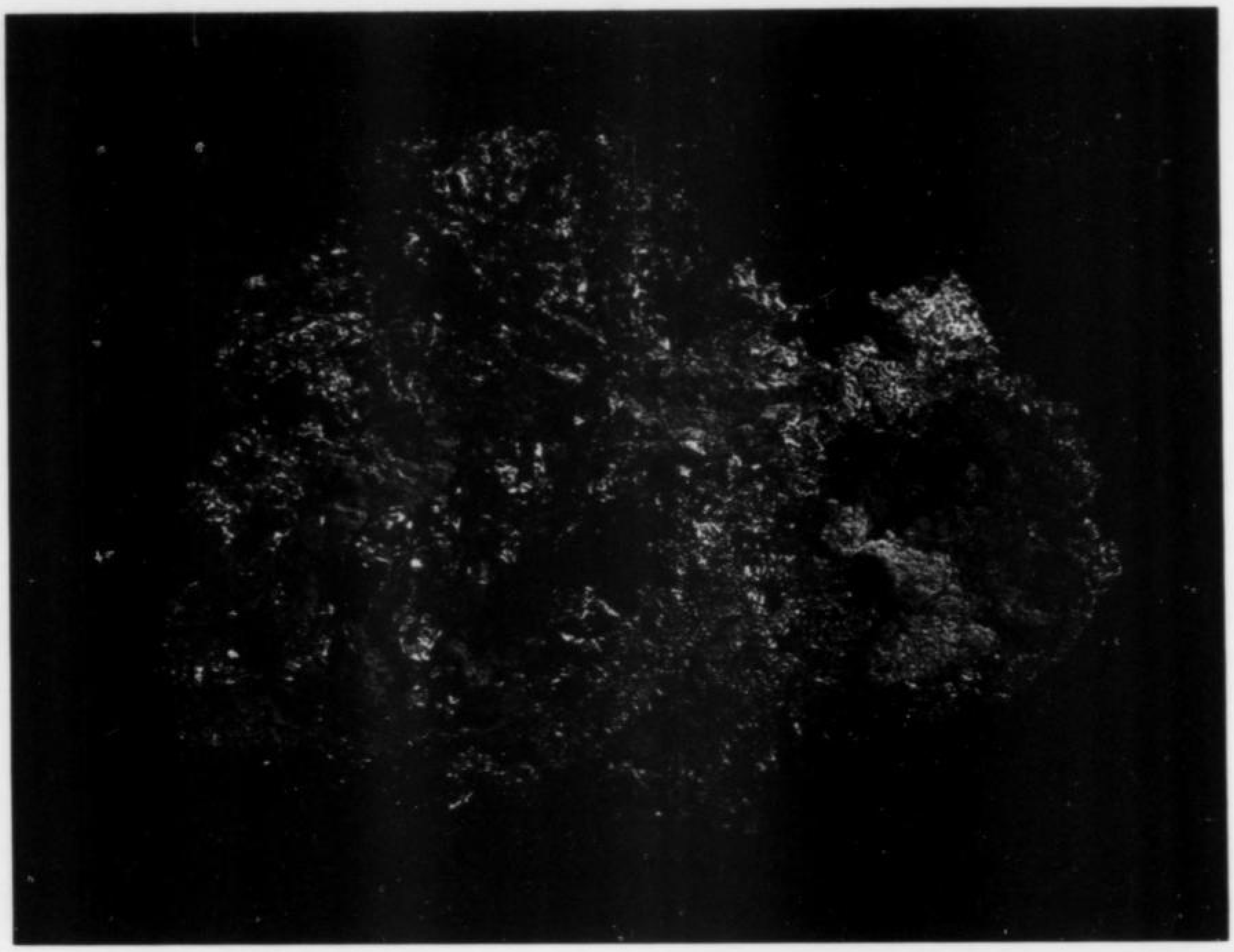


Figure 8. **Silver, 4 cm across, from the Enterprise mine, Newman Hill; collected ca. 1890. Author's collection; photo by Jeff Scovil.**

Figure 9. **Pyrite coated with chalcocite, 5 cm across, from the Rico Argentine mine, Silver Creek; collected ca. 1960. Author's collection; photo by Jeff Scovil.**

Figure 10. **Pyrite, 8 cm tall, from the Mountain Springs mine, C.H.C. Hill; collected in 1954. Author's collection; photo by Jeff Scovil.**

credited with producing what is probably the most attractive stephanite specimens found at Rico. These consisted of dull, black, platy crystals associated with lustrous silvery red pyrargyrites. There apparently were no occurrences of stephanite other than in the mines of Newman Hill.

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

Like the previously mentioned silver-bearing minerals, polybasite was commonly found in the blanket ores of Newman Hill. Ransome (1901) reported crystallized polybasite associated with proustite at the Enterprise mine. The Rico Aspen mine is also credited

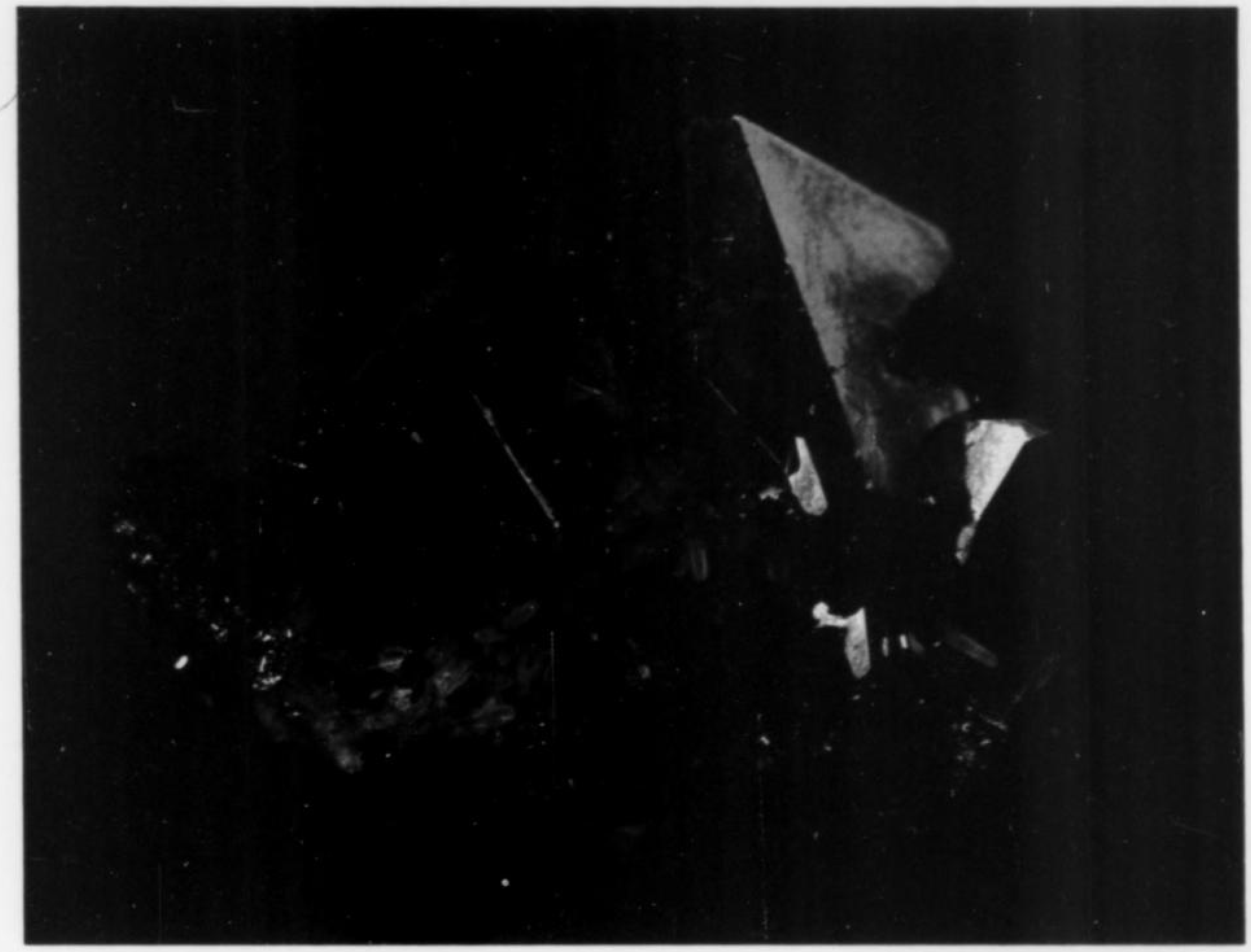
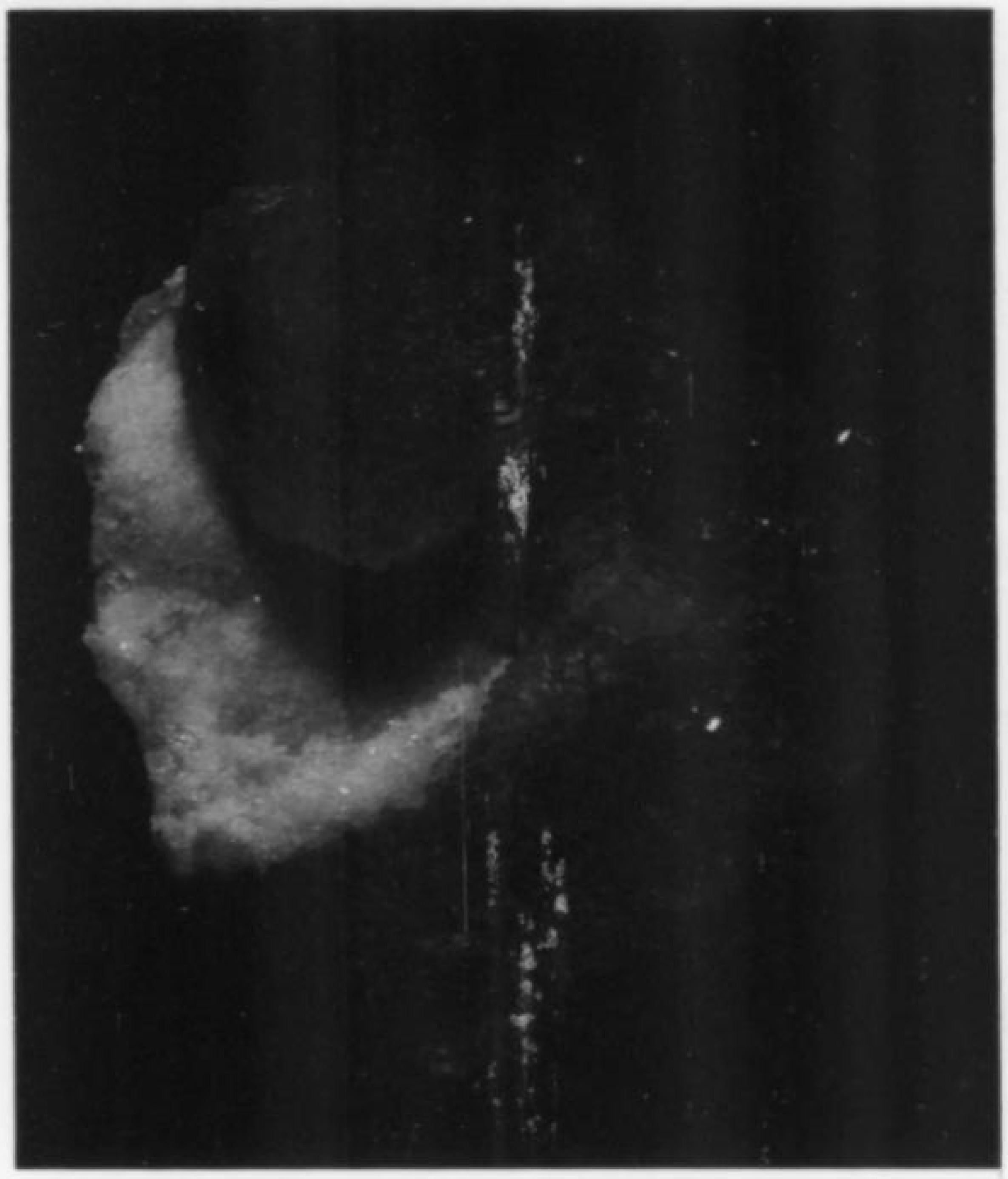


Figure 11. **Octahedral pyrite specimen, 3.6 cm across, from the Rico Argentine mine, Silver Creek. Harold Michel collection; photo by Jeff Scovil.**

Figure 12. **Fluorite, 6 cm across, from the Rico Argentine group, Blaine tunnel; collected ca. 1940. Harold Michel collection; photo by Jeff Scovil.**



with producing nice polybasite. At the Iron Clad mine hexagonal discs of polybasite were found associated with pyrargyrite and argyrodite. The Revenue tunnel, on the northwest slope of Newman Hill was also the source of nice crystals of polybasite with quartz (McKnight, 1974).

Halides

Fluorite CaF_2

Though found in many of Rico's mines as massive material, fine crystallized fluorite was a little more scarce. Ransome (1901) reported nice crystals of pale lilac, pink and colorless fluorite at the Black Hawk tunnel. The Black Hawk material was associated with chalcopyrite, galena and sphalerite. Ransome in the same report mentioned the occurrence of colorless, pink and green fluorite at the Fortuna and Duncan prospect on the north bank of Silver Creek. The finest fluorite observed by this writer was collected in the late 1930s in the Blaine tunnel (Rico Argentine mine), on the north bank of Silver Creek. The crystals are a bluish green in color and are composed of minute cubes stacked one upon another into the shape of crude octahedrons. The Rico Argentine mine has been the source of many fine fluorite specimens. One interesting specimen from this locality consists of purple fluorite with crystallized bismuthinite, collected in the 1930s (Ed Raines, personal communication, 1984). McKnight (1974) reported 12-mm crystals of fluorite from C.H.C. Hill. Newman Hill also produced some nice fluorites, notably at the Hibernia tunnel.

Sulfates

Barite $BaSO_4$

Barite was not commonly found in the Rico district until the mining of the replacement beds began. Silicious casts of barite show that the mineral was present as an early phase, however in most cases these crystals were leached away before completion of mineralization (McKnight, 1974). These casts can make for some very attractive specimens. One such incidence occurred in the Blaine tunnel (Rico Argentine mine) where barite had been covered by quartz, then leached away, and then in the voids were deposited scalenohedral manganoan calcite (McKnight, 1974). These types of associations were apparently quite common in the replacement beds of the Rico Argentine mine. The Enterprise mine produced beautiful pseudomorphs of quartz after barite (Rickard, 1897). Perhaps Rico's finest barites came from the west side of the Dolores River on Expectation Mountain. At the Aztec mine, thin white rosettes of barite with individual crystals up to 2.5 cm were found

(McKnight, 1974). Numerous stopes within the Rico Argentine mine produced druses and clusters of white to golden colored barites.

Carbonates

Calcite $CaCO_3$

Calcite, commonly called "spar" by the early miners, has always been abundant in the Rico district. Calcite in the district typically crystallizes as scalenohedrons or rhombohedrons and in nearly all cases is manganoan. It would be impractical to cite all the many calcite occurrences, so a few typical finds will be mentioned. On the Blaine level of the Rico Argentine mine, clear to pink scalenohedral crystals with rhombohedral terminations were commonly found (McKnight, 1974). At the Jones mine pale pink, curved rhombohedrons of manganoan calcite were found often associated with the gold pockets (McKnight, 1974). As would be expected in a limestone replacement deposit, the Rico Argentine was the source of hundreds of individual pockets of nice calcite. Other mines producing calcite specimens included the Pro Patria, Revenue, Iron Clad, Atlantic Cable and numerous mines on C.H.C. Hill.

Rhodochrosite $MnCO_3$

No discussion of a Colorado mineral locality could possibly be complete without mention of rhodochrosite. However, a specimen of Rico rhodochrosite is truly a rare thing. This writer has in fact never seen such a specimen, other than massive material. Early writers spoke of crystalline rhodochrosite frequently. The mines of Newman Hill, chiefly the Enterprise and Rico Aspen, produced the finest material (Ransome, 1901). Curved rhombohedrons of a pale pink color were found on Newman Hill associated with numerous silver-bearing minerals (McKnight, 1974). Rhodochrosite was considered a good indicator of highgrade silver ore in deposits on Newman Hill (Ransome, 1901). The Rico Argentine has produced some rhodochrosite, however massive material is the usual form. Miners speak of rare times when delicate pink rhombs of rhodochrosite were recovered in the Rico Argentine. Other mines producing rhodochrosite include the Pro Patria, Revenue and the Black Hawk tunnel (pre-Rico Argentine mine).

CONCLUSION

As is the case with most mining camps, so it was with Rico: times of boom and times of bust. The saloons, the dance halls and the mines are now faded memories. There remains only an occasional broken down headframe, a weathered mine dump or perhaps an old building to remind us of those lively days in the late 1800s. In the summer of 1900, F. L. Ransome visited the Rico area, and in his subsequent report remarked, "In the year 1900 the only ore being shipped from the district was an occasional carload taken out by leasers working small areas of unexplored ground in the larger mines. Whether the present inactivity is final or not is a question that cannot be decided offhand. Prosperity and depression, following each other in rhythmic procession, are the lot of many mining districts, and it is often difficult to distinguish a state of quiescence from one of extinction." As it turned out, in 1900 Rico was only in a state of quiescence, and though much time has elapsed, Ransome's remarks are just as valid today as they were over 80 years ago. Perhaps now, Rico will be left to rest. However, to those of us who care about such things, there is always the hope of another deposit, another Enterprise or Argentine, one which will again bring life and prosperity to this deserted old ghost.

ACKNOWLEDGMENTS

No work of this nature could be accomplished without the help of numerous people. I offer special thanks to: my wife Carole for typing and proofing this paper, and for not divorcing me when I subjected her to four rain-soaked days of camping at Rico; Mark Hay and Wendell Wilson for reviewing this paper and offering constructive suggestions; Jeff Scovil for his excellent photography; Orval Jahnke (Anaconda Minerals-Rico, Colorado) for invaluable historical information regarding Rico; Bob Cobban (Denver Museum of Natural History) for supplying research material and placing the museum's collection of Rico minerals at my disposal; Keith Williams and Ed Raines for help and information regarding many obscure Rico minerals; Rich Kosnar, for providing much useful discussion; the many collectors who made their Rico material available for my viewing; and, lastly, the many people who came to Rico in the late 1800s and early 1900s and wrote of their experiences, for it is they who truly have preserved the past. To these individuals I express my appreciation.

Table 1. **Minerals reported or observed from the Rico area.**

Acanthite	Ag_2S
Allophane	$Al_2SiO_5 \cdot nH_2O$
Alunite	$KAl_3(SO_4)_2(OH)_6$
Anglesite	$PbSO_4$
Argentite-acanthite	Ag_2S
Argyrodite	Ag_8GeS_6
Barite	$BaSO_4$
Bismuthinite	Bi_2S_3
Bornite	Cu_5FeS_4
Calcite	$CaCO_3$
Carnotite	$K_2(UO_2)_2(VO_4)_2 \cdot 3H_2O$
Celestite	$SrSO_4$
Cerussite	$PbCO_3$
Chalcopyrite	$CuFeS_2$
Chlorite	$(Mg,Fe,Al)_6(Si,Al)_4O_{10}(OH)_8$
Copper	Cu
Dolomite	$CaMg(CO_3)_2$
Embolite	$Ag(Cl,Br)$
Enargite	Cu_3AsS_4
Fluorite	CaF_2
Galena	PbS
Gold	Au
Halloysite	$Al_2Si_2O_5(OH)_4$
Hematite	Fe_2O_3
Jarosite	$KFe_3(SO_4)_2(OH)_6$
Limonite	FeO(OH)
Magnetite	Fe_3O_4
Massicot	PbO
Pearceite	$Ag_{16}As_2S_{11}$
Pisanite	$(Fe,Cu)SO_4 \cdot 7H_2O)$
Polybasite	$(Ag,Cu)_{16}Sb_2S_{11}$
Proustite	Ag_3AsS_3
Pyrargyrite	Ag_3SbS_3
Pyrite	FeS_2
Quartz	SiO_2
Rhodochrosite	$MnCO_3$
Siderite	$FeCO_3$
Silver	Ag
Sphalerite	ZnS
Stephanite	Ag_5SbS_4
Sulfur	S
Tetrahedrite	$(Cu,Fe)_{12}Sb_4S_{13}$
Wollastonite	$CaSiO_3$
Vesuvianite	$Ca_{10}Al_4(Mg,Fe)_2Si_9O_{34}(OH)_4$
Epidote	$Ca_2(Al,Fe)_3(SiO_4)_3(OH)$
Manganese Oxides	MnO
Selenite	$CaSO_4 \cdot 2H_2O$

(continued on page 247)

minerals of the

Pikes Peak Granite

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The Pikes Peak Batholith is a complex igneous intrusion which covers a large part of central Colorado. It is composed in part of a distinctive rock called the Pikes Peak granite. Well-known mineral localities such as Crystal Peak, Devils Head, Glen Cove, Crystal Park and Harris Park, among others, are found within the limits of the Pikes Peak batholith.

INTRODUCTION

The Pikes Peak granite is famous for spectacular amazonite which has been found at many separate locations. What makes this region of increased interest is the wide variety of associated mineral species which are found in large, well-formed crystals. This article will acquaint the reader with the major specimen-producing areas within the Pikes Peak batholith, as well as some of the characteristics and associations of mineral species found within its confines. No attempt will be made to be exhaustive, since many species are represented only in microcrystals. However, if a rare species has been documented as having occurred in even a few well-formed or large crystals, an attempt will be made to note the occurrence. By and large the information reported here on specimens and localities was obtained directly by inspection of various private and public collections and by many visits to the actual occurrences.

GENERAL BACKGROUND

The Pikes Peak batholith covers about 2,800 square kilometers (1,080 square miles) in central Colorado. This large area encompasses parts of five counties, including Douglas, El Paso, Jefferson, Park and Teller. The Pike National Forest covers much of the area, although there is private land interspersed with forest land. Pikes Peak, situated just west of the city of Colorado Springs, is the best-known landmark within the batholith which bears its name. Other landmarks include Crystal Peak, north of Florissant; Sheepshead, another granitic knob slightly to the west of Crystal Peak and northeast of Lake George; Devils Head, a prominent jagged peak due west of the town of Castle Rock; and Specimen Rock and Sentinel Rock, two near-vertical cliffs west of Colorado Springs.

