

DEPARTMENT OF THE INTERIOR  
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UNITED STATES BUREAU OF MINES  
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INFORMATION CIRCULAR

MINERAL INDUSTRIES SURVEY OF THE UNITED STATES

CALIFORNIA  
KERN COUNTY  
MOJAVE DISTRICT

THE GOLDEN QUEEN AND OTHER MINES  
OF THE MOJAVE DISTRICT, CALIFORNIA



BY

C. E. JULIHN AND F. W. HORTON

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By C. E. Julihn<sup>2</sup> and F. W. Horton<sup>3</sup>

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1 The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used:

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## INTRODUCTION

In the fall of 1935 a new discovery of gold was made in the old Mojave mining district of California about 70 miles north of Los Angeles. It led to mining operations that have surpassed in their results all reasonable expectations and are of exceptional promise for the future. In less than 3 years, exploration has opened up a number of veins, from some of which a substantial amount of high-grade ore has been shipped, while a large tonnage of milling ore has been disclosed.

Two mills, operating on ore averaging better than \$12 a ton, will probably produce more than a million dollars worth of gold in 1936, and a considerable increase of their output in the following year is anticipated. While continuance of these operations for a number of years is already assured by ample reserves of ore, future discoveries of still other veins are reasonably possible, as occurrence of gold throughout the volcanic rocks of the district is widespread and the veins now being mined showed little to attract attention at the surface.

In fact, most all of the ore being produced at present is derived from veins unworked and presumably unknown during the earlier period of the district, so there is presented here the unusual case of what might be regarded as an entirely new district superimposed upon an old one, rather than a revival of dormant mines, made possible by improved technology and a higher price for gold. The circumstances are rendered all the more remarkable by the fact that three of these newly discovered veins were found only a short distance from several of the most productive veins at the old camp.

Field Work and Acknowledgments

The field work upon which this paper is based included the larger part of a 4-month study of the mines and prospects of the Mojave district and nearly adjacent territory, beginning in April 1936, during which the authors were cordially assisted by mine operators of the district, and by many others, to all of whom thanks are given. Especial acknowledgments for helpful assistance are due W. C. Browning, general manager, Chas. A. Kunke, superintendent, and V. T. Berner, assistant superintendent in charge of milling, all of the Golden Queen mine; Cecil Burton and Clifford Burton, owners of the Tropico mine; Henry Kelsey, leaser and operator of the Fairview mine; Walter Trent, owner, and L. K. Requa, geologist, of the Trent and other mines; James E. Babcock, president, and Walter Schauss, superintendent, of the Soledad Mojave mine; E. L. Wegmann, owner of the Karma mine; John Rogers, manager of the Lodestar Mining Co.; and A. J. Bruce, leaser of the Exposed Treasure, the Desert Queen, and the Yellow Rover mines. Thanks are also due Spence Air Photos, of Los Angeles, for permission to use several of their photographs.

## GENERAL DESCRIPTION OF MOJAVE DISTRICT

The town of Mojave lies in the arid plain known as the Mohave Desert, within 10 to 20 miles of its western limit at the foothills of the Tenachapi Mountains. That part of the plain is known to represent the almost level top of detritus filling a broad, deep valley eroded by an ancient drainage system in a granitic (monzonite) batholith. This valley became the site of Tertiary volcanic activity, with a number of volcanic vents scattered through it. About some of them extensive cones must have been built, as suggested by remnants of the gently sloping lavas, tuffs, and breccias that usually surround the base of a volcano and by some massive cores of lava still remaining after the cones that once enclosed them had been almost entirely eroded away into the valley.

### Soledad Mountain

Soledad Mountain, situated about 6 miles south and a little west of Mojave, is the largest of these volcanic cores. It covers several square miles and rises to a height of 1,450 feet above the plain. It consists almost wholly of siliceous lavas, in which were found both the Queen Esther, a highly productive mine of the early camp, and the Golden Queen, which has the largest ore body disclosed by recent operations.

This mountain (fig. 1) is also the site of several other early-day mines, including the Karma, the Elephant-Eagle, and the Echo, and of two other important new discoveries on the Starlight and the Soledad Extension claims.

### Bowers' Hill

Bowers' Hill lies a mile north of Soledad Mountain, of which it was probably once a low-outlying part. Structurally, however, it differs considerably from its neighboring mountain mass of lava, as a considerable part of it is the top of what was once a hill of the buried monzonite valley. The monzonite here has been intruded by several large masses of volcanic rocks. It is also mantled, in part, by extrusive flows of lava.

On this hill the old Exposed Treasure mine was developed in a vein that passes down through volcanic rocks into the underlying monzonite, where some ore still was found. It is also the site of the old Desert Queen and Yellow Rover mines, and of the Yellow Dog and other mines more recently discovered.

### Tropico Hill

Tropico Hill lies about 7 miles south and a little west of Soledad Mountain. Here again the monzonite is exposed, but the eastern part of the hill consists of volcanic rocks similar to those of Soledad. It probably likewise represents a volcanic core, rather than surface flows of lava. In it was located the old Lida mine, a producer of considerable former importance; and here the Tropico mine, with its subsidiary, the Fairview, was developed in recent years into a substantial producer that accounts for a considerable part of the district's present output.

### Middle Buttes

Middle Buttes is a fourth area of volcanic rocks and sedimentaries derived from them that forms a long, flat-topped hill rising moderately from the plain about 5 miles west of Soledad Mountain. It was the site of a recent discovery of rich ore at the surface of the Trent mine. Other mines of the Middle Buttes are the Cactus Queen and the Silver Prince, recently opened and now in course of exploration. Figure 2 is an index map of the Mojave mining district showing the location of Middle Buttes with respect to Soledad Mountain.

## HISTORY

### Early Camp

In 1894, George Bowers, finding gold float scattered over the little hill that is now known by his name, gathered up and shipped at a profit 2 carloads of the rock. The ground was appropriately named and staked as the Yellow Rover claim. This soon led to discovery of the Exposed Treasure mine, nearby on the same hill, and to prospecting of Soledad Mountain, where gold ore was likewise found on the Queen Esther, Karma, Echo, Elephant, and Gray Eagle claims.



FIGURE 1.- Soledad Mountain from the north: 1, Mojave Mining & Milling Co.'s workings; 2, Karma mill and main haulage adit; 3, Karma open-cut; 4, Queen Esther mill and tailings; 5, Queen Esther mine, caved stopes; 6, Mojave Bonanza workings; 7, Golden Queen office; 8, waste glory hole, Golden Queen; 9, discovery shaft, Silver Queen claim (later Golden Queen mine); 10, adit, 200-foot level, Golden Queen; 11, adit, 400-foot level, Golden Queen; 12, Golden Queen mill; 13, main haulage adit, 600-foot level, Golden Queen; 14, tailings pond, Golden Queen; 15, No. 3 adit, Lodestar.



FIGURE 2.- Index map of Mojave mining district.

Soledad Mountain: Golden Queen Mining Co.- 1, Golden Queen; 2, Queen Esther. Lodestar Mining Co.- 3, Starlight; 4, Echo; 5, Elephant-Eagle; 6, Excelsior. E. L. Wegmann Mines- 7, Karma; 8, Mojave Mining & Milling Co.; 9, Soledad-Mojave Mining Syndicate; 10, Bobtail; 11, Desert Gold Mining Co.

Bowers' Hill: Standard Gold Mines Co.- 12, Exposed Treasure; 13, Desert Queen; 14, Yellow Rover; 15, Whitmore Mines, Inc.; 16, Yellow Dog Mining Co.; 17, Victory; 18, Blue Bird; 19, Pride of Mojave; 20, Enterprise; 21, Four Star.

Middle Buttes: 22, Trent; 23, Burton-Blank-Brite; 24, Crescent; 25, Cactus Mining Co.; 26, Silver Prince; 27, Nebeker and Shockley; 28, Hematite; 29, Queen Sabe; 30, Golden Slipper.

Tropico Hill: Burton Bros., Inc.- 31, Home; 32, Fairview; 33, Kid; 34, Lida.

Other localities: 35, Rosamond feldspar mine; 36, Rosamond clay deposit; 37, Webb clay deposit.

The high cost of shipping their ores led to building of the first mill in 1901, at the Exposed Treasure. It included 20 stamps and a cyanide plant, for which the water supply was obtained through a 14-mile pipeline from Oak Creek in the Tehachipi Mountains.

Construction of other mills followed rapidly - that of the Echo in 1902 with 10 stamps, later increased to 20; of the Queen Esther in 1903, with 75 tons dry-crushing capacity, increased to 150 tons in the following year; and of the Karma in 1904, with 20 stamps.

Of these old properties the Exposed Treasure, with an output of about \$2,100,000, was the largest producer, the Queen Esther ranking second with about \$1,250,000, and the Karma third with \$750,000. By 1914 their profitable ore was exhausted, and the camp was practically abandoned when in that year the Exposed Treasure finally closed down. In 20 years Bowers' Hill and Soledad had produced, in all, a little more than \$5,000,000, equivalent to about \$8,000,000 at the present price of gold and silver.

Eight years later the camp again attracted brief attention when a find of rich surface ore was made at the Yellow Dog, on a small butte near the west end of Bowers' Hill, but interest soon subsided as the ore body proved small.

Subsequent revival of the old camp is attributable less, as commonly supposed, to a lucky accident, than to the intelligent efforts of two men of sturdy, generous character, in temperate pursuit of their own self-interest. These are the Burton Brothers, hard-rock miners themselves, who had labored and sacrificed to become owners of Tropicco mine, mill, and general supply store. With faith in the district, they were persistent grubstakers of worthy prospectors, as well as outstanding good citizens of the little hamlet of Rosamond in the Mohave Desert.

It was they who, at the onset of the great depression, leased the Exposed Treasure and other old properties, subleased small parcels of the ground to miners out of employment, grubstaked them, and milled at Tropicco whatever small lots of ore the mines produced. As a result there were ultimately 50 to 60 groups of leasers in the district making a living through deliveries of ore to the Tropicco mill. These small leasing operations produced \$180,000 worth of ore. A leaser looking for a new place to work found the now famous horn-shaped piece of rich gold float that led to discovery of the Golden Queen vein, to his suddenly becoming a millionaire, and to revival of mining in a big way throughout the moribund Mojave district.

#### Development of Mining on Tropicco Hill

This fortunate intervention of the Burtons had been made possible by a course of events on Tropicco Hill to the south of the old Soledad-Bowers' Hill camp.

Both the Lida and Home veins on Tropicco Hill had been discovered previous to 1910, when the Burtons were first employed there as miners. The Lida produced \$260,000 (gold at \$20 an ounce) from a narrow vein of ore that carried 1 to 5 ounces of gold per ton. In the Home a large body of mill ore was found at the surface, which was mined by a glory hole, with an average yield of about \$8 a ton.

The Burtons, after serving in the World War, returned to find the mines shut down. They were employed in reopening them, later leased them, treated a little custom ore at the mill, and gradually acquired an interest and finally ownership of the entire hill. They spent nearly 20 years acquiring and equipping the property. In it they reinvested whatever profits they made until it finally emerged as the Tropicco mine, which includes not only the Lida and Home veins but several others lying between the two.

The total production of the Tropicco has exceeded \$2,000,000, reckoned at the present price of gold. But for these operations at Tropicco, that provided a mill where low-grade ore could be treated, the subsistence leasing through which the old camp was revived, would, of course, have been impossible.



Revival of Soledad

Golden Queen

The pleasing romance of well-deserved success by the Burtons at Tropico proved but a prologue to the story of spectacular good fortune that befell George Holmes, though not his original associates, in the discovery, development, and sale (for an enormous price) of the mine now called the Golden Queen.

Since 1929 Holmes had been one of the leasers on Soledad Mountain in the vicinity of the Elephant claim. He had done very well. On one lease he had cleared a profit of \$1,000, which he was anxious to duplicate by finding another promising piece of ground to work.

On a Sunday morning in September 1933 he was scouting about the mountain, high up in a gulch on its northwest side, when he encountered Bruce Minard, another leaser, who, like himself, was also prospecting for a better place to work. Later he noticed a piece of rock, weighing about 300 pounds with a horn-shaped projection that he broke off. It showed free gold on the fresh fracture and was undoubtedly rich ore. But how far had it come? What was its source?

Holmes showed the piece of rock to Minard, who had the reputation of having an uncanny knack in tracing the course of float by panning; and they agreed to a partnership, merely in expectation of joining in a lease if they should discover the source of the horn-shaped piece of ore.

Within a few days they believed they had, indeed, found the place, and upon searching the records to find the owner of the ground so that they could ask him for a lease, they were amazed to learn that nobody owned it. It was on an old claim that had been abandoned! The ground was thus open for location by anyone.

In relocating this ground as the Silver Queen, Minard wanted to include Virgil Dew, with whom he had been accustomed to work, so Holmes in assenting included his own father on the notice as one of the locators. Each of the four thus had a fourth interest - to start with.

Each of two small shafts, sunk 50 feet apart, encountered ore at depths of a few feet. Its value was only \$12 a ton, but this increased to about \$30 at a depth of about 30 feet. As a road was needed to get the ore down the mountain, Minard and Dew each surrendered a 5-percent interest to Holmes to get funds for that purpose, as they had no money to contribute; yet that still left them a 40-percent interest in the mine.

Thereafter, for a little over a year, until the property was sold, Holmes sank and drifted on the vein at ever-increasing speed and was always in ore, so that 200 carloads, averaging better than \$20 per ton, were shipped during the period, solely from development.

The property was sold in January 1935 to a syndicate headed by the Gold Fields American Development Co., at a price reported to have been about \$3,000,000. At any rate, Holmes and his family will ultimately receive more than a million; but young Bruce Minard and Virgil Dew had already sold their interests some months before.

Minard had sold out for \$500. Dew appears to have been twice as hard a trader, as he got \$1,000 for his 20 percent. Both sold to Cy Townsend, formerly a professional baseball pitcher of note, who, upon his retirement had sought a more lucrative career as a business man in Mojave.

The Gold Fields Co., after purchasing the mine (now known as the Golden Queen) from Holmes and Townsend, conducted intensive exploration resulting in a large increase of ore reserves by October 1935, when a 300-ton cyanide mill was completed. More recently it has been reported that another vein of the same general character as the Silver Queen has been found, dipping away from it to the southwest.

Starlight

Meanwhile, an area of Soledad Mountain south and west of the Golden Queen was being prospected by leasers, whose work disclosed another large vein on the Starlight claim. It paralleled the Golden Queen in strike but dipped to the southwest. Control of this area was obtained by the Lodestar Mining Co., which pressed exploration of the Starlight by several tunnels, with such success that the property is now reported to have reserves exceeding a million dollars gross value of ore, averaging about \$11 a ton.

Soledad Extension

A third important development on Soledad was the discovery of the Soledad Extension vein, southwest of the Starlight and parallel to it both in strike and dip. Here again an exploration tunnel was soon in ore of excellent grade and width. Its present production of about 800 tons a month, averaging about \$14 a ton, is being treated by the Golden Queen mill.

Discoveries on the Middle ButtesBurton-Brite

The Middle Buttes had been almost entirely neglected previous to the revival of mining on Soledad, but Clyde Westfall realized their possible importance when, early in 1934, inspired by the recent success of Holmes and Minard, he prospected their eastern slopes. There, on a patented quarter section, he was rewarded by finding rich, gold-bearing float scattered over a considerable area. The property was acquired by Burton, Blank, and Brite, who gathered up a small shipment of the float for a test of its value by milling at Tropic. It yielded \$1.39 a pound, but some of it contained as much as \$2.50 a pound in gold. Over \$20,000 worth of this float was quickly shipped, and trenching was begun with confident assurance that an important vein would soon be found; but as yet no ore of anything like such high value has been discovered in place. Nevertheless, a substantial showing of rather low-grade mill rock has recently been made, and shipments to Tropic mill have begun.

Trent

Far more satisfactory were the results obtained by Walter Trent, who, having heard of the rich float on the Burton-Brite property, made a speculative purchase of the quarter section adjacent to it on the south. Almost immediately, in March 1935, he found, near the boundary between the two properties but beyond the crest of the slope from which the Burton-Brite float had been shipped, an outcrop of ore that sampled 3 ounces in gold. An open-cut 150 feet long and 10 feet wide revealed ore averaging equally well, or better. Mined to a maximum depth of 80 feet, about 1,500 tons of ore averaging about \$100 a ton were quickly produced from this cut. Subsequent shipments have brought the total value to about \$300,000; incidentally, a moderate tonnage of milling ore has been developed in these workings. Meanwhile a parallel vein, the Ella, has been found on the Trent property and is now in course of exploration.

Cactus Queen, Blue Eagle, and Silver Prince

On the western edge of the Middle Buttes a large vein of low-grade silver-gold ore was discovered in the fall of 1934. This has led to the development of the Cactus Queen, Blue Eagle, and Silver Prince mines, the ore of which follows the same general course through a distance of about 4,000 feet.

### Other Recent Discoveries

Bowers' Hill had contributed no new discoveries to the revival of mining in the district until April 1936, when 4 feet of extremely rich ore was found on the surface of the Exposed Treasure, north of the shaft. Coarse gold was plainly visible, yet it had escaped notice of the hundreds of men who must have passed by the spot during the years in which the mine had been operated. Although this bonanza ore did not persist, its discovery has encouraged a substantial revival of leasing on the old properties of the hill.

Likewise, in other parts of the district there are various prospects and small leases, to which further reference will be made later. In all, there are more than 40 active operations in the district.

### Total Value of Production

The total production of the Mojave district since its discovery reckoning the value of gold at \$35 an ounce, is estimated as about \$12,000,000.

This includes 8 millions from Soledad and Bowers' Hill in early days, 2 millions from Tropico, \$1,300,000 recent production from Soledad, \$300,000 from Middle Buttes, and \$400,000 not otherwise accounted for that was derived in part from the Yellow Dog, near Bowers' Hill, but chiefly from small operations on Soledad.

### GEOLOGY

The geology of the Mojave district has not been reported upon as yet by the United States Geological Survey, but both Bateson<sup>4</sup> and De Kalb<sup>5</sup> contributed valuable papers upon it to the American Institute of Mining Engineers in the earlier period of the camp. Tucker and Sampson<sup>6 7</sup> and others<sup>8</sup> have provided current reports as to the camp's operations in the California Journal of Mines and Geology, to which also Simpson<sup>9</sup> recently contributed a geological paper that includes a mapping of the district as a part of a considerably larger area.

Much geological work, that would be of great value to mining however remains to be done. Very little is known, for instance, of the faulting that is generally the locus of ore deposition. A study of this would require correlation of the rocks by the aid of structural features and petrographic determinations, as a means of preparing large-scale maps of the four relatively small volcanic areas in which ore occurs. Such mapping is also needed to establish an authoritative nomenclature for rocks of the mineralized areas that is lacking at present, the same rock, for instance, being variously referred to as rhyolite porphyry, quartz porphyry, dacite porphyry, or dacite.

Nevertheless, the larger geological features of the district are fairly well understood, and with them the Bureau of Mines is chiefly concerned in discussion of the geology related

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4 Bateson, Charles E. W., The Mojave District of California: Trans. Am. Inst. Min. Eng., vol. 37, 1907, pp. 160-177.

5 De Kalb, Courtenay, Geology of the Exposed Treasure Lode, Mojave, California: Trans. Am. Inst. Min. Eng., vol. 38, 1908, pp. 310-319.

6 Tucker, W. Burling, and Sampson, R. J., Gold Resources of Kern County: California Jour. Mines and Geology, State Mineralogist's Report, vol. 29, 1933, July-October Quarterly, pp. 271-339.

7 Tucker, W. B., Mining Activity at Soledad Mountain and Middle Buttes - Mojave Mining District, Kern County: California Jour. Mines and Geology, vol. 31, 1935, October, pp. 465-485.

8 See also California Jour. Mines and Geology, vols. 14, 19, and 25.

9 Simpson, Edward C., Geology and Mineral Deposits of the Elizabeth Lake Quadrangle, California: California Jour. Mines and Geology, vol. 30, October 1934, pp. 371-416.

to mines, its viewpoint being that of the mining engineer rather than of the geological specialist.

### Rocks of the District

The rocks of the Mojave district include: (1) The underlying granite (monzonite or quartz monzonite); (2) acidic lavas, breccias, and tuffs; (3) sedimentaries of the Rosamond series, derived chiefly from the volcanic rocks; and (4) recent detritus.

