GOLD SPRINGS MINING DISTRICT, IRON COUNTY, UTAH, AND LINCOLN COUNTY, NEVADA

by Lee I. Perry[1]

ABSTRACT

Gold and silver mineralization in the Gold Springs mining district on the Utah-Nevada border is restricted to veins in Tertiary volcanic rocks. Mining began in 1897 and continued intermittently until the early 1940's. The principal mines have been the Jennie, Little Buck, Snowflake, Independence, Aetna, and Jumbo. Three mines had mills where ores were beneficiated. However, these mills were primitive and met with varying success. Few records were kept; nevertheless the district is credited with producing 9,335 ounces of gold, 40,279 ounces of silver, 12,031 pounds of copper, and 19,268 pounds of lead.

The past production and this study of the surface and the underground workings indicate that the ore deposits are small but high in grade.

INTRODUCTION

Gold Springs is a small mining district located in western Iron County, Utah, with a part of its mineralized area extending into Lincoln County, Nevada. The center of the district is 60 miles (97 km) west of Cedar City, Utah, and 40 miles (64 km) east of Pioche, Nevada (figure 1).

Mineralization at Gold Springs is restricted to veins in extrusive volcanic rock. The veins bearing gold and silver and very little amounts of lead and copper occupy open fissures. Gold is generally in the native form, finely disseminated, and probably derived from gold-silver tellurides (Butler and others, 1920). Most of the gold is light in color and contains considerable silver. Some cerargyrite or horn silver has been found, but it is not common. Most of the ore is oxidized and, near the surface, secondary enrichment has increased the tenor. In the deeper workings sulfide minerals have been mined. The major gangue minerals are quartz, calcite, and adularia. The proportions of gangue minerals vary greatly in different parts of the veins. Little gold and silver is found in calcite, and often these parts of the veins were left in the mines while the adjacent higher grade ore was mined. A rule of thumb in the camp at the turn of the century was that adularia and quartz made the better gold and silver ore. Adularia, which can be up to half of the vein material, made higher grade ore than quartz, although most quartz was a shippable grade.

Records for Gold Springs are incomplete and do not list some of the earliest production. The district has been credited with approximately $500,000 in gold, silver, lead, and copper[2] (Asher, 1959; Butler and others, 1920; Tschanz and Pampeyan, 1970; Block, 1971). The value of the ore is in gold and silver as lead and copper are insignificant by-products.

LOCATION

Gold Springs is in the southwestern part of Utah in the western end of Iron County and in the eastern end of Lincoln County, Nevada, adjacent to the Stateline mining district.[3] The Utah-Nevada border passes through the district dividing it into an eastern or Utah portion, called the Gold Springs mining district, and a western or Nevada part, called the Eagle Valley mining district. For the purpose of this report, this area, shown in plate 1 (a combination of the two districts), will be referred to as Gold Springs mining district. Mineralogically and geologically these two districts are the same.

Gold Springs is approximately 70 miles (113 km) west of Cedar City, Utah, and 40 miles (64 km) east of Pioche, Nevada. From Cedar City the easiest route is 52 miles (84 km) via Utah Highway 56 to Modena, Utah, a spur on the Union Pacific Railroad. Outside Modena, 2¾ miles (4.4 km) west on Highway 56, an improved dirt road leading off to the northwest to Gold Springs intersects with the highway. The townsite of Gold Springs is 12 miles (19 km) from the intersection.

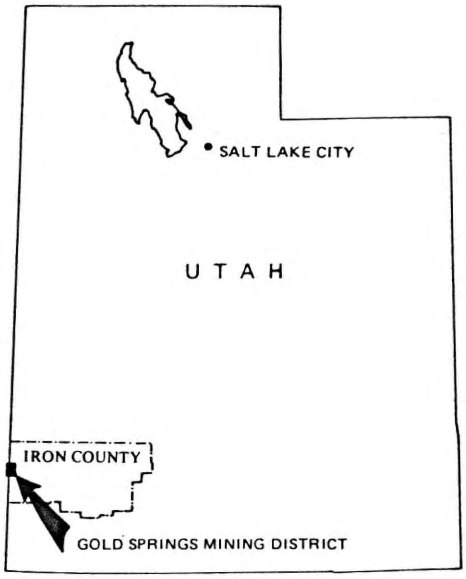

Figure 1. Index map of Gold Springs mining district.

GEOGRAPHY

The climate of Gold Springs is arid; annual precipitation is 11 inches (27 cm), and temperatures range from 101°F (38°C) to -32°F (-35°C). Vegetation in the higher areas consists of juniper and pinyon; in the flats sagebrush is most common (Thomson and Perry, 1975, p. 27).

Several small springs are found in the area, but the principal one is Gold Springs near the townsite of Gold Springs. The springs are perennial, but flow is reduced during periods of drought. Alluvium in the washes usually absorbs the spring's runoff a short distance below its source. Gold Springs supplied culinary water for the town of Gold Springs and furnished water for the Jennie mine and mill. In drier years when it was not adequate for the Jennie mine, water had to be piped from springs in Nevada.

Local topographic relief is 1,650 feet (503 m): the southern end of the study area is approximately 6,400 feet (1,950 m) above sea level; Bull Hill in the northwest corner of the area is 7,668 feet (2,337 m). Gold Springs townsite is at 6,720 feet (2,048 m). Many roads cut

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[2] Gold at $35.00 an ounce.

[3] For report on Stateline mining district, see "Reconnaissance Study of the Stateline Mining District, Iron County, Utah," by Kenneth C. Thomson and Lee I. Perry, *Utah Geology*, Vol. 2, No. 1, Spring 1975.

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through the area, allowing easy a[illegible]s, but some are in poor repair and require a four-wheel drive vehicle for safe passage.

The town of Gold Springs is now abandoned. Four cabins and the pump house at the springs are all that remain of the once thriving community (figure 2). In the surrounding area where mining took place, mine dumps, abandoned cabins, mill buildings and foundations are common.

HISTORY OF THE DISTRICT

Gold Springs, or Pike's Diggings as it was known in earlier days, was discovered fairly late in relation to other mining districts of the west. Little prospecting had been done in the area, except for the work of "Old Man Pike" who started prospecting here in the 1870's. His attempts to trace the high-grade float found in the district back to its place of origin were in vain, and he died without striking the bonanza of his dreams. It was not until the discovery in 1896 of gold and silver veins in the State-line mining district, a few miles to the north, that any great number of prospectors were attracted to the area (Thomson and Perry, 1975). The first locations since Pike's work were made in 1897 (Tschanz and Pampeyan, 1970) on the Jumbo and Wild Irish claim groups (*Salt Lake Mining Review,* 1903). The rest of the veins were prospected and located shortly thereafter. The prospector had little trouble in tracing a vein because the silicification caused it to stand in bold relief above the adjacent ground. Much rich float was present that pointed to the veins and the type of ore to be found in them.

The town of Gold Springs was established in the late 1890's, and in 1908 it boasted of a population of 250 (*Salt Lake Mining Review,* 1908). The townsite was in the middle of the district, east of the Utah-Nevada border. Adequate water for all immediate purposes was obtained from Gold Springs for which the town was named.

AVAILABLE MAPS AND METHODS OF STUDY

Topographic maps available are the Army Map Service (AMS) map of Caliente (NJ 11-9) and the 7½-minute quadrangle, Deer Lodge Canyon, Nevada-Utah. The AMS map is at a scale of 1:250,000 and the 7½-minute quadrangle is at a scale of 1:24,000. A preliminary geologic map by William Block was available to the author at a scale of 1 inch equals 1,000 feet. The 7½-minute quadrangle and the geologic map were enlarged to 1 inch equals 800 feet and used in the field. No additional surface geologic mapping was done by the author. Underground mapping of accessible workings and field work were done during the summer of 1974 and the spring of 1975. Samples were cut at right angles to the vein structure and sent to the Union Assay Office, Salt Lake City, Utah, where they were fire assayed for gold and silver.

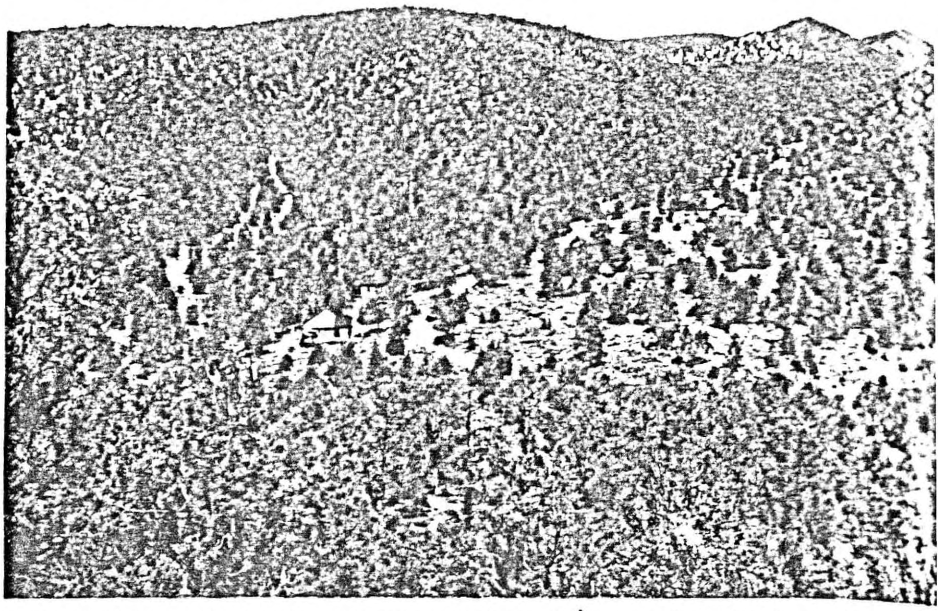


Figure 2. Town of Gold Springs as seen from U. S. Land Monument 2 (USLM 2), looking north.

GEOLOGY

Stratigraphy

Most of the rocks in the study area are Tertiary igneous rocks; the rest are Tertiary and Quaternary sediments (Block, 1972). The igneous rocks are divisible into five extrusive units and five intrusive units. The extrusive rocks are broken down into four rhyolite flow units and an andesite unit consisting of several flows lumped together into one mappable unit. The intrusive rocks consist of two rhyolite porphyrys, the mappable brecciated part of one of the porphyrys, and two types of dikes. The sedimentary rocks consist of Tertiary water-laid tuff and Quaternary alluvium.

Sedimentary Units

The Tertiary unit (Tt) is water-laid tuff derived from an underlying igneous unit (Tr_1), a lithic crystal tuff. The Quaternary unit is alluvium that occupies the southwestern part of the area where it buries all of the other units.

Alluvium (Qa)

Alluvium described by Block (1972) as "outwash material" is composed of pieces of igneous rocks and vein material that range in size from boulders to sand particles. Where observed this unit is unsorted. Alluvium covers the southern and western part of the study area, lapping up on the west flank of Buck Mountain and extending to the south and west for a considerable distance beyond the study area (plate 1).

Water-Laid Tuff (Tt)

A water-laid tuff, derived from the underlying igneous unit (Tr_1), a lithic crystal tuff, was deposited shortly after the deposition of Tr_1. The water-laid tuff is composed of pumice and lithic fragments that have been reworked and slightly sorted by water. This unit lies conformably upon the lithic crystal tuff. Exposures are seen in two areas: The best outcrop is one-half mile north of the Gold Springs townsite on a hill where more than 200 feet (61 m) of water-laid tuff is exposed. The second exposure is on the west side of a gully cutting into Bull Hill in NE¼ sec. 29, T. 1 N., R. 71 E., Nevada.

Igneous Units

The extrusive rock units include a series of rhyolites overlying andesite flows. The andesites are the host rock for most of the gold and silver veins in the district. The intrusives are rhyolite plugs that are probably the source of the rhyolite flow units (Block, 1972). In addition to the rhyolite plugs, two types of dikes are found that are composed of rhyolite and perlite.

Platy Rhyolite (Tr_4)

The uppermost platy rhyolite flow rock is the youngest of the rhyolite units (Block, 1972). It consists of a thick uniform section of tuffaceous flows ranging in color from medium to dark gray and weathering to a platy appearance. The only exposure is along the eastern edge of the study area in NE¼ sec. 36, T. 33 S., R. 20 W., Utah (plate 1) where it occupies the top of the mountains.

Rhyolite Tuff (Tr_3)

The rhyolite tuff is the next to youngest unit in the district. This unit is not as thick as the overlying platy unit and is discontinuous throughout the district. It has a well-developed welded zone containing solid and hollow lithophysae, which distinguish it from the tuff unit below. The outcrop area, the smallest of the rhyolite units, is only found on the northeast side of Bull Hill in sec. 29, T. 1 N., R. 71 E., Nevada.

Rhyolite Tuff (Tr_2)

This rhyolite tuff unit is the next to the oldest of the rhyolite units of the area. It is similar in appearance to the tuff unit above but has a perlitic vitrophyre at its base and does not contain lithophysae as in the unit above. The exposures are small and found along the east side of the map area. The best exposure is in NE¼ sec. 36, T. 33 S., R. 20 W., Utah, where it overlies the lithic crystal tuff and is capped by the platy rhyolite.

Lithic Crystal Tuff (Tr_1)

The lithic crystal tuff is the lowest of the rhyolite flows and is the most widespread of the four units. Except for the andesite flows, it covers the largest area of any unit in the district. The unit is composed of ten percent quartz crystals, which are generally broken, ten percent lithic fragments, and flattened pumice lapilli, which make up the remainder of the rock. The rock ranges in color from light pink to pinkish brown. The distinguishing features of this unit are the unwelded pumice lapilli, lithic fragments, and broken quartz crystals. The best exposures are northeast of the Jennie mine, on the hill that is almost entirely made up of this unit. According to Block (1972) the source of this flow was probably Bull Hill.

Porphyritic Andesite Flow (Ta)

The porphyritic andesite flow is the most extensive unit in the area and the most important because it is the host rock for all but one of the veins. This unit consists of several andesitic flows that have been lumped together for mapping. The unit has large (up to 5 mm) plagioclase crystals in a matrix of aphanitic glass. The lower flows are locally fragmented in parts of the district. In some places along the vein contacts, the andesite is kaolinized or silicified. A good example of kaolinization is seen in the E-2 adit where the wall rock has been altered almost completely to kaolin. Silicification of the andesite is seen in the Snowflake and Aetna vein where the wall rock is almost a jasperoid near the veins. A good exposure of this unit can be seen in the hill east of Gold Springs townsite and south of Gold Springs Wash.

Intrusive Rock

Bull Hill Rhyolite Porphyry (Tbh)

The Bull Hill rhyolite porphyry makes up one of the two rhyolite plugs that are located in the district. It was named by Block (1972) after the hill which it occupies. The unit, light purple to pinkish brown in color, is more resistant to erosion than the surrounding flow rocks. The area of outcrop is small and occupies only the top of Bull Hill. This unit serves as the host rock for a small gold-bearing fluorspar and hematite vein that occurs on the southeast side of its exposure. Block suggests that the plug on Bull Hill is the source of the lithic crystal tuff unit (Tr_1) which crops out southeast of Bull Hill.

Buck Mountain Rhyolite (Tmbr) and Brecciated Rhyolite (Tbmb)

The Buck Mountain rhyolite is the second of two rhyolite plugs found in the district. The unit was named by Block (1972) after Buck Mountain, the top of which is made up of the unit. It has been divided into two mappable units: a brecciated eastern part of the plug and an unbrecciated western exposure. The rhyolite is the host for two perlite dikes, which strike N. 15°-35° W. on the eastern slope of Buck Mountain.

The brecciated unit has been resilicified into a distinctive green jasperoid. Its eastern contact with the andesite flows parallels roughly the N. 20° W. strike of the Snowflake vein. No mineralization has been found in either rhyolite unit to date.

Rhyolite Dikes (Tdr)

Rhyolite dikes are found in two places in the district. These dikes are lithologically similar and are probably related to either the Bull Hill or Buck Mountain rhyolite plugs. The best exposure of a dike is 800 feet (244 m) west of Gold Springs townsite. This dike, which has been displaced by a fault, strikes N. 15° W. to N. 10° E. for 1,600 feet (488 m). The southern end of the Thor (Talisman) vein has been displaced by the same fault, which dates the dike as the same age or earlier than the mineralization of the Thor vein. Another exposure of a rhyolite dike is about 1,000 feet (305 m) north of the Little Buck mine in sec. 32, T. 1 N., R. 71 E., Nevada. This exposure does not have the linear shaped outcrop seen in the exposure west of Gold Springs.

Perlite Dikes (Tdp)

Two perlite dikes are found on the eastern slope of Buck Mountain. These dikes are very glassy and occur in the Buck Mountain rhyolite. The larger one of the dikes starts near the south line of sec. 32, T. 1 N., R. 71 E., Nevada, strikes N. 15° W., and extends 2,000 feet (610 m) to the northwest. Near the southern end the dike has a thickness of 20 feet (6 m), but near the northern end it narrows to about 2 feet and then dies out. The second and smaller dike starts near the south line of sec. 32, strikes north, and merges with the larger dike after a few hundred feet. Both dikes dip about 70 degrees to the west into the Buck Mountain rhyolite.

STRUCTURE

Sedimentary rock ranging in age from Cambrian to Triassic underlies the Tertiary volcanics of the surrounding region. Prevolcanic deformation is localized along northeast-trending axes. Narrow belts of deformed rocks are adjacent to broad areas of undeformed Paleozoic rocks. The exposed sequence of volcanic rocks occupies basins formed on top of these Paleozoic rocks. In the undeformed volcanics, the Paleozoic rocks lie disconformably; in deformed areas the contact is an angular unconformity (Cook, 1965; Block, 1971).

In the Gold Springs area ignimbrites have accumulated in a basin 2,500 to 3,000 feet (762 to 914 m) thick and are believed to rest on an erosional surface of lower Paleozoic rocks. The nearest exposed Paleozoic rocks (Middle Cambrian, Highland Peak Limestone) are 10 miles (16 km) to the north (Cook, 1965).

The volcanic rocks dip gently to the east, and the only noticeable structural features are the veins that are believed to be associated with faulting. These veins trend roughly northwest and dip 50 to 75 degrees east. Close examination of the district shows two ages of faulting cutting Tertiary volcanic rocks. These faults can be classified as premineral and postmineral faults, although Young (1934) suggests some movement took place during emplacement of the vein materials. As a general rule, the premineral faults have a northerly strike varying a few degrees to the east or west, while the postmineral faults strike northeast to east. Premineral faulting broke the ground and formed open spaces, which allowed deposition of ore and gangue minerals. Faulting provided a plumbing system that allowed ore-bearing solutions to permeate the rock. The premineral faults might well represent Paleozoic fault systems extended into the volcanics. Postmineral faults with their northeast to east strike tend to cut off the mineralized veins, such as the Jennie vein north of the Jennie shaft. Faults of both ages are normal and displacements are small.

MINERALOGY

The metals of economic value in the veins are gold, silver, lead, and copper. The oxidized part of the vein contains gold in the native state and, also, a small amount of silver. Most of the gold can be seen with a hand lens. Colors can be panned with ease from a sample crushed in a mortar. In the bottom of the pan the gold is fine and a hand lens is usually necessary to see it. Cather (1975), a mineralogist for the U. S. Bureau of Mines, reported that the gold in all of the samples "is rather pale and may contain small amounts of silver." Gold is generally free from any gangue, but some locking does occur generally with limonite and occasionally with quartz.

Lead and copper have been recovered from the ores, but the quantities are small making them insignificant by-products. The Jennie, Little Buck, Big Buck, and Pope mines have been the main producers of the by-product metals (U. S. Bureau of Mines, oral communication).