The Pikes Peak batholith, Precambrian in age, is estimated to be between 1.01 and 1.04 billion years old. It was intruded much later by younger formations during the great uplift which formed the Rocky Mountains. The granite which forms the batholith is generally highly eroded and decomposed; for the most part, the granite is coarse-grained, pinkish or cream-colored material containing numerous pegmatitic dikes running in all directions. Some of these dikes extend for more than 100 meters (but most are much shorter). Within these dikes have formed the cavities or pockets which may contain fine mineral specimens. Foord and Martin (1979) provide a detailed description of the geology.

In general, collecting locales within the Pikes Peak batholith occur in open forest along rolling hillsides which lie between 2,130 and 2,740 meters (7,000–9,000 feet) in altitude. Some localities, of course, are extremely rugged, but conditions for the most part are quite pleasant. The entire area lies east of the Continental Divide,

Figure 1. **Amazonite and smoky quartz, Crystal Peak area, found in the summer of 1983. Specimen measures 11 cm across. Authors' collection. All photos by John and Barbara Muntyan.**

Figure 2. **Amazonite and smoky quartz, Crystal Peak area, found in 1981. Specimen measures 6 cm high. Authors' collection.**

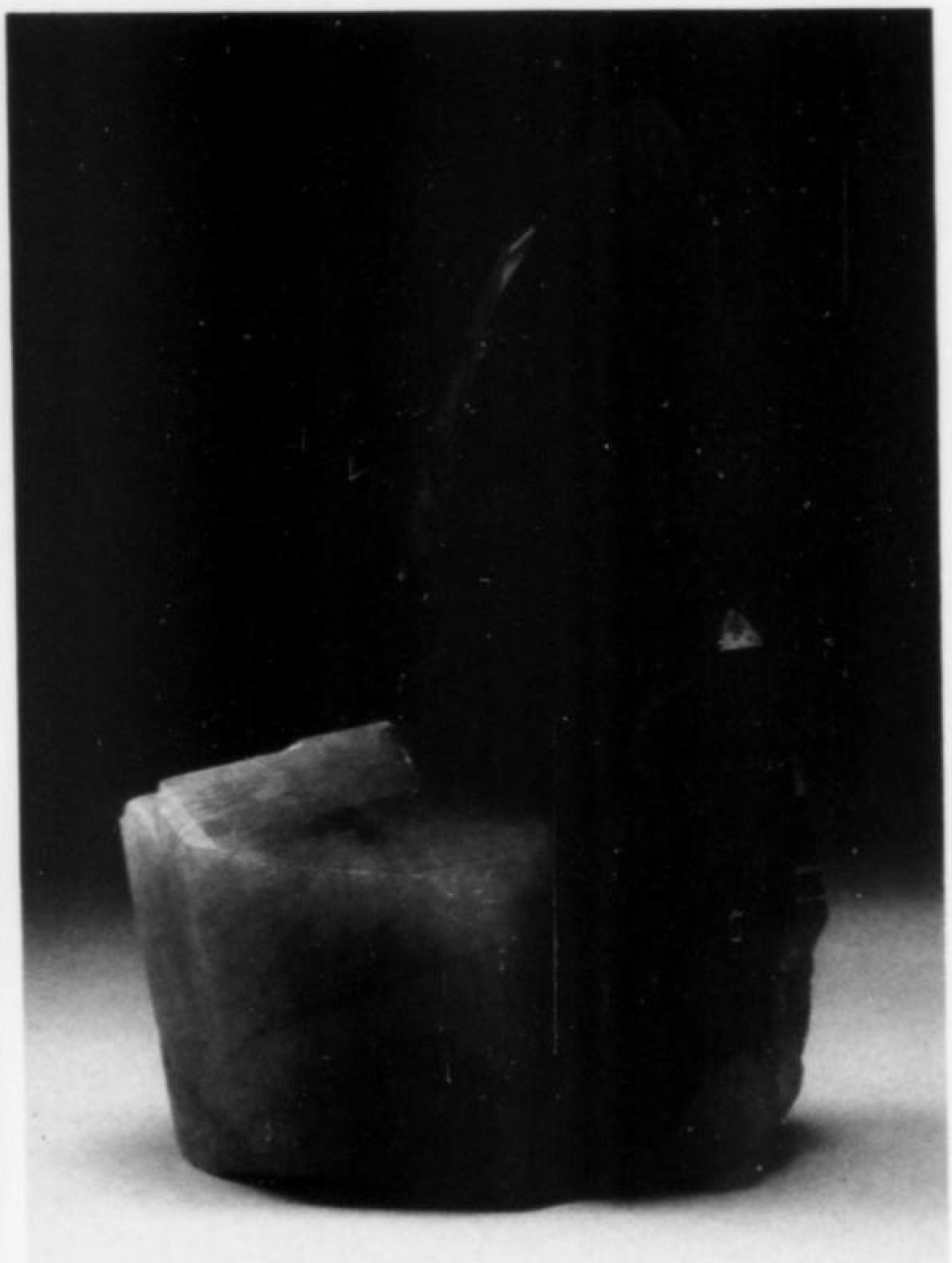


Figure 3. **Amazonite, sharp Manebach twin with minor albite. Specimen measures 8 cm across. Dug by Ray and Eliose Berry; now in authors' collection.**

Figure 4. **Amazonite and albite, another specimen from the "stripe pocket" dug in 1979, showing oriented overgrowth. Specimen measures 6.5 cm across. Authors' collection.**

and winters are sometimes mild. Although snow covers the region during the winter months, pockets have been removed even in December and January in warmer years.

COLLECTING LOCALITIES

There are numerous collecting areas within the Pikes Peak batholith where fine mineral specimens have been found. Within large regions, many local field collectors have certain favorite hillsides, knowledge of which is often jealously guarded from one another. Several prominent regions have produced fine specimens;

Figure 5. **Cluster of fluorite cuboctahedrons showing zonation, pale lavender cubes with darker octahedron edges. Specimen from Crystal Peak area, along Vermillion Creek, found in summer of 1982 by authors and in their collection. The specimen is 4 cm across.**

Figure 6. **Specimen of "onegite" (amethyst with included goethite) topping smoky quartz and microcline, from the Crystal Peak area. Specimen measures 6 cm across. Dug by Ray and Eliose Berry; authors' collection.**

the names of these locations commonly appear both on dealer labels and in the older literature. The more important localities include the following:

Crystal Peak

Crystal Peak is the name frequently given as the origin of many older amazonite specimens – which may or may not have actually come from this area. The Crystal Peak region is located north of the towns of Florissant and Lake George. It extends for about 5 km (3.1 miles) in an east-west direction, and 3 km (1.9 miles) north-south. The collecting area straddles the county line between Park and Teller County, and specimens are found labeled either way. Florissant lies in Teller County; Lake George is in Park County. Crystal Peak is located at the eastern edge of the main collecting area, in Teller County, but a large percentage of the total specimens from this vicinity have been dug in Park County.

Other names given to this area, especially in the older literature, include "Topaz Butte" (referring to Crystal Peak itself, where topaz has been found), and "Cheops Pyramid" (also referring to the same hill and its general appearance).

The best-colored amazonite seems to be found toward the western end of the locale, on the ridges running from the Platte River toward Crystal Peak between three small tributaries of the river: Beaver Creek, Crystal Creek, and Vermillion Creek. Part of this land belongs to the Pike National Forest, but there is also a considerable amount of private property. Access to the locale is limited, and most of the better sites are presently under claim by various collectors.

Harris Park

Harris Park has produced many outstanding specimens in recent years. It is found in the far northeast corner of Park County near the little town which bears the same name. The hillside containing the collecting site is heavily wooded, and the dikes seem to run more nearly vertically (or at least steeper) than do their counterparts at Crystal Peak. The wallrock of the dikes and pockets is usually cream-colored and less decomposed than the equivalent pink-toned material at Crystal Peak. The main digging area at Harris Park is

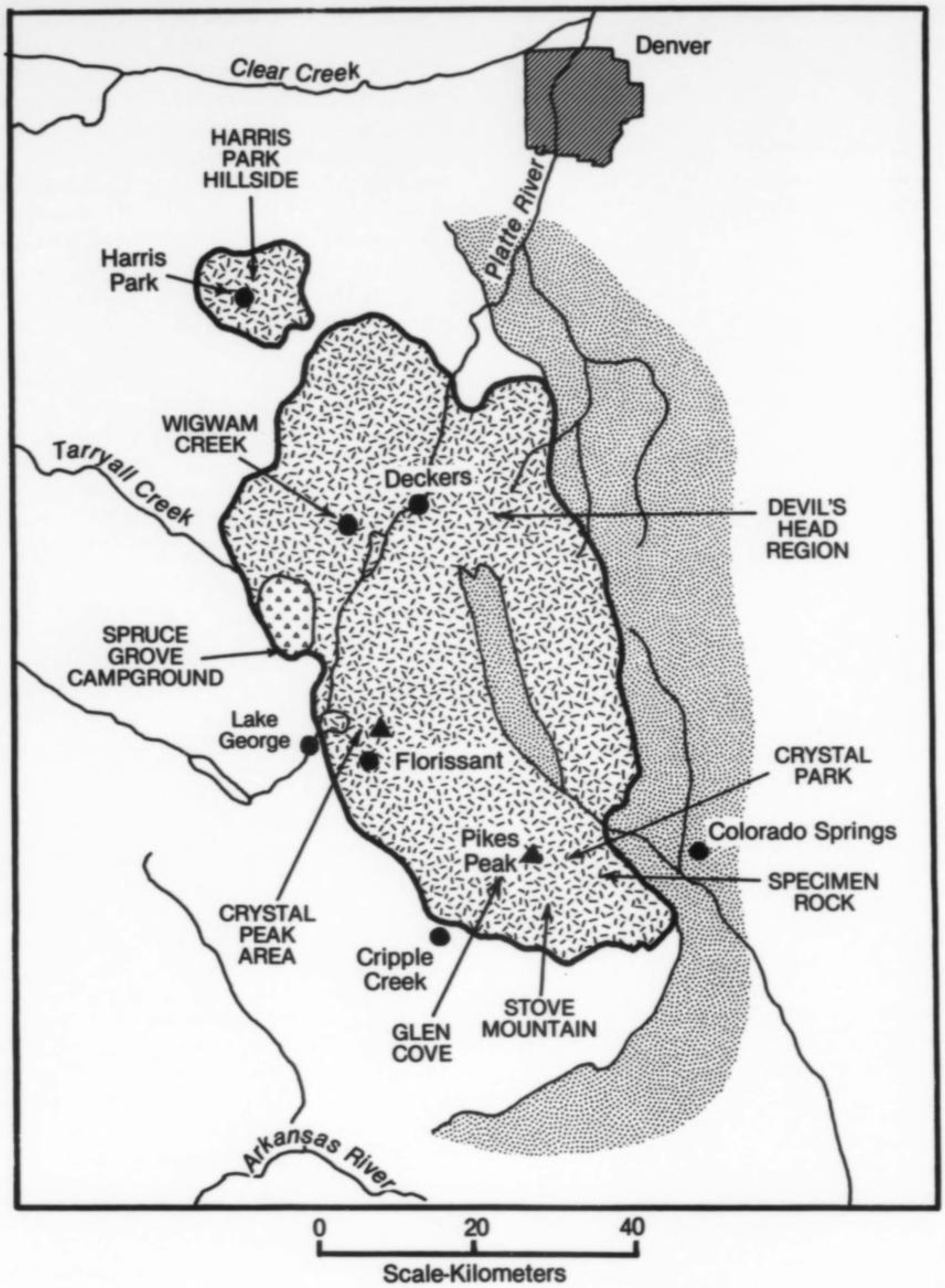


Figure 7. **Location map (after Barker *et al.*, 1976).**

presently under claim by several parties, including the Littleton Gem and Mineral Club, a Denver group. However, the surrounding territory has not been extensively prospected, and there may be other outcrops yet to be found.

Crystal Park

Crystal Park, lying in El Paso County, yielded some very fine specimens, particularly during the last century and first years of this one. This area is a high plateau at the base of Cameron Cone, a rugged mountain which lies southeast of Pikes Peak. Access today is by a long, steep and difficult hike cross-country. There are no roads into the main area, which lies near the watershed of the reservoir system for the city of Colorado Springs. Years ago, there was a toll road up from below.

Specimens from this locale may also be labeled "Cameron Cone" or sometimes as "Pikes Peak," especially if the specimen is an older one. While some specimens have actually come from Pikes Peak, many others so-labeled most probably have come from Crystal Park, particularly if the specimen is an amazonite of dark color.

Devils Head

Devils Head is located in Douglas County along the Rampart Range Road between Deckers and Woodland Park. Compared to the first three localities mentioned, relatively little good-quality amazonite occurs here. Devils Head is famous, however, for some very good topaz, and for smoky quartz and common microcline crystals which also grow to very large dimensions. At least one pocket of large crystals of high-quality amazonite has also been documented from an area about 1 km south of Devils Head.

The terrain is fairly rugged, open, pine forest. There are good access roads from a number of directions. The granite in which pockets are found is coarse-grained and pink-colored. Heavy hematite discoloration is common in the pockets from this area.

Specimens from Devils Head may also on occasion be labeled the

"Virgins Bath," or "Long Hollow." These are the names of two specific collecting sites within the Devils Head district from which good pockets have come in the past.

Glen Cove

Glen Cove is a locality noted for outstanding-quality gem topaz. It is situated high on the side of Pikes Peak. The cliffs near where the topaz occurs are nearly vertical, with steep talus slopes running for hundreds of meters. This is not a place for amateurs. There is little to stop a long fall for any unlucky individual who stumbles. Access to the locale is by the toll road which goes to the top of the mountain; the site lies about half-way up the road and is a moderate, but somewhat tricky, walk from the roadway.

In the period around World War II and after, many very fine specimens of sky-blue gem topaz were recovered from a number of pockets at Glen Cove; some of these have since found their way into museum collections around the world.

Spruce Grove

Spruce Grove Campground, which lies just above the town of Tarryall northwest of Lake George, is also noted for fine topaz crystals. In this area the older Pikes Peak granite has been intruded by the much younger Redskin stock. The topaz is generally found in pegmatites along the contact between these two granites, in and near the cliffs at the southern end of the Tarryall Mountains.

Many of the best crystals found here by collectors such as Edwin Over and Bob Beale have come from "the Spires," a group of rugged, highly eroded cliffs which require ropes and climbing gear in order to collect with some measure of safety. Less daring individuals have also found crystals in the gravels at the base of the Spires which have presumably weathered out from pockets in the cliffs above.

Specimens from the area of the Spruce Grove Campground may also be labeled "Tarryalls," "Tarryall Mountains," or "Spruce Campground." The Spruce Grove Campground is maintained by the Forest Service and is used as a convenient parking place by people going to the collecting site. The topaz is found about 1.6 km (1 mile) southeast from the parking area, by following a well-defined trail across Tarryall Creek and beyond.

Specimen Rock and Sentinel Rock

Specimen Rock and Sentinel Rock are two prominent granite monoliths which stand side by side in the park system at the west edge of Colorado Springs. In the older literature, these landmarks were sometimes referred to as the "Tenney Crags," or "Tenney Peaks." At the base of these cliffs and on a ridge to the north lies another well-known locale within the Pikes Peak batholith. Amazonite is known from this area, but it occurs mainly in frozen pockets and rarely as perfect crystals. The predominant good specimen material from here includes large smoky quartz crystals, excellent mica books of large size, common microcline and very fine pseudomorphs of hematite after siderite, which form sharp rhombohedrons often associated with smoky quartz. Access to this locale is from the High Drive in Cheyenne Mountain Park. It is a long, steep climb uphill from there to the collecting sites.

Other Localities

There are other localities which should be mentioned and which have produced noteworthy examples of various species, although perhaps not in such quantity as the aforementioned localities. **Wigwam** or **Wigwam Creek** (also referred to as the **Oliver claims**) is one such place, situated toward the northern end of the Pikes Peak batholith near Deckers in Jefferson County. Good amazonite, smoky quartz, goethite, and fine mica books of large size have all been found in this region. There is a claim of the Denver Gem and Mineral Guild here. Other nearby locales include the **Cheeseman Reservoir,** which has produced similar material.

In the region south and east of Pikes Peak lie several important locales, including Stove (or Cookstove) Mountain, Saint Peter's Dome, the Eureka tunnel and North Cheyenne Canyon. **Stove Mountain** lies along the Gold Camp Road between Colorado Springs and Cripple Creek. This area is heavily enriched with rare-earth elements and fluorine; it contains some uncommon minerals, including bastnaesite and thorite. Collecting is along a high ridge at treeline. **Saint Peter's Dome** is another mountain located a little further along the Gold Camp Road from Stove Mountain; it also contains some unusual minerals in its vicinity, including cryolite (the world's second largest deposit, according to Pearl, 1972), riebeckite, astrophyllite, zircon, and genthevelite, among others. The **Eureka tunnel** is close by and is a locale for gem zircon crystals which fluoresce strongly. **North Cheyenne Canyon,** also referred to as the **Helen Hunt Falls** area, is north and east of these other locales and is a site for large zircons to 5 cm of an opaque, mottled, cinnamon-brown color. The site is a few hundred meters from the scenic falls which bears the same name. There are several other nearby sites for large zircon crystals as well.

Still other places have special names known only to a small circle of local collectors who frequent the area; these names do not necessarily appear on topographic maps. Occasionally, however, such names do show up on a specimen label. Made-up names such as "Yucca Hill," "Aspen Hill," "Goethite Hill," and "Quartz Hill," all refer to specific collecting sites of important pockets within the Crystal Peak region. The "Virgins Bath" and "Long Hollow" are near Devils Head. "Hunters Run" and "Bear Creek" are near Specimen and Sentinel Rocks.

Another locale within the Pikes Peak batholith deserves special mention but will not be dealt with in detail in this article. This is the area northwest of Devils Head known as the **South Platte district.** It includes pegmatites which contain many rare minerals but relatively few attractive collector specimens. Minerals found here include some containing cerium-lanthanum series elements. The locale is described in detail in a study by Simmons and Heinrich (1980), *Rare earth pegmatites of the South Platte District*. Specific locales such as the "Little Patsy," the "Seerie pegmatite," the "White Cloud," the "Oregon group" and others may be found on specimen labels from time to time.

GENERAL CHARACTERISTICS OF POCKETS

The general characteristics of the pockets of the Pikes Peak granite are similar to other pegmatitic occurrences. Dikes run in all directions and are generally more resistant to weathering than the surrounding rock, thus showing a tendency to form ridges along hillsides. The miarolitic cavities which may contain crystal specimens occur at random intervals. Often these cavities are clustered together, with long sections of dike completely barren. Sometimes, a main pocket may have one or more "stringer" pockets extending from it along the dike.

The majority of pockets in the Pikes Peak granite are quite small, perhaps 13 cm (5 inches) in size. A few pockets approach 60 cm (2 feet), and a very few have been reported as large as 3 meters (10 feet) long. Crystals occurring in these pockets are commonly found up to 2.5 cm (1 inch) in size, although larger examples to 10–13 cm (4–5 inches) and even larger are recovered on occasion. The overall size of the pocket does not seem to control the size of individual crystals. Large pockets can contain hundreds of single 2–3 cm (1 inch) crystals and none any larger.

Most pockets, including even the largest pockets in the Pikes Peak granite, tend to be collapsed and mud-filled. It is relatively rare to find an intact pocket with the cap rock still in place and an unfilled "hole" in the middle. Because of the tendency to be breached, a majority of pockets contain crystals which have been damaged or at least separated from matrix: It is not unusual to

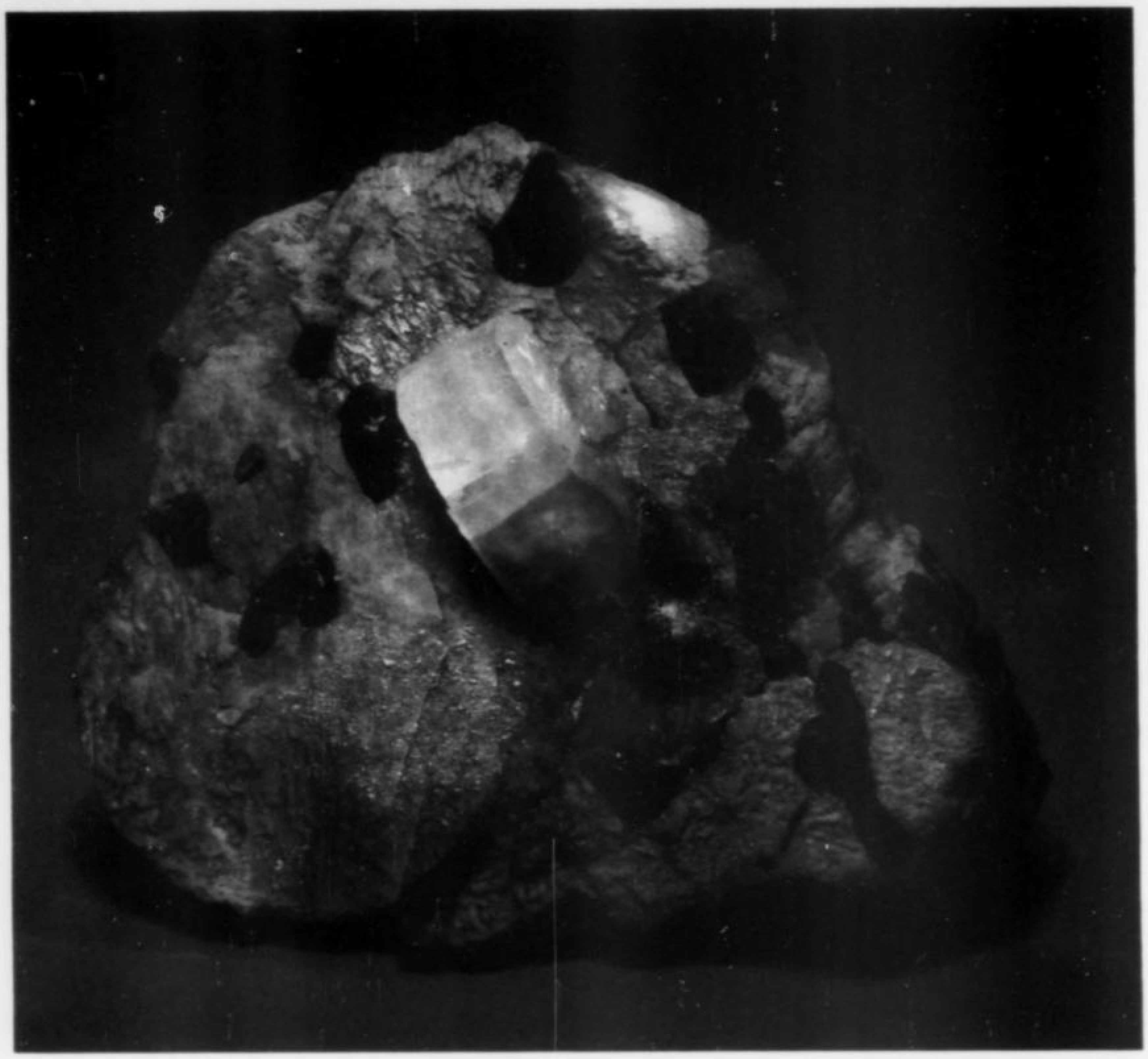


Figure 8. **Double-terminated clear crystals of bertrandite on graphic granite matrix, dug in 1979 in the Crystal Peak area by the authors. Crystal measures 2.5 cm long.**

Figure 9. **Large crystal of mottled, cinnamon-brown zircon on granite matrix, from Helen Hunt Falls in North Cheyenne Canyon. Dug by the authors.**

recover dozens of single crystals from a pocket and not find one complete group.