#### Granite

Bateson describes the granite as "a coarse-grained, quartz-orthoclase-albite rock, containing a very small quantity of biotite." De Kalb speaks of it as a "typical granite", using the word, no doubt, in its broader sense, as is customary among miners. Simpson maps it as quartz-monzonite and describes it as a "medium- to coarse-grained, even-granular rock, gray when fresh - composed chiefly of quartz, microcline, and andesine." Essentially it is a granitic rock, highly siliceous, whose feldspars include both alkaline and soda-lime varieties. It will here be referred to as granite, as it usually is by miners of the district. Simpson considers the granite to be a part of the great Sierra Nevada batholith and of late Triassic age.

#### Volcanic Rocks

A magma produced by the remelting of such a batholithic rock might be expected to yield, when extruded and cooled more or less quickly, a siliceous obsidian, a siliceous felsite, or a porphyry containing quartz phenocrysts, any of which might reasonably be regarded as rhyolitic. Still slower cooling, however, might reveal the dacitic character of the rock by showing a preponderance of plagioclase feldspars.

Though this is merely a concept, rather than a hypothesis as to what actually happened, it is a useful one to bear in mind as a simple and practicable guide to reasoning in regard to genetic relations of the volcanic rocks found in the district.

It suggests their primary origin from a single magma in which only slight differentiation in chemical composition, if any, occurred during the period of their emission; but it also implies the possibility of any phase of physical constitution, from quickly chilled, amorphous obsidian to rocks approaching a granitic texture, if conditions permitting extremely slow cooling existed anywhere. All the volcanic rocks observed fit into this concept, with the exception of a few small areas of basalt not in the immediate vicinity of the mines.

#### Rhyolite-Porphyry

Bateson recognized the probability of at least two periods of extrusion of volcanic rocks, followed by explosive eruptions producing large quantities of volcanic breccia and tuff. With the first period he identified what he described as the rhyolite-porphyry, "lying upon and in contact with the granite and having by far the greatest exposure of all the rocks of the district." This rock will be referred to herein as rhyolite-porphyry, following the nomenclature of Bateson, though this and other related extrusive rocks of the district are mapped together as dacite by Simpson. The distinction of this rock, as made by Bateson, is too important with respect to mining to be disregarded.

He describes it as follows:

Both in hand-specimens and under the microscope, it presents a much decomposed appearance. Quartz, often showing a decidedly hexagonal outline, is the only mineral distinguishable to the naked eye. In hand-specimens it is nearly or quite white. In thin sections under the microscope the rock is seen to be extensively altered. Because of the complete obliteration of all traces of structure, quartz is the only original mineral recognizable. Quartz occurs also in considerable amount as a secondary mineral. Kaolin, showing slightly developed spheroidal structure, is present in large quantities.

It may be added that recognizable feldspar crystals are, in fact, occasionally to be seen, while some of the quartz is obviously a replacement of such crystals. The phenocrysts typically average an eighth to a quarter of an inch in diameter.

### Rhyolite

Bateson identifies his second period of extrusion with a rhyolite he describes as follows:

"This rock, in sheets and patches, overlies the rhyolite-porphry and forms the summits of many hills. A few veins outcrop in the rhyolite, but they have not been developed, even slightly." (The new discoveries of the Golden Queen, the Starlight, and the Soledad Extension have been made in felsite, treated by Bateson as a part of the rhyolite.)

In hand-specimens, the rhyolite is dirty brown in color, and greatly resembles devitrified obsidian, having strongly marked flow lines. In thin sections under the microscope, it is seen to be very much decomposed and similar to the rhyolite-porphry. Quartz, the only recognizable mineral, is both primary and secondary. In many cases the secondary quartz has replaced feldspar crystals, molecule by molecule; and in one case it has even preserved the orientation of an orthoclase twin crystal.

This rock will here be referred to as rhyolite, following the Bateson nomenclature and the custom of miners in the district. Though his descriptions of the two rocks are very similar, they are actually very different in appearance and can usually be distinguished apart without difficulty. The phenocrysts in the rhyolite-porphry are much larger and much more abundant; moreover, it has no flow lines and is less brittle unless it has been indurated with secondary quartz, as often happens. In the rhyolite the phenocrysts are usually small, less than an eighth of an inch in diameter, and sparsely scattered through the ground mass.

### Felsite

The Golden Queen, the Starlight, and the Soledad Extension veins were found in a felsite area lying beneath rhyolite. It is in turn underlain by rhyolite porphry. The felsite was not described by Bateson or De Kalb, who probably regarded it as a merely local facies of the rhyolite, due to quick chilling. Browning, however, is convinced from his observations while exploring the Golden Queen that it is a separate flow; and this seems probable.

The felsite is a light-colored, almost white rock that shows no phenocrysts whatever but is strongly marked by flow lines. Its texture is even, and it has the general appearance of a devitrified obsidian. It is usually hard and brittle, so that fissuring in it has tended to remain open, in contrast with the tendency of the rhyolite-porphry to close. The felsite is therefore now generally regarded as the most favorable locus for the finding of ore.

Obsidian

There are at least two small areas of obsidian on Soledad Mountain, one near its southern crest being described by Bateson merely as "black and full of small holes." He thought it the quickly-chilled top of a rhyolite that can be seen below it, though the actual contact between the two is concealed by talus. There is also a small, circular area of gray obsidian, strongly suggesting a pipe, on the western side of the mountain near its middle. Another small area has been reported on its northeastern flank.

There is also a prominent extrusion of black obsidian on one of the Twin Buttes that form a low hill on the plain 2 miles northwest of Soledad.

Tuff

There are several areas of tuff on Soledad and a strong suggestion, in at least one underground exposure, of its being intercalated between lavas in the vicinity of ore, though as yet no tuff is known to have been actually mined as ore. Bateson reports that his specimens of it were all so decomposed that little could be made of their mineralogical character, except that quartz and, at rare intervals, a fragment of feldspar were recognizable. He describes it as of a "dirty white to a pale, greenish color" with a rather fine texture for tuff. In two cases he reports it as overlying the rhyolite, "while in a third it seems to overlie a contact between the rhyolite and the rhyolite-porphyr."

Sedimentaries

The sedimentary rocks of the district are of the Rosamond series described<sup>10</sup> as "a series of tuffs, sandstones, conglomerates, volcanic flows, and agglomerates", "nonmarine sandstones, beds of white volcanic ash and thick flows of dacite, rhyolite, and basalt." "The lower part is characterized by volcanic flows, breccias, and ash beds." The upper is of conglomerates. It is chiefly the lower part that is seen in the Mojave district, where it includes about 1,000 feet of tuff, pumice, and lava beds, according to Simpson.

In the low hills between Soledad and Tropic there is a considerable area of these rocks whose appearance strongly suggests a direct relation to the former as a volcanic skirt. At any rate, the beds of lava and tuff dip away from Soledad at a low angle that is unlikely to represent a tilting of horizontal beds, and within the beds themselves there is little evidence of aqueous sorting.

The sedimentaries are of chief interest with respect to mining because of Simpson's conclusion that the Middle Buttes "is an outcrop of lower Rosamond rocks thoroughly impregnated with silica, probably through the agency of siliceous springs. In places silica has completely replaced the original rocks."

Simpson concludes that the Rosamond series is of Middle Miocene age, and the age of the volcanic rocks of the district would, of course, be the same.

Distribution and Structural Character of Rocks

The granite is exposed only in rather small areas here and there, one on Bowers' Hill, another on a small hill east of Soledad, still others on Tropic Hill and the Rosamond Hills nearby. It seldom rises more than a few hundred feet above the surface of the plain, below

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<sup>10</sup> Simpson, E. C., work cited (footnote 9), pp. 395-401.

which it was eroded to a depth as great as 1,600 feet, as shown by drill holes in the middle of the valley<sup>11</sup>. The exposures evidently represent mountain peaks and ridge crests of the old granite valley that have been protected from erosion until recently by lavas blanketing them.

The volcanic rocks constitute almost the whole of Soledad Mountain, the eastern part of Tropic Hill, a large part of Bowers' Hill, and probably a considerable part of the Middle Buttes.

Bateson gives much thought to the question of whether there was one period of eruption or two. If one, the rhyolite would be regarded as a more quickly chilled facies of the rhyolite-porphry. But on the whole he concluded that each of these rocks probably represented a separate period of extrusion, the rhyolite being later and hence in the nature of a cap rock that had flowed out upon the rhyolite-porphry.

A glance at the aerial photographs of Soledad, shown in figures 1, 3, and 4, immediately suggests a structure far more complex than that of one series of lava flows capped by another. There is a strong suggestion of flows at all angles from approximately horizontal to nearly vertical. This should be expected in a volcanic core built up by the alternate periods of activity and quiescence that characterize most volcanoes. Since each extrusion must rise through the rocks previously extruded, its course through them would be represented by dikes, though, upon arriving at the surface, the lava might form a level pool in the cup of the volcano or, overflowing its sides, might pour down over the surface to solidify in lava beds of gentle inclination; and there are many other forms it may take that imagination will readily suggest.

De Kalb estimates that Soledad was once 2,000 feet or more higher than at present. Undoubtedly, however, its height has been greatly reduced by erosion, so its present crests were once deeply buried in the core of the volcano.

It seems certain that there were many extrusions of lava at Soledad, but whether it should be assumed that the relative age of the rocks, as earlier or later, is shown by their constitution as rhyolite-porphry or rhyolite seems doubtful, though locally it might be true. There is much evidence supporting the doubt, too technical in character for discussion here, but it is obvious that any long period of quiescence might have resulted in the development of sufficient phenocrysts in a magma before extrusion to constitute a rhyolite-porphry when solidified. On the other hand, there is a part of the rhyolite near the very crest of Soledad in which large phenocrysts are so frequent that it might be supposed to be a large inclusion of rhyolite-porphry, though it is probably a facies of the rhyolite resulting from locally slower cooling.

On Bowers' Hill rhyolite-porphry is preponderant, but there is also considerable rhyolite that is definitely of later origin. Both are intrusive into granite, but remnants of the former also appear as lava flows upon the granite.

The volcanic rocks of Tropic Hill are chiefly rhyolites and felsites, although there is some rhyolite-porphry that might prove to be merely a facies of the rhyolite. These rocks do not present the complex of an actual volcanic core, such as is seen in Soledad. They represent either flows from a nearby volcano or from exceedingly gentle local extrusion - from a fissure, perhaps. The former would seem more probable, though no actual volcano can be identified as the source of the lava.

Simpson apparently considers the whole of the Middle Buttes as consisting of sedimentaries of the Rosamond series. It should be recalled, however, that these sedimentaries are described as including volcanic tuffs, breccias, and lava beds. In fact, the volcanic rocks are so greatly in evidence in the Middle Buttes that they may have been the site of at least

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<sup>11</sup> De Kalb, Courtenay, work cited (footnote 5).



FIGURE 3.- Golden Queen mine and mill.





FIGURE 4.- Soledad Mountain from the northwest: 1, Golden Queen mill; 2, main haulage adit, 600-foot level, Golden Queen; 3, adit, 400-foot level, Golden Queen; 4, adit, 200-foot level, Golden Queen; 5, discovery shaft, Silver Queen claim (later Golden Queen mine); 6, waste glory hole, Golden Queen; 7, No. 1 adit, Lodestar; 8, No. 2 adit, Lodestar; 9, No. 3 adit, Lodestar; 10, No. 4 or Echo adit, Lodestar; 11, tailings, Echo mill; 12, upper adit, Soledad Mojave; 13, lower adit, Soledad Mojave; 14, Elephant-Eagle mill; 15, Elephant shaft.

quiet extrusions. Both rhyolite and rhyolite-porphry are seen. The Trent mine is bottomed at present in a thick formation of rhyolite-porphry that may have been a surface flow but strongly suggests a sill intruding the Rosamond sedimentaries. If so, it would probably be much later than the rhyolite-porphry of Soledad and Bowers' Hill.

#### Faulting and Ore Deposition

Faulting in the Mojave district is neither frequent nor intense, though one of the great faults of the Pacific coast region - the San Andreas Rift - passes within 20 miles of it on the south and another great fault - the Garlock - is found 3 or 4 miles west of the Middle Buttes, striking thence to the northeast. A third smaller, but still extensive, fault the Rosamond, is shown by Simpson as passing just south of Tropic Hill on an east-west course, constituting, in effect, the southern boundary of the Mojave mining district.

In the vicinity of the mines, however, the faults effect only very slight displacements, as far as known, and are local rather than major in character. Yet knowledge of them is of great importance, as practically all occurred before the mineralization, so ore is likely to be found in any of them in areas reached by the mineralizing solutions.

De Kalb during the period of his management of the Exposed Treasure mine appears to have had an excellent opportunity to work out the nature of the faulting there. He concludes<sup>12</sup> that there were "three distinct periods of faulting", the first, with a strike of N.80° E., producing clean-cut fractures with horizontal displacement of about 20 feet and vertical displacement of 5 feet, which "opposed porphyry against granite faces, thus disturbing the original relations of the dikes and the intercalated granite masses."

The second, striking nearly due north and south, "produced extensive rupture under shearing strains, resulting in excessive crushing of wide zones traversing rhyolite and granites indiscriminately." The Exposed Treasure belonged to this series.

The third likewise produced breaking, described as shear zones with a northwest-southeast strike. De Kalb decided that the second and third were closely related and were "due to an approximately horizontal thrust coming from the direction of Soledad." He found the hanging wall of the Exposed Treasure displaced only 32 feet as measured by the displacement of a cross fissure. The vein dips 60° near the surface but gradually flattens to 27° in the lower workings. It shows heavy grooving on its footwall, "approximately 3 feet from crest to crest"; the grooves dip 31°.

On Soledad a strong presumption has been established by recent developments that the important veins are normal faults along which successive blocks of ground have subsided both to the northeast and the southwest of a crest that extends through the Silver Queen mining claim as more fully described later (see Golden Queen mine).

On Tropic Hill the veins represent premineral faulting characterized by crushing stresses that probably caused very moderate displacements. One post-mineral fault is seen that effects a displacement of about 20 feet.

Most of the faulting on Middle Buttes appears to have resulted from stresses that shattered zones of rock without effecting much displacement. A thick bed of rhyolite-porphry in which the Trent mine is bottomed at present may possibly be an intrusive sill. If so, its intrusion beneath the siliceous rocks above it would account for such a fissure as the Trent vein, and some genetic relation between the sill and the ore might then be presumed.

De Kalb reports that he found appreciable quantities of gold in all volcanic rocks of the district. Presumably this is related to silicification, even from the early volcanic

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<sup>12</sup> De Kalb, Courtenay, work cited (footnote 5), pp. 315-317.

waters. Everywhere there is evidence of general silicification going on at an early period. A later generation of quartz frequently contains values nearly sufficient to make ore, but the higher values were deposited, invariably it seems, in connection with at least a third generation of quartz, subsequent to practically all fissuring, though some postmineral movements of minor character, such as those described at Tropico, probably occurred.

Most of the values in the ore are derived from gold in exceedingly fine particles, together with silver sulphides and silver chloride, which likewise are seldom apparent. The ore usually appears to be merely quartz or silicified country rock, often brecciated and recemented. Secondary enrichment occurs, but rarely, except on Bowers' Hill, where it was more pronounced than elsewhere in the district.

## INDIVIDUAL PROPERTIES

### Soledad Mountain Area

#### Golden Queen

The Golden Queen Mining Co. was organized early in 1935. W. C. Browning is general manager and Charles Kumke mine superintendent. It is owned by a syndicate that is headed by the Gold Fields American Development Co., but also includes other subsidiaries of Consolidated Goldfields of South Africa and several of the larger American mining groups.

Starting with the purchase of the Silver Queen claim from George Holmes and associates, the company has acquired control of about 300 acres of contiguous mining ground, including the Queen Esther group of claims. Its property comprises an area about 2,000 feet wide by 1 1/2 miles long, extending north and south over the crest of Soledad Mountain (see figs. 2 and 5).

The Silver Queen vein was discovered high up on the northwest flank of Soledad Mountain. It strikes N. 40° W. and dips 60° to the northeast. Its width usually ranges from 10 to 40 feet in exposures underground, though in one section of the mine, where the ore is of low value, the vein is nearly 100 feet wide.

Southeast from the discovery the vein rises to a saddle in the crest of the mountain. In the other direction it descends the mountainside to its junction with a detrital fan that slopes more gently to the plain. The topography thus permits exploration and mining of the vein by tunnels (see figs. 1 and 3).

The mountain consists chiefly of lava flows, included within which there are probably dikes of so nearly the same character that their intrusive nature is not readily apparent. Lowest in position and probably earliest is a rhyolite-porphry, characterized by numerous good-sized phenocrysts of quartz and feldspar. The next flow above it is a felsite, and over this a rhyolite appears to have flowed, some of it being seen above the felsite, though much of it has been eroded. The rhyolite is also seen in direct contact with the rhyolite-porphry in areas to which the felsite either did not extend or from which it had been eroded before the rhyolite eruptions.

The discovery of the Silver Queen vein occurred in a felsite through which it passes into rhyolite-porphry at a depth of several hundred feet. The best ore was found in the felsite where the fissuring, locally at least, is more open than in the rhyolite-porphry.

This vein is now regarded by W. C. Browning, general manager, as the most westerly of a probable series of parallel fissures on which normal faulting has caused subsidence of successive blocks of ground northeast of the Silver Queen vein. The displacement of the Silver Queen vein has been estimated to be about 150 feet, as indicated by contacts of felsite and rhyolite-porphry in the foot and hanging walls. The Queen Esther, located about 1,000 feet to the northeast, is considered another vein of this series.

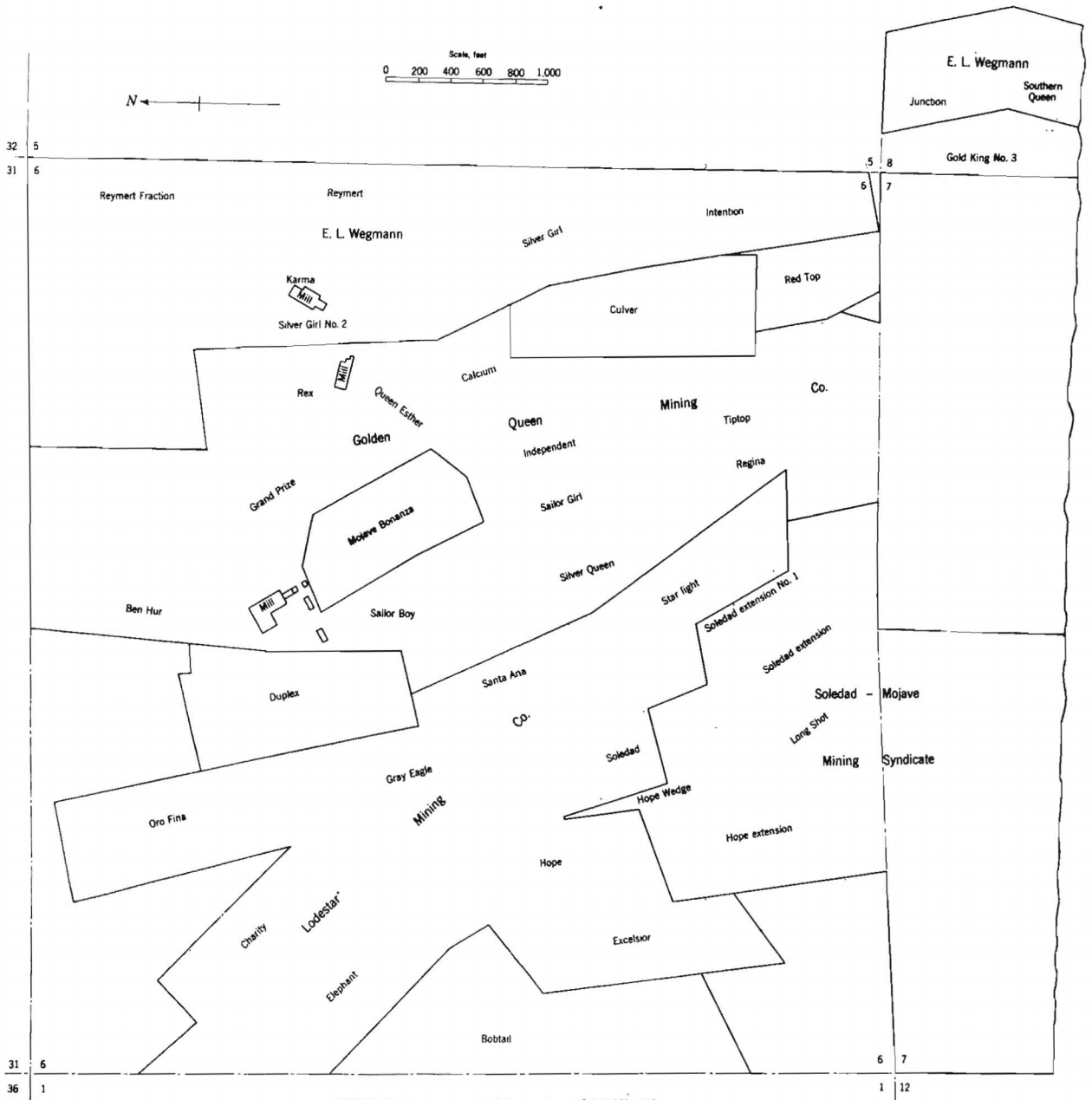


FIGURE 5. Map showing principal mining properties on Soledad Mountain.