Some limonite, common in the ores mined in the district, is associated with gold. It is suggested that the gold may have been brought in with pyrite and then later oxidized to limonite. Limonite is massive or pseudomorphic after pyrite. In a sample from the Thor vein, Cather (1975) found gold locked in the limonite (figure 3).

Gangue minerals that are found in veins in their order of abundance are quartz, calcite, and adularia. The quartz occurs in several different forms: as druse, the filler for vugs or cavities, as large white fine-grained masses, as small stringers running in all directions in silicified rock, and as chalcedony. Calcite is banded or crustified and generally coarsely crystalline but may be massive. Quartz that has replaced calcite is found in parts of the veins. Adularia is found in most of the veins, giving them a yellowish green or greenish gray cast; it may fill up to half of the vein. The gold seems to be associated with the adularia, which is generally fine grained and massive or in some places coarsely crystalline.

Young (1934) suggests that there is evidence to support at least two ages of calcite and quartz mineralization. He suggests the first mineralizing solution brought in the calcite and deposited it on the walls of the open fissures. The next solutions entering the fissures brought in the adularia, gold, silver, and most of the quartz. This was followed with a second influx of calcite followed by another of quartz. The last quartz stage had very little gold associated with it.

There is little doubt that secondary enrichment has increased the value of the veins near the surface (Young, 1934). The gradual decrease in value with depth, the boxwork left by the pyrite, and the presence of manganese stains on the calcite reinforces this idea. According to Young the effect of secondary enrichment is limited to the upper 200 feet of the veins.

No placers have been found in the district. Young suggested that gold might have been carried downward in the vein faster than erosion could remove the vein material. There is a possibility that the size of the gold removed by erosion was too fine to allow it to be deposited in any concentrated amounts in the immediate area.

LOCATION OF MINES

The mines and workings of the district have been located by two methods: township and range and the Universal Transverse Mercator system (UTM) (table 1).

VEINS AND ASSOCIATED MINES

The principal veins in the district are listed from east to west: Jumbo, Independence, unnamed vein on Sigbee

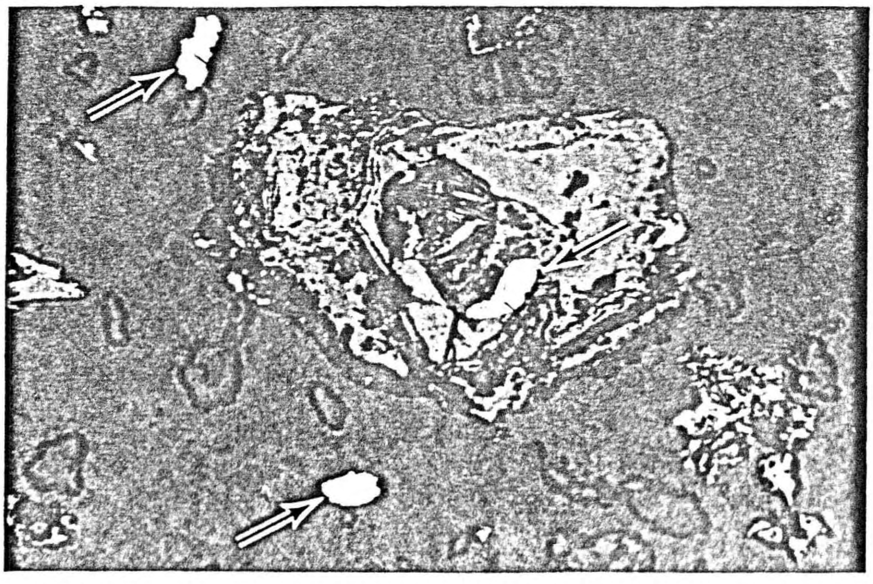


Figure 3. Polished section magnified 160 times shows the locking of gold in limonite. Sample is from Thor vein. Arrows indicate gold locked in limonite and isolated as grains in the bakelite matrix.

Table 1. Location of mine workings.

Name	Township and range	Universal Transverse Mercator	
		North (in meters)	East (in meters)
Jumbo shaft	NW¼SE¼ sec. 25, T. 33 S., R. 20 W., Utah	4198710	761370
Independence shaft	NW¼SE¼ sec. 25, T. 33 S., R. 20 W., Utah	4198690	761020
Independence adit	NW¼SE¼ sec. 25, T. 33 S., R. 20 W., Utah	4198720	761130
Aetna shaft	SW¼SW¼ sec. 36, T. 33 S., R. 20 W., Utah	4196740	760590
Adit on Aetna vein	SE¼NW¼ sec. 1, T. 34 S., R. 20 W., Utah	4196030	760790
E-2 adit	E½ sec. 26, T. 33 S., R. 20 W., Utah	4198440	759820
Jennie shaft	Lot No. 4 sec. 26, T. 33 S., R. 20 W., Utah	4198480	759470
Thor crosscut	E½ sec. 32, T. 1 N., R. 71 E., Nevada	4198450	759250
Uvada adit	E½ sec. 32, T. 1 N., R. 71 E., Nevada	4198700	759300
Little Buck shaft	NW¼ sec. 32, T. 1 N., R. 71 E., Nevada	4199140	758640
Big Buck shaft	NW¼ sec. 32, T. 1 N., R. 71 E., Nevada	4198960	758670
Snowflake quarry	SW¼ sec. 32, T. 1 N., R. 71 E., Nevada	4199690	758800
Red Eagle adit	SW¼ sec. 32, T. 1 N., R. 71 E., Nevada	4198270	759020
Pope shaft	SW¼ sec. 29, T. 1 N., R. 71 E., Nevada	4199770	758720
Charley Ross shaft	NW¼ sec. 32, T. 1 N., R. 71 E., Nevada	4199400	758930
Adit below Charley Ross shaft	NW¼ sec. 32, T. 1 N., R. 71 E., Nevada	4199290	758930
Adit southeast of Charley Ross shaft	Lot No. 2 sec. 32, T. 1 N., R. 71 E., Nevada	4199030	759030
Adit one-quarter mile west of Pope mine on northwest side of gully	SW¼ sec. 29, T. 1 N., R. 71 E., Nevada	4199770	758280
Adit one-quarter mile west of Pope mine on southeast side of gully	SW¼ sec. 29, T. 1 N., R. 71 E., Nevada	4199770	758280
Shaft on Bull Hill	NW¼ sec. 29, T. 1 N., R. 71 E., Nevada	4200580	758580
Adit one mile south of Buck Mountain	SW¼ sec. 4, T. 1 S., R. 71 E., Nevada	4196840	758650

[illegible], Aetna or Etna, E-2, E-1, Jennie, Thor or Talisman, Snowflake, Charley Ross, Pope, and an unnamed vein on Bull Hill. These veins all strike northwest with the exception of the Jumbo, an unnamed vein on Sigbee claim, the Pope, and the vein on Bull Hill. The Jumbo has a northerly strike. The unnamed vein on Sigbee claim, the Pope vein, and the unnamed vein on Bull Hill have a northeast strike.

Jumbo Vein

The Jumbo vein, the easternmost vein in the district, is in the eastern half of sec. 25, T. 33 S., R. 20 W., Utah. The outcrop can be traced on the surface for 2,500 feet (762 m); for the greater part of this distance it stands out in bold relief as a massive white quartz vein (figure 4). The vein strikes north and dips steeply to the east. The southern end of the vein is cut off by a fault; the northern end feathers out and is lost in the country rock. The vein is formed by filling with quartz an open fissure or breccia zone. The bulk of the vein material is white, massive quartz, crystalline quartz, and fine drusy quartz in vugs. Cavities and vugs are common through the vein. Very little calcite is observed in outcrop, but drilling indicates an increase in calcite with depth. At the apex, the vein is 50 feet (15 m) wide, and the silicified outcrop stands 20 feet (6 m) above the country rock. Sample 4-16-1 (table 2) is a 10-foot (3 m) cut across the vein at the apex against the hanging wall. The sharp contact of the vein footwall commonly produces a wall 10 feet (3 m) high in places. The heaviest silicification appears along the footwall; the hanging wall is indefinite and grades into the altered country rock. Inclusions or horses of partially silicified country rock are common in the vein.

A sample of ore was taken from the footwall at the southern end of the Jumbo vein at its intersection with a small northwest-striking vein. Panning the Jumbo vein in the field reveals abundant gold and an unidentified dark gray sulfide. This sample was submitted to Cather (1975) for determination of gold and silver mineralogy. The sample was crushed and separated by a heavy liquid; the residue heavier than the liquid, called the heavy fraction, was briquetted, polished, and examined with a reflecting microscope. Cather (1975) reported that the main gangue mineral was quartz and that gold was common, generally occurring as free grains in the polished section. The gold was pale suggesting dilution by silver. Argentite was also common and occurred as free grains up to 400 by 200 microns in size. Limonite was the other common constituent of the heavy fraction.

Jumbo Mine

Several excavations have been made on or near the Jumbo vein with the largest being the Jumbo mine. The Jumbo mine consists of a single compartment shaft, a crosscut from the west near the southern end of the vein, and an adit on a parallel vein. The shaft, approximately 100 feet (30 m) deep, is on the hanging wall of the vein (figure 5). A grab sample, 4-16-3, from the shaft dump is listed in table 2. Sample 5-12-1 is a grab sample of ore stockpiled on the shaft dump. According to Asher (1959) the vein was accessible by a crosscut adit from the west (this adit was caved in when the author visited the area in 1974). He stated that the vein had then been followed 100 feet (30 m) north and 100 feet (30 m) south. The crosscut showed a heavy gouge zone on the vein hanging wall. In the gully near the southern end of the vein, an adit was driven north for approximately 75 feet (23 m) on a parallel vein, which is 100 feet (30 m) west of the Jumbo vein. The portal of the adit is caved in, but access is possible through a 15-foot (5 m) shaft that intersects the adit about 50 feet (15 m) from the portal. From the bottom of the shaft the drift extends northeast 25 feet (8 m). A 3-foot (1 m) sample, 4-16-4, was cut in

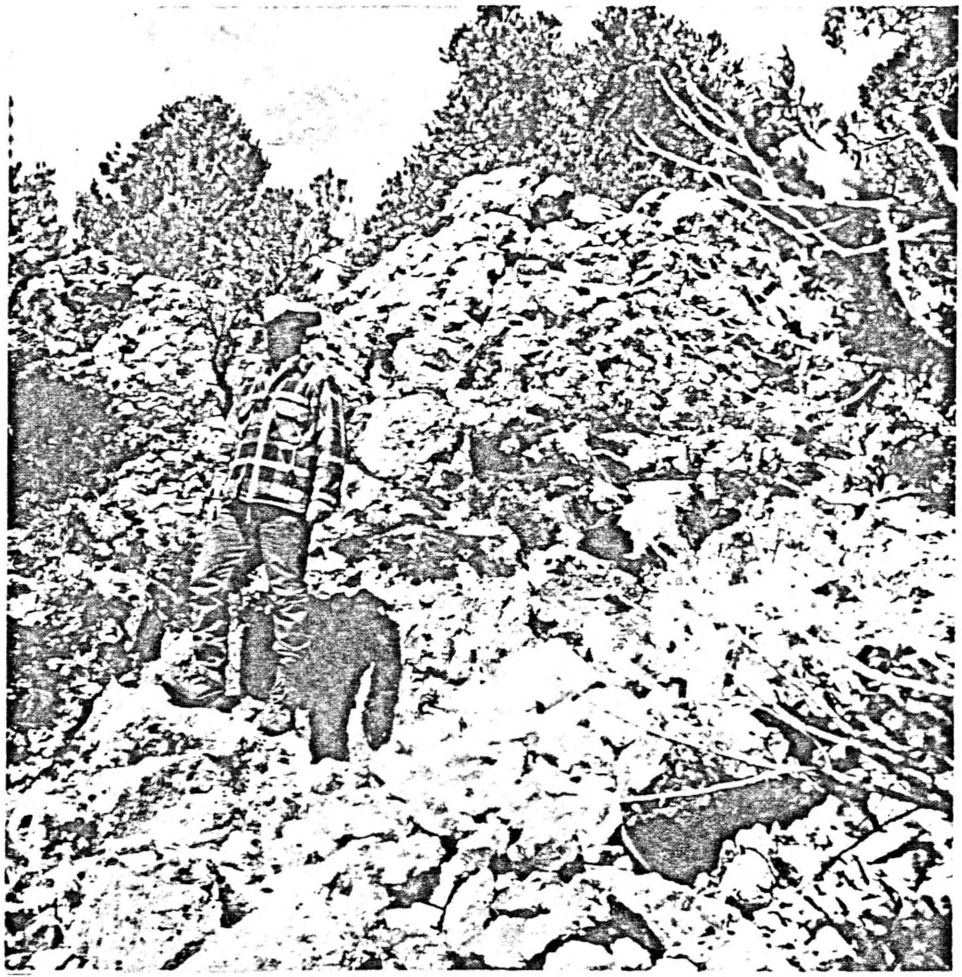


Figure 4. Jumbo vein, looking northwest. Note resistance to erosion caused by the hardness of the vein in relation to the country rock.

the face of the drift in the vein. The sample consists of quartz stained by limonite (table 2). Approximately 100 yards (91 m) south of the apex of the vein a 10-foot (3 m) shaft has been sunk on the vein. A grab sample, 5-12-2, was taken from the dump and is shown in table 2. East of the vein and about 100 feet (30 m) below the apex, an adit has been driven west to crosscut the vein. The portal is caved in, but material on the dump shows the vein was reached. The vein material on the dump is brecciated, altered country rock surrounded with quartz. A small amount of ore was stockpiled on the dump, and sample 4-16-2 is a grab sample from the pile on the dump.

Table 2. Assays of samples from Jumbo and Independence mines.

Sample number	Width	Gold (ounces/ton)	Silver (ounces/ton)
4-16-1	10 feet	0.010	0.4
4-16-2	grab	0.010	6.4
4-16-3	grab	0.080	0.8
4-16-4	3 feet	0.035	0.4
5-12-1	grab	0.120	26.5
5-12-2	grab	0.040	1.4
5-12-3	grab	1.020	3.9

Independence Vein

The Independence vein is in the central part of sec. 35, T. 33 S., R. 20 W., Utah, about 1,000 feet (305 m) west of the Jumbo vein. The exposure of the vein is not good, but where visible it is 2 to 5 feet (0.5 to 1.5 m) in width. Workings along the vein delineate its length, which is about 1,500 feet (457 m). The strike of the vein is variable ranging from N. 30° W. to N. 40° W.; the dip varies from 70 degrees south to steeply north. The Independence vein is composed of massive and crystalline quartz, calcite, and some limonite. The limonite is pseudomorphic after pyrite, and some residual pyrite is seen in the limonite. Native gold can be found in the pseudomorphs, suggesting that it was introduced with the pyrite. The gold is fine, but some can be seen with the naked eye.

Independence Adit and Shaft

The Independence adit is driven along the Independence vein about 800 feet (244 m) north of the road leading to the southern end of the Jumbo vein. The drift is caved in approximately 75 feet (23 m) from the portal, but the amount of dump material suggests workings of several hundred feet (figure 6). The material on the dump is moderately veined with quartz; a few fine blebs of native gold may be seen, especially in the limonite that is pseudomorphic after pyrite. A high-grade sample of the ore, listed as 5-12-3 in table 2, on the dump of the adit at the southern end of the vein contains visible gold.

A sample of ore from the dump of the Independence adit was submitted for examination to Cather who reported that microscopic examination revealed limonite as a common constituent of the heavy fraction. Some of the limonite was pseudomorphic after pyrite and contained residual cores of pyrite. Argentite and gold were scattered constituents, and both were generally free from locking. The vein can be traced northwest from the adit portal for about 200 feet (61 m) into the southern end of an open cut extending along the vein for about 400 feet (122 m). The open cut is approximately 5 feet (1.5 m) wide, and all of the vein material has been removed to an indeterminable depth (figure 7). Near the southern end of the open cut a small amount of vein material, containing residual pyrite and specks of native gold in blebs of limonite, was left on the east side of the excavation. The dump from the open cut is composed of altered andesite and quartz containing limonite.

The Independence shaft is approximately 75 feet (23 m) southwest of the northern end of the open cut. The shaft, cut on a small vein that is parallel to the Independence vein, dips 70 degrees south and is 200 feet (61 m) deep (*Salt Lake Mining Review*, 1903) (figure 8). A crosscut was probably run east from the shaft to inspect the Independence vein. The dump from the shaft contains a fresh, light blue andesite, a large amount of calcite, and a small amount of siliceous vein material. Two-hundred feet (61 m) south of the shaft, a 15-foot (5 m) pit exposes a 4-foot (1.3 m) quartz vein not seen on the surface that strikes N. 40° W and dips 65 degrees south. About 1,200 feet (366 m) northwest of the Independence shaft on the north side of Gold Springs Wash is a caved in adit that is driven along a 2- to 3-foot (0.5 to 0.75 m) quartz vein containing pyrite. The adit

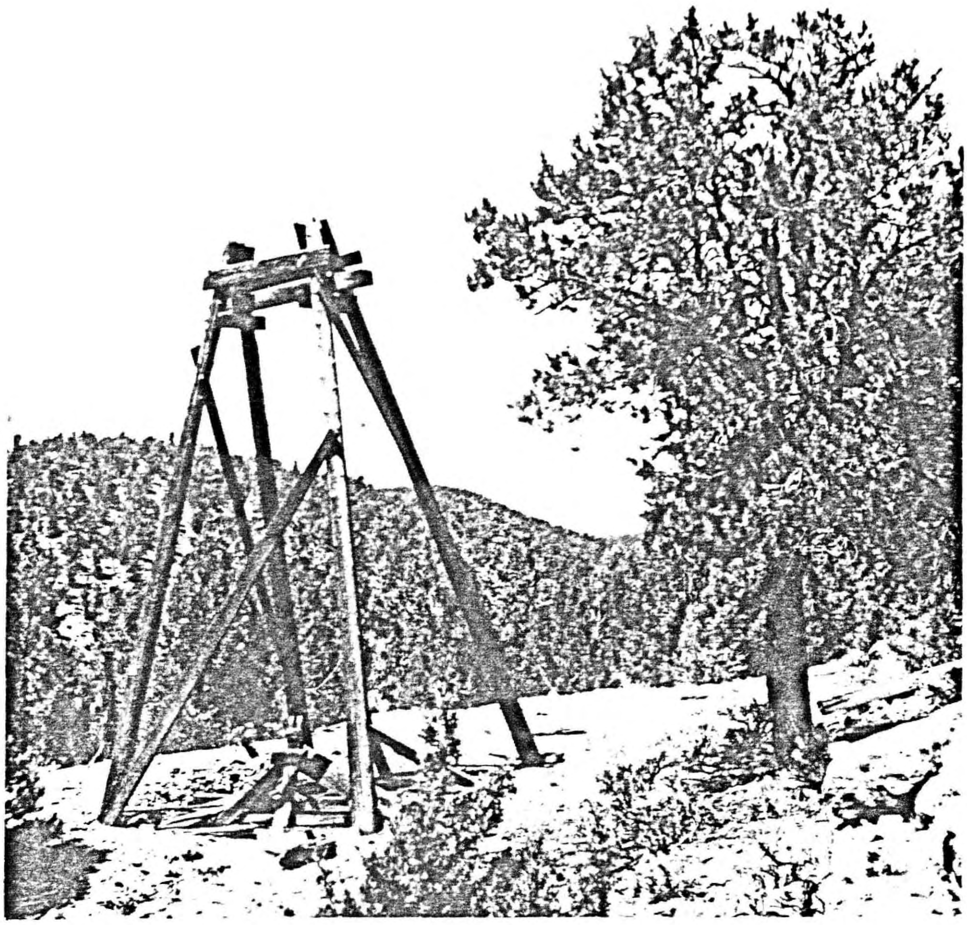


Figure 5. Jumbo shaft, looking southwest.