Occasionally, additional mineralization occurs on surfaces of damaged crystal sections in a pocket. Thus, although two parts to a naturally broken crystal may be found, the sections will not fit together exactly because of the subsequent deposition. This phenomenon suggests that some pockets were breached long ago and that growth continued within the pocket after that event.

The collapse of pockets has other effects as well. Many pockets found near to the surface have been exposed to weathering as a result of the breaching. This weathering is typically in the form of frost-fracturing, which causes internal cracking of the crystals or spalling-off of crystal edges. Moreover, when such a pocket is opened by a field collector, removal of the crystal contents is largely a blind process of feeling around in hard-packed mud and sharp slivers of broken crystal shards. Between damage by nature and damage from careless removal of specimens, very few groups of fine crystals survive intact and unblemished. Perhaps this is why such specimens are sought after and are correspondingly expensive.

The crystal pockets of the Pikes Peak batholith do not lend themselves to commercial recovery methods for at least two reasons. First, the random nature of miarolitic cavities makes cost-effective use of heavy equipment for removal impossible. Second, most pockets are small and very tight. Thus use of any heavy equipment will almost certainly damage small or delicate specimens. In collapsed pockets, crystal members are interlocked in jumbled fashion and cemented together with a mixture of crystal fragments, mud, and various iron oxides. The crystals in such pockets simply cannot be removed *en masse* without chipping or breaking individual crystals.

From time to time, someone tries to mine commercially for crystal specimens within the Pikes Peak granite. At best, these efforts are a break-even proposition. Between the restrictions imposed by the Forest Service, which controls much of the area, and the impracticality of commercial mining methods in this application, it seems safe to say that there is no likelihood of underground operations. Pockets will continue to be dug via shallow open pits on or near the surface. Hence, there will be no flooding of the market with fine mineral specimens from any of the areas described in this article.

POCKET MINERALS

The great majority of pockets in the Pikes Peak granite contain primarily quartz or primarily microcline. No one seems to have performed a systematic quantification of pocket contents found over the last century. An informed estimate, however, based upon more than a dozen years of field collecting in this region, as well as numerous discussions with other field collectors, leads the authors to believe that the ratios listed in Table 1 might be representative.

When one keeps in mind that many of these pockets may be quite small, and that many more will have poorly developed crystals, one begins to understand the relative scarcity of really good collector specimens from anywhere in the Pikes Peak granite.

One seasoned field collector has said that there are ten holes dug for every pocket found, and ten pockets for every one good one, or a 1% success rate on finding good pockets. The minerals of the Pikes Peak granite have been known and sought after since the 1870s. There have undoubtedly been many thousands of pockets excavated during that time. However, it may be a fair estimate to say that in that entire period, there have scarcely been two dozen pockets which contained really outstanding specimens in quantity.

Minerals which have been identified as occurring in the Pikes Peak granite include both common species as well as some very rare ones. Some species occur only in microcrystals; other species are known to have produced individual crystals up to many centimeters in length, and even larger. A list of crystallized species which have been reported with reasonable certainty is given in Table 2.

In addition to these minerals, there is a long list of mostly rare minerals found concentrated in the region around Saint Peter's Dome and Stove Mountain. Minerals reported from there include apatite, astrophyllite, bastnaesite, chalcopyrite, cryolite, elpasoite, fayalite, fergusonite, fluocerite, galena, gearksutite, genthelvite, hornblende, kasolite, lanthanite, microlite, molybdenite, pachnolite, prosopite, pyrochlore, ralstonite, riebeckite, sphalerite, thomsenolite and titanite (Pearl, 1974).

A total of nearly 60 species have been reported from the Pikes Peak batholith (with several more reported but not identified with certainty). A significant number of these, including some of the rare ones, form excellent large crystals and deserve additional discussion.

Main Pocket Minerals

Albite $NaAlSi_3O_8$

Albite, especially the coarse variety known as *cleavelandite,* occurs in association with quartz, common microcline, amazonite and other minerals in the Pikes Peak granite. It is most often pure white or light pink in color, forming bladed mounds. Mounds of pure white cleavelandite, with amazonite and smoky quartz crystals "nesting" within, form some of the showiest collector specimens from this region.

With lesser frequency, albite forms individual, blocky, semi-transparent crystals up to about 1 cm. The slopes of Sheepshead in the Crystal Park region have produced some very good, unusually large crystals to 5 cm (2 inches) in association with tan to pink microcline. Smaller individuals are sometimes found growing epitaxially along the axis from the bottoms of amazonite crystals in the same area.

Fluorite CaF_2

Fluorite is a rather common mineral in the Pikes Peak granite, but it frequently occurs as only a small percentage of the total pocket, in poorly formed crystals, or as massive material. Pockets consisting primarily of fluorite are rare.

Fluorite comes in a wide variety of colors including lilac, pale green, pale blue and dark purple. Less often, it can be found in colorless crystals and in a medium green; zoned crystals with dark purple cores and lavender outer shells are also known. Rarely, lavender crystals form with dark purple edges when the cube form is modified by the octahedron. Dark green, pink or yellow colors of fluorite are not found in the Pikes Peak granite.

The most common crystal habit is the cube, with the octahedron second in frequency. Another habit is the cuboctahedron, with all faces developed almost equally. Other, more complex, crystal forms of fluorite are almost non-existent.

Goethite $Fe^{+3}O(OH)$

Goethite is well represented in the Pikes Peak granite, occurring at many localities. Outstanding specimens with sprays of radiating blades up to 10 cm (4 inches) were dug in the Crystal Peak region by Clarence Coil and others in the mid 1960s. Other locations producing good crystals include Wigwam Creek, Stove Mountain (associated with hematite), Harris Park, and Mt. Rosa, a mountain southeast of Pikes Peak. Frequently, goethite occurs as only a minor overlay to other crystals. Pockets of really good specimens with long, brilliant, bladed crystals, are rare. The finest examples are highly prized by knowledgeable mineral collectors.

Hematite Fe_2O_3

Hematite occurs much less commonly than does goethite, but can be found in combination or separately from the latter mineral in a number of locales. Very fine, flattened little rhombohedrons of discoidal habit have been found in several areas, most notably at Stove Mountain, in association with hematite-included beta quartz crystals and goethite.

Hematite also forms very sharp pseudomorphs after siderite, with especially good ones occurring at Specimen Rock and Sentinel Rock. Similar crystals are also found near Crystal Peak and at Harris Park, although these are generally not as sharp as the pseudomorphs from Specimen Rock. The best specimens of hematite have a high silvery metallic luster, and the best pseudomorphs are a

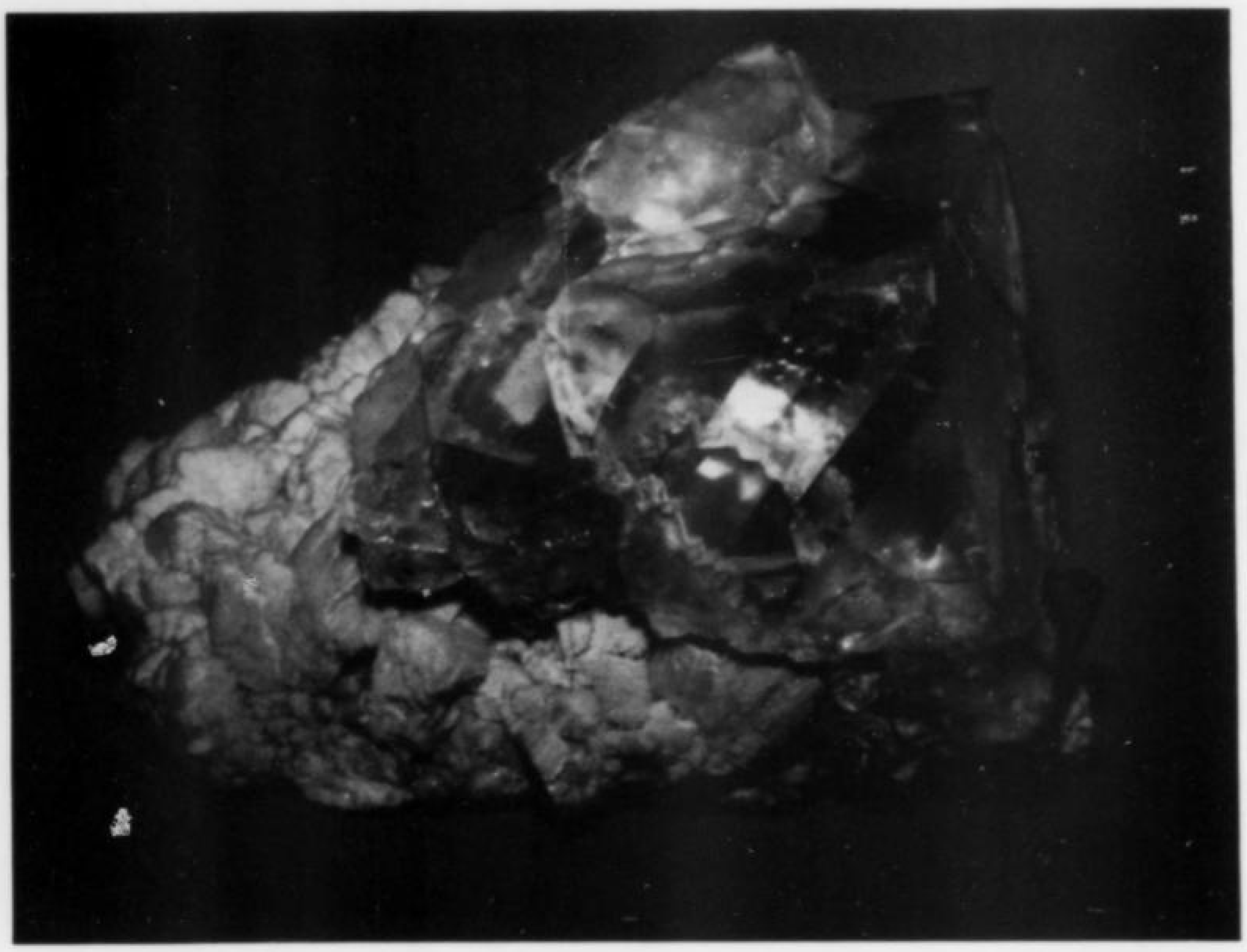
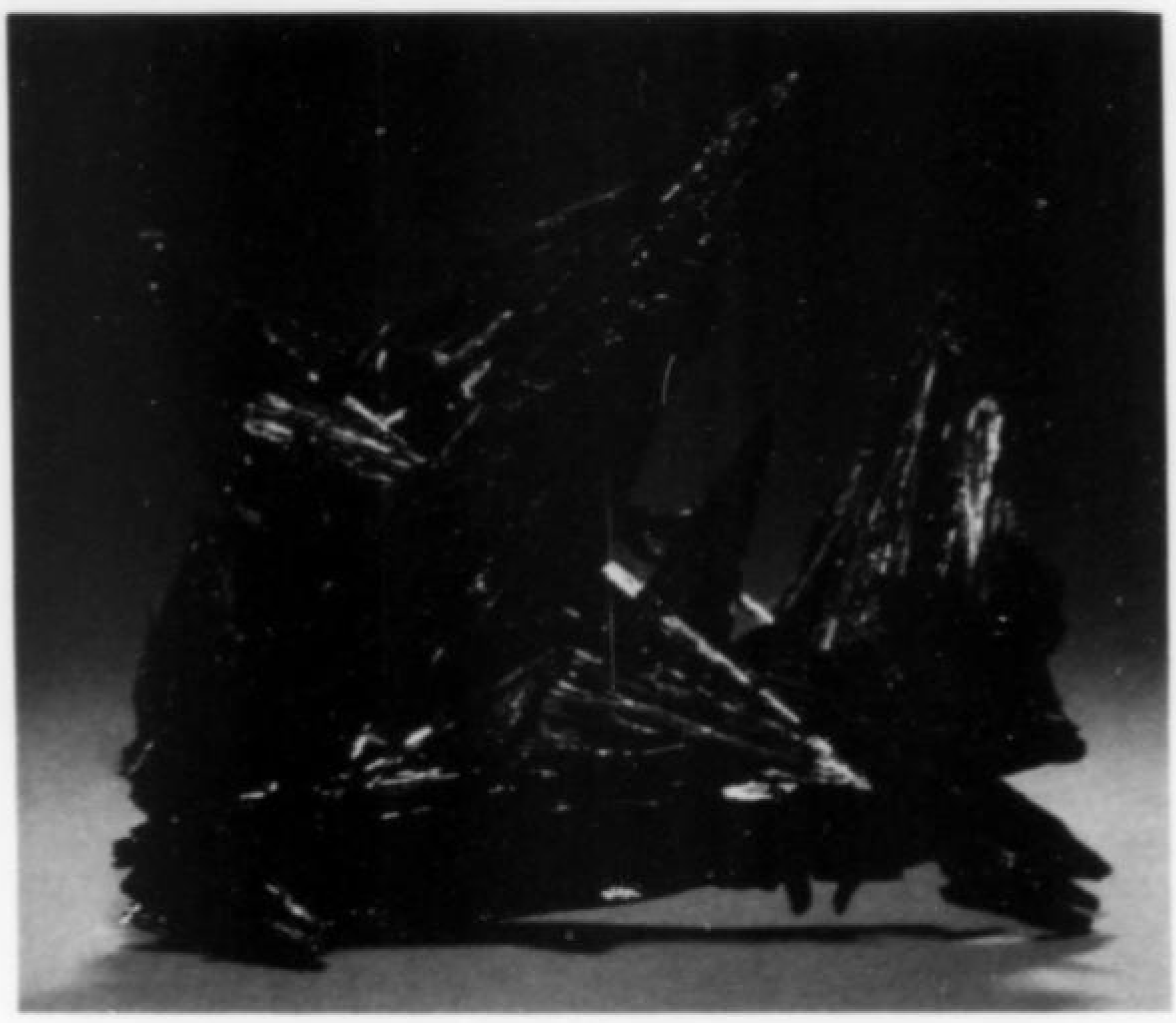


Figure 10. **Large, complex cube of fluorite on granite matrix, light blue-green color and gemmy in sections. Fluorite measures about 10 cm on edge. Overall size of the specimen is about 15 x 20 cm. Dug by Jerry and Thelma Hurianek and in their collection.**

Figure 11. **Sprays of slender goethite needles, no matrix. Specimen measures 8 cm across. Found on Mt. Rosa by Ray Berry and presently in the authors' collection.**



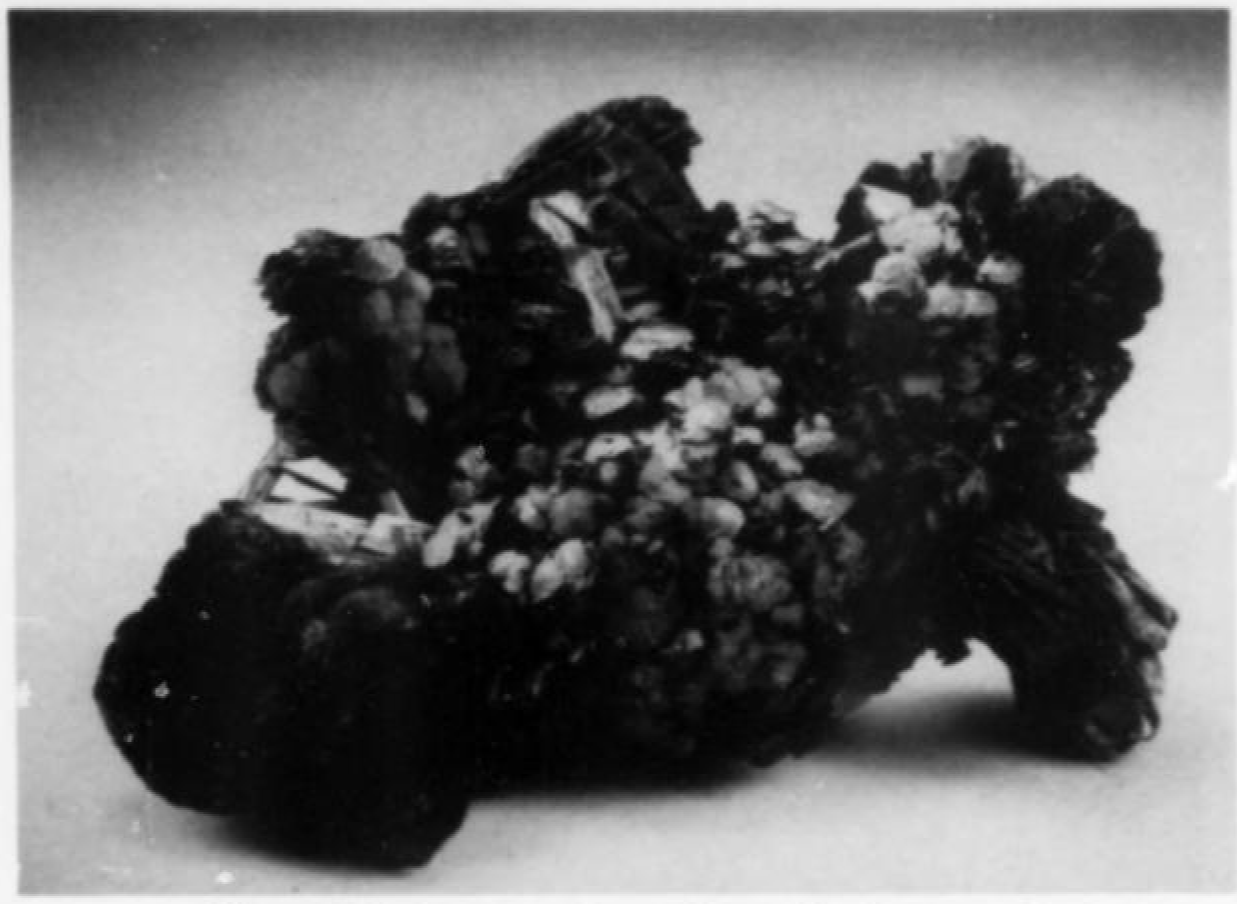


Figure 12. **Sprays of goethite with hexagonal hematite plates at center, from the Crystal Peak region. Specimen measures 5 cm across. Dug by Clarence Coil. Authors' collection.**

splendent silver-gray, often associated with dark smoky quartz crystals and with tan microcline.

Mica Group

Biotite $K(Mg,Fe)_3^{+2}(Al,Fe)^{+3}Si_3O_{10}(OH,F)_2$

Muscovite $KAl(AlSi_3)O_{10}(OH)_2$

Zinnwaldite $KLiFe^{+2}Al(AlSi_3)O_{10}(F,OH)_2$

At least three members of the mica group are found in the Pikes Peak granite. By far the most common are biotite and muscovite, which occur almost universally as small flakes within the granite. Less frequently, biotite forms large, pseudo-hexagonal books, often associated with common microcline or amazonite. Books up to 8 cm (3 inches) and larger have been found at Cameron Cone, Specimen Rock and Wigwam Creek.

Zinnwaldite forms large crystals, often in blackish, lozenge-shaped or pseudo-hexagonal books as much as 10 cm (4 inches) across. It has been reported from the Specimen Rock area, Crystal Peak and Wigwam Creek.

Microcline $KAlSi_3O_8$

Amazonite, while only a variety of microcline, is certainly the best-known mineral from the Pikes Peak granite. This region is one of only a half-dozen locales in the world for good amazonite, the other major ones being in the Ural Mountains of Russia, in Brazil, Nevada and Virginia.

Amazonite from the Pikes Peak batholith is found in many colors, ranging from the faintest blue-tinged cream color, to light turquoise, robin's egg-blue, gray-blue, dark greenish blue and intense blue-green. It is generally believed that the darker shades of amazonite are the more desirable from a collector's standpoint.

The darker shades of amazonite occur randomly. Pockets of fine color material are found immediately adjacent to other vugs of poor color, or ones containing only common pink or tan microcline. In fact, it is not unusual to have color grading occur within a single pocket.

The occurrence of the darker shades of amazonite seem greatest in four general areas of the Pikes Peak batholith, including Crystal Peak (which has probably produced the greatest quantity of fine color), Harris Park, Cameron Cone and Wigwam Creek.