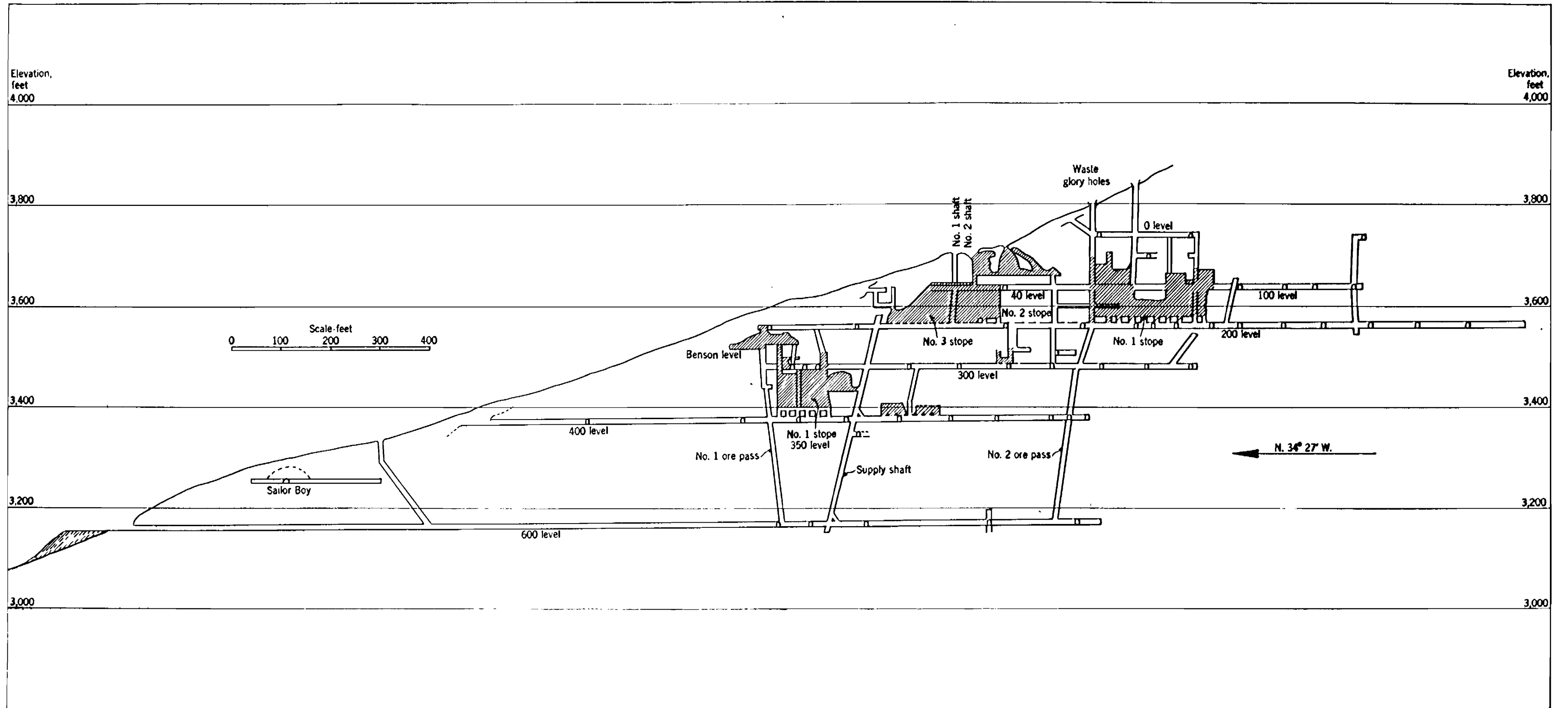


FIGURE 6. Longitudinal projection of Golden Queen mine.

This presumption of block faulting along normal faults was strengthened by the discovery of a second vein, called the Golden Queen. It was found at a depth of 100 feet by a 200-foot crosscut southwest of the Silver Queen. This second vein parallels the Silver Queen in strike but dips in the opposite direction, to the southwest. As it also proved to be a normal fault, the block of ground to the southwest of it having subsided, the ground between the Silver Queen and the Golden Queen veins appears to be a crest, on both sides of which subsidence has occurred.

The Starlight vein of the Lodestar Mining Co. lies several hundred feet southwest of the Golden Queen, and still farther on in the same direction the Soledad Mojave vein is found. Both of these strike parallel to the Golden Queen and also dip to the southwest, so these three veins are regarded as a southwest-dipping series of normal faults bounding a succession of subsidence blocks that moved down upon them southwest of the crest.

The vein filling of the Silver Queen vein is an exceedingly hard quartz in which gold is so finely disseminated that it can scarcely be seen except by very fine crushing and most careful panning. Silver is believed to be present as cerargyrite and probably also as argentite and other silver sulphides. An interesting phenomenon is the appearance of spots and thin films of a brownish-black silver mineral, thought to be cerargyrite, on many of the ore faces 5 or 10 days after they are exposed. Many patches of this dark silver mineral may be observed throughout the mine. Some think the specks are formed by the sweating of a mineralized solution from the ore, but they are more likely to represent thin films of a silver mineral, such, perhaps, as silver chloride, that is merely made visible through its alteration soon after it becomes exposed.

The best bodies of ore thus far disclosed by exploration have been found in the first 400 to 500 feet beneath the surface, where there is felsite. Below it, in the rhyolite-porphry, the vein, though continuing, tends to narrow, tighten, and decline in values. This was also true in the Queen Esther; and in the Starlight and the Soledad-Mojave veins the ore thus far discovered is likewise in the felsite. Future major discoveries of ore are therefore expected to result from lateral exploration within the felsite rather than from extension of ore in depth. As yet, however, it is far from certain that good ore bodies may not be found in the underlying rhyolite-porphry. Apparently the granite lies far beneath the lowest level of the mine, as a drill hole below the 600 level had not passed out of the rhyolite-porphry at a depth of 600 feet.

The average of smelter returns on ore shipped by Holmes from his exploration previous to January 1935 is reported to have been about \$23 a ton, the gold-silver ratio being 1 ounce of gold to 12 ounces of silver. Lower costs of mining and milling now permit mining of much lower grade ore at a profit, so that the mill feed is said to average between \$11 and \$12 a ton. The total value of production from the mine to August 1936, is about \$1,200,000.

The equipment and development of the mine and the construction of the mill provide an interesting and highly creditable record of accomplishment. Starting with less than 2,000 feet of workings, the mine had been explored by more than 2 miles of additional workings and had attained its planned steady output of 300 tons a day in less than 1 1/2 years. Even more notable were the design, erection, and initial operation of the all-sliming cyanide plant capable of treating 300 tons a day of an extremely hard ore requiring twice the usual grinding capacity, all within 7 1/2 months from the time its site was determined by location of the main haulage level.

Figure 6 is a longitudinal projection of the mine as of August 1, 1936. Principal development is by three adits on the 200-, 400-, and 600-foot levels, the lowest of which is the main haulage or mill level. The 100 and 300 are intermediate levels, and the 0 level is a communication drift to three glory holes which supply waste rock for fill.

Two ore passes and a supply shaft extend from the 200 to the 600 level, and there are several auxiliary raises to serve levels above the 200.

The principal stoping has been above the 200-foot level and above the 400 level between the supply shaft and no. 1 ore pass. No ground has been stoped as yet below the 400 level.

Presumably the workings shown will presently be extended a considerable distance to the southeast, as ore of commercial grade has been found in rhyolite on the eastern slope of Soledad, beyond its crest.

Square-Set Slot-and-Pillar Method of Mining.— When the Golden Queen mine was first opened it was thought that all its ore bodies could be mined by shrinkage stoping, and the extraction of ore was begun by this method. However, in some places the vein attained widths of 40 to 50 feet, the backs became dangerous and would not stand, and the ore ran into the footwall in flat-bottomed pockets from which it would not draw. Hence, with these stopes partly mined, it became necessary to find a safe, efficient method of completing their extraction. To meet the emergency the engineers of the company devised what they described as a square-set slot-and-pillar method. In preparation for its use the shrinkage stopes were drawn and filled with waste. Then slots at right angles to the vein, one set wide, were mined and timbered with square-sets, extending through the ore block to the limits of the ore. The distance between the slots is 25 to 50 feet, depending upon the condition of the ground in the ore pillars.

The cutting of the slots provides an excellent opportunity for prospecting the footwall and determining the limits of ore. For this purpose the ground ahead is examined by long holes into the face of the slot. When flat pockets from which broken ore will not run are encountered in the footwall in the slots the muck must be moved by hand, but ore slides are used in the slots wherever practicable to shoot the muck into a cribbed raise from which it is drawn into the drift below.

When the square-set slots have been completed, a floor is laid over the fill beneath an ore pillar. The pillar is then mined either by cut-and-fill or square-set methods, depending on the character of the ground. If the backs stand fairly well, the cut-and-fill method is used, and scrapers are employed to pull broken ore on the floor into the nearest cribbed raise. The stope is filled with successive layers of waste in the usual manner as mining progresses, the sides of the square sets in the slots being lagged to retain the fill. The square sets of the slots are anchored with old cable to those in an adjoining slot or to deadmen in the waste to strengthen them in case this seems necessary. Where the ground is dangerous it is fully square-set, the sets resting on a double floor of crossed planking on top of the fill.

Waste fill derived from 3 glory holes on the surface is passed through waste raises to the levels below where it is distributed by slushers operated by air hoists.

Figure 7 shows three sections of a stope that is being mined by the square-set slot-and-pillar method and illustrates its principal phases. The method has served to reduce materially the cost of mining where the vein is very wide, direct stoping cost being less than a dollar. About a fourth of it is the cost of filling. The method is said to have proved safe and flexible, as well as economical. It is of course unnecessary to use the method, except where the backs will not stand, and much of the ground, particularly where the veins are under 20 feet in width, can be mined successfully by shrinkage stoping.

Golden Queen Mill.— The Golden Queen mill, pictured in figure 3, is on the north slope of Soledad Mountain a few hundred feet east of the portal of the 600-foot or main-haulage level of the mine. Completed in October 1935, it is a strictly modern 300-ton plant for crushing, fine grinding, and cyanidation, with three-stage countercurrent decantation and precipitation by the Merrill-Crowe process. Its capacity is already being increased to 400 tons. The unusual amount of clay in some of the Golden Queen ore caused difficulties in

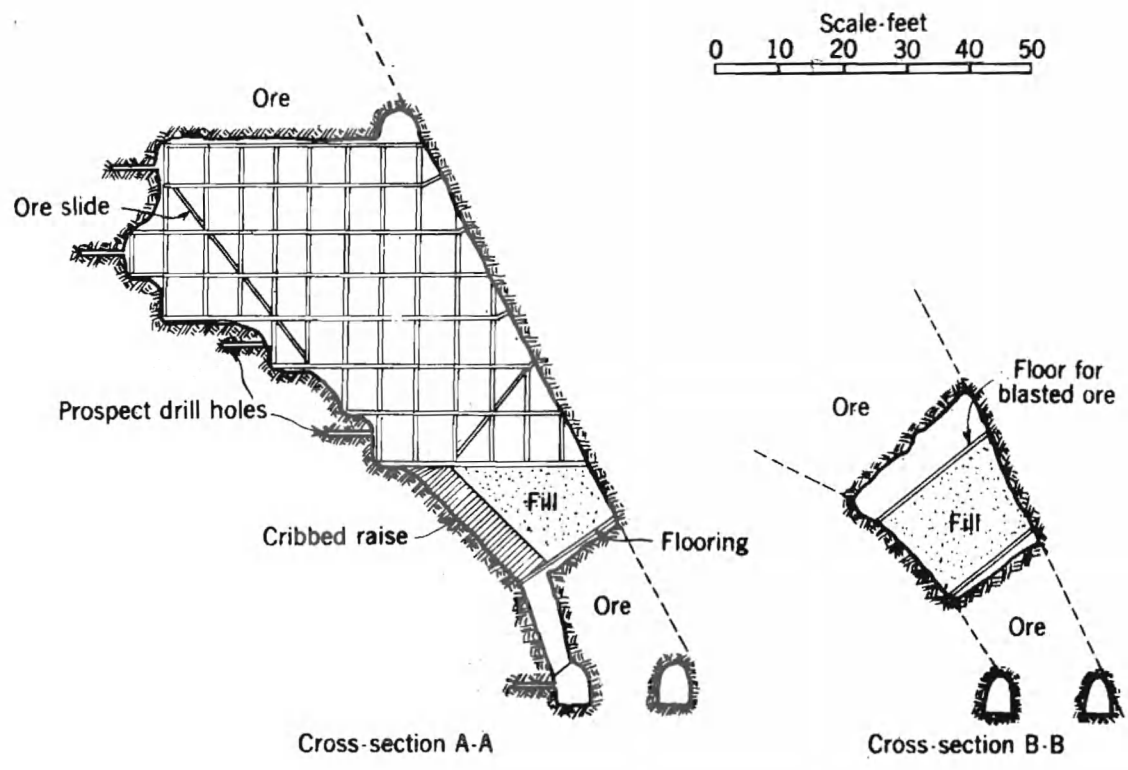
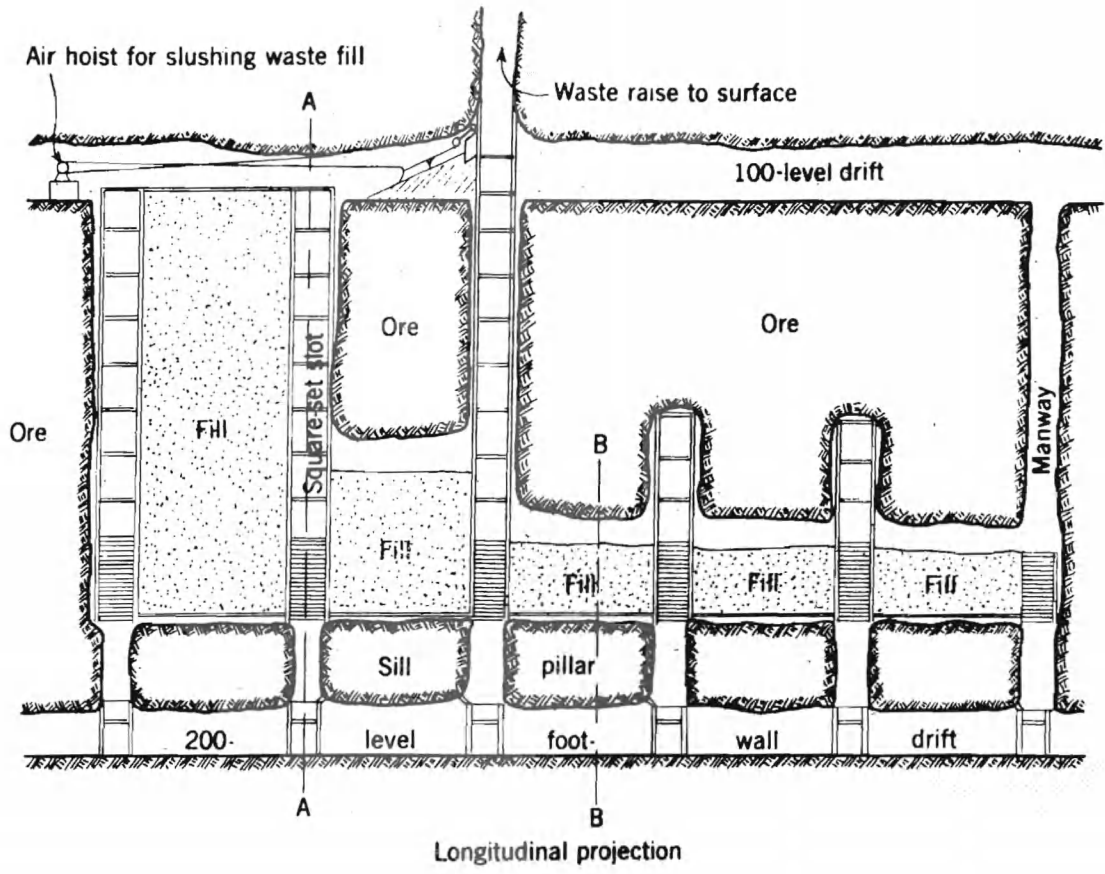


FIGURE 7.- Square-set slot-and-pillar method of mining as used in the Golden Queen mine.



decantation at first, but they were quickly overcome, and excellent recoveries of both gold and silver are made. Milling operations are under the direction of V. T. Berner, assistant superintendent.

Ore is hauled from the mine by storage-battery locomotives in 12-car trains of 2-ton, hopper-bottom, Magma-type, side-dump ore cars, discharging into a 1,000-ton wooden bin. Adjacent to it there are two 250-ton steel-bottom chute bins for custom ore delivered by auto trucks. The ore is discharged from the bins by seven 36-by 50-inch apron feeders to a 30-inch conveyor belt with a magnetic head pulley for removing tramp iron. This belt delivers the ore to an inclined grizzly, the oversize from which, minus 10 plus 1 1/2 inches, goes to a 3-foot gyratory crusher which reduces it to minus 1 1/2-inch size. The grizzly and the throat of the crusher are sprayed with water to reduce dust.

The crusher is driven by nine V-belts from a 100-horsepower motor. It handles only about 35 percent of the ore, as the remainder passes through the 1 1/2-inch grizzly. This undersize joins the discharge from the primary crusher and is elevated to a 4-by-5 foot Hummer screen by a 24-inch, 4-ply belt conveyor 118 feet long with a slope of 16°. The conveyor has a maximum capacity of about 125 tons an hour, and its head pulley is equipped with a solenoid brake to prevent its load from piling up if the power is shut off. The Hummer screen has 1/2-inch openings and makes 60 vibrations per second. Its oversize, minus 1 1/2 plus 1/2 inch, discharges to a second gyratory crusher set to crush to 1/2-inch size. This secondary crusher handles about 65 percent of the feed to the screen, the remainder being undersize.

The discharge from the secondary crusher joins the undersize and is elevated to the top of a sampling unit by an 18-inch, 4-ply belt conveyor 79 feet long with a 21° slope. This conveyor has a maximum capacity of about 125 tons an hour, and its head pulley is equipped with a solenoid brake. Near its foot is a conveyor weightometer which records the weight of all ore handled by the conveyor and affords a check on the weight of custom ore as determined by platform scales before it is dumped into the ore bins.

The sampling unit consists of 3 samplers in series, each cutting one-tenth of the ore stream and thereby furnishing a 2-pound sample from each ton of ore. The third cut, or final sample, is ground in a pulverizer to minus 100-mesh before it is cut down in a riffle splitter to provide quadruplicate assay samples.

The first reject from the sampling unit falls directly onto a horizontal, 18-inch, 4-ply belt conveyor 90 feet long, which discharges to either of two circular steel fine-ore bins with a capacity of 250 tons each. This same conveyor receives all the other rejects from the sampling unit via a bucket elevator with 6-by 4-inch buckets. The fine-ore bins are discharged by a 24-by 36-inch traveling feeder which delivers to either of two 18-inch horizontal belt conveyors, discharging at a common point onto another 18-inch belt which carries the fine ore to the first of three No. 67 ball mills.