Figure 6. Independence adit. Arrow indicates the partly caved in portal as seen from the dump, looking northeast.

Figure 7. Open cut on the Independence vein as seen from the dump on the southern end, looking northwest.

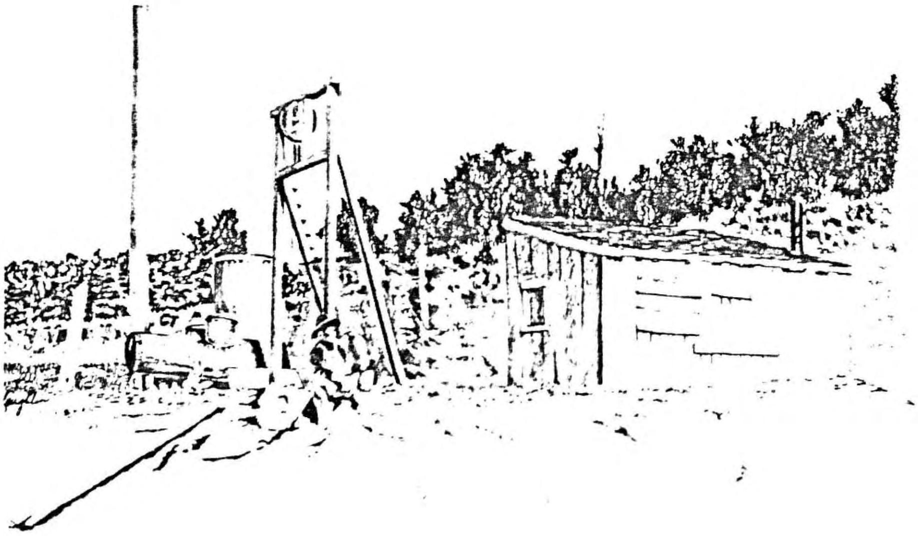


Figure 8. Illustration copied from a photograph in the *Salt Lake Mining Review* (1903) of the shaft of the Independence mine as it appeared in 1903.

is said to have about 700 feet (213 m) of workings (Haigh, oral communication).

Unnamed Vein on Sigbee Patented Claim

An unnamed vein crops out on the Sigbee patented claim striking N. 20° E. and dipping 70 degrees east. The vein can be traced for 800 feet (244 m) as a bold white quartz outcrop up to 15 feet (5 m) wide. Slickensides on the hanging wall side of the vein suggest postmineral movement. The hanging wall of the vein forms an abrupt contact with the country rock; in places the vein stands 20 feet (3 m) above the ground (figure 9).

Workings on the Unnamed Vein on the Sigbee Patented Claim

At least three prospects were dug on this vein in search of ore, but little or no ore was produced from them. According to Burgess (oral communication) the vein was sampled and panned in several places but with little or no color found.

Aetna (Etna) Vein

The Aetna vein is in the southern part of the study area with the northern end of the vein in sec. 36, T. 33 S., R. 20 W., Utah, and the southern end extending into sec. 1, T. 34 S., R. 20 W., Utah. The vein strikes N. 80° W. and dips 70 degrees west. In outcrop it appears as small quartz and calcite stringers, which thicken to 10 feet (3 m) at the Aetna mine.

Aetna Shaft

The main development on the vein consists of the Aetna shaft in the SW¼ sec. 36, T. 33 S., R. 20 W., Utah (figure 10). It is an inclined shaft with several hundred feet of workings on the 100-foot level and three winzes below this level to the 175-foot level. Figure 10 contains a map of the 100-foot level. The shaft is collared in the footwall of the vein and is inclined 69 degrees west. The vein is crosscut on the 100-foot level, 10 feet (3 m) west of the shaft, and drifts run north and south in the vein. The drift extends approximately 200 feet (61 m) north of the shaft station at which point it is caved in. The vein has been mined almost to the surface with a little ore left as pillars for support. Two winzes go below the level at 60 and 120 feet (18 and 37 m) north of the shaft station. These winzes connect to the 175-foot level but are flooded to within 10 feet (3 m) of the 100-foot level. A drift follows the vein south for at least 60 feet (18 m). At this point the vein is displaced by a postmineral fault. Close examination of slickensides on the fault surface indicates that the north side of the faulted vein rakes downward 51 degrees to the east for an unknown distance. A branching drift extends farther to the south but is caved in at the fault zone. Stoping above the level extends to a height of approximately 50 feet (15 m). Ten feet (3 m) south of the shaft station, a winze has been sunk below the level for an unknown distance. This winze, like the others north of the shaft, is filled to within 10 feet (3 m) of the level with water. The extent of stoping below the level is unknown owing to its flooded condition.

Other Workings

There are two small shafts and an adit on the Aetna vein besides the Aetna shaft. One shaft is approximately 400 feet (120 m) south of the Aetna shaft collar, and the other is near the southern end of the vein just north of Newels Spring. Both of these shafts are shallow and were not entered. An adit has been driven into the west side of the gully that parallels the vein to the east. The portal is approximately one-half mile (805 m) south of the Aetna mine and was driven into the hillside about 50 feet (15 m) above the bottom of the gully (plate 2a). The adit is driven N. 75° W. for approximately 225 feet (69 m), crosscutting several stringers of quartz and calcite. The stringers range from the width of a pencil to 6 feet (2 m). One 6-foot (2 m) vein is crosscut 190 feet (58 m) from the portal. From this point the vein is followed by the workings north for 60 feet (18 m). Intense argillic alteration and moderate to intense limonitic alteration is associated with quartz and calcite in the stringers and veins intersected by the crosscut. Two samples were taken in this adit and the results are shown on plate 2a.

An open cut about 150 feet (46 m) south of the Aetna shaft exposes the Aetna vein. Two samples were taken across a part of the vein in the open cut. The sampled vein consists half of stringers of quartz and limonite-stained calcite and half of silicified andesite. Sample PJ-3 is a 3-foot (1 m) cut; sample PJ-4 is a 3-inch (7 cm) cut across an intensely limonitically-altered calcitic-quartz part of sample PJ-3; results are shown in table 3. Sample PJ-4 was resampled and sent for examination to Cather, who reported that the gangue minerals were mainly quartz containing small amounts of limonite. The heavy fraction of a heavy liquid separation contained limonite, a small amount of pyrite, and gold.

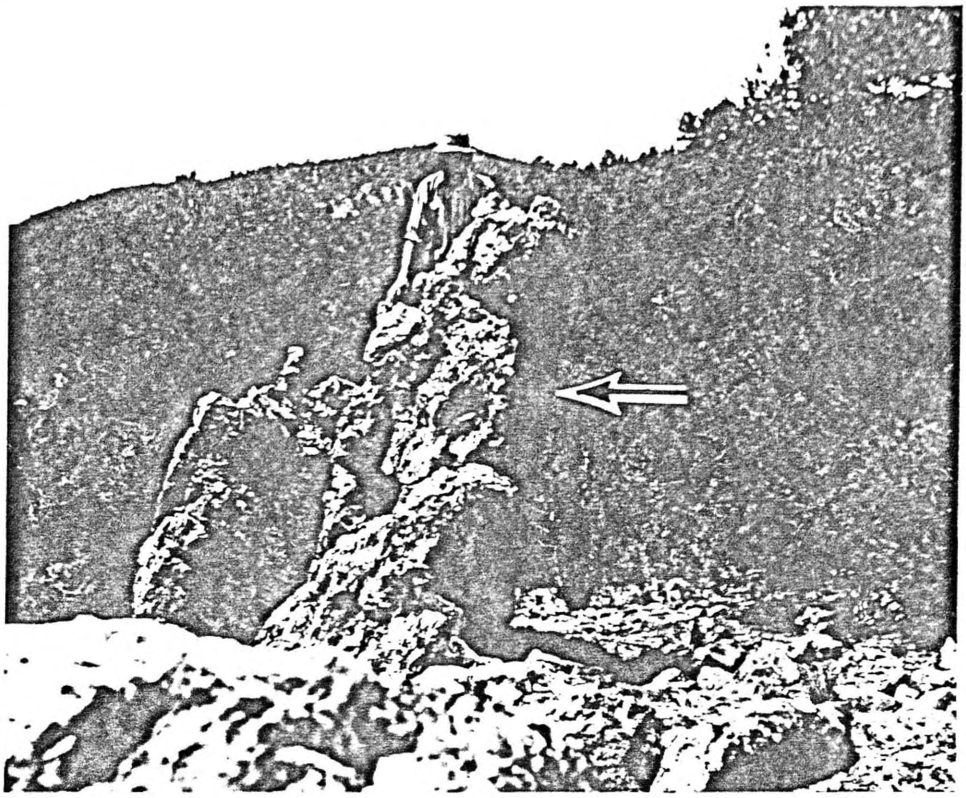


Figure 9. Unnamed vein on the Sigbee patented claim, looking south. Arrow indicates the contact of the sharp hanging wall with the country rock.

E-2 Vein

The E-2 vein in the southern half of sec. 26, T. 33 S., R. 20 W., Utah, strikes north and dips steeply to the west. The outcrop of the vein, with an average width of 2 feet (0.6 m), is traceable on the surface for about 400 feet (122 m). Much argillic alteration accompanies the vein, and intense alteration is found on the hanging wall of the vein. Quartz, hematite, and limonite are also in the vein.

E-2 Workings

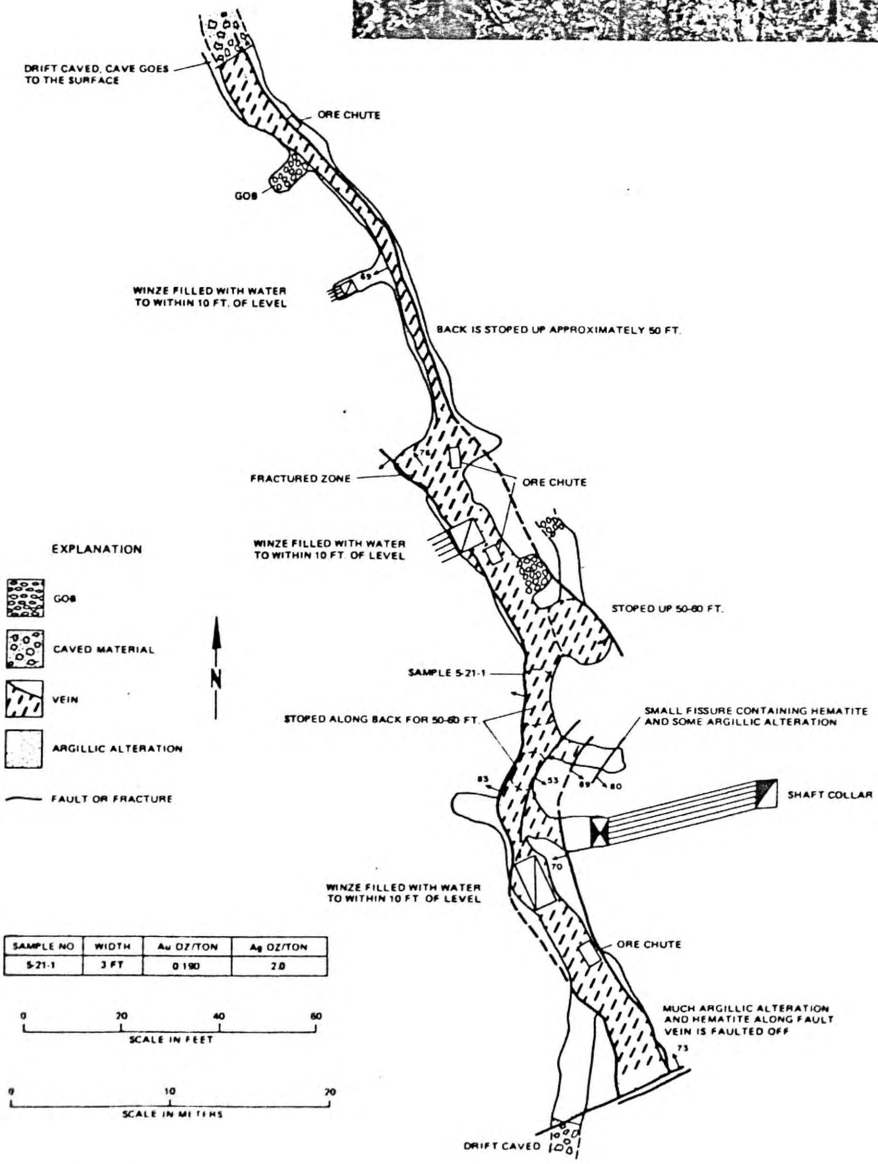
Development of the E-2 vein consists of a shaft and an adit, one on each side of the road between the Gold Springs townsite and the Jennie mine. The shaft on the downhill side of the road is sunk on the vein. At the time of the investigation the shaft was caved in, but the amount of material on the dump suggests that there is at least 50 feet (15 m) of workings. The adit is on the uphill side of the road, and its dump is adjacent to the road. The map of this adit is shown in plate 2b. The adit has 150 feet (46 m) of drifting along the vein. In the portal the vein is 2 feet (0.6 m) wide and consists of quartz and limonite. Much white clay, possibly kaolin, and hematite are on the hanging wall side of the vein, and some white clay is on the footwall side. The argillic alteration extends for a couple of feet on either side of the vein. Approaching the face of the drift the vein becomes less argillaceous, and the quartz disappears. Five samples were taken from the adit; the results are shown in plate 2b.

E-1 Vein

The E-1 vein, in sec. 26, T. 33 S., R. 20 W., Utah, lies between the Jennie and E-2 veins. The vein outcrop is subdued and can only be traced by float for most of its strike length. The vein is composed of quartz, calcite, and adularia. The adularia gives the vein a greenish yellow color that is characteristic of most of the veins in the area.

E-1 Workings

Workings on the E-1 vein consist of a shallow inclined shaft and a short adit. The shaft is inclined about 65 degrees and is 30 feet (9 m) deep. At the shaft collar, the vein is approximately 3 feet (1 m) wide but narrows to almost a foot (0.3 m) near the bottom of the shaft. The vein has been cut off in the bottom of the shaft by a fault striking N. 40° E. and dipping N. 70° W. The displacement along this fault is probably small. A



SAMPLE NO	WIDTH	Au OZ/TON	Ag OZ/TON
5-21-1	3 FT	0.190	2.0

Figure 10. Map of 100-foot level of Aetna mine. Photograph shows the Aetna mine and mill as seen from across the gully, looking southwest; arrow indicates the position of the shaft collar. Assay of ore sample is shown in table.

Table 3. Assays of samples from open cut, Aetna vein.

Sample number	Width	Gold (ounces/ton)	Silver (ounces/ton)
PJ-3	3 feet	0.730	2.3
PJ-4	4 inches	1.230	4.6

14-inch (36 cm) wide sample taken across the vein in the bottom of the shaft above the fault shows a trace of gold and 0.4 ounce of silver. Near the southern end of the vein a short adit has been driven along the hanging wall of the vein for about 25 feet (8 m). No stoping was done from the adit.

Jennie Vein

The Jennie vein is 4 to 6 feet (1.2 to 1.8 m) wide with some swells of 10 to 20 feet (3 to 6 m). According to Standish (1939) the vein occurs in andesite and is intersected at intervals by 4- to 24-inch (0.1 to 0.6 m) ore stringers which branch out at acute angles from the main vein. The junctions of the stringers and the vein provide thicker vein material and a concentration of gold and silver. The vein, which strikes N. 15° W. and dips 55 to 70 degrees east, is composed of quartz and calcite and has well-defined walls. Standish reported that the best ore is found "in the hard blue quartz, which carries about 35% free milling gold, and the balance are in the oxides of iron." The vein material fills an open fissure and is distinctly banded and crustified. Standish reports that the calcite was first to form and later replaced by quartz and adularia.

Jennie Mine

The Jennie mine on the Jennie vein is the largest producer in the Gold Springs district (figure 11). It is on the Utah-Nevada border on the western edge of sec. 26, T. 33 S., R. 20 W., Utah. Mining had commenced at the turn of the century, but production was first reported in 1907 and last in 1948, although no substantial production was reported after 1937. According to the U. S. Bureau of Mines the total production of the Jennie mine is 16,391 tons of ore containing 3,647 ounces of gold, 21,535 ounces of silver, 70 pounds of copper, and 140 pounds of lead. This total gives an average grade for the ore at 0.22 ounce of gold and 1.3 ounces of silver per ton.

The Jennie mine has been developed on the 60-, 100-, 200-, and 300-foot levels. The levels are serviced by a single compartment shaft collared on

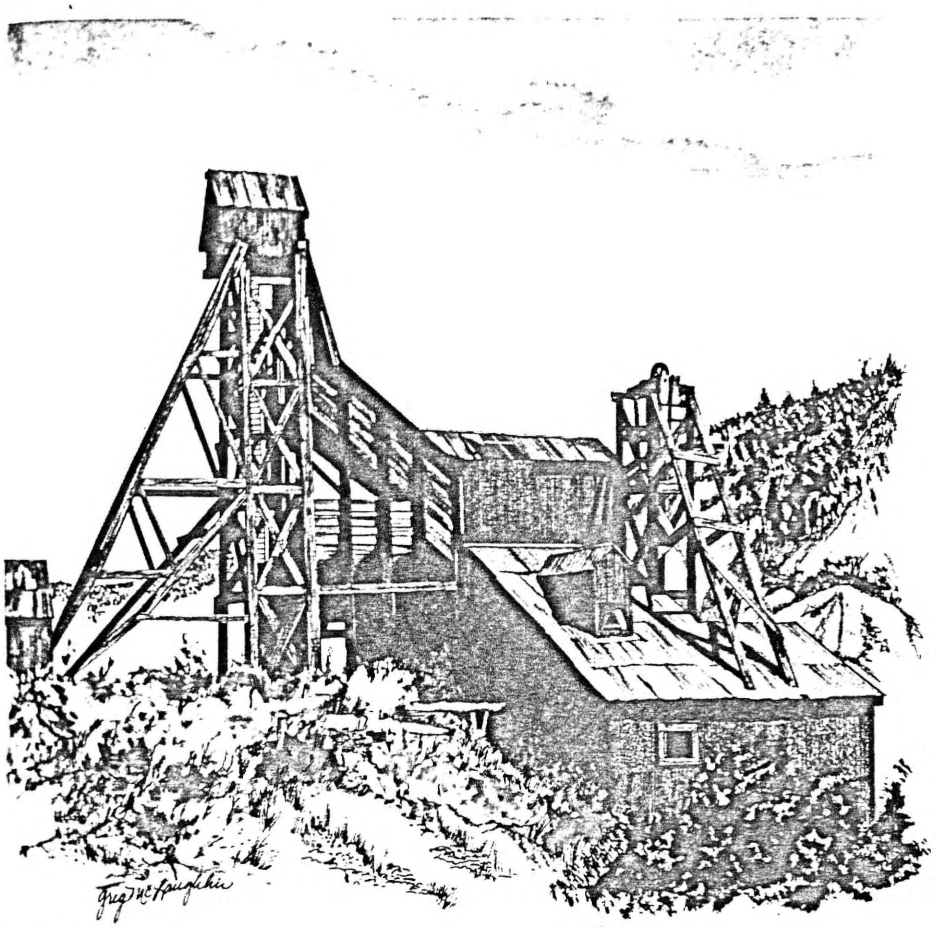


Figure 11. Headframe and rock house of the Jennie mine as seen in 1974 from the dump, looking north.

the hanging wall side of the vein and bottomed on the footwall side. The vein is cut by the shaft between the 60- and 100-foot levels. Development on the levels follow the vein northwest and southeast of the shaft. A composite level map and two cross sections by Standish (1939) are included as figures 12, 13, and 14. Figure 13 is a N. 45° W. longitudinal section through the mine. Figure 14 is a N. 75° E. section across the vein.