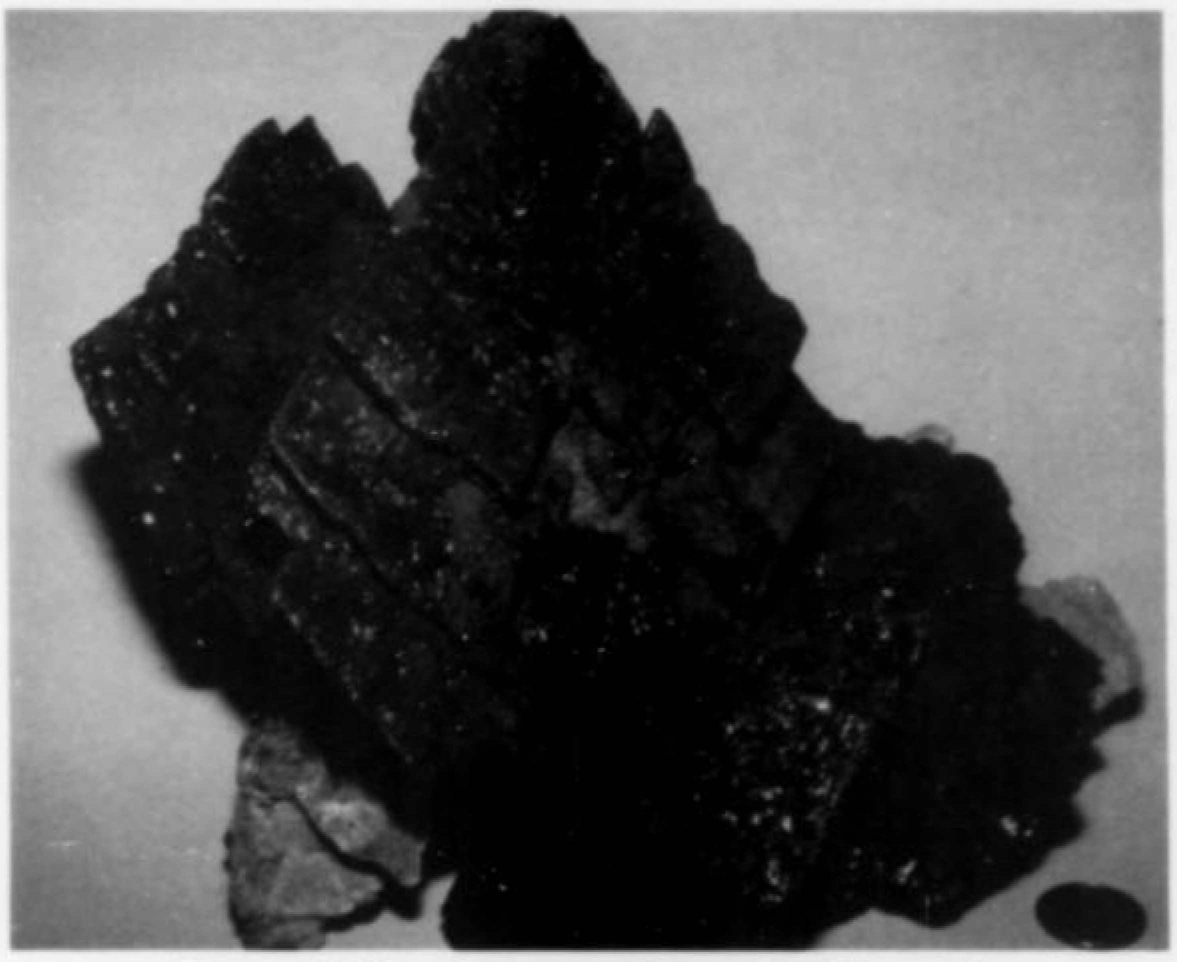


Figure 13. **Very large pseudomorph of hematite after siderite, with minor smoky quartz and microcline association, from Crystal Peak area. Specimen measures about 15 cm across. Anonymous collection.**

Figure 14. **Amazonite, large Baveno twin from Harris Park, measuring approximately 20 cm high. Dug by Lee and Tag McKinney in 1977, and in their collection.**

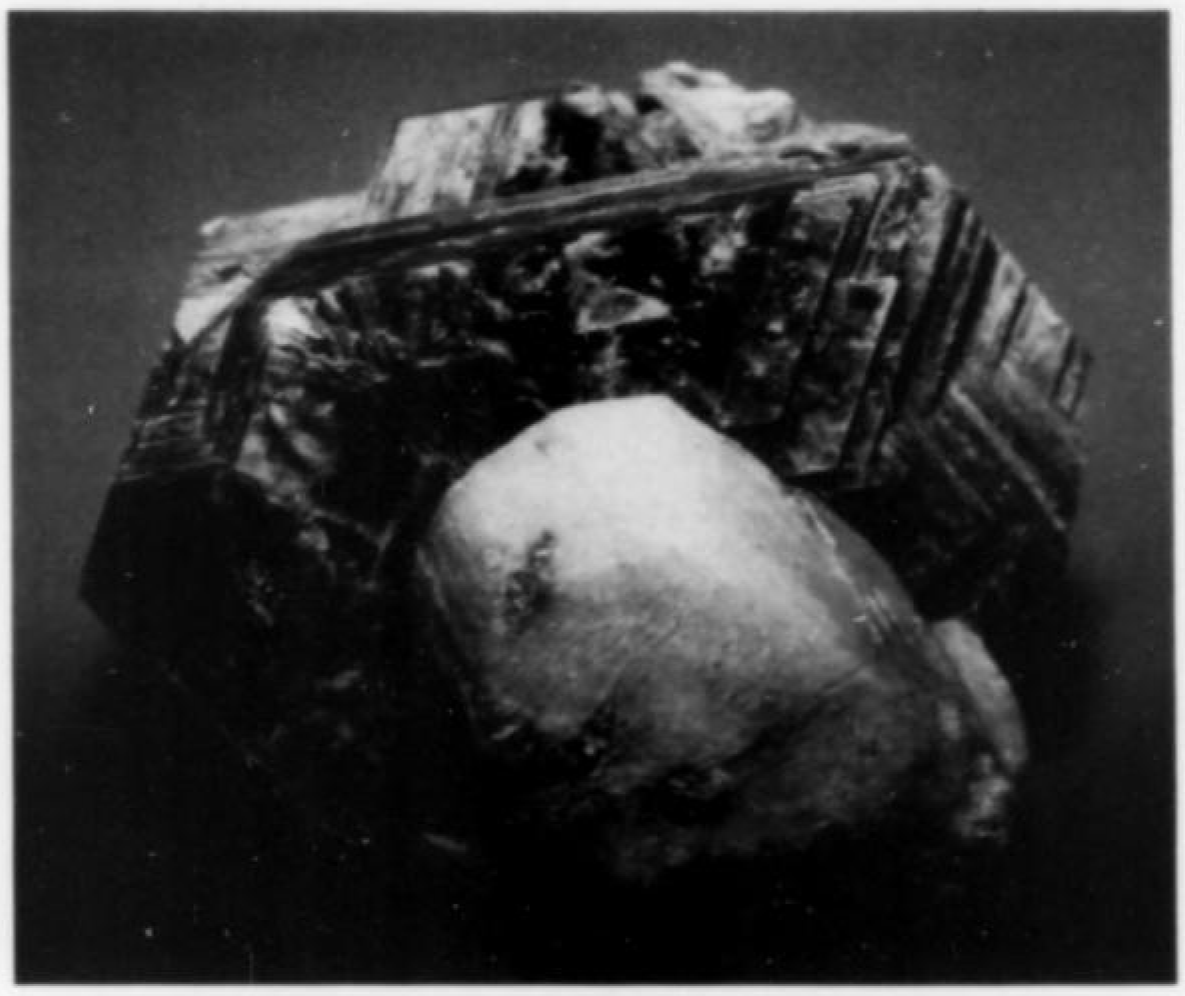


Figure 15. **Fine pseudohexagonal book of zinnwaldite with amazonite, from Wigwam Creek. Dug by Roger Bennett and in his collection.**

Figure 16. **Large group of amazonites, with minor smoky quartz and albite, from the Devil's Head area. Specimen measures approximately 25 cm high. Dug by Larry and Carmen Pieckenbrock and in their collection.**

Twinning in amazonite seems to be less frequent than in the pink or tan varieties of the mineral. Occasionally, really fine Manebach or Baveno twins are found, especially in the Harris Park area. Twinned crystals as large as 25 cm (10 inches) have been found there by such collectors as Lee and Tag McKinney and H. H. "Tom" and Ann Ordiorne. Carlsbad twins of amazonite are much less common than other forms of twinning.

Another noteworthy habit of amazonite is the formation of "white cap" crystals. These specimens have an overgrowth of albite on one of the dome faces. Very good examples are known from a number of locations, including some old-timers of dark blue-green color and thick creamy-white capping which came from the Crystal Peak area.

Perhaps the most unusual amazonite habit it the oriented overgrowth of albite on alternating prism faces, giving a "striped" appearance to the crystals. Very faint overgrowths of this type are fairly common; a really thick, well-defined overgrowth is rare. Only two such pockets of high quality have been found, the first dug by the late Clarence Coil and his associates in the early 1970s and the second, lesser, pocket dug by the authors and Charles Baldwin in 1979. Both pockets were located toward the western end of the Crystal Peak region. Two fine examples from Coil's pocket are shown in color in Foord and Martin (1979), and a detailed technical discussion is provided.

Common or non-amazonitic microcline is far more abundant in the Pikes Peak granite than is amazonite, but it is also less desirable from a collector's point of view. The most frequently seen colors are tan, pink and gray; cream and pure white are also found occasionally, as is a mottled gray-brown tone. Very large crystals have been found in all areas, notably at Devils Head, Cameron Cone and Harris Park. Associations include smoky quartz, albite and small crystals of rare minerals like columbite, zircon, cassiterite, hematite, or pseudomorphs of goethite, hematite or limonite after siderite. Crystals more than 10 cm (4 inches) long are reported with some frequency.

Figure 17. **Scepter of white quartz topping a smoky quartz crystal. Specimen measures 7 cm high. Dug in the Crystal Peak area by Bob King and presently in the authors' collection.**

Quartz SiO_2

Quartz, in particular the smoky quartz variety, is also well represented in the Pikes Peak granite. Quartz crystals can grow very large – individual crystals up to 30 cm (12 inches) and larger are found. There are several reports of crystals weighing more than 45 kg (100 lbs.), each of which must have been a lot longer than 30 cm. The largest crystals, however, are often not the best formed and are frequently opaque. The finest material can be absolutely transparent and lustrous. These smoky quartz crystals rival the best material from the Swiss Alps. When high quality smoky quartz is found in association with high quality amazonite, it produces the most sought-after specimens for display. Fine examples are in major collections throughout the world.

Quartz most commonly forms milky crystals or milky massive material. Less often, it forms zoned crystals with milky bases and darker (smoky) tips. Less frequently still, it forms water-clear crystals. If fluorite is also present in the pocket, the quartz will probably show the effects of etching by the fluorine-rich solutions.

In many places, dark smoky quartz crystals have been overgrown by a milky secondary growth, thus indicating at least two periods of mineralization. Sometimes, the later stage of deposition causes sceptered crystals to form. Good examples have been found in the Crystal Peak region. More often, unfortunately, the milky secondary growth envelops the entire original darker crystal, producing a generally unattractive result.

On occasion, one may find a quartz specimen labeled "onegite." This is nothing more than amethystine quartz crystals with included goethite needles. Sometimes the quartz is so heavily filled by the goethite that it acquires a tannish brown coloration. These crystals are highly prized by local collectors and have been found primarily in the Crystal Peak vicinity. The best examples are lustrous, blackish purple quartz crystals associated with tufts of goethite.

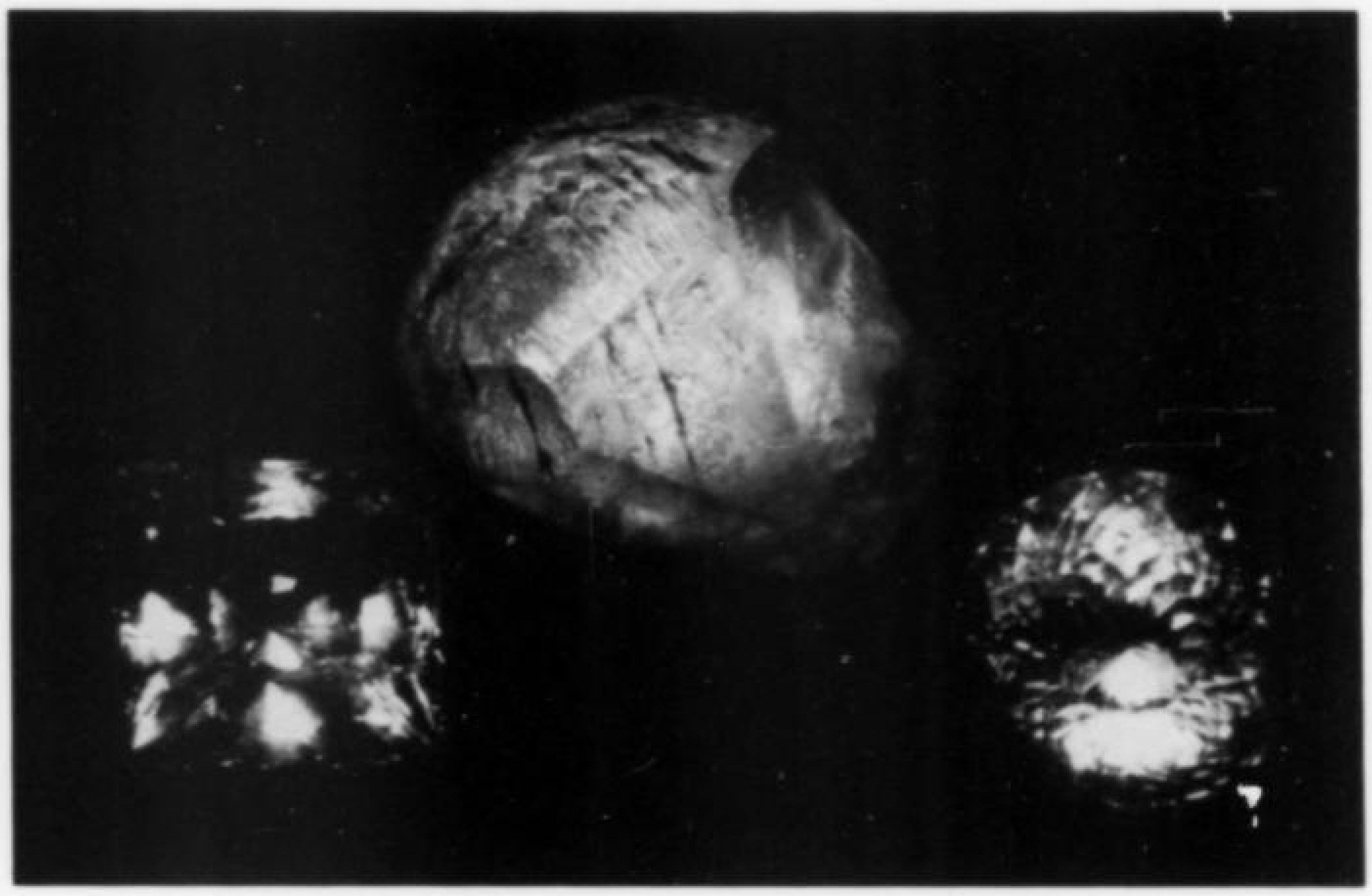


Figure 18. **Sherry-color topaz crystal showing typical etching, and two cut stones, all from a pocket at Devil's Head. Dug by Steve Brighton and in his collection.**

Topaz $Al_2SiO_4(F,OH)_2$

Topaz is a rare mineral in the Pikes Peak batholith, but one of the most famous and desirable. It has been found in several localities; the best known are Devils Head, Glen Cove, the Tarryall Mountains and Cameron Cone.

Glen Cove topaz is normally sky-blue in color, forming gemmy, large, highly modified crystals to 10 cm (4 inches). Many of the best specimens were found by field collectors such as Edwin Over, John Alexander, William Hayward and Clarence Coil in the late 1930s and 1940s. At least one large pocket of Glen Cove topaz, dug in the 1950s, contained sherry-color crystals, many of which altered to either colorless or sky-blue upon exposure to light. Perhaps all blue topaz crystals from this area started out as sherry color, but this is not known for certain.

The Devils Head locale was also dug extensively in the 1930s, by Ed Over and Arthur Montgomery, among others. Topaz from this locale is frequently sherry color, and is also reported to fade upon extended exposure to light. The terminations of crystals obtained at Devils Head commonly show distinctive etch patterns, which make these crystals quite recognizable as to locality.

Topaz crystals up to 5 cm (2 inches) and perhaps slightly larger have come from the Tarryall Mountains near the Spruce Grove Campground in Park County. Crystals are gemmy, either pale blue or clear, and are generally prismatic in habit with simple terminations. These crystals are not as complex as those found at Glen Cove, and not as etched as those from Devils Head. They almost uniformly bear characteristic light etch patterns on the terminations which distinguish them from similar crystals from Spitzkopje in

Figure 19. **Large gem crystal of topaz, 6 cm tall, no matrix. Pale blue with darker zonation along *b* axis. From area of the Spruce Grove Campground. Authors' collection.**

Africa (which were plentiful on the market several years ago). Also found with the topaz in the Tarryalls are smoky quartz, tan microcline and mica books. Crystals are almost always separated from matrix, but can form excellent specimens when they remain attached.

Many smaller topaz crystals have been found at other localities within the Pikes Peak granite, including Cameron Cone (where it is often mistaken for phenakite), at Crystal Peak, which was called "Topaz Butte" in the older literature, and at Harris Park, where it forms rough, small crystals and non-gemmy larger ones to 5 cm (2 inches). Topaz crystals from all of these locations are often found on matrix in association with amazonite, microcline and albite.

Accessory Minerals

A large number of rare species occur within the Pikes Peak granite and have formed perfect (although often small) crystals. The better represented accessory minerals include the following:

Allanite $(Ce,Ca,Y)_2(Al,Fe^{+3})_3(SiO_4)_3(OH)$

Allanite is found on occasion in good crystals in the Pikes Peak granite. It forms blocky, brownish black crystals somethat similar in appearance to blocky columbites from this region. It has been reported from the Crystal Peak area and from the Stove Mountain-Saint Peters Dome vicinity.

Barite $BaSO_4$

Barite is an uncommon species in the Pikes Peak granite. It has been found in the Crystal Peak district associated with amazonite, smoky quartz and cleavelandite. It forms spear-shaped blades of white to pale gray color.

Calcite $CaCO_3$

Calcite is another mineral species not often found in the Crystal Peak area. It forms rhombohedrons or long, slender scalenohedrons, colored grayish white or stained deep red by the prevalent iron oxides of the pockets.

Barylite $BaBe_2Si_2O_7$

Barylite is one of three very rare beryllium minerals, the other two being bertrandite and phenakite, which has reliably been reported from the Pikes Peak granite. Two crystals were cited as having come from the Crystal Peak vicinity by the late Clarence Coil and his family. The larger crystal was sent to the Smithsonian for identification; it measures more than 2.5 cm long, is blocky in habit and grayish white in color. The occurrence was described by White (1972).

Table 1. **Predominant minerals of pegmatite pockets, Pikes Peak granite.**

Percentage of Pockets	Predominant Mineral	Associated Species	Comments
40%	Quartz	Microcline, mica	Occurs as milky, smoky, clear, and amethyst (rare)
25%	Microcline	Quartz, mica, fluorite	Colors: tan, gray, pink, cream, and (rarely) white
18%	Quartz and microcline	Albite, mica	Two main minerals occur about equally in pocket contents
9%	Amazonite	Albite, quartz	Full range of blue to green hues and intensities from pale to dark
3%	Amazonite and quartz	Albite, fluorite	Two main minerals occur about equally
2%	Goethite	Quartz, microcline, fluorite	Tufts or sprays, on or off matrix
1%	Fluorite	Quartz, microcline	Individual cubes 5 mm to 8 cm; colors: purple, lavendar, pale green, clear, blue
1%	Pseudomorphs	Microcline, quartz	May be hematite, goethite or limonite
1%	Important minor accessory minerals	Microcline, albite, quartz, etc.	Columbite, topaz, cassiterite, zircon, allanite, barylite, bertrandite, etc. in significant minor association
100%			

Bastnaesite $(Ca,La)(CO_3)F$

Bastnaesite has been found in the area of Stove Mountain and Saint Peters Dome in small, straw-yellow to reddish hexagonal crystals in association with zircon and the usual granitic constituents. The largest known crystal from this area measures about 2.5 cm long and is a rich reddish brown color and doubly terminated. It was found within the last two years by Ray and Eliose Berry.

Bertrandite $Be_4Si_2O_7(OH)_2$

Bertrandite, another rare beryllium mineral, has been found in only one documented pocket near Crystal Peak by the authors in 1969. Two bertrandite crystals were found among the contents of an amazonite pocket. The smaller crystal was sent to Eugene Foord of the U.S.G.S. for identification at that time. The second crystal, almost 2.5 cm (1 inch), doubly terminated, is on a matrix of typical graphic granite of the pocket's wallrock, with traces of amazonite. Unlike the bladed habit of bertrandite found at Mt. Antero, Pikes Peak bertrandite is blocky, with complex terminations, and is transparent to translucent.

Cassiterite SnO_2

Cassiterite is another rarely-found mineral which may be associated with cleavelandite, amazonite and zircon. Its crystals are normally very small, well under 5 mm, but rarely a larger crystal is found. A specimen in the authors' collection is a twinned cassiterite crystal about 1.1 cm long, associated with amazonite, cleavelandite and a large limonite pseudomorph.

Ferrocolumbite $FeNb_2O_6$

Ferrocolumbite occurs as small, acicular crystals, often imbedded in cleavelandite in association with amazonite or quartz. Crystals rarely exceed 1 cm in length. A few larger crystals, up to 2.5 cm, have been found in the Crystal Peak region. These crystals tend to be more blocky than their small cousins. All ferrocolumbite crystals are black, with a brilliant to somewhat silky luster.

Phenakite Be_2SiO_4

Phenakite is the third of the rare beryllium species (with barylite and bertrandite) which have been reported with certainty in the Pikes Peak granite. Phenakite occurs both at Cameron Cone and at Hunter's Run (near Specimen Rock), as well as at Harris Park and at Crystal Peak. In all places it has been found on amazonite or microcline, often associated with cleavelandite, and occasionally with topaz, as at Harris Park.

In all probability, phenakite, barylite and bertrandite are more common than is currently believed. Due to their small size and similarity to milky quartz, many crystals may have been tossed aside over the years.