The grinding unit has great flexibility and is adapted to either two- or three-stage grinding. In two-stage grinding, which is normally practiced, the first ball mill receives 17 to 18 tons of original feed per hour in addition to a circulating load of 300 percent, so 68 to 72 tons of ore per hour pass through the mill. The primary mill was originally charged with 5 tons of 5-inch and 4 tons of 3-inch steel balls. It makes 25 revolutions per minute. Each of the three mills is driven by a 150-horsepower synchronous motor. Grinding is done in mill solution containing 2.75 pounds of total NaCN and 0.5 pound of protective CaO per ton.

The discharge from the primary mill goes to a Dorr classifier 6 feet wide and 21 feet 8 inches long, with a slope of 3 1/2 inches per foot. This classifier is in closed circuit with the primary mill, to which it refeeds plus 10-mesh material. Its minus 10-mesh overflow discharges to a pump sump through a small trommel for screening out wood splinters.

One of two 4-inch Hydroseal pumps, the other of which is reserved as a standby, delivers the pulp containing 20 percent of solids from the pump sump to a surge tank, from which it flows to an 8-by-30 foot Dorr classifier with a slope of 2 inches per foot and a 12-foot turret bowl. This classifier is in closed circuit, through the pump sump and surge tank, with the third ball mill, which was originally charged with 3 tons of 3-inch and 6 tons of 2-inch steel balls. It makes 25 revolutions per minute. The bowl classifier is so regulated that 80 percent of the ore particles in its overflow are minus 200-mesh. When it is desired to grind in three stages the overflow from the first classifier is passed to a second similar classifier in closed circuit with the second ball mill. This classifier has a slope of 3 inches to the foot, and its overflow goes to the pump sump.

The finely ground pulp, now containing 12 percent of solids, flows to a 55 by 12-foot thickener with a capacity of 700 tons. The overflow from this thickener, amounting to 1,600 tons of solution a day, flows to a 40-by 12-foot pregnant-solution tank. The underflow, containing 40 percent solids, is transferred by a 4-inch triplex diaphragm pump to the first of three agitators arranged in series.

Each of these agitators is 24 feet deep by 34 feet in diameter. Their arms make three revolutions per minute. The pulp, which is here diluted with mill solution until it contains one-third solids, is aerated by air lifts supplied with air under 9 pounds pressure by two pumps. In cold weather a heating plant warms the agitator pulp to an average of 75° F. to promote more rapid dissolution of silver. The pulp overflowing from the third agitator goes to thickener No. 2, which is the first of a series of three in which the pulp is washed by countercurrent decantation. The overflow from thickener no. 2, amounting to about 2,100 tons of solution a day, is transferred by a centrifugal pump having a capacity of 300 gallons per minute to a 20-by 30-foot mill-solution tank with a capacity of 650 tons. The underflow, thickened to about 35 percent solids, is transferred by a diaphragm pump to thickener no. 3, the overflow from which, amounting to 1,500 tons a day, flows back to thickener no. 2. In a similar manner thickener no. 4 receives the underflow from thickener no. 3, to which it returns its overflow. The underflow from the no. 4 thickener, containing 40 percent of solids, is transferred by a pump to two 14-by 16-foot filters on which the cake is washed with barren solution and warm fresh water from the compressor before it is blown off, repulped to about 60 percent solids, and delivered by a 2 1/2-inch pump to the tailings pond at the foot of the hill. Both the weak and strong solutions from the filters are returned to thickeners no. 3 and no. 4, which also receive about 1,200 tons of solution a day from a 30-by 20-foot, barren-solution tank with a capacity of 425 tons.

The pregnant solution is precipitated by the Merrill-Crowe process. Before going to the vacuum tank for removal of air, the solution is clarified in a Butters-type filter. A 10-percent solution of lead acetate is added to the pulped zinc dust to speed precipitation of the gold. The precipitates are washed, dried, and melted in 50-pound lots in a tilting oil-fired furnace, with 30 pounds borax glass, 6 pounds silica, 15 pounds soda ash, and 3 pounds manganese dioxide. Bullion is shipped to the mint at San Francisco.

A high recovery of both gold and silver is made. The dissolution of about 60 percent of the gold and silver in the ore is effected in the primary mill-solution circuit.

Water for the mill is obtained from two wells, one 1 1/4 miles and the other 5 miles distant. The first is 215 feet deep and supplies 20 gallons per minute; the second, 282 feet deep, provides 75 gallons per minute. The water is pumped into a 220,000-gallon supply tank at the mill. Black Aero cyanide containing 48 percent NaCn is used. Sixteen men are employed in the mill on 3 shifts.

A more detailed description of this mill by its designer, Otto Wartenweiler, of Los Angeles, has recently been published<sup>13</sup>.

### Queen Esther

The Queen Esther mine is on the north slope of Soledad Mountain in sec. 6, T. 10 N., R. 12 W., S.B.M., about 4 miles south of Mojave (see fig. 2). It lies between the Wegmann property on the east and the Golden Queen mine on the west and has been leased recently by the Golden Queen Mining Co. The Queen Esther is one of the oldest mines in the district, having started active production in 1904 when it was taken over from John Boyle and associates by the Small Hopes Co. and operated under the management of the late Seeley W. Mudd until 1911. In January of that year the mine was closed and it has not been worked since. Under Colonel Mudd's management it produced about \$1,250,000 from 200,000 tons of ore, which was treated in a 100-ton plant by dry-crushing and cyaniding. The value of this output is based on gold at \$20 an ounce and silver at \$0.54 an ounce (the average price of silver during the period of production).

The Queen Esther vein ranges in width from 3 to 20 feet or more. It is widest along its high outcrop and tapers with depth until at the portal of the main adit it is only 7 feet wide, and in many places on the lower levels is but 3 feet wide. The vein strikes N. 40° W. and has an average dip of 50° northeasterly. For the first 50 to 70 feet in depth beneath its high outcrop the vein is said to have been in felsite, and it was in this upper portion of the vein that the richest ore in the mine, containing 30 to 40 ounces of silver per ton, was encountered. Beneath the felsite horizon both walls of the vein are rhyolite-porphry. The vein filling is a light-colored quartz containing gold and silver in widely varying ratios but averaging about \$6 a ton at old prices. There has been some movement along the vein, and it has been offset along its dip by a series of step faults at right angles to the vein, each of which throws it 3 to 30 feet to the west. There are two parallel veins in the foot-wall, the Center and West veins, but they are minor fractures and have not yielded ore except near the surface.

The mine is developed by six adits on the main vein, the lowest of which has a 290-foot winze serving 5 additional levels. There are also two short adits which explore some of the higher ground. In all there are about 7,500 feet of workings, most of which are now inaccessible, as the collar of the winze has fallen in and many of the upper stopes have caved.

Considerable difficulty was experienced at first in obtaining satisfactory recoveries in cyaniding the ore. Mill heads averaged \$6 per ton, and initial recoveries were 60 to 70 percent. These recoveries were later raised to nearly 90 percent by the addition of 2 to 3 pounds of litharge per ton of ore in the cyanide treatment. The values of the ore decreased progressively with depth in the mine, and the mill feed averaged only about \$4 per ton for many months before the suspension of operations. During this period many of the old tailings were re-treated in the mill.

### Lodestar Mining Co.

The property of the Lodestar Mining Co. is on the northwest slope of Soledad Mountain in sec. 6, T. 10 N., R. 12 W., S.B.M. (see figs. 2 and 5). It comprises about 150 acres adjoining the holdings of the Golden Queen Mining Co. on the east and those of the Soledad-Mojave Co. on the south and includes the Starlight, Soledad, Gray Eagle, Echo, Elephant, and other claims. John C. Higgins of New York City is president of the company; John M. Rodgers

<sup>13</sup> Wartenweiler, Otto, *The New Mill of the Golden Queen*: Eng. and Min. Jour., vol. 137, no. 7, July 1936, pp. 327-335.

of Mojave, Calif., is vice president and general manager; and W. M. Benham is mine superintendent. The present holdings of the company were acquired early in 1935.

Six roughly parallel veins, striking from N. 12° to 40° W. were developed on the property in early days and have been mined subsequently by numerous leasers. They are the Starlight, Soledad, Echo, Elephant, Gray Eagle, and Excelsior. The first four dip from 54 to 85° to the southwest, the Echo being nearly vertical. The other two dip steeply to the northeast. Near the surface the veins are in felsite, but at depth some of them are known to pass into the rhyolite-porphry. In this property, as in other nearby mines, the best ore bodies have occurred in the felsite.

The total production of these veins to date has probably exceeded considerably the \$450,000 that includes \$350,000 from treatment of 40,000 tons by the old Echo mill and the Elephant mill which succeeded it, and about \$100,000 in ore shipped to smelters and to the Tropic mill.

The Starlight.— In August 1935 a discovery of ore by a leaser, high up on the mountain in the Starlight claim, led to intensive exploration by the company during the past year which has resulted in development of about 100,000 tons of ore, a substantial part of which exceeds \$13 a ton in value. The whole developed tonnage is expected to yield \$10 to \$11 a ton as mined.

The part of the vein in which this development occurred lies southeast of what appears to be a fault, so the management, having recently concluded this was a new vein instead of an extension of the Starlight, as it had first supposed, renamed it the Albertoli vein after the leaser of that name who had discovered the ore.

The vein is in a normal fault a short distance southwest of the Golden Queen vein, as described under the Golden Queen section, where it is referred to as the Starlight, following the custom of the district. It ranges from 3 to 15 feet in width, strikes N. 33° W., and has an average dip of about 66° to the southwest. Its ore is all in the felsite horizon of the vein, to the south of the east-west fault against which it abuts 1,300 feet from the portal of the lower adit described below.

The vein is developed by three main adits. The upper has an average of 140 feet of backs to the surface. The middle adit is 100 feet on the dip of the vein below the upper adit. The Gray Eagle tunnel or lower adit is 200 feet beneath the middle adit. In the upper adit south of the east-west fault the hanging wall of the vein is a tuff, and the footwall is felsite; in the middle and lower adits both walls are felsite. The three adits open the vein for a maximum length of over 1,100 feet. The ore shoots have an average width of about 12 feet, and sampling is said to show that about 50 percent of the vein filling is rich enough to stope. The ore is an exceptionally hard quartz similar to the Golden Queen ore, and it is equally difficult to crush. The average content is 0.2 to 0.4 ounce of gold and 3 to 5 ounces of silver per ton.

The Echo.— The Echo mine, opened in 1900, is one of the oldest in the district. Over \$30,000 worth of ore averaging \$34 a ton was shipped to smelters from the property before it was equipped with a 10-stamp mill by the Echo Consolidated Mining Co. in 1902. This mill was later increased to 20 stamps, and about \$170,000 was extracted from a mill feed that averaged about \$15 a ton. The plant was dismantled in 1906. The ore contained little silver, the gold-silver ratio being 1:2.

The Echo vein is about 300 feet west of the Starlight vein. It strikes N. 38° W. and dips 70° SW. It has an average width of 3 feet, ranging from 1 to 6 feet. The vein is developed by a 1,100-foot tunnel, which starts as a 280-foot crosscut to the vein and then proceeds southeast as a drift along the vein. This tunnel is 175 feet lower than the Gray Eagle tunnel, and it is planned to extend it south to serve as a main haulage level for the workings on the Starlight claim. There is a 100-foot winze 560 feet from the portal of the

tunnel, and 260 feet beyond there is a crosscut driven toward the Gray Eagle vein for 500 feet without intersecting it. In the northern part of the vein the hanging wall is a bluish felsite and the footwall rhyolite-porphry.

Elephant-Eagle.— The Elephant vein lies west of the Echo. It strikes N. 22° W., dips 70° SW., and has an average width of 4 to 4 1/2 feet. It is developed by a 400-foot inclined shaft with levels at 100, 200, and 300 feet and by a 200-foot crosscut tunnel from the east side of the ridge. This tunnel intersects the vein at a depth of 125 feet, and the best ore was found above it. The foot wall is rhyolite-porphry and the hanging wall felsite. The vein continues 200 feet south and 100 feet north of the shaft, breaking up at each end into veinlets that disappear into the rhyolite-porphry.

Near the surface the ore contained \$70 a ton at old prices, but below the 100-foot level mill heads averaged about \$15 a ton, excluding a rich pocket locally called "The Hot Spot." Seventy sacks of ore from this pocket yielded \$7,000 or about \$1 a pound and 70 tons yielded \$70,000 or \$0.50 a pound. The property is equipped with a 50-ton mill and cyanide plant that have been idle since 1935. The principal milling equipment consists of a crusher which broke the ore to 3/4-inch mesh, a tube mill in closed circuit with a classifier, three sand tanks, two 40-foot thickeners, and three agitators. The property is reported to have produced about \$250,000.

The Gray Eagle vein is immediately west of the Starlight vein. It strikes N. 22° W. and dips about 85° NE. It intersects the Starlight near the northern end of the latter, diverges from it for a few hundred feet in a southerly direction, and then parallels it. The vein is 1 to 6 feet wide with an average width of 2 feet. In its upper portion both walls are felsite, but with depth it passes into the rhyolite-porphry where its values fade and the vein pinches rapidly.

It is developed by the 1,300-foot tunnel of the Gray Eagle which starts as a 180-foot crosscut running a little south of east to intersect the Gypsy vein, then crosscuts north-east to the Gray Eagle vein along which it runs for several hundred feet before turning to crosscut the formations to the southeast.

The Gray Eagle tunnel developed an ore shoot about 250 feet long on the Gray Eagle vein. This shoot, which was 4 to 6 feet wide, has been stoped to the surface a distance of 150 feet. The ore is reported to have averaged about \$18 per ton (old price) and to have had a gold-silver ratio of about 1 to 17.

Previous to the acquisition of the property by its present owners the Gray Eagle tunnel did not extend beyond the east-west fault, but it has since been driven over 1,000 feet to a total length of 2,300 feet. North of the Starlight fault a stope on the Starlight vein about 150 feet long extends from the Gray Eagle tunnel to the surface. The vein at this point is a double fracture separated by about 6 feet of country rock. Most of the stoping is on the foot-wall fracture. The ore contained about \$7 per ton and the stope had an average width of 5 feet.

Excelsior.— The Excelsior vein is the most westerly of those on the property and is a continuation of the Bobtail vein described on page 24. It is under lease to William Harwood and M. P. Raab of Mojave. It strikes N. 12° to 14° W., dips 80° E., and averages about 2 feet in width. The ore consists of a brecciated quartz stained with iron oxide and assays 0.3 to 1.2 ounces of gold and 1 to 4 ounces of silver per ton. The vein is developed by a 100-foot inclined shaft intersected 30 feet below its collar by a crosscut adit. At the bottom of the shaft there are drifts 250 feet north and 75 feet south. The vein traverses a felsite, with well-developed flow lines.

The property is equipped with a 40-ton ore bin and a single-drum hoist belt-driven from a gasoline motor. Compressed air is purchased from the Lodestar Mining Co. and the ore is shipped to the Burton mill at Tropico.

E. L. Wegmann Mines - the Karma

The E. L. Wegmann property consists of about 160 acres of patented ground in sec. 6, T. 10 N., R. 12 W., S.B.M., on the north slope of Soledad Mountain. It lies between the holdings of the Golden Queen Mining Co. on the west and sec. 5 on the east (see figs. 2 and 5). The property also includes two adjoining claims in the northwest quarter of sec. 8. The principal development work is on the Karma, Silver Girl, Silver Girl No. 2, and Reymert claims.

The Karma mine was opened in 1896. It is one of the oldest mines in the district and has produced approximately \$750,000. During the first 7 years of its operation ore averaging 50 ounces of silver and 0.5 ounce of gold per ton was shipped to the smelter. Assay records of these early shipments show that they contained 30 to 80 ounces of silver and 0.25 to 2 ounces of gold per ton. Smelter shipments yielded \$287,000. In 1904, a 20-stamp mill and cyanide plant were built at the mine, and in the next few years about \$250,000 was recovered from the treatment of relatively low grade ore. As the metallurgical extraction was only about 50 percent, milling was unprofitable. After operating sporadically for 4 years the mine and mill were closed down in 1909. In 1917, however, the United States Smelting & Refining Co., being in great need of siliceous ore for its smelter at Kennett, Calif., offered a liberal contract for ore from the property containing over 80 percent silica. Under this contract about 7,500 tons of low-grade ore were shipped, much of it coming from a glory hole on the Karma vein. Then the mine was shut down again, and except for development work it has since remained idle.

Five quartz veins that strike N. 20° to 25° W., roughly paralleling the Golden Queen, Starlight, and other major veins of Soledad Mountain, occur on Wegmann property within a lateral distance of 700 feet. Of these the best developed are the Karma, Ajax, and Reymert. All of the veins occupy fissures in rhyolite-porphyry. The Karma and Ajax are strong veins ranging in width from 4 to 40 feet, with outcrops that can be traced for several thousand feet, and as far as developed they show no faulting. On the surface the two veins are 50 to 150 feet apart, the Ajax being on the east and dipping slightly toward the almost vertical Karma. Consequently the veins may join in depth. In fact, at a point about 1,100 feet from the portal of the mill adit they are in contact at a depth of 350 feet, but their relative course with further depth is unknown.

Figure 8 is a plan and longitudinal projection of the Karma mine, showing its development by the Ajax and Mill adits, 170 feet apart, and by a 160-foot shaft, from the bottom of which a drift runs south 680 feet. A vertical winze from this drift descends 480 feet to water level and is by far the deepest working on Soledad Mountain. The Ajax and Mill adits are 880 and 1,460 feet long, respectively, and there are well over 1 1/2 miles of workings in the mine. Both adits show much low-grade ore containing \$3 to \$9 a ton, and their faces are both in ore of that character. The better ore having been stoped and shipped, the average grade of ore encountered in the adits was considerably higher than that of the present exposures. An extension of the Mill adit until vertically beneath the crest of the mountain would give 800 feet of backs. The ratio of gold to silver in the ore is said to be steadily increasing toward the south.

About 500 feet east of the Karma workings is the Reymert vein, which is over 10 feet wide at the surface and in places assays \$5 to \$15 a ton. It strikes N. 18° W. and dips about 60° W. It is developed by two inclined shafts 90 and 150 feet deep, respectively, and by a 60-foot adit along the vein. The ore is highly brecciated and contains angular fragments of rhyolite-porphyry in a matrix of iron-stained quartz.