An attempt was made by the author to examine the workings of the Jennie mine in May 1975. The 60-foot level north of the shaft was open, and no additional work appeared to have been done other than shown in figure 15. Forty feet (12 m) south of the shaft the drift is caved in, and the workings past that point could not be examined. The 100-foot level was reached through the stopes from the 60-foot level north of the shaft. This level was open for approximately 75 feet (23 m) south of the shaft at which point it was caved in. North of the shaft the drift, open for 50 feet (15 m), was examined. On the 100-foot level the footwall of the vein consists of 6 to 8 feet (1.8 to 2.4 m) of white- to gray-banded calcite. This part of the vein has been left intact, and 4 to 5 feet has been mined on the hanging wall of the vein. The back of the stope was sampled approximately 50 feet (15 m) north of the shaft; assays show a trace of gold and 0.2 ounce of silver to the ton. An ore chute is open just south of the shaft from the 100-foot level to the 200-foot level, but it was not explored because of badly caving ground.

The cross section (figure 15) by Ferri shows that the Jennie vein was cut off above the 300-foot level. This is explained by Mallory (1928) (figure 16) to be the result of a series of north-south faults dipping to the west that have cut the Jennie vein into at least four segments. According to Mallory, the faulted segments from the west to the east are the Thor or Talisman, Jennie, and the E-1. He suggests that an undiscovered vein segment would be found to the east of the E-1 vein (figure 16). The surface was examined in the vicinity of the Jennie mine for these faults, but owing to heavy soil cover and abundant vein float no evidence could be found to support or disprove Mallory's idea. Block's mapping (1972) of the surface does not show any north-south faults in this area. Perry (this paper) found vein float just below the contact of the andesite and lithic crystal tuff on the hill northeast of the Jennie by which he infers the possibility of a concealed vein as suggested by Mallory.

A fault striking N. 80° E. and dipping 55 degrees south has displaced the Jennie vein north of the shaft. According to Mallory this north fault block is displaced 147 feet (45 m) to the east. No drifting has been done to look for the faulted part of the vein. Float located northeast of the Jennie implies that the displaced vein might be under Jennie Hill but is concealed by the lithic crystal tuff.

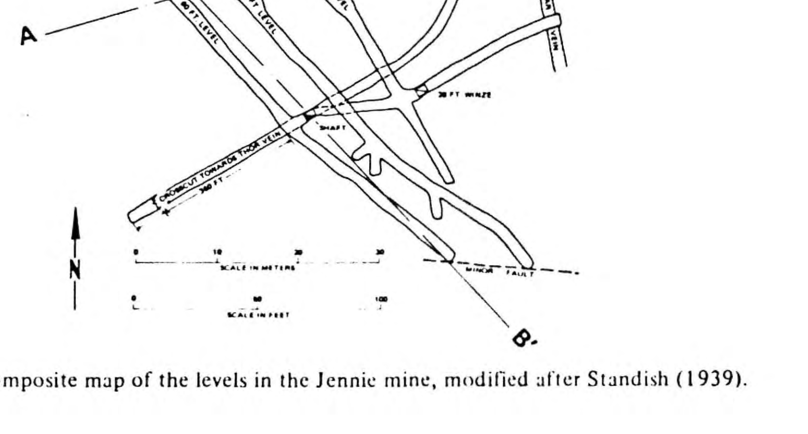


Figure 12. Composite map of the levels in the Jennie mine, modified after Standish (1939).

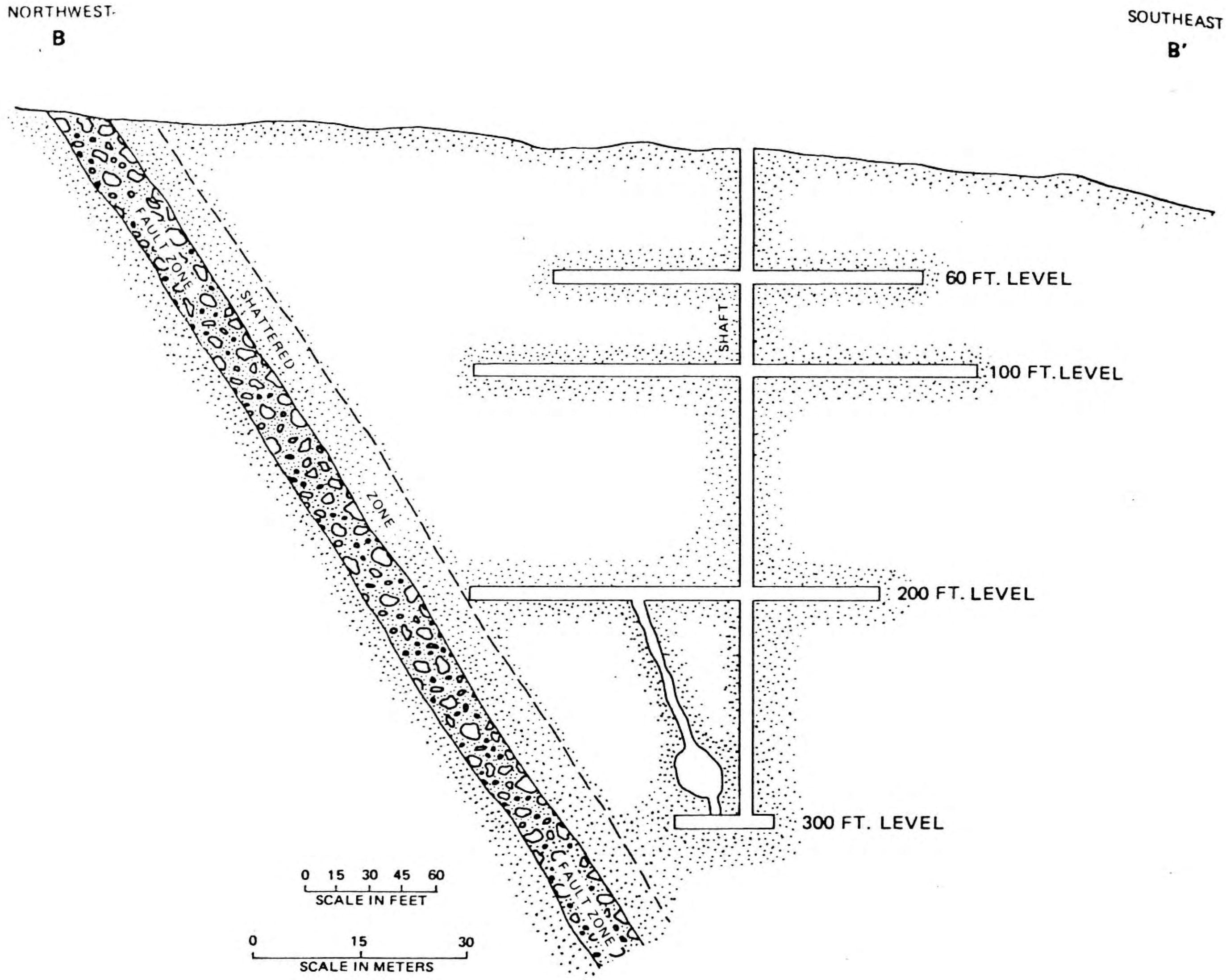


Figure 13. Inclined section of Jennie mine through B-B' (see figure 12), modified after Standish (1939).

Vein Cut by Uvada Tunnel

A vein is intersected by the Uvada tunnel, which is approximately 800 feet (244 m) northwest of the Jennie shaft. This is probably the northern end of the offset Jennie vein. The vein ranges from 2 feet (0.6 m) to 4 feet (1.2 m) and averages 3 feet (1 m) in width. The vein is mostly calcite that is stained with manganese. Disseminated and blebby manganese oxides are throughout the calcite in the vein.

Uvada Tunnel

The Uvada tunnel (plate 2c) was driven to crosscut the Thor and Jennie veins. From the portal to the face it is 960 feet (293 m). One major vein, 520 feet (158 m) from the portal, is crosscut in the workings. The entire length of the adit is in andesite that is slightly to intensely fractured and contains argillic alteration. Stringers of calcite are common, ranging from one-sixteenth of an inch (1 mm) to a foot in width. An area of massive calcite, 25 feet (8 m) in width and approximately 50 feet (15 m) from the face, may possibly be the Spar vein in the Jennie mine (figure 12). A calcite vein containing manganese oxides, which is probably the Jennie vein, was intersected 520 feet (293 m) from the portal, and a drift was driven along it to the north for 170 feet (52 m). Three samples were taken along this vein, and only one showed gold and silver. Assays from the Uvada tunnel are shown in plate 2c.

Thor (Talisman) Vein

The Thor vein is in the SE¼ sec. 32, T. 1 N., R. 71 E., Nevada, approximately 600 feet (183 m) west of the Jennie mine. The vein is poorly exposed but can be traced for approximately 1,000 feet (305 m) on the surface. The vein strikes N. 20° W. to N. 15° E. and dips 55 degrees east. The vein, which ranges in width from 2 to 20 feet (0.6 to 6 m) with the widest point near the central part of the vein, consists of much calcite, adularia, and a small amount of quartz.

Thor Workings

The main workings on the Thor vein consist of two open cuts and two adits. The adits intersect the vein approximately 50 feet (15 m) vertically below the surface outcrop (figure 17). The Thor adit (plate 2d), driven in an easterly direction for 240 feet (73 m), crosscuts the Thor vein 65 feet (20 m) from the portal; at this point a drift follows the vein south for 140 feet (43 m). No stopes were developed in the drift to the south. At 120 feet (37 m) from the portal another drift to the south was driven along a small calcite fissure. Seven samples were taken in the Thor underground workings; the results are shown in plate 2e. Another adit was driven to cut the vein south of the Thor adit. The portal is near the ore bin and was caved in at the time of visit. From the open cuts on the outcrop the ore has been along the hanging wall of the vein. This rock is mostly calcite and a little adularia and quartz. Some native gold can be seen with a hand lens and can be concentrated by panning.

Surface buildings consist of the remains of three cabins that served as tool shops or living quarters. An inclined track runs from the open cuts to an ore bin at the level of the Thor crosscut. From the open cuts the grade of an old track can still be seen going south around the hill to the Herzog mill in the bottom of the gully southeast of the workings. Other workings on the Thor vein consist of at least two small prospect pits near the southern end of the vein.

A sample from the hanging wall of the vein in the largest open cut southeast of the Thor adit was submitted to Cather. In the sample, gold, which can be seen with the hand lens, is associated with limonite. According to Cather's report the sample consisted "primarily of coarsely crystalline quartz, subordinate adularia, and minor amounts of limonite. Gold was seen primarily as free grains ranging up to almost 0.25 millimeters. Some locking of gold with limonite was also seen."

The Thor vein is cut off by post-mineral faults on both ends. In addition the fault on the north displaces the Jennie vein in the Jennie mine. The fault on the southern end of the vein terminates the known outcrop of the Thor and also cuts the E-2 vein located 1,500 feet (457 m) to the east.

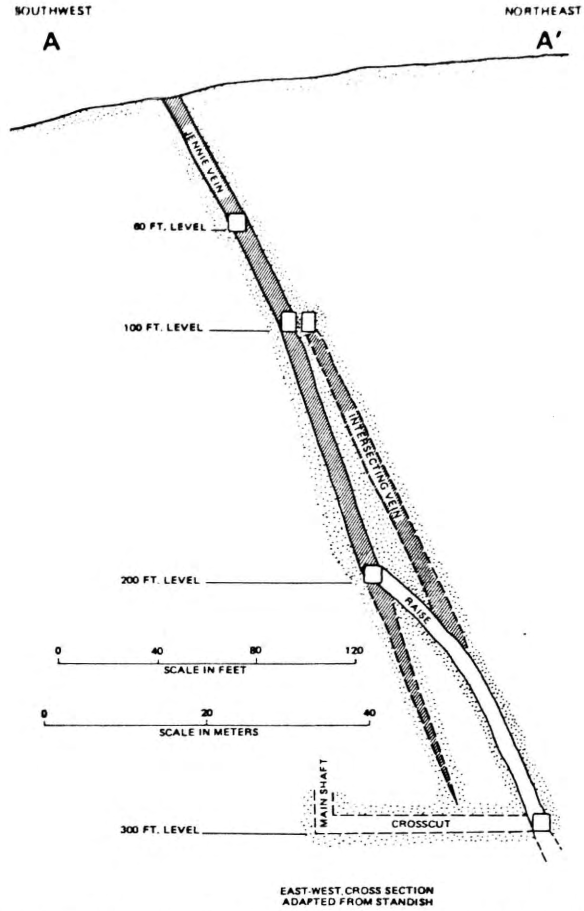


Figure 14. Vertical section of Jennie mine through A-A' (see figure 12), modified after Standish (1939).

Vein on Bull Hill

A vein on Bull Hill in SE¼ sec. 29, T. 1 N., R. 71 E., Nevada, strikes N. 20° E and dips steeply to the west; it averages 2 feet in width but has swells up to 3 feet wide. The vein consists of purple and green fluorspar and some hematite containing gold and silver. Purple fluorspar is much more common than the green. The hematite-rich material on the shaft dump will yield good color in the pan.

Shaft on Bull Hill

A shallow shaft, 30 feet (9 m) deep, has been sunk into the vein on Bull Hill (figure 18). In the bottom of the shaft the vein splits into two stringers, each one foot wide. An attempt has been made to upgrade the ore from the shaft by screening the ore and retaining the fine-grained gold-bearing hematite. The shaft was examined and samples were taken 25 feet (7.5 m) below the collar (table 4). Sample 5-12-1 is a grab sample of fluorspar and hematite from the shaft dump. Sample 5-12-2 is a grab sample from the dump of the fines that were saved after screening. Sample 7-17-1 is a 1-foot cut in purple fluorspar and hematite on the north side of the shaft 15 feet (5 m) below the collar. Sample 7-17-2 is a 1-foot cut across a stringer of purple fluorspar and hematite in the bottom of the northeast corner of the shaft. Sample 7-17-3 is a 1-foot cut across purple fluorspar and hematite in the bottom of the southwest corner of the shaft. Sample 7-17-4 is a 2-foot cut across purple fluorspar and hematite on the west side of the shaft 25 feet (7.5 m) below the collar.

Charley Ross Vein

The Charley Ross vein in the NW¼ sec. 32, T. 1 N., R. 71 E., Nevada, strikes N. 30° E and dips 72 degrees northwest; it is made up of quartz, calcite, and much dark red hematite stained clay. Argillic alteration has intensely altered the andesite wallrock to a whitish clay that is possibly kaolin. The outcrop of the vein is subdued and can be traced, although with difficulty, for 400 feet (122 m) on the surface.

Charley Ross Mine

The Charley Ross mine consists of an inclined shaft and an adit to explore the Charley Ross vein and the altered area associated with it. The Charley Ross vein is 1,000 feet (305 m) northeast of the Little Buck shaft. The shaft and adit are in the NW¼ sec. 32, T. 1 N., R. 71 E., Nevada. According to the *Salt Lake*

Table 4. Assays of samples from the shaft on Bull Hill.

Sample number	Width	Gold (ounces/ton)	Silver (ounces/ton)
5-12-1	grab	0.080	0.8
5-12-2	grab	0.430	0.6
7-17-1	1 foot	0.040	0.2
7-17-2	1 foot	0.020	1.1
7-17-3	1 foot	0.025	2.6
7-17-4	2 feet	0.085	0.2

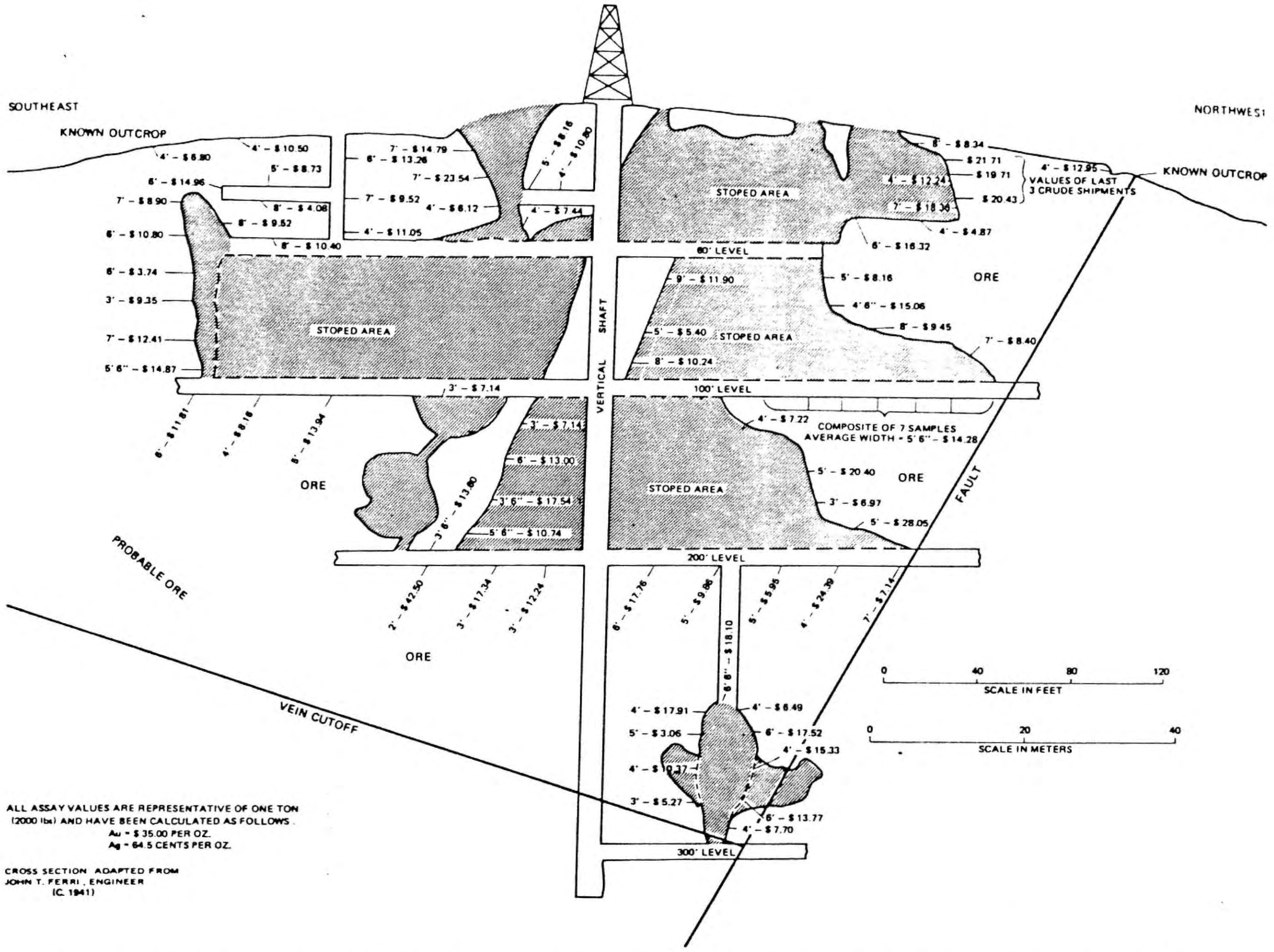


Figure 15. Inclined section of Jennie mine through B-B′ showing assay results (see figure 12), modified after Ferri (circa 1941).