Riebeckite $Na_2Fe_3^{+2}Fe_2^{+3}Si_8O_{22}(OH)_2$

Riebeckite forms black, monoclinic prisms frozen in quartz near

Table 2. **Some minerals reported from the Pikes Peak granite.**

Species	Formula	Comments
Albite	$NaAlSi_3O_8$	White or pink blades; also blocky crystals.
Allanite	$(Ce,Ca,Y)_2(Al,Fe^{+3})_3(SiO_4)_3(OH)$	Blocky, blackish brown crystals to 2 cm.
Aragonite	$CaCO_3$	Bubbly white coatings on some amazonite, quartz.
Barite	$BaSO_4$	White to gray spears. Rare.
Barylite	$BaBe_2Si_2O_7$	Rare. Gray blocky crystals to 2.5 cm. Only two reported.
Bertrandite	$Be_4Si_2O_7(OH)_2$	Rare. Blocky translucent crystals to 2.5 cm with complex terminations. Only two crystals reported.
Beryl	$Be_3Al_2Si_6O_{18}$	Not gemmy. Green, gray.
Biotite	$K(Mg,Fe^{+2})_3(Al,Fe^{+3})Si_3O_{10}(OH,F)_2$	Common.
Calcite	$CaCO_3$	Rhombohedrons or long, thin scalenohedrons. White or iron-stained red.
Cassiterite	SnO_2	Small, brilliant black crystals, often twinned, to 1 cm. With albite, amazonite.
Chlorite group	$A_6(AlSi_3)O_{10}(OH)_8$ $A = Mg,Fe^{+2},Fe^{+3},Mn$	Various (green) mica-like thin coatings.
Ferrocolumbite	$Fe^{+2}Nb_2O_6$	Forms small acicular black crystals. Also, larger blocky crystals to 2 cm (rarely).
Fluorite	CaF_2	Cubic or octahedral crystals in lilac, dark purple, blue, pale green, clear. Typically to 5 cm, rarely much larger.
Goethite	$\alpha\text{-}Fe^{+3}O(OH)$	Black tufts and long, black brilliant sprays to 10 cm with microcline, smoky quartz
Hematite	$\alpha\text{-}Fe_2O_3$	Flattened metallic silver rounded rhombohedrons or sharp pseudomorphs after siderite.
Ilmenite	$Fe^{+2}TiO_3$	Tiny crystals with microcline.
Microcline	$KAlSi_3O_8$	Major constituent. In crystals to 12 cm, in tan, pink, gray, green, blue.
Monazite	$(Ce,La,Nd,Th)PO_4$	Rare-earth mineral. Reddish rough crystals.
Muscovite	$KAl_2(Si_3Al)O_{10}(OH,F)_2$	Pseudohexagonal books to 7.5 cm; with microcline, amazonite, smoky quartz.
Orthoclase	$KAlSi_3O_8$	Dimorphous with microcline.
Quartz	SiO_2	Forms everywhere, in milky, smoky, amethystine and clear crystals. Some very large.
Pyrite	FeS_2	Tiny crystals in granite with zircon from Stove Mountain.
Pyrochlore	$(Na,Ca)_2Nb_2O_6(OH,F)$	Small, rough crystals to 1 cm.
Samarskite	$(Y,Ce,U,Ca,Pb)(Nb,Ta,Ti,Sn)_2O_6$	Metamict, vitreous, black.
Sanidine	$KAlSi_3O_8$	Disordered K-Na feldspar occurring with microcline.
Schorl	$Na(Mg,Fe,Mn,Li,Al)_3Al_6(Si_6O_{18})(BO_3)(OH,F)_4$	Crystals of small size with microcline.
Sericite	– –	Fine-grained mica, an alteration product.
Siderite	$Fe^{+2}CO_3$	Almost all replaced by hematite, goethite.
Thorite	$ThSiO_4$	Brown crystals to several cm.
Topaz	$Al_2SiO_4(F,OH)_2$	Crystals to 6 cm, gemmy blue, colorless. Complex at Glen Cove; simple prismatic crystals at Devils Head, Tarryalls.
Xenotime	YPO_4	Rare; pale yellow to brown.
Zinnwaldite	$KLiFe^{+2}Al(AlSi_3)O_{10}(F,OH)_2$	Forms lozenge-shaped books.
Zircon	$ZrSiO_4$	Forms brown crystals to 5 cm. Also cyrtolite.

Figure 21. **Twinned 15 mm cassiterite crystal (left) on a matrix of amazonite, albite, and a limonite pseudomorph after siderite, from the Crystal Peak area. Dug by Clarence Coil; now in the authors' collection.**

Figure 20. **Scalenohedral calcite crystals stained deep red by iron oxides, on smoky quartz from the Crystal Peak area along Vermillion Creek. Dug by the authors.**

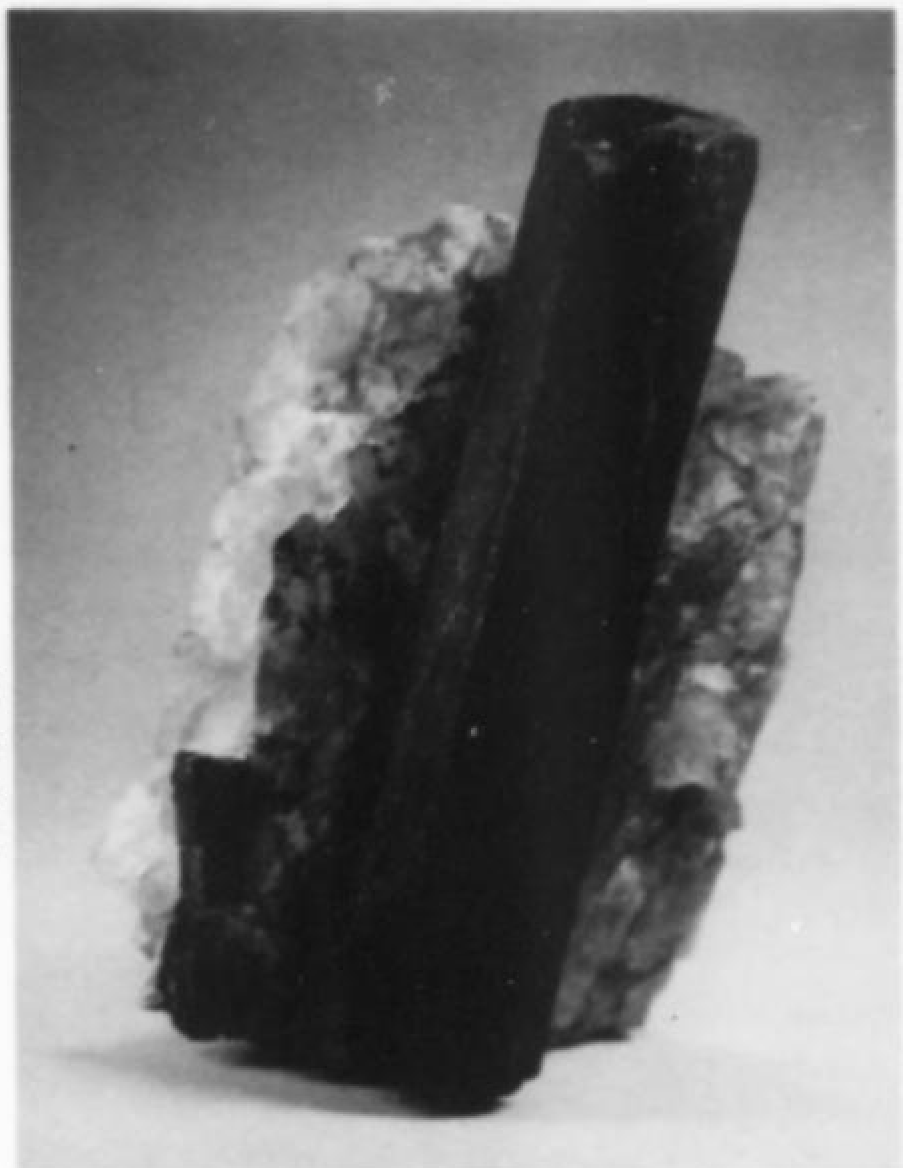


Figure 22. **Long, pseudohexagonal crystal of riebeckite on milky quartz. Crystal measures about 8 cm long. Dug by Clarence Coil in the 1930s at Saint Peter's Dome. Authors' collection.**

Figure 23. **Large elongated crystal of metallic golden brown astrophyllite on quartz matrix. Crystal measures 7 cm long. Dug by Clarence Coil in the 1930s at Saint Peter's Dome. Authors' collection.**

Saint Peters Dome. It is found in a very limited area of the Pikes Peak granite and is thus a highly desirable mineral. Since the mineral is normally frozen in matrix, it rarely has good terminations; when a crystal is found with one, it is much prized by collectors.

Zircon $ZrSiO_4$

Zircon is very heavily concentrated in the area to the southeast of Pikes Peak. It has been found at North Cheyenne Canyon, at Mt. Rosa, at Saint Peters Dome, at the Eureka tunnel and at Stove Mountain. Cinnamon-brown, rough bipyramidal crystals to 5 cm (2 inches) have been found at these localities associated with

Figure 24. **Small allanite crystal 2 cm high with tiny limonite pseudomorphs after siderite, from the Crystal Peak area. Authors' collection.**

massive quartz, columbite, microcline and (rarely) dark purple fluorite crystals. Small but gemmy zircon crystals to 1 cm occur at the Eureka tunnel in this same vicinity.

Cyrtolite is the metamict variety of zircon which occurs widely in the Pikes Peak granite. It forms small, reddish brown, earthy-luster crystals. The vast majority are under 1 cm in size, although some groups of intergrown crystals to 8 cm (3 inches) have been reported, especially in the rare-earth pegmatites of the South Platte district.

CONCLUSIONS

The Pikes Peak batholith is a large and complex region containing many important collecting localities which contain a wide variety of mineral species in well-crystallized examples. Amazonite and smoky quartz are perhaps the two best known species which are found in this region in fine specimens. But other less common species are also found in excellent crystals.

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the Cresson Vug Cripple Creek

Arthur E. Smith, Jr.
9118 Concho Street
Houston, Texas 77036

Ed Raines
11902 Queensbury Avenue
Houston, Texas 77024

Leland Feitz
Cripple Creek District Museum
P.O. Box 475
Cripple Creek, Colorado 80813

Imagine a walk-in vug lined with 20,000 ounces of sparkling crystals of gold and gold tellurides. That's how much was scraped off the walls and sacked in the first few days after the fabulous Cresson Vug was discovered in 1914. And more lay underneath.

INTRODUCTION

The Cripple Creek mining district is located in Teller County, approximately 32 km (20 miles) southwest of Colorado Springs, Colorado. It is Colorado's only major precious metals deposit lying outside of the Colorado Mineral Belt. U.S. Geological Survey topographical map coverage is provided by the Cripple Creek North, Cripple Creek South, and Big Bull Mountain quadrangle sheets. Most visitors to the area travel State Highway 67 from Divide, but those preferring more stimulating mountain scenery and drives can take either the Gold Camp Road from Colorado Springs or the Phantom Canyon Road from U.S. 50 near Florence.

Mention Cripple Creek and there will be much talk of gold and tellurides of gold. In the 70 years spanning 1891 to 1961, the district produced nearly 20 million ounces of gold worth close to $425 million at the then prevailing prices. Today (at $310 per ounce) that same 20 million ounces would be worth close to $6 billion. Now, after 20 years of idleness, the district is once again producing even more gold.

DISTRICT HISTORY

Cripple Creek gold was actually discovered in 1878 by Bob Womack, erstwhile cowboy turned prospector. Many factors delayed the boom, among them several hoaxes, Womack's reputation as a storyteller when in his cups, and, most importantly, the unfamiliar nature of the district's telluride ores. Finally the truth of Womack's tales was recognized, and the late blooming district began to develop rapidly in 1891. Production peaked at about 870,000 ounces in 1900. That same year saw the district's population peak as it topped 50,000. The story that we want to relate quite appropriately concerns a mine that was also a late bloomer.

THE CRESSON MINE

In 1895 Cross and Penrose did not even mention the Cresson mine in their paper on the Cripple Creek district in the 16th Annual Report of the U.S. Geological Survey. In Hill's *Official Manual of the Cripple Creek District,* published in 1900, we learn that the Cresson Consolidated Gold Mining and Milling Company owned

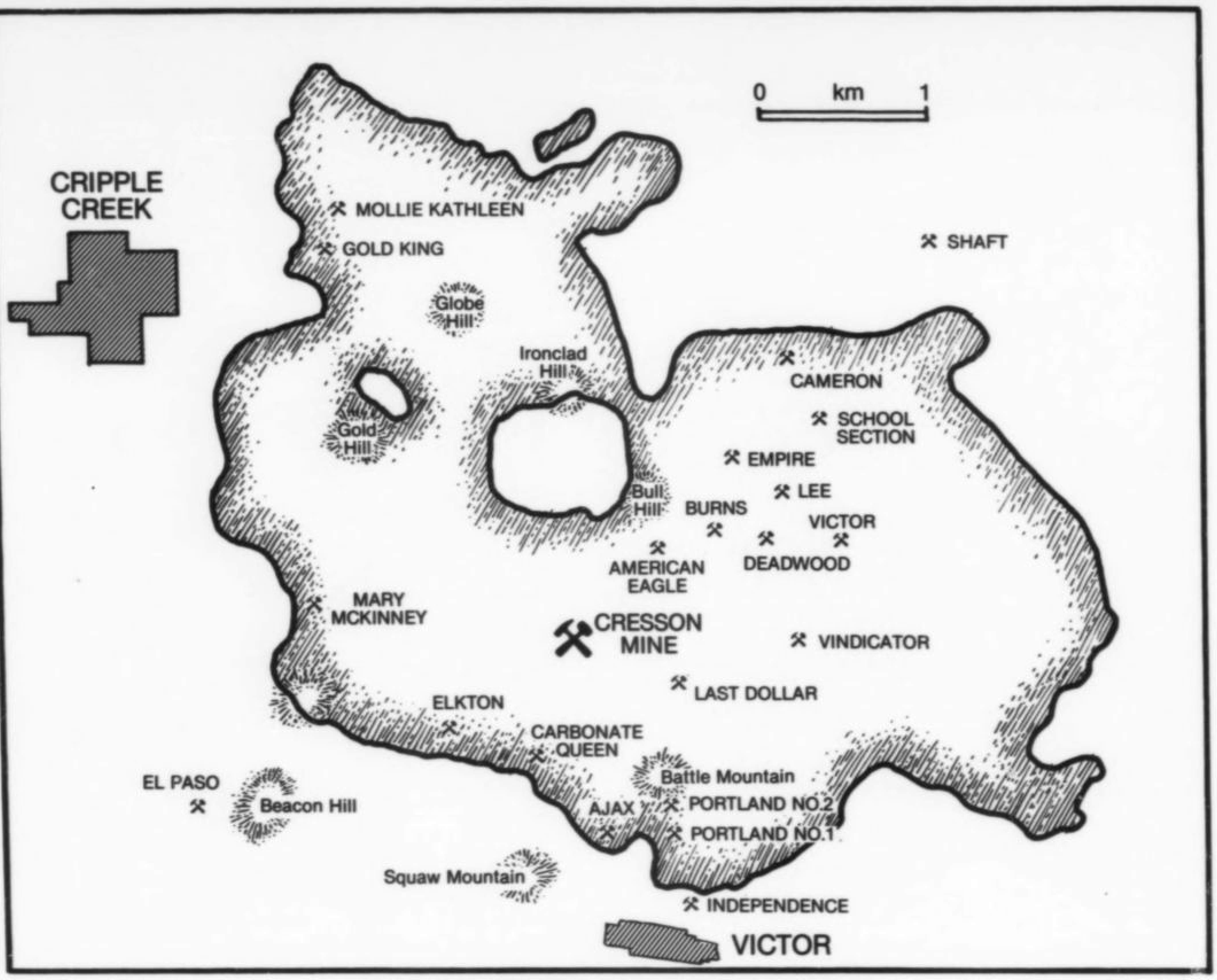

Figure 1. **Outline of the Cripple Creek Crater showing the location of important mines. Modified from Koschmann (1949).**

the Mary L., Sadie Bell, Draper, Robin Hood and Friar Tuck patented claims. These claims lie in the upper, eastern part of Arequa Gulch (sometimes called Eclipse Gulch) between Raven and Bull Hills. The company had operated and leased-out the property on several occasions and it had lain idle at least once. Lindgren and Ransome (1906) did no more than show the property's location on their map of the district. Yet Loughlin and Koschmann (1935) devoted 16 pages and 11 diagrams plus numerous short discussions to this same Cresson mine. The reason is quite simply that from 1903 through 1933 the Cresson produced nearly 1.8 million ounces of gold worth $35 million while paying nearly $12.5 million in dividends to its stockholders. At today's prices the Cresson's production would be valued at $560 million, which is more than enough to make it the second largest producer in the district.

Our story of the fabulous Cresson begins when the Harbeck family of Chicago gained possession of the property in 1894. Stories say that J. R. and Eugene Harbeck "came to" after a night on the town and discovered that they had been "gold-bricked" into buying the Cresson. Periodically the Harbecks sold a few shares of Cresson stock to suckers around Chicago, Illinois, and Battle Creek, Michigan. They used the money (unsuccessfully) to try to develop their "mine." For reasons that no Cripple Creekers understood, the Harbecks continued to try to develop what everyone considered a "lemon." Then, in 1905, on the recommendation of one of the district's leading figures, they hired Dick Roelofs to manage their worthless 200-meter hole. Roelofs, an engineer from Pennsylvania, had worked in the district for several years but had never been part of a big operation up to that time. That was soon to change.

Astute mangement and some innovative mining techniques began to pay off. Roelofs deepened the shaft and found that the ore began to improve in value. He succeeded in paying 45% dividends on low grade ore averaging $15.67 per ton. Soon he was being referred to as the "Miracle Miner." Earnings increased as the mine hit the 300-meter level, then at 370 meters things really began to happen.

THE VUG IS DISCOVERED

Late in the afternoon of November 25, 1914, the Harbecks' tax attorney, Hildreth Frost, who lived in Colorado Springs, received a phone call from Roelofs. What transpired is best told in the words from Marshall Sprague's 1953 book, *Money Mountain*:

> Roelofs was in a terrible state. His voice was hushed and strained. He told Hildreth, for God's sake, to catch the evening train and go to Dick's rooms in Cripple.
>
> Hildreth reached Cripple on the Short Line at 10 p.m. He walked up Second Street to the Palace Block at the corner of Bennett and climbed the stairs to Dick's second-floor rooms. He could hear Dick's typewriter clicking faintly. But when he reached the landing the typing had stopped. Hildreth banged twice on Dick's door. No answer. Then he yelled through the keyhole.
>
> Dick opened the door. He yanked Hildreth in, closed the door and locked it. Dick's round face was pale. He parked Hildreth in a chair, drew another close up and whispered that something unmentionable had happened that afternoon on the twelfth level of the Cresson. It was so big a thing that Dick couldn't take the responsibility alone. Two witnesses

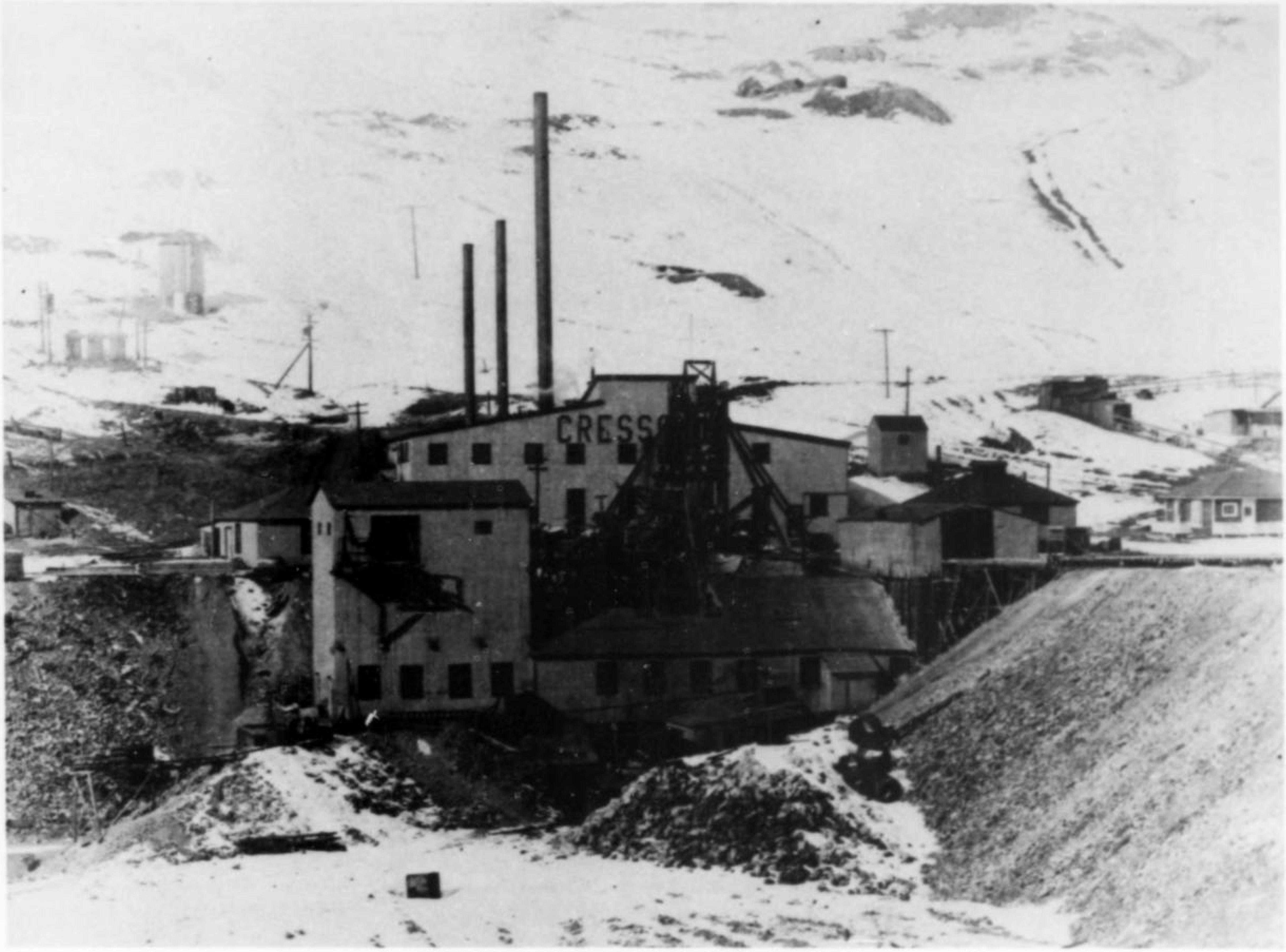

Figure 2. **Cresson mine, Cripple Creek, winter, circa 1915. Courtesy of Cripple Creek District Museum.**

must go down into the Cresson with him in the morning. Dick told Hildreth to be a witness and to ask Ed De LaVergne to be a second witness. Hildreth phoned Ed at the Elkton and made a date.

Dick Roelofs and Frost rode the Low Line to Elkton at seven next morning. Then with De LaVergne, they walked up the gully to the Cresson where Luke Shepherd gave them magnesium flares. They descended the cage to the twelfth level. Dick walked them around a half mile down there, so they wouldn't know exactly where they were. They turned off the drift into a lateral and brought up against a double steel door. Dick banged a signal against the door and it opened. Behind it were three guards with six revolvers. Beyond the guards at one side of the lateral was a sort of ladder-platform beneath a large hole in the wall five feet wide. Dick motioned to Ed and Hildreth to climb on the platform and stand in the hole. When the three men were lined up there Dick struck a kitchen match and lighted the magnesium flares. Ed thrust his flare through the hole into the darkness.

What the three men saw stunned them as a child is stunned by his first Christmas tree. It was a cave of sparkling jewels. The brightness blinded them at first but then they made out that the jewels were millions of gold crystals – sylvanite and calaverite. Spattered everywhere among the crystals were glowing flakes of pure gold as big as thumbnails. The cave was forty feet high, twenty feet long and fifteen feet wide. Small boulders glittered on the rough floor. Piles of white quartz sand glowed like spun glass.