The Gold Blossom vein on the Silver Girl claim shows 8 feet of milling ore in a trench across its outcrop. The Black vein, between the Reymert and Ajax veins, extends from the

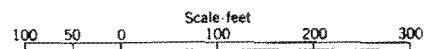
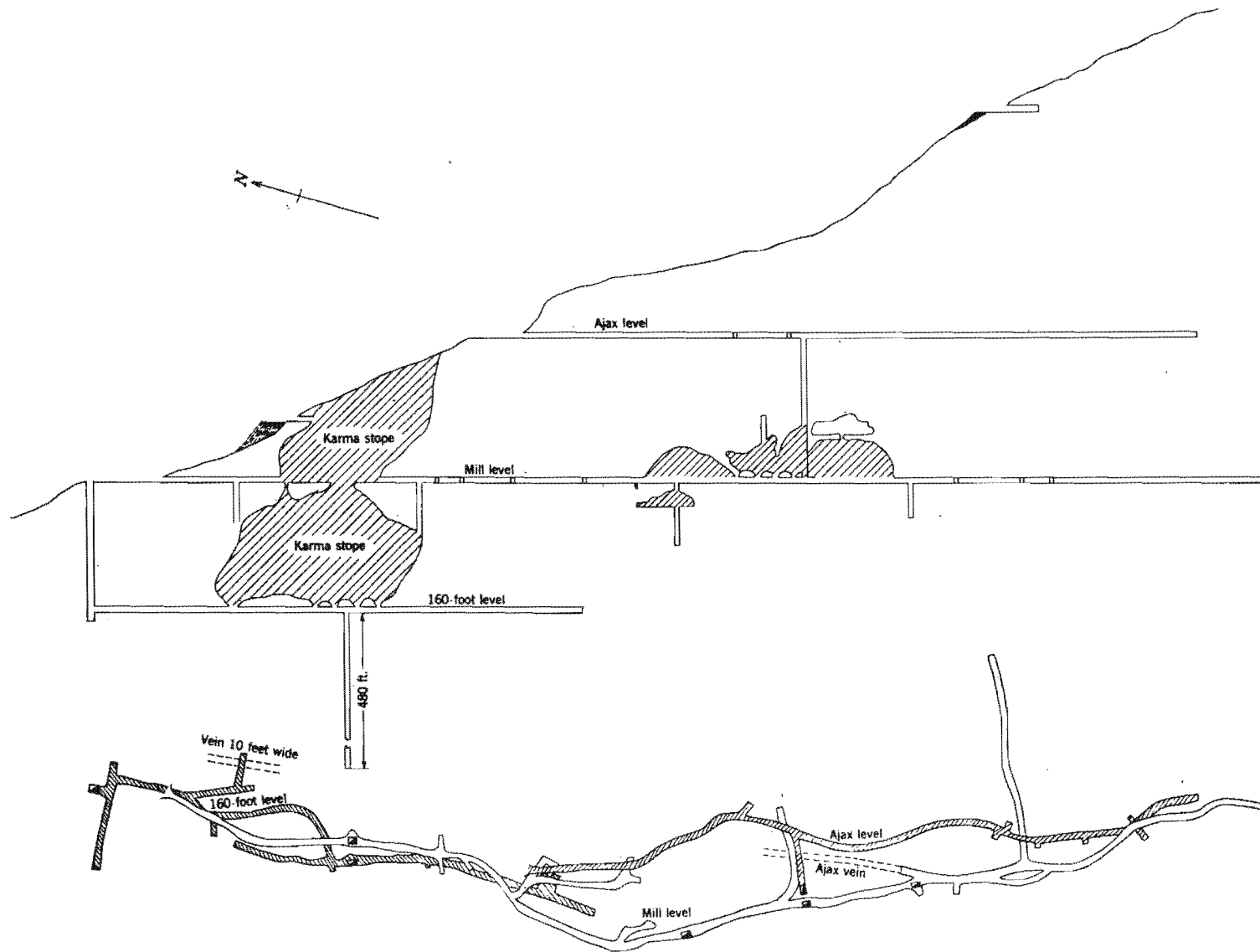


FIGURE B. Plan and longitudinal projection of Karma mine.

Reymert Fraction through the Reymert and Silver Girl claims and continues over the crest of the mountain. Its outcrop is heavily stained with manganese. In the northeast corner of the Reymert Fraction the vein is 3 to 10 feet wide and strikes almost due north. Here it has been developed by a 350-foot adit along its strike and by two shafts 50 and 70 feet deep, respectively. This vein is similar to those on Bowers' Hill in that it contains a large percentage of calcite. The ore is said to be of good milling grade, assaying \$3 to \$18 a ton, with its value largely in silver.

The Karma and Ajax veins outcrop for several thousand feet south of the main workings and extend into the Junction and Southern Queen claims on the southeastern slope of the mountain.

#### Mojave Mining & Milling Co.

The Mojave Mining & Milling Co. owns about 30 acres on the northeastern slope of Soledad Mountain in sec. 5, T. 10 N., R. 12 W., S.B.M., just east of the E. L. Wegmann property (see fig. 2). The company is managed by Englebort Wegmann of Mojave. The property is developed by three adits on three small quartz veins. The Buddy vein ranges from 6 inches to 6 feet in width, strikes northwest, and dips 75° SW. It is opened by a 1,000-foot adit which also cuts a small vein called the "zink" that strikes almost west and dips 72° southwesterly. The ore from the three veins was treated on the property in a five-stamp mill and yielded about \$12.50 a ton at old prices. The gold-silver ratio of the ore was approximately 1 to 25. The property has been idle for several years, as a portion of its area has been in litigation.

#### Soledad-Mojave Mining Syndicate

The Soledad-Mojave Mining Syndicate, owned equally by the Waltrow Corporation and the Nevada Syndicate, controls about 360 acres on the northwestern and southern slopes of Soledad Mountain (see figs. 2 and 5). This is the largest individual holding on the mountain and includes the entire western half of sec. 7, T. 10 N., R. 12 W., S.B.M. James E. Babcock of Los Angeles is president, L. K. Requa of Santa Barbara supervising engineer, and Walter Schauss of Rosamond mine superintendent.

The property is developed by a 1,300-foot adit driven southwesterly into the mountain from the Soledad claim at an elevation of 3,349 feet. The adit follows a vein of iron-stained brecciated quartz 2 to 6 feet in width. Four hundred feet from the portal of the adit is an ore shoot 150 feet long. This shoot strikes N. 35° W. and dips 52° to the southwest. It has an average width of 4 feet and an average assay of 0.4 ounce of gold and 2.75 ounces of silver per ton. Both walls of the shoot are of felsite, which shows no flow lines, although toward its portal the adit cuts felsite in which flow lines are beautifully developed and farther in it traverses a soft rhyolite tuff.

The ore shoot has been stoped irregularly along its entire length above the tunnel to a maximum height of 140 feet, leaving 165 feet of cover at this point. However, as the shoot does not outcrop its vertical extent is as yet unknown. It is cut by minor faults in four places, but nowhere is the displacement more than 5 feet. A 100-foot winze has been sunk from the adit beneath the ore shoot, but short crosscuts from its bottom did not encounter ore. From 900 to 1,000 feet from the portal of the adit there are numerous quartz stringers, all containing varying quantities of gold and silver, but none is large enough to mine.

The northeast portion of the Soledad-Mojave property is traversed by the Soledad fault, which strikes southeasterly.

During February 1936, 763 tons of ore were shipped from this property to the Golden Queen mill, with an average return of \$12.17 a ton. In March there was a notable improvement



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in the grade of shipments, and one lot of 112 tons assayed 0.89 ounce of gold and 3.04 ounces of silver per ton. Small lots of high-grade containing from 3 to 6 ounces of gold per ton were also discovered. In August shipments were at the rate of about 800 tons a month, and the ore was reported as averaging \$14 a ton.

The property is equipped with a compressor house, water tanks, blacksmith shop, and a 100-ton ore bin. A two-stage, air-cooled compressor run by 6-V-belts from a 75-horsepower slip-ring motor and rated at 360 cubic feet per minute supplies air at 100 pounds pressure. Water for drilling and other purposes is hauled from Willow Springs and costs 1 cent a gallon delivered. Thirteen men are employed.

### Bobtail

The Bobtail comprises three fractional claims on the western slope of Soledad Mountain in sec. 6, T. 10 N., R. 12 W., S.B.M., adjoining the western boundary of the property of the Lodestar Mining Co. (see fig. 2). The mine is owned by Mrs. D. Berger of Mojave, but in August 1936 it was under option to Loren H. Ryder and Harry Lindgren of Westwood, Los Angeles, Calif.

The Bobtail vein, on which the most development work has been done, is a continuation of the Excelsior vein of the Lodestar Mining Co. It averages about 2 feet in width, varying from 6 inches to 5 feet. The vein strikes N. 40° W. and dips 80° NE. It traverses a fine-grained felsite showing flow lines and is traceable on the surface for 600 or 700 feet north from the Excelsior claim. The ore consists of iron-stained quartz and normally contains 0.4 to 1.2 ounces of gold and 1 to 4 ounces of silver per ton.

Development consists of a 150-foot shaft on the dip of the vein, with drifts on the 60-, 100-, and 150-foot levels. On the 60-foot level a drift extends north about 50 feet, and above it the vein is stoped to the surface. On the 100-foot level there is a 150-foot drift to the south and a 50-foot drift north. The vein is stoped to the surface above the entire length of the south drift and to the 60-foot level above the first half of the north drift. On the 150-foot level the dip of the vein flattens to about 50°. Here drifts run to the north and south 50 feet, but there has been no stoping from this level. At the end of the north drift a cavity in the vein about 15 by 20 feet forms a curious natural winze.

Several hundred feet north of the shaft an adit driven east into the hill cuts the Bobtail vein within a few feet of its portal and then proceeds to the Elephant vein. A 200-foot drift runs south from this adit along the Bobtail vein, and the ore above it has been stoped to the surface. Another tunnel shows fissuring in felsite but has not reached the vein.

The property has been operated for many years, principally by leasers, and it has no equipment other than a crude cableway for lowering ore from the shaft on the hill to a small ore bin on the road about 150 feet below.

The property is said to have produced over \$100,000. It is also said that the owner of this property successfully resorted to it as a means of supporting eight miners, three women, and eight children during the early years of the depression.

### Desert Gold Mining Co.

The Desert Gold Mining Co., of which E. H. Whitcomb of Los Angeles is president, is operating the Hope claims on the west slope of Soledad Mountain (see fig. 2), under a lease from Goodwin Knight of Los Angeles. R. A. Hawkes of Mojave is in charge.

The vein under development ranges from 6 inches to 4 feet in width and has an average width of about 15 inches. It strikes a few degrees west of north and dips almost vertically.

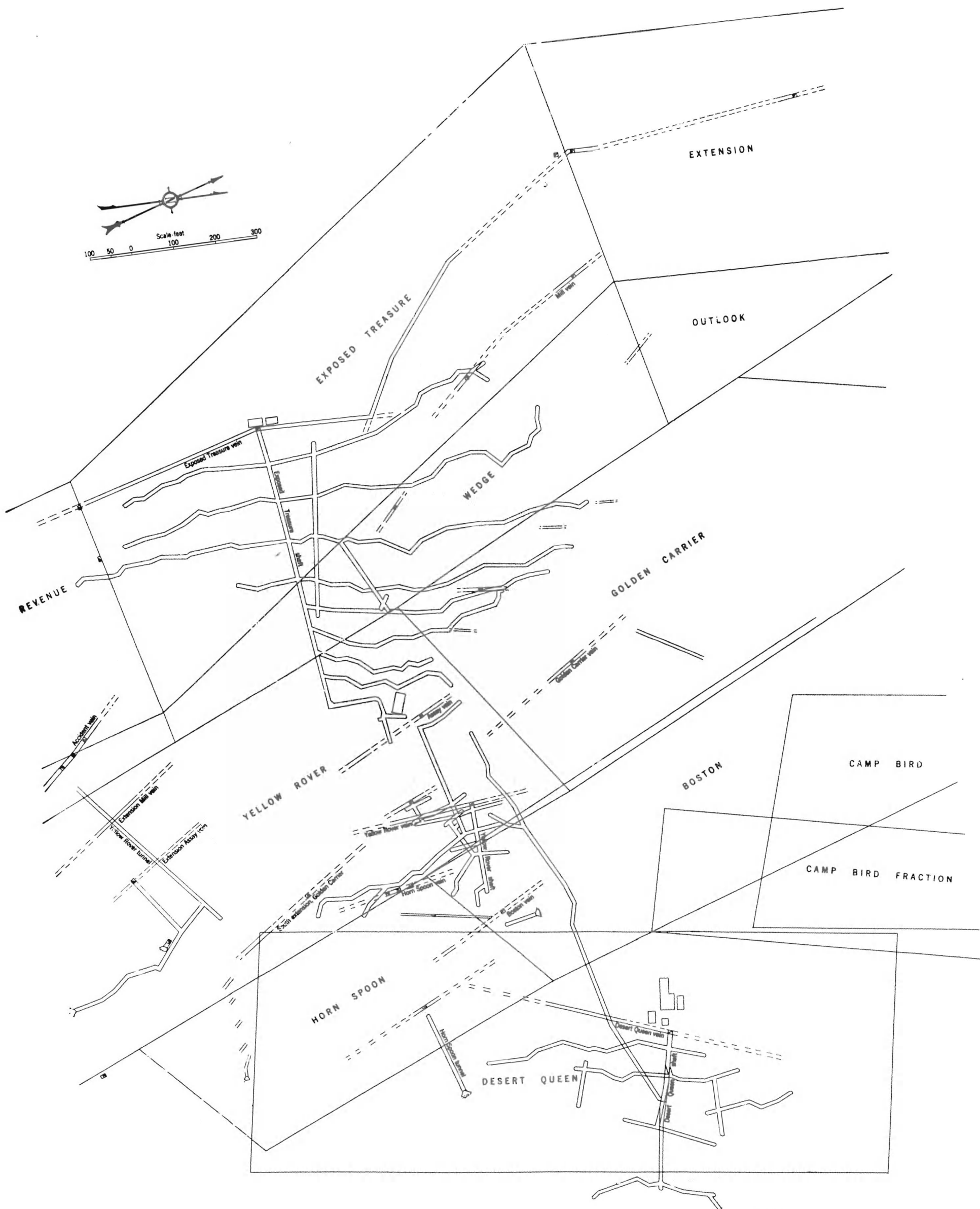


FIGURE 9.- Plan of Exposed Treasure, Yellow Rover and Desert Queen mines.

It is in a fine-grained felsite. The ore is a yellow-stained quartz that has been crushed so that most of it as mined will pass a 2-inch mesh screen. It runs from \$12 to \$25 per ton and averages about \$15. Two recent shipments to the Burton mill at Tropicco contained 0.40 ounce of gold and 3.66 ounces of silver, and 0.66 ounce of gold and 6.02 ounces of silver per ton, respectively.

The vein is developed by two adits along its strike. The lower or main adit is 500 feet long, and its portal is about 300 feet vertically below the crest of the hill. The second adit is 100 feet above the main adit and is 175 feet long. A raise from the main adit connects with the level above near its face, where a 200-foot raise has been driven through to the surface. Hence the workings are well-ventilated. They are also in excellent shape to mine the block of ground, about 200 feet long and 300 feet deep which lies between the faces of the adits and the side line of the claim.

The property is equipped with a 15-ton ore bin. Compressed air is purchased from the Lodestar Mining Co. Three men are employed.

#### Bowers' Hill Area

##### Standard Gold Mines Co.

The property of the Standard Gold Mines Co. comprises 17 claims in sec. 32, T. 11 N., R. 12 W., S.B.M., on Bowers' Hill, 3 miles south of Mojave (see fig. 2). It contains 265 acres and includes the Exposed Treasure mine, with an accredited output of \$2,100,000, larger than that of any other mine in the district, the Desert Queen mine, and the Yellow Rover. It is equipped with a flotation mill that is now idle. At the latter, the original discovery of gold in the district was made in 1894.

The entire property is under lease to A. J. Bruce of Mojave, who is preparing for active mining in the old workings of the Exposed Treasure and Desert Queen.

A series of roughly parallel veins has been developed on the property, of which the Exposed Treasure, Desert Queen, and Yellow Rover, in the order named, have been the most productive. Other smaller veins lying between the Exposed Treasure and Desert Queen veins and in the hanging wall of the former are the Golden Carrier, Russian Boy, Mill, Accident, Assay, Wedge, and Hornspoon. All of these veins, with the exception of the Desert Queen, are composed principally of quartz, stained with iron and often by manganese and frequently containing nodular masses and stringers of manganiferous calcite. The Desert Queen vein, however, and the Hobson vein, which lies to the east of it, consist largely of manganese-stained calcite with but little quartz. The strike of the veins varies widely, from N. 13° E. to N. 60° W., but their average strike is approximately N. 30° W. They dip easterly at inclinations ranging from 60° to 75° near the surface but flatten rapidly with depth, and they range in width from a few inches to 20 feet. The gold in the ore occurs both free and associated with small quantities of pyrite, arsenopyrite, galena, and cerussite and occasionally with chalcopyrite, bornite, malachite, and azurite. The gold was often fairly coarse, and specimens of crystallized gold were found in the Exposed Treasure. Figure 9 is a plan of the workings of the Exposed Treasure, Yellow Rover, and Desert Queen claims showing the development of the three principal veins on the property.

Exposed Treasure.— The Exposed Treasure is one of the oldest mines in the district, and, as stated, produced \$2,100,000. In 1901 it was equipped with a 20-ton stamp mill and cyanide plant, water being brought in from the Tehachapi Mountains through a 4-inch pipe line 18 miles long. The mine was operated steadily until 1914, but due to flooding of its workings, burning of its mill, and frequent changes in ownership entailing a consolidation with neighboring properties, it has since been worked only sporadically and chiefly by leasers.

About 100,000 tons of ore are said to have been extracted, with an average recovery of \$21 a ton at the old price of gold or over \$35 a ton at its present price.

The Exposed Treasure vein is explored by a 900-foot inclined shaft with levels at 100-foot intervals and by over 7,000 feet of drifts and crosscuts (see fig. 9). It ranges in width from 2 to 20 feet and has an average width of 5 to 6 feet. At the surface the vein dips 60° easterly, but it flattens rapidly until on the 900-foot level its inclination is only 28°. Its average dip is about 33°. The outcrop of the vein has been traced for nearly 3,000 feet along a very irregular strike. The best ore shoot in the mine occurred along a sharp bend in the course of the vein. From the 100-foot level to the surface both walls of the vein are rhyolite; between the 100-foot and 400-foot levels the foot wall is rhyolite-porphry and the hanging wall a fine-grained granite; below the 400-foot level both walls are granite. The vein material is principally quartz stained by iron and sometimes by manganese. A little calcite occurs in the upper levels, particularly south of the shaft and in the winze below the 900-foot level. Accompanying minerals are principally pyrite, arsenopyrite, galena, and cerussite, although some chalcopyrite, bornite, malachite, and azurite also occur. In the upper 500 feet of the workings the vein often intersects the rhyolite-porphry dike, but it generally lies between the granite hanging wall and the dike. In the northwest end of the workings where the dike is about 100 feet wide the vein cuts through it and has silicified the porphyry for a width of 20 feet, forming excellent ore. In some places the granite walls have also been silicified and transformed into ore for depths of 1 to 2 feet.

The ore shoots were well-defined, and some of the stopes have been mined for widths of 10 feet. Though the mine has not been actively operated for over 20 years, the ground has generally remained open.

The mine still offers interesting possibilities for exploration. It is equipped with a compressor and hoist house and blacksmith shop. The first contains a 220-cubic foot, single-stage compressor belt driven from a 20-horsepower motor and a single-drum hoist operated by a 15-horsepower slip-ring motor. Power is purchased from the Southern California Edison Co.

Desert Queen.— The Desert Queen mine is on the east slope of Bowers' Hill about 1,700 feet east of the Exposed Treasure shaft (see fig. 2). The vein ranges in width from 2 to 6 feet, strikes N. 13° E., and dips 70° easterly. It follows a fissure in a fine- to medium-grained hornblende granite that has been intruded by a rhyolite-porphry dike. The gangue is composed largely of massive calcite heavily stained by iron and manganese and containing stringers and lenses of quartz. The calcite was barren, but the quartz stringers and lenses contained excellent values, from \$20 to \$60 per ton. The mine is said to have produced several hundred thousand dollars.

The vein is developed by a 400-foot inclined shaft, serving four levels that include over 3,000 feet of drifts and crosscuts (see fig. 9). On the 100-foot level it has an average width of 4 feet with a granite foot wall and areas of both granite and rhyolite-porphry on the hanging wall. On the 200-foot level the rhyolite-porphry in the hanging wall occurs in only two places in the north drift. On this level crosscuts in the hanging wall terminate in granite after piercing the rhyolite-porphry. It is apparent that the porphyry is intrusive, as it could not be accounted for as a surface flow. On the 300-foot level both walls are granite.

On the 380-foot level a crosscut 1,100 feet long has been driven northwesterly through the Boston claim and into Yellow Rover ground to within 280 feet of the lower workings of the Exposed Treasure. The crosscut serves as a drainage tunnel for the workings of the Exposed Treasure, as the intervening ground is fissured and allows the water to filter through. This seepage, together with the water originating in the Desert Queen workings, is pumped from the mine by a 4-inch pump driven by a 75-horsepower motor and lifting against a 380-foot

head. Large volumes of water were encountered in driving this crosscut, but the water-bearing formations were gradually drained and at present it is necessary to handle only 8,000 gallons a day. The mine is equipped with a hoist and compressor house which contains a single-drum hoist belt driven from a 10-horsepower electric motor, and a two-stage, 350-cubic foot compressor powered by a 60-horsepower motor.

Yellow Rover.— The Yellow Rover mine is situated midway between the Exposed Treasure and Desert Queen shafts on the ridge that forms the crest of Bowers' Hill. It was here that George Bowers made the first discovery of gold in the district in 1894, shipping 2 carloads of float from the Yellow Rover vein that are reported to have returned \$1,600. Boulders of float up to a ton in weight and assaying \$50 to \$300 a ton in gold were found in quantity below the outcrop.