Mining Review (1903) the shaft is 175 feet (53 m) deep. The shaft is inclined 72 degrees and has two small levels at 60 feet and 80 feet (18 m and 24 m) below the collar (figure 19). On the 60-foot level workings go northeast and southwest from the shaft. The northeast drift was not examined, but it had at least 40 feet (12 m) of working on the vein. The southwest drift was 50 feet (15 m) long. The 80-foot level has 45 feet (14 m) of drifting to the southwest along the vein. The vein has been stoped up about 10 feet (3 m) above the back of the drift. On the 80-foot level the vein is 6 to 8 inches (15 to 20 cm) wide and is composed of dark red hematite and quartz. The shaft is caved in at the 80-foot level and was not accessible below there. Four samples were taken; the results are shown in table 5. Sample 8-10-1 is a 6-inch (15 cm) cut in limonite 40 feet (12 m) southwest of the shaft on the 60-foot level. Sample 8-10-2 is a 2-foot (0.6 m) cut in a limonite-stained clay on the hanging wall of the vein, 40 feet (12 m) southwest of the shaft on the 60-foot level. Sample 8-10-3 is a 6-inch (15 cm) cut in hematite, 30 feet (9 m) southwest of the shaft on the 80-foot level. Sample 8-10-4 is a grab sample from dark red hematite that had fallen out of the back of the drift 25 feet (8 m) southwest of the shaft on the 80-foot level.

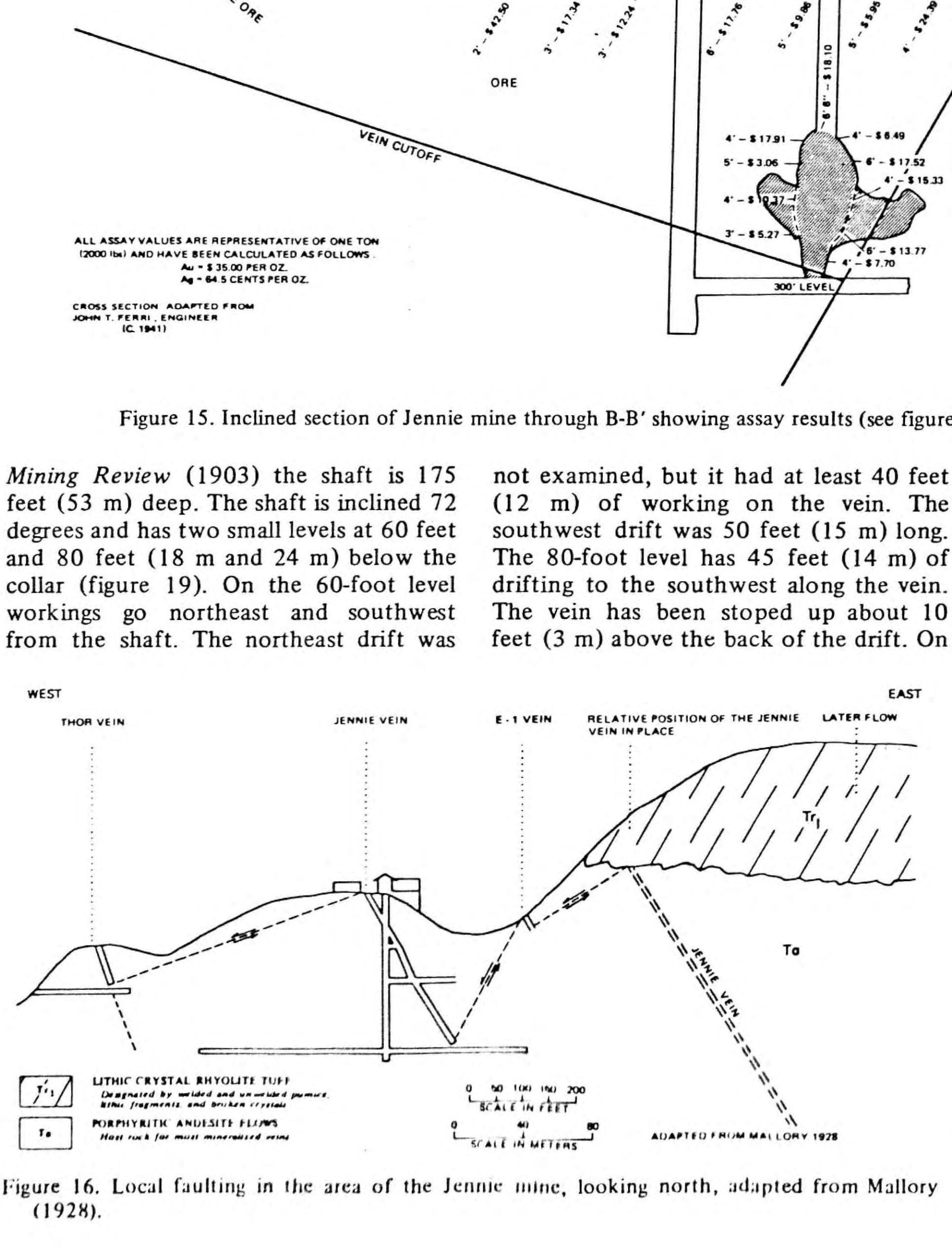


Figure 16. Local faulting in the area of the Jennie mine, looking north, adapted from Mallory (1928).

An adit was driven into the hill 400 feet (122 m) south of the Charley Ross shaft to look for the southern extension of the Charley Ross vein (figure 20). The adit cut and drifted along a fault zone accompanied by intense argillic alteration similar to that seen in the Charley Ross

Table 5. Assays of samples from the Charley Ross shaft.

Sample number	Width	Gold (ounces/ton)	Silver (ounces/ton)
8-10-1	6 inches	0.040	0.2
8-10-2	2 feet	0.005	none
8-10-3	6 inches	0.145	0.2
8-10-4	grab	0.040	0.2

shaft. The lack of stoping in the adit suggests that the metal value was not present in quantities of ore grade. After following the zone for 80 feet (24 m), the drifting continued to the northwest and failed to find minable rock. No samples were taken from this adit.

Snowflake Vein

The Snowflake, the largest vein complex in the district, is just over the Utah state line on the east side of Buck Mountain. Starting at Gold Springs Wash in sec. 4, T. 1 S., R. 71 E., Nevada, and going N. 15°-20° W. to the northern edge of sec. 32, T. 1 N., R. 71 E., Nevada, the strike of the complex can be traced about 6,800 feet (2,072 m). The Snowflake consists of several small veins or veinlets that range from 1-inch stringers to ones more than 20 feet wide (2.5 cm to 6 m). In places the complex is over 100 feet (30 m) wide but generally is around 50 feet (15 m) of stockwork-type mineralization. The veins are composed chiefly of calcite, quartz, and adularia and small amounts of limonite and pyrite. Boxwork derived from pyrite is common in the vein and suggests the presence of pyrite with depth (Asher, 1959). The presence of gold and silver is spotty and usually not in minable amounts. In the early days high-grade pockets and lenses were mined and shipped as smelting ore. The best concentrations of gold and silver seem to be where the main vein complex is cut by cross structures, which cause a swelling in the vein width. The Snowflake quarry was developed along several of these cross structures on the north end of Buck Mountain.

Several samples from different spots on the complex were crushed and panned, and gold was found in some. All of the gold seen was fine, and most was not visible to the naked eye. A sample taken from the open cut 100 feet (30 m) west of the Little Buck shaft was examined by Cather and was reported to be composed of quartz and small amounts of limonite. The gold present was up to 100 microns in diameter and was free from any gangue mineral. Some scattered pyrite was seen in the sample.

The principal workings on the Snowflake vein, listed from the north to

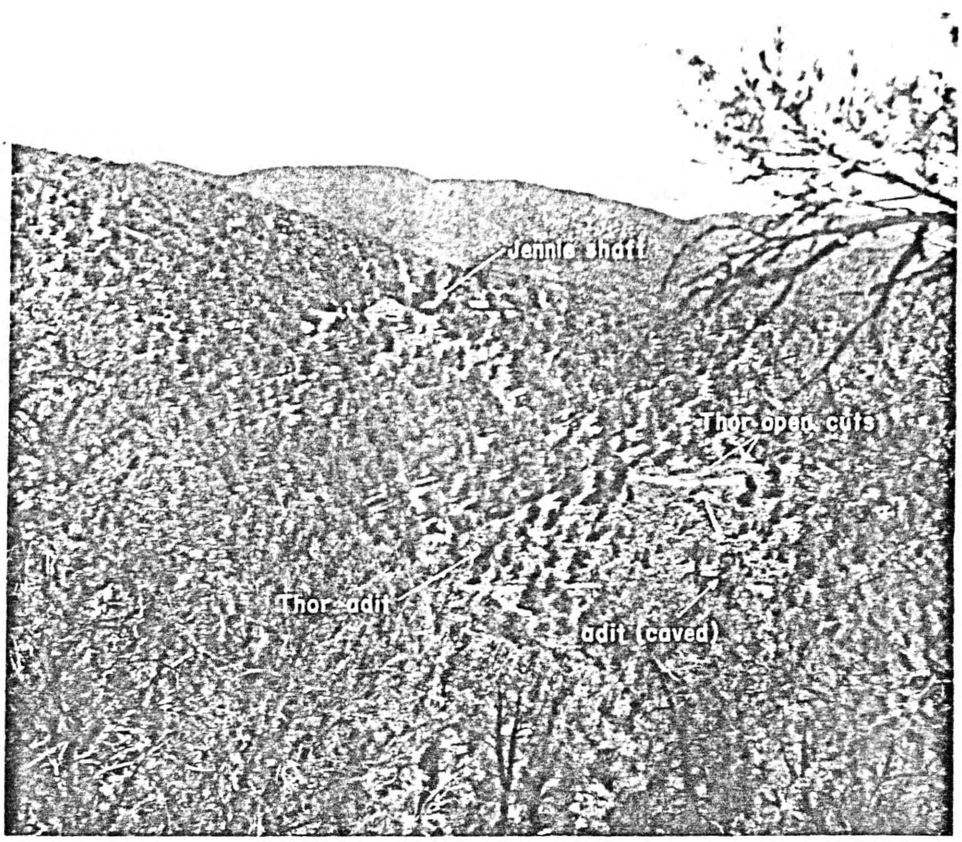


Figure 17. Workings on the Thor vein as seen from Buck Mountain, looking east.

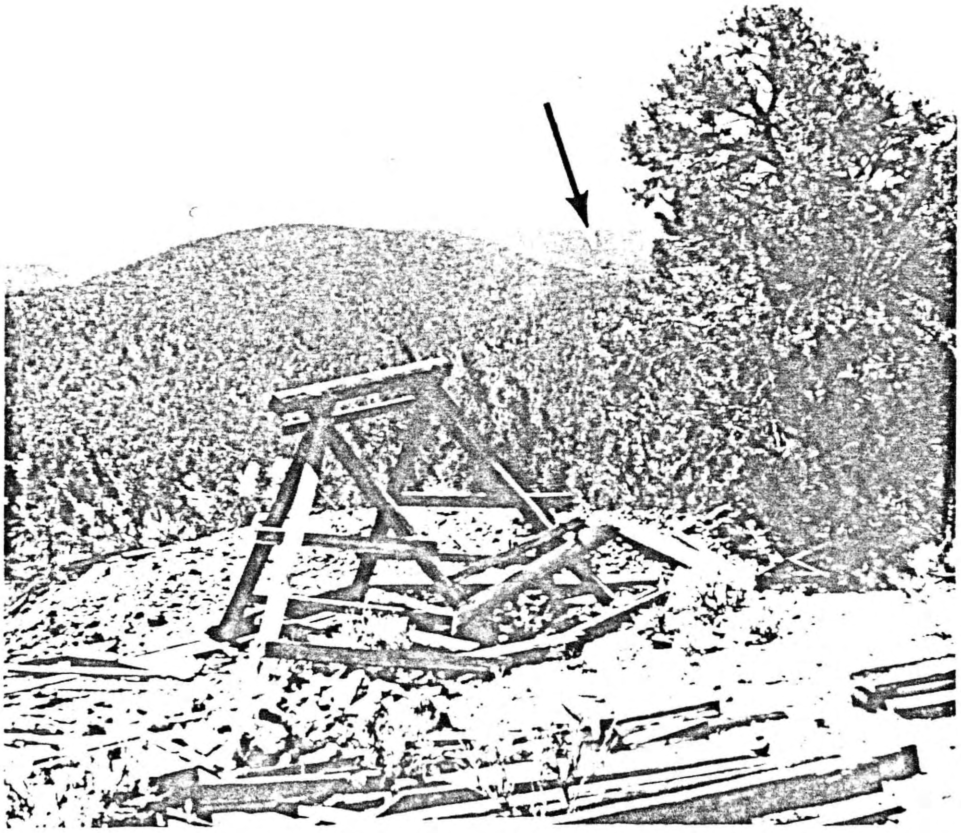


Figure 18. Shaft on the vein on Bull Hill, looking southeast. The Jennie mine, indicated by arrow, can be seen in the distance.

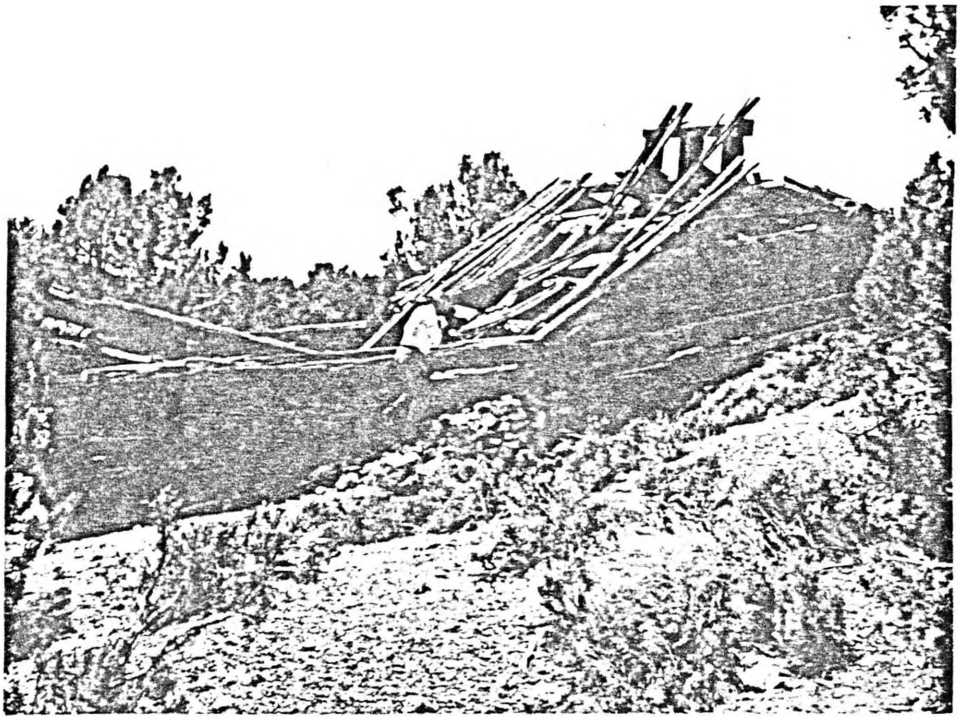


Figure 19. Headframe of the Charley Ross shaft, looking south.

the south, are the Little Buck mine, Big Buck mine, Snowflake quarry, and the Red Eagle mine. Several other prospects are at various points on the complex.

Little Buck Mine

The Little Buck (plate 2e), the largest mine on the Snowflake vein, possibly rivals the Jennie as the largest producer in the district. It is on Winner No. 2 patented claim near the head of Midnight Wash in the NW¼ sec. 32, T. 1 N., R. 71 E., Nevada (plate 1). The shaft is located on an eastern strand of the Snowflake vein called the Little Buck vein. The Little Buck vein, according to Young (1934), ranges in width from a few inches to nearly 3 feet: "At some places [in the Little Buck mine] there is a splitting or feathering out of the vein, but after a few feet the average width again develops." The strike is N. 20° W. dipping 70 degrees east, varying locally 10 to 15 degrees.

The Little Buck shaft is inclined 70 degrees and has four levels developed from it. These levels are cut off the shaft at 70 feet (21 m), 135 feet (41 m), 185 feet (56 m), and 270 feet (82 m). Plate 2e is a reproduction of a composite map of the Little Buck mine by Jensen (1935) for the Andesite Mining Company. According to this map the mine contains 60 feet (18 m) of drifts on the 70-foot level and 340 feet (104 m) of drifts on the 135-foot level. The 185-foot level is the most extensive in the mine, consisting of 180 feet (55 m) of drifts south of the shaft and 340 feet (104 m) of drifts north of the shaft for a total of 520 feet (158 m). The 270-foot level consists of drifts 90 feet (27 m) south of the shaft and 330 feet (101 m) north of the shaft for a total of 420 feet (128 m). The total for the four levels is 1,340 feet (408 m). The ore body was developed and mined by raising from the levels and stoping the ore between the levels. According to Young (1934) most of the ore above the 185-foot level had been mined at that time, and the only remaining ore with any significant tonnage was below the 185-foot level. Jensen (1935) reported the reserves of the mine at 4,619 tons on November 1935, with an average grade of 0.20 ounce gold and 2.5 ounces silver to the ton. The mine was operating at the time of Jensen's report, and this ore was probably extracted.

There has been little faulting in the Little Buck mine to displace the ore body, but premineral faults have been a factor in the control of the Little Buck vein. According to Young there is a fault on the north end of the 135-foot level striking N. 50° W. and dipping 38 degrees northeast. This fault is picked up on the 185-foot level as shown in plate 2e; the drifts following the vein bend around to the west. Young describes this fault as "probably premineral with a small post-mineral movement." He also describes a fault in a stope above the 270-foot level south of the shaft with 5 feet (1.5 m) of displacement and with the north side of the fault shifted eastward. Other small minor postmineral faults are mentioned by Young, but the displacement is less than 5 feet (1.5 m) in all cases.

At the time of the author's visit the workings of the mine were inaccessible because the shaft was caved in 20 feet (6 m) below the collar. The surface plant is almost gone with only a shop building, headframe, and ore bin standing. The steam boiler and hoist are still on the mine property and are reproduced in figure 21 as they appeared in 1975.

Big Buck Mine

The Big Buck mine is on Winner No. 2 patented claim near the head of Midnight Wash in the NW¼ sec. 32, T. 1 N., R. 71 E., Nevada (figure 22). The shaft collar is 650 feet (198 m) southeast of the Little Buck shaft. The Andesite Mining Company map by Jensen dated October 31, 1935, reproduced in figure 22, shows three levels at 30, 50, and 100 feet. The workings were examined by the author in 1974 but were not remapped. A sample was taken from the 50-foot level at the point designated in figure 22 as 5-1-1. This is a 1-foot cut across a calcite and quartz vein containing some limonite, its analysis showed 0.170 ounce of gold and 0.3 ounce of silver to the ton. The vein sampled appeared to be from a parallel or branch vein other than the one that was mined above the 50-foot level. The drifts on the 50-foot level are open with the exception of the N. 80° W. drift which was caved in. The 100-foot level was examined and appears as shown on Jensen's map. The drift going to the south from the shaft station is along a 3 to 6 inch (7 to 15 cm) vein; no stoping was done on this level south of the shaft. Extensive stoping has been done on and above the 50-foot level with stopes up to 20 feet (6 m) wide extending to the surface. The ore seems to have pinched out with depth, and the only evidence of ore on the 100-foot level is in the 3-inch to 6-inch (7 to 15 cm) vein. Jensen's map shows up to 2 feet of ore on the 100-foot level with 0.15 to 0.25 ounce of gold to the ton, but no samples were taken to verify this.