During the next month Dick Roelofs' crew scraped 1400 sacks of crystals and flakes from the walls of the Vug and sold them for $378,000. A thousand more sacks of lower-grade ore brought $90,637. Before Christmas, the crew stoped out the Vug to a depth of several yards. This outer section realized some $700,000. Altogether the Cresson Vug produced $1,200,000 in four weeks.

In November the Harbecks had pleased the Chicago suckers who had bought Cresson stock by declaring a $200,000 dividend. After Christmas the suckers received an extra dividend of $1,000,000. That extra dividend gave most stockholders ten times the amount each had paid originally for his sucker shares.

MINERALOGY OF THE VUG

Initially Dick Roelofs kept the discovery of the Vug a secret, but by the second week in December the word was out. On December 16, 1914, three weeks after the discovery, he gave two professors from the Colorado School of Mines the opportunity to view it. They were H. B. Patton, a geologist, and H. J. Wolf, head of the Department of Mining Engineering. Part of the Vug had already been destroyed and much of its contents already removed. This probably accounts for their lack of awe and resulting matter-of-fact descriptions of the pockets and its minerals. They were, however,

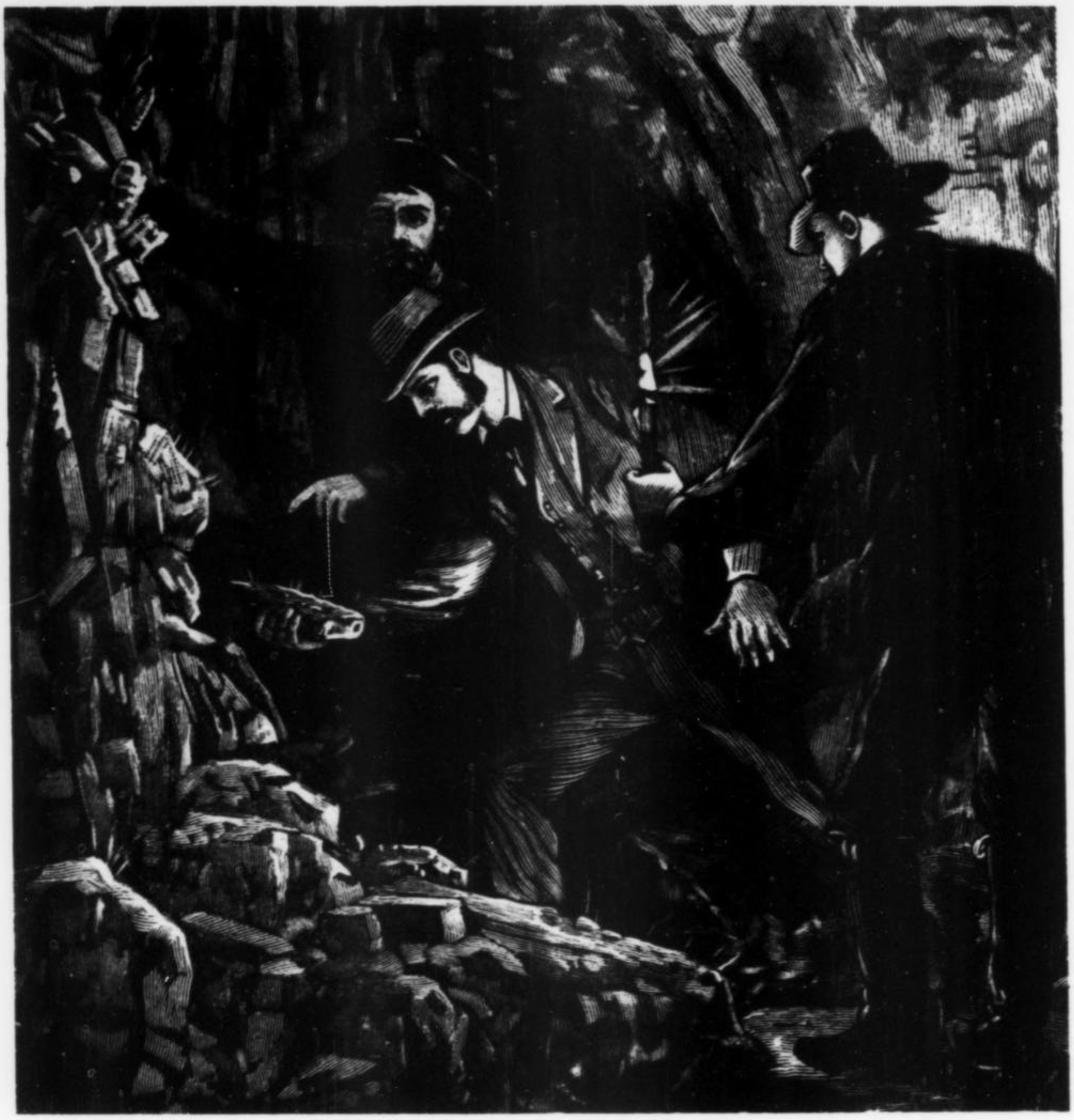

Figure 3. **Contemporary engraving, probably from a local newspaper, depicting Dick Roelofs showing the Vug to Hildreth Frost and Ed De LaVergne (reprinted in Beebe and Clegg, 1955).**

much impressed by its richness: $1.2 million by 1914 prices. To them the significance of the find was the depth of such mineralization, which would stimulate additional exploration and mining in the district. The following, a more scientific description of the Vug, is abstracted from their 1915 report and combined with a 1917 paper by Patton.

> In the latter part of November 1914 a raise from one of the cross-cuts driven in the larger of the two ore-shoots on the 12th level suddenly broke into a large cavity or chamber at a point five or six feet above the floor of the level. Such an event is by no means rare in the Cripple Creek district. But as large chambers have not ordinarily been found to contain ore, no one could have anticipated such a "strike" as this soon proved to be. The chamber was opened near the lowest part. The floor and lower part of the walls consisted of a soft, porous, almost chalk-like, whitish material. Apparently the entire chamber was at one time lined one or two feet thick with this material, which was so soft that it could readily be shoveled. From the upper part of the chamber it had become loosened and had fallen, accumulating to a thickness of several feet on the floor. At the time of examination much of the loose material had been removed. All of this white lining assayed high in gold, and some astonishingly high. As sacked and shipped it yielded from $10,000 to $16,000 per ton.
>
> The soft lining, when closely examined under a magnifying glass, was seen to consist in part of minutely crystalline matter and in part of an earthy substance. The crystalline material was celestite. The earthy portion looked like kaolinite. The gold content of this lining consists of calaverite, which occurs in small crystals thickly scattered throughout the white gangue. The great richness of the material could hardly be surmised from its appearance. The calaverite can readily be seen in irregular crystals and grains, from very small specks up to those measuring a quarter of an inch in length. The crystals occurring in this matrix appear to have undergone some slight alteration. They are dark colored and tarnished, have lost their luster, and are specked with ir-

Figure 4. **Cresson mine shift foremen and Dick Roelofs, fifth from left, no date. Courtesy of Cripple Creek District Museum.**

Figure 5. **Loading sacks of highgrade ore from the Vug at the Cresson mine, 1914–15. Courtesy of Cripple Creek District Museum.**

regular minute patches of gold. They occur in thin deeply striated, rough forms.

The chamber as first opened may be said to have had the shape of a pear, the narrow portion being above. Its dimensions were approximately 23 feet long, 13½ feet wide, and 40 feet high.

Behind the porous lining, the walls of the chamber consisted of ordinary breccia of the large ore-shoot. The fragments composing the breccia had been extensively altered by thermal water, and solution-cavities had been formed between them. Crystals of calaverite thickly studded the surfaces of the solution-cavities and penetrated the substance of the rock-fragments. Close to the wall of the large chamber the impregnated breccia showed varying but extremely high gold contents approaching those of the chamber-lining. On working outward from the chamber it was found that the rock became less impregnated with calaverite until at, say five or six feet, the assay-value was not greatly above the average of the main ore-shoot.

The irregular solution cavities above referred to are thickly studded with brilliant clusters of calaverite crystals. Each crystal usually measures from one to three millimeters in length and about half that in width. The thickness is usually about a quarter that of the width. The crystals are not very deeply striated, although striations are always plainly developed. Numerous small faces may be seen on the two ends of the crystals.* Such crystals of calaverite are to be seen not only on the surfaces of the cavities or lining the faces of fragments, but are often developed throughout the rock material. In this respect the ore of this chamber differs from that in most of the deposits of the camp in which it is expected that the sylvanite or calaverite will be confined to films along very narrow cracks or to crystals on the faces of rock fragments.

A second type of calaverite crystal is to be seen usually developed in the narrow cracks of the more solid and less altered parts of the rock. These crystals occur in very thin, relatively large, and extremely fragile leaves. They have very irregular and even ragged outlines and are very deeply striated or grooved. One large block of rock blasted from the side of the chamber was observed on which was to be seen

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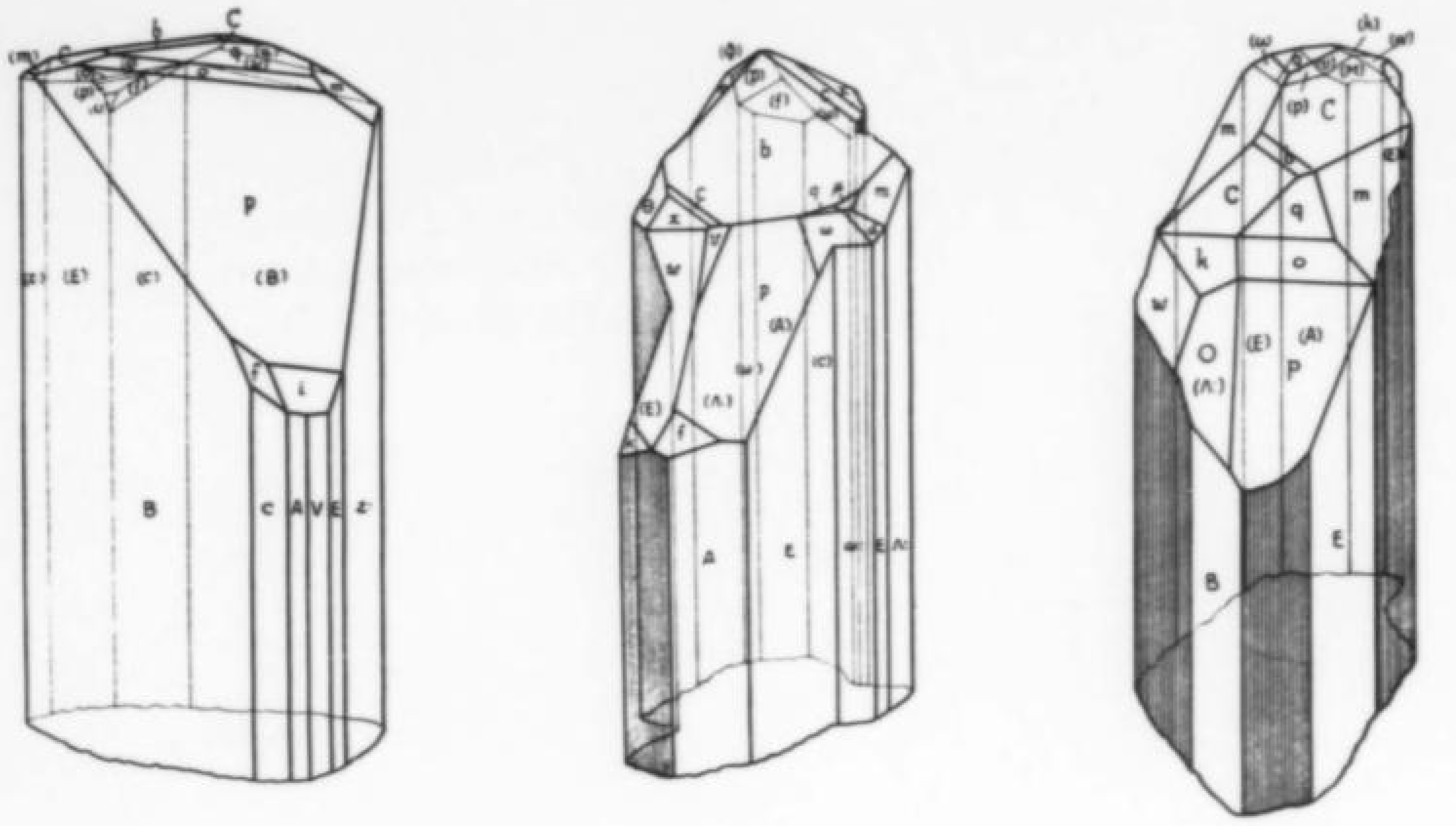
*Author's note: The well-known crystal drawings of Cripple Creek calaverite made prior to the Vug discovery and published in Goldschmidt's *Atlas der Krystallformen* (1913) are all top-view drawings showing only the various terminations seen on calaverite. Hence they can be rather difficult to visually correlate with the actual, elongated, striated crystals.



a. *b.* *c.*

Figure 6. **Cripple Creek calaverite crystals; from Goldschmidt *et al.* (1931).**

> about one square foot of surface thickly covered with brilliant-lustered calaverite leaves that measured from one-half inch to one inch in length. These leaves were so extremely delicate that it was impossible to break one of them off without it falling to pieces.
>
> The calaverite occurring in both above described types is sometimes a little tarnished so as to present a deep yellow or perhaps brownish color. Occasionally also, a little gold in irregular specks may be seen in or upon the sylvanite crystals in such a manner as to suggest partial alteration.
>
> The gangue minerals with the calaverite in the wall-rock were chalcedony, quartz, dolomite and celestite. Recognizable quartz was rather rare, as the silica occurred almost entirely in the form of a spongy chalcedony. Dolomite is to be seen in plainly developed small rhombohedrons that may or may not be warped. Very frequently the dolomite has been partly or entirely altered to porous quartz pseudomorphs. Celestite was observed in well crystallized bluish crystals measuring up to an inch in length. Calaverite occurs grown with the celestite in such a way as to indicate simultaneous deposition. Pyrite, usually so very abundant in Cripple Creek ores, is surprisingly scarce. Extremely minute pyrite crystals in the form of pentagonal dodecahedrons may be recognized with the aid of a magnifying glass. No other sulphides were noticed. Fluorite, so common in association with quartz in the veins of Cripple Creek, was missing.

The noted absence of fluorite in the material associated with the Cresson Vug is significant. It helps eliminate specimens that are incorrectly labeled as being from the Vug. We have noted several of these specimens in recent years. However, there is no assurance that specimens without fluorite did come from the Vug. The writers have seen specimens from the Cresson mined at much later dates than 1914–15 both with and without fluorite, and also containing calaverite and celestite in vugs in a brecciated matrix.

Patton and Wolf (1915) suspect that some of the calaverite that had specks of gold might actually be pseudomorphs. Eckel (1961) reports that A. M. Koschmann found that some of the ores of the Cresson mine contained gold and melonite ($NiTe_2$) pseudomorphs after what was possibly calaverite. This possibility has been confirmed by X-ray diffraction work by one of us (ER) on several specimens not from the Vug, but having similar characteristics to the tarnished, striated crystals of Patton and Wolf from the chamber lining.

There is one other species notably absent in these first-hand accounts of the Vug's mineralogy. Krennerite is not mentioned at all. Yet this omission is not exactly unexpected, as krennerite was not recognized by many early workers. Eckel (1961), quoting Koschmann, states that krennerite is nearly as abundant as calaverite in Cripple Creek ores. The writers know of one specimen of X-ray-confirmed krennerite that carries the label, Cresson Vug; however, the great amount of fluorite present on this specimen discredits the Cresson Vug as the source of the specimen. At this point, we can say that it is not at all clear if krennerite was an important mineral in the Vug. As a matter of fact, it is not certain if sylvanite was present in the Vug. In many cases these three minerals are very difficult to distinguish. X-ray diffraction work (ER) on over 50 Cripple Creek telluride specimens has turned up 20 misidentifications on labels.

GEOLOGY

According to Koschmann (1949) the ore deposits of the Cripple Creek district occur in brecciated volcanic and bedded sedimentary rocks of Tertiary age that occur in an irregular, steep-walled basin or caldera in Precambrian rocks. There were three overlapping stages of recurrent fracturing and vein mineralization. The first stage is characterized by quartz-fluorite veins and coarse pyrite. The minerals of the second stage include the tellurides of gold, pyrite, sphalerite, galena and tetrahedrite (the ore minerals). Quartz, fluorite, dolomite, ankerite, celestite and roscoelite (the gangue minerals) were also deposited during the second stage. The minerals of the third stage, deposited chiefly in openings, are clear and smoky quartz, chalcedony, fine-grained pyrite, calcite and (locally) cinnabar. The Cresson Vug, however, did not exhibit nearly so wide a range of minerals.

The 12th level (1200-foot) of the Cresson mine contains an irregular, elliptical area 150 x 300 meters where the normally tightly cemented breccia of the mine has been reshattered leaving numerous small cracks and cavities. This feature, which extends upward to near the surface, is called the Cresson blowout. On the 12th level there are two ore-shoots which are continuous above the level to about the 3rd level. Their size and richness increases with depth down to the 12th level. The telluride minerals in the ore-shoots are often invisible and not uniformly distributed. The Cresson Vug was associated with the larger ore-shoot on the 12th level.

G. F. Loughlin and A. H. Koschmann studied the area of the

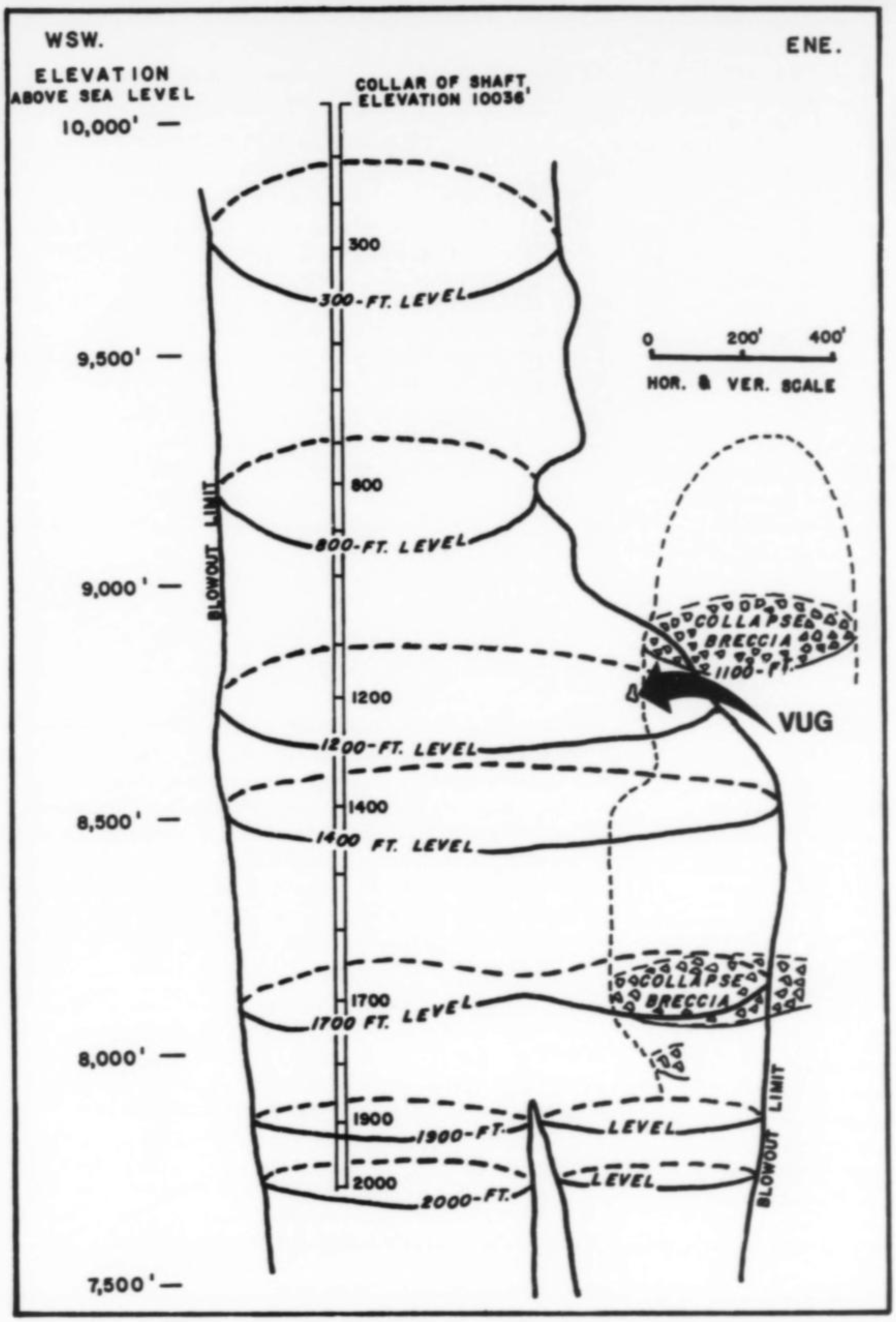


Figure 7. **Generalized outline of the Cresson blowout showing the location of the Vug. Modified from Loughlin and Koschmann (1935).**

Vug several years after it was mined out. In their 1928 report that was published in 1935, they gave further insight as to the Vug's location and possible origin:

> Other factors in the localization of ore shoots were the thinly fluid if not gaseous character of the gold-tellurium solutions and the low pressure under which they were introduced. Not only were they deflected to another course if confronted by a sealed or tight fissure, but they could travel long distances through open ground without depositing any minerals until they were retarded or stagnated by some obstruction and could find no way to escape. The contrast between the Dante [another mine adjoining the Cresson blowout] collapse breccia as a whole and the large Vug that borders it on level 12 of the Cresson mine illustrates this condition. The term "collapse breccia" is here applied to rubble-like masses of pipelike form where shattered ground has been corroded until its originally angular fragments have become rounded. The largest pipe of collapse breccia is well exposed in the Dante mine and overlays the east end of the Cresson blowout. The voids in the collapse breccia were so large and continuous that the solutions could move freely, and, as there were no minerals present that were efficient precipitators of tellurides, practically no deposition took place. The [Cresson] vug, which had been formed by the corrosion along a fracture of a large mass of basalt in the Cresson blowout, admitted a large amount of solution but allowed it to escape very slowly, so that stagnation, saturation and deposition were favored and one of the richest shoots in the district was formed.