The Yellow Rover vein resembles that of the Exposed Treasure, as it is highly siliceous and occupies a fissure nearly adjacent to a contact of granite with rhyolite-porphry. The vein is 1 to 3 feet wide, strikes N. 8° W., and dips 55° east. It is developed by a 290-foot inclined shaft serving three levels having 2,000 feet of drifts and crosscuts (see fig. 9). The outcrop has also been glory-holed for a length of 200 feet and a depth of 70 feet, yielding over \$50,000 in ore running from \$30 to \$200 a ton. The vein is apparently bottomed at the 300-foot level, but leasers are mining ore containing \$15 to \$25 a ton from both ends of the workings. The values are largely in gold, but there are fissures intersecting the vein which often carry 40 to 60 ounces of silver per ton. The property is reported to have produced nearly \$100,000.

Standard mill.— A small flotation mill was erected on the Yellow Rover claim in the winter of 1933-34 to serve as a pilot plant for the properties of the Standard group. It is equipped with an 8- by 12-inch crusher, the discharge from which, minus 3/4-inch size, goes to a 4- by 8-foot rod mill in closed circuit with a high-weir modified Esperanza classifier. The overflow from the classifier, minus 60-mesh with 70 percent minus 100-mesh and about 40 percent minus 200-mesh, is discharged into a tank where the various flotation reagents are added and thoroughly mixed by forcing the pulp with a centrifugal pump to a small tank at the top of the mill. When it discharges into this tank the pulp is well mixed and aerated. It flows through a tap on the bottom of the tank to a pneumatic cell having an air lift. Ethyl-xanthate, American Cyanamide No. 15 oil, Barrett No. 4, pine oil, and cresylic acid are used as reagents, the last being employed as a depressant for cerussite. Middlings from the pneumatic cell are returned to the reagent tank. Concentrates contain 6 to 14 ounces of gold and 16 to 30 ounces of silver per ton and are shipped to a smelter.

#### Whitmore Mines, Inc.

The Whitmore group of 12 unpatented claims is 3 1/2 miles south of Mojave between Bowers' Hill and Soledad Mountain (see fig. 2). It embraces 160 acres in sec. 32, T. 11 N., R. 12 W., S.B.M. The claims are owned by Whitmore Mines, Inc.

Four veins striking from north to N. 30° W. and dipping easterly from 60 to 80° occur along a series of roughly parallel rhyolite and rhyolite-porphry dikes. The veins range from 1 to 3 feet in width and are composed chiefly of quartz heavily stained with iron and sometimes with manganese. The most westerly vein in some places also contains much calcite, which occurs principally on its hanging wall, and a little pyrite. Generally gold constitutes the major value in the ore, but occasionally the silver is more valuable. The structure and mineralization are very similar to that of the Exposed Treasure.

The principal development is on the Whitmore no. 1 claim, where no. 1 shaft on an incline of 75 to 80° follows the easterly dip of the vein for 225 feet, and then descends vertically for 75 feet. On the 100-foot level a drift runs north 165 feet and south 60 feet.

Here the vein is 2 to 5 feet wide and strikes N. 20° W. There is a layer of dark-stained calcite from a few inches to 2 feet thick along the foot wall, which here is a light-gray rhyolite. The hanging wall is a fine-grained hornblende granite. On the 200-foot level a drift runs north 150 feet and south 120 feet. Here the vein is 2 to 4 feet wide. The workings below this level are flooded, but it is reported that a crosscut to the vein on the 270-foot level shows 4 feet of milling ore containing considerable sulphides. The ore extracted in development work and in the little stoping that has been done averaged 10 to 20 ounces of silver and up to 0.30 ounce of gold per ton. This vein is the most westerly of those on the Whitmore property. The old shaft has recently been equipped with a new headframe and put in repair for active development by the company. A new compressor and hoist house is equipped with a two-stage, air-cooled motor compressor direct-connected to a 50-horsepower motor and capable of delivering 200 cubic feet of air per minute at 100 pounds pressure. It also houses a 15-horsepower electric hoist. A crosscut from a 50-foot shaft 300 feet north of the no. 1 shaft shows 4 feet of ore assaying 14 ounces of silver and 0.3 ounce gold per ton. The vein here is being developed by J. R. Helvey and Roy Ryan under a lease and will be worked temporarily through the 100-foot level of no. 1 shaft.

On the Whitmore no. 2 claim, south of No. 1, development consists of two vertical shafts, 55 and 80 feet deep, respectively. The former is on a 2-foot vein of low-grade ore along the east or hanging wall of a quartz-porphry dike; the latter, which is 75 feet east of the dike, has a crosscut from its bottom which intersects a 2-foot vein thought to be the same as the one in the 55-foot shaft but now in granite. E. H. McMurray and O. G. Bray and associates are operating leases here. The former has uncovered the vein at the surface and reports \$4 to \$5 in gold and 1 ounce of silver per ton across 4 feet of ore.

The Whitmore no. 3 claim lies south of no. 2 and is developed by a 100-foot inclined shaft on a vein 2 to 4 feet wide. The vein is on the east side of a rhyolite-porphry dike and dips about 75° E. It apparently is a continuation of the vein on the Whitmore no. 1 and no. 2 claims. On the 50-foot level a drift runs north 15 feet and south 45 feet. On the 100-foot level there is a 10-foot drift to the north and a 40-foot drift to the south. Some stoping has been done on the 50-foot level. The shaft has been recently retimbered, and a new headframe, a 30-ton ore bin, and a hoist and compressor house containing a 10-horsepower electric hoist and a 2-stage, air-cooled motor compressor direct-connected with a 50-horsepower electric motor and having a capacity of 205 cubic feet of air per minute at 100 pounds pressure have been installed by the company. Albert Hansen and Gilman G. Brown are operating these workings under a lease. The ore ranges from 0.1 to 0.6 ounce of gold and from 3 to 12 ounces of silver per ton and normally is valued at \$10 to \$25 per ton.

On the Whitmore no. 4 and no. 5 claims there is a narrow vein on each side of a rhyolite-porphry dike. The vein on the east side of the dike, as disclosed in a 40-foot shaft on the no. 4 claim, has an average width of 18 inches and dips 75° E. The vein here is being developed by Clyde Frizell under a lease. A sample of the ore dump assayed 0.35 ounce of gold and 67 ounces of silver.

The vein on the west side of the dike is developed by a 50-foot shaft on the no. 4 claim and by an open pit on the no. 5 claim. It appears to average 1 to 2 feet in width and dips 87° E. The hanging wall is rhyolite-porphry and the foot wall granite. A. L. Cornett and A. J. Luchine have a 200-foot block of ground contiguous to this shaft under sublease and have recently mined ore containing as high as 2.10 ounces of gold and 54 ounces of silver per ton. A sample from the ore dump assayed 0.36 ounce of gold and 19 ounces of silver per ton. Bunches of calcite which are occasionally found in the vein contain only 0.01 to 0.03 ounce of gold and 3 to 5 ounces of silver per ton, and these values seem to be contained in little quartz veinlets and stringers within the calcite rather than in the mineral itself. The same is true of the calcite from the no. 1 claim.

Several shafts and open pits on other claims in the group have yielded interesting assays, but no ore has as yet been developed on them.

#### Yellow Dog Mining Co.

The property of the Yellow Dog Mining Co. comprises four claims totaling about 80 acres in sec. 32, T. 11 N., R. 12 W., S.B.M., on the west flank of Bowers' Hill, 3 miles south of Mojave (see fig. 2).

An outcrop of high-grade quartz carrying coarse free gold was discovered on this group of claims by Percy Wegmann of Mojave in the spring of 1922. It was the most important strike made in the district for many years and led to a temporary revival of interest in its mines.

The Yellow Dog vein strikes N. 20° W. and dips 60° easterly, outcropping on the eastern slope of a small butte of rhyolite-porphry. The vein ranges from 2 to 15 feet in width and has an average width of 6 feet. In composition and structure it is similar to other veins in the Bowers' Hill area, occupying a fissure related to granite intruded by rhyolite-porphry dikes. The vein filling consists largely of calcite heavily stained with iron and manganese and associated with stringers and lenses of auriferous quartz, obviously of later origin. On the Yellow Dog claim the quartz occurs along the hanging wall in widths up to 4 1/2 feet, with 4 to 6 feet of calcite on the foot wall. The calcite, which in itself is barren, has been intruded by small stringers and veinlets of gold-bearing quartz, so that in some cases it has become ore containing from 0.1 to 0.2 ounce of gold per ton. The quartz generally assays 1 to 3 ounces of gold per ton, and some shipments have averaged 4 to 8 ounces per ton. The ore shoots occur next to the rhyolite-porphry dikes in the hanging wall, and where the intrusive is missing the vein is usually poor. In some cases the rhyolite-porphry wall has been silicified and transformed into high-grade ore for depths of 1 to 5 feet. In one place this altered dike material yielded 4 1/2 feet of phenomenally rich ore containing 20 to 30 ounces of gold per ton. Silver in quantities up to 16 ounces a ton has been found in the calcite gangue, but invariably where these high silver values occurred the calcite adjoined rich siliceous ore and had been invaded by silica.

The vein is developed by five shafts, the deepest of which is a 336-foot incline sunk at an angle of 60° and having levels at 100-foot intervals, with about 2,000 feet of drifts and crosscuts. The best ore shoot was found just north of this shaft and was stoped for a length of 200 feet from the 100-foot level to the surface. This shoot was encountered again on the 300-foot level 280 feet north of the shaft, and a winze was sunk on it to a depth of 30 feet. The ore from this shoot is reported to have assayed between 3 and 4 ounces of gold per ton. From a point 120 feet north of the shaft on the 100-foot level a crosscut was driven 200 feet west in the footwall in the hope of intersecting a parallel vein, but none was found. Water level in this shaft is 240 feet below the collar and as these workings are idle the lower portion of the mine is under water. A hoist and compressor house at this shaft is equipped with a 15-horsepower single-drum electric hoist and a 400-cubic foot Chicago pneumatic compressor driven by a 60-horsepower motor.

South of the main shaft 420 feet there is a second incline, called the cook shaft, 165 feet deep with levels at 50-foot intervals and about 400 feet of drifts. In this shaft the vein has granite walls, and the ore occurs as occasional siliceous pockets in manganiferous calcite. These workings are under lease to Alfons De Grave of Mojave, who reports having recently taken 5 tons of ore containing over 4 ounces of gold per ton from one of these pockets. In this rich ore fine, free gold is plainly visible. On this lease, the values are confined largely to the fines, so the muck is sifted on a 1/2-inch mesh screen. The undersize assays from 1 to 1.75 ounces of gold per ton while the oversize contains only 0.2 to 0.25 ounce per ton. The fines are trucked to Burton Brothers' mill at Tropic.

I.C. 6931.

There are three old shafts, varying from 40 to 70 feet deep, between the shafts already described, but they are in such bad repair as to be inaccessible.

The Yellow Dog mine is credited with a total output of about \$100,000 from ore having a gold-silver ratio of 2 to 1.

### Victory

The Victory property consists of two fractional claims, the Victory and Liberty, in sec. 32, T. 11 N., R. 12 W., S.B.M., on the south slope of Bowers Hill, 3 miles south of Mojave (see fig. 2). It is owned by Jessee Knight of Mojave, and H. N. Hammond is superintendent.

A quartz vein 8 to 12 inches wide runs along the west side of a rhyolite-porphry dike 40 to 50 feet wide that forms the backbone of the ridge on which the claims are situated. The vein strikes N. 25° W., dips 47° easterly, and is thought to be a continuation of the Assay vein on the adjoining Yellow Rover claim of the Standard Gold Mines Co. The ore generally contains 0.6 to 1 ounce of gold a ton and about twice as much silver. The vein is developed by a 120-foot inclined shaft. The ore mined in sinking the shaft yielded \$3,000, and the shaft is being continued to the 200-foot level where it is planned to crosscut both the foot and hanging walls in the hope of intersecting continuations of the Accident, Desert Queen, or other veins which have been developed on the adjoining property of the Standard Gold Mines Co.

Equipment consists of a 110-cubic foot compressor belt-driven by an automobile engine and a single-drum hoist operated through a chain-and-sprocket gear by an automobile engine. The head frame at the shaft enclosed a tool shed and a 15-ton ore bin.

### The Blue Bird

The Blue Bird claim, under lease to E. Renz of Los Angeles from C. C. Calkins of Los Angeles, is at the south end of Bowers' Hill 3 miles south of Mojave (see fig. 2).

The ridge on which this claim is situated is formed by a dark rhyolite-porphry dike 40 to 50 feet wide running in a general northwest-southeast direction. The intrusion of this dike shattered the surrounding granite badly and fissured it in all directions. Some of these fissures were later filled with manganiferous calcite and others still later with quartz. The calcite, as elsewhere, on Bowers' Hill is barren except where invaded by silica; but the quartz is auriferous, and the siliceous solutions carried gold even into the granite and in places have transformed considerable widths of it into low-grade ore. The country rock has been so badly broken and the dike is so irregular that existing development is inadequate to determine even the principal structural features of the ore deposit.

A shaft dipping 75° N. has been sunk to a depth of 40 feet on a quartz vein 4 feet wide and locally striking east and west. The shaft then passes into granite and flattens to about 60°, cutting 10 feet of rhyolite-porphry at the 60-foot level and proceeding in granite to a depth of 165 feet. There are about 300 feet of drifts and crosscuts on the 40-, 80-, and 160-foot levels of this shaft. On the surface the quartz vein referred to showed spotty occurrences of rich ore, and 4 tons assaying \$242 a ton in gold as well as 15 tons of \$20 ore, were shipped to Burton Brothers' mill at Tropicco. However, down to the 40-foot level this vein has averaged only \$4 to \$6 a ton. On this level the vein has been drifted on to the east for 50 feet, and a crosscut to the southwest shows 30 feet of altered granite cut by many small fissures stained with iron and manganese, all of which is said to assay \$3 to \$5 a ton in gold. A stringer of manganiferous calcite about an inch wide was encountered in this crosscut and followed for about 70 feet, in which distance it widened to 4 feet.



This calcite vein apparently dips about 35° northeast and is encountered again in a 35-foot crosscut in this direction from the 80-foot level. The calcite vein contains only \$3 to \$5 a ton in gold. It is of the same value as some of the altered granite. Its gold content is probably confined to small stringers of quartz that have invaded the calcite and to silicified bands 1/2 to 1 1/2 inches in thickness on either wall. Arborescent crystallized gold has been found in several places in the workings, especially in vugs lined with small quartz crystals along the face of the dike at the 60-foot level in the shaft. On the surface small quartz veinlets in the granite over a wide area, and the granite itself where it has been silicified, yield excellent pannings.

Equipment consists of an 8 by 10-inch compressor powered by a gasoline engine, and a single-drum hoist belt-driven by a 6-horsepower gasoline engine. Two men are employed in development work.

### Pride of Mojave

The Pride of Mojave property consists of 29 acres in section 33 T. 11 N., R. 12 W., S.B.M., on the east slope of Bowers' Hill 3 miles south of Mojave (see fig. 2). The land is under lease from C. C. Calkins of Los Angeles; J. J. Murray of Mojave is general manager. The property is part of one of the oldest locations on Bowers' Hill having been held by the present owner since 1896.

A number of more or less parallel veins outcrops on this lease. They have an average strike of N. 20° W. and dip northeasterly at inclinations starting at 60 to 65° but flattening rapidly with depth to about 40°. These veins consist of calcite and quartz heavily impregnated with oxides of iron and manganese, and carry both gold and silver associated at depth with pyrite and occasionally with galena. The granite country rock has been fissured and intruded by rhyolite-porphry, and the veins occur in these fissures. There has been considerable post-mineral faulting and several minor faults traverse the property. The principal one of these strikes N. 80° W. and pitches steeply to the north, cutting the veins at an angle of 60°.

The property is developed by a 260-foot shaft following the dip of one of the veins at an inclination of 65° northeasterly. This shaft serves two levels at depths of 135 and 230 feet, respectively. Extensive drifts and crosscuts on these levels are reported as developing four veins. On the lower level, a crosscut 270 feet to the northeast encounters a vein 170 feet from the shaft which has been drifted on 85 feet south and 75 feet north. A 40-foot winze from near the face of the north drift is reported to be all in ore. A 130-foot raise has been driven on the vein from this drift to the upper level. In all there are over 4,000 feet of workings, and they are being extended at the rate of about 300 feet a month.

As the property is still under development and not as yet in production, the management did not wish to supply information for publication concerning the extent or value of any ore bodies that have been encountered.

Surface equipment consists of a hoist and compressor house containing a 12- by 10-inch compressor driven by a 40-horsepower motor and a 30-horsepower single-drum hoist, blacksmith shop, assay office, and mine offices. Ten men are employed.

### Enterprise

The Enterprise property is on the eastern slope of Bowers' Hill in sec. 33, T. 11 N., R. 12 W., S.B.M. (see fig. 2). On the south it adjoins the Pride of Mojave and on the west the property of the Standard Gold Mines Co. It is owned by C. C. Calkins of Los Angeles.

Development consists of a 175-foot adit driven southwesterly into the hill and connecting with a short drift from a 50-foot shaft. At the junction of the adit and drift a 120-

foot winze has been sunk along the foot wall of a narrow quartz vein dipping about 60° NE. Near the bottom of the winze the dip of the vein flattened to about 45°, and the winze passed into the footwall, but the vein was disclosed again by a crosscut and is said to have shown 5 feet of \$16 ore. On this level, which is at the same elevation as the 135-foot level of the adjoining Pride of Mojave workings, the vein was drifted on to the south for about 100 feet, where it was faulted. As the fault was near the southern boundary of the property no further work was done in that direction, and drifting was started to the north. Several shipments of ore reported to have yielded \$12 to \$28 a ton were made from the south drift, but values in the north drift were disappointing and it was discontinued.

In August 1936, negotiations were under way which are expected to lead to the acquisition of the Enterprise lease and an additional area to the north of it by the Pride of Mojave Co.

#### Four Star

The Four Star property is at the foot of the eastern slope of Bowers' Hill in sec. 33, T. 11 N., R. 12 W., S.B.M. (see fig. 2). It is owned by C. C. Calkins of Los Angeles. It adjoins the property of the Standard Gold Mines Co. on the west and the Enterprise lease on the south.

Development consists of a 240-foot vertical shaft which successively traverses 25 feet of overburden, 130 feet of granite (the upper half of which is quite soft and rotten) and 85 feet of altered rhyolite. The shaft was sunk with the expectation of encountering ore bodies along the contact of the granite and rhyolite-porphyr. Two narrow quartz veins are said to have been cut in this shaft at depths of 135 and 190 feet, respectively. The lower vein was on the contact sought, but sinking of the shaft was discontinued in September 1935, and water has filled it to about 200 feet from its collar.

#### Middle Buttes Area

#### Trent

The Trent mine, sometimes called the Middle Buttes mine, comprises the SW. 1/4 of sec. 16, T. 10 N., R. 13 W., S.B.M., on the southeastern slope of Middle Buttes (see fig. 2). Walter E. Trent of Rosamond obtained a bond and lease on the property early in 1935, following the discovery of rich float on the Burton-Blank-Brite ground which adjoins it on the north. Later he organized Middle Buttes Mines, Inc., to develop and operate the property under the supervision of L. K. Requa of Santa Barbara.

On March 14, 1935, rich ore was found in place near the crest of the ridge only a few yards south of the Burton-Blank-Brite property. The outcrop contained \$50 to \$600 in gold per ton. Even the soil immediately adjoining it and for a number of yards downhill from the outcrop was rich enough to ship. Mining with pick, shovel, and wheelbarrow was started at once, and many thousands of dollars worth of ore was sacked and shipped to the smelter at Selby, Calif., before a compressor and air drills could be brought to the property. After the installation of this equipment the outcrop was developed by an open-cut 150 feet long, 10 feet wide, and 30 to 80 feet deep. Most of this cut was in bonanza ore. Shipments from it averaged over \$100 a ton, almost entirely in gold, and yielded a total of \$150,000. One carload netted \$420 a ton.

The Trent vein strikes N. 28° W. and traverses a fine-grained red siliceous rock which caps the Middle Buttes at this point. It is said by some to be a silicified sedimentary but by others to be silicified rhyolites and felsites. The dip of the vein is extremely irregu-

lar. In the open-cut and down to the level of tunnel 51 it is 48° NE., but the vein then flattens until nearly horizontal and within a few feet steepens again to about 30°. As far as developed the ore body has no distinct walls and varies in width from 6 to 25 feet. The ore is so similar to the surrounding country rock that its limits can generally be determined only by sampling.