Just north of the Big Buck shaft is a postmineral fault that strikes N. 55° W. and dips steeply to the northeast. This fault offsets the northern end of the Snowflake vein complex a little over 100 feet (30 m) to the west. The Big Buck shaft is on a vein on the west side of the

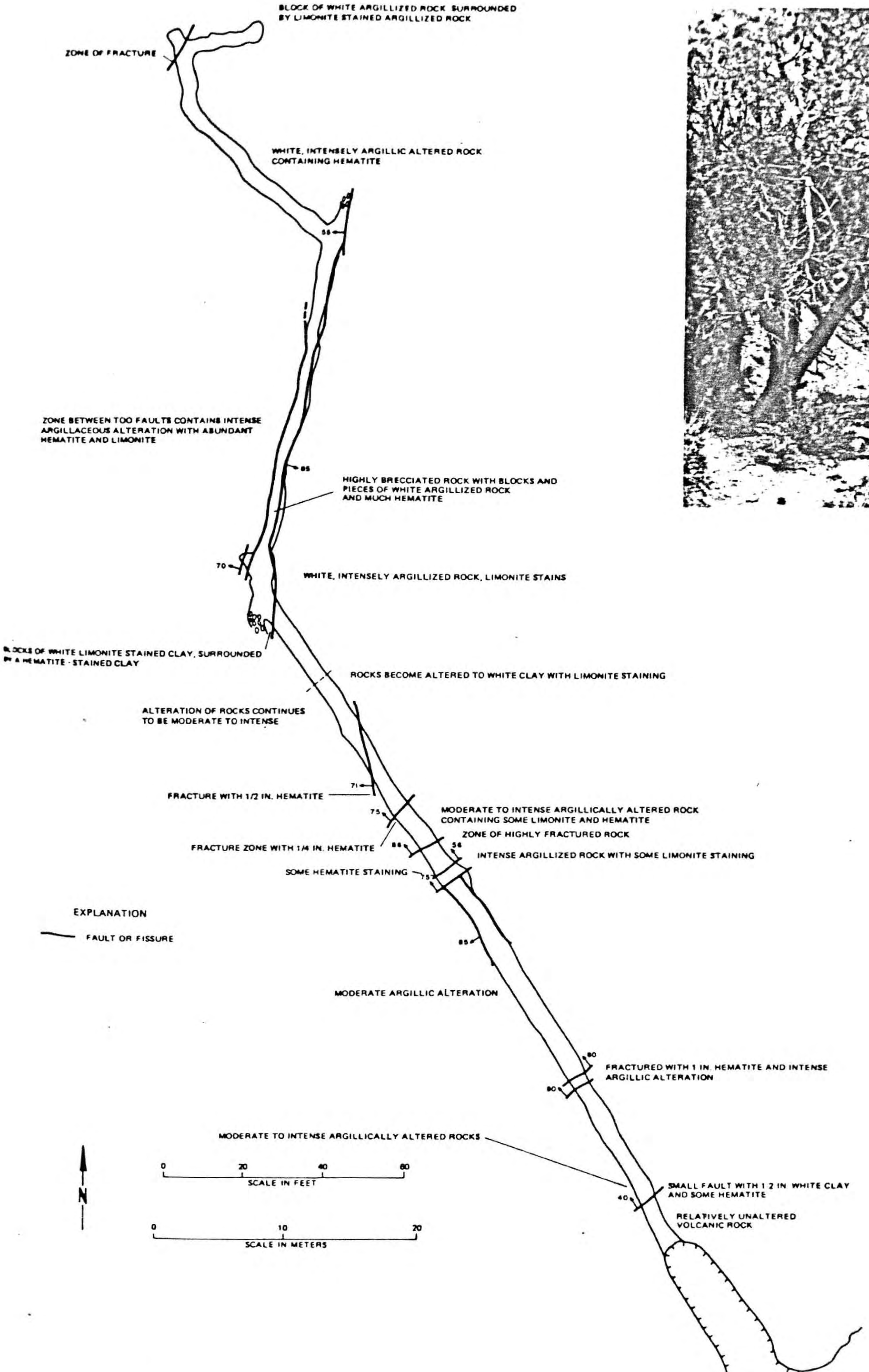


Figure 20. Map of Charley Ross adit, looking northwest. Photograph shows the partly caved in portal, indicated by arrow.

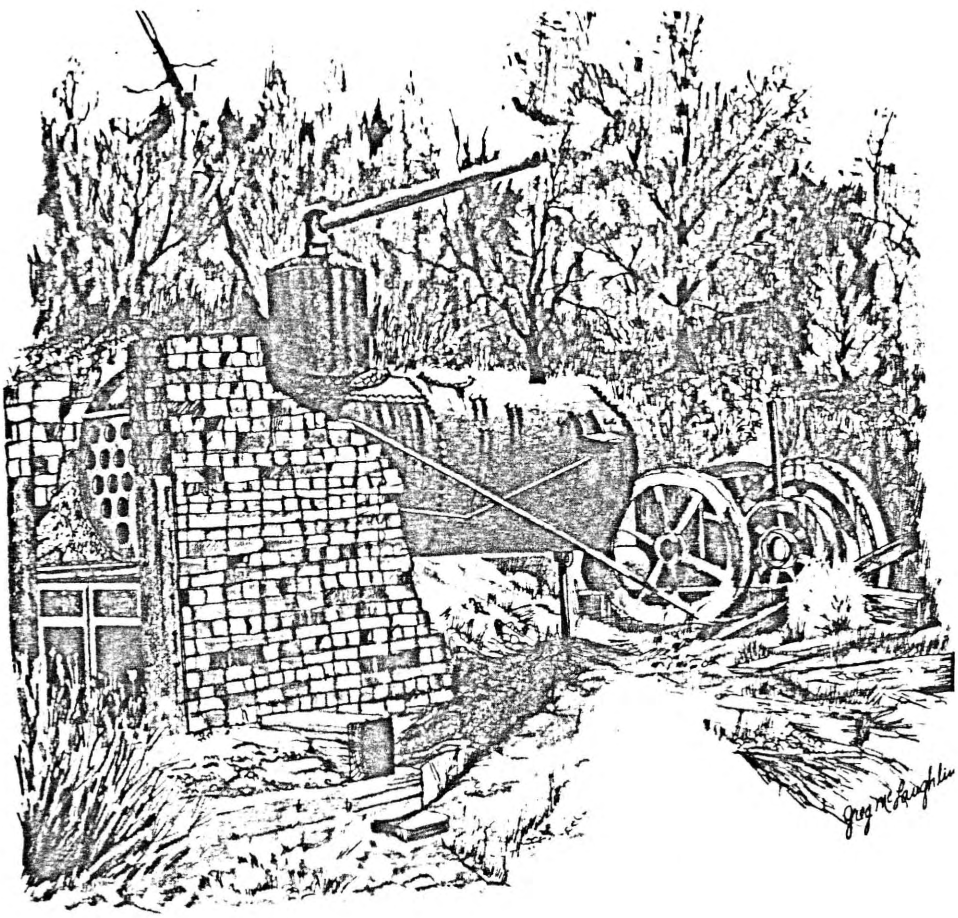


Figure 21. Steam boiler and hoist of the Little Buck mine as seen in 1974.

Snowflake vein complex, whereas the Little Buck is on a vein that is on the east side.

Snowflake Quarry or Glory Hole

The Snowflake quarry (figure 23) is in the W½ sec. 32, T. 1 N., R. 71 E., Nevada, on the Snowflake patented claim. The quarry is a large glory hole on the Snowflake vein complex where several quartz stringers crossing the complex cause an increase in vein width and value. According to Young (1934) several thousand tons of ore had been mined from the quarry prior to 1934. He reports 550 tons of ore taken from an underhand stope in the quarry that was milled at the Horseshoe mill in Fay, Nevada, and which returned $9.91 a ton (this ore was milled when gold was $20.00 an ounce). Young (1934) reported "a substantial tonnage of ore that will run about 0.185 oz. in gold and 2.2 oz. in silver" around the quarry. No samples were taken from the quarry for assay, although some samples were panned and showed color.

A tunnel was driven about 180 feet (55 m) vertically below the quarry to cut the vein complex at depth. Although the tunnel was driven below the quarry, the vein was not found. Young (1934) reported that "a flat northwest fault passes underneath the quarry and has displaced the vein." Figure 24 is a plan and cross section of the quarry and tunnel taken from Young's report to the Andesite Mining Company in 1934.

Red Eagle Mine

The Red Eagle mine is on the patented Snowflake No. 2 claim on the east slope of Buck Mountain approximately one-fourth mile southwest of the Jennie mine. It is driven into Buck Mountain to intersect the Snowflake vein and has about 200 feet of workings. The mine workings consist of several prospect holes and an adit that is driven S. 70° W. for 70 feet (21 m), crosscutting a 15-foot (5 m) zone of calcite approximately 10 feet (3 m) from the portal (plate 2f). The calcite is bladed and associated with quartz and much hematite. The workings follow the calcite S. 30° W. for 45 feet (14 m), along which some stoping was done. At a point 45 feet (14 m) from the portal, a drift is driven S. 45° W. for approximately 90 feet (28 m) and crosscuts a fault containing clay and hematite. On the hanging wall of the fault is a zone of massive calcite and some quartz. The calcite is brecciated along the fault and has been recemented with calcite. Some stoping has taken place in the calcite on the hanging wall of the fault. The stoping extends upward for about 20 feet (6 m) above the back.

Pope Mine

The Pope mine is in the SW¼ sec. 29, T. 1 N., R. 71 E., Nevada (figure 25). The Pope vein on which the mine is located is different from any other vein in the district in that it has a strike of N. 60°-65° E. and a southeast dip that varies from steep to vertical. The vein is narrow, averaging 2 to 6 inches (5 to 15 cm) in width, but is ore grade. The shaft is inaccessible, so the examination of the vein was restricted to the surface. Prospects and open cuts follow the vein outcrop for most of its 1,200 foot (366 m) strike length. The vein was sampled in three places and the results are shown in table 6. Sample 5-25-1 was taken 50 feet (15 m) west of the shaft in the east end of the open cut that crosses under the road. At this point the vein was 2 to 3 inches (5 to 8 cm) wide. Sample 5-25-3 was taken at the west end of the open cut 50 feet (15 m) east of the Pope shaft. The vein is 4 inches (10 cm) wide at the point of sampling. Sample 5-25-4 was taken in the open cut 100 feet (30 m) east of the Pope shaft. Some fine gold can be seen with a hand lens at this sample location. The vein was 4 to 6 inches (10 to 15 cm) wide at this sample location.

A sample was taken 50 feet (15 m) west of the shaft in the east end of an open cut and sent to Cather for examination. Cather (1975) reported the sample to be "mainly quartz with small amounts of limonite." Gold was found in the heavy fraction as "free grains up to about 50 microns. Gold up to 15 microns occurs locked with limonite. Tourmaline is a sporadic constituent of the sample." A single grain of chalcopyrite was also seen in the heavy fraction.

Miscellaneous Workings

Twelve hundred feet (366 m) west of the Pope mine in the bottom of the

Table 6. Assays of samples from the Pope vein

Sample number	Width	Gold (ounces/ton)	Silver (ounces/ton)
5-25-1	2-3 inches	0.580	3.3
5-25-3	4 inches	0.270	1.1
5-25-4	4-6 inches	0.630	1.9

gully is a shaft and three adits. The shaft and one adit were caved in and inaccessible, but the other two adits were mapped. The adit going into the southeast side of the gully has 300 feet (91 m) of workings (figure 26). Two veins were found; the first vein was followed to the south for 70 feet (21 m) along which no stoping was done. The second vein has an inclined winze going down for at least 40 feet (12 m) on a 3-foot (1 m) calcite vein. Sample 5-25-5 is a 2-foot (0.6 m) cut across this vein; analysis showed 0.020 ounce of gold and no silver per ton.

On the northwest side of the same gully, 1,200 feet (366 m) west of the Pope mine, an adit is driven to the north for 180 feet (55 m) where it meets a vein containing calcite and quartz (figure 27). This vein was followed for 30 feet (9 m) before the adit was abandoned. No samples were taken from this working.

An adit has been driven into the north side of Gold Springs Wash, one mile (1.6 km) south of Buck Mountain to prospect a minor north-trending quartz vein up to 6 inches (15 cm) wide (figure 28). The vein was followed for 35 feet (11 m) before it was abandoned. Near the face of the adit, two fractures with up to 1 inch (2.5 cm) of limonite were found and followed for 10 feet (3 m). No samples were taken from this working.

One thousand feet (305 m) south of the Charley Ross shaft in the bottom of a gully, an adit was driven to the west (figure 29). Two hundred feet of workings are in the adit that crosscuts a 7-foot (2 m) vein in a portal. The vein strikes north and dips steeply to the west. The workings follow the vein to the south for 70 feet (21 m) and then turn sharply to the northwest for 20 feet (7 m). From the portal the workings extend 95 feet (29 m) west, crosscutting four small veins besides the main vein. These small veins contain quartz, calcite, and limonite. Two samples were taken from the workings, and analysis showed a trace of gold and 0.1 ounce of silver to the ton.

PRODUCTION OF MINES

Records from the early mining years are incomplete, which makes it impossible to determine the actual production, although the district is credited with mining 21,941 tons of ore and producing 9,335 ounces of gold, [illegible],279 ounces of silver, 12,031 pounds of copper, and 19,268 pounds of lead. On some mines there are no records at all, and on others only incomplete ones are available. The Jennie mine recorded the

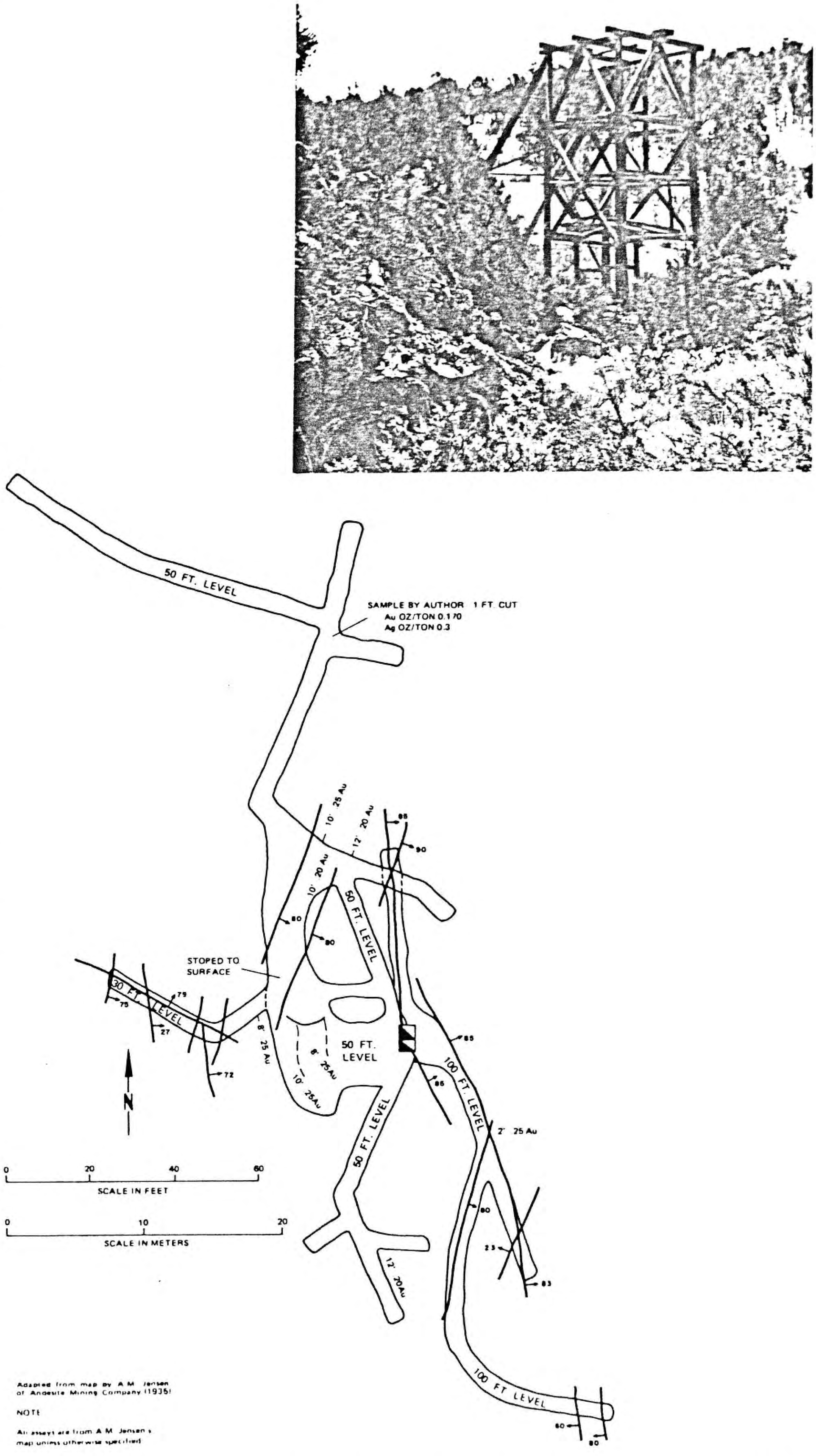


Figure 22. Composite map of the levels in the Big Buck mine, modified after Jensen (1935). Photograph shows the headframe of the Big Buck mine, looking southeast.

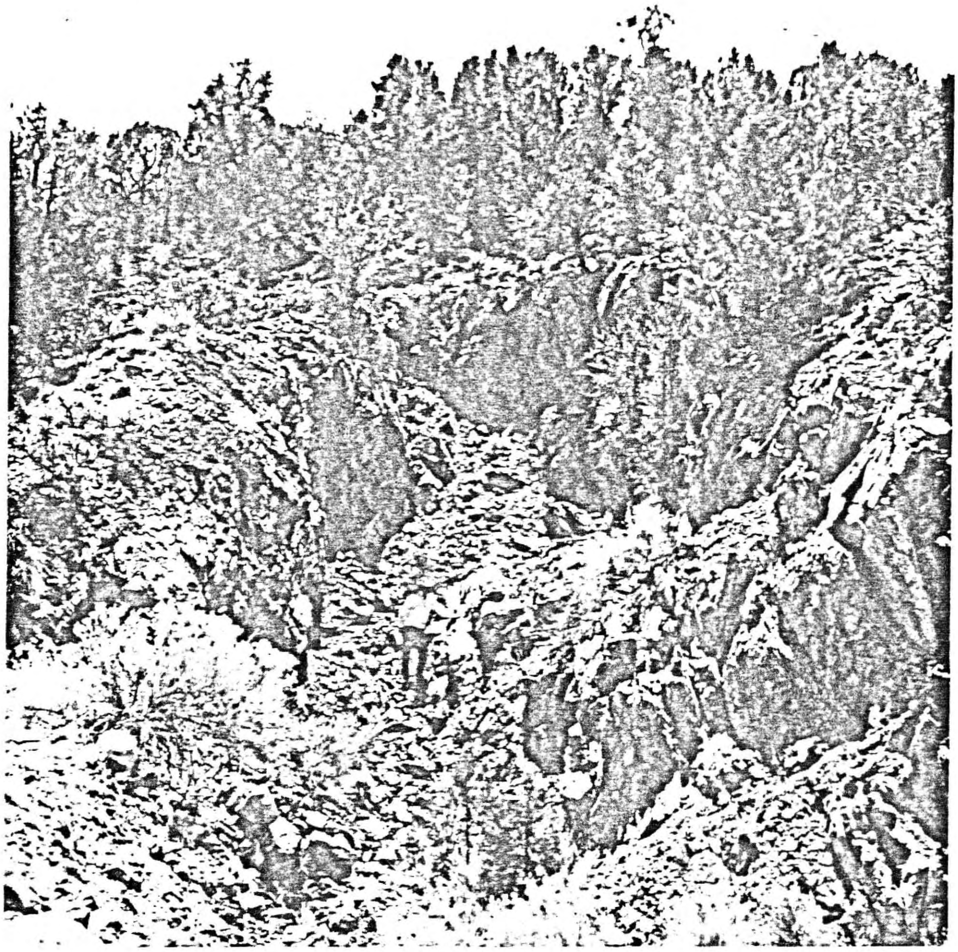


Figure 23. Part of the Snowflake quarry as seen from the dump, looking southwest.

largest production (table 7). No production is recorded for the Independence, Jumbo, or Thor mines. The workings of the open cut on the Independence vein alone probably produced several thousand tons of ore. In 1917 the production of Gold Springs and Stateline mining districts was combined and has been recorded this way since, making it hard to determine the production of Gold Springs district alone. Much of the recorded production of Stateline mining district during the 1930's came from the Jennie mine (tables 7 and 8). If the production of the Aetna were added to the Jennie's production, it would probably account for most of the recorded production for Stateline mining district.