There is a difference in the location of the Vug on the 12th level given by Patton and Wolf (1915) and that given by Loughlin and Koschmann (1935). Patton and Wolf say it is situated within the larger ore shoot which they show located in the southeast part of the blowout. Loughlin and Koschmann also say the Vug was associated with the larger ore shoot but have it located in the northeast part of the blowout adjacent to the collapse breccia. This second location is probably correct, as it is doubtful that Roelofs would give the actual location to Patton and Wolf. There was always the possibility of extension of this zone into adjacent ground, the ownership of which would be disputed, with litigation sure to follow. Boundary problems could jeopardize continued successful mining of the area. Such possibly valuable information was always a well kept secret.

EPILOGUE

Many mine owners encouraged publicity concerning the Vug in order to stimulate capital investment in deep exploration and development of their own mines. This publicity accounted for several other names that were applied to the Vug: the Jewelry Shop, the Bank Vault, Aladdin's Cave, and the Sugar Bowl. The publicity helped the Harbecks cash in on their bonanza, for in 1916 they sold the Cresson for $4.2 million. The syndicate that purchased the mine included Dick Roelofs.

There were other pockets of bonanza ore found in the Cresson and in other mines at Cripple Creek but none had the total value or potential to produce outstanding mineral specimens as the Cresson Vug. Unfortunately, very few specimens survive that can be authenticated. The specimens from the Vug that we have seen are not esthetically outstanding; certainly the best material went to the smelter. Better specimens from other areas of the mine were preserved because of less strict security in these areas. We can only dream of what might have been collected if different circumstances had prevailed when the Vug was opened.

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the Geology Museum Colorado School of Mines

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The Colorado School of Mines claimed in 1892 that their "collection, taken as a whole, is the most complete in the state and one of the finest in the country." The Geology Museum still strives toward this goal by exhibiting minerals from Colorado and around the world. The collection has more than 40,000 specimens in storage, and up to 3500 minerals and 100 different faceted gemstones on display.

INTRODUCTION

Both the Colorado Scientific Society collection, which was started in 1882, and the Colorado Bureau of Mines collection were legally transferred by the Colorado State Legislature from the Colorado Historical Society to the Colorado School of Mines Geology Museum. This created an extensive reference collection of Colorado, United States and foreign minerals. In addition the Thomas Allen mine lamp collection, Irwin Hoffman's mining murals, vertebrate and invertebrate fossils, and the famous Wolcott silver pitcher and tray are on permanent exhibit, as well as displays of geology and mining in general. These include a series of special exhibits on the tools used by surveyors, geologists, assayers and prospectors of the late 1800s.

HISTORY OF THE COLLECTION

The nucleus of the collection was started in the early 1880s through purchases from Ward & Howell of Rochester, New York, gifts from various mining companies, and specimen donations from students of Professor Arthur Lakes, the first curator (1880?–1892). The Colorado School of Mines grew out of Bishop Randall's Episcopal School (of Golden) which was established in 1868. The Episcopal School did not survive, but his Department of Mines was transferred in 1874 to the territorial legislature which officially established it as the School of Mines. The school's purpose at that time was to teach practical mining skills. Students would attend a few basic courses and then disappear into the mountains in search of wealth. To provide this basic training, the professors needed a collection of mineral samples to teach ore identification and blowpipe analysis. This basic sample collection, which was housed on the second floor of the "Building of 1880" (which was torn down circa 1959) was, of course, a teaching collection and did not have showy specimens.

The two most important early additions to the school's collection were the collections of J. Alden Smith of Boulder, Colorado, and J. S. Randall of Georgetown, Colorado. Smith, during his career as

Figure 1. **Entrance to the Geology Museum, Colorado School of Mines.**

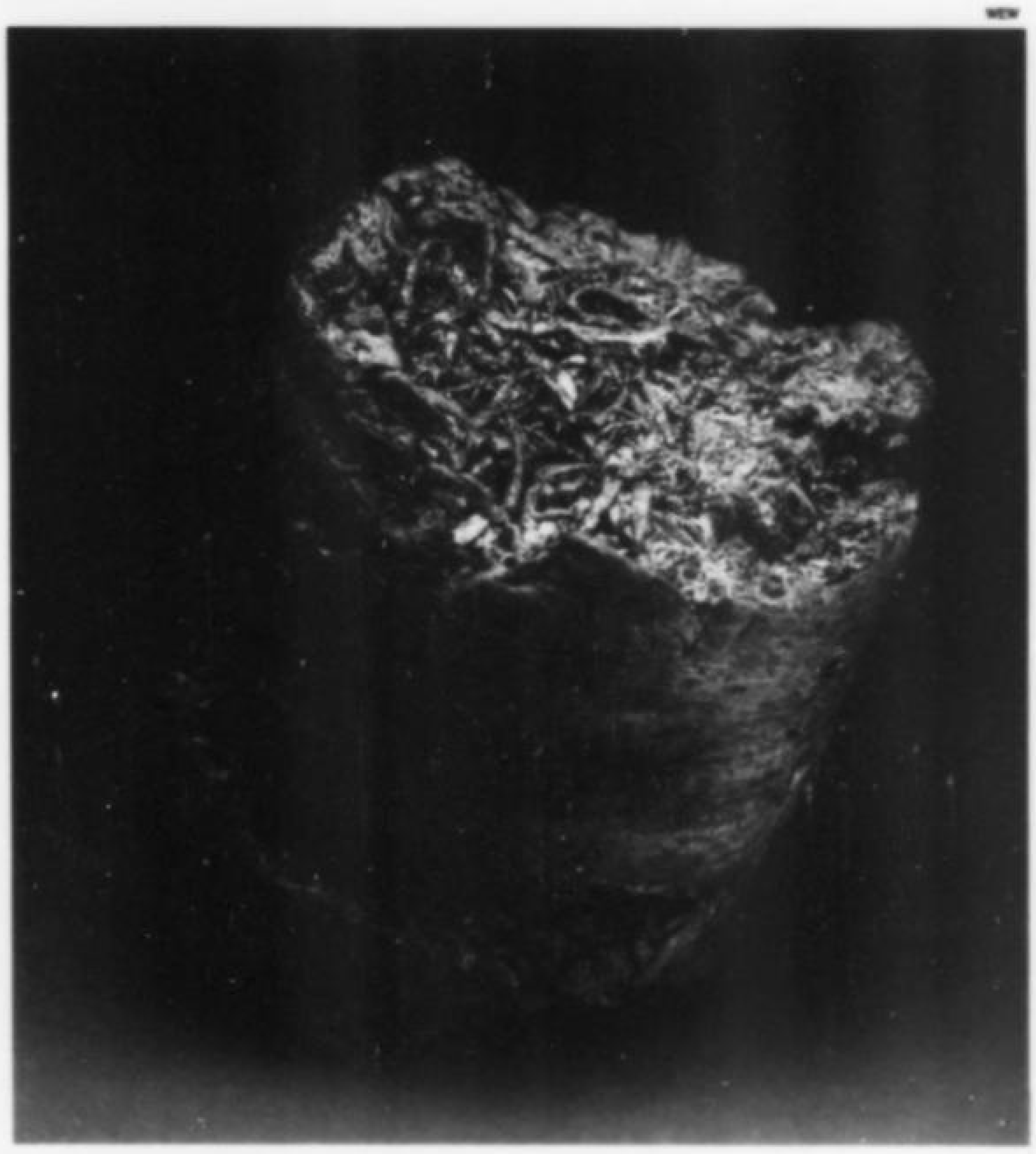
state geologist, built a collection that was especially known for its tellurides, gold and silver specimens but was also rich in fossils. It was purchased in 1890 for $1500. After the acquisition of Smith's collection, the school collection was moved to the newer "Building of 1890." Randall, the publisher of the *Georgetown Courier,* was well-known in Colorado as an amateur mineralogist. In his book, *Minerals of Colorado,* which was first issued in 1887, Randall described many of his specimens. His collection was purchased for $1700 in 1892, and was added in that same year to the state's display at the World's Columbian Exposition in Chicago.

Figure 2. **Brass binocular microscope made in the late 1800s by Swift and Son, Tottenham Court Road, London. Formerly owned by Regis Chauvenet, President of the Colorado School of Mines from 1883 to 1902; presented to the Museum by his family in 1972.**

WEW

Figure 3. **Electrum crystals, 3.7 cm across, from Oaxaca, Mexico. Donated in 1979 by Phillip Doerr, class of 1927.**

Figure 4. **Native silver brought up in a 2.6-cm drill core at Aspen, Colorado. Frank Allison collection, donated to the Museum in 1937 by Claude and Charles Boettcher.**



The period from 1893 to 1914 was one of vigorous growth for the School of Mines collection. The overall collection grew from 22,080 cataloged specimens in 1895 to 66,000 specimens in 1914. The collection was still dominantly composed of specimens for classroom use and not for display. The growth of the collection can be credited to the museum's second curator, Professor Horace B. Patton (1893–1916), who initiated an aggressive and extremely time-consuming program of trading, purchasing, soliciting donations, and organizing mineral-collecting trips (the senior student field trips). It was said of Patton's collecting habits that one must "get there before Patton does, for he will clean the place out" (Eggleston, 1931). The school had a standing offer during his tenure to pay shipping costs on all mine ores and gangue minerals donated to the school. Patton corresponded with mineral dealers, mine owners, college professors and curators, state geologists and amateur mineral collectors throughout the United States as well as in Mexico, South America and Europe. Some of the people he traded with or bought from included A. E. Foote of Philadelphia (during 1895), Maynard Bixby of Salt Lake City, Utah (1895–1897), O. Farrington of the Field Columbian Museum in Chicago, Illinois (1895–1902), and F. Krantz of Germany (during 1894).

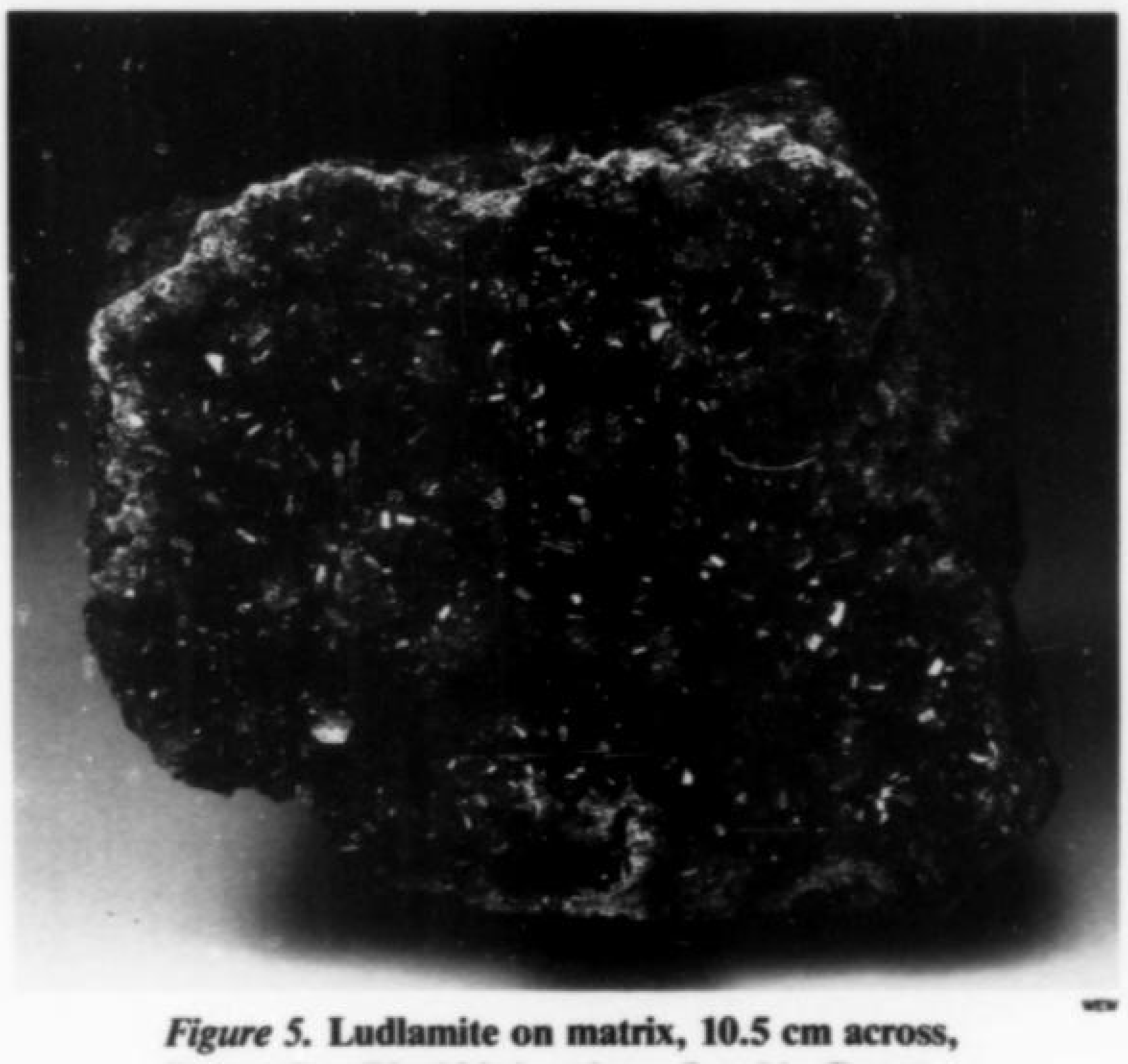


Figure 5. **Ludlamite on matrix, 10.5 cm across, from the Blackbird mine, Lemhi County, Idaho.**

In addition, Professor Patton corresponded with laymen and educators requesting geologic information, help in identifying economic mine ores, and aid in locating classroom rock and mineral sets. Patton's considerate and responsive replies brought benefits that extended past his lifetime since many of his contacts later donated or sold their collections to the school. Eggleston (1931) stated that "in him was the spirit of both the devoted teacher and an enthusiastic collector. His patience, good humor and energy were always in evidence on these (field-collecting) trips."

After becoming curator, Professor Patton subdivided the Mines collection into eight separate collections, each to serve specific purposes. Among them he had: a student's working collection, a blowpipe collection, a type (Dana) collection and an exhibition collection. The exhibition collection in 1895 had 21 cases of smoky quartz and amazonite from Florissant, calcite from numerous localities, an assortment of Colorado ore minerals, and 120 specimens of gems, both cut and uncut.

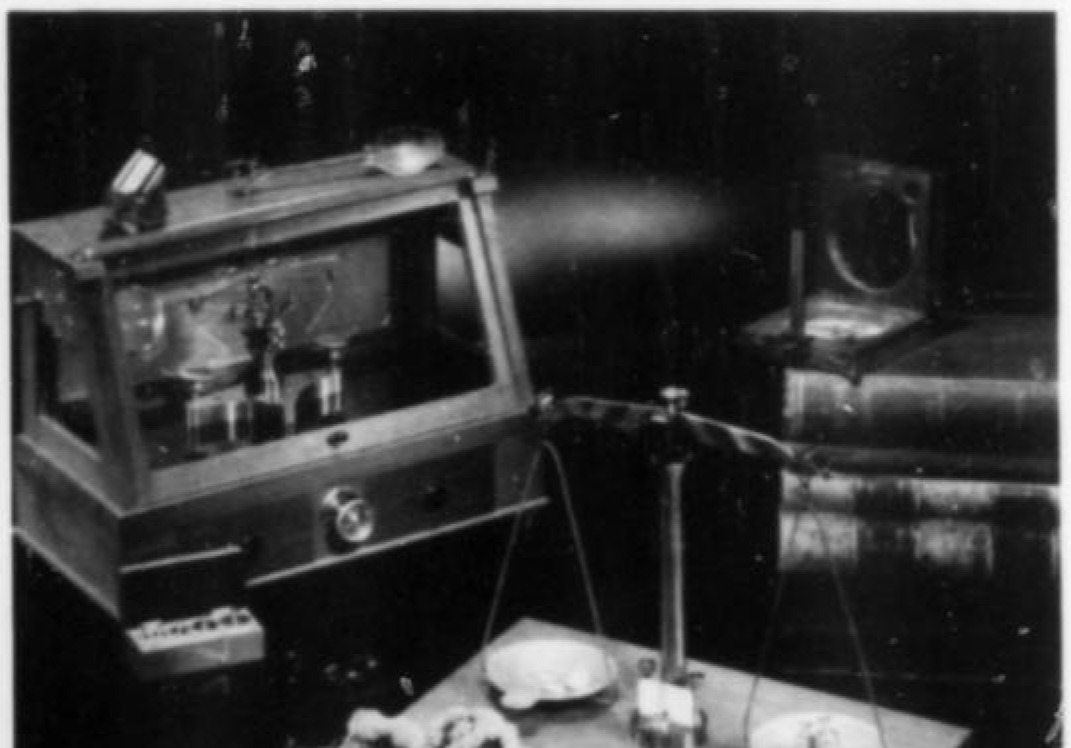
In 1906 the exhibition collection was moved to the north end of the Simon Guggenheim Hall. Since the bulk of the School of Mines collection was used by mineralogy professors in classroom instruction, many of the poorer specimens were consumed. The superior specimens were kept either in the exhibition collection (1305 specimens) or the type (Dana) collection (217 species and 61 varieties).

Following the retirement of Patton, from 1917 to 1939 the collection was nominally cared for by the head of the Department of Geology. In 1922, the exhibition collection was put in storage and the scanty records of this time indicate that the collection was neither actively cared for nor significantly increased in size. The comment was made (probably by J. Harlan Johnson) in 1941 that "the collection had suffered from lack of care, so an effort was made to replace many old specimens with others from the same localities." The collection also appears to have suffered from erosion by student mineralogy classes.

In 1940, the display mineral collection was unpacked and moved to the newly erected geology and geophysics building, which was officially dedicated as Berthoud Hall. Dr. J. Harlan Johnson became the curator (1940–1957) and reinstituted a period of active care and growth of the collection. In 1940, he stated that, "This is the first time that the school has had a museum for 18 years." However, early in his endeavor of rebuilding the collection, he was forced to wait. The U.S. Army took over many of the museum facilities from 1943 to 1946 for use in training activities during World War II. Afterwards, Johnson continued his work. During this period, purchases were made from E. M. Gunnell, a mineral dealer in Denver, Colorado; Ward's Natural Science Establishment in Rochester, New York; and from R. F. Hutchinson, whose specimens were from eastern United States localities, particularly Pennsylvania. The museum also received a large number of donations. J. W. Adams donated pegmatite specimens from the Black Hills, South Dakota, which were collected during his U.S. Geological Survey work (Page *et al.*, 1953). J. B. Hanley also donated Colorado pegmatite minerals collected during his U.S. Geological Survey work (Hanley, Heinrich and Page, 1950). Gunnar Bjareby, the noted New England collector for whom bjarebyite was named, donated New England minerals.

Professor J. Harlan Johnson stated at his retirement in 1957 that he hoped the school would hire a new curator who would continue to maintain and improve the museum collection. Unfortunately, his wish was not immediately fulfilled. The lack of a curator was corrected after the school received the Colorado State collection in 1965, when Jerri Hamilton was hired to curate the donation. This collection was started in 1895 and consisted of 11,177 items (Pearl, 1972) valued at $116,900 in 1966 (Anonymous, 1966). The collection contains the Colorado Scientific Society collection and the Colorado Bureau of Mines collection. The 777 specimens in the Colorado Scientific Society collection were collected by the pioneers of Colorado geology, including Walter B. Smith, Whitman Cross and Richard C. Hills.

Nancy Knepper, the curator after Jerri Hamilton, continued the active growth of the collection until 1977. At that time John Shannon and Virginia Mast took over the leadership, and are in charge of the collection today.



ABOUT THE COVER . . .

Our cover for this issue depicts a number of mining antiques and mineral specimens from the collection of the Geology Museum, Colorado School of Mines.

At upper left is a gold balance and at center is an assay balance, both instruments designed to be packed together in a single black leather carrying case. They were made around 1900 by the Denver Balance Company.

Atop the balance at upper left is a pyrite from Central City, Colorado, and silver souvenir spoon with mining tools and windlass marked "DENVER" (private collection).

The books are *Prospecting for Gold and Silver* by Lakes, *Textbook of Assaying* by Beringer, and two volumes of the *Proceedings of the Colorado Scientific Society.* Resting on the books is a French-made Boussold-Alidade miner's compass bearing the inscription: "Julien P. Riez & Sons, Delagrave, Editeurs, Paris."

The circular device in the foreground is a surveyor's aneroid barometer made by Short and Mason, Ltd., London. To the left of it is a surveyor's alidade made by C. & M. Schlumberger and Tavernier-Gravet, Paris. It was used by a Mr. Corbett in the Witwatersrand gold field, South Africa.

The mineral specimens, from left to right, are: silver from Batopilas, Mexico; sponge gold from the Tightener mine, Sierra County, California; botryoidal azurite, malachite and chrysocolla from Bisbee, Arizona; golden barite from the Sherman tunnel, Leadville, Colorado; and galena from the Eagle mine, Gilman, Colorado.

The photo is by Harold and Erica Van Pelt.

PRECIOUS MINERALS and FACETED GEMSTONES

The precious minerals section of the museum currently displays portions of the Boettcher gold and silver collection and several cases of faceted gemstones. The Boettcher gold and silver collection is the result of about 35 years of labor by Frank C. Allison of Cripple Creek. Allison started his collection possibly as early as 1896, by obtaining many of his specimens directly from the mining camps, but during the 1930s financial problems forced him to mortgage the collection. When Allison was later unable to redeem the collection, it was threatened with being melted for its bullion value. Luckily, Charles Parker, the Denver assayer holding the collection, brought it to the attention of two prominent Denver citizens, Charles Boettcher and his son, Claude K. Boettcher. They purchased and donated the collection to the Colorado School of Mines in 1937.

The strength of the Boettcher gold and silver collection lies in its representation of a large number of different Colorado gold localities. Localities represented in this collection are Farncomb Hill, Breckenridge; Cresson mine, Cripple Creek; Orphan Bell mine, Aspen; Smuggler Union mine, Silverton; Dixie mine, Idaho Springs; Little Jonny/Ibex mine, Leadville; and several Central City mines. Specimens from localities outside of Colorado include native gold from Nome, Alaska; gold with fluorite from the Bullfrog mine, Rhyolite, Nevada; Australian wire gold with calaverite; and fine-grained gold in white opaque vein quartz from the Laguna mine, New Gold Field, Venezuela. The collection also contains an especially fine specimen of dendritic native silver in parallel growth, 3.75 cm across, from Houghton, Michigan.