The vein is further developed by tunnel 51 which is 400 feet long and cuts the vein at a depth of 100 feet below its apex, and by tunnel 201 driven 775 feet northwesterly toward the outcrop from the east slope of the ridge. This tunnel, the dump from which is plainly shown in figure 12 (preceding page 39), is 175 feet lower than tunnel 51. It is in a soft, highly-altered rhyolite-porphry. Five hundred feet from its portal it is connected by a raise with tunnel 51 but as of June 1, 1936, it had not encountered ore. On that date the ore shoot was developed for a length of 250 feet and a depth of 200 feet. From its discovery in March 1935 it has produced about 4,500 tons of ore, which have yielded over \$300,000, practically all in gold as the ore contains very little silver.

A few hundred feet west of the Trent vein on the hillside across the gulch is the Ella vein, which was discovered in the summer of 1935 and developed by trenching across its strike and by a 137-foot vertical shaft in its footwall. This vein has approximately the same strike and dip as the Trent vein and is of the same general character. However, so far, little ore rich enough to ship has been found in it. On the 50-foot level of the Ella shaft a crosscut through the vein shows 20 to 30 feet of ore said to average about \$3 per ton with a 6-foot streak along the footwall containing \$7 per ton. A crosscut toward the vein from the 100-foot level cut a 4- to 5-foot vein of \$7 ore almost vertically beneath the intersection of the Ella vein with the level above. This may be another vein in the footwall of the Ella. Since little ore of shipping grade has been found in the Ella workings, development through the shaft was discontinued, as it is planned to explore the ground more economically by continuing tunnel 201 of the Trent workings into this territory.

Equipment includes a 75-ton ore bin, blacksmith shop, concrete powder magazine, and 300-cubic foot portable air compressor. Thirteen men are employed.

#### Burton-Blank-Brite

In January 1934 high-grade float gold ore was discovered near the foot of the east slope of Middle Buttes on patented ground in the NW. 1/4 sec. 16, T. 10 N., R. 13 W., S.B.M. The quarter section was promptly purchased by Clifford Burton, Ernest Blank, and T. H. Brite of Rosamond, and within a few days over \$20,000 of float was picked up and shipped to the Tropico mill. The first truckload of 2 tons yielded \$5,200 in gold, and float boulders containing \$2 to \$2.50 per pound were not uncommon. Active search for the vein from which this bonanza ore came was started immediately, and an adit was run into the hill for 100 feet or more in the hope of finding the vein. However, no ore was discovered, and the general opinion was that the rich float had been brought in by a slide. Nevertheless, when the rich surface ore of the adjacent Trent mine was discovered just over the ridge and only a few feet beyond the southern boundary of the property, a shaft was started on the summit of the ridge in expectation of easily finding a continuation of the high-grade ore in the Trent mine. Although ore was finally found, it was only of medium grade, assaying \$10 to \$20 a ton in gold.

In the meantime a new adit was started into the hill about 160 feet above the old adit. A vein of iron-stained clay 2 to 5 feet wide with quartz bands on the hanging wall was found within a few feet. This vein averaged about \$12 a ton, and the adit was continued south along its strike until a connection was made through a 12-foot raise with the northerly workings from the top of the hill. The portal of the new adit is about 500 feet north of

the shaft and 130 feet vertically below its collar, so the adit opens a considerable area of the vein for exploration. A road has been built to the portal of the adit, and all the ore mined is now trammed through this exit. The headframe at the shaft has been taken down, and its timbers have been used in building an ore bin at the mouth of the adit. About 25 tons of ore averaging \$12 per ton in gold were being shipped daily to the Tropic mill at the time of writing, (early in August 1936).

It is worthy of note that the place where the bonanza float was discovered is directly on the calculated outcrop of the vein. It therefore appears that this rich float did not move far, as first assumed, but may have remained almost in place after the erosion of the soft clay portion of the vein. Now that the course of the vein has been proved it is evident that the old adit was run in the wrong direction to intersect it. It is now hoped that bonanza pockets, such as yielded the rich float and also occurred in the Trent mine, may be found along the hanging wall of the vein. As the mine is even now being operated at a profit it will be actively developed. To August 1, 1936, the mine had yielded approximately \$40,000.

Immediately east of the portal of the new adit the highly siliceous rock that forms the hanging wall of the vein is reported to assay \$4 to \$5 a ton in gold for a width of 30 feet.

### Crescent

The Crescent property comprises the SE. 1/4 of sec. 17, T. 10 N., R. 13 W., S.B.M. (see fig. 2). It is owned by Thaddeus White of Los Angeles, and Frank Royer of Red Mountain, Calif., is managing engineer. Development of the property has just commenced. A quartz vein near the summit of the ridge on the eastern side of the property has been exposed by an open-cut across its strike and by a short adit driven to it from the eastern side of the ridge. It is reported that ore of fair milling grade is being drifted on in both directions from the face of the adit, but no definite information as to values was made available.

### Cactus Mines Co.

The Cactus Mines Co. is developing the Cactus Queen and Blue Eagle claims in the SW. 1/4 of sec. 17, T. 10 N., R. 13 W., S.B.M., on the southwest end of Middle Buttes (see fig. 2) under the supervision of Roy W. Moore of Los Angeles.

The two claims are traversed by a quartz vein with an average width of 7 feet, which strikes N. 45° E. and dips at 36 to 40° SE. The vein is near the contact between a granite (presumably the basement granite of the district) and a rhyolite-porphry which has been highly altered. Both of its walls are usually in the rhyolite-porphry; but at several places, notably at the portal of the adit on the Blue Eagle claim and near the bottom of an 80-foot winze on the Cactus Queen claim, the footwall is granite. Although the vein does not follow the contact exactly, the latter probably was the governing factor in establishing the position of the vein. The ore is a highly brecciated quartz, and an occasional double brecciation proves that there were at least three periods of silicification. The older quartz, which is milky white and often chalcedonic, is barren. Finely brecciated fragments of it are included in a matrix of later blue-gray quartz, which carries gold and silver. It is thought that the silver occurs largely as sulphides, probably as argentite and ruby silver, but the presence of cerargyrite is also inferred, and fine flakes of native silver have been found in the ore just above water level. Well-rounded boulders of the blue-gray quartz which contain three to four times as much silver as the surrounding ore are commonly found in the vein and present further evidence of at least two periods of mineralization. After the first there was a considerable movement along the vein. An unidentified sulphide that has the appearance of arsenopyrite occurs sparingly in some of the ore from the 400-foot level.

An 8- by 9-foot vertical shaft, collared in the hanging wall of the vein on the Cactus Queen claim, has been sunk to a depth of 100 feet. It intersects the vein at a depth of 40 feet and is connected with it by a crosscut at the bottom. On the 100-foot level drifts run about 600 feet northeast and 100 feet southwest of the shaft. A winze from this level at its intersection with the crosscut from the shaft follows the vein for 80 feet along its dip. From the bottom of the winze a drift runs 550 feet northeast and 130 feet southwest. The ends of both of the northeast drifts extend well into the Blue Eagle claim, which is further developed by a 175-foot adit from a point about 260 feet northeasterly from the Cactus Queen shaft. This adit follows the vein, and a winze has been sunk from it along the dip of the vein at a point about 100 feet from its portal. This winze intersects both of the northeast drifts from the Cactus Queen shaft and continues to a depth of 445 feet, where drifts have been run both ways for 200 feet. The bottom of this winze is a few feet below water level, and seepage amounts to about 300 gallons of water a day. On August 1, 1936, there were approximately 2,600 feet of underground development work on the property. The various levels have exposed several ore shoots that range from \$9.50 to \$11 per ton in gold and silver.

The Cactus Queen claim is equipped with a hoist and compressor house, headframe, and 50-ton ore bin. Mechanical equipment at the shaft consists of a 12-horsepower gasoline hoist and two 230-cubic foot portable compressors; the second compressor was installed to provide air for sinking the 400-foot winze on the Blue Eagle claim and to operate an air hoist on its 100-foot level. The latter is used to raise muck to that level, whence it is trammed to the Cactus Queen shaft and hoisted to the surface. It is thought that the showing will soon warrant the sinking of a new inclined working shaft with equipment providing increased hoisting capacity. Twenty men are now employed on two shifts.

### Silver Prince

The Silver Prince mine embraces 120 acres in the western portion of the NW. 1/4 of sec. 17, T. 10 N., R. 13 W., S.B.M. (see fig. 2). It is owned by Joseph A. Otto of Los Angeles. Frank Royer of Red Mountain, Calif., is superintendent. A vein of low-grade silver-gold ore averaging about 10 feet wide on the surface has been traced by frequent open pits and shafts for over 1,000 feet. The vein strikes north, dips 45° east, and in some places widens rapidly on its dip to as much as 85 feet. In general, the ore contains 3 to 8 ounces of silver and 0.04 ounce of gold per ton, but the silver-gold ratio is extremely variable, and the north end of the vein has supplied several shipments containing 0.35 ounce of gold and only 1 to 3 ounces of silver per ton. Consisting largely of quartz, the vein appears to result from the silicification of a crushed zone in a rhyolite-porphry. Where most intensive this silicification has produced a crypto-crystalline quartz similar to nevaculite in physical structure; this quartz, varying in color from light gray to slate blue, forms the ground mass of the ore breccia.

A double brecciation, with fragments of an original breccia included in a later breccia, proves that there have been at least two periods of movement and three of silicification. Where the silicification is less intense, the ore plainly shows altered remnants of the rhyolite-porphry country rock. Kaolinization of the country rock has also been extensive, and in many places the vein has a clay seam along the footwall, which causes much trouble in drilling.

The gold in the ore is said to be free, while the silver is present as sulphides - probably mostly argentite and proustite. Minute pyrite crystals occur in both the ore and the country rock and are probably an original constituent of the latter. In general, the ore developed averages \$2.50 to \$5.00 per ton. The hardest ore is the richest. Fines may

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contain 0.04 ounce of gold and 2 ounces of silver per ton, while well-silicified ore may show 0.10 ounce of gold and 4 ounces of silver per ton. These are characteristic assays. However, occasional small bunches of high-grade ore have been encountered containing up to 80 ounces of silver per ton.

Subsurface development consists of a 150-foot incline with drifts running north from the 63- and 150-foot levels. On the 63-foot level the vein is exposed for a width of 85 feet by a 35-foot crosscut west and a 50-foot crosscut east and has been drifted upon for 175 feet. The average assay of all muck samples from this level is reported as \$4.62, with the gold averaging about 0.04 ounce per ton. Here both walls of the shear zone which constitutes the vein are rhyolite-porphyry, which has been extensively kaolinized but not silicified. On the 100-foot level a drift has been run about 100 feet north from the shaft, and a crosscut at the shaft shows 83 feet of vein material with the hanging wall still unseen. The east face of this crosscut shows heavy breaking in a mineralized breccia, which is oxidized but contains relatively unaltered inclusions of the porphyry. Muck samples from this level are reported to average \$3.50 to \$4.00 per ton.

Surface improvements consist of a hoist and a compressor, shed, and bunk and cook houses. Air is supplied by a 120-cubic foot compressor. Water for drilling is hauled in drums from Mojave. Six men are employed.

#### Nebeker and Shockley

E. A. Nebeker and Grant Shockley are operating a lease on the western slope of Middle Buttes on ground owned by H. T. Shumake and J. W. Beery, of Rosamond, in the NE. 1/4 of sec. 17, T. 10 N., R. 13 W., S.B.M. (see fig. 2).

Outcropping ore containing as high as 25 ounces of silver and 0.2 ounce of gold per ton was found on the hillside in what apparently is a badly broken and decomposed rhyolite-porphyry that has been highly silicified. About 35 tons of ore from the outcrop was shipped to the Tropico mill and is said to have yielded \$14.00 per ton in gold and silver. A 200-foot adit driven southeast into the hill from the point of discovery failed to disclose ore. A vertical shaft sunk at the portal of the adit for 100 feet is reported to have yielded a small shipment of ore containing 0.3 ounce of gold and a few ounces of silver per ton. No well-defined ore body has as yet been found, but prospecting is being continued. Three men are employed.

#### Hematite

The Hematite property consists of four claims on the north end of Middle Buttes in sec. 8, T. 10 N., R. 13 W., S.B.M. (see fig. 2). The claims are owned by George Stambook of Mojave but are under lease and bond to Burton Brothers, Inc.

In the early summer of 1936, quartz stringers reported to assay 0.5 to 2 ounces of gold per ton were discovered on this property. These stringers, which averaged 4 to 6 inches in width, were followed into the hill by an adit, but as they dipped slightly southward they passed into the floor of the adit about 30 feet from its portal. The adit was continued and about 20 feet farther on encountered a 12- to 18-inch vein having a much steeper dip and apparently intersecting at a slightly greater depth the stringers originally followed. Accordingly, an inclined winze dipping into its floor and the stringers are being followed in the hope of finding a workable vein at their intersection with the larger stringer in the face of the adit.

The property is equipped with a 105-cubic foot, 2-stage portable air compressor. Two men are employed.

Quien Sabe

The Quien Sabe property, consisting of 80 acres, is in the northeast quarter of sec. 9, T. 10 N., R. 13 W., S.B.M., at the northern end of Middle Buttes (see fig. 2). It is owned by William S. Allen, Jr., of Pasadena, and associates.

Two quartz veins with outcrops about 100 feet apart strike N. 40° W. diagonally across the ridge south of the camp. These outcrops have been traced for several hundred feet and range from 18 inches to 4 feet in width. The most easterly vein is developed by a 22-foot vertical shaft and the westerly one by a 72-foot shaft which is nearly vertical for 50 feet below its collar, then flattens gradually to about 40° following the dip of the vein to the northeast. Samples from the outcrops and exposures in the shafts are said to assay 0.1 to 0.15 ounce of gold and about 1 ounce of silver per ton.

An adit has been driven from the north side of the ridge with the intention of intersecting these veins at a depth of approximately 200 feet. The adit runs south 522 feet and then southwest 135 feet, cutting a vein 18 inches to 2 feet wide 410 feet from its portal. The position of the vein in the adit corresponds closely to the calculated intersection of the easterly vein with the adit, assuming the dip of the vein as 40°, but there has been too little development on the vein to prove such a correlation.

Other outcrops of quartz heavily impregnated with iron oxide and said to assay up to 12 ounces of silver per ton occur on the property but remain undeveloped.

Golden Slipper

The Golden Slipper property comprises 80 acres in the northeast corner of the NW. 1/4 of sec. 9, T. 10 N., R. 13 W., S.B.M. (see fig. 2). It is owned by R. W. Ross of Temple City, Calif., and associates.

Several roughly parallel quartz veins striking about N. 40° W. have been developed by open-cuts and shallow shafts on their outcrops. These veins occur in rhyolite-porphry, are 2 to 5 feet wide, and dip steeply to the northeast. They are said to contain 0.1 to 0.15 ounce of gold and 1 to 3 ounces in silver per ton. The best surface exposures are just below the crest of the hill on its eastern slope. A very crooked adit about 400 feet long has been run in a general easterly direction from the western side of the hill to intersect these veins, but in July 1936 its face was about 30 feet west of the crest of the ridge and still 100 feet or more from its calculated intersection with these veins. Several small veins are encountered in the adit, but their values were evidently disappointing, as none was developed.

The SW. 1/4, sec. 9, is under the same ownership as the Golden Slipper. A 10-acre lease in its southwest corner is being developed by F. Y. and W. H. Lechlitter and Allen E. Webster but is still in the prospecting stage.

Tropico Hill AreaTropico Mines - Home, Fairview, Kid, and Lida

The Tropico mines are on the south slope of Tropico Hill, 5 miles by paved road northwest of Rosamond and 14 miles by road south of Mojave (see fig. 2). They comprise 12 patented and 4 unpatented claims, together with a 40-acre campsite in secs. 10, 11, 14, and 15, T. 9 N., R. 13 W., S.B.M., and include four mines - the Home, Fairview, Kid, and Lida. The property is owned by Burton Brothers, Inc., of which Cecil and Clifford Burton of Rosamond are the president and secretary, respectively. Mining was first begun at Tropico on the Lida and Fairview claims about 1900 and has been practically continuous since then. Produc-

tion for the 3-year period ended December 31, 1935, was 9,332.88 ounces of gold and 21,009 ounces of silver. The owners report that the property has produced over \$2,000,000 in gold at present price.

The vein system, as disclosed by existing developments, consists of four parallel veins ranging from 3 to 6 feet in average width, following fault fissures in rhyolite and some felsite. The veins strike east and west and dip 65° to 70° south. The most southerly is the Home or Main vein; then comes the North no. 1, North no. 2, and Lida veins, 125, 350, and 700 feet north of the Home vein, respectively. The vein material is quartz, usually brecciated and mixed with clayey material and heavily stained with iron oxides. Small amounts of pyrite are but slightly auriferous. The ore generally carries 0.3 to 0.5 ounce of gold and 1 to 2 ounces of silver per ton, but spotty occurrences of high-grade ore in all of the veins are frequent, and the old Hamilton workings of the Lida vein in particular have yielded a considerable tonnage of ore containing 1 to 5 ounces of gold per ton. Most of the gold is free and very fine.

Figure 10 is a generalized vertical longitudinal projection along the strike of the veins of the Tropic mine, showing the various shafts, drifts, and stopes.

Figure 11 is a vertical cross-section through the Home shaft of the Tropic mine at right angles to the strike of the veins. It shows the development of all four veins by crosscuts from the shaft and the openings of the Lida vein by the Ella shaft, an incline from an adit driven from the opposite side of the hill.

The Home vein, which has an average width of 6 feet, is developed by two shafts. The Home shaft, a 75° incline on the Home claim, reaches a vertical depth of 670 feet and serves eight levels. Near the surface it is in the vein but passes into the footwall at the no. 2 level as the dip of the vein flattens to 68°. The Fairview shaft, on the Fairview claim 1,000 feet east of the Home shaft, slopes south, following the vein with its inclination gradually increasing from 56° at the collar to 70° at the bottom. This shaft reaches a vertical depth of 343 feet and serves five levels, of which the no. 3 or 240-foot level is connected with the workings of the Home shaft by a stope from the no. 4 level of the Home workings.

An adit 76 feet below the collar of the Home shaft serves as a main haulage level from this shaft to the mill. At this level a drift 350 feet west from the shaft connects with a glory hole in which an ore shoot 125 feet long had a maximum width of 90 feet. The ore mined in the glory hole averaged 0.4 ounce of gold per ton. The Home vein has been stoped irregularly both east and west of the Home shaft for a depth of 600 feet and a length of 2,000 feet and has produced 100,000 tons of ore averaging 0.4 ounce of gold per ton.

The North no. 1 vein, developed by four crosscuts from the Home shaft, is stoped between the second and sixth levels for a depth of 390 feet in ore averaging 0.5 ounce of gold per ton.

The North no. 2 vein, opened by crosscuts on the no. 3 and no. 4 levels, is stoped for a length of 105 feet and a height of 85 feet between these levels. The ore averages 0.5 ounce of gold per ton.

On the Lida vein the principal development is by the Lida shaft at the old Hamilton mine, about 1,000 feet west of the intersection of the vein and no. 4 crosscut from the Home vein. This shaft is 300 feet deep and with five levels explores an ore shoot with a granite footwall that is stoped from the surface to a depth of 300 feet and a length of 120 feet. These old workings are reported to have yielded over 13,000 ounces of gold in high-grade ore. The Lida-Mohave Co., which has leased this portion of the property, is sinking a shaft in the hanging wall near the old Lida shaft in expectation of cutting the vein at a depth of 500 feet. About 1,500 feet east of this shaft the Lida vein is opened on the Piute claim by the Ella shaft, but here it is only a narrow clay seam, though it is rich enough in spots to pay wages to leasers.