Table 7. Recorded production of Jennie mine.

Year	Tons	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)
1907	3,095	631.56	2,448		
1908	7,850	1,138.79	3,120		
1909	550	219.42	1,332		
1910	477	238.50	467		
1911	198	80.79	766		
1915	750	154.58	521		
1932	38	16.80	99	70	140
1933	110	43.01	341		
1934	1,800	665.16	6,505		
1936	1,162	333.00	4,604		
1937	361	126.44	1,322		
1948	[1]	1.22	10		
Total	16,391	3,649.27	21,535	70	140

Source: Compiled from records from U. S. Bureau of Mines.
[1] Not reported.

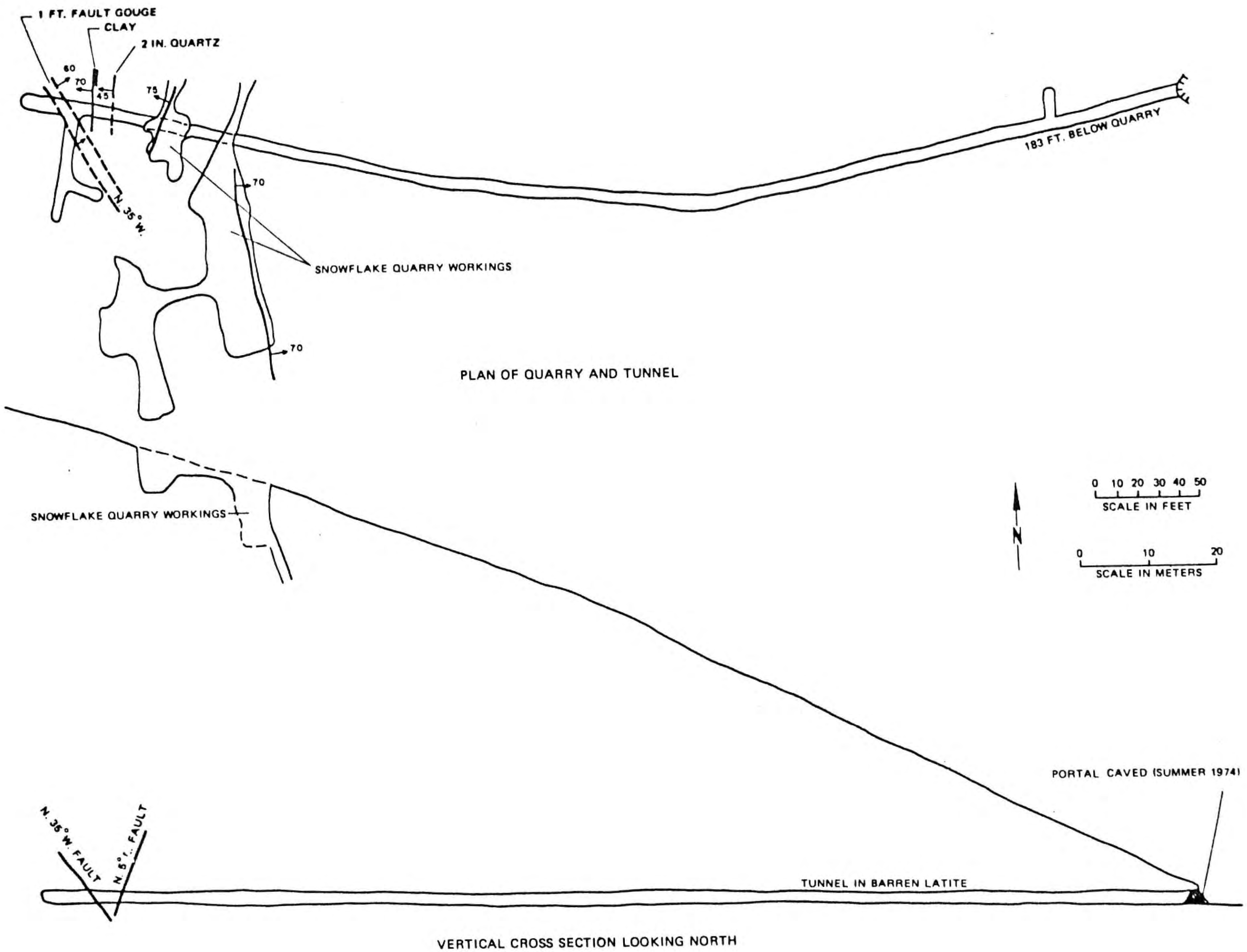
The mines on the Nevada side of the district have been recorded separately and show a production of 5,550 tons of ore containing 5,688 ounces of gold, 18,744 ounces of silver, 11,961 pounds of copper, and 19,128 pounds of lead (U. S. Bureau of Mines, written communication). These figures cannot represent the actual tonnage of ore produced, as the ore mined from the Snowflake quarry alone would probably exceed this figure. To this total could be added the production of the Little Buck mine, which was proabably as large or larger than the Jennie mine.

MILLS IN THE GOLD SPRINGS DISTRICT

Four mills were built in the Gold Springs mining district: two at the Jennie, one south of the Thor, and one at the Aetna mine. According to Snider (1927) the first Jennie mill was a 15-ton-a-day stamp mill. Later, the mill was replaced by a 100-ton-a-day mill (figure 30). Short (1909) described this new mill as an amalgamation mill with a cyanide plant to process the tails. He claimed that this process recovered 83 percent of the gold, 54 percent by the amalgamating plates and 29 percent by a cyanide leach. Snider (1927) described the milling equipment as a primary jaw crusher accompanied by a secondary gyrating crusher. After the ore left the crushers, it traveled by conveyor belt to a battery of 12 Nissen stamps of 1,350 pounds each. The ore moved from the stamps to a series of amalgamation plates, and the tailings were sluiced to a 100-ton-a-day cyanide plant for further processing (figure 31). Varley (1933) suggested that "from evidences still existing in the way of equipment and dumps, perhaps 50,000 tons or more of ore was treated in the mill." However, according to Snider, "the plant was only run, off and on, for thirty days, when operations ceased" owing to insufficient electrical power. Production figures in table 7 suggest that further milling must have been done in the late 1930's.

The Aetna mill was east of the collar of the Aetna mine (figure 32). According to Asher (1959) the mill was a 75-ton-a-day operation. The primary crusher was probably a jaw type with final crushing done in a small ball mill. Gold and silver were recovered by amalgamation and cyanide leaching of the tails. This mill was running in the mid-1930's and worked until the shutdown of gold mines during World War II.

The Herzog mill was constructed to process the ore from the surface workings



Adapted from Andesite Mining Co. map (1934).

Figure 24. Plan and vertical cross section of the Snowflake quarry and the tunnel driven under it to intersect the Snowflake vein at depth; modified after a map of the Andesite Mining Company (1934).

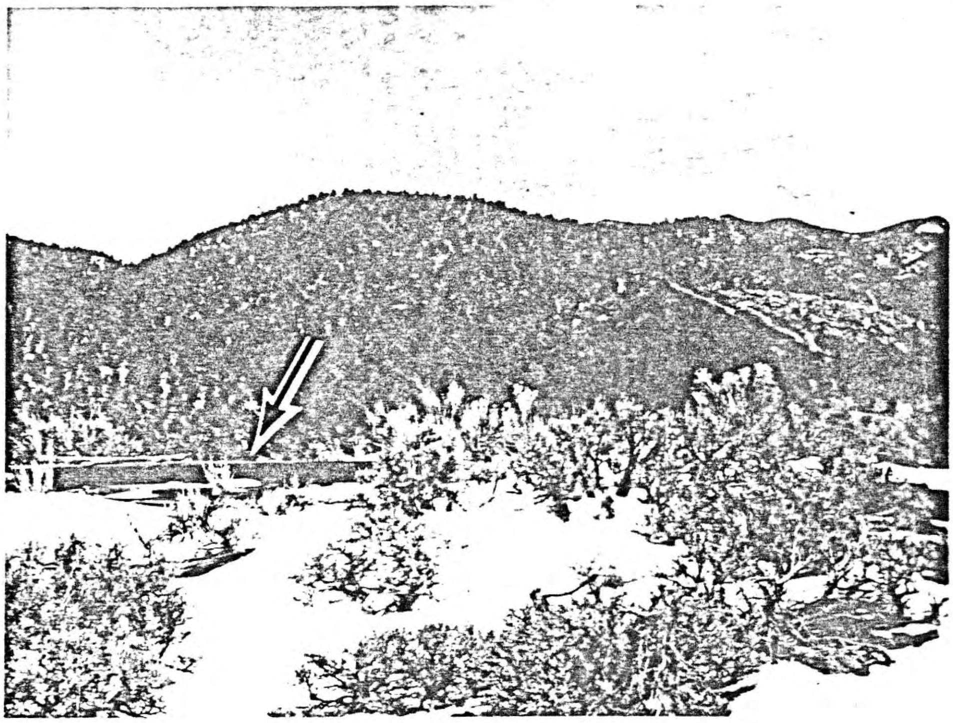


Figure 25. Pope mine as seen from the road leading to the mine, looking northeast. Arrow indicates the shaft collar.

Table 8. Mineral production of Stateline mining district 1918-1973.
[Gold Springs mining district included in Stateline mining district's production since 1918.]

Year	Crude ore (tons)	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Total value
1918[1]						
1919[1]						
1920	17	2.63	589			$ 697
1921[1]						
1922	5	2.00	10	1,498	2,120	370
1923[1]						
1924[1]						
1925[1]						
1926	21	11.86	64	16		287
1927[1]						
1928[1]						
1929[1]						
1930	120	22.01	31			467
1931	115	20.85	85			456
1932	38	16.83	99	70	140	384
1933	536	160.56	608			4,317
1934	2,842	1,231.70	11,340			50,379
1935	1,813	678.20	10,432			31,235
1936	4,138	1,596.60	16,284	185	717	68,543
1937	3,835	1,267.00	19,086	595	6,610	59,570
1938	1,255	562.00	4,902			22,839
1939	1,844	1,189.00	8,275	461	702	47,313
1940	889	275.00	3,292	425	9,200	12,475
1941	552	37.00	727			1,812
1942	1,445	209.00	1,018			8,039
1943[1]						
1944[1]						
1945[1]						
1946	60	12.00	99			500
1947	45	9.00	73			381
1948	1	1.00	10			44
1949 to 1973[1]						
Total	19,571	7,304.24	77,024	3,250	19,489	$310,108

Source: U. S. Bureau of Mines.
[1] No production.

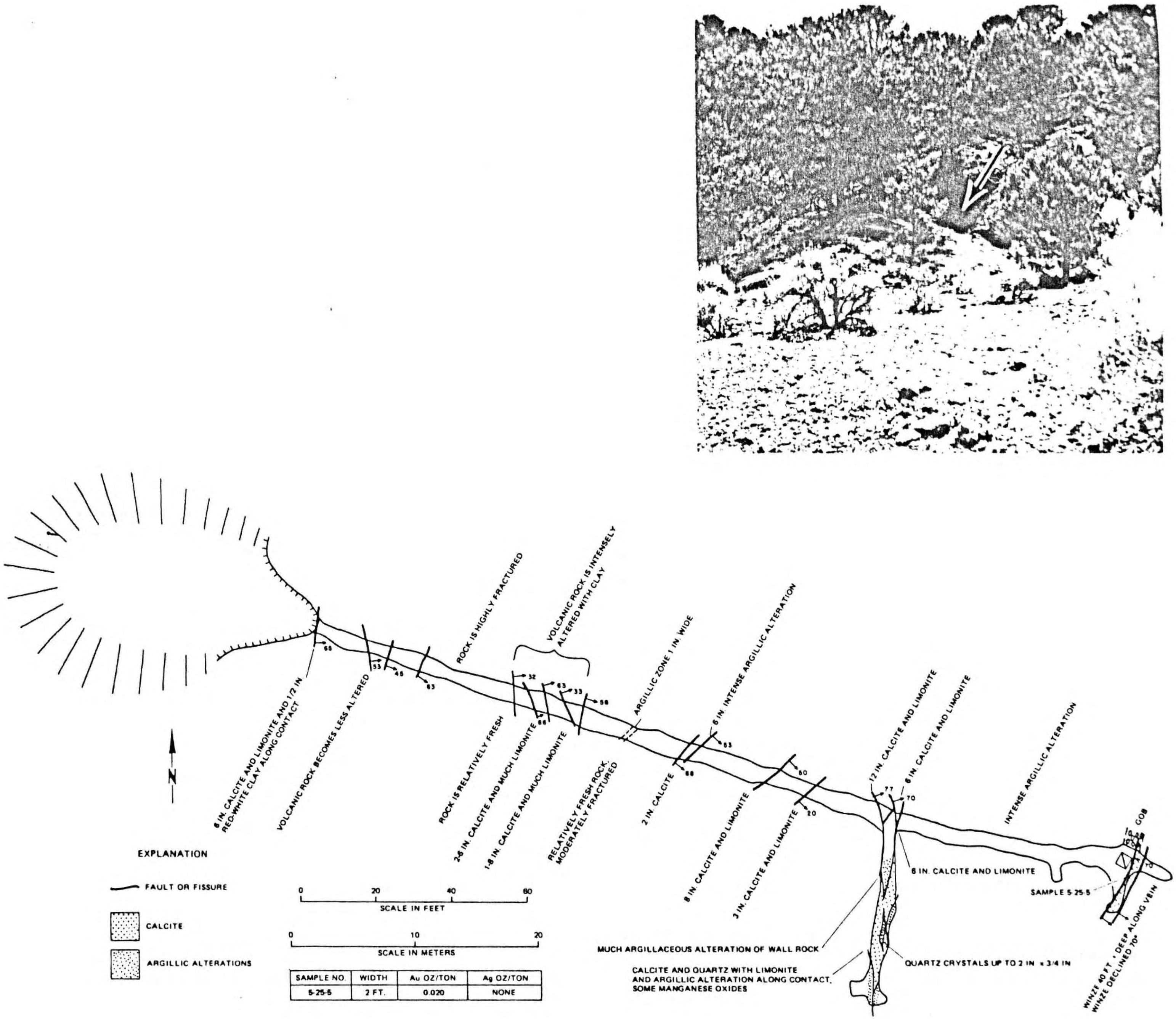
on the Thor vein. The mill site is approximately one-sixteenth mile west of the Utah-Nevada line. According to Ferri (1929) the mill had a daily capacity of 35 tons and consisted of two Agnew pulverizers, a pulsating screen, and amalgamation plates. The mill was powered by a steam boiler and a 25 horse-power engine (figure 33).

None of the mills remain intact today. The Jennie mill building is still standing, but all of the equipment has been removed. The Aetna building has collapsed, leaving only the ore bins. The Herzog mill has been torn down; the steam boiler and engine remain.

EXPLORATION POSSIBILITIES

The past production of the district and the tendency of the valuable minerals in the veins to be scattered suggest that any ore deposits found in the district will probably be small. Today's high metal prices make the grade of the ore attractive to low tonnage mining operations. There is a good possibility of finding concealed veins in the district, as alluvium and the postmineral lithic crystal tuff (Tr_1) cover large areas. The faulted parts of veins that have not been found such as the north end of the Jennie vein might be worth looking for. Some of the veins such as the Jumbo and Snowflake might produce a large enough tonnage to interest a limited mining operation.

The best prospects for low-grade deposits that might be mined with surface



SAMPLE NO.	WIDTH	Au OZ/TON	Ag OZ/TON
5-25-5	2 FT.	0.020	NONE

Figure 26. Map of unnamed adit 1,000 feet (305 m) west of the Pope mine. The portal of the adit is on the southeast side of the gully. Photograph shows the partly caved in portal as seen from the dump, looking east. Assay of ore sample is shown in table.

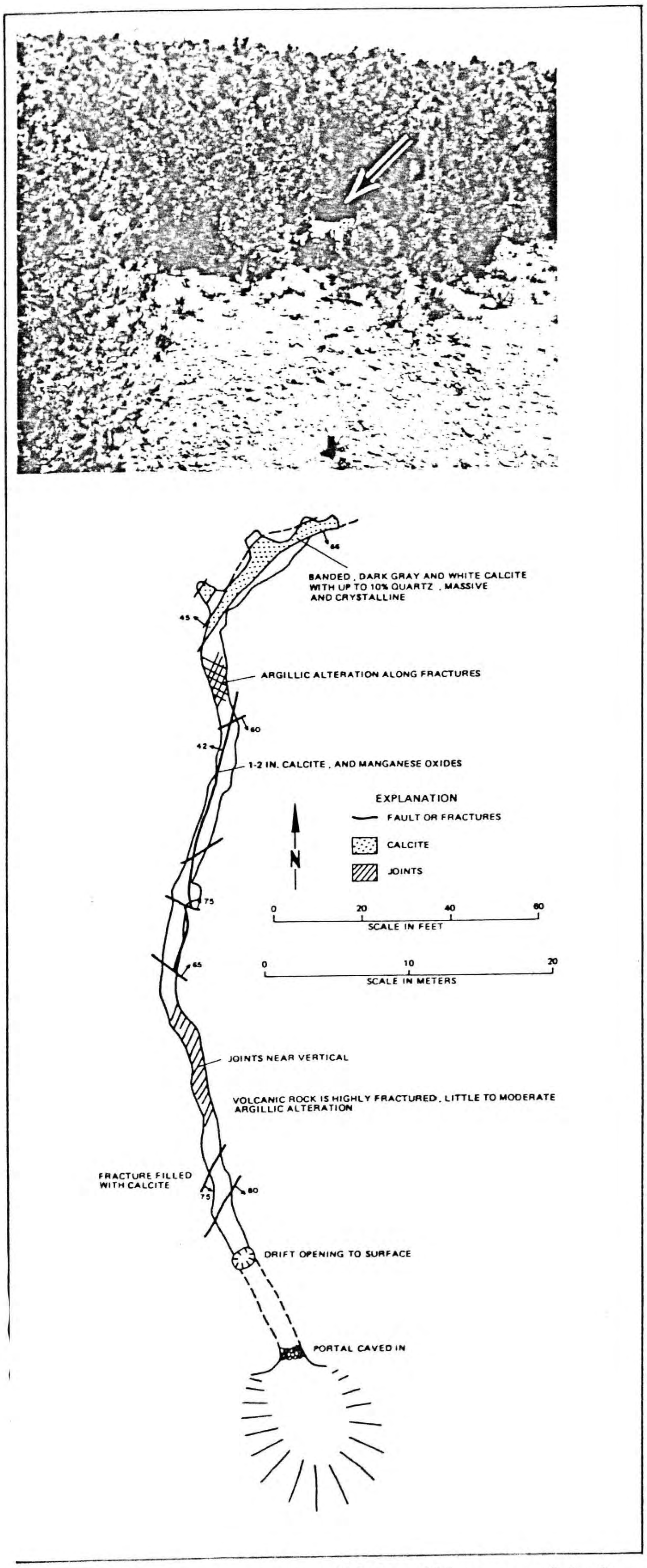


Figure 27. Map of unnamed adit 1,000 feet (305 m) west of the Pope mine on the northwest side of the gully. Photograph shows the caved in portal as seen from the dump, looking north, of the unnamed adit on the southeast side of the gully; arrow denotes portal.