The gemstone collection includes a display of both faceted and unfaceted minerals. This collection was put together by Pala Properties of Fallbrook, California, and purchased by an anonymous donor for the museum in 1979. It contains 58 gemstone minerals from worldwide localities, including minerals that are rarely seen as crystals or faceted stones, such as kornerupine (blue-purple) from Madagascar, jeremejevite (light purple-blue) from Nambia, and manganotantalite (deep red) from Alto Ligonha, Mozambique. Each of the specimens is accompanied by a faceted stone. The terminated green peridot crystal from St. John's Island, Egypt, for example, is accompanied by an 8.85 carat faceted stone. The gem-quality diopside crystal and the 8.66 carat faceted gemstone are from the classic Dana locality on the Calvin Mitchell farm, Dekalb Township, New York.

The occurrence and origin of several gemstone samples is shown in a series of six panels which illustrate the elementary concepts of igneous, metamorphic and sedimentary petrology. The igneous origin of the pegmatitic gems is illustrated by minerals such as a 1334.5-carat terminated kunzite from Afghanistan, a 1.25-cm royal-purple apatite from Mt. Apatite, Auburn, Maine, and a 3.75-cm terminated morganite from the Stewart Lithia mine, Pala, California. The pink morganite crystal deserves special mention since morganite is found infrequently at the Stewart Lithia mine and then usually as small crystals and fragments. Metamorphic gemstone occurrences are illustrated by grossularite, almandine and emeralds. The emeralds include a 2.5-cm group of three sub-parallel, lustrous crystals from the Muzo mine, Colombia. Sedimentary gemstones such as precious opal (with blue fire) from Australia and red fire opal from Queretero, Mexico, are also on display.

Beauty, durability and rarity of gemstones are illustrated by fine examples of labradorite from Labrador, aquamarine from Brazil and Mt. Antero, Colorado, golden beryl and elbaite from Brazil, and polished malachite from Arizona. Several of these specimens are from the Colorado State collection.

REGIONAL MINERAL DISPLAYS

South America is represented by minerals from the fabulously rich Brazilian pegmatites. In 1942, Allan Caplan, a former student at the school, donated two dozen gemmy green chrysoberyls from Espirito Santo, Brazil. He later donated a thick topaz cleavage fragment weighing over 45 kg (100 pounds), and a doubly terminated 68-kg (150-pound) smoky quartz crystal, both from Minas Gerais, Brazil. In the 1940s Caplan was well known for obtaining large gem crystals for several other American museums such as Harvard, the Smithsonian Institution, and the American Museum of Natural History in New York. Another South American acquisition is the 8.75 cm cranberry-red tourmaline from the Jonas mine, Itatiaia district, Minas Gerais, Brazil. This mine has been estimated as having produced as much as four tons of fine rubellite. Some of the other minerals displayed in the South American case are brazilianite, eosphorite, rose quartz crystals, all from Brazil; a 1.25-cm emerald from Chivor, Colombia; and a 25-cm geode section of amethyst from Uruguay.

The Colorado gem trail case highlights some of the minerals mentioned in Richard M. Pearl's book, *Colorado Gem Trails and Mineral Guide*. Among the outstanding specimens are a 25-cm matrix piece of amazonite and smoky quartz on cleavelandite from Florissant, two deep purple amethysts from Red Feather Lakes, a 30-cm flower-like mass of aragonite from Aspen, and a 12.5-cm matrix of golden barite from the Gilman mine. Specimens of similar quality and size can still be found in Colorado by the diligent collector.

For the visitor who has only a little time to collect in Colorado, the specimens in the Golden area case offer examples of minerals that can be found locally. The zeolites from North Table Mountain present a distinctive assemblage unlike that found in the New Jersey traprocks. In 1898 the museum declared that "no thomsonites have ever been found so unique and so beautiful as are some of these specimens" (School of Mines Catalog, 1898). Samples from this locality include fine specimens of analcime in 2.5-cm crystals, radiating spherical groups of 0.625-cm natrolite crystals, and mesolite as hairy tufts up to 3.75 cm long. The mesolites in 1902 were claimed to be "unique as well as beautiful, as [they] can not be duplicated by any cabinet in the world" (School of Mines Catalog, 1902). At the Trans-Mississippian Exposition (1898) at Omaha, Nebraska, several of these zeolite specimens received a medal (Patton correspondence, 1898). Today, these accolades seem a little excessive, but the Deccan traprock zeolites from India were not yet known.

The minerals of the Tri-State district of Oklahoma, Kansas and Missouri are highlighted in a mineral case near the museum entrance. This was one of the United States' largest mining districts, producing half the country's zinc for many years. The rich sulfide ore deposits of the district were formed by aqueous solutions at low temperatures and shallow depths in Mississippian-age limestone and dolomite. The district, now essentially abandoned, was well known for its magnificent euhedral crystals of sphalerite, galena, chalcopyrite, and gangue minerals of calcite, dolomite and marcasite. Specimens from Cherokee County, Kansas; Picher, Oklahoma; Granby, Missouri; and Baxter Springs, Kansas are displayed. Four magnificent matrix specimens are particularly attractive. These are a 45-cm group of golden calcite scalenohedrons, with the largest calcite crystal at 20 cm, a 30-cm matrix specimen of euhedral sphalerite on dolomite; a 45-cm matrix specimen of cockscomb marcasite crystals up to 1.25 cm long; and another 45-cm matrix specimen of 5-cm crystals of galena and sphalerite on chert.

The eastern United States and Canada mineral case contains typical specimens from many of the famous localities of the 1800s. Eastern United States localities are represented by rutile from Graves Mountain, Georgia; franklinite from Franklin Furnace, New Jersey; and purple apatite from Mt. Apatite, Maine. The Canadian specimens include stilbite and chabazite from Wasson's Bluff, Nova Scotia and titanite with apatite on 5-cm octahedrons of

Figure 6. **Amazonite and smoky quartz on cleavelandite from Crystal Peak, Teller County, Colorado. The matrix measures 15 x 17.5 cm. Acquired before 1940.**

Figure 7. **Leaf gold on quartz from the Smuggler Union mine, Telluride, Colorado; 5 cm tall. Allison collection, donated by Claude and Charles Boettcher.**

magnetite from Cardiff, Ontario. Some of these specimens are from the collection of W. D. Mateer, who was a School of Mines professor. His collection was purchased in 1953 and is predominantly of southeastern Canadian specimens.

The western United States case contains several outstanding specimens. The 15-cm matrix specimen of epidote from Prince of Wales Island, Alaska, was acquired by the museum in the 1940s. A 15-cm matrix specimen of gemmy vivianite crystals from the Blackbird mine, Lemhi County, Idaho, has individual crystals up to 1.25 cm. Other minerals from famous localities are benitoite from San Benito County, California, jackstraw cerussite from the Flux mine, Arizona; and deep red wulfenite from the Red Cloud mine, Arizona.

THOMAS ALLEN MINE LAMP COLLECTION

Thomas Allen, a Colorado state mine inspector, collected mine lamps from various sources. His collection was bought by Max Grimes and donated to the school in 1952. As a birthday present, Grimes' employees wrote and published an illustrated catalog of the collection. Much of that description has been used in the museum display. This display is in keeping with the School of Mines tradition – mining and geologic engineering. Forty lamps from his collection portray the progress made in mine lighting from the 1600s to today. This collection has been discussed and illustrated in the *Mineralogical Record* (Bentley, 1979).

RECENT ACQUISITIONS

Donations and sales from the museum shop have allowed the museum staff to acquire excellent specimens. Eleven recently purchased specimens on display include a gemmy 1.25-cm amblygonite crystal and 2.5-cm childrenite crystal, both from Conselheira Pena, Brazil; a 12.5-cm matrix specimen of pyromorphite from the famous Wheatley mine, Phoenixville, Pennsylvania; a 2.5-cm, terminated proustite crystal from Chanarcillo, Chile; and a dark green, 3.75-cm epidote crystal from Pobery Ridge, Australia.

Two recent acquisitions that are not yet on display are a 130-carat faceted peridot from Burma, donated in 1980, and three Australian precious opal cabochons. The three free-form opals weigh 363.87, 232.53, and 63 carats respectively.

The Lee Burnett copper mineral collection, donated in 1979, consists of 45 classic specimens from the Lake Superior district, Upper Michigan. Most of these were collected in the early 1900s, including several native copper crystals and dendritic wire copper masses.

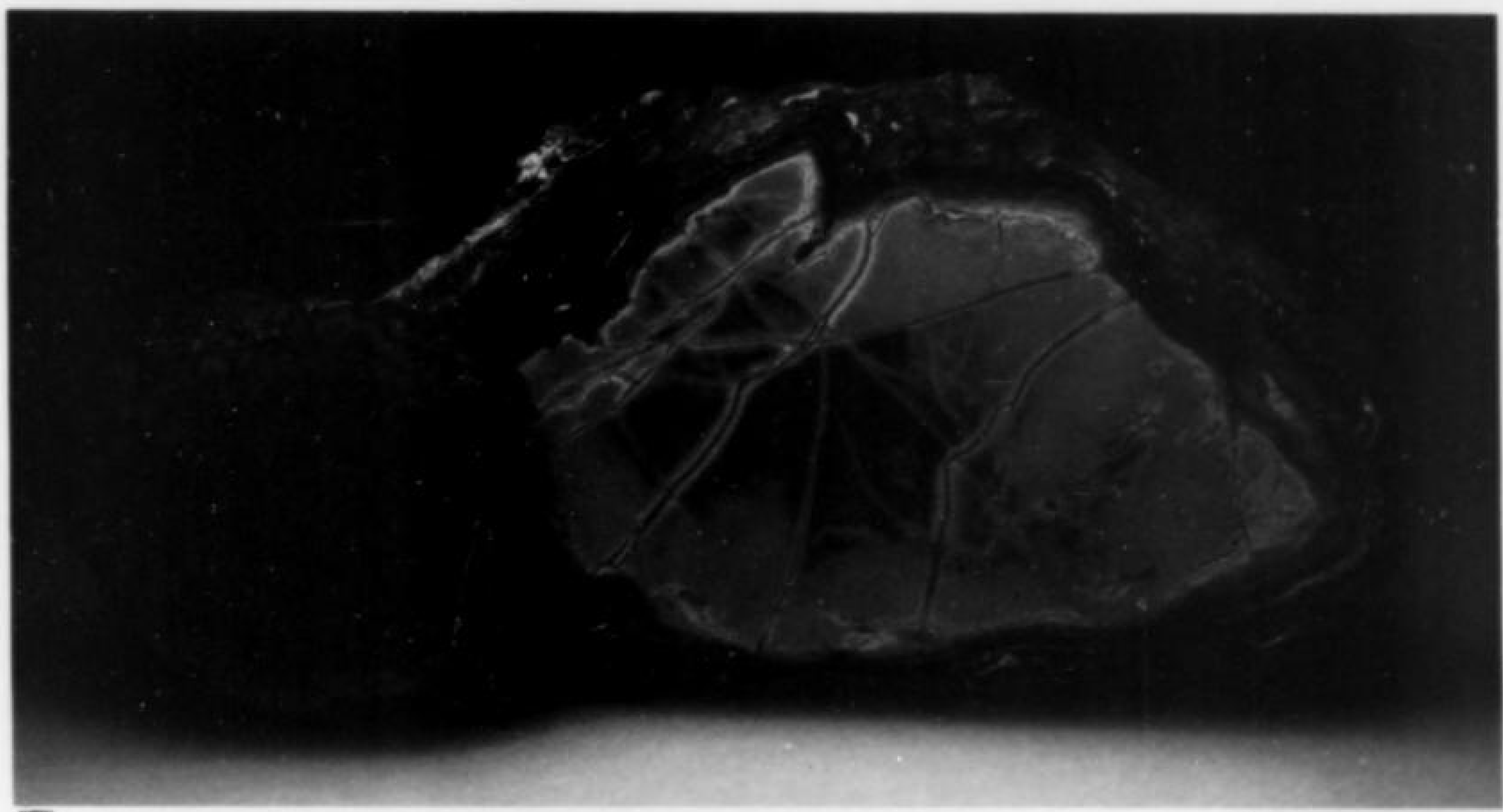


Figure 8. **Azurite-malachite stalagmite slab from Siberia (left), and variscite nodule slab 9.5 cm across from Fairfield, Utah.**

Figure 9. **Smoky quartz crystals, 10.5 cm tall, from the La Sal Mountains, Utah. McGuire collection, collected in 1898.**

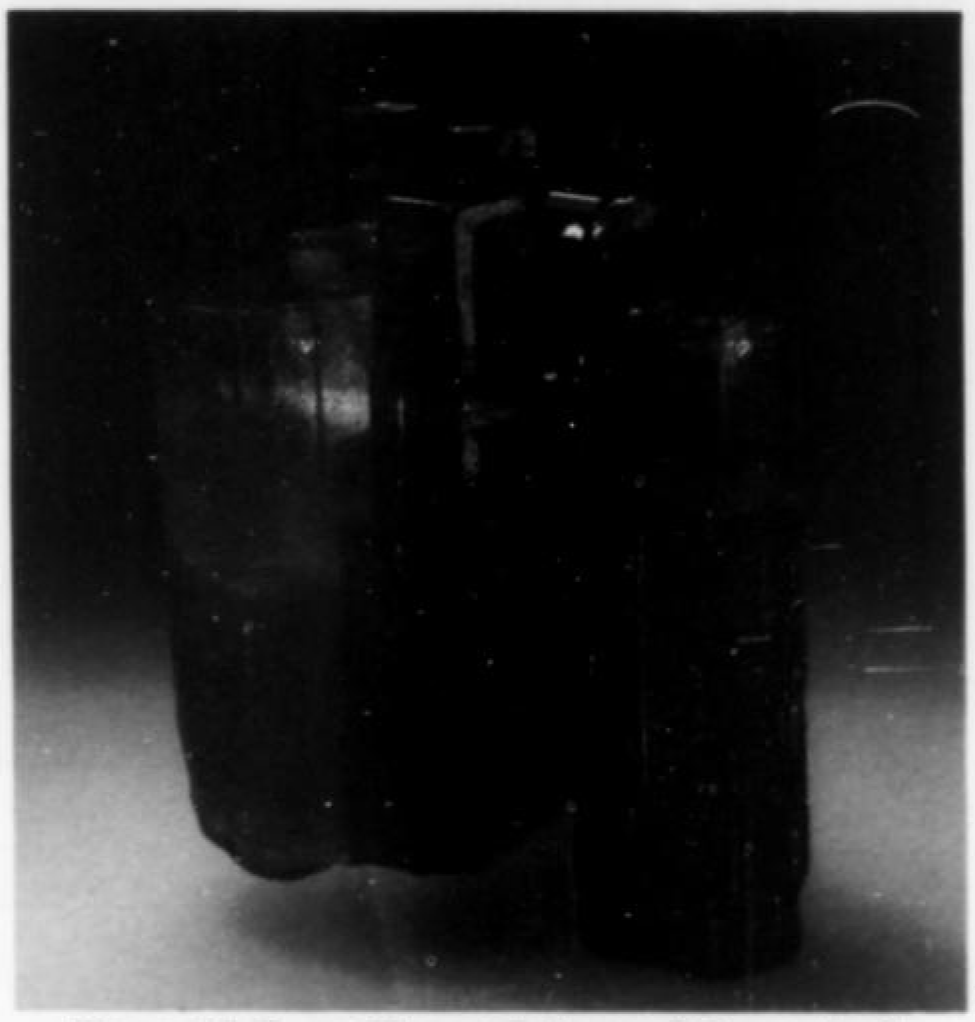


Figure 10. **Emerald crystals in parallel growth, 3 x 3.8 cm, from Colombia. The specimen was donated to the Museum by M. L. McCormack, class of 1926.**

FUTURE WORK

Museum director John M. Shannon and museum curator Virginia Mast are working on several projects. A systematic mineral display (minerals organized by chemical composition) is planned and will be used to aid mineralogy students in their course work at the school. The Guild Gold mine exhibit is presently being remodelled. To encourage local support for the museum, both a 1-ounce silver coin and notecard stationery with the museum logo (an ore car) are for sale in the museum shop. Soon to be available will be color posters of museum specimens and mining-related instruments. The museum will continue as in the past to send special exhibits to local and distant mineral shows. Recent special exhibits were shown at the Tucson Show (Arizona), Las Vegas, Nevada, and almost all the shows in Colorado.

VISITORS INFORMATION

The Geology Museum occupies the west wing of Berthoud Hall on the campus of the Colorado School of Mines, Golden, Colorado. Berthoud Hall is located at the intersection of 16th and Maple Streets. The museum entrance can be recognized by an ore car near the front door. This ore car was recovered from the Moose mine, Central City, and donated to the museum by Hal Miller in 1971. Visiting hours are 10 a.m. to 4 p.m. Monday through Saturday, and 1 p.m. to 4 p.m. Sunday. The museum is open all year round except on legal holidays, and during the Colorado School of Mines Christmas and Spring recesses. Admission is free.

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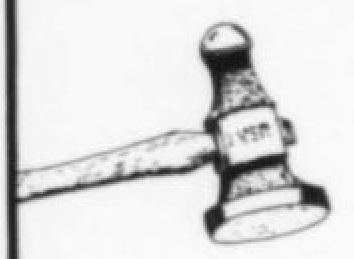

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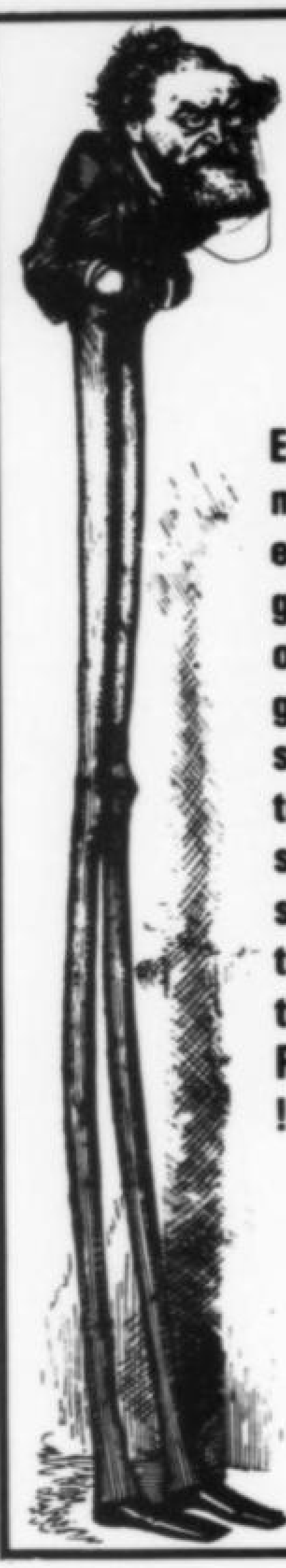

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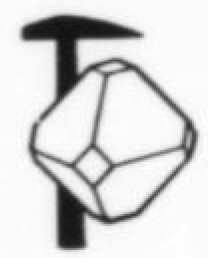

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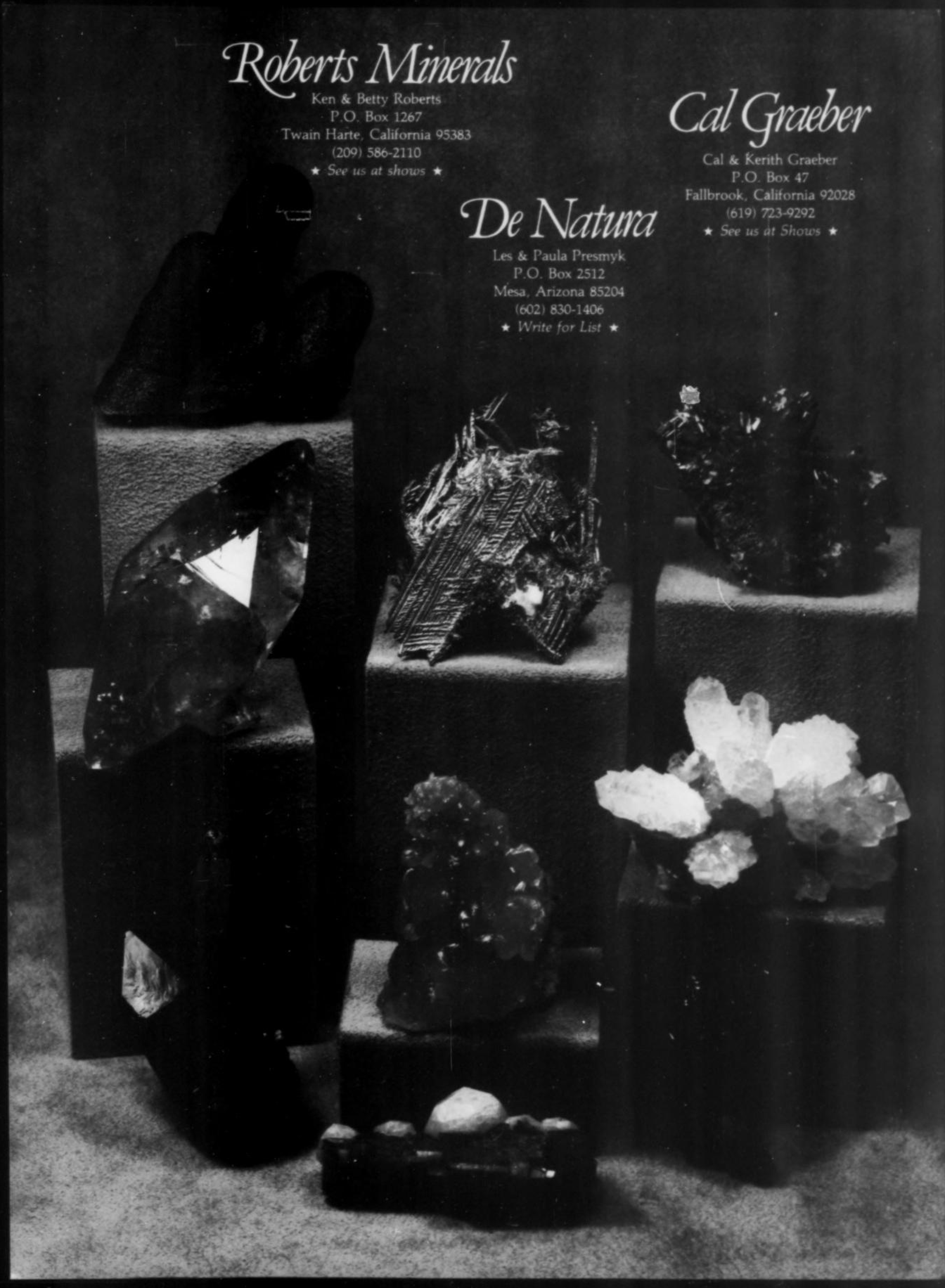
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