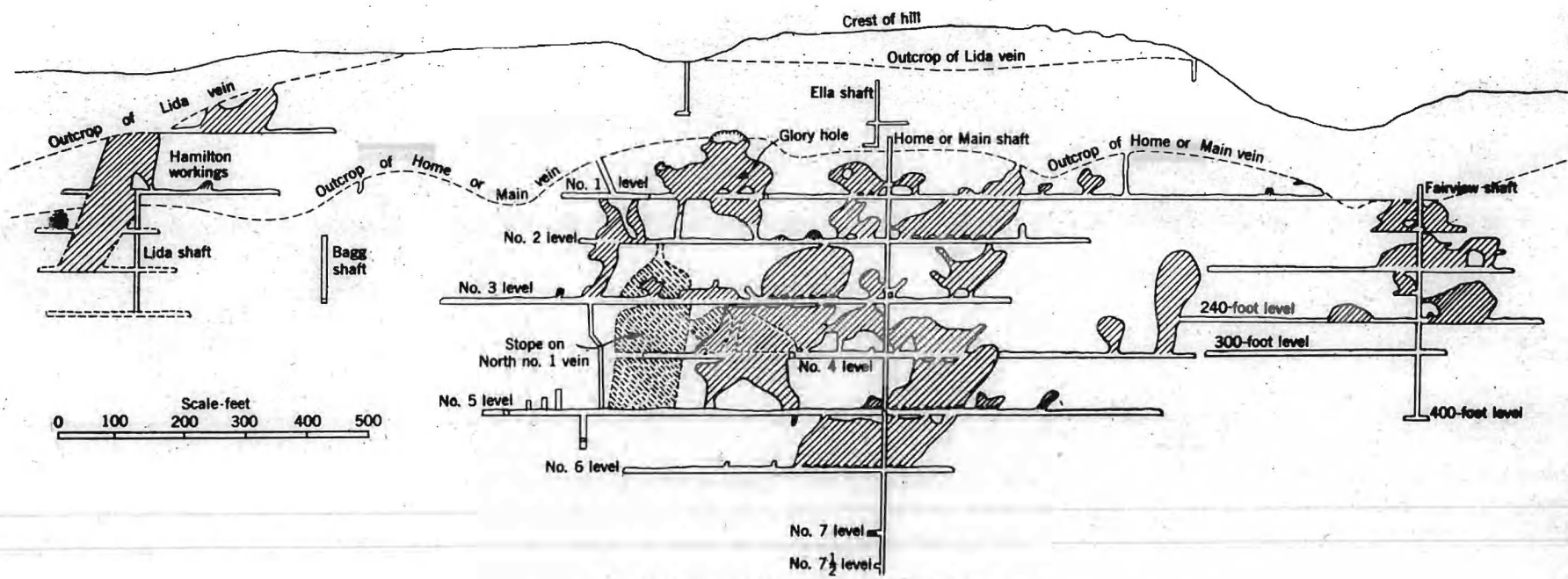


FIGURE 10.- Longitudinal projection of Tropico mine.

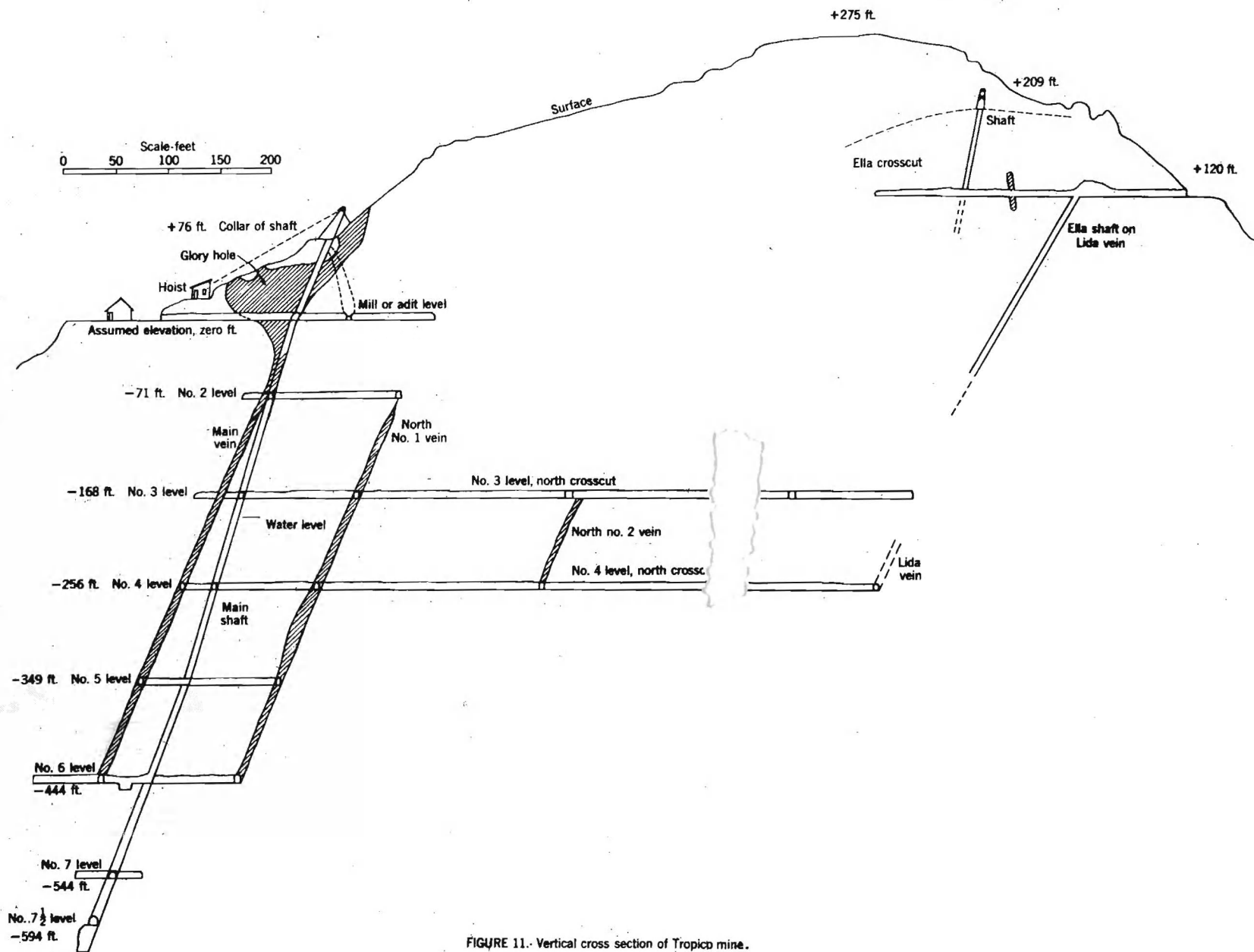


FIGURE 11. Vertical cross section of Tropic mine.

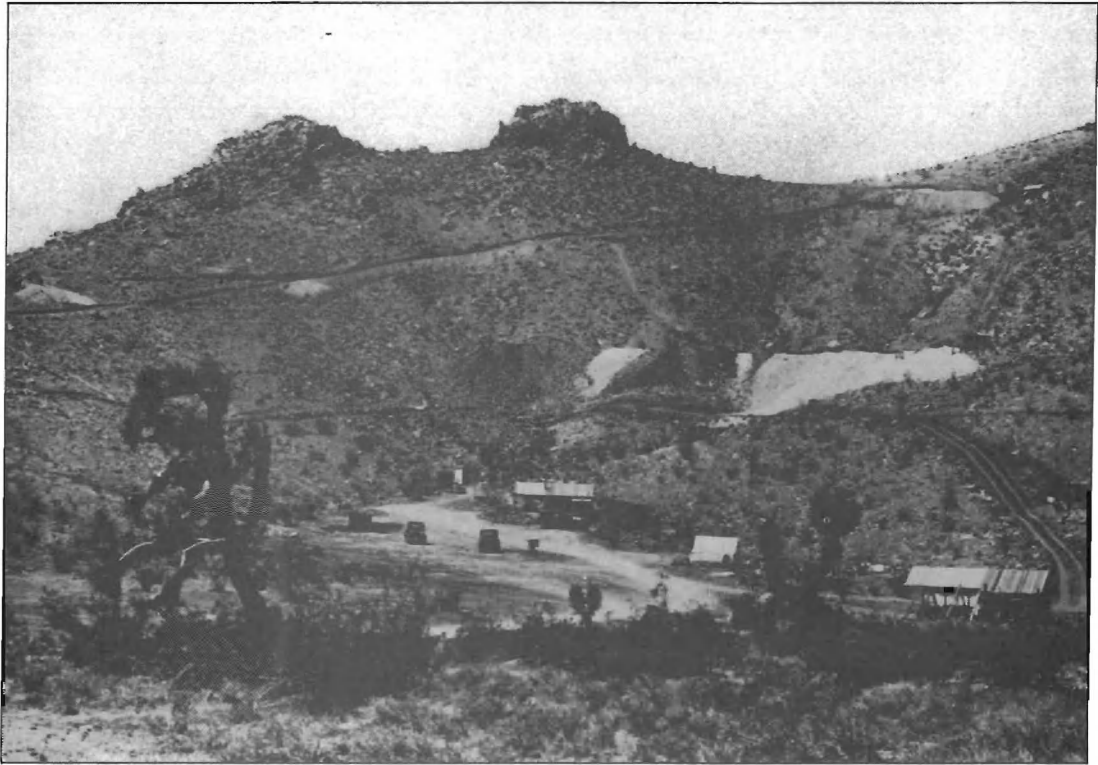


FIGURE 12.- Trent mine on Middle Buttes.



FIGURE 13.- Tropic mine and mill.

The natural water level in the mine is between no. 3 and no. 4 levels at a vertical depth of 200 feet below the collar of the Home shaft. The mine makes only 30,000 gallons of water a day, which is used to supplement the mill supply obtained from a well.

Mine equipment at the Home shaft consists of a 50-horsepower electric hoist, an 870-cubic foot 2-stage compressor driven by a 150-horsepower motor, a pump on the 600-foot level driven by a 25-horsepower motor and having a capacity of 70 gallons per minute, a 10-horsepower centrifugal pump on the 700-foot level which delivers to the main pump, and an air pump that lifts water from the shaft sump to the 700-foot level.

Drill sharpening is done by two automatic sharpeners. A store handling a wide stock of mining supplies, a well-equipped machine shop, and an assay office serves not only this property but other mines in the district.

As over half the capacity of the Tropicco mill is supplied by custom ores, the tonnage of Tropicco ore that it can treat is limited to 50 tons per day, so work in the mine is largely confined to development. Twelve men are employed in the Home workings, six in the Fairview workings which are under lease to Henry Kelsey of Rosamond and six men at a new shaft being sunk on the Kid claim 940 feet west of the Home shaft by John Bagg of Los Angeles who has leased this claim. It is expected that this shaft, sunk vertically in the hanging wall of the Home vein, will intersect it at a depth of 500 feet. The shaft is now 108 feet deep, and a crosscut is being run from the 100-foot level to intersect the vein. At this shaft a novel method of ventilation is used. A swinging-funnel ventilator similar to those used on steamships but kept facing the wind by a vane is mounted on top of the headframe. This ventilator has a 3-foot throat tapering to a 10-inch pipe which conducts the air to the bottom of the shaft. In this region of almost constant winds this apparatus, which is called a "wind sail", supplies efficient ventilation.

On the west end of the Tropicco property R. A. Lythe and W. W. Hartman have a lease on a portion of the Rosamond claim. Here a 3-foot vein, which dips 70° SW., is developed by a 150-foot inclined shaft. Above the 100-foot level the vein has been stoped east for 130 feet and to a maximum height of 60 feet; and to the west for 60 feet and to an equal height. Equipment consists of a 6-horsepower hoist and a 15-horsepower gasoline engine which runs a compressor and a small pump. Water level is 110 feet, vertically, below the collar of the shaft. At present this lease is under development and is not shipping. Two men are employed.

Adjoining this lease on the south, William Harwood of Mojave is developing another portion of the Rosamond claim by an adit running west on a 4 to 5-foot vein which is reported to contain occasional bunches of good ore.

#### Tropicco Mill

The Tropicco Mill, pictured in figure 13, is on the south slope of Tropicco Mountain on the Home no. 2 claim. In March 1936 it treated an average of 90 tons of ore daily by cyanidation. About half of this came from the Tropicco mines; the balance was custom ore from many different properties in the Mojave, Neenach, Randsburg, and Rademaker districts. Starting custom milling on a small scale in 1922, this mill under the management of Burton Brothers has proved a boon to the mining industry of the entire Mojave district and by providing a market for ore has made possible the leasing which has kept the district alive through periods of depression. L. D. Loomis of Rosamond is mill superintendent.

The many sources from which this mill obtained ore are shown in the following table, which gives the source, weight, and content of the ore milled in 1935, comprising 1,175 lots from 160 different shippers:

Source, weight, and content of ore treated at  
the Tropico mill in 1935

<u>Source</u>	<u>Weight,</u> <u>tons</u>	<u>Content</u>	
		<u>Gold,</u> <u>ounces</u>	<u>Silver,</u> <u>ounces</u>
Tropico mines.....	11,144	3,670.93	10,981
Soledad Mountain.....	6,584	3,453.46	24,750
Bowers' Hill.....	102	83.67	109
Middle Buttes.....	3,857	2,920.31	5,167
Neenach district.....	2,624	2,650.43	3,886
Randsburg and Rademaker districts.....	223	148.06	94
Other districts.....	<u>832</u>	<u>733.25</u>	<u>567</u>
Total.....	25,366	13,660.11	45,554

A description of the milling operation follows:

The major portion of the mill feed and particularly the coarser ore goes to a 12- by 22-inch jaw crusher with a 2-inch discharge opening and thence by belt conveyor to a No. 3 gyratory crusher, which breaks it to 1-inch mesh. It is then carried by belt conveyor to a sampling unit, where about 10 percent is taken for a sample and progressively reduced in size by the usual methods to provide triplicate assay samples. The 90-percent reject from the sampling unit is elevated to a 100-ton mill bin which delivers to a 5- by 6-foot ball mill in closed circuit with a chain-driven drag classifier which returns material coarser than 30-mesh to the ball mill for regrinding.

A minor portion of the mill feed, especially the finer ore, goes to an 8- by 12-inch jaw crusher with a 2-inch discharge, after which it is sampled and delivered to a 70-ton bin from which it is fed to a 10-stamp mill having a 4- to 6-mesh screen. The stamp mill discharges to a 4- by 4-foot Cottrell ball mill in closed circuit with a Cottrell classifier. The overflow from this classifier and that from the drag classifier, both with their ore particles minus 30-mesh, join here and are conveyed by a Hydroseal pump to a bowl classifier which separates the sands and slimes. The former pass over two corduroy tables and thence to a rake classifier which deslimes them further and delivers them to a drag-type dewatering machine mounted on wheels above a row of five 175-ton leaching tanks. The dewatering machine also acts as a distributor for properly loading the tanks and delivers sand to them with less than 15 percent moisture.

The slimes from the bowl and rake classifiers go to a 700-ton Dorr thickener from which they are drawn in 50-ton batches to one of five agitating tanks for cyanidation.

The barren cyanide solution used contains 1 1/2 to 2 pounds of NaCN per ton, and enough lime is added to the bowl classifier to give the solution a free-lime content of 1/2 pound per ton. In leaching, the sands are first covered with fresh cyanide solution containing 4 pounds of cyanide per ton and allowed to stand in this strong solution for 24 hours. They are then drained for 24 hours and next leached with barren solution for 4 to 6 hours, after which they are again drained for 24 hours. They receive four more similar leachings with barren solution before they are finally washed, the whole leaching operation taking 9 to 10 days, depending on the volume of ore coming to the mill.

The slimes are agitated by propellers for 5 hours and then settled for 18 to 30 hours before decanting and refilling the tanks with fresh solution. These operations are repeated six times, and the slimes are washed once before they are discharged to the tailings pond at the foot of the hill.

About 300 tons of pregnant solution are precipitated daily in a Merrill-Crowe unit. The precipitates are melted in an oil-fired tilting furnace and the bullion, which averages 275 fine in gold and 615 fine in silver, is shipped to the United States Mint at San Francisco. The slag after reworking is sent to the smelter at Selby, Calif.

Approximately 10 percent of the gold recovered is saved on the corduroy tables as free gold and sulphides. The concentrates from these tables, normally valued at \$1,500 to \$3,000 per ton in gold, are ground in a pan amalgamator with a recovery of 90 percent of their gold. The tailings from the amalgamator are shipped to the smelter.

The normal recoveries effected by the Tropicco mill exceed 90 percent of the gold and 80 percent of the silver in the ore. These are excellent results considering that almost half the mill feed is custom ore varying widely in its source, grade, and composition.

The mill is electrically driven throughout, and most machines have individual motors. The capacity of the mill will be increased presently to over 100 tons per day by the installation of a third ball mill.

About 2 tons of water are lost for each ton of ore treated. The major water supply for the mill is pumped through 3,000 feet of 4-inch pipe from a well directly south of Tropicco Mountain. About 20 percent of the water used comes from the Tropicco mines. Fourteen men are employed.

#### Nonmetallic Minerals

##### Rosamond Feldspar deposit

The Rosamond Feldspar deposit is situated in the SW. 1/4 of sec. 6, T. 9 N., R. 12 W., S.B.M., 2 miles northwest of Rosamond (see fig. 2). It is owned by Nelson W. Sweetser of Mojave. The property covers 7 1/2 acres, 5 of which are owned in fee simple and the remainder (the White Hill claim) is held by location. The outcrop of the pegmatite forms a slight knoll on the floor of the desert and covers an area about 100 by 200 feet. The deposit consists of pink feldspar interspersed with streaks and bunches of quartz and intergrowths of the two minerals that are too intimate to allow hand-sorting. However, it contains large lenses of commercial spar, and one of these 20 feet wide has been mined for a length of 125 feet and to a depth of 75 feet, yielding carload shipments containing less than 2 percent of free silica. The pegmatite strikes N. 45° E. and dips 45° NW. Both walls are a medium-grained biotite granite. Development consists of a 75-foot vertical shaft and 175 feet of drifts.

The feldspar to the depth reached so far is thoroughly fractured and loosened, possibly by a fault that cuts the pegmatite, and in mining much of it breaks along its cleavages to pea and nut size. This fracturing has hastened weathering and allowed the infiltration of a little ferruginous clay, which gives a slight greenish tinge to the burned spar. The removal of this clay was satisfactorily accomplished by thoroughly drying the spar in the sun on a drying floor, and then running it through a 20-mesh trommel which removed the clay as fines. After this treatment, the feldspar analyzed as follows and burned to a pure white: Al<sub>2</sub>O<sub>3</sub>, 17.5 percent; K<sub>2</sub>O, 12 percent; Na<sub>2</sub>O, 4 percent; SiO<sub>2</sub>, 65 percent; Fe<sub>2</sub>O<sub>3</sub>, 0.08 percent. The high potash and soda content of the spar renders it particularly suitable for glass-making, and its natural fracturing enables it to be crushed with the production of a minimum of fines.

To date the property has produced 2,500 tons of feldspar, which was trucked 3 miles to the Southern Pacific Railroad at Rosamond and shipped to Los Angeles, 90 miles by rail. The property is now idle, although it has good showings of commercial spar and can produce a considerable tonnage. It was last operated in May 1931.

Rosamond Clay deposit

The Rosamond clay deposit is 4 1/2 miles northwest of Rosamond and about 1/2 mile north of the eastern end of Tropico Hill in the NW. 1/4 of the SE. 1/4 of sec. 11, T. 9 N., R. 13 W., S.B.M. (see fig. 2). A flat clay bed of undetermined dimensions on the north side of a little hill of badly decomposed felsite porphyry has been opened by a pit 120 feet long, 50 feet wide, and 15 to 20 feet deep. The clay has been derived from the decomposition of the surrounding highly felspathic lava. A 330-foot adit has been driven from the south face of the pit into and almost through the little hill. This adit is in a soft, highly altered rock for its entire length but shows no merchantable clay. The clay in the pit is light gray and of fine texture. It is said to be a pottery clay of good quality.

Webb Clay deposit

The Webb clay deposit is 5 1/2 miles northwest of Rosamond in the NW. 1/4 of sec. 10, T. 9 N., R. 13 W., S.B.M., and about 1 mile west of the Rosamond clay deposit (see fig. 2). It is owned by W. S. Webb of Rosamond and is developed by three small prospect pits. The clay seems identical in character with that of the Rosamond deposit and it is unquestionably of similar origin. Existing development is insufficient to warrant an estimate of either the average depth or lateral extent of the deposit.

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