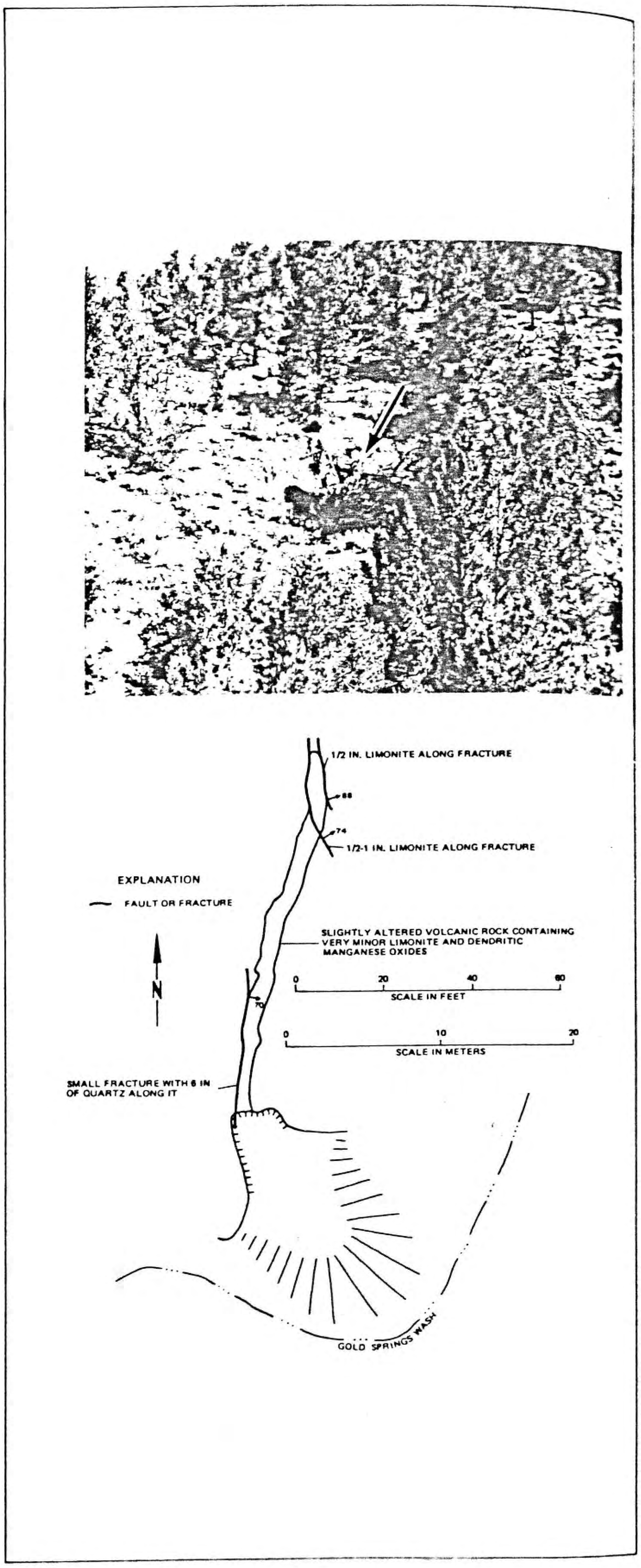
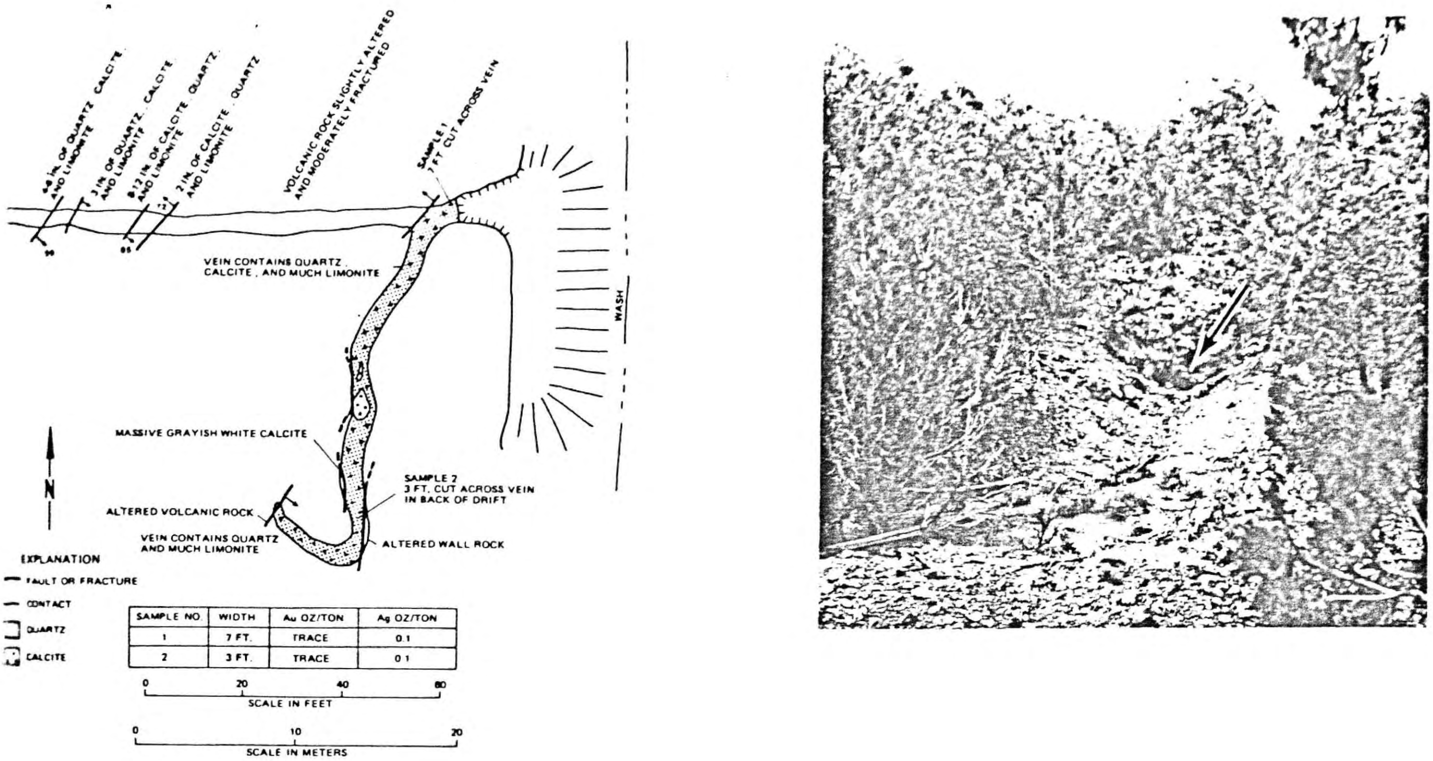


Figure 28. Map of unnamed adit on the north side of Gold Springs Wash. Photograph shows portal as seen from the south side of the wash, looking north; arrow denotes portal.



SAMPLE NO.	WIDTH	Au OZ/TON	Ag OZ/TON
1	7 FT.	TRACE	0.1
2	3 FT.	TRACE	0.1

Figure 29. Map of unnamed adit in the bottom of the gully south of the Charley Ross shaft. Photograph shows the partly caved in portal as seen from the east side of the gully, looking west; arrow denotes portal. Assays of ore samples are shown in table.

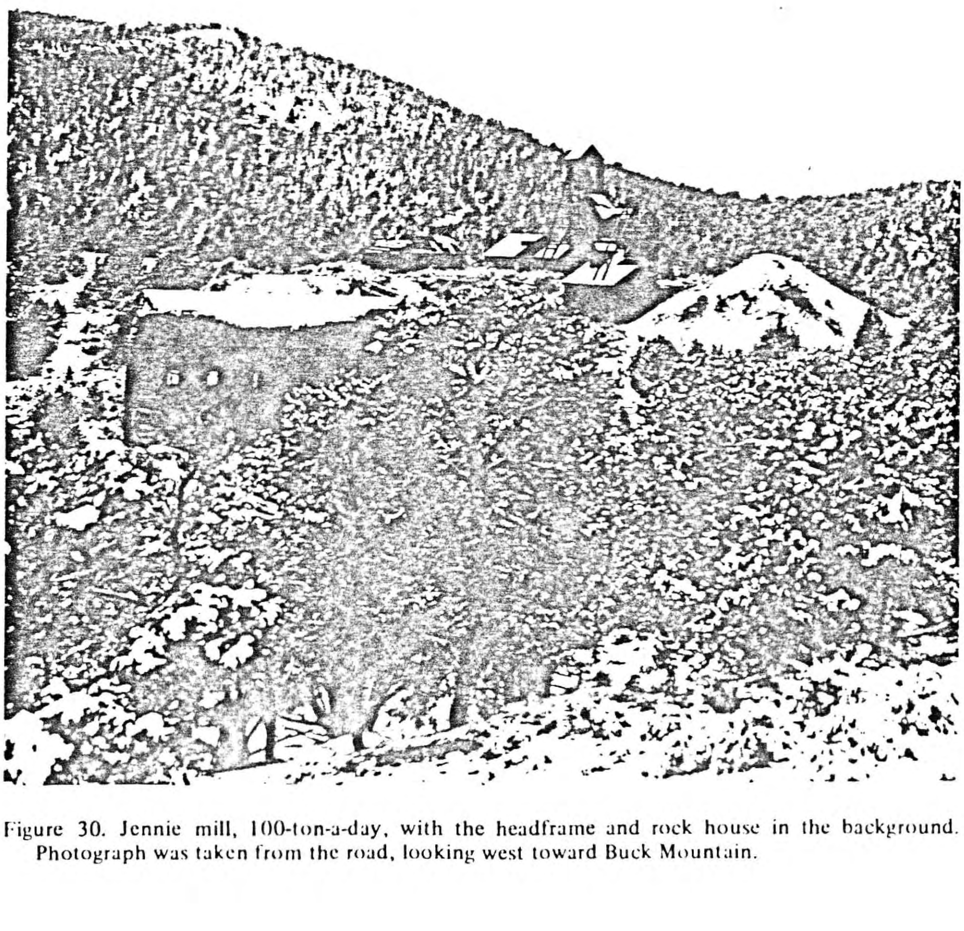


Figure 30. Jennie mill, 100-ton-a-day, with the headframe and rock house in the background. Photograph was taken from the road, looking west toward Buck Mountain.

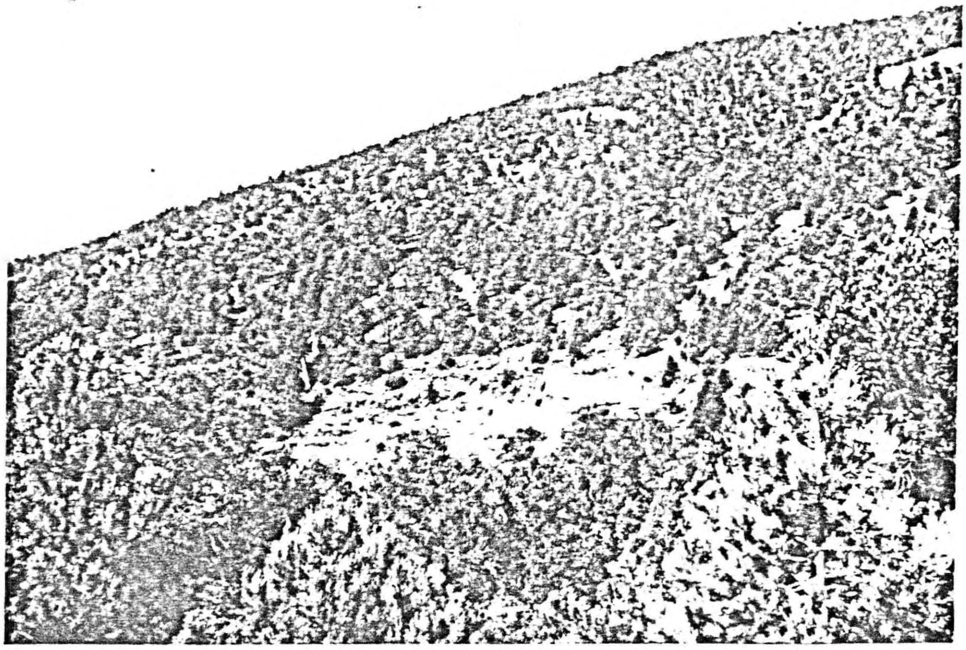


Figure 31. Foundations of cyanide leach plant of Jennie mill as seen from across the gully, looking west.

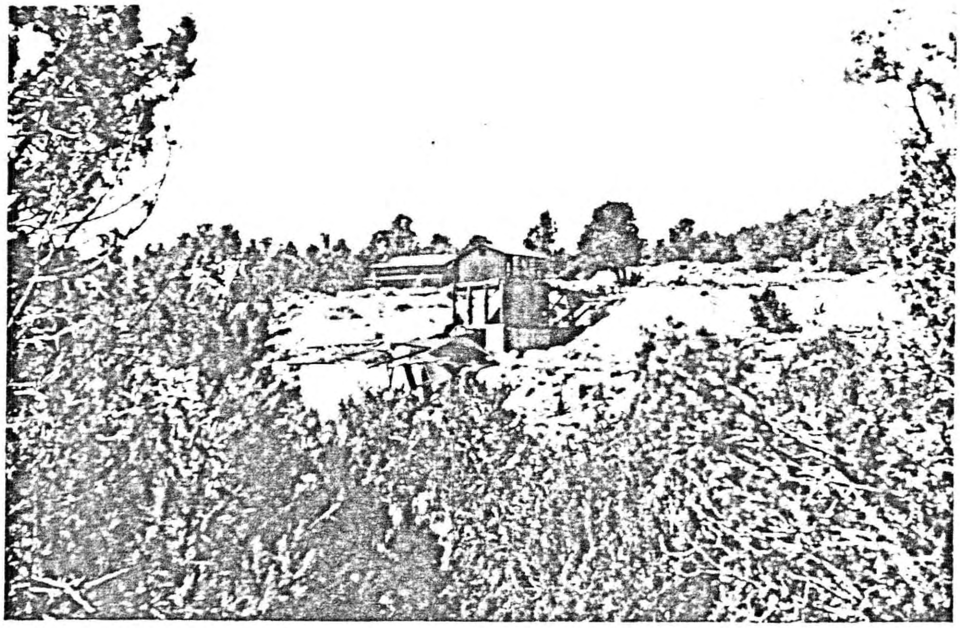


Figure 32. Aetna mill as seen from across the gully, looking southwest.

excavations are the Jumbo and Snowflake veins. The Jumbo is wide enough to produce a sufficient tonnage for a small company. Much of this vein could be mined from the surface at a low cost per ton. However, further exploration would be necessary to determine if the grade is good enough to support the small operation. The Snowflake vein represents another prospect that could be mined from the surface. Jensen (1935) suggested that 119,000 tons of ore averaging 0.18 ounce of gold and 2.4 ounces of silver to the ton could be obtained from the Snowflake vein at a reasonable mining cost. A careful sampling of the outcrop along with the findings from several shallow diamond drill holes would be necessary to substantiate these figures.

The faulted north end of the Jennie vein could probably be found with one or two diamond drill holes. Mallory (1928) stated that the horizontal displacement of the Jennie vein is about 150 feet to the east of the north side of the fault. If the vein is in this position as suggested, it would be concealed by the lithic crystal tuff unit in the hill northeast of the Jennie mine. The possible presence of other concealed veins under this hill should not be overlooked.

The Independence vein might contain a small tonnage of minable ore and useful water below the old workings that could be tested with a couple of diamond drill holes. The *Salt Lake Mining Review* (1903) reported water at 135 feet (41 m) in the Independence shaft. At 200 feet (61 m) the flow was reported to be 3,000 gallons-per-day (11,355 liters-per-day). This water would be a valuable asset to any mining or milling operation in the area.

SUMMARY

The mineral potential of the Gold Springs mining district lies in the areas of the Jennie, Snowflake, Jumbo, and Independence veins. Most of the production has come from two veins, the Jennie and the Snowflake. These are probably the best two areas in which to concentrate future exploration. The Jennie property should be drilled to find the faulted north end of the vein. Drilling would require one or two diamond drill holes to locate the vein. Further drilling would depend on the grade of ore found. The Snowflake vein has a good potential for an openpit operation. A detailed sampling program including bulldozer cuts to expose the vein would be necessary to evaluate the outcrop. Diamond drilling could be used to substantiate surface findings.

The Jumbo and Independence veins should be looked at in more detail. The wide outcrop of the Jumbo vein might be mined from the surface by openpit methods. A detailed sampling program along with a few diamond drill holes would determine if further work was warranted. The Independence vein should be looked at for ore potential as well as for water that would be a necessary by-product of any underground mining on the vein. The lower parts of the vein could be tested with two or three drill holes to determine if further work would be fruitful.

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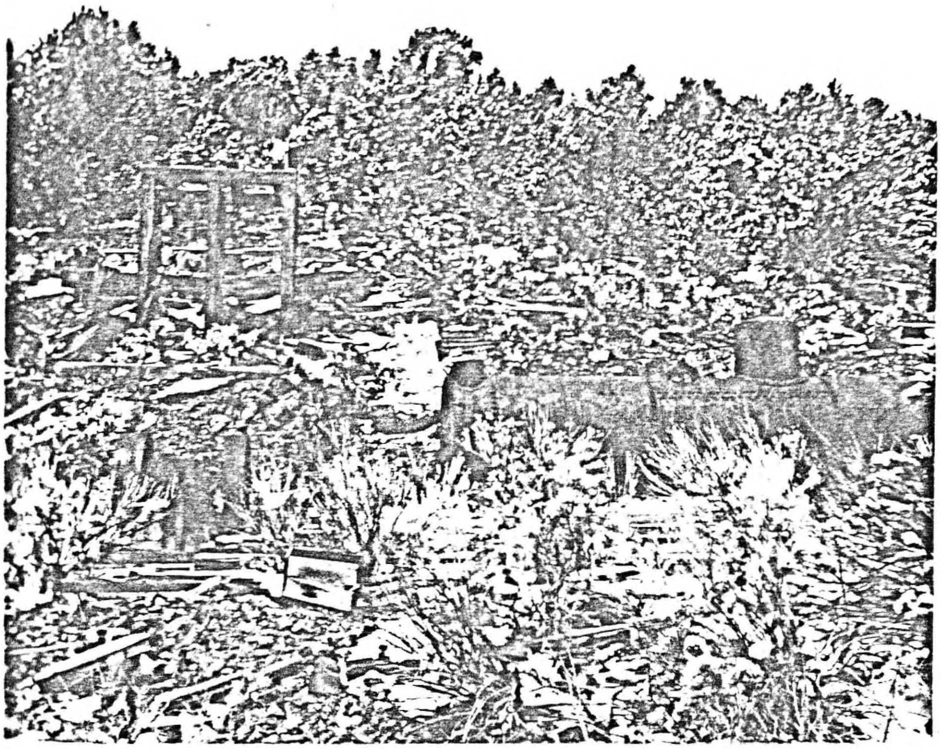

Figure 33. Remains of the steam boiler and engine of the Herzog mill as seen from the tailings of the Jennie mill, looking north.

author's work. Thanks is given to Paul Anderson and Larry Trimble who helped the author map the underground workings of the district. The illustrations of surface buildings and equipment were done by Greg McLaughlin.

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