ROADSIDE GEOLOGY AND MINING

HISTORY OF THE MOTHER LODE

GEOLOGIC GUIDEBOOK
Mariposa, Tuolomne, and Calaveras Counties, California

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PART 1: MARIPOSA TO JACKSON

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U.S. Bureau of Land Management
Far West Geoscience Foundation
Buena Vista Museum of Natural History

ROADSIDE GEOLOGY AND MINING HISTORY

OF THE MOTHER LODE

Gregg Wilkerson and David Lawler

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This field guide and four regional geologic maps can be downloaded from:

http://www.blm.gov/ca/bakersfield/geologytrips.htm

Copies of this guidebook are available through

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INTRODUCTION

This field guide follows, with modifications, California Division of Mines and Geology Bulletin 141 which was published in 1949. Photographs from that publication are noted in this guidebook by the annotation “1949, CDMG”. Incorporated for that portion of the trip from Mariposa to Placerville is information provided by Landefeld and Snow in Yosemite and the Mother Lode Gold Belt, American Association of Petroleum Geologists Book GB68, 1990. In our guidebook, sections that are adapted from the 1949 field guide are noted by the reference "Bowen and Crippen, 1949". Those sections that are adapted from the 1990 guide are noted by the reference "Landefield and Snow, 1990". In 1997, the March/April, May/June, July/August, September/October, and November /December issues of California Geology (“CG”) contained a condensed and updated series of articles on the Mother Lode with new colored maps, and several photographs. These are noted in this guide as “1997, CGS”. Points of interest described in the text with the notation (#00) correspond to points on the road and geologic maps of this guide with a triangular orange symbol. Several images are also duplicated from DNG CD 98-001 “California Gold Mines: A Sesquicentennial Photograph Collection”. These are noted in the photos of this guide as “1998, CGS.”

Mine Production Statistics

All mine production values are from the 1941 or 1991 guides. Most of those values were presented in dollars. They have been converted in this guide to ounces using the assumption that between 1849 and 1949 the average value of gold produced in California was $25.00 per ounce.

Mileage Markers

Whenever possible, this field guide is keyed to highway mileage posts with the denotation "MP."

Maps

This road guide has two sets of maps. There are four regional maps printed at a scale of 1:50,000. These are compiled from 1:250,000 California Geological Survey (CGS) topographic maps. The geology for these maps is from the USGS digitized 1:750,000 scale map of California. These maps are designed to be printed on a 36 inch-wide plotter. The regional maps are designed to be printed at a page size of 36 inches by 44 inches.

The second set of maps is produced at a scale of 1:24,000. These use the same 1:750,000 scale geologic map base as the regional maps, but use the 1:24,000 scale USGS topographic maps to depict location. These maps also contain mine and mineral occurrence site locations from the MRDS dataset of USGS and the MAS data set from the former Bureau of Mines.

When the California Division of mines and geology re-printed portions of Bulletined 141, it printed a set of strip geologic maps for California Geology Magazine. These were scanned and are also included in the guidebook, and are used by permission.

All maps are available in .PDF format.

Overview

California State Highway 49, variously known as the Mother Lode Highway or the Golden Highway, traverses over 270 miles of the Sierra Nevada, beginning at Mariposa on the South and ending at Sattley on the north. It passes through nine counties, each of which represents an important part of the Sierran Gold Belt (Bowen and Crippen, 1949).

This entire region has come to be known generally as the "Mother Lode Country", but more technically speaking, the Mother Lode is a belt of gold-bearing quartz veins which appears to start at Mariposa and to terminate at Georgetown in Placer County and which are associated with the Melones Fault. It forms a more or less continuous belt of quartz veins that occupy a fault zone approximately one mile wide and 120 airline miles long. The 10-mile segment of this belt between Jackson and Plymouth is its richest section and was the source of one-half the gold produced in the entire 120-mile extent, which has amounted to a quarter of a billion dollars. It is noteworthy that this 10-mile segment lies at the bend in the belt where its trend changes form northwest to nearly due north. The Melones fault structure (Clark, 1964, 1970) with which the Mother Lode quartz veins are associated may possibly extend 50 miles farther northward to Downieville through Quincy. This guidebook series uses the more general definition of "Mother Lode" and provides an overview of the geology and mining history from Mariposa to Quincy.

Highway 49 leaves the Melones Fault Zone at Placerville and swings 10-15 miles to the west, traversing the even more productive Grass Valley-Nevada City district and other gold-bearing areas of the northern Sierra Nevada (Bowen and Crippen, 1949).

The veins range from great white quartz masses 150 feet wide, down to stringers less than the thickness of one's little finger. The thickness of a vein is no criterion as to its potential value. Rich pocket mines such as those of Jackass Hill were found largely in narrow veinlets, whereas the massive silica-carbonate rock of the Penon Blanco is practically barren of gold (Bowen and Crippen, 1949).

Mining methods and techniques developed in the California gold belt have spread to the far corners of the earth and have become standard practice everywhere. Many famous technicians and financiers had their training in the Mother Lode Country before attaining even greater distinction and achievement in other fields. Bret Harte and Mark Twain owe much of their reputation to the gold country, and through their stories the romance of the region has become familiar to the world (Bowen and Crippen, 1949).

Although so much has been written of the history, romance, and folklore of the Sierra Gold Belt, little of general geologic interest has been published for the use of the traveler. The following notes on geology along Highway 49 attempt to correlate the geologic, mining, historic, scenic, and cultural features encountered as one travels north along the route from Mariposa to Yuba Pass and Sierra Valley (Bowen and Crippen, 1949).

The geologic maps for the Highway 49 guide of 1949 are reproduced in this guidebook. They form a continuous strip through the Sierran Gold Belt and cover an area a few miles wide on either side of Highway 49.

Photo 1. Weathered outcrop of quartz-ankerite-mariposite rock, northwest of the McAlpine Mine, southern Tuolumne County. This rock is part of a narrow linear mass of altered rock and quartz veins that holds up the steep hill immediately east of Highway 49, about 1 mile (1.6 km) northwest of the Tuolumne-Mariposa county line. The rock was formed by hydrothermal alteration of serpentinite in the Melones Fault Zone, a major fracture in the earth's crust along which many of the gold-bearing quartz veins of the Mother Lode were emplaced. *Photo by Chris Higgins.* Calif. Geol. 1997:36

Figure 1. Quartz-ankorite outcrop, McAlpine Mine (1997, CGS)

GEOLOGIC MAP 01

Mariposa to Mount Bullion
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

REGIONAL MAP 01

Mariposa to Moccasin
With Cathey's Valley, Hornitos, La Grange and Coulterville

MARIPOSA

A point a few miles south of the town of Mariposa marks the southern terminus of Highway 49. Mariposa, the county seat of Mariposa County, is on the tourist route to Yosemite Valley, and its fine old County Courthouse, a white frame structure erected in 1854 has been in use continuously since that date. The town lies at an elevation slightly above 2,000 feet in a northwesterly trending valley bordered to east and west by ridges of moderate height. Vegetation in this region is sparse and is composed largely of digger pines, small oak trees, and patches of chaparral. There are a few small stands of yellow pine on protected north slopes southwest of Mariposa. Early day

logging operation remove much of the timber in this region (Bowen and Crippen, 1949).

Mariposa, “Butterfly” in Spanish, is part of the Mariposa Land Grant which was awarded, under protest, to John Freemont. Freemont was a soldier and had acquired a great deal of land “script”. The script was given to soldiers as part of their discharge papers. Many returned to the east and sold them for a discount to people choosing to “go west”. In 1843??, with his pile of script and $3,000, Freemont applied for a ranchero homestead in 1840 (?). Instead, he was granted 45,000 of barren wilderness in the south-central foothills of the Sierra Nevada. His protests were in vain. So he settled down near Bear Valley. In August, 1948 miners swarmed over his land grant and began staking claims and digging. It was on the Mariposa land grant that hard-rock mining started in California in 1948 with discovery of the “Mother Lode Vein”.

Disputes with the miners were common and one band of prospectors from Merced attempted to “jump” the Pine Tree Mine. They came with guns and the workers barricaded themselves in the mine portal. The siege lasted 5 days while Freemont appealed to the Governor for help. When work came from the Governor to leave or face the Territorial militia, the claim jumpers gave up and went back to Merced.

COUNTY FAIR GROUNDS

A mile south of Mariposa, in the vicinity of the County Fairgrounds, are the dumps and partly caved workings of the Mariposa Mine (#1) (Bowen and Crippen, 1949).

Kit Carson, and two of his associates, are reputed to have discovered the Mariposa Mine in 1849, but it is more likely that Mexican miners found placer gold nearby in 1848. The first American to find gold in this area was probably Alexis Godey who prospected the streams on Fremont's Las Mariposa grant in 1849 (Gudde, 1975), (Landefeld and Snow, 1990).

By July of that year, Palmer, Cook and Company built a stamp mill and were crushing quartz ore at the Mariposa Mine.

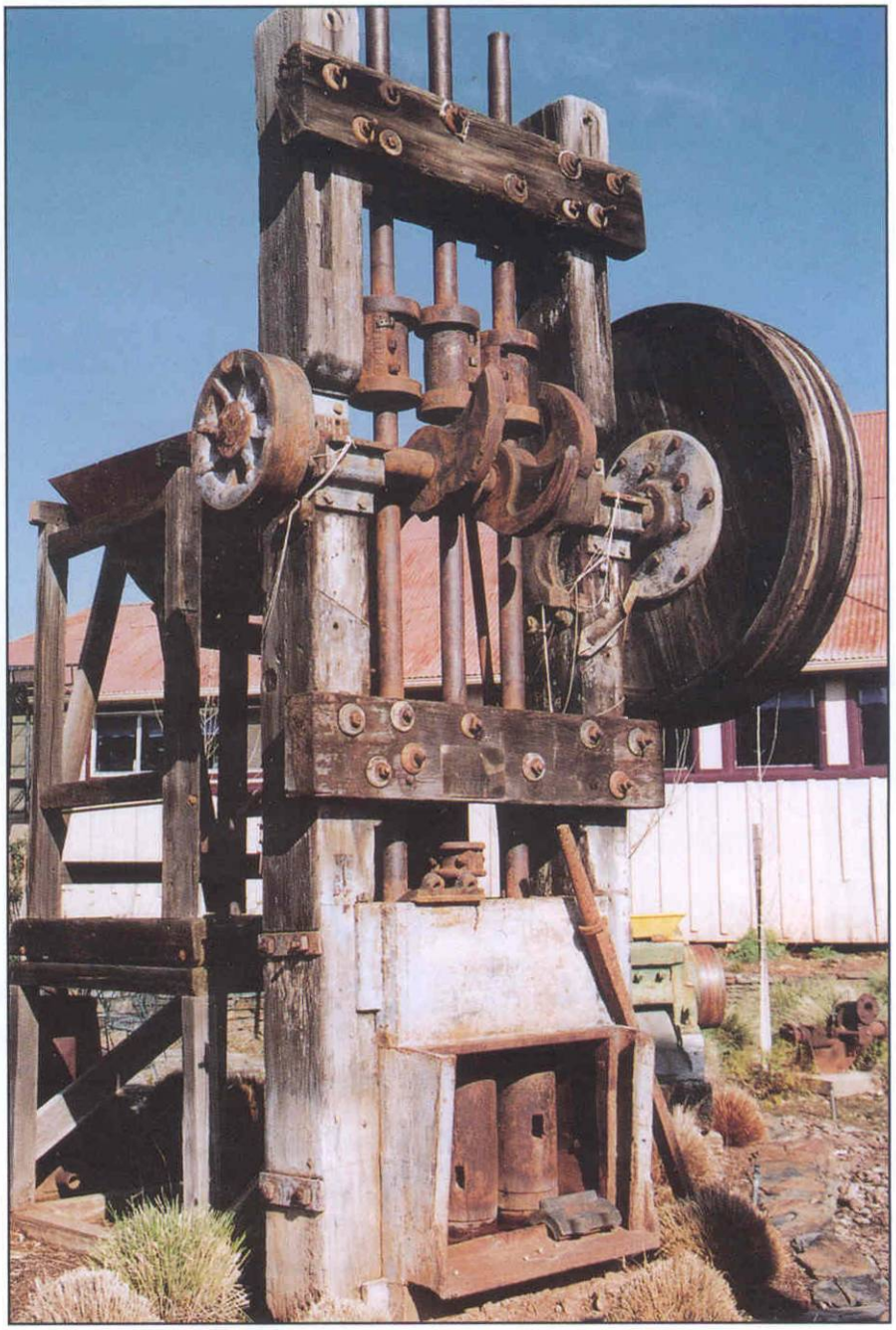


Photo 2. A stamp mill for crushing ore, displayed on Main Street, Coulterville. *Photo by Max Flanery.*
Calif. Geol. 1997:37

Figure 2. Coulterville stamp mill (1997, CGS)

The mine is notable as the first lode or hard rock mine (as distinct from a placer mine) in California. Recorded production from the mine is estimated to be $2,195,205 (approximately 116,000 ounces gold), which makes it the seventh largest gold producer in the country. Most of the ore was mined between 1900 and 1915, with the peak production in 1901. The vein is composed of milky quartz up to 4 feet wide with "ribbons" of quartz on its outer edges. The ribbons are defined by lamina and by inclusions of metavolcanic and slate wall rock. Ore related minerals are gold, pyrite, and arsenopyrite. Classified by some as being within the East Gold Belt, the vein is different from a typical Mother Lode vein in that it strikes N50^{o}W. to N70^{o}E. and dips

50-70°S (Julihn and Horton, 1940; Bowen and Grey, 1957). Degree of wall rock alteration is not known. The vein may have formed in a dilatant zone between the Melones fault to the west and a serpentinite silver to the east (Landefeld and Snow, 1990). The Mariposa Mine, north of the Fairgrounds and east of the Mariposa County Courthouse mine lies near the contact between the Penon Blanco metavolcanic rocks and Tonalite of Blue Canyon

As early as July 1849, Palmer, Cook, and Company were running a stamp mill on ore from the Mariposa Mine. In 1859 John C. Fremont wrested the title to the mine from its original owners when accorded title to the Las Mariposas grant of 44,000 acres. Mines of the Las Mariposas grant also included the Pine Tree, Josephine, Princeton, and many minor workings such as the Penon Blanco claim. The latter is one of the longest claims on record (5,850 ft, 1.8 km), titles having been recorded before length limitations on mining claims became law. Workings reached a depth of about 1,550 feet along a 60°E to 70°E incline or about 1,350 feet vertically. The veins lie in meta-augite andesite of the Penon Blanco formation, locally called greenstone. The veins lie in meta-augite andesite of the Penon Blanco Volcanics. (Bowen and Crippen, 1949).

The Mariposa County Fairgrounds is now the site for the California State Mining and Mineral Museum which opened in 1990. Mormon Bar, south of the Fairgrounds is underlain by Tonalite of Blue Canyon with east-west striking foliations. The north side of the horse racing track at the Fairgrounds marks the contact between the tonalite and metavolcanic rocks.

The ridge west of Mariposa has the Melones Fault at its eastern base with a 0.25 mile wide slice of "metamorphosed ultrabasic rocks west of the Melones Fault (Pre-Cretaceous)" between it and "metasedimentary rocks west of the Melones Fault (Jurassic)"; Krauskopf (1985).

A side trip from Mariposa to Horinitos, Merced Falls and La Grange by way of Cathy's Valley is provided in Appendix II.

0.0 At the Fairgrounds parking lot, metavolcanic rocks of the Penon Blanco Formation are exposed. Leave the Fairgrounds parking lot, turn right and head north on Highway 140 toward Mariposa.

0.2 (MP 17.0) Contact aureole of the Sierra Nevada Batholith

Pull out on right of shoulder. Walk north along highway to the road cut. Here is an exposure of the contact metamorphic aureole of a relatively old batholith pluton, the tonalite of Bass Lake (114 million years, Bateman, 1988). This unit is mapped as the Tonalite of Blue Canyon by Krauscopf (1985). Most other plutons in the Mother Lode are younger. The contact aureole here is about 0.6 km wide (Landefeld and Snow, 1990). The metamorphic rocks in contact with the batholith are "Metavolcanic rocks east of the Melones Fault" (Krauskopf, 1985), or "Penon Blanco Formation" (Bowen and Crippen, 1949).

0.4 (MP 17.2) South strand of the Melones Fault Zone crosses the roadway at Stockton Creek Bridge. Here the lithology of the fault zone is a serpentine-hosted tectonic mélange (Landefeld and Snow, 1990).

Continue north toward Mariposa on Highway 140. The ridge west of Mariposa has the Melones Fault at it's eastern base. There is a 1/4 mile wide slice of "Pre-Cretaceous Metamorphosed Ultramafic Rocks West of the Melones Fault" between the fault and "Jurassic Metasedimentary Rocks West of the Melones Fault" (Krauskopf, 1985).

1.3 End of exposures of Melones fault zone. Enter mafic metavolcanic flow rocks of eastern belt.

1.7/0.0 (MP 21.2) Intersection of Highways 140 and 49.

At the southern end of the town of Mariposa, Stockton Creek flows under the highway bridge at this intersection. Turn right and go north. Reset odometer.

Highway 49 at Mariposa begins in metavolcanic rocks of Jurassic age of the Penon Blanco (metavolcanics) or Logtown Ridge (metasediments) formation and passes successively through metasedimentary rocks of the Mariposa Formation, a serpentine intrusive body, more metasediments of doubtful age, and finally into the black slates and sandstones of the Mariposa Formation (Bowen and Crippen, 1949). The narrow belt of rocks to the west of the serpentine near Mount Bullion was originally mapped as Calaveras but probably belongs to the Amador group and is Jurassic rather than Paleozoic in age (Wagner et al, 1990).

0.3 Mariposa County Court House, erected in 1854, on the right (west).

The town of Mariposa is in the southwestern part of the 44,000 acre Mariposa Land Grant. According to Irving Stone (1956), Fremont had given Thomas O. Larkin, the U.S. Consul to the Territory of California, $3,000 in 1846 to buy the Santa Cruz Ranch which had been cultivated by mission padres and was already producing fruit and grapes. Fremont and his wife next met Larkin at a constitutional convention to establish California as a state on September 3, 1849. "To their stupefaction the Fremonts learned that Larkin had not bought the Santa Cruz Ranch with the money John had given him, as he had agreed to do, but instead had bought for them a wild tract of land somewhere high in the Sierra Nevada called the Mariposa Ranch. It was inaccessible, a hundred miles from San Francisco, with no farming land, too wild and cold in winter even to graze cattle, and overrun with hostile Indians." Larkin had bought the Santa Cruz Ranch for himself (Landefeld and Snow, 1990).

Several streets in Mariposa are named for Fremont, his wife Jesse and their relatives. Bullion Street is named for Jesse's father ("Old Bullion") and Jones Street is named for her brother-in-law, William Carey Jones. The hospital bears the name of John C. Fremont (Landefeld and Snow, 1990).

Figure 3. Indian Gulch Vein (1949, CDMG)

Figure 4. Mariposa Fremont Company Office, 1949, CDMG

Figure 5. Mariposa Jail (1949, CDMG)

Figure 6. Mariposa Jail, 2006

Figure 7. Mariposa Schlageter Hotel, 1949, CDMG

Figure 8. Mariposa Schlageter Hotel, 2006

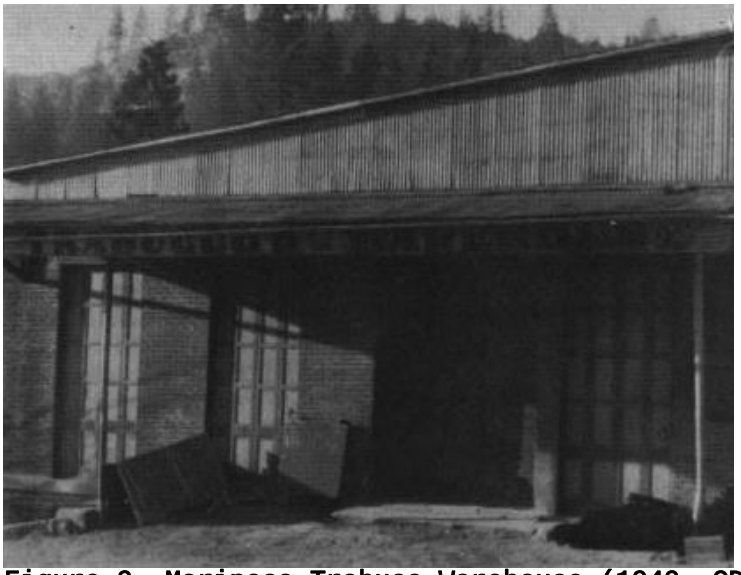


Figure 9. Mariposa Trabuco Warehouse (1949, CDMG)

Figure 10. Mariposa Trabuco Warehouse, June 26, 2006

Figure 11. Mariposa Gold nugget, California Mining and Mineral Museum, 2006

Figure 12. Mariposa County Courthouse, Mariposa, 2006

Photo 1. Weathered outcrop of quartz-ankerite-mariposite rock, northwest of the McAlpine Mine, southern Tuolumne County. This rock is part of a narrow linear mass of altered rock and quartz veins that holds up the steep hill immediately east of Highway 49, about 1 mile (1.6 km) northwest of the Tuolumne-Mariposa county line. The rock was formed by hydrothermal alteration of serpentinite in the Melones Fault Zone, a major fracture in the earth's crust along which many of the gold-bearing quartz veins of the Mother Lode were emplaced. *Photo by Chris Higgins.* Calif. Geol. 1997:36

Figure 13. Mariposa Quartz-Ankorite vein, McAlpine Mine (1979, CGS)

MARICOPA COUNTY HISTORICAL CENTER

0.5 Mariposa County Historical Center (#2). This institution has demonstrations of an authentic stamp mill.

Figure 14. Mariposa County Historical Center stamp mill, 2006

0.9/0.0 Intersection of Highways 140 and 49 at the north end of town.

Turn left, go west on Highway 49 toward Mount Bullion. For the next few miles, we will traverse metavolcanics, serpentine bodies and Mariposa Formation. Reset odometer at this intersection.

The 295-mile long Highway 49 has been called the "Mother Lode Highway because it connects the towns that were built in the middle of the mining districts along the Sierran foothills. The Mother Lode Highway Act of 1921 allotted funds to five host counties to maintain the road. Since that time several State legislative acts have provided for the improvement of the road, and in 1933, the number "49" was assigned to it; the state route signs were made in the shape of a miner's shovel. As one travels along this highway, especially in Mariposa County, it is not difficult to imagine Fremont's surprise at owning this "inaccessible" land in 1949 (Landefeld and Snow, 1990).

Continue through schistose metavolcanic flow rocks with discernable pillow shapes

0.6 Carbonate altered, sheared metavolcani-clastic rock on left.

1.0 (#3) California Division of Forestry Fire Station on right.

The roadway lies southeast of a sliver of serpentinized ultramafic rocks (Mesozoic) which is confined to and define the approximate limits of the Melones Fault Zone. The roadway is

underlain by Greenstone of Mount Bullion (Jurassic). This is chiefly andesitic and basaltic metatuff and metatuff breccia, but includes lava flows (Bates and Krauskopf, 1987).

1.0 (MP 19.62) Mariposa Creek Bridge

1.4 Mine dumps of King Midas Mine at left.

KING MIDAS MINE

This mine is part of the Mount Bullion Mining District (#5). Discovered in 1925, "gold [at King Midas] occurs chiefly in serpentinite in a series of 5 parallel shear zones striking NW. and dipping about 70o NE. Gold has been deposited in thin seams of gouge along joint planes and in fractures in talc-serpentinite schist" (Bowen and Grey, 1957). Quartz vein material was milled, but production is not known (Landefeld and Snow, 1990).

This is one of several *en-echelon* veins that make up the Mount Bullion District. The Princeton Mine, Mount Ophir Mine, and other smaller mines are on gold-quartz veins northwest and southwest of here, commonly on the margins of sheared serpentinite bodies which define splays of the Melones fault zone. Two twin beds of rhyolite have been mapped as part of the Mariposa Formation in this district (Bowen and Evans in Clark, 1970). One of these, which truly is an altered rhyolite-dacite, runs through Princeton property. The other one, however, is a sheared, carbonate-talc+minor mariposite body that is altered serpentinite (Landefeld and Snow, 1990).

1.5 Highway passes through serpentinite of the Melones fault zone.

Carbonate altered serpentinite and metagabbro in Melones fault zone on right. The fault zone is about 2,700 feet (0.8 mile) wide here and has numerous metagabbro and diorite inclusions, one of which yielded an 40 Argon\39 Argon plateau radiometric age of about 197+-7 million years (unpublished data). This age is similar to those of diorite-gabbro subvolcanic plutons intruded into the Penon Blanco Formation in other locations along Highway 49 (Landefeld and Snow, 1990).

For the next 0.9 mile the route passes through this serpentinite-mélange. On the hillside to the right, serpentinite bedrock can be identified by the sparse vegetation (see papers by Huntington on the soil and McNeal on the vegetation, in the 1991).

2.8 Serpentine. Mt. Bullion is on the right at 2:00 o'clock position.

3.5 Black slate.

Route crosses into black slate, pebbly sandstone, and pebble conglomerate of the Mariposa Formation which here is in the footwall to the Melones fault zone. About 0.5 miles farther west on Highway 49 the route passes through a pebbly sandstone with a green tuffaceous matrix and black shale pebbles (rip-up clasts). These are part of the turbidite sequence of the Mariposa Formation. The tuffaceous matrix probably comes from a slump dominated by volcaniclastic material such as that seen in the Penon Blanco Formation from upper part of a marine fan or continental slope failure (Landefeld and Snow, 1990).

GEOLOGIC MAP 2

Mt. Bullion to Trabucco Gardens
(Bowen, 1969; Bogen, 1983)
(Logan, 1934; Wagner et al, 1990)

3.7 Mount Bullion Youth Conservation Camp on right.

The camp was established in 1955 near a campsite of the Fremonts near Fremont Peak. The hill

and town of Mount Bullion were named for Captain John C. Fremont's father-in-law, Thomas Hart Benton, who was a U.S. Senator from Missouri. Both Fremont and Benton shared a vision of United States expansion into the American West. Benton pushed a bill through Congress to map a route to Oregon and selected Fremont to lead the expedition. Senator Benton was called "Old Bullion" because he advocated adoption of metallic currency (Gudde, 1969). Another Thomas Hart Benton, a grandnephew of Old Bullion, was a renowned painter (1889-1975). The younger Benton painted murals and canvases, many of which were "vigorous, realistic portraiture of mainstream, ordinary" people of the Midwest (Merriam-Webster, 1988). His work is now the subject of renewed interest (Landefeld and Snow, 1990).

SIDE TRIP TO MOUNT BULLION YOUTH CAMP

0.0 Turn right toward California Youth Conservation Camp (#5(. Road climbs to Mt. Bullion.

0.5 Volcaniclastic and mafic flow rocks exposed on hillside above the road are part of an informal volcanic member of the Mariposa Formation similar to the Brower Creek Member of the Logtown Ridge Formation (Landefeld and Snow, 1990).

1.7 On right, from here to 1.8 mile, variably deformed metabasaltic rocks which range from massive flows of plagioclase-pyroxene porphyry to aphanitic, flattened pillow lavas. Still in footwall west of Melones fault zone (Landefeld and Snow, 1990).

2.4 Pass into volcanic sandstone and siltstone beds. Tops of beds are not discernable, so it is unclear as to whether these beds are younger or older than flows seen at other points along this section of Highway 49. After 0.5 miles and hairpin turn, route returns to flow units (Landefeld and Snow, 1990).

3.3 Narrow part of Melones Fault Zone. Pull to shoulder for this stop, and then proceed to the top of the hill to turn around. This 2,000 foot wide zone of sheared serpentinite is the narrowest part of the main Melones fault zone (Landefeld and Snow, 1990).

3.5 Turn around at top of hill and return to Highway 49. The ridge west of Highway 49 is volcaniclastic rock of the Penon Blanco Formation. The intervening valley is a strike valley in the Mariposa Formation (Landefeld and Snow, 1990).

END OF SIDE TRIP (mileages below are measured from intersection of Highways 140 and 49 at north end of Mariposa, continuing the mileage prior to the side trip).

4.1 Mariposa County Airport. This airport had its first runway built in 1937 by the Works Projects Administration (Landefeld and Snow, 1990).

MOUNT BULLION

4.2 From Mount Bullion to the divide where the highway begins its drop into the Merced River canyon, the rocks on both sides of the road belong to the Mariposa Formation.

4.4 Mount Bullion cut off road.

Mount Bullion, 4.7 miles northwest of Mariposa, was once a flourishing mining center being the site of the Princeton Mine and the supply center for placer diggings close by. Evidences of hand placer working are manifest along every stream bed and gravel exposure. The Princeton Mine had the largest gold production in Mariposa County. From 1852 until its closure in 1933, the year the gold price was raised from $20.67 to $35 per ounce, the mine produced closed to $5 million of gold (approximately 242,000 ounces gold). The inclined shaft followed the vein at angles between 45° and 60° to a depth of 1,660 feet. The vertical depth is slightly greater than 1350 feet (410 m).

The Carlo Marre store, Mariposa Chamber of Commerce Historical Marker and the more recent Frank Trabucco store, across the street, mark the center of present day Mount Bullion (Bowen and Crippen, 1949).

4.6 Pass Agua Fria Road. Enter Mount Bullion, formerly Princeton.

This town used to be a supply center for placer miners whose workings can be seen in every stream bed in the area. Agua Fria (cold water) town site, named for two springs, lies east of this road about two miles south of here. It was a placer mining camp settled by Sonorans after gold was discovered there in 1849 (Bowen and Gray, 1957; Gudde, 1969; Landefeld and Snow, 1990).

4.85 Hornitos Road (Old Toll Road) on left (west), built on the old Zinkand Burkhalter toll road to Hornitos (#6) and Merced Falls. Hornitos is about 10 miles west. The Mount Bullion-Hornitos road cuts across the strike of Jurassic rocks of the Mother Lode Belt.

Interbedded black argillite, gray siltstone, sandstone, and pebbly sandstone of the Mariposa Formation extend from here until just past the top of the grade north of Bear Valley. Immediately on right, just past turnoff to the Old Toll Road, is a pebbly sandstone with a tuffaceous matrix and black argillite rip-up clasts. As the route progresses north, the road nearby parallels beds in the Mariposa Formation. Toward Bear Valley sandstone beds (mostly Bouma Series A) are up to 10 and 20 centimeter thick (Landefeld and Snow, 1990).

5.7 Narrow part Melones Fault Zone.

WASHINGTON OR JENNY LIND MINE

The Washington or Jenny Lind Mine (#7), 1/2 mile northeast of Hornitos has was one of the best in the Hornitos District. It was discovered in 1850 and installed the first milling machinery of the district the following year. The stamp mill which operated in the 1850's is reputed to have turned out $1,000 in gold per day. The vertical Jenny Lind shaft is 1540 feet deep. The production is estimated at 29,900 ounces ($2,247,000) (Bowen and Crippen, 1949).

Figure 15. Jenny Lind Isabella Gold Dredge, 1919 (1949), CDMG

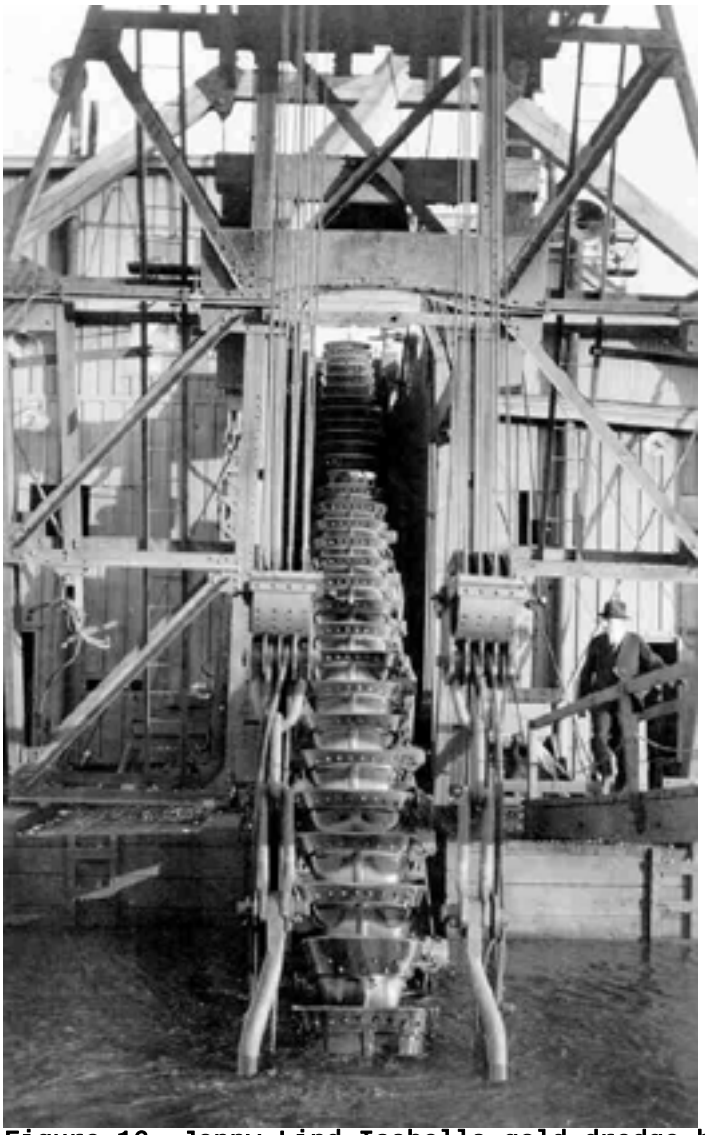


Figure 16. Jenny Lind Isabella gold dredge buckets, 1919 (1949, CDMG)

Figure 17. Jenny Lind Isabella Gold Dredge Machine Shop, 1919 (1944 CDMG)

Figure 18. Washington Mine, 1967 (1949 CDMG)

Figure 19. Jenny Lind Mine tuff limestone building (1949, CDMG)

6.0 Ophir Mine Road. Metavolcanics (Penon Blanco Formation) are in hills to right (East). Mariposa Formation is in hills to left (West).

MOUNT OPHIR MINE

Mount Ophir Mine (#8) is on left about 1.4 miles past the Old Toll Road. The hill is partly underlain by a sliver sheared serpentinite that strikes N.55-60 W. The vein at the Mount Ophir Mine was up to 30 feet thick but averaged 5 feet. It had a serpentinite footwall, a slate hanging wall, and little associated mariposite-carbonate alteration. Ore was in shoots in the hanging or footwall rather than in the vein. Estimated total gold production was up to $300,000 (approximately 14,500 ounces; Bowen and Grey, 1957). Note that sheared serpentinite bodies such as that at Mount Ophir are exposed along the Old Toll Road but pinch out just south of Highway 49. Parts of a few of the original slate and greenstone buildings identify the old Mount Ophir town site (Landefeld and Snow, 1990).

6.6 (MP 25.00) Mount Ophir Road intersection.

9.0 Quartz veins in roadcut.

South of Bear Valley marks one branch of the Mother Lode. Two and two-tenths miles south of the town of Bear Valley prominent outcrops of quartz can be seen to the west of the highway. These stand up like white walls on the gently rolling land surface and mark the trace of one branch of the Mother Lode (Bowen and Crippen, 1949).

9.6 "May" Rock (#9) on left, about 2 miles (3 km) south of Bear Valley. A wall of quartz, a large vein, can be seen through the oak trees jutting from gently rolling hills west of the highway. May Rock was reportedly named by Jesse Fremont after a May picnic there (Sargent, 1976; Landefeld and Snow, 1990).

The ridge to the southwest is composed of Penon Blanco volanics. The valley along with Highway 49 traverses is Mariposa Formation. The crest of Mount Bullion to the northeast is Jurassic metavolcanic rocks (Wagner et al, 1990).

GEOLOGIC MAP 3

Trabucco Gardens to Bagby
(Bowen, 1969; Bogen, 1983)
(Logan, 1934; Wagner et al, 1990)

10.2 Pendola Garden Road. Bear Creek on left has been worked by placer miners.

10.5 BEAR VALLEY (#10)

Bear Valley, originally called Haydensville, Biddles Camp, Simpsonville, and Johnsonville, was promoted by J.C. Fremont during his administration of the Las Mariposas grant. The town is now largely a ruin of small stone, adobe, and frame buildings marked by Division of Highways Historical Marker 331. Another road from Hornitos joins Highway 49 just north of Bear Valley (Bowen and Crippen, 1949).

Figure 20. Bear Valley adobe building (1949, CDMG)

Figure 21. Bear Valley adobe with stucco exterior (1949, CDMG)

Figure 22. Bear Valley adobe with stucco exterior (1949, CDMG)

Figure 23. Bear Valley Jail (1949, CDMG)

Figure 24. Bear Valley Jail, 2003 A

Figure 25. Bear Valley Jail 2003 B

Figure 26. Bear Valley Jail, 2006

Figure 27. Bear Valley ruin and house, 2006

Figure 28. Bear Valley Ruins (1997, CGS)

The town was named by Fremont in 1848 (Gudde, 1969). A few original buildings stand here including the Bear Valley jail and Oso Hall on the left (Landefeld and Snow, 1990). Oso means "bear" in Spanish, an allusion to the California Grizzly bear, which is now extinct.

North of Bear Valley the route continues sub-parallel to the strike of the Mariposa slate, but it climbs in section and approaches the Melones fault zone on the east. The high ridge to the west is Hunter Valley Mountain. It is supported by basaltic volcaniclastic rocks of the Penon Blanco Formation (Landefeld and Snow, 1990).

10.9 Historical Marker #331 for Bear Valley. Hunter Valley Mountain is the ridge to the west.

11.0 Bear Valley Road to Hornitos and Yellowstone Mine. Upper Penon Blanco and Lower Mariposa Formations.

SIDE TRIP TO HORNITOS

GEOLOGIC MAP 3-B

Bear Valley to North of Hornitos
(Bowen, 1969; Bogen, 1983)
(Logan, 1934; Wagner et al, 1990)

Merced Falls and Hornitos

At the northern end of the Mount Bullion town site, a road from Hornitos and Merced Falls joins Highway 49. Hornitos is the hub of a very old mining district, the town having been founded by Spanish Californians before gold rush days. The Mount Bullion-Hornitos road cuts successively across the strike of Mariposa and Amador group rocks and then enters exposures of Guadeloupe granodiorite near the town of Hornitos. The Ruth Pierce Mine is at the contact of the uppermost member of the Amador group, the Agua Fria formation, and the Guadeloupe granodiorite. The Agua Fria formation consists of thin-bedded, hard, platy sediments and interbedded volcanics. It lies, in different areas, both uncomfortably and gradationally on the Penon Blanco or Logtown Ridge member of the Amador group and may be a non-volcanic member of that formation. The latter formation is, typically, a green meta-andesite agglomerate having prominent augite phenocrysts. This formation persists in more or less parallel alignment to the Mariposa slate from Mariposa County well into El Dorado County (Bowen and Crippen, 1949).

A 2.8 mile round trip on Bear Valley Road (County Road J16)
shows a section through the upper part of the Penon Blanco Formation consisting of basaltic volcaniclastic beds and the lower part of Mariposa Formation consisting of black argillite, gray sandstone, and sandstone (Landefeld and Snow, 1990).

0.0 Bear Valley Road an Highway 49. Go west toward Hornitos.

1.2 Cross Bear Creek.

1.3 Road to Yellowstone Mine on right (west).

1.8 Road to Juniper Mine on the left (south).

3.2 Road to right (north) goes to Cotton Creek Mine, Pyramid Mine and the Williams Ranch.

4.7 Road to left (south) goes to unnamed mines.

5.1 Mount Gains road to the left (south). This road takes you to the Mount Gains Mine.

GEOLOGIC MAP 1-D

Blueledge Mine to Hornitos
(Bowen, 1969; Bogen, 1983)
(Logan, 1934; Wagner et al, 1990)

Mount Gains Mine

The Mount Gaines Mines (#11), located five miles (8 km) northeast of Hornitos on the Hornitos-Bear Valley road, is the last major gold producer in Mariposa County. It has an inclined shaft with an average dip of 30° having a total inclined depth of 1,322 feet. The ore is of sulfide type and the veins dip at 30°E to 35°E from horizontal. Steeply dipping veins are more common along the Mother Lode than flat ones. In this respect the Mount Gaines veins are unusual. The wall rock is meta-andesite and vein minerals are pyrite, quartz, chalcopyrite, galena, and sphalerite as well as disseminated gold. Bornite, proustite, arsenopyrite, and argentite have been found in small quantities. Early production of the Mount Gaines totaled 50,000 ounces (approximately $1,250,000) to 1911 (Bowen and Crippen, 1949).

Figure 29. Mt. Gains Mine, 1930 (1999, CGS)

Figure 30. Mt. Gains landscape (1949, CDMG)

Between 1988 and 1991 a heap-leach gold operation took place at Mt. Gaines. There was an unfortunate mercury poisoning accident at this mine in 1990.

Badger Mine

This mine is 0.3 miles north of the Number Five Mine (#138) on El Dorado Creek, between Mount Gains and the Number Five Mine. It opened in the 1950's and closed in 1934. It was mostly owned by the Cavagnaro Family. No production estimates are available.

Number Five Mine

The Number Five Mine (#138) mine is on the Mount Gains Road, 1.1 miles south of the Mount Gains Mine. This was the most active mine in the area between 1909 and 1914. It has a shaft that is 260 feet deep. The quartz vein of this mine was 5 to 30 feet wide (Phillips, 2002).

6.1 Cemetery on right (northwest).

6.4 Quartzburg school (#149) on right (west).

Number Nine Mine

7.0 Number 9 Mine (#136) road on the left (southeast). This mine is 0.6 miles down the Number Nine Road, located west of corrals. The Number Nine was opened in the 1850's and operated until 1936. Before 1873 the ore was processed at Mount Gains. In 1880, a 30-ton stamp mill was erected. The quartz veins at the Number Nine mine were 3 to 5 feet wide, and there where 12 of them. The mine had six shafts. (Phillips, 2002).

Barker Group Dredge Grounds

These dredging grounds (#137) are 1.2 miles south of the Number Nine Mine. They were active from 1940 to 1942 and produced $1,000,000 (41,600 oz) in gold

7.6 Road on right (west) goes to the Red Cloud Mine.

Hornitos

9.6 Hornitos (#7).

Figure 31. Hornitos Ghirardelli building 2002

Figure 32. Hornitos Ghirardelli building (1949, CDMG)

Figure 33. Hornitos Ghirardelli building adobe wall (1949, CDMG)

Figure 34. Hornitos area ground sluicing, 2002

Figure 35. Hornitos jail (1949, CDMG)

Figure 36. Hornitos jail, 2006

Figure 37. Hornitos Masonic Lodge, 2006

Figure 38. Hornitos St. Anne's Catholic Church

Figure 39. Hornitos Plaza (1949, CDMG)

Figure 40. Hornitos Plaza, 2002

Figure 41. Hornitos Post Office (1949, CDMG)

Figure 42. Hornitos Post Office, 2006 A

Figure 43. Hornitos Post Office, 2006 B

Figure 44. Wells Fargo Building (1949, CDMG). This building is now removed. A plaque has taken its place in history.

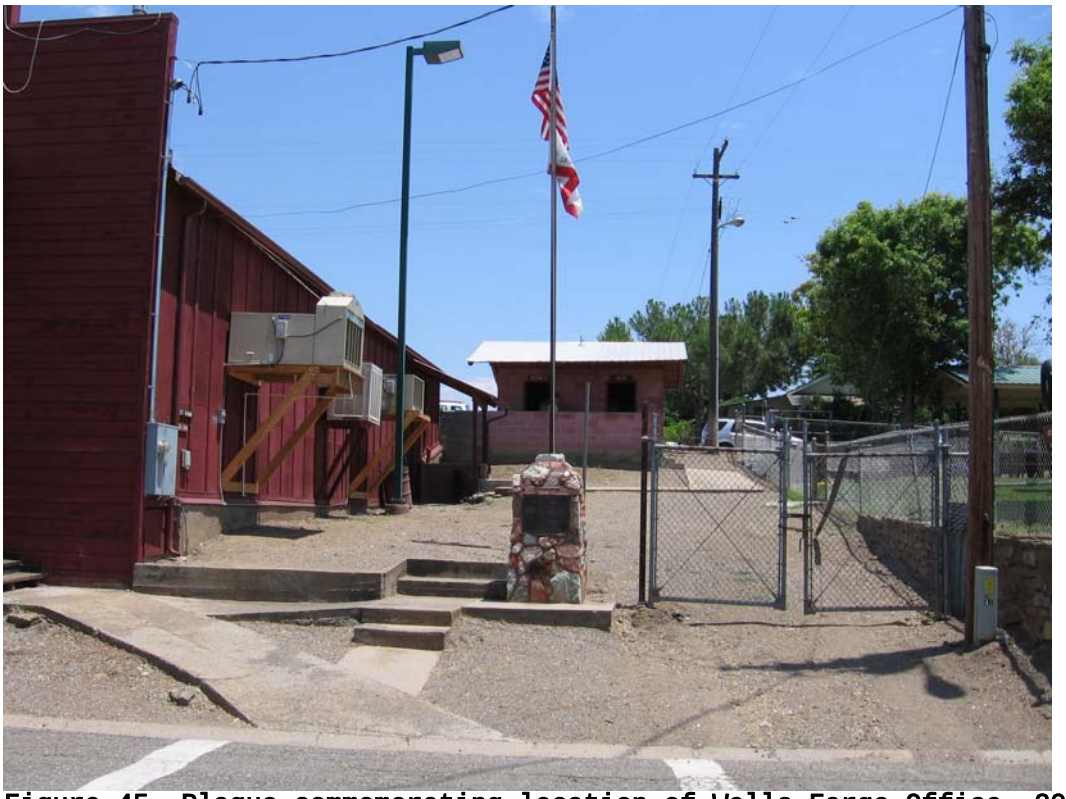


Figure 45. Plaque commemorating location of Wells Fargo Office, 2006

Figure 46. Hornitos brick building with gas pump, 2006

Figure 47. Hornitos stage stop, 2006

The geology between Hornitos, Merced Falls, Snelling, La Grange and Coulterville is described in Appendix II.

Resume Road Log on Highway 49.

GEOLOGIC MAP 3

Trabucco Gardens to Bagby
(Bowen, 1969; Bogen, 1983)
(Logan, 1934; Wagner et al, 1990)

12.3 Intersection with substation power house access road on left (west).

12.4 Historical marker describing Freemont Fort

MERCED RIVER CANYON OVERLOOK

Two miles (3.3 km) north of Bear Valley and one-tenth of a mile past the divide marking the drop into the Merced River canyon, a broad shoulder on the west side of the highway affords a good parking place (#12) from which to observe the panorama to the northwest (Bowen and Crippen, 1949).

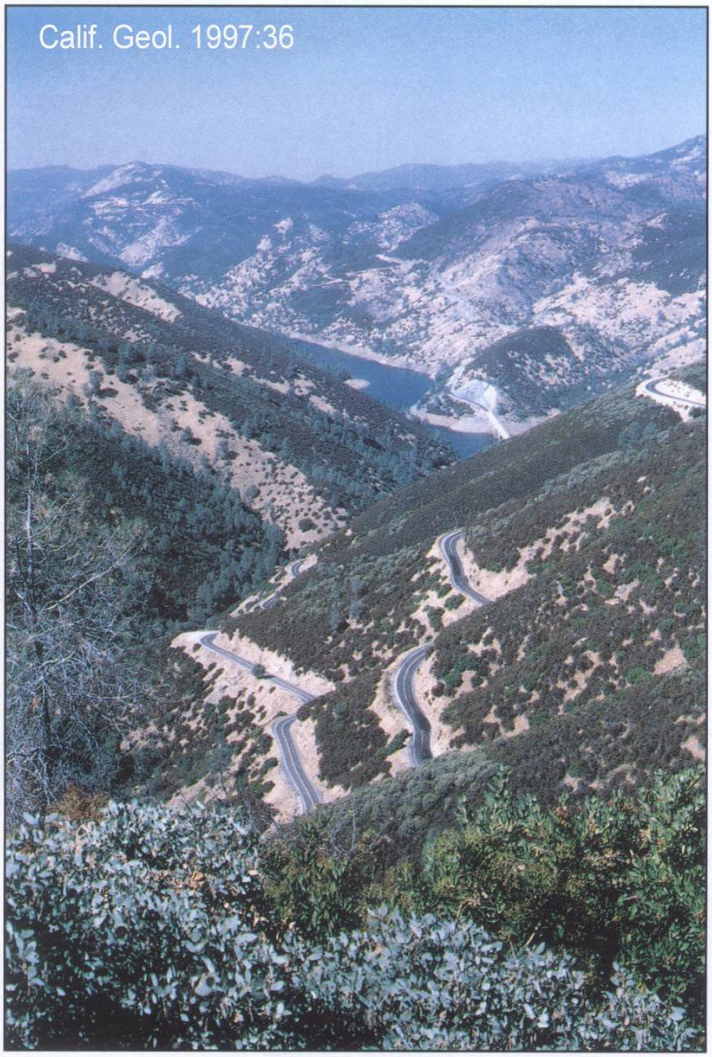


Photo 4. View north of the Merced River canyon and Highway 49 from the Bagby overlook, Mariposa County. The Mother Lode extends from the right side of the photograph in the foreground to the center of the far horizon. This section of Highway 49 passes through the most rugged landscape of the Mother Lode. Fossils used to first date the Jurassic Mariposa Formation were found in Hell Hollow, the deep gulch in the foreground. *Photo by Chris Higgins.*

Figure 48. Merced River Canyon at Bagby (1997, CGS)

The river has cut a gorge which is over 1,200 feet (365 m) below the level of Bear Valley and more than 2,000 feet (610 m) below the ridge tops on either side. Remnants of the old rolling land surface can be seen on the ridge to the east of the river. Hell Hollow, which is a narrow gorge tributary to the Merced, lies immediately below the road to the northwest. The first fossils by which the age of the Mariposa slates were determined came from outcrops in Hell Hollow. To the east of the Merced River and more or less paralleling its course, the white outcrops of the main branch of the Mother Lode can be followed for miles. In the vicinity of Whites Gulch, the quartz outcrops take an abrupt turn and strike almost due north. It is possible that the Mother Lode, at that point, is offset by a cross fault, but work on that area has been insufficient to establish the fact conclusively. The abrupt change in strike of the Mother Lode outcrops is very noticeable from several points along Highway 49 as it drops from Bear Valley into the canyon of the Merced. The Mother Lode thrust fault system has displaced many thousands of feet of beds. More than 15,000 feet of strata may have been cut out in some places. Steeply dipping linear

outcrops of meta-volcanics of the Penon Blanco Formation can be seen in the hillside to the west of the Merced River (Bowen and Crippen, 1949).

From this point, the Josephine and Pine Tree mines can be seen as dozer cuts to the east. From here we will descend to Hell Hollow which is an important site for fossil collecting. The fossils help geologists determine the age and sequence of geologic events along the Mother Lode.

Hell's Hollow is a locality for the endangered Limestone Salamander, which can be found during the wet season. The name is not indicative of the rock types in this area.

12.5 Dozer Cuts exposing Mother Lode vein structures.

12.7 Quartz vein and altered wall rock of the Melones fault zone in roadcut on right (east). These are part of the Pine Tree-Josephine property. The vein in solid ground dips steeply; its apparent shallow dip at this outcrop is the result of slope creep. The roadway winds through Melones fault zone (Landefeld and Snow, 1990).

12.8 Mariposa Slate in road cut.

13.4 Serpentine on right (east).

13.5 Road on left leads to Pine Tree and Josephine Mines.

PINE TREE AND JOSEPHINE MINES

These Pine Tree and Josephine properties (#13 and #14) are idle. An unsuccessful permitting effort to re-open them was attempted in 1992. Recent ore piles can be seen on the left (west). The geology of this area was mapped in detail by Evans and Bowen (1977).

The mine buildings, cyanide tanks, and adits of the Pine Tree and Josephine mine lie in a gulch between two major switchbacks between Bear Valley and the Merced River Bridge. These mines were opened about 1850 and were among the earliest of the lode mines in California (Bowen and Crippen, 1949).

Figure 49. Pine Tree-Josephine Mine, 1957 (1997, CGS)

The mine was part of the Mariposa grant, and owned by Lt. Fremont. Soon after it's discovery and development, bandits attacked the mine, and Fremont's son left to seek reinforcements and to protect his mother who lived in Bear Valley. A message was sent to Sacramento, and an army continent sent to lift the siege.

As the veins outcrop on the flanks of a ridge of considerable height, a unique 3-dimensional view of the vein system is possible. They have been worked largely by tunnels and winzes, rather than deep shafts. None of the veins extend lower than 800 feet from the entrance tunnel levels. Some of the veins have been traced for 1,200 feet along their strike. Production records on these mines are incomplete, but the total figure for both mines is in excess of 107,200 ounces ($2,679,000). Prominent exposures of veins of the Mother Lode vein system can be seen in the road cuts in the vicinity of the Pine Tree and Josephine mines. A narrow belt of serpentine discontinuously parallels the Mother Lode Fault east of the vein system. Between the electrical substation at the rim of this canyon and the Merced River, the highway drops down rather abruptly across a typical section of the Mariposa Formation. Several distinct members are identified by Evans and Bowen (1977). The rocks are mainly black slates with interbedded lenses of black, arkosic sandstone. The sandstone contains fragments of slate which are probably re-worked Mariposa material. The slates weather to a tan or grayish buff as they approach the soil mantle (Bowen and Crippen, 1949).

13.7 ALTERNATE MERCED RIVER CANYON OVERLOOK. The Pine Tree-Josephine Mine Lower Workings (#15).

Pull off to right to see outcrop on inside of hairpin curve. Dumps, tailing, and Pine Tree adit of the Pine Tree-Josephine Mine below on left. The view to the north looks down the Merced River strike valley in the Mariposa Formation. The ridge west of the valley is Hunter Valley Mountain which is underlain by the Penon Blanco Formation. The lower slopes of the ridge east of the valley are underlain by serpentinite mélange of the Melones fault zone; the upper slopes and plateau beyond are underlain by metavolcaniclastic and flow rocks of the eastern belt (Landefeld and Snow, 1990).

Exposures of serpentine are seen from this overlook on north and south sides of Merced River. White rocks are part of the Mother Lode vein system. Proceed downhill on Highway 49 to the north, toward Coulterville.

13.9 Tailings of Pine Tree/Josephine Mine at the 11:00 o'clock position.

Tailings from operations in the 1930's can be seen on the left. The tailings are ground ore from which the gold has been removed As the road winds down the grade note the massive gray sandstone beds on east side of road. They form the base of an upward-fineing succession of turbidite deposits. The beds dip at low angles into the hill, a classic example of slope creep. Subhorizontal joints and steep slopes facilitate slope creep (Landefeld and Snow, 1990).

14.0 Mine adit (closed) and sign "contaminated water" on left (east).

The sulfide minerals in the Mariposa Formation produce sulfuric acid upon decomposition, increasing the pH of waters that drain down through mine workings and create "acid mine drainage." Where carbonate exists in the veins (as calcite) or in metasediments (as limestone), these act as a buffer and can return discharged waters to acceptable pH conditions. There is not much of this carbonate material in the Mariposa Formation, so these waters remain acidic.

14.2 Descending Hell Hollow (#16) at hair pin turn.

Note abrupt changes in orientation of the Mariposa schist and slate due to drag folding and soil creep. Our route passes through the slate, siltstone, and sandstone of the Mariposa Formation into Hell Hollow, site of a 19th century discovery of rare fossils in the Mariposa Formation (belemnites, pelecypods, Late Oxfordian-Early Kimmeridgian ammonites). The fossils were found in the "Mother Lode portion" of the "auriferous slates", as the gold-bearing rocks were then called. They were first described in 1864 by Clarence King, who later became the first head of the U.S. Geology Survey. Those fossils were used to establish the age of these slates as Jurassic and post-Triassic. Hell Hollow was so named because of numerous accidents along the rough trail in the early days (Whitney, 1865; Landefeld and Snow, 1990).

16.0 (MP 34.35) Bagby Bridge.

The Bagby Bridge over Merced River/Lake McClure is near the abandoned town of Bagby. On the south side of the bridge, and on the east side of Highway 49 is the Lake McClure-Bagby Recreation Area. It is administered by the Lake McClure-McSwain Parks Department. At times of low water, the ruins of the Bagby Mills can be seen.

Just before the road crosses the Merced River, at Bagby Mills, the Mariposa Formation is exposed in fault contact with serpentine. The serpentine is sheared into the Mariposa at some points along this contact. Jurassic metasediments lie to the east of the serpentine belt (Bowen and Crippen, 1949).

BAGBY (BENTON MILLS)

The site of the hamlet of Benton Mills, now known as Bagby (#17) , lies just across the Merced River. A stamp mill which processed gold ore from Fremont's mines above was situated there. None of the old buildings remain although foundations of some can still be located. The Yosemite Valley Railroad once passed through Bagby but only the roadbed now remains. The tracks were removed during World War II (Bowen and Crippen, 1949).

Both sides of bridge expose serpentine, the state rock of California. At Bagby there is a fault

contact between the serpentine and the Mariposa Formation to the right (east) of the bridge. Bagby ruins are at the river's edge. Mariposa Formation and Penon Blanco Formations can be seen west of Bay Bridge, along Lake McClure on the dammed Merced River (Landefeld and Snow, 1990).

Figure 50. Bagby Mills foundations at Highway 49 bridge (1949, CDMG)

Good exposures along the strike of the Mariposa Formation are found on either side of Lake McClure and extend about 4 miles downstream. North, then west of that, the Merced River cuts down section, providing superb exposures of the Penon Blanco Formation (Landefeld and Snow, 1990).

Foundations of buildings of the former town of Bagby (called Benton Mills in Fremont's day) are below the bridge on the right (Landefeld and Snow, 1990).

North of the bridge the route enters a 0.1-1.5 mile by 7 mile pod of serpentinite-dominated mélange of the Melones fault zone. Tectonic inclusions, largely of mafic metaplutonic rock and some rodingite and albitite, tend to be concentrated close to the edges of the pod. The Melones fault zone thins at the Pine Tree-Josephine Mine. North of here, the main fault zone strikes N.25° W, whereas a thin fault splay footwall to the large pod of serpentinite mélange strikes N.45° W, on strike with the Pine Tree-Josephine veins. Mother Lode-style mineralization and alteration are localized along the splay for about 5 mile. About where the alteration weakens, the large Mother Lode veins and altered wall rocks "jump track", and continue northwest along the hanging wall side of the large pod of serpentinite mélange to the Coulterville Mining District. There the

Melones fault zone narrows to about 500 feet wide, and nearly all the fault zone is altered, veined, and mineralized. Gold-quartz veins on the Malvina group of claims in the western Coulterville district are on the strike extension of the footwall splay (Landefeld and Snow, 1990).

At this point on the Merced River, suction dredging operations can often be seen between May 1 and October 15.

GEOLOGIC MAP 4

Bagby to Virginia Mine
(Evans and Bowens, 1977; Wagner et al. 1990)
(Bogen, 1983; Bowen, 1969; Logan, 1934; Bowen, 1983)

16.7 Serpentine body in road cut at Vista Point sign and overlook.

To the east, in the SE corner of Section 31 is a 0.5-mile wide mass of "rodingite gabbro" (Evans and Bowen, 1977). This is an unusual, sodium-rich gabbro which is only known to occur a few places on earth. Another occurrence of this type of gabbro is in New Zealand.

North from Bagby for a distance of over six miles (9.6 km) , Highway 49 winds up a steep slope through a barren area of serpentine and related basic and ultra-basic rocks. Serpentine ordinarily is not a favorable medium for supporting plant life although some species grow luxuriantly on it. Vegetation here is exceedingly sparse and consists principally of California holly and chemise with an occasional digger pine. The serpentine series of rocks invades the basement sedimentary series in late Jurassic time intruding Paleozoic (?) and Mesozoic rocks alike. The body of serpentine north of Bagby is one of the largest areas of this type of rock to be round along Highway 49 (Bowen and Crippen, 1949).

16.8 (MP 35.00) Fault contact between serpentine and Mariposa Formation.

RED BANK MINE

17.7 Red Bank mine is in the SE1/4 of Section 36.

As the route passes from the outer part of the serpentinite pod to the interior, note the sheared edges and the massive, blocky interior with fewer shears. This is typical of all the larger pods of serpentinite-dominated mélange in the Melones fault zone and in the Bear Mountain fault zone to the west. There are small nephrite and chrysotile asbestos deposits in this pod, some of which have been mined (Landefeld and Snow, 1990).

The Red Bank Mine is to the left, down the slope on west side of the road. There are two major veins there; the main one is at the contact between serpentinite and slate. Quartz and mariposite-carbonate occur in both the main vein and altered wall rock. Ore minerals were argentinferous galena, native gold, and minor tetrahedrate, chalcopyrite, and sphalerite. Pyrite was also present. Ore milled in 1939-1940 yielded about 4 times as much silver as gold. Gold production was in excess of $100,000 (about 4,800 ounces, Bowen and Grey, 1957; Landefeld and Snow, 1990).

18.0 Prospect pits on left. Powerlines cross overhead.

20.2 Scott Gulch on left (west).

20.7 Oxidized serpentine in roadcut at right. In road cuts not the peculiar texture of weathered serpentine.

Described by Landefeld and Snow (1990) as "alligator rock", it is reddish and has a reptile-skin

texture owing to weathering of bastite and fine-grained serpentine. Bastite is a serpentine mineral that is pseudomorphous after pyroxene, especially orthopyroxene. The fine-grained serpentine replaces the olivine matrix of harzburgite or dunite. On fresh surfaces, cleavage faces of 3-6 millimeter single crystals of bastite reflect light and stand out in contrast to the matte greenish black serpentine. The original, coarse-grained, plutonic texture of the rock is readily discernable (Landefeld and Snow, 1990).

21.9 Serpentine in road cut.

22.4 Bagby Grade Summit in serpentine. To the northwest is the Merced River and Lake McClure area. Penon Blanco Peak is at the 10:00 o'clock position. Quartz of the Virginia Mine are in the foreground, across the valley.

Slightly less than two miles beyond the summit of the Bagby grade, the highway crosses the eastern border of serpentine and continues along the contact of serpentine and Jurassic metavolcanics for a distance of about a mile. These are the first good exposures northbound along Highway 49 of what used to be mapped as "Calaveras Complex". The outcrops consist mainly of weathered tan mica schist and phyllite, both of which somewhat resemble weathered Mariposa slate. They have, however, suffered a much greater degree of metamorphism, being schistose rather than slaty (Bowen and Crippen, 1949).

22.7 We cross the Melones Fault Zone separating metavolcanics to the northeast from serpentine to the southwest. The Black Spider and Red Ball prospects lie along this fault 1/4 mile to the east of this point.

23.1 Albitite dikes in black phyllite and slate of eastern belt less than 0.1 mile east of east margin of serpentinite in Melones fault zone (Landefeld and Snow, 1990).

23.2 Jurassic metavolcanic rocks in roadcut.

23.3 Road to Virginia Mine to left (west). Dike swarm on right.

At a distance of 1.7 miles north of the Bagby Summit, the highway crosses several dikes of an unusual grayish white rock known variously as albitite, soda syenite, and albite granophyre. Intrusive bodies of this rock are also found in many places to the east of Moccasin Creek. It is a medium to fine grained rock with aplite plus variable amounts of soda-rich minerals such as riebekite and aegirine. The latter two are not present in the dikes crossing Highway 49 but are present in some of the Moccasin Creek outcrops (Bowen and Crippen, 1949).

23.4 White quartz vein forms ridge on left (west). This is the structure that was excavated at the Virginia Mine.

VIRGINIA MINE

A short distance north of the summit of the Bagby grade, 3.8 miles from Bagby, a narrow dirt road from the Virginia Mine (#18) leads off to the west. The Virginia Mine was one of the earliest patented claims in Mariposa County and has been worked on a small scale over a very long period. The mine is 1,300 feet (396 m) deep on the incline and the wall rocks are "Calaveras schist", Logtown Ridge greenstone, and serpentine (Bowen and Crippen, 1949).

The Virginia Mine was discovered in 1850 and produced about 37,000 ounces ($660,000) of gold. The mine exploited a "bull" quartz vein (large, generally low grade, milky white) and adjacent mariposite-carbonate-quartz rock. Both are localized at the contact between serpentinite in the footwall of the Melons fault zone and metasedimentary and metavolcaniclastic rocks of the hanging wall. The Virginia vein system strikes N.50° to 55o W and dips 60° NE. The vein and

alteration envelope is up to 150 feet wide. Bull quartz of the large vein is barren, but gold-bearing veins which range from 4 to 8 inches thick cut the bull quartz and those were of such spatial density and quality to be mined. The main ore shoot is near vertical, of highly variable dimensions, and was worked to a depth of 1,200 feet. It was not found on the 1,300-foot level. The upper 80 feet contained some bonanza ore. Ore minerals were free gold, pyrite, chalcopyrite, and galena (Bowen and Grey, 1957; Landefeld and Snow, 1990).

The Virginia Mine lies in the Melones Fault Zone which, at this point, separates metapyroclastic rocks to the northeast from serpentine to the southwest. At the mine are two slivers of Mariposite talc-chlorite-pyrite schist.

GEOLOGIC MAP 5

Virginia Mine to Coulterville
(Evans and Bowen, 1977; Wagner et al. 1990)
(Bowen, 1961; Bogen, 1983; Logan, 1934)

23.2 Intersection of Schilling Road on the right (east).

23.5 Dikes (albitite, soda syenite, albite, granophyre). Mafic to intermediate dikes introduced along the hanging wall contact of the Melones fault zone into serpentinite and epiclastic and volcaniclastic rocks of the eastern belt. These dikes establish relative ages of geologic events related to Mother Lode formation (Landefeld and Snow, 1990).

23.9 Albitite Dikes at the Melones Fault Zone-Eastern Belt Contact on right. There is a pullout on the left.

Albitite dikes are an integral part of the history of alteration along the Melones fault zone, but they are not directly related to the gold-quartz veins and concomitant alteration. The albitite predates main stage Mother Lode formation. Albitite is a relatively common alteration byproduct of serpentinization, (Coleman, 1967) but the large amount of albitite associated with and concentrated near the margins of serpentinite pods in the south-central Mother Lode region is notable (Landefeld and Snow, 1990).

24.1 Buckhorn Creek. Buckhorn Flat is an exhumed pediment surface which represents a former topographic leveling of the land in this area.

24.4 Albitite dikes. These dikes are about 2 miles (3 km) north of Bagby summit. They are an unusual grayish white rock variously described as ablitite, soda syenite, and albite granophyre. Intrusive bodies of this rock are also found in many places to the east of Moccasin Creek. The rock is medium to fine grained with aplitic and porphyritic phases. It is composed mainly of soda feldspar albite plus various amounts of soda-rich minerals such as reibekite and aegerite. These latter two minerals are not present in the dikes crossing Highway 49, but are present in some of the Moccasin Creek outcrops (Bowen and Crippen, 1949, modified by CGS, 1997).

MARY HARRISON MINE

24.8 Mary Harrison Mine Road.

A red brick furnace and chimney and a concrete foundation are all that remain of the boiler house and other buildings of the Mary Harrison Mine (#19). These are located on a knoll to the west of Highway 49, 1.8 miles (3.3 km) south of Coulterville. The Mary Harrison was discovered sometime before 1867 and was operated for a considerable period prior to 1895 by the Cook Estate. In 1895, the mines of the Cook Estate passed into the ownership of the Merced Gold Mining Company which is responsible for most of the recorded production. This was well in

excess of 13,200 ounces (about $330,000). The mine was worked to a depth of 1,200 feet by shaft and winze. Most of the workings were in the dolomite-ankerite-mariposite-quartz rock which forms a very broad zone along this part of the Mother Lode. The mine has not been operated since 1903 (Bowen and Crippen, 1949).

Photo 5. Quartz-ankerite-mariposite rock along an abandoned segment of Highway 49, just north of the Mary Harrison Mine, Mariposa County. The mineral mariposite, a chrome-bearing mica, imparts an attractive shade of green to the rock. Such rock has been quarried at a few places in the southern Mother Lode as decorative stone. The cross-cutting white quartz veinlets indicate several episodes of hydrothermal alteration. *Photo by Chris Higgins.* Calif. Geol. 1997:41

Figure 51. Quartz-ankerite-mariposite outcrop, Mary Harrison Mine (1997, CGS)

Immediately north of the ruins of the Mary Harrison, the highway has been cut through the main part of the Mother Lode vein system. This locality is easily accessible and is an excellent place to observe the minerals which are associated with gold ores. Beautifully banded rocks composed of mariposite (chrome mica), white quartz, and carbonate minerals, such as dolomite, ankerite, and calcite, can be collected there. Talc schist is present in some places and is probably derived by the shearing of serpentine. The gold ore itself consists of gold bearing iron pyrites, usually somewhat oxidized (Bowen and Crippen, 1949). This exposure is on an abandoned section of the road near the refuse disposal site.

The geology of the Mary Harrision is similar to the Virginia with the distinction that there is a wider (1/8 mile wide) and longer (1.5 mile) ribbon of Mariposite schist and also dioritic dikes.

26.1Louisa Point Hill on left. The northern extension of the Louisa vein is exposed in this Highway 49 roadcut.

MAXWELL CREEK BRIDGE

26.3 Maxwell Creek Bridge (#20).

From the Highway 49 bridge over Maxwell Creek, 0.2 mile eastward to the private railroad bridge is county property and open for recreational prospecting. South of the old railway bridge is the site of an old cement plant which is now a stockpile for county road base material. The sand and gravel that has been piled here since the 1940's is rich in gold. The owner periodically leases the land to gold mining clubs who conduct sluicing and other gold recovery programs, usually on weekends.

26.3/0.0 (MP 44.62): Coulterville Historical Monument #332. Reset odometer to 0.0.

REGIONAL MAP 02

Coulterville to Fourth Crossing

COULTERVILLE

The town of Coulterville (#21) is situated in a small valley which is at about the same elevation as Bear Valley. Coulterville was founded about 1850 and was the center of a placer and gold quartz mining district which embraced the Malvina, Louisa, Potosi, Champion, and Tyro mines as well as the Mary Harrison. Many fine old buildings still remain including one built and operated by Chinese. An old mine locomotive and other pieces of early day mining equipment are on exhibit directly across the highway from Division of Highways Historical Monument #332 (Bowen and Crippen, 1949).

The town was named for G. W. Coulter who opened a store here in 1849. He later was one of the first commissioners of the Yosemite Valley grant. Congress granted Yosemite Valley to California as a recreational reserve in 1864 (Gudde, 1969). A few stone and adobe buildings built in the 1870's and before are still standing (Landefeld and Snow, 1990). When the U.S. Post Office was first opened, the town names Maxwell and Coulter were nominated and decided by a coin toss (Bill Shiner, personal communication, 1996). The is a museum at the southwest corner of Highways 49 and 132.

The Coulterville town site lies 1/8 mile east of the Melones Fault which, at this point, places Upper Jurassic metasiltstone and metaclaystone to the southwest against metavolcanic rocks of similar age to the northeast.

Mariposite-Carbonate-Quartz Alteration in the Melones Fault Zone

An excellent exposure of the veins of the Mother Lode is found in the 300 feet south of the Coulterville Museum, on the north side of across Highway 132, across from the old railway bridge and south of the Maxwell Creek Bridge (#22).

Figure 52. Coulterville brick and stone building, 2006

Figure 53. Coulterville brick and stone building (1949, CDMG)

Figure 54. Coulterville Bruschi building (1949, CDMG)

Figure 55. Coulterville Bruschi building, 2006

Figure 56. Coulterville Hotel, now a museum (1949, CDMG)

Figure 57. Coulterville Hotel, now a museum, 2006

Figure 58. Coulterville Sun Sun Wo store, 2006

Figure 59. Coulterville Mother Lode Vein (1949, CDMG)

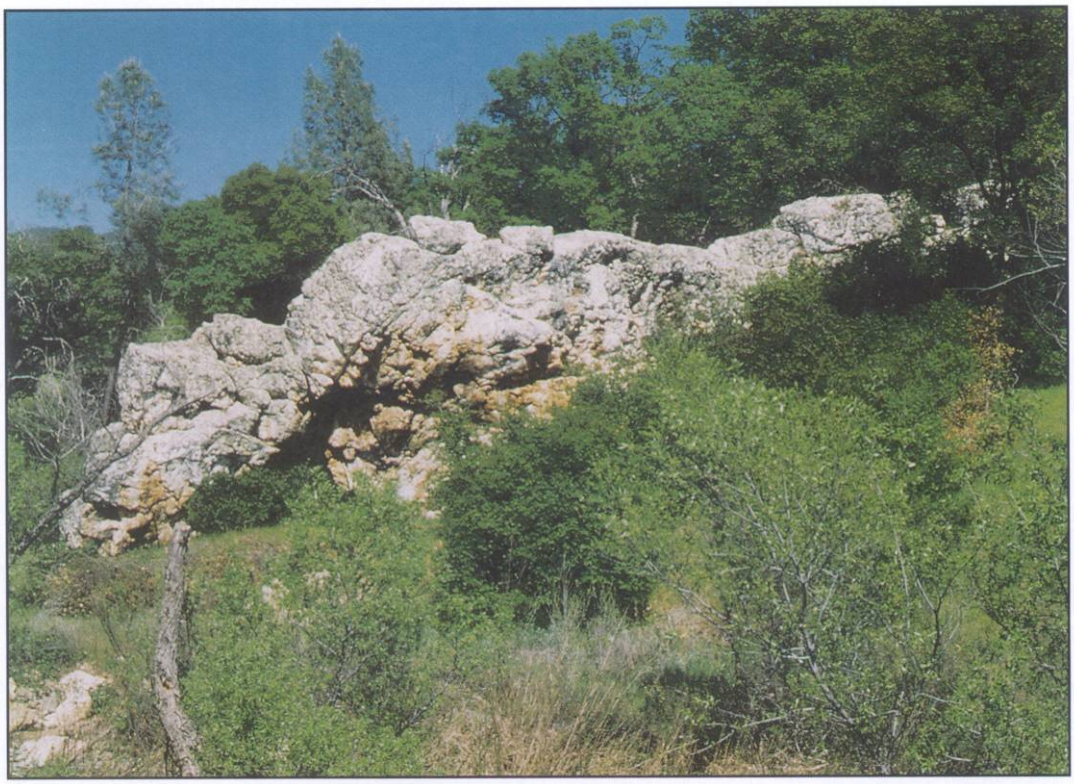


Photo 6. Massive quartz vein of the Mother Lode by Maxwell Creek just south of Coulterville along Highway 132. When viewed on end from the highway, a steep easterly dip of the vein is noticeable. This dip approximates that of the Melones Fault Zone. *Photo by Chris Higgins.*

Calif. Geol. 1997:42

Figure 60. Coulterville Mother Lode Quartz vein (1997, CGS)

Photo 7. Road cut along Highway 132, a few hundred yards southwest of Coulterville and Highway 49. This is probably the premier site along Highway 49 for easily accessible viewing of the massive quartz veins and quartz-ankerite-mariposite rock that mark the main trace of the Mother Lode. The rock is not a single vein, but rather a complex of individual veins that have been emplaced during several episodes of hydrothermal activity along the Melones Fault Zone. Pyrite is visible in places in this rock. *Photo by Chris Higgins.*

Cal. Geol. 1997:42

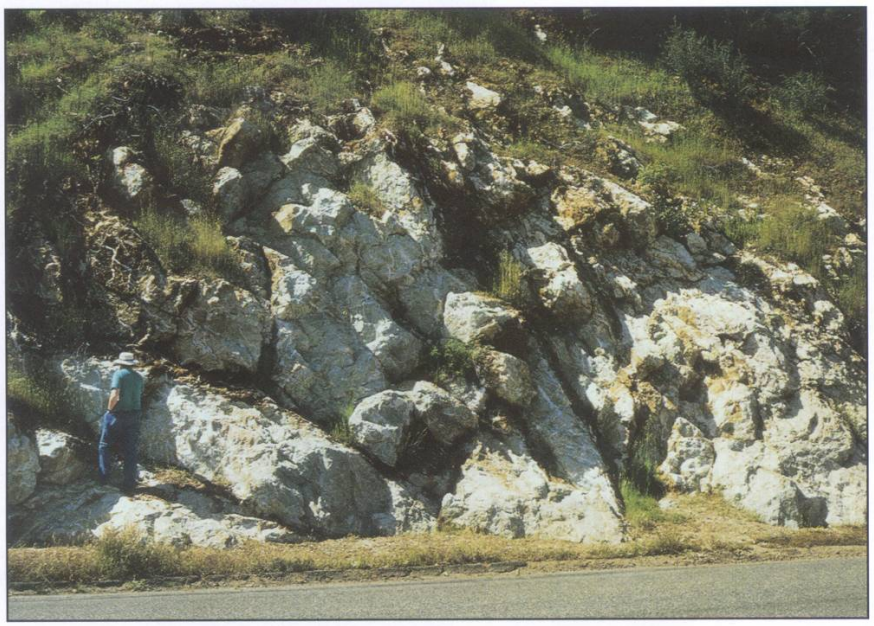


Figure 61. Coulterville Quartz-Mariposite-Ankorite vein (1997, CGS)

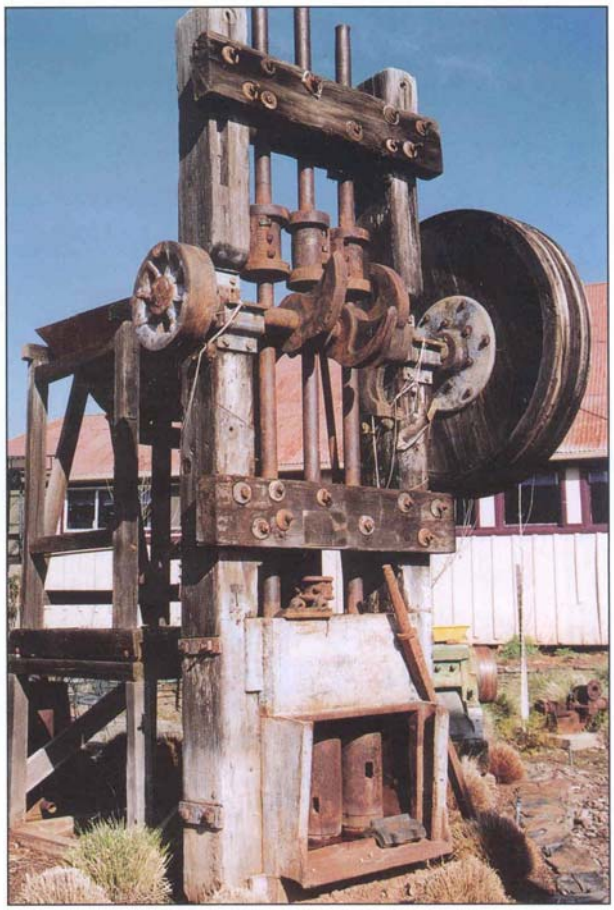


Photo 2. A stamp mill for crushing ore, displayed on Main Street, Coulterville. *Photo by Max Flanery.*

Calif. Geol. 1997:37

Figure 62. Coulterville Stamp Mill

Many invasions of vein material along the same line of weakness can readily be seen in this exposures. The white silica-carbonate vein rocks are accentuated, in many places by rust-colored zones which mark the positions of sulfide-bearing gold horizons. Other yellowish-brown zones are made up of a leached, pulverized vein material which represents intra-mineral or post-mineral movement along the Mother Lode Fault system (Bowen and Crippen, 1949).

This is the best and most accessible exposure of mariposite-carbonate-quartz + pyrite altered serpentinite and pyritic "grey ore" (here, altered mafic dikes) in the Melones Fault Zone (slate and siltstone of the Mariposa Formation), and a series of dikes intruded along the footwall margin are exposed at the west end of the roadcut. White silica-carbonate veins lace rust-colored (weathered) surfaces of carbonate-mariposite-quartz rock. Mariposite is the bright green mineral seen on fresh fracture. The large white Louisa vein crops out on the middle of the alteration zone and in Maxwell Creek south of the road (Landefeld and Snow 1990).

West of the Coulterville, a mariposite outcrop can be seen the Middle Penon Blanco Formation and Diorite-Gabbro of Horseshoe Bend. The middle Penon Blanco Formation contains a poorly sorted, matrix supported volcanic conglomerate with augite-phyric clasts (Landefeld and Snow, 1990).

The diorite gabbro of Horseshoe Bend ("rodingite gabbro" of Evans and Bowen, 1977) was identified as part of a pluton in 1991. This pluton intruded into the beds of the Penon Blanco Formation. An augite-phyric flow breccia is at the "top" of the pluton, and gabbro with local pyroxenite is at the base. This rock type is a common tectonic inclusion in the southern Melones fault zone (Landefeld and Snow, 1990).

GEOLOGIC MAP 6

Coulterville to McAlpine Mine
(Evans and Bowen, 1977; Wagner et al. 1990)
(Bowen, 1969; Bogen, 1983; Logan, 1934)

SIDE TRIP TO LA GRANGE

Thirty miles west of Coulterville on Highway 132, at the western edge of Stanislaus County, is the placer mining district and town of La Grange. Today much of the placer dredging area is a county park.

La Grange

The settlement of La Grange was founded in 1850 by John W. Inman. The stone-and-mortar building erected by Inman still stands. La Grange became a thriving town in 1852 following the flooding of French Bar. That year it had an Oddfellows Hall and a Catholic Church (Saint Louis). These were the second Oddfellows Hall and the first church in Stanislaus county. In 1956 the county seat was moved from Empire City to La Grange. That year also the Masonic Lodge received its charter.

Figure 63. La Grange bucket monument and building, 2002

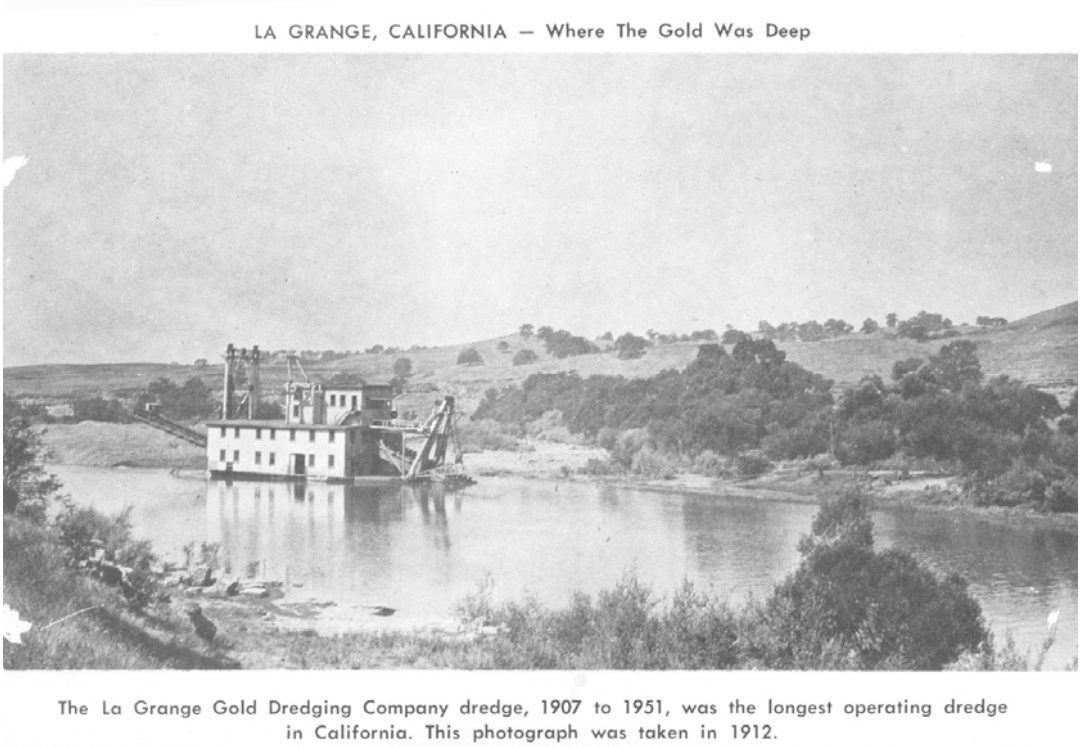


Figure 64. La Grange dredge postcard. From La Grange Musuem collection

Figure 65. La Grange Tuolumne Dredge, 2002 A

Figure 66. La Grange dredge postcard. From La Gange Museum collection

Figure 67. La Grange Tuolumne Dredge 2002 B

The huge Tuolumne Gold Dredging Corporation dredge was a floating factory, operating from 1938 to 1949.

Figure 68. La Grange Tuolulmne drege postcard. From La Grange museum collection

Figure 69. La Grange Tuolumne Dredge, 2002 C

Figure 70. La Grange Tuolumne Dredge, 2002 D

Figure 71. La Grange jail, 1897 postcard. From La Grange museum collection.

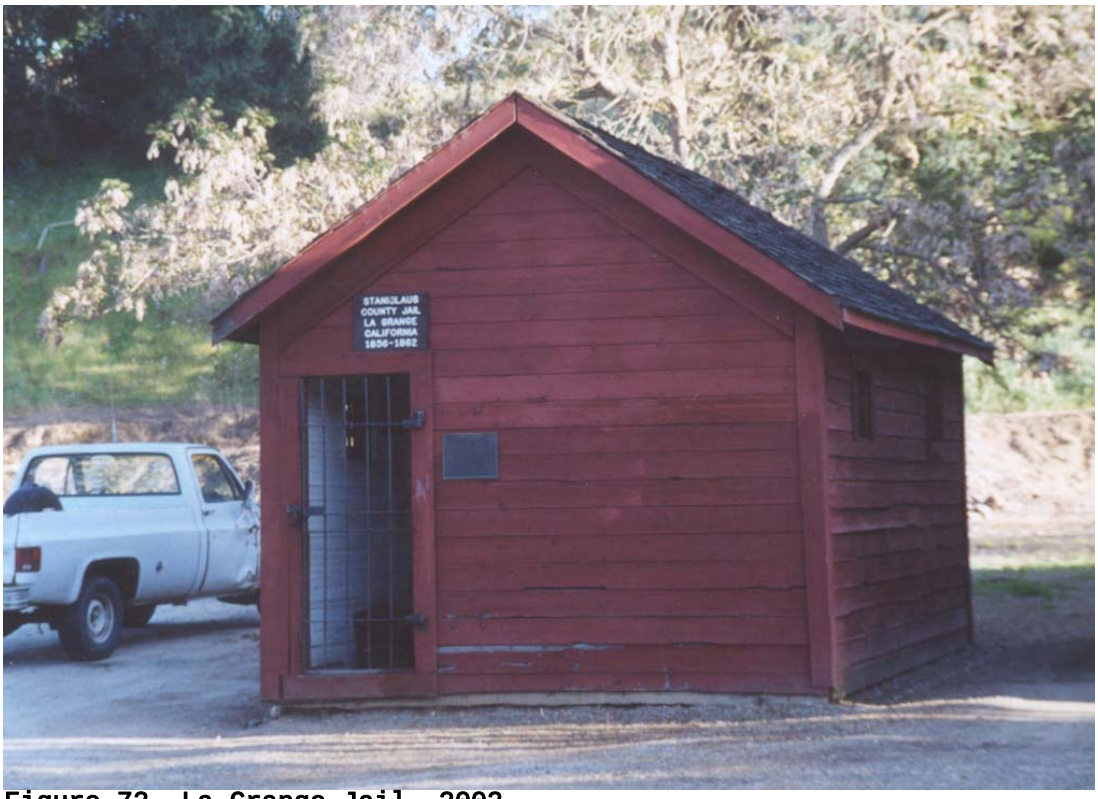


Figure 72. La Grange Jail, 2002

Figure 73. La Grange sandstone building (1949, CDMG)

Figure 74. La Grange Trading Post, 2006

LA GRANGE, CALIFORNIA — Where The Gold Was Deep

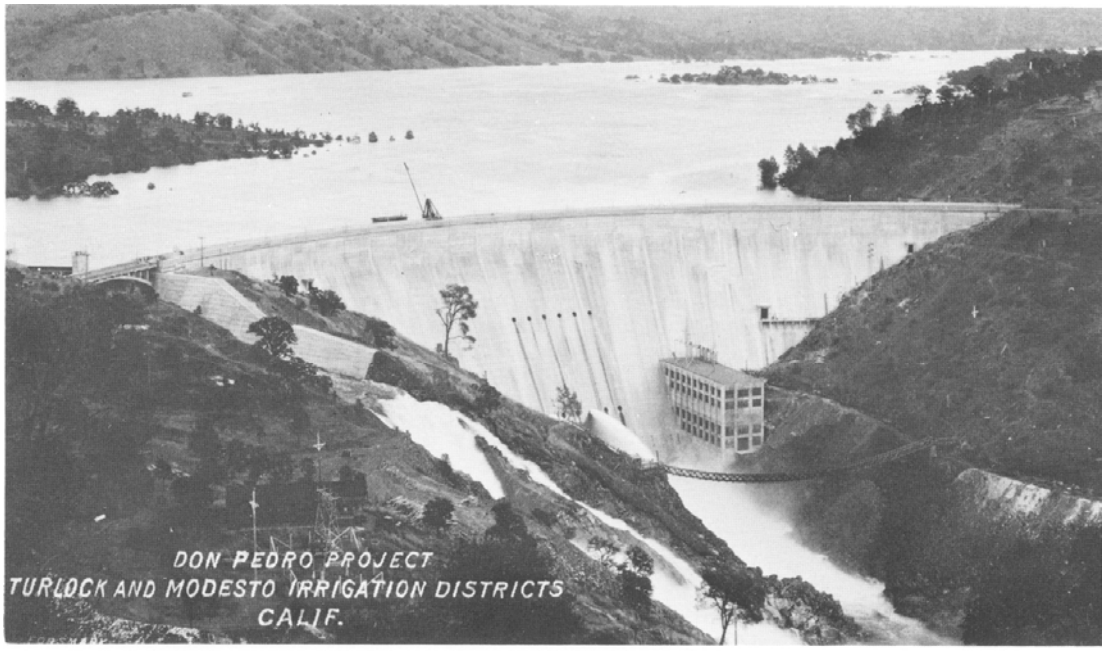
STREET
SCENE
in
La Grange,
Calif.
March 6,
1948

SMP-29

Figure 75. La Grange main street postcard, 1948. From La Grange museum collection.

Hydraulicing in early days near La Grange.

Figure 76. La Grange monitor, c, 1900, postcard. From La Grange Museum collection



Don Pedro Dam was the highest in the world when completed in 1923. Now it is under water, Drowned in a lake created by New Don Pedro Dam.

Figure 77. La Grange, old San Pedro reservoir dam 1923 postcard. From La Grange Museum collection.

THE OLD SCHOOL HOUSE

Figure 78. La Grange Schoolhouse, c. 1900, postcard. From La Grange Muesum collection.

Dredge mining and farming lead to the construction of the La Grange dam and organization of the Turlock and Modesto Irrigation Districts, the first of their type on California.

Much of these early mining ditches are still in use. Stone piles from placer mining operations are still evident, and the remains of the La Grange dredge, which operated into the 1950's, can still be seen west of La Grange road on the southeast shore of Dawson Lake.

COULTERVILLE TO MCALPINE MINE

Between Coulterville and Moccasin Creek Canyon, Highway 49 passes over a rough region of serpentine and greenstone resembling the terrain north of the Merced River Bridge at Bagby. The principle features of scenic and geologic interest along this part of the route are the many white-tipped comb-ridges which mark the surface trace of the Mother Lode quartz veins, here named the Penon Blanco (white cliff). Although the long white walls are hardly tall enough to be considered cliffs, the name has persisted through many years. The weather-resistant quartz has kept the softer country rock, which forms the flanks of the ridges, from being obliterated by erosion. The best views of the Penon Blanco may be seen along the highway about 3 miles (5 km) north of Coulterville, and at the Mariposa-Tuolumne county line.

0.5 Gabbro of Horseshoe Bend in roadcut

0.8 Enter volcanic rocks of the hanging wall of the Melones fault zone.

1.1 California Division of Forestry Fire Station on right.

1.2 Re-enter the Melones fault zone. Quartz vein with altered wall rock on right.

2.6 Quartz vein and alteration halo in Melones fault zone on right. Serpentinite of the fault zone can be seen in road cuts on both sides of highway.

2.8 Serpentine at Penon Blanco Road.

2.9 (MP 47.5) Haigh Road to the right.

3.0 Penon Blanco on the right (East).

A one to five-mile wide zone of metasiltstone, serpentine and dioritic dikes are sandwiched between larger masses of metavolcanic is found on this portion of the Melones Fault Zone. The rock sequence dips 75-85° east (see cross section, below).

3.1 Campground on left with white quartz outcrops of the Mother Lode.

PENON BLANCO POINT

3.3 Penon Blanco Point with Mother Lode Vein exposed on right (east) side of road cuts (#25).

ORO RICO MINE

4.0 The Oro Rico Mine (#26) and Mother Lode vein on right.

The white cockscomb of vein quartz that forms the ridges in an altered serpentinite mélange of the Melones fault zone was called Penon Blanco (white cliff) by the Spanish. The Oro Rico (rich

ore) vein holds up one of these ridges, the highest point of which is called Penon Blanco Point (2,470 feet elevation). Note the Chaparral vegetation on the ridge is underlain by serpentinite and gabbro. A 2,878-foot-high promontory about 1.3 miles west-southwest, called Penon Blanco Peak, is underlain by volcaniclastic rocks of the Penon Blanco Formation, but no Mother Lode-related quartz veins have been found there (Landefeld and Snow, 1990).

The Melones Fault Zone in this area is composed largely of pods of serpentinite-matrix mélange with gabbro and diorite tectonic inclusions up to 10,000 by 2,500 feet, but generally less than 1,000 by 200 feet in size. In this area, Mother Lode veins generally bisect the pods of serpentinite-matrix mélange (Landefeld and Snow, 1990).

GEOLOGIC MAP 7

McAlpine Mine to Moccasin Reservoir
(Evans and Bowens, 1977; Wagner et al. 1990)
(Logan, 1934; Morgan, 1976)

4.3 (MP 48.83) Tuolumne County Line (#27).

The county's name comes from a group of Central Sierra Miwok people who once lived on the Stanislaus River (Gudde, 1969). From the County line to about Mile 4.7, included diorite masses are more common than gabbro in the Melones fault zone, although there are inclusions of gabbro within diorite and serpentinite (Landefeld and Snow, 1990).

PENON BLANCO

4.35 The Penon Blanco

This series of quartz exposures was named the Penon Blanco or white cliff by Spanish Californians. Although the long white walls are hardly tall enough to be considered cliffs, the name has persisted through the years. The weather-resistant quartz has kept the softer country rock, which forms the flanks of the ridges, from being obliterated by erosion. The best views of the Penon Blanco may be had at a sharp bend in the highway 3.2 miles north of Coulterville, and again at the divide which marks the boundary between Mariposa and Tuolumne Counties, about five miles northwest of Coulterville (Bowen and Crippen, 1949).

4.4 Oxidized red gabbro-diorite within a breccia cemented by calcite.

This rock is in a gabbroic tectonic inclusion within the Melones fault zone in the roadcut on right. Irregular patches of hematitic gabbro are a product of oxidation that occurred before regional dynamic metamorphism. The oxidized minerals are the result of seafloor hydrothermal alteration of the gabbro (Landefeld and Snow, 1990).

4.7 Penon Blanco Formation outcrops on right (east).

4.9 McAlpine Mine (#28) and vein. A northern extension of the Oro Rico quartz vein system that forms another "Penon Blanco" ridge in the serpentinite of the Melones fault zone. Evans and Bowen (1977) reported an age of 123 (+/-4) million years on mariposite from here (Landefeld and Snow, 1990).

5.3 Penon Blanco Point on right.

MCALPINE MINE

5.4 Haigh Mariposite Quarry (McAlpine Mine, #28) road on right. This mine is land

administered by the Bureau of Land Management.

Mariposite-carbonate-quartz rock has been mined here and sold as ornamental stone. Kistler and others (1983) calculated ages of 116 (+/-3) and 114.6 (+/-3) million years based on Potassium-Argon and Rubidium-Strontium dating, respectively). These radiometric dates derived from analyses of mariposite from this quarry. They noted that an older age was determined on a mariposite concentrate with less chlorite from a sample collected on the old Harvard dump. Both carbonate minerals and mariposite are deformed at this locality as a result of syn-alteration and post-alteration deformation (unpublished data, Landefeld) (Landefeld and Snow, 1990).

5.7 Tectonic inclusions of albitite and rodingite in serpentinite of the Melones fault zone.

Albitite in and along the Melones Fault Zone generally is found as dike-like bodies and in places as tectonic inclusions in serpentinite mélange. Rodingite in the Melones fault zone generally occurs as tectonic inclusions within serpentinite mélange. Rodingite is named for bodies of rock found in serpentine near the Roding River, South Island, New Zealand (Landefeld and Snow, 1990). It is a calcium-rich metasomatic product of the alteration of gabbro or diorite. Hydrogrossular and diopside are diagnostic minerals of the rodingite in this area. In places, diopside is altered to chlorite. It is not clear whether rodingitization took place during seafloor hydrothermal alteration of gabbro or during synteconic serpentinization as the inclusions were being entrained in the serpentinite mélange (Landefeld and Snow, 1990).

6.2 Mariposa Formation in fault contact with serpentine.

Leave serpentinite of Melones fault zone and enter folded black slate, grey siltstone, sandstone and greywacke of the Mariposa Formation in the footwall of the fault zone. Descend into the strike valley of Moccasin Creek in the Mariposa Formation (Landefeld and Snow, 1990).

MOCCASIN CREEK

6.3 Cross Moccasin Creek (#29)

Two-tenths of a mile below the horseshoe bend where Highway 49 drops to the level of Moccasin Creek, the serpentine bodies end against the Mariposa slate. The latter lies in a deep synclinal trough which is disrupted on both eastern and western sides by faults. The Mother Lode thrust-fault system which lies to the east of the syncline is a broad mineralized zone which in places reaches a width of more than 180 feet. Along the western fault contact, the Penon Blanco or Logtown Ridge andesite agglomerate has been sheared into the Mariposa slate in many places (Bowen and Crippen, 1949).

6.5 Moccasin Creek was so named because miners, probably from Georgia, mistook water snakes for water moccasins found in swamps of the south (Gudde, 1969). This creek has been extensively placer mined. The piles of sorted cobbles and boulders are evidence of the mining (Landefeld and Snow, 1990).

Where Highway 49 drops into the level of Moccasin Creek, the serpentinites end against the Mariposa Formation. Here, the Melones Fault Zone is a broad mineralized zone which in places reaches a width of more than 1,890 feet (576 m). Along the western fault contact, the Penon Blanco Formation has been sheared into the Mariposa Formation in many places (Bowen and Crippen, 1949, modified by CGS 1997).

6.6 Moccasin Creek with several placer workings occur along it.

7.2 (MP2.98) Big Jackass Creek Bridge (#29) with placer workings on both sides.

7.7 Placer workings on left (west).

8.3 Active placer operation on left (west).

8.7 (MP 4.47) Bridge over Moccasin Creek.

The first detailed study of albitite and rodingite associated with serpentinite of the Melones fault zone was done in this area. The workers concluded that in the Melones fault zone albitite bodies are sodium metasomatic products of wall rocks altered during serpentinization, and that the rodingitic gabbro is a calcium metasomatic product of gabbro (Leonardos, 1966; Leonardos and Fyfe, 1967; Landefeld and Snow, 1990).

9.0 Placer workings with large cobbles on right (east).

9.8 Moccasin Creek Power House (#30).

At the Moccasin Creek dam and powerhouse of the city of San Francisco, a road joins Highway 49 which connects with the old placer mining district of Big Oak Flat (Bowen and Crippen, 1949).

Moccasin Powerhouse on the Hetch Hetchy aqueduct of the Hetch Hetchy Water and Power Project was completed in 1925. The project and the town of Moccasin are owned by the city and county of San Francisco. In the "company town", rent was on the order of $25 per month (in 1949) for a house and utilities, and only project workers can live there. The project began in 1915 with the building of the Hetch Hetchy dam on the Tuolumne River north of Yosemite Valley. The reservoir flooded Hetch Hetchy much to John Muir's despair. It took 20 years and $100 million to build seven dams, three powerhouses, and miles of tunnels and power lines. The Hetch Hetchy project has about 2.2 million water customers in the San Francisco Bay area. The Hetch Hetchy Railroad, built in 1916-1917, connected with the Sierra Railway at Hetch Hetchy Junction, 10 miles west of here, and continued up to the dam site, 30 miles east of here. It was used to carry supplies and people to the dam site and stations along the way (Landefeld and Snow, 1990).

10.1 Road to Big Oak Flat (Moccasin Creek Dam) by way of New Priest Grade. Go straight toward Chinese Camp.

10.3 Trout hatchery on right (east).

10.6/0.0 (MP 6.50) Intersection of Highways 49 and 120.

Turn left toward Sonora. Rocks in this area are serpentine mélange. Old Highway 49 followed the east side of the Tuolumne River on what is now Jacksonville Road. This is an alternative route to Jamestown from the Moccasin Reservoir. That route goes through metavolcanics and passes the towns of Stent and Quartz.

The new Highway 49 is on the west side of Don Pedro Reservoir, which inundated the river. Turning right takes you east to the Big Oak Flat mining district. Reset odometer to 0.0. If you don't take the side trip to Groveland (below), turn left and to northwest along the west side of the lake.

GEOLOGIC MAP 7A

Moccasin Reservoir to Groveland
(Morgan, 1976; Wagner et al., 1990; Logan, 1934)
(Evans and Bowens, 1977; Wagner et al. 1990)
(Logan, 1934; Morgan, 1976)

SIDE TRIP TO BIG OAK FLAT

A description of this side trip is made by Clark (1970, p.30). Big Oak Flat can also be reached via Highway 120. The placers of Big Oak Flat together with the adjoining Deer Flat and Groveland district are credited with production in excess of 1,000,000 ounces (about $25,000,000). A few miles northeast of Big Oak Flat in the vicinity of Soulsbyville, several highly productive mines are located in what is known as the East Belt. The East Belt roughly parallels the main Mother Lode about five miles to the east of it. Veins of this belt tend to be discontinuous and much narrower than the main Mother Lode system and cut granodiorite or rocks close to it as well as meta-sediments and meta-volcanics of the Calaveras Complex (Bowen and Crippen, 1949, modified by CGS, 1997).

Big Oak Flat

Figure 79. Big Oak Flat, IOOF Hall (1949, CDMG)

Figure 80. Big Oak Flat, Longfellow Mine Adit, 2002

Figure 81. Big Oak Flat, Longfellow Mine ball mill with 10-stamp mill in background, 2002

Figure 82. Big Oak Flat, Longfellow Mill, 2002

Figure 83. Big Oak Flat, Longfellow Mill, ore lifter, 2002

Figure 84. Big Oak Flat, Longfellow Mill, northwest window, 2002

Figure 85. Big Oak Flat, Longfellow Mill, floatation cells, 2002

Figure 86. Big Oak Flat, Longfellow Mill, 2002 B

The most productive mines in the Soulsbyville vicinity were the Soulsby with a production of 220,000 ounces (approximately $5,500,000), and the Black Oak with a production of 140,000 ounces (approximately $3,500,000) (Bowen and Crippen, 1949, modified by CGS, 1997).

RESUME FIELD LOG ON HIGHWAY 49

GEOLOGIC MAP 8

Moccasin Reservoir to Jamestown

(Morgan, 1976; Wagner et al., 1990; Logan, 1934)

A short distance beyond the intersection of Highways 49 and 120, on the east side of the reservoir, the old route of Highway 49 crosses the Tuolumne River and continued into Jacksonville (now submerged) along the northwest bank of the river. This was a very scenic part of the southern third of Highway 49. There were good picnic spots along the river, several areas suitable for water sports, and the one of the few eating places between Coulterville and Jacksonville (Bowen and Crippen, 1949).

Good exposures of greenstone and schists of the Jurassic metasedimentary sequence can be seen in road cuts at the south abutment of the Old Tuolumne River Bridge (Map 8, Section 20) and westward along the roadbed of the Hetch-Hetchy Valley Railroad to the serpentine contact. Jurassic rocks are also exposed in road cuts along the old route of Highway 49 from the Old Bridge to the Harriman Mine (Bowen and Crippen, 1949).

Serpentinite-hosted mélange of the Melones fault zone is on the side of the hill to the right

(Landefeld and Snow, 1990).

1.5 Deformed pillow lavas are exposed in road cuts northwest of the Highway 120/Highway 49 intersection.

Variably deformed metabasaltic pillow lavas are of mid- greenschist facies in the eastern belt. Pillow lavas close to the Melones fault zone, in the hanging wall, are fattened to 2-4 inches thick and about 3 feet long. They can be seen on nearly horizontal joint faces. Hydrated pillow rims are darker than pillow interiors. These flattened pillow rims have been mistaken for tuffaceous rocks, but they indeed define barely discernable pillow shapes. Farther east, uphill, relatively undeformed pillow lavas are clearly visible (Landefeld and Snow, 1990, Figure 13).

The Hetch Hetchy Railroad followed a grade up the ridge southeast of Moccasin to Priest, Big Oak Flat, Groveland, and the dam site (Landefeld and Snow, 1990).

The Harriman Mine is on the north side of the reservoir from the Highway 49/Highway 120 intersection.

HARRIMAN MINE

The Harriman Mine (#36) is located close to Old Highway 49 (east side of Don Pedro Reservoir), 1.8 miles southeast of the now-submerged town of Jacksonville. In 1949 the headframe, sheet metal buildings, and mine dumps were very conspicuous. Considerable capital was invested in this mine but no great production was ever recorded (Bowen and Crippen, 1949).

The Harriman lies at the eastern side of the Melones Fault Zone in Jurassic metavolcanics. They were formerly mapped as "Calaveras Formation" because of assumed Paleozoic affinity.

Considerable capital was invested in the Harriman Mine, but no great production is was ever recorded. With the exception of the Eagle-Shawmut, few mines in the Jacksonville district contained ore of sufficient grade to warrant major development. The gold values are disseminated through the wall rock in association with pyrite in what is locally called gray ore (Bowen and Crippen, 1949, modified by CSG, 1997).

2.1 Moccasin Point turnoff and Jacksonville Road to Stent.

2.4 Don Pedro reservoir (Lake Don Pedro) on the Tuolumne River on right.

Plant and belemnite(?) fossil fragments, and pyrite nodules, all centimeter-scale, are scattered throughout slate, siltstone, and sandstone of the Mariposa Formation in road cuts on west side of road (Landefeld and Snow, 1990). The lake occupies the Melones Fault Zone and is underlain by Mariposa Formation. East of the lake is Jurassic metavolcanic rocks ("Calaveras Formation") and west of the lake is Penon Blanco Formation.

2.5 Turnoff to Vista Point and Don Pedro Placer Workings.

GEOLOGIC MAP 9

Moffats Bridge to Chinese Camp

(Eric et al., 1955; Morgan, 1976)

(Logan, 1934; Wagner et al, 1990)

3.9 Republican Mine on right, across river.

MOFFATS BRIDGE

4.0 (MP 19.88) Moffats Bridge (#37)

Less than half a mile southwest of Jacksonville (now submerged) and a short distance west of the junction of Woods Creek (now the northern arm of Don Pedro Reservoir) with the Tuolumne River, the abutments of Old Moffats Bridge can be seen jutting out into the Tuolumne River. The vicinity of Moffats Bridge and the adjacent Hetch-Hetchy Valley Railroad cuts present good exposures of the Mariposa Formation in which fossils are found. These occur in a conglomerate and were first described by H. W. Turner in the 1880's. The fossils include cephalopod and pelecypod mollusks of upper Jurassic age which correspond to Oxfordian stage fossils of Europe. Fossil leaves are also present. West from Moffats Bridge, the Tuolumne River has cut directly across a 2,500 foot ridge of agglomerate and serpentine. This represents a vertical down cutting of the edge of the gorge of more than 1,800 feet (Bowen and Crippen, 1949).

4.1 Tuolumne River Bridge over Don Pedro Reservoir.

Don Pedro is the name of placer diggings, now inundated, about 10 miles southwest of here. "Don Pedro" was Pierre Sainsevain who was a pioneer in the area in 1839 and later a member of the California Constitutional Convention. The Tuolumne River followed a strike valley in the Mariposa Formation between Moccasin and this point. To the west, the river has cut across the strike of the bedding of the Penon Blanco Formation and through large serpentinite bodies of the Bear Mountain fault zone (Landefeld and Snow, 1990).

4.5 Vista Point turnout for historical marker for Jacksonville. Historical Landmark 419 is at this turnout.

JACKSONVILLE

The reservoir waters cover the former town of Jacksonville Mining district. The town was founded in 1848. Colonel Aldan Apollo Moore Jackson discovered gold here in 1849; both this town and the town of Jackson in Amador County were named for him. Jacksonville was on the north side of the Tuolumne River where it was joined by Woods Creek. The Hetch Hetchy Railroad was built on the south side of the river, and served the district for a time. It crossed the river about a mile downstream from the town (Landefeld and Snow, 1990). Jacksonville was a supply and amusement center for the mines along Moccasin and Woods creeks.

Mines of the district are localized along veins which occur mostly at the hanging wall contact between serpentinite in the Melones fault zone and metasedimentary and metavolcanic rocks of the eastern belt. The Eagle-Shawmut Mine was the largest producer with production of $7.4 million (approximately 300,000 ounces gold). Rich placer diggings here and at Stephens Bar (southeast of here on the river) and Don Pedro produced about $9 million of gold (approximately 435,000 ounces, Clark, 1970; Landefeld and Snow, 1990).

To the northeast of the Jacksonville historical marker are the Mammoth, Orcut and Republican mines.

5.2 Fossils in roadcut.

This part of the Mariposa Formation contains sparse but easily discernable centimeter-scale fossil fragments of woody plants and belemnites(?). A remarkably well-Preserved cycad frond more than one foot long was collected from the Mariposa Formation in "Hetch-Hetchy Valley, Moccasin Creek" (presumably near Moccasin powerhouse) by Wieland (1929). He described it and compared it to Jurassic *Zamites spp*. It now resides in the Museum of Paleontology collection at

the University of California, Berkeley (Landefeld and Snow, 1990).

The fossil fragments here are mostly in 4 to 12 inch thick sandstone beds which, 1.6 miles to the north, thicken to about 300 feet. These sandstone beds, which are abnormally thick for the Mariposa Formation, overlie a 30 foot-thick, clast supported, epiclastic conglomerate in an upward-, eastward-fining sequence that grades into hemipelagic black argillite. Using Walker's fan model (Walker, 1978), these beds appear to be part of a small channel in a middle to outer fan complex (Landefeld and Snow, 1990).

5.8 Evidence of eluvial gold mining on the left: Note the hummocky ground. Serpentinite underlies the Red Hills in the middle fore ground which are sparsely vegetated with digger pine and magnesium-tolerant herbaceous plants (Landefeld and Snow, 1990).

6.2 Sheared serpentinite-hosted mélange.

Seen on both sides of road, this mélange has numerous tectonic inclusions of diorite (similar to that described in next note), gabbro cumulate plutonic rocks, metavolcanic , and metasedimentary rocks. This serpentinite is in a splay of the Bear Mountain fault zone that strikes S.60o E. and swings almost due east toward the Melones fault zone in the vicinity of the Clio mine in the southern part of the Jacksonville district (Landefeld and Snow, 1990).

Serpentinite has not been traced through the Mariposa Formation but Landefeld has mapped a fault, on strike with the splay through the Mariposa Formation with either a south-side-up or left-lateral offset (Landefeld and Snow, 1990).

7.8 Road to Shawmut Mine. Once accessible on old Highway 49, the Eagle-Shawmut is now reached from the west on this road which connects to new Highway 49.

EAGLE-SHAWMUT MINE

The extensive dumps and large mine buildings of the Eagle-Shawmut mine (Section 11, #38) are located less than two miles northwest of the now inundated town of Jacksonville at the foot of the Shawmut grade. This is one of the many gold mines along the Mother Lode which were forced to shut down because of wartime limitations on gold mining and postwar high operating costs. The Eagle-Shawmut has many miles of workings and has produced huge tonnages of low grade ore. The total vertical depth of the mine via shaft and winze is about 3,550 feet from the surface outcrop. The main shaft dips at an angle which averages 65°E and has been entered for many years from adit number two. Ores in the mine consist of auriferous quartz, gold bearing massive iron sulfides, and gold bearing ankeritized country rock. The mine was opened at a very early date, being a consolidation of the old Eagle and Shawmut claims. However, most of the extensive workings were driven since the turn of the century. The Eagle-Shawmut has a recorded production of approximately 300,000 ounces ($7,500,000). With the exception of the Eagle-Shawmut, few mines in the Jacksonville district contained ore of sufficient grade to warrant major development. The gold values are disseminated through the wall rock in association with pyrite in what is locally called gray ore The Eagle-Shawmut was one of the many major mines along the Mother Lode that was forced to shut down because of World War II limitations on gold mining and post-war high operating costs, and low gold price. (Bowen and Crippen, 1949, modified by CGS staff, 1997).

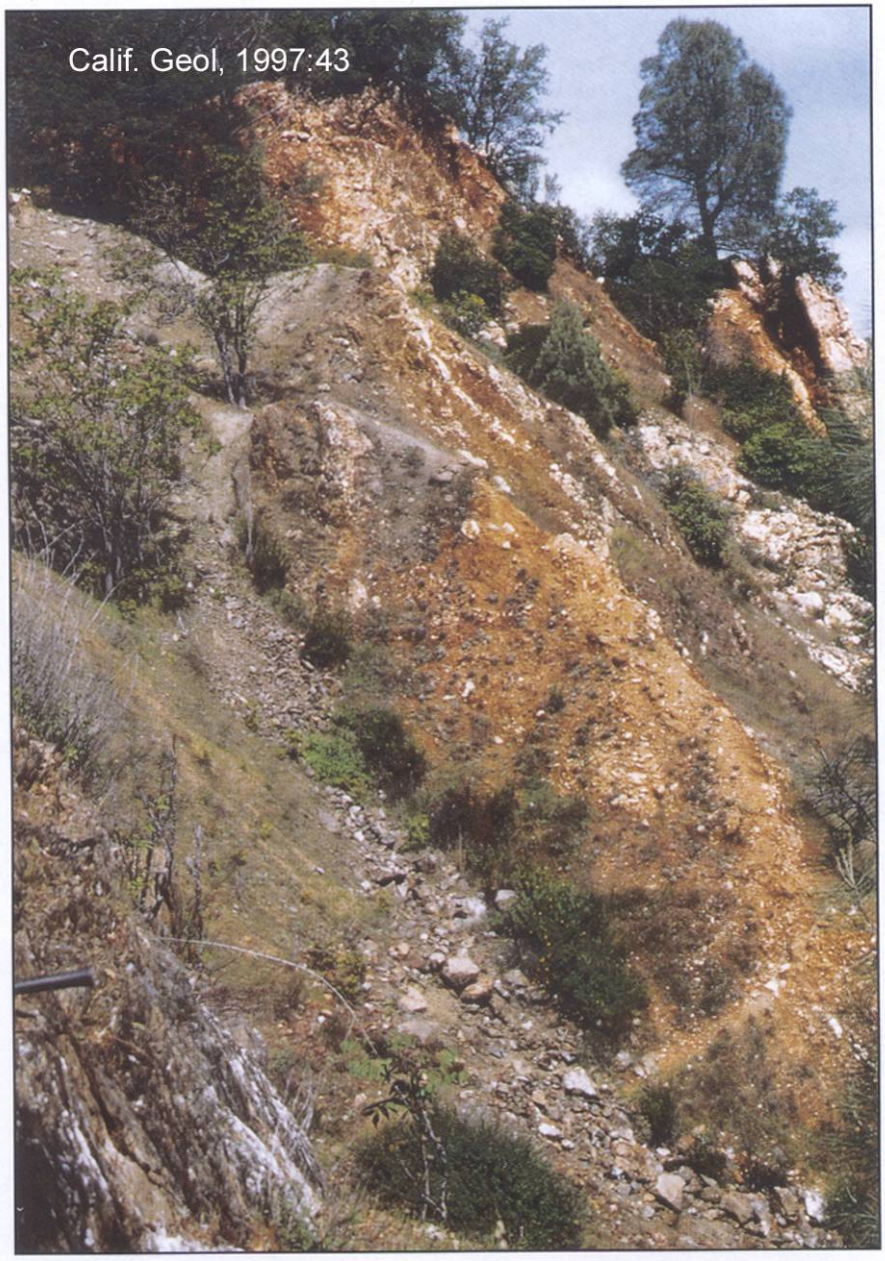


Photo 8. Quartz veins and hydrothermally altered rock of the Mother Lode, exposed at the Eagle-Shawmut Mine, east of Chinese Camp. Eagle-Shawmut, the most productive underground gold mine in Tuolumne County, was typical of many Mother Lode mines in that it produced gold from quartz veins and altered country rock. The mine and mill site can be viewed from the end of Shawmut Road, a remnant of the old Highway 49 right-of-way that now ends at Don Pedro Reservoir. *Photo by Chris Higgins.*

Figure 87. Quartz vein at Eagle-Shawmut Mine (1997, CGS)

The geology at the Eagle-Shawmut is similar to that of the Harriman Mine. It is at the eastern edge of the Melones Fault Zone with Jurassic metavolcanic rocks to the east and Mariposa Formation to the west.

5.1 Road cut in Mariposa Formation.

5.9 Placer tailings on left (south).

7.6 Shaw Mountain Road.

CHINESE CAMP

8.0 (MP 16.4) Enter Chinese Camp (#39).

8.1 Chinese Camp Historical Marker: Tuolumne County Visitor's Bureau.

After passing the Eagle-Shawmut Mine, Highway 49 winds up the narrow Shawmut grade to Chinese Camp. The summit of the grade affords an excellent northwesterly view of the flat surface of the Table Mountain lava flow. The road-cuts along the Shawmut grade expose Mariposa slates and green Logtown Ridge agglomerates. After passing the divide, the highway crosses gently rolling country in which there are few exposures of basement rocks (Bowen and Crippen, 1949).

Figure 88. Chinese Camp Post Office (1949, CDMG)

Figure 89. Chinese Camp Store (1949, CDMG)

Chinese Camp was a placer-mining center first settled by Chinese laborers in 1849. Ruins of structures built in the 1850's still remain together with a few more modern dwellings. Piles of soil and gravel which were turned over in frantic search for gold can still be seen in every gulch. These gravels are reworked remnants of pre-existing Eocene and later Tertiary deposits most of which have since been stripped off by erosion (Bowen and Crippen, 1949).

THE RED HILLS OF TUOLUMNE COUNTY

Allen Franklin

INTRODUCTION

The Red Hills Management Area (#40) consists of 7,100 acres (slightly more than 11 square miles) of public land located near the intersection of State Highways 49 and 120, just south of the historic town of Chinese Camp in Tuolumne County.

The Red Hills came into Federal ownership along with most of California with the signing of the Treaty of Guadalupe Hidalgo in 1848 to officially end the war with Mexico. They are still in

Federal ownership simply because no one wanted the land in the days when it was Government policy to dispose of the public domain. There was little or no gold associated with the serpentine rocks, and crops wouldn't grow properly in the serpentine-derived soil.

A county-maintained road, dating back to 1849, runs through the heart of the Red Hills.

In recent times the Red Hills have mostly been used for recreation. The main recreation uses have been target shooting, off-road vehicle driving, camping, hunting, hiking, horseback riding, nature study, wildflower viewing, and hobby prospecting. To protect the fragile biological resources of the area, in 1991 target shooting and off-road vehicle use were prohibited on public land in the Red Hills.

TOPOGRAPHY AND CLIMATE

Elevations within the Red Hills vary between 750 and 1,750 feet above sea level. Slopes of the hills themselves vary from about 30% to 75%.

Average rainfall for the area is roughly between 25 and 30 inches per year. Occasionally, there is a light snowfall. Typical of California, most precipitation occurs between November and April. During the winter, temperatures can range between 14 degrees F. to 82 degrees F. with an average of 47 degrees F. Summertime temperatures range between 35 and 109 degrees F., with an average of 74 degrees F.

GEOLOGY

The Red Hills Management Area is located within the western tectonic block of the Sierra Nevada metamorphic belt. Within this block are Upper Jurassic volcanic and sedimentary rocks of island arc derivation which were highly deformed and weakly metamorphosed during the Nevada orogeny. These rocks were then intruded by plutons associated with the emplacement of the Sierra Nevada batholith, east of the metamorphic belt.

The Management Area includes much of the Tuolumne ultramafic complex, one of the largest exposures of serpentine rocks in the Sierra Nevada metamorphic belt. Nearly the entire area is underlain by dunite, a variety of peridotite consisting of dark green olivine and minor chromite, which as been partly or entirely serpentinized to antigorite magnesite-magnetite. The dunite intruded into andesite pillow breccias and flows of the Peñon Blanco volcanic formation, which crops out near the northeast and southern boundaries of the Management Area. The intrusion of ultramafic material occurred along crustal weaknesses associated with the Bear Mountain fault, a northwestward trending thrust fault that dips steeply to the northeast, and has over 10,000 feet of vertical displacement. The fault zone is on the southwestern boundary of the Management Area, and is believed to have once penetrated the earth's crust down to the mantle, a probable source of the peridotite.

Other geologic features of the area include northeastward trending dikes that consists of massive, dark brown, hornblende-plagioclase diorite which intruded into the dunite bedrock. A swarm of several dikes occurs in the southeast portion of the Management Area. Some of the dikes exceed one mile in length. Amphibolite and chert tectonic blocks also occur in the dunite near the area's southern and western boundaries.

Tertiary and Pleistocene alluvium consisting of sand, gravel, pebbles, and cobbles has accumulated in Six Bit and Poor Man's Gulches in the northern and eastern portions of the Management Area.

MINERALS

Although the potential for the development of mineral resources in the Red Hills is limited, deposits of chromite and magnesite occur in serpentine rocks. Placer gold occurs in stream channel deposits within the natural area, primarily Six Bit Gulch and Poor Man's Gulch, mostly washed in from the north.

From the 1860s to the 1940s, roughly 10,000 tons of chromite ore and several hundred tons of crude magnesite ore were mined. Most of the chromite came from the McCormick Mine, located northwest of the Management Area. All of the magnesite production in Tuolumne County occurred in the 1920s and came from two sites in the northern portion of the Red Hills. Currently, there is no market for crude magnesite in the United States.

The placer gold produced from this district was recovered by ground sluicing and hydraulic mining in earlier years, and by dragline dredging in the 1930s and 1940s. In the 1850s, during the great California Gold Rush, Chinese laborers, with their legendary patience and thoroughness, mined much of the placer gold within Six Bit Gulch, a major drainage channel that courses through the natural area. The dredging of Six Bit Gulch and Poor Man's Gulch produced over $100,000 worth of gold, but the mining operations were reportedly not profitable. Because lode gold is not usually associated with serpentine bedrock, the intermittent streams which originate within the Red Hills contain little, if any, placer gold.

SOIL AND VEGITATION

The major soil type is the Delpiedra Series. Henneke and Fancher soils, also derived from serpentine parent material, are also present.

The Red Hills are vegetated mostly by a foothill pine-buckbrush chaparral/woodland. Virtually the only tree species in the Red Hills is foothill pine (Pinus sabiniana), which is found throughout the Red Hills in low densities. Buckbrush (Ceanothus cuneatus) comprises a majority of the shrub cover. Other shrubs include Toyon (Heteromeles arbutifolia), coffee berry (Rhamnus californica tomentella), chamise (Adenostoma fasciculatum), hollyleaf redberry (Rhamnus crocea ilicifolia), California yerba santa (Eriodictyon californicum) and manzanitas (Arctostaphylos spp.).

Native perennials constitute a large percentage of the grass cover in the Red Hills. This is in contrast to similar elevations in the foothills, without serpentine substrates, where native perennials have been mostly replaced by exotic annuals. Important native perennial species include California oniongrass (Melica californica), big squirreltail (Sitanion jubatum) and pine bluegrass (Poa secunda). Disturbed areas, including burned areas, have a typical array of Mediterranean annual grasses.

Herbaceous plants provide a spectacular wildflower bloom in the spring that attracts tourists, amateur naturalists, and classes from educational institutions. Although most of the species comprising the display are widespread on and off serpentine, some (in addition to the rare species discussed below) are strict serpentine endemics (e.g., Streptanthus polygaloides).

Sensitive plants: Five plants which occur on the public lands of the Red Hills are considered sensitive species by BLM due to their rarity. Three of the plants have been proposed for listing under the Endangered Species Act indicating that the U.S. Fish and Wildlife Service feels it has accumulated sufficient evidence to list these species. These plants are the California verbena (Verbena californica), Rawhide Hill onion (Allium tuolumnense) and Layne's butterweed (Senecio layneae).

California verbena is a Red Hills endemic, meaning it is found nowhere else in the world. Its distribution in the Red Hills is confined to the short stream reaches that remain moist year round

because of ground water seepage.

The Rawhide Hill onion has many, mostly small, colonies in the Red Hills. Rawhide Hill onion is confined to areas with sparse vegetation, south facing slopes with shallow soils, and intermittent drainages.

Senecio layneae, the other species proposed for federal listing, has only a few very small occurrences in the Red Hills. Here as elsewhere, it is often associated with disturbances like road cuts. Senecio layneae is also found in El Dorado County on serpentine and gabbro.

Two plants that had been designated as federal candidate category 2 species were eliminated from the list of candidate species when the U.S. Fish and Wildlife Service changed its rules for the inclusion of species as candidates in 1996. Congdon's lomatium (Lomatium congdonii) and the Red Hills soaproot (Chlorogalum grandiflorum) are locally common throughout the Red Hills favoring north slopes and ridgetops respectively. Congdon's lomatium is only known from the Red Hills and the Peoria Valley area. Red Hills soaproot is also found in El Dorado County on serpentine and gabbro.

An additional species proposed for federal listing occurs on private lands just west of Chinese Camp and within a mile of the public land. Chinese Camp brodiaea (Brodiaea pallida) grows near a low gradient drainage in soils that remain wet late into the growing season. This species has not been located on the public lands of the Red Hills.

Another plant, Hoover's butterweed (Senecio clevelandii var. heterophyllus) has been included on the California Native Plant Society's Watch List. It grows with the California verbena in riparian zones. It may be recognized as a separate taxon that is endemic to the Red Hills, or it may be included as a single taxon with plants found in the Coast Ranges.

WILDLIFE

In the Red Hills buckbrush and other shrubs provide browse and seeds for small populations of mammals, including mule deer, jackrabbits, rodents. Coyotes, bobcats and fox can also be found in the Red Hills.

88 bird species have been observed in the Red Hills. Some common species include mourning dove, acorn woodpecker, ash-throated flycatcher, scrub jay, wrentit, plain titmouse, bushtit, Bewick's wren, and house finch. Valley quail and mourning doves are the major game birds in the Red Hills. An abundant insect population supports insectivorous birds including western kingbirds, ash-throated flycatcher, tree swallows, barn swallows, black phoebes, and others. Raptors include the red-tailed hawk, Cooper's hawk, prairie falcon, and great horned owl. Fish-eating birds seen in the Red Hills include the belted kingfisher and great blue heron. Roadrunners can also be found.

Reptiles and amphibians are rarely observed in the Red Hills but interestingly two rare species are represented (see below).

Fish in the Red Hills, found in Six Bit Gulch and Poor Man's Creek, include the green sunfish, large-mouth bass, Sacramento sucker, and the mosquito fish. These fish are predators or competitors with the Red Hills roach, a rare taxon (discussed below). The presence of these mostly introduced species may limit the roach population.

Rare fauna: Four sensitive species of animals are known from the Red Hills. Wintering bald eagles roost along the shores of Don Pedro Reservoir and have been observed where Six Bit Gulch enters the lake. As many as 20 bald eagles have been sighted during the winter on the shores of Don Pedro Reservoir, roosting in stands of foothill pines.

Although the Red Hills has no perennial streams, it has a number of intermittent streams that have spring fed reaches and pools. Two sensitive riparian animal species are associated with these areas, Hesperoleucus symmetricus (California roach, a minnow; the distinctive Red Hills population has been called the Red Hills roach) and Rana boylii (foothill yellow legged frog).

The Red Hills roach is found in abundance in several pools of permanent water located along the intermittent streams which drain into Six Bit Gulch and Poor Man,s Gulch. It is thought that the permanent pools are spring-fed. During the dry part of the year the fish are confined to these permanent pools surviving in warm shallow water until spring when they move upstream to spawn. A recent study by ichthyologists at the University of California, Davis, and the California Department of Fish and Game has indicated that the Red Hills variety of California roach has unique morphologic characteristics, which make them noticeably different from other roach populations, notably a chisel lip. The chisel lip is used to scrape algae, a major food source, off submerged rocks.

Up until 1996 the U.S. Fish and Wildlife Service had recognized the Red Hills roach as a candidate (category 2, now eliminated) for listing under the Endangered Species Act. The isolated nature of the population of the Red Hills roach due in part to past and continuing habitat degradation has led some researchers to be concerned about the roach's long-term survival. The presence of a number of introduced fish species such as green sunfish, large mouth bass and mosquito fish may limit the roach population by predation and/or competition.

The foothill yellow-legged frog has been found in the western portion of the Red Hills in the Andrews Creek drainage. The western pond turtle has been found in the eastern portion of the Red Hills in Poor Man's Gulch. Both are rare species, formerly candidates for federal listing.

CULTURAL RESOURCES

Compared to surrounding areas, the Red Hills Management Area has fewer cultural resources.

Prior to the Gold Rush of 1849, the Management Area was probably lightly populated by the Central Sierran Miwok people. There are several grinding rocks near one of the intermittent streams, but no occupation sites have been found. This is in contrast to nearby areas where several occupation sites have been recorded. The Red Hills were probably not heavily used by the Miwok people because of the scarcity of game and the lack of acorns. It is possible that the Miwok people may have utilized the riparian areas along Six Bit Gulch, however, any trace of that use was likely wiped out years ago by placer mining activities, as were so many other sites in the Mother Lode region.

Some evidence of Chinese habitation has been found at a few scattered sites. The first Chinese miners arrived in the vicinity during 1849. Most of their activity was centered around the town of Chinese Camp to the immediate north of the Red Hills. A large fight between two feuding Chinese factions--a Tong War--occurred in 1856, supposedly just to the south of the Red Hills in the vicinity of the historic Crimea House.

Red Hills Road, which bisects the study area, dates back to 1849 when it was a major route between Central Valley locations and the southern mining camps. The Crimea House, an inn which was located just to the south of the public land, provided lodging and food to early travelers. The Crimea House itself was destroyed in a fire in 1949. The site is marked by a plaque erected by the Fraternal Order of E Clampus Vitus.

An abandoned railroad grade is located in the northwestern portion of the Red Hills. It was part of the old Sierra Railroad, constructed during the 1890s, to carry freight between the main railroad lines in the central valley and the mining communities of the Mother Lode region.

AREA OF CRITICAL ENVIRONMENTAL CONCERN

The entire Red Hills Management Area has been designated as an ACEC. The purpose of the designation is to protect the rare plant species found there, the unusual serpentine soils that provide habitat for unique flora of the area, habitat for the rare minnow known as the Red Hills roach and to protect bald eagle wintering habitat.

GEOLOGIC MAP 10

Chinese Camp to Ohio Diggins

(Eric et al., 1955; Wagner et al, 1990; Logan, 1934)

The highway, from Mountain Springs and on into Jamestown, more or less parallels the trend of Table Mountain. Bedrock exposures are poor because of the low relief, there being few good outcrops until Woods Crossing is reached. The Mariposa slates appear briefly from beneath the Tertiary gravel and andesite series, and then are faulted off against a thin belt of Logtown Ridge metavolcanics. This contact is close to the junction of the Montezuma cutoff and Highway 49 about 2.5 miles northeast of Mountain Springs. From that point to Woods Crossing the basement rocks are principally serpentine and related gabbro-diorite (Bowen and Crippen, 1949).

Two tenths of a mile north of Chinese Camp (#39) rounded exposures and boulders of metadiorite of Chinese Camp are on the right. The diorite is similar in composition and origin to the Horseshoe Bend pluton. This diorite intrudes flows and flow breccias in the Penon Blanco Formation (Morgan, 1976) and is probably a subvolcanic pluton. It is a heterogeneously textured pyroxene-hornblende diorite; plagioclase is mostly altered to epidote, white mica + carbonate minerals; primary mafic minerals are partly altered to amphibole, chlorite, and serpentine. Ages of 190-198 million years have been reported from samples of this diorite collected near Chinese Camp (Moran, 1976; Stern et. al, 1981; Saleeby, 1982; Landefeld and Snow, 1990).

8.4 Intersection of Highways 120 and 49, keep right, go northeast toward Sonora. Reset to 0.0. In the 1949 guide by Bowen and Crippen, Highway 49 went east to old Highway 106, then north to Jamestown and entered the town through Woods Crossing.

The geology between Chinese Camp and Sonora is very complicated with numerous fault-bounded blocks of Jurassic metasediments and metavolcanics, ultrabasic rocks and gabbros. Within the triangle defined by highways 49, 108 and 120 is Eocene "auriferous" gravels overlain by Mehrten Formation volcanics (andesitic mudflow and breccia of Miocene age). Within the Mehrten is the Table Mountain Latite, a distinctive flow unit, often with columnar jointing.

9.2 View of Table Mountain at 12:00 o'clock position.

TUOLUMNE TABLE MOUNTAIN

The prominent flat surface of Tuolumne County's Table Mountain (other counties have their own "Table Mountains") lies 2.5 miles (4.0 km) northwest of Chinese Camp. Though appearing as a table when viewed from the road, it looks more like a sinuous river when seen from the air; and that is what it is -- a fossil river -- an ancient stream canyon cut in a broad flat sheet of volcanic ash but filled to the brim by a viscous flow of dark colored lava extending for 60 miles from the high Sierra Nevada to its terminus against a bluff of sedimentary andesitic beds near Knights Ferry. As the Sierra Nevada mass was raised and tilted slightly westward, the softer ash beds were largely washed away by erosion, leaving the very resistant lava flow high and dry as a dominating table. In places the stream which originally cut the channel later occupied by the lava, cut clear through the ash beds and even into the tops of some underlying buried hill tops of bed rock. In other places, where the ash beds lay deep beneath the lava flow, the pre-volcanic stream courses were occupied by river gravels containing gold placer deposits. An example is the old

New York tunnel. The younger channel, (above the Mehrten volcanic mudflows) of Table Mountain was largely barren of gold.

The resistant latite lava flow of Table Mountain, which has been dated at approximately 9 million years, has thus protected some of the earlier softer Tertiary deposits from obliteration by erosion. The latite lava capping is flat-topped, with vertical cliffs along the edge, showing columnar joining of the rock. Andesitic tuffs and mudflows are exposed under or close to the base of the cliffs. The latite closely resembles a porphyritic olivine basalt, the potash feldspars being entirely confined to the groundmass. Some plagioclase crystals, however, are more than an inch (2.5 cm) long.

Andesitic tuffs and mudflows of the Mehrten Formation lie directly above Eocene gravels and boulders at Mountain Pass. Here the ancient stream channel, now occupied by the lava, cut a V-shaped gorge in the andesite cobble deposit. Some of the younger quartz gravels are intermixed with the andesite. These represent post-Eocene channels that cut through earlier Eocene deposits and robbed them of their gravels and also their gold. At this point is a watering place known as Mountain Springs, located less than a mile from the junction of Highways 49 and 108 or 4.5 miles from Chinese Camp. An area suitable for picnicking adjoins the spring and water fountain. The water flows from the ancient ash-covered bed of the Tertiary channel (Bowen and Crippen, 1949, modified by CGS, 1997).

9.9 Sims Road on the left.

10.1 Cross the Sierra Railway-much used in western movies.

Flat-topped Table Mountain (#42) can be seen dead ahead on skyline. Tuolumne Table Mountain is a classic example of inverted topography. The latite of Table Mountain flowed down the Miocene channel of the Stanislaus River which was carved in bedrock, prevolcanic gravels, and Tertiary pyroclastic rocks. The flows erupted from a vent near what is now a cluster of jagged volcanic peaks --the Dardanelles--, 50 miles east of here in the High Sierra. Their western terminus is near Knights Ferry, 12 miles due west of here. The 9 million year old lavas are part of the Late Miocene-Late Pliocene Mehrten Formation (Dalrymple, 1964). Subsequent erosion removed the less resistant rock of the former river bank, but preserved it in places beneath the latite. The gravels have been mined from drifts beneath the Table Mountain latite (Landefeld and Snow, 1990).

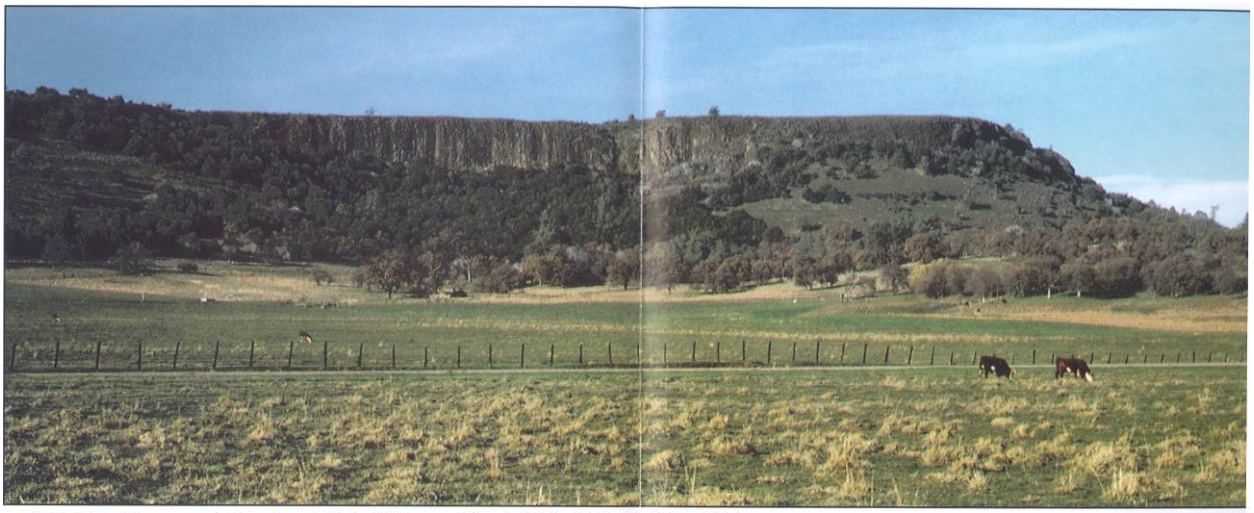


Table Mountain , near the junction of State Highways 49 and 198.Calif. Geol., 1997:84-85

Figure 90. Table Top Mountain, near Jamestown, (1997, CGS)

MONTEZUMA

11.0 Montezuma (Ghost) Town site (#41). The old water tower is all that remains of this placer mining center.

11.4 Montezuma Town site historical marker. About 3 miles (5 km) northwest of Chinese Camp, Highway 49 passes the historical monument commemorating the Gold Rush town of Montezuma

11.2 Placer gold mining pits and tailing on right (east).

12.0/0.0 (MP 12.28) Intersection Highway 49 and 108.

There is a commemorative sign here. Table Mountain Latite lava flow can be seen on hill north of intersection. Turn right (east) toward Sonora. Reset odometer. This area is underlain by serpentine and related gabbro-diorite. Surface exposures are poor because of the low relief.

INVERTED TOPOGRAPY

1. Paleozoic-Mesozoic Rocks formed, uplifted and eroded.

2. Gold-bearing gravels form in stream valley

3. Extrusion of volcanic lava flows cover gravels and older metamorphic rocks.

4. Uplift and differential erosion result in topographically high lava-capped ridges of land that used to be river valleys.

MOUNTAIN PASS AND YOSEMITE JUNCTION

The bouldery andesite below the Table Mountain Latite is known as the Mehrten Formation and is well exposed on the road southeast of Mountain Pass. It lies stratigraphically above the Eocene quartz gravels which are present lying on bedrock. Some of the earlier quartz gravels, however, a mile northeast of Mountain Pass, occur intermixed with the andesite cobble. These gravel deposits represent post-Oligocene channels which cut through the earlier Oligocene deposits and robbed them of their gravels and also their gold.

The earliest gold-bearing stream channels, Oligocene in age, often followed the strike of bedrock, cutting channels and depositing gold nuggets. The Eocene gold-bearing stream channels often also followed the strike of bedrock, but the andesite was spread far and wide, covering the bedrock Eocene channels. The much later latite lava flow took the course of a prominent post-andesite stream gorge and filled it to the brim. Where drift mining discovered the deep Eocene quartz gravel channels, rich placers were found. However, where the mines encountered post-Eocene channels cut only through barren volcanic ash, disappointment was the result. For this reason, only a few of the drift mines that pass under Table Mountain were successful; many others were not (Bowen and Crippen, 1949, modified by CGS, 1997).

GEOLOGIC MAP 11

Ohio Diggins to Jamestown

(Wagner et al., 1990; Eric et al., 1955)

(Taliaferro et al., 1930; Logan, 1934)

REGIONAL MAP 03

Jamestown to Mokelulmne Hill
With Copperopolis, Camp Nine Quarry and Murphys

JAMESTOWN MINE

1.4/0.0 Sonora Mining Company's Jamestown Mine

This recently rejuvenated operation is a low grade gold project (#43). The gold is recovered by gravity separation and floatation. Concentrates are shipped to a smelter for refining. The original Harvard Mine (see discussion below) worked a series of rich gold-quartz veins. The open pit mine worked the low-grade alteration halo surrounding these mined-out veins. The pit had stability problems, and a large landslide lead to premature closure of the mine. Reclamation is continuing.

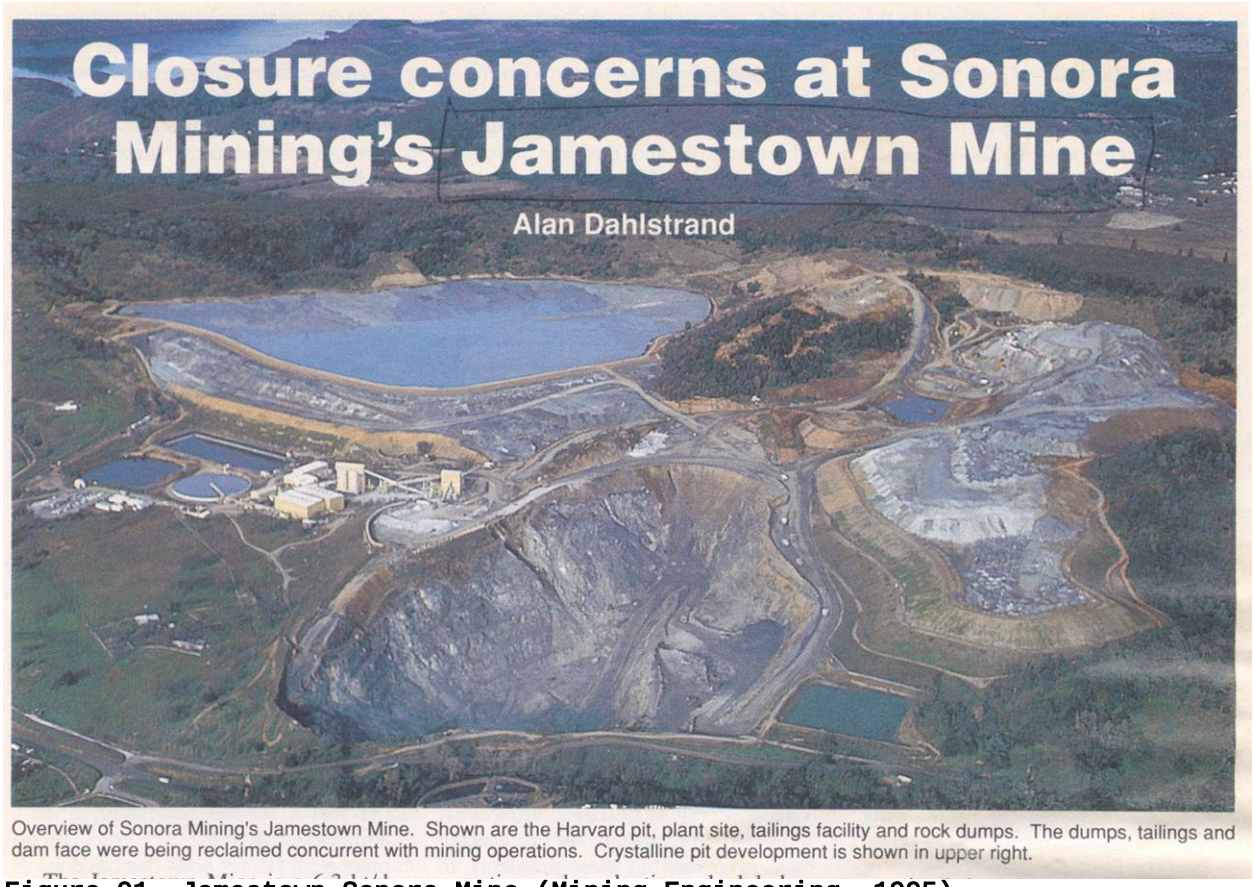


Figure 91. Jamestown Sonora Mine (Mining Engineering, 1995)

0.1 Harvard Mine Rd. Jamestown (Harvard) Mine on slope of Whiskey Hill.

1.9 (MP 13.53) WOODS CROSSING NEAR HARVARD MINE ROAD

Woods Crossing (#45), now a cross roads rather than a ford, and the site point where old Highway 49 came into Jackson, has several interesting features. It is marked by a sign commemorating the passage of Bret Harte and Mark Twain through the gold country which was placed there by the Tuolumne County Chamber of Commerce in honor of two authors who did

much to bring the color of the "Days of 49" to the public. When the new alignment of Highway 49 was made, the historical marker was moved to the southeast corner of the intersection of Harvard Mine Road and new Highway 49.

HARVARD MINE

2.0 Harvard mine mill.

A short distance to the northwest of the Woods Crossing historical monument are the foundations of the Harvard Mine stamp mill (#44) on the slope of Whiskey Hill. This mine was discovered in 1850 and was worked continuously until 1916 on the now-removed Whiskey Hill. The prominent quartz-ankerite outcrops close to which the ore lay also outcrop conspicuously in the long roadcut between Woods Crossing and Woods Creek. The multiple nature of the vein system can readily be seen there and some minerals, such as the attractive mica mariposite, can be obtained. The veins lie along the contact of Jurassic metasedimentary schist and the serpentine body mentioned in preceding paragraphs. The Harvard had two shafts but only one was used to any great extent. The main shaft has a 700 foot (213 m) vertically and then continued 1,150 feet (350 m) at an angle of 58° to a depth of 1850 feet (457 m). The veins have been worked for 1500 (457 m) feet along the strike of the Mother Lode. Post-mineral faulting has displaced the ore shoots from 8 to 20 feet (2.4-6.1 m) in some places. A 60 stamp mill employing 1200 (544 kg)pound stamps in on the property. some recent development work has been done, but no attempt at major production has taken place in recent years. The Harvard has a pre-1948 production of 81,500 oz ($2,036,697) but no records were kept prior to 1897, and a much larger figure is probable (Bowen and Crippen, 1949). A rejuvenation of the Harvard Mine by open pit-floatation milling and followed by shipping and roasting of concentrates in Nevada was discontinued in 1993.

Figure 92. Downtown Jimtown, post card (1998, CGS)

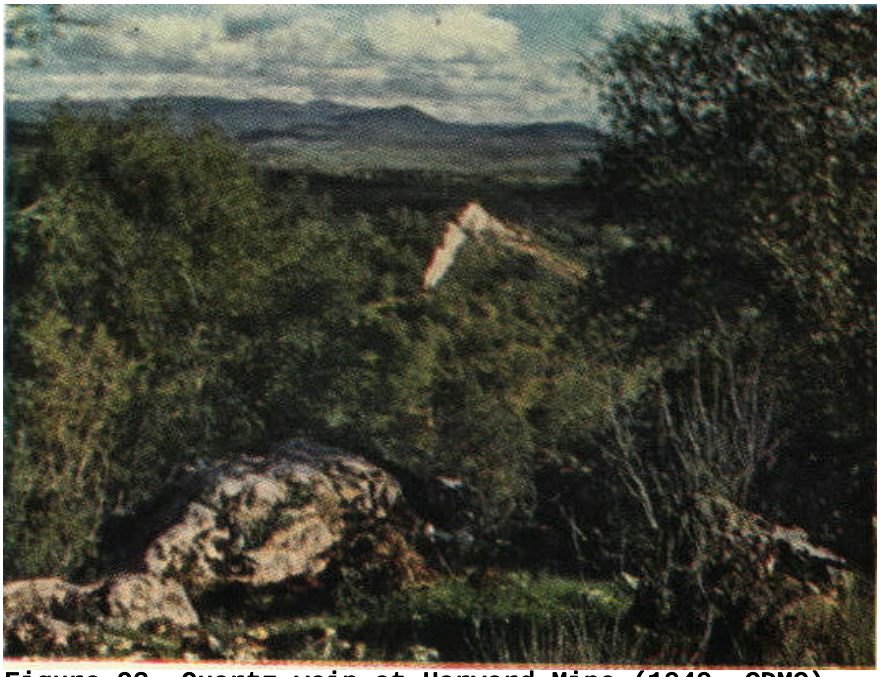


Figure 93. Quartz vein at Harvard Mine (1949, CDMG)

Photo 2. North wall of the Harvard Pit at the Jamestown Mine, just southwest of Jamestown. Exposed in the pit wall is the major fault contact between altered phyllite, stretched conglomerate, and metavolcanic rock on the right and serpentinite, chlorite schist, and greenstone on the left. In the distance is Crystalline Hill, a topographic high along the Mother Lode belt, held up by resistant masses of vein quartz and quartz-ankerite-mariposite rock. Much of the gold extracted from this pit was from auriferous sulfide minerals. Not all pyrite is "fool's" gold! *Photo by Chris Higgins.*

CG 1997:87

Figure 94. Jamestown Sonora Mine Harvard Pit (1997, CGS)

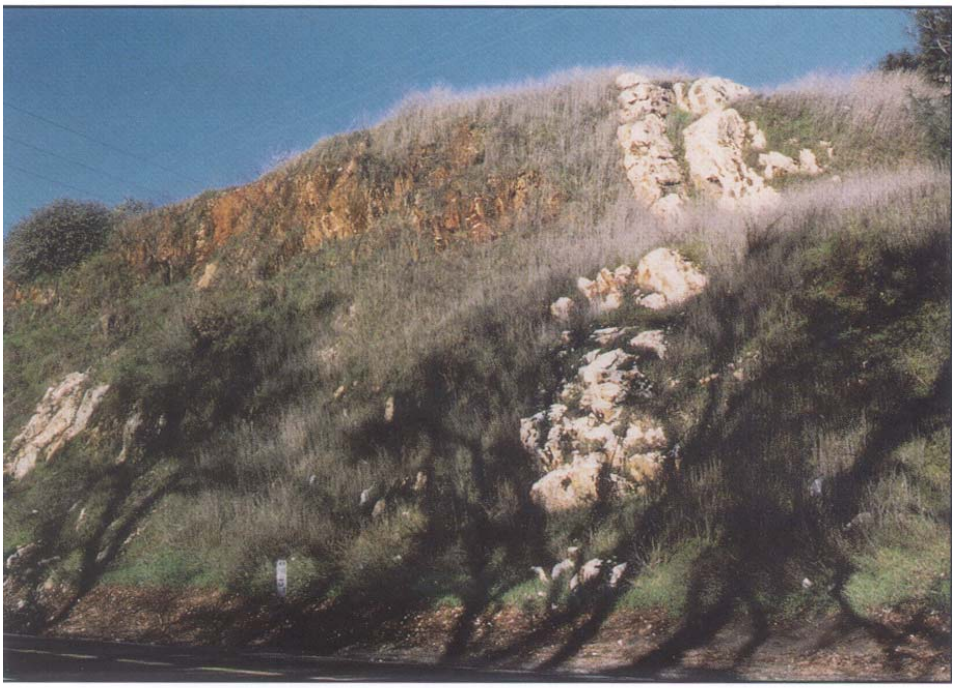


Photo 3. Exposure of quartz veins of the Mother Lode in a road cut along State Highway 49 between Bell Mooney Road and Woods Creek. The veins consist of massive quartz, which fills fractures of the Melones Fault Zone. They extend north and south of the highway, the north extension having once held up Whiskey Hill (now removed) at the old Harvard Mine. Woods Creek is famous for its deposits of placer gold. *Photo by Chris Higgins.* CG 1997:88

Figure 95. Quartz vein at Harvard Mine (1997, CDMG)

Figure 96. Jamestown Sonora Mine, aerial photo (Mining Engineering, 1995)

2.2 Enter Jamestown (#46).

JAMESTOWN

2.8 Central Jamestown

Jamestown or Jimtown (#46), as it is familiarly called, is a still thriving community with a history dating from 1848. It long has been the supply center for a great many small mining camps, and the major workings at Stent and Quartz has been mentioned in previous paragraphs.

The name "Jamestown" was given in 1848 to this town started by Colonel G. F. James, a lawyer from San Francisco. "After a series of disputes with Mexican settlers, which ended in James' ruin and departure, the name of the town was changed to American Camp, but later the old name was restored (Gudde, 1969; (Landefeld and Snow, 1990).

The original Jamestown town site has Federal reserved minerals under it.

Figure 97. Jamestown Chromium stamp mill (1949, CDMG)

SIDE TRIP TO THE STENT- QUARTZ MINES

To the east of new Highway 49, about half way between Chinese Camp and Jamestown are the old mining camps of Stent and Quartz (Sections 2, 26, 27). Both used to be reached from Bell Money Road out of Jacksonville and Jamestown, being about 2.5 miles south of the latter. In addition to local placering, Stent and Quartz are famous for a group of hardrock mines the best known of which are the App, Dutch Sweeney, Heslep, and Jumper. These mines around the hill called Quartz Mounting. This hill is composed of veins and altered rock along the Melones Fault Zone. The Jumper (#47) had been recently been rehabilitated in 1949, but no recent production has yet been reported. It is a consolidation of the old Jumper, New Era, and Golden Rule claims, the combined production of which is more than 120,000 ounces (about $15,000,000). The presence of the gold tellurides petzite and hessite has been reported from the Jumper. Combined

production of the App and Heslep has been placed at more than 69,700 ounces (about $1,742,000) and that of the Dutch and Sweeney at approximately 84,700 ounces (about $2,118,000). These were fairly deep mines, the Dutch having a vertical depth of about 2,070 feet (630 m) (Bowen and Crippen, 1949).

Beyond the Mother Lode vein exposures at Woods Crossing, a very thick section of Jurassic metasedimentary rocks begins. These rocks can be seen on both sides of Highway 49 from Jamestown to well beyond the Calaveras River bridge. They include mica schists, phyllites, limestones, and green metavolcanics. Several more or less parallel branches of the Mother Lode traverse the Jamestown-San Andreas strip, and the vein systems tend to finger out into the wall rocks in many places, forming networks of veinlets or stringers. Some of the stringer lodes were extremely auriferous and were responsible for the famous pocket mines of Rawhide and Jackass Hill. Some of the ore bodies on Carson Hill were of this type. It is probable that a great deal of high grade ore of this nature was eroded off during Cretaceous and Eocene time to form the fabulously rich placers of Columbia and Shaws Flat (Bowen and Crippen, 1949).

This side trip starts 2 miles south of Jamestown on Jacksonville Road.

0.0 Junction Bell Mooney and Jacksonville Road near Old Wood's Crossing.

Note Table Mountain Latite flow to right (west) exemplifying a textbook case of inverted topography. Jamestown Mine to right (west) on skyline.

0.6 Town site of Quartz.

0.8 Quartz Mountain on the right (west).

GEOLOGIC MAP 11-B.1

Quartz Mountain to Mormon Chapel
Eric et al., 1955; Morgan, 1976)
(Logan, 1934; Wagner et al, 1990)

1.3 Stent Cutoff Road/Jacksonville road. Go right on Jacksonville Road.

Stent

1.4 Town site of Stent.

1.9 Lode gold mine operation (inactive).

2.4 Cross Sullivan Curtis Creek.

2.9 Mines on right (west).

4.0 Mine shafts on both sides of road.

4.4 Cross Blue Gulch

4.5 Jacksonville Road/Lulu Mine Road. Continue south on Jacksonville Road.

5.0/0.0 Junction with Twist Road. Road to the Eagle-Shawmut Mine is on the right (west). Reset odometer. Southward of this junction, the road follows Smarts Gulch.

0.7 Mammoth Mine Road on the right (west).

Figure 98. Mammoth Mine Boarding House, c. 1940 (1998, CGS)

GEOLOGIC MAP 9

Moffits Bridge to Chinese Camp
(Morgan, 1976; Wagner et al., 1990; Logan, 1934)

1.9 Cross Kanaka Creek.

2.9 Roadcut on left (west) 100 yards north of north end of bridge contains limestone pods and highly folded metasediment blocks.

Tuolumne River Bridge

3.0 North end of Old Tuolumne River Bridge.

3.5 Cross Jacksonville Bridge to south side, then use turnout to turn around. Drive back across bridge and proceed north on Jacksonville Road. Return to the junction of Jacksonville Road and Twist Road.

GEOLOGIC MAP 11-B.1 and 11-B.2

Quartz Hill to Mormon Chapel
Eric et al., 1955; Morgan, 1976)
(Logan, 1934; Wagner et al, 1990)

SIDE TRIP TO STANDARD PLUTON AND MORGAN CHAPEL

0.0 Reset odometer at the intersection of Jacksonville Road and Twist Road. Go east on Twist Road. Note weathered dioritic dike outcrops forming rounded boulders to left and right of road near hillcrest.

3.9 Intersection of Twist Road, Algerienne Wards Ferry Road and Limekiln Road. Proceed straight on Algerinne Wards Ferry Road.

4.5 Lime Kiln Road on left (north).

5.3 Cross Rough and Ready Creek. Note limestone outcrops on hilltop to left (north).

5.9 Limestone body visible in creek bed to right. Exposures of an extensive limestone body parallels the road for the next three miles.

7.0 Intersection Algerienne Wards Ferry Road and Wards Ferry Road. Go left on Wards Ferry Road. Ward's Ferry site is location #49.

7.4 Exposure of amphibolite schist/limestone contact in roadcut on right.

8.3 Yosemite Road intersection on right. Continue straight.

8.5 Exposures of Standard Pluton form low rounded hillocks on both sides of road.

Morgan Chapel

10.1 Morgan Chapel Historic Site and Cemetery (#48).

11.5 TURNOUT STOP. Panoramic view of Sonora-Stent region. Note the vista of Jamestown Mine, Bear Mountains in distance and limestone belt outcrops in foreground.

11.8 Intersection of Wards Ferry Road/Old Wards Ferry Road. Proceed left on Old Wards Ferry Road.

11.9 Murphy Road Intersection. Continue straight.

GEOLOGIC MAP 11-B.3

North of Morgan Chapel to Sonora
(Eric et al., 1955; Morgan, 1976)
(Logan, 1934; Wagner et al, 1990)

12.1 Tinnen Road intersection. Continue straight.

12.4 Road crosses old mining ditch.

12.7 Route 5 intersection. Continue straight.

13.6 Unnamed Road intersection. Continue straight

15.0 Intersection Old Wards Ferry Road and Highway 108. Turn left (west) to return to Sonora.

SIDE TRIP TO COPPEROPOLIS AND THE ROYAL MOUNTAIN KING MINE

GEOLOGIC MAP 11

Chinese Camp to Jamestown
(Wagner et al., 1990; Eric et al., 1955)
(Taliaferro et al., 1930; Logan, 1934)

0.0 Jamestown - Southern intersection of Main St. and Highway 108. Go left (west) on Highway 108.

0.2 Intersection with Harvard Mine Road. Go right on Harvard Mine Road.

Woods Creek Bridge

0.4 Cross Woods Creek bridge. The Woods Creek drainage was reportedly rich placer diggings and was heavily worked during the early gold rush period.

0.8 Sonora-Jamestown Mine - open pit gold mine operation. See detailed discussion below. Historic Harvard Mine Stamp Mill foundations on right and historical marker on left.

1.0 Junction Harvard Mine Road and Highway 108. Proceed right (west) on Highway 108.

1.8 Junction Highway 49 and Highway 108. Continue west on Highway 108.

5.1 Highway 108 passes through modern stream valley that has downcut through the Tertiary

age Table Mountain channel.

GEOLOGIC MAP 11-C.1

South of Jamestown to Ward Ranch
(Eric et al., 1955; Wagner et al, 1990; Logan, 1934)

5.5 Junction Highway 108/Highway 120. Continue west on Highway 108 ("Yosemite Junction").

6.4 Junction Highway 108/O'Brynes Ferry Road (E15). Go right on O'Byrne's Ferry Road.

Sierra Conservation Center

8.4 Sierra Conservation Center on right.

GEOLOGIC MAP 11-C.2

Ward Ranch to Calaveras Asbestos Repository
(Eric et al., 1955; Wagner et al, 1990; Logan, 1934)

8.8 Mariposa Formation "tombstones" outcrops on right.

10.9 Road to Green Spring Mine on left (south).

11.1 Stanislaus River Bridge Crossing (#50). Calaveras/Tuolumne County line. Table Mountain is to the northwest and northeast on both sides of the river.

O'Byrne Ferry

11.8 O'Bryan Ferry Road roadcut (on right) of Tertiary age Stanislaus River sands and gravels. The Table Mountain latite caps the ridge. Note the tremendous volume of Tertiary channel sediments completely eroded out by the modern Stanislaus River canyon (on left).

13.8 Road to Bowie Flat is on the right (east).

California Asbestos

13.9 CAM Road (California Asbestos Monofill) on right (#51).

GEOLOGIC MAP 11-C.3

Calaveras Asbestos Repository to Copperopolis
(Eric et al., 1955; Wagner et al, 1990; Logan, 1934)

15.1 Copper Cove Road on the left (west).

16.8 Black Creek Bridge crossing. Note metavolcanic rock sequence exposed in creek bed to right.

17.2 South Morrissey Road on the right (east).

17.9 Outskirts of Historic Copperopolis. Note smelter stack - historic refining facility to left.

Copperopolis

18.4 Copperopolis historic town site (#52).

The 1949 guidebook contains the following statement about wildlife on the side trip to Copperopolis:

> "Several interesting sidelights on the wildlife of the vicinity may be observed along the Copperopolis route. Telephone poles and fence posts are riddled by the acorn studded holes of California woodpeckers. The fence posts are further burdened by the carcasses of dozens of predatory animals which the ranchers have trapped or otherwise disposed of. It seems to be a custom of the country to exhibit "varmints" in this fashion. No less than 34 coyotes and three bobcats were strung on consecutive fence posts within a two-mile stretch on the authors' last trip through that country!"

The Copperopolis copper mining district 12 miles southwest of Altaville was a major producer through both World Wars but has been idle much of the time between war periods. The North Keystone, Empire, and Keystone-Union are the principal mines of the district and are all located in its town within a short distance of each other. The Copperopolis mines were discovered in 1861 and for several years thereafter were the principal producers of California copper. The upper parts of the ore bodies were very rich and the Union and Keystone mines paid huge dividends. The Copperopolis mines are on a fault system as are the Mother Lode gold mines, but the Copperopolis mines carry little coarse gold and lack the quartz-carbonate gangue of the Mother Lode veins. The ore is of simple sulfide type, principally pyrite and chalcopyrite. The massive sulfides pass into pyritic or chalchopyritic slate at peripheries of the ore shoots. The ore bodies lie in a narrow belt of hydro thermally-altered black slate of the Mariposa Formation with Logtown Ridge meta-andesite agglomerate on either side. Dikes of diorite cut the Logtown Ridge in many places near Copperopolis paralleling the strike of the bedded rocks. Tailings from the mines are visible at several points west of the road (Bowen and Crippen, 1949, modified by CGS, 1997).

Figure 99. Copperopolis brick and schist building (1949, CDMG)

Figure 100. Copperopolis IOOF Hall (1949, CDMG)

The town of Copperopolis, located in the east edge of Salt Springs Valley, has but few buildings remaining. The red brick I.O.O.F. Hall had been dedicated as a church in 1866. It was originally built as an armory in 1861. When it was an armory, it was a training center for the Union Guard 3rd Brigade. It is one of the few still in a good state of preservation. A Mr. McCarty had mined and farmed in Salt Springs Valley as early as 1852 and had prospected the copper veins for gold. Finding no gold, he paid no further attention to the copper deposits until he returned with two others in 1861 and helped to found Copperopolis. The history of Copperopolis has been one of periods of great activity interspersed with periods of virtual abandonment (Bowen and Crippen, 1949, modified by CGS, 1997).

Copperopolis lies in a belt of Jurassic rocks named the Copper Hills Volcanics in a valley formed by the Bear Mountain Fault Zone. It is a classic locality for study of the Western Copper Belt of the Mother Lode.

The copper district is now the site of a gold operation that produced gold by simple milling and heap leaching. It is now in the late stages of reclamation.

GEOLOGIC MAP 11-C.4

Copperopolis to the Royal Mountain King Mine
Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et. al, 1955; Logan, 1934)

18.8/0.0 Intersection of O'Byrne's Ferry Road and Highway 4. Go across intersection to Rock Creek Road. Proceed northward on Rock Creek Road.

Keystone Mine

0.2 Keystone Mine (#53) is on the right (west).

Figure 101. Copperopolis Keystone Mine, 1900 (1998, CGS)

0.4 North Keystone Mine is on the right (west). Homestead Ridge is on the right (west), Copperopolis Mountain on the left (east). The valley between them is a fault zone.

6.3 View of Royal Mountain King Mine in distance to left.

8.8 Metasediment rock "Tombstone" outcrops of Mariposa (?) Formation on right.

9.3 Intersection Rock Creek Road and Royal Mountain King Mine Road (Hodson Road). Go left (south).

10.0 Guard Gate - Royal Mountain King Mine (#54). YOU MUST HAVE PERMISSION TO VISIT THIS PRIVATE PROPERTY. Contact the mine manager at 209-785-3222.

Royal Mountain King Mine

The Castle vs. Womble Decision of 1894

The Royal Mountain King Mine played a role in U.S. mining law and in the government's procedures for administering it. In 1861 a dispute arose between an agricultural homesteader and a miner about lands in Section 30, T.2N, R.12E that encompassed the Empire Quartz Mine. The case is known as Castle vs Womble and set a legal precedent that is followed by government geologists and mineral examiners to this day. The farmer, Martin Womble argued that the lands were not "mineral in character" and that his agricultural homestead application should be honored. The miner, Walter Castle, filed a protest alleging that the property in question contained a lode of quartz rock in place carrying gold in paying quantities and that this land was more valuable for mineral than for agricultural, grazing or other purposes.

The decision summary of the Administrative Law Judge read as follows:

> ...where minerals have been found and the evidence is of such a character that a person of ordinary prudence would be justified in the further expenditure of his labor and means, with a reasonable prospect of success, in developing a valuable mine, the requirements of the statute have been met. To hold otherwise would tend to make of little avail, if not entirely nugatory, that provision of the law whereby "all valuable mineral deposits in lands belonging to the United States...are...declared to be free and open to exploration and purchase.1" For, if as soon as minerals are shown to exist, and at any time during exploration, before the returns become remunerative, the lands are to be subject to other disposition, few would be found willing to risk time and capital in the attempt to bring to light and make available the mineral wealth, which lies concealed in the bowels of the earth, as Congress obviously must have intended the explorers should have proper opportunity to do...
>
> 1. Citation from the 1872 Mining Law

This legal precedent has been refined through several other court cases since 1894, but the "Prudent Man Rule" found in the Castle vs Womble case continues to be the driving force in U.S. mining law administration.

Royal Mountain Mine and King Mine

The following information about the Royal mine and Mountain King mine is adapted from Clark and Lydon (1962, p. 68-69):

The Royal Mine (NE1/4, Sec. 30, T.2N, R.12E) was the most productive and largest gold mine of the Western Belt in Calaveras County. The mine was originally worked prior to 1883. In 1844 it was developed by the Pine Log Mining Company and had and inclined depth of 185 feet and a 10-stamp mill in 1895. A major expansion of the mine to 40 stamps occurred in 1895 and by 1903 there was a new 120-stamp mill. This mill only operated for two years. Idle from 1905 to 1914, it reopened and operated intermittently until 1931 (Logan and Franke, 1936)

Between 1932 and 1942 ten or twenty of the 120 stamps were used for a moderate scale operation. Some custom milling was also performed. Surface ores were developed by a consortium of independent lessees.

In 1955-1956 an exploration drilling program for the Royal and Mountain King properties was conducted by New Jersey Zinc Company. Some of these drill holes were 1,000 feet deep.

The Royal mine and the adjacent Mountain King mine are on the northwest side of the Hodson

Fault Zone. This zone contains a series of parallel northwest-striking and east-dipping gold-quartz veins. Host rocks for these veins are mineralized greenstone and schist. The mineralized zone is 500 feet or more thick and nearly 4,000 feet long (Harry Bush, personal communication, 1958). The minable material is termed "gray ore" . Within this zone are at least five major quartz veins ranging from a few up to 20 feet thick. The gray ore is a hydro thermally alteration of greenstone and ankerite schist containing disseminated free gold and auriferous pyrite. During 1895-1904, processed ores averaged $3.75 per ton. (Tucker, 1916, p. 103).

The Royal mine was originally produced through a 1,200-foot inclined shaft. Most grey ore was extracted between the 700- and 1,000-foot levels prior to the 1930's. Afterwards production occurred mainly form stopes between 1,000- and 2,000-foot levels. During this time the Goodenough shaft (125 feet) was sunk and ores developed by room-and-pillar. Ore was conducted from the mine to the 120-stamp mill by an electric tramway. Free gold was amalgamated and sulfides were concentrated by floatation and vanning.

The Mountain King mine (SW1/4. Sec. 19 and NW1/4, Sec. 30, T.2N, R. 12E) was active in the 1890's (Crawford, 1896, p. 114) and by 1904 had been developed to an inclined depth of 500 feet. The mine was reopened in 1930 (Logan and Frank, 1936, p. 277) with a 10-stamp mill. In 1936 the Jumbo Consolidated Mining Company operated the property on a major scale until 1941. During this time the shaft was deepened to an inclined depth of 1,200 feet and a large, new mill was constructed. During World War II the mill was used to process copper ores from the Keystone-Union mines at Copperopolis. In 1941 and 1942 the El Gabilan Corporation worked the mine.

Between 1945 and 1948 the Mountain King Mill and Mine Company reopened the mine as an open pit operation.

Up to 1962 the Mountain King produced 300,000 tons of material ranging in grade from $3 to $8 per ton (F.R. Wicks, private report, 1940).

The Mountain King is the northern portion of the mineralized Hobson Fault Zone described above.

The most recent operation at the Royal Mountain King Mine began in 1984 with a new drilling and feasibility study by Meridian Gold Company. In 1988 construction was initiated and in March 1989 the first gold bars were poured from the new open pit mining operation. The property was purchased by FMC in 1990 and the property continued to mining activity until 1994. The Meridian operation produced gold from an ore body along the Hodson Fault Zone, which separates the Salt Springs Slate on the southwest from the Copper Hill Volcanics to the northeast. Approximately 6.8 million tons of ore were removed. More than 300,000 ounces (8,500 kg) each of gold and silver were recovered during the life of the mine (Bowen and Crippen, 1949, modified by CGS, 1997.

Mine closure commenced in 1994 and is continuing. Gold and silver are recovered by flotation followed by leaching. From this modern operation, 307.053 ounces of gold and 317,296 ounces of silver have been produced.

After visiting the mine, return to:

0.0 Intersection Hodson Road and Rock Springs Road. Go left (northwest).

1.1 Intersection Rock Springs Road and Salt Springs Valley Road. Go right (east) on Salt Springs Valley Road.

3.0 Intersection of Hunt Road and Salt Spring Valley Road. Go right (east) on Hunt Road.

GEOLOGIC MAP 11-C.5

Royal Mountain King Mine to Pool Station
Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et. al, 1955; Logan, 1934)

Carmen City

4.7 Historic building structure on left (Carmen City). Salt Springs Valley Reservoir in distance to right.

6.4/0.0 Junction Hunt Road and Highway 4. Reset odometer and go east on Highway 4 toward Angels Camp.

Pool Station

0.7 Pool Station Road intersection. As you proceed east, you will cross the Bear Mountain-Calaveras Complex.

1.1 Bear Mountain Ranch on the right (south).

GEOLOGIC MAP 11-C.6
Pool Station to Champion Mine
Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et. al, 1955; Logan, 1934)

1.3 Elkhorn Station

5.0 Placer gold tailings on Cherokee Creek.

Champion Mine

5.6 Champion Mine Road intersection.

GEOLOGIC MAP 11-C.7

Champion Mine to Altaville
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et. al, 1955; Logan, 1934)

Gold Hill

6.0 Gold Hill pocket mine (#101)

6.7 Wagon Rut-Tollgate pocket mine (#100). This is the best-known of the Gold Hill pocket mine group. The Belmont-Osporne Mine (#102) is 0.5 miles (800 m) southwest of Gold Hill (Bowen and Crippen, 1949, modified by CGS, 1997).

7.1 Intersection Highway 4 and Highway 49 in Altaville. Go right (south) on Highway 49.

GEOLOGIC MAP 11

Ohio Diggins to Jamestown
(Wagner et al., 1990; Eric et al., 1955)
(Taliaferro et al., 1930; Logan, 1934)

SIDE TRIP: RAWHIDE AND OMEGA MINES

0.0 Southern intersection of Main Street and Highway 108/49. Reset odometer and proceed northeast on toward Sonora.

1.1 Jamestown Cemetery

1.3 State Historic Park, Railtown 1897, on right. This is the site of Jamestown Station of Sierra Railway, although original station burned down years ago.

3.2 Rawhide Road (County Road E5)

From Jamestown, the Rawhide Road leads off northwesterly from the center of town and crosses Table Mountain, goes through the ghost town of Rawhide, and rejoins Highway 49 about a mile east of Tuttletown. This route crosses Table Mountain close to the old Tuttletown-Jamestown segment of the abandoned Sierra Railroad. A close-up view of the latite lava cap and underlying tuffaceous sediments can be can be seen in the railroad cut close to the road. The columnar jointing in the latite is conspicuous. The rim, or contact with bedrock along the old slope of the fossil stream bank, shows in the old weathered surface of the covered schist. Here the roadway exposes a cross section of surface hillside creep which has been preserved since the lava covered it. Close by this spot gold bearing gravels lie beneath rhyolitic lake beds, covered by bridge. The New York tunnel, to the north, was one of the few drift mines under Table Mountain which could boast any considerable profit. Its heyday was prior to 1868 (Bowen and Crippen, 1949).

Omega Mine

West of the Table Mountain crossing, a distance of 0.7 mile from Jamestown, the Rawhide road joins a road from the Old Omega mining district. Southeast of this road junction the red sheet metal stamp mill of the Omega Mine can be seen. Although the Omega Mine (#58)itself has never been very successful, the mill was in operation for many years and in 1948 was one of the few stamp mills still in operation along the Mother Lode. The mill site is of further geologic interest because a post-latite normal fault, Pleistocene in age, passes almost under it and then cuts through Table Mountain, displacing the lava cap a vertical distance of 60 feet (18 m), the western side being higher than the eastern. The Omega was unusual in that it produced placer gold from overlying Tertiary sediments and lode gold from underlying Mother Lode veins (Bowen and Crippen, 1949, modified by CGS 1997).

Rawhide

The site of the old mining camp of Rawhide (#59) lies a short distance north of the Omega-Rawhide road junction almost due west from the railroad cut on Table Mountain. A body of pure antigorite serpentine lies to the south and west to the town of Rawhide. This was extensively prospected during the World War II as a possible source of magnesium. The Rawhide Mine, also located close to the abandoned town site of Rawhide (near junction of Rawhide and Shell roads), was on of the most successful early day mines. It was very active up to 1867; was idle until 1891;

and had a very productive period up to 1905. Since then only pocket mining in the old workings has been done. The veins are typically quartz-ankerite rock containing both free gold and gold bearing sulfides. The wall rocks are Jurassic metasedimentary rocks on the east (Calaveras schist) and serpentine on the east. The total depth is 1,845 feet (562 m)via shaft and winze. Probable production is in the neighborhood of 240,000 ounces (about $6,000,000; Bowen and Crippen, 1949, modified by CGS 1997).

On this side trip columnar joints in the Table Mountain Latite can be seen. In 1898 Ransome introduced the term latite to describe the Table Mountain lavas in both places is between trachyte and andesite (Landefeld and Snow, 1990).

SIDE TRIP TO SHAWS FLAT

3.5/0.0 Northern end of Jamestown.

0.0 Reset odometer. Road to Shaws Flat in Mariposa Formation. Go north on the Jamestown Road

Four-tenths of a mile north of central Jamestown, a road which leads to Shaws Flat (#60) joins Highway 49 near the turnoff to Columbia. Shaws Flat is accessible from Sonora and Columbia also.

0.7 Shore gold mine on left (west) at road intersection

GEOLOGIC MAP 12

Jamestown to Columbia
(Wagner et al., 1981; Jennings, 1979; Baird, 1962)
(Logan, 1934)

3.0 Geologic contact between metavolcanic rocks to the south and Paleozoic limestone to the north.

3.9 Shaws Flat Road and Jamestown Road. Turn left, go west on Shaws Flat Road.

Shaws Flat

3.9 Shaws Flat

The town of Shaws Flat (#60) was founded in 1850 but the rich placer diggings of the Shaws Flat-Sonora district were discovered in the summer of 1848. As at Columbia, which is but a few miles to the north, the Calaveras limestone underlies most of the diggings. The limestone has an extremely rough, hummocky, and irregular surface with many crevasses and potholes. These landforms have been caused by surface leaching of ground water and probably accomplished, for the most part, since the gold was deposited by subaerial erosion after exhumation. They provide a model for what the bedrock surface upon which the rich placer deposits were laid must have been like. Much of the gold was found in the red, weathered clay of the limestone, and not directly on the bedrock. Some of the Eocene gravels which once covered the limestone surface can be seen, but they are scarce because they were probably stripped off this surface by erosion long before the days of 1849. Most of the rest was removed by the placer miners. Although exceedingly rich, the Shaws Flat deposits were very shallow and were soon worked out. The source of the gold from these early rich placers may well have been close by. North of Sonora on the road to this area is a hillside covered with early pocket mines which may have been the source for some of the place gold. No accurate breakdown on the production of Shaws Flat,

Whimtown, and other diggings in the Shaws Flat vicinity are available, but it is probable that part of the 3,480,000 ounces (about $87,000,000) credited to Columbia came from diggings to the south. Some of the channels of this district were followed partly under Table Mountain, separated from it by deposits on andesitic cobble (Bowen and Crippen, 1949).

4.2 Highway 49. Turn right, go north toward Columbia

4.7 Parrots Ferry Bridge road. Turn right, go north toward Columbia.

Figure 102. Shaw's Flat hummocky placer ground (1949, CDMG)

Figure 103. Shaw's Flat lime kiln (1949, CDMG)

RESUME MAIN ROAD LOG ON HIGHWAY 49 AT JAMESTOWN

Jamestown to Columbia on Highway 49

Between Jamestown and Sonora, the countryside along Highway 49 becomes more hilly and is rather well forested. There are several resorts and picnic spots along the highway and several nice stands of pine timber. The rocks along the way are Paleozoic and Mesozoic (Jurassic) metavolcanic mica schists, phyllites, limestone, and green stone metavolcanic rocks. Several more or less parallel branches of the Mother Lode traverse the Jamestown-San Andreas strip, and the vein systems tend to finger out into wall rocks on many places, forming networks of veinlets or stingrers. Some of the stringer lodes were extremely auriferous and were responsible the famous pocked mines of Rawhide and Jackass Hill. Some of the ore bodies on Carson Hill were o this type. It is probable that a great deal of high grade ore of this nature was eroded during Cretaceous and Eocene times to form the fabulously rich placers of Columbia and Shaws flat. (Bowen and Crippen, 1949, modified by CGS, 1997).

The NNW-SSE trending ridge one mile south of Sonora in Section 1 and in the extreme northeast corner or Section 2 marks a contact between Jurassic metavolcanic rocks and Paleozoic limestones of the Calaveras Complex.

0.0 Southern intersection of Main Street and Highway 108/49. Reset odometer and proceed northeast on toward Sonora.

1.1 Jamestown Cemetery

1.3 State Historic Park, Railtown 1897, on right. This is the site of Jamestown Station of Sierra Railway, although original station burned down years ago.

3.2 Rawhide Road (County Road E5)

1.5 Columbia State Park Exit in Calaveras Group rocks. Take exit to stay on Highway 49. Note hydrothermal alteration (#61) of metasediments in the roadcut just north of the Highway 108 overpass.

2.1 Sonora city limits.

SONORA

Mexican miners from the State of Sonora established the camp in 1848, and stayed until a tax levied on noncitizen miners in 1851 forced most of them to leave. It was first called Sonoran Camp to distinguish it from American Camp (Gudde, 1969). The population in 1849 was about 5,000; in 1946 it was 4,170. It is Tuolumne County's only incorporated city, and its county seat. Sonora boasted a newspaper as early as 1850. Sonora is a flourishing and attractive town with its yellow county courthouse and rustic read St. James Church. (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

Figure 104. Sonora 919 Washington St (1949, CDMG)

Figure 105. Sonora 803 Stewart St. (1949, CDMG)

Figure 106. Sonora building behind Purity Store (1949, CDMG)

Figure 107, Sonora City Hotel , 1895 (1998, CGS)

Figure 108. Sonora 905 Shepherd St. (1949, CDMG)

Figure 109. Sonora Italia Hotel (1949, CDMG)

Figure 110. Sonora-Jamestown house with stone basement (1949, CDMG)

The Sonora Mining District was both a placer and lode pocket mining district. The placers were extremely rich, especially in crevices and potholes in limestone. Placer gold production is reportedly about $11 million (approximately 530,000 oz. gold). In 1854, The Holden Chispa gold nugget, weighing 28 pounds (approximately 430 ounces) was found on the present site of Sonora High School. Lode gold was commonly mined from high grade pockets in quartz veins generally less than a few feet wide in metasedimentary and volcanic rocks. The high grade pockets commonly were the found at intersections of fissure-veins. The veins contained crystalline gold along the fractures. Gold minerals in these veins were petizite ([Au,Ag]2Te4), and sylvanite (Ag3AuTe). The Bonanza mine was the largest gold producer in the district with approximately $1.5 million (about 72,000 ounces). The Holden Chispa nugget, which weighed more than 28 pounds (12.7 kg) was taken from within the present city limits. The Tuolumne County Historical Society Museum (#62) in downtown Sonora houses an excellent collection of gold specimens. Sonora is the gateway to Sonora Pass in the high Sierras; Bowen and Crippen, 1949, modified by CGS, 1997; Landefeld and Snow, 1990).

BALD MOUNTAIN

The Bald Mountain-Browns Flat Gold Mining District (#63) is immediately northeast of Sonora in the east half of section 25 and west half of section 30. The lode mines in the Bald Mountain District are pocket mines, characterized by small, discontinuous, but often very rich ore pockets localized along intersections of northerly-trending graphitic schist layers and easterly-trending porphyry dikes. At the northern margin of the area lies the Sugarman Mine whose workings extend down more than 600 feet on the incline with a reported production of $700,000 (Logan, 1949). To the south of the district lies the Bonanza Mine witch is probably the most famous pocked mine in the United States (U.S. Bureau of Mines Bulletin 424, 1940, p.61). The Bonanza produced more than $1,500,000 in gold at $20.00 per ounce (Logan, 1928). Between these two mines there are seven other productive mines whose working depths do not exceed 200 feet. Based upon the depth of ore in the adjacent mines and the continuity of the ore forming system, this district was classified as having over $500,000 of inferred gold resource (1978 equivalent

dollars, Loyd, 1986).

2.6 Fairgrounds on right (east).

3.4 Intersection Highways 49 and 108. Turn left (west) toward Columbia. Reset odometer to 0.0.

0.2 Sonora Courthouse on left.

0.3 Historical Marker #139: St James Church on left.

The red brick landmark of St. James Episcopal Church is one of the best preserved 49er era building on the Mother Lode. Behind the church building, under church property, lies the Bonanza Mine which is claimed to have been the most famous pocket mine in the United States. The mine was the richest in the district, having produced $1,500,000 worth of gold (approximately 72,600 ounces; Julihn and Horton, 1940; Clark, 1970). First discovered in 1851 by some Chileans, its largest gravels yielded about 990 pounds of gold (approximately 14,429 troy ounces) in a single week. "The rich pockets...were found along a narrow quartz seam in a diorite dike 10 to 16 feet thick and in quartz sheathings on the walls of the dike, which strikes N. 30 degrees E. and dips 20-35 degrees NW...Generally, the pockets are found where an iron seam [weathered pyrite?] and a quartz crossing meet in the quartz sheathings on the walls of the dike or in its central vein" (Julihn and Horton, 1940; Clark, 1970). Petizite [Ag_3AuTe_2] and other tellurides were found with native gold. Julihn and Horton (1940) noted that the formation of the pocket-bearing veins appeared to be the "latest geologic phenomenon recorded by the local rocks" (Julihn and Horton, 1940; Clark, 1970; cited in Landefeld and Snow, 1990).

0.0 to 5.0 Highway 49 and North Main Street, Sonora. Calaveras Complex limestone and Tertiary gravels are exposed in road cuts along Highway 49 between Sonora and Columbia

1.8 Limestone outcrops in Calaveras Complex.

Route passes through the recrystallized limestone + dolomite of the Calaveras Complex, east of the Sonora fault, for the next 0.6 mile. This is part of a bed of marble in slate and phyllite that is about 0.1 mile wide here and extends 14 miles to the southeast. In the vicinity of Columbia to the northwest marble is exposed over a 2 to 4 mile width. The amount of tectonic thickening that has taken place has not been determined. In these road cuts, one can see mafic dikes of the ENE-striking Sonora dike swarm. About 1 mile east of here an early batholith pluton, the Callovian Standard tonalite-diorite-gabbro, forcefully intruded the Calaveras Complex around 164-165 million years (U-Pb on zircon, Sharp, 1984). The Calaveras phyllite and limestone wrap around the margin of the pluton (Landefeld and Snow, 1990).

Some of the limestone has been quarried for building stone, terrazzo, and other uses. Quarrying and mining started in the Columbia district in 1860, with peak production between 1862 and 1866. Competition from Vermont and Italy put many of the quarries out of business by the 1870's as freight costs from Columbia were high. The building of the Sierra Railway in the early 1920's helped revive interest in the marble quarries (Logan, 1947; Landefeld and Snow, 1990). Recently these marbles have attracted interest as a source of sculpturing stone.

2.1 Historical Marker

2.4 Columbia turnoff on Parrots Ferry Road. Keep to the right. If you keep on Highway 49 and go to the west you will pass the Tuttletown, Melones and the Carson Hill Mine (Appendix 1). Note limestone boulders scattered in pasture land alongside the road.

SIDE TRIP TO VIEW KARST TOPOGRAPHY

2.5/0.0 Junction Parrots Ferry Road and Union Hill Road. To see karst features go left (west). To proceed to Columbia go straight (north).

Karst Topography

0.2 ROADSIDE STOP. View of limestone outcrop - karst features that made the Columbia placer gold deposits famous world wide due to their excellent ability to retain heavy gold particles on the highly irregular shaped limestone bedrock surface.

0.6 Junction Union Hill Road/Shaws Flat Road. Continue to intersection of Parrots Ferry Road, then proceed east to historic Columbia State Park.

Resuming trip from Union Hill Road:

3.5 Winery with stamp mill in right.

3.7 Airport turnoff to the left in limestone.

3.9 Columbia Elementary School.

COLUMBIA

4.1/0.0 Columbia State Park

Two miles northwest of Sonora is the famous placer mining camp of Columbia (#65). Saint Ann's Church, a red brick structure located to the south of town, has all of its old charm. The search for gold is said to have stopped at the church grounds and remnants of the gold gravels supposedly lie untouched beneath the church. The rough limestone bedrock, which is much like that at Shaws Flat, is credited with having caught and held gold to the fabulous sum of 34,800 ounces ($87,000,000). Few if any gold placers of similar area have yielded so rich a harvest! Several very large nuggets were taken from the Columbia diggings. A slab-shaped mass found on Knapp's Ranch weighed over 50 pounds avoirdupois (22.7 kg), and $8,500 in gold was recovered from it. Another from Gold Hill weighed 362 troy ounces valued at $6,500. Two others were valued at $5,265 and $5,000 respectively. The town contains many interesting buildings, a local museum, and a sweatshop par-excellence. State Division of Highways Historical Marker #123 marks the turn onto Colombia's main street (Bowen and Crippen, 1949).

Figure 111. Columbia D.O. Mills building (1949, CDMG)

Figure 112. Columbia hummocky limestone bedrock (1949, CDMG)

Figure 113. Columbia IOOF Hall (1949, CDMG)

Figure 114. Columbia marble quarry (1949, CDMG)

Figure 115. Columbia Pioneer Saloon (1949, CDMG)

Figure 116. Columbia springfield brewery (1949, CDMG)

Figure 117. Columbia St. Anne Church (1949, CDMG)

Figure 118. Wells Fargo Building (1949, CDMG)

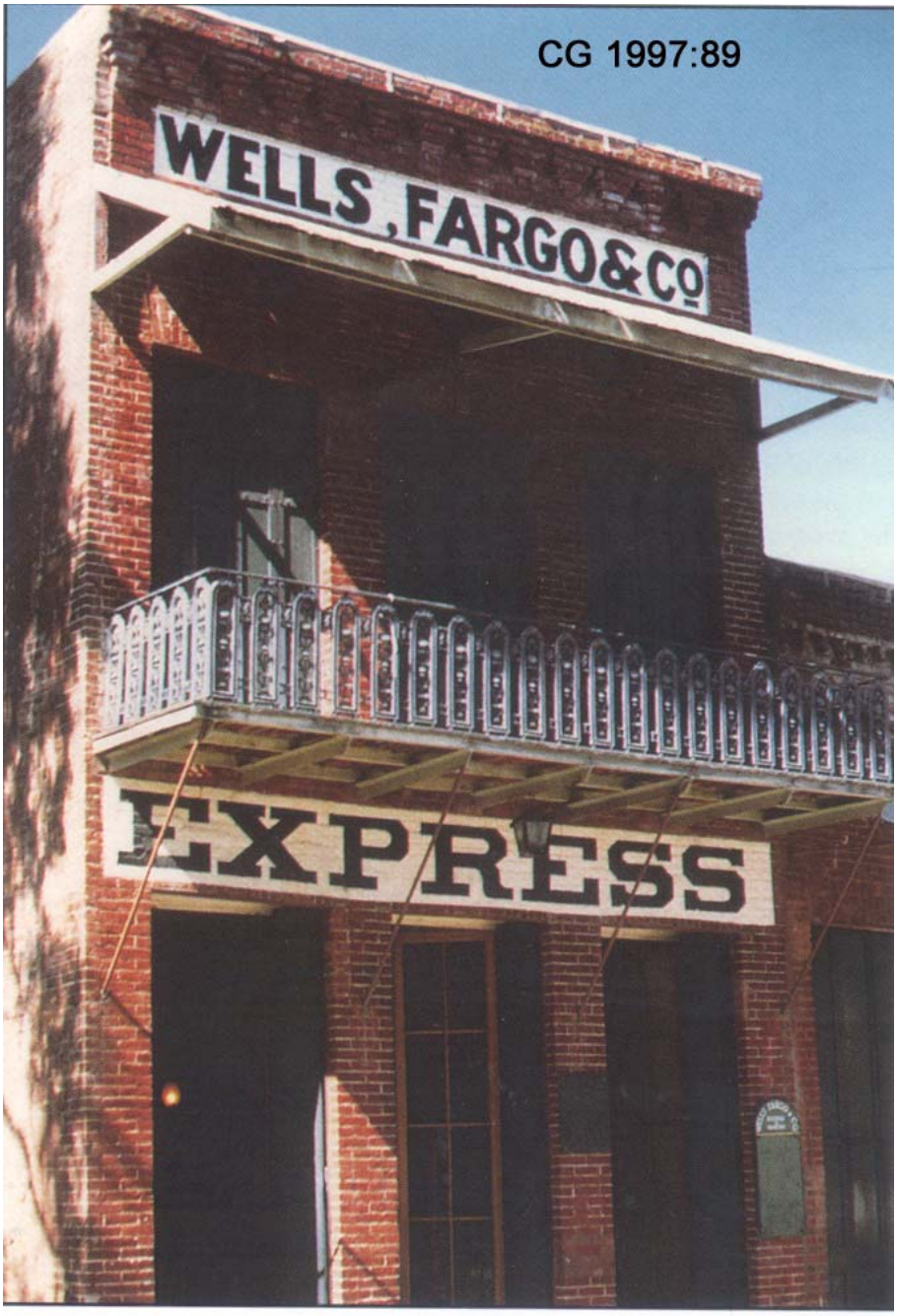


Photo 4. One of many historic buildings in Columbia, Tuolumne County. Also in Columbia State Historic Park are museums, displays, shops, and restaurants. *Photo by Chris Higgins.*

Figure 119. Columbia Wells Fargo building (1997, CGS)

The town site of Columbia is underlain by Calaveras Complex limestones.

GEOLOGIC MAP 12-B

Columbia to Angels Camp
(Wagner et al., 1981; Jennings, 1979; Baird, 1962)
(Logan, 1934)

POINTS OF INTEREST BETWEEN COLUMBIA AND ANGELS CAMP ALONG HIGHWAY 49

0.0 Intersection of Highway 49 and Parrot's Ferry Road. Union Hill is to the northwest. Go west on Highway 49, past an area of karst topography.

1.2 Shaws Flat Road

1.7 Crystal Springs mine on right (north)

2.2. Geologic contact. Paleozoic limestone (Pz) to north, metamorphic rocks (m) to south.

3.4 Highway 49 takes sharp turn to the northwest.

4.5 Tuttletown

Tuttletown

After leaving the vicinity of Columbia, Highway 49 bends around the northern end of Table Mountain and follows along its western base for about two miles before turning west into Tuttletown (#71). Some of the gravels in the creek beds of this vicinity are being worked for gold by small dragline dredges. Tuttletown, located seven miles from Sonora via Highway 49, was first settled by Mormons in 1848, and was originally called Mormon Camp. James M. Tuttle, whose name the town now bears, arrived considerably later than the first Mormons. A fairly well preserved stone structure dating from 1852 is one of the few relies remaining in old Tuttletown. Division of Highways Historical Marker 124 is located near this spot (Bowen and Crippen, 1949).

Figure 120, Tuttletown Swerer's store (1949, CDMG)

Arbona Mine

The headframe and red sheet iron buildings of the Arbona Mine are located close to the highway near the center of Tuttletown. The mine has a 600-foot (183 m) inclined shaft in schist country rock. Production from this mine has not been extensive and there has been no major exploitation since 1909. Some pocket gold was recovered from it during the early thirties (Bowen and Crippen, 1949).

5.9 Turnoff to Jackass Hill and Mark Twain's Cabin

Jackass Hill (Chileno Group)

State Division of Highways Historical Marker 138, one mile from Tuttletown, is close to the turnoff to Jackass Hill. Jackass Hill was once famous for its "pocket" gold mines and has since been made a shrine to the memory of Mark Twain who stayed there with the Gillis Brothers for an indefinite period. The present Mark Twain Cabin (#72) is a reconstructed replica of old cabins in the area and is not the original Gillis Cabin. No production figure is available for the mines on Jackass Hill, known generally as the Chileno group, but some of the pockets were exceedingly rich. The gold occurs in quartz and carbonate stringers cutting metavolcanic rock (greenstone, Calaveras schist). The Jackass Hill mines produced beautifully crystallized specimens of gold as

well as the gold tellurides petzite and calaverite (Bowen and Crippen, 1949).

A mile and a half northwest of the Mark Twain historical marker, the mine dumps and building foundations of the Norwegian mine can be seen northwest slope of Jackass Hill although it is some distance from the pocket mines near the Mark Twain cabin. This mine has been worked discontinuously in a small way since 1851, but is now idle. The ore was in pockets and ore minerals included gold, pyrite, chalcopyrite, galena, petzite, and small quantities of others tellurides. The total recorded production is only $131,000 but considerably more was undoubtedly produced of which there is no record (Bowen and Crippen, 1949).

6.9 Noriega Mine is to the northeast.

Norwegian Mine

The Norwegian Mine (#74) is of interest principally because the notorious outlaw Black Bart was caught as a result of a fracas involving a stage carrying Norwegian mine gold. Bart is supposed to have dropped, during the holdup, the handkerchief by which he was traced to his lair in San Francisco. The Noriega was worked intermittently in a small way since 1851, and is now abandoned. Ore pockets, included gold, pyrite, chalcopyrite, galena, petzite and small quantities of other tellurides. The total recorded production was only $131,000 (5,550 oz), but undoubtedly more was recovered. (Bowen and Crippen, 1949).

7.5 Robinson’s Ferry

Stanislaus River: Robinson’s Ferry

Beyond the Norwegian mine, Highway 49 drops into the canyon of the Stanislaus River, and crosses the latter at Robinson's Ferry (#75), immediately south of the town of Melones. During high water, the canyon bottom is flooded by the lake which backs up behind the Melones Dam, located more than seven miles downstream. The most recent high-water mark can be seen on the canyon walls as a line of dirt and debris. When full, the reservoir covers the old town of Melones. The bridge at Robinson's Ferry is at the Tuolumne-Calaveras County line, a line which follows the course of the Stanislaus in this area (Bowen and Crippen, 1949).

Melones and Carson Hill Mines

8.9 Carson Hill Mine, entrance gate. YOU MUST HAVE PERMISSION FROM THE MINE OWNER TO VISIT THIS PRIVATE PROPERTY

Melones, situated on the north bank of the river, would be a very scenic spot were it not for the shambles of shacks and worn out mining equipment which clutter the hillside behind the town. The large 100 stamp mill and some other buildings burned in 1942 and the mine premises have badly deteriorated since then. The Melones-Carson Hill Mining District has one of the most colorful histories of any along the Mother Lode and mining on Carson Hill has for the most part been a very lucrative enterprise. Although early records are incomplete, the Carson Hill mines are credited with a production of more than $26,000,000 (about 1,000,000 ounces). Spanish American miners found placer gold along the Stanislaus and its tributaries early in 1848. They are responsible for the name Melones, which was applied to the area because of the placer gold which resembled melon seeds. In 1850, two years after the Spanish Americans located the town of Melones, James Carson and John Hance were producing placer gold from Carson Creek. Hance is credited with the initial lode-gold discovery on Carson Hill when he followed placer gold showings uphill to their source near the massive quartz outcroppings. The Billy Mulligan gang jumped the claims and held them for nine months before being thrown off the property by court order in 1853. Little more than a year later, the largest mass of gold ever produced in California

and one of the largest on record was taken from Carson Hill. It weighed 195 pounds troy which, calculated at in 1949 prices and 900 fineness, would be worth $43,534. Presence of this huge mass of gold brought business to Robinson's Ferry to the tune of $10,000 in tolls in less than six weeks (Bowen and Crippen, 1949).

The mines of Carson Hill are famous for the telluride minerals produced in quantity during the early decades of operation. Calaverite, hessite, petzite, and sylvanite were common minerals in Carson Hill. Melonite, a telluride of nickel, is a very rare mineral named after the town of Melones and is found in but few other parts of the world. The mineral Melonite, a telluride of nickel found in few other parts of the world, is named after the town of Melones (Bowen and Crippen, 1949, modified by CGS, 1997).

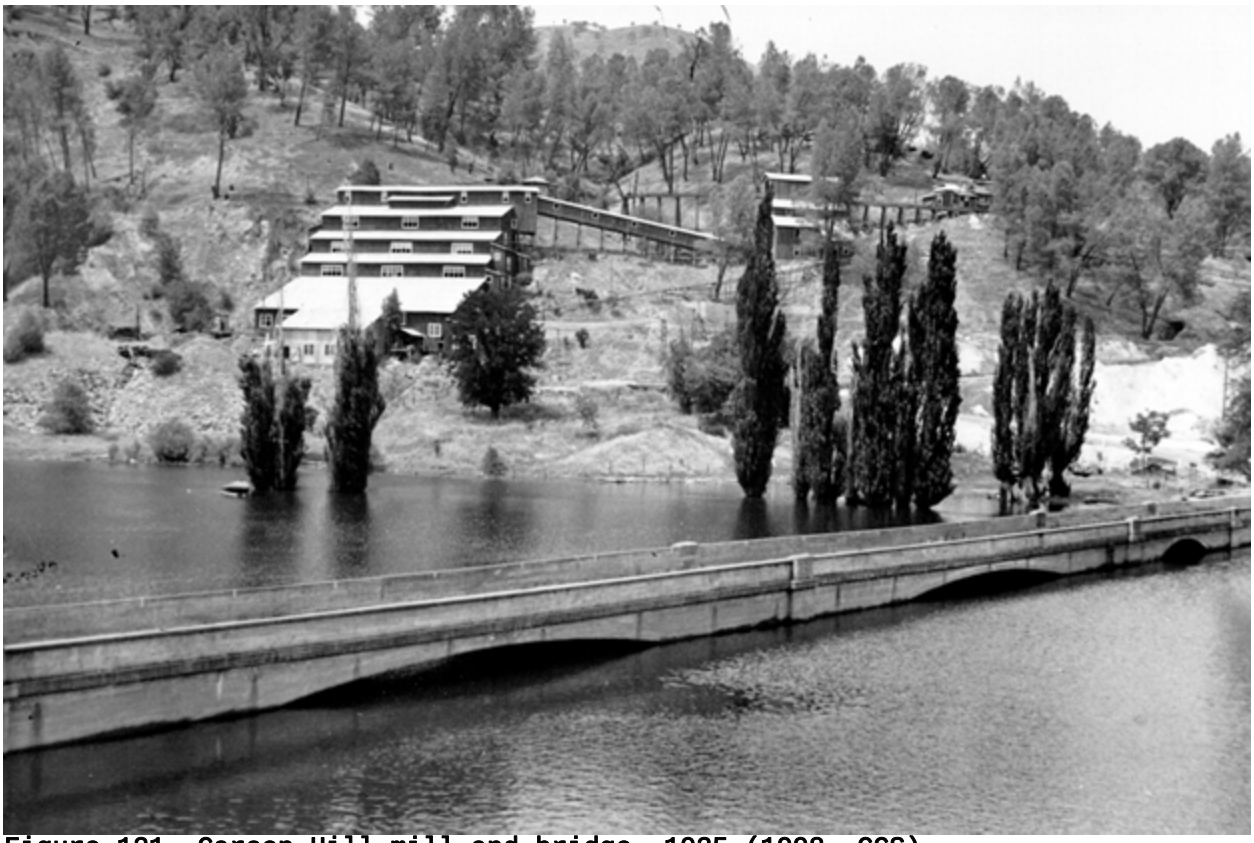


Figure 121. Carson Hill mill and bridge, 1935 (1998, CGS)

Figure 122. Carson Hill Mill at Melones, 1925 (1998, CGS)

Photo 6. View south from State Highway 49 of the remnants of Carson Hill, a lithologically and structurally complex feature along the Mother Lode. Mined by both underground and open-pit methods since the 1850s, much of the north part of the hill was removed by open-pit mining in the late 1980s. This recent activity produced less than 100,000 ounces of gold, which did not meet expectations of the operators. This view can be compared with that on page 41 of DMG Bulletin 141 (Bowen and Crippen, 1948). *Photo by Chris Higgins.* CG 1997:91

Figure 123. Carson Hill Mine (1997, CGS)

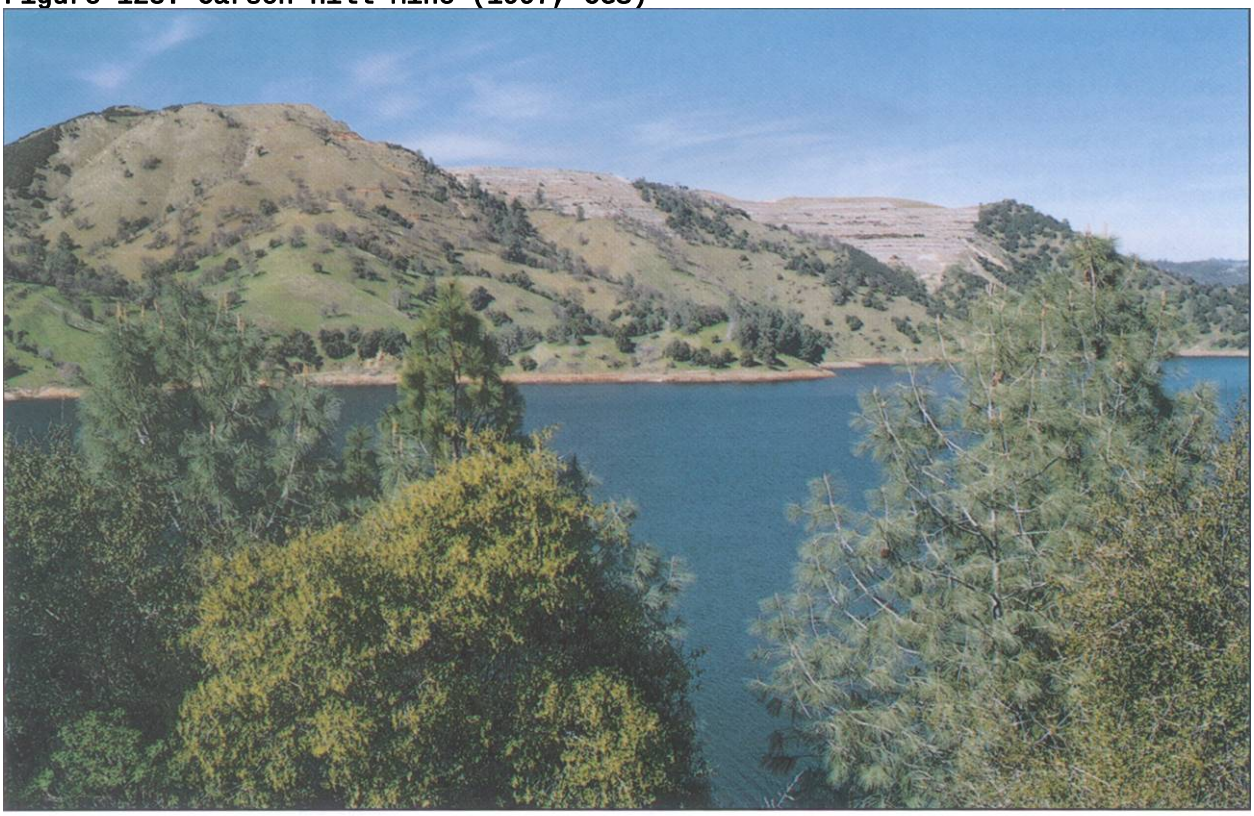


Photo 5. Carson Hill and New Melones Lake from the Robinson's Ferry area. Note the extensive workings on the south side of the hill and compare with Photo 6. *Photo by Max Flanery.* CG 1997:90

Figure 124. Carson Hill Mine and New Melones Lake (1997, CGS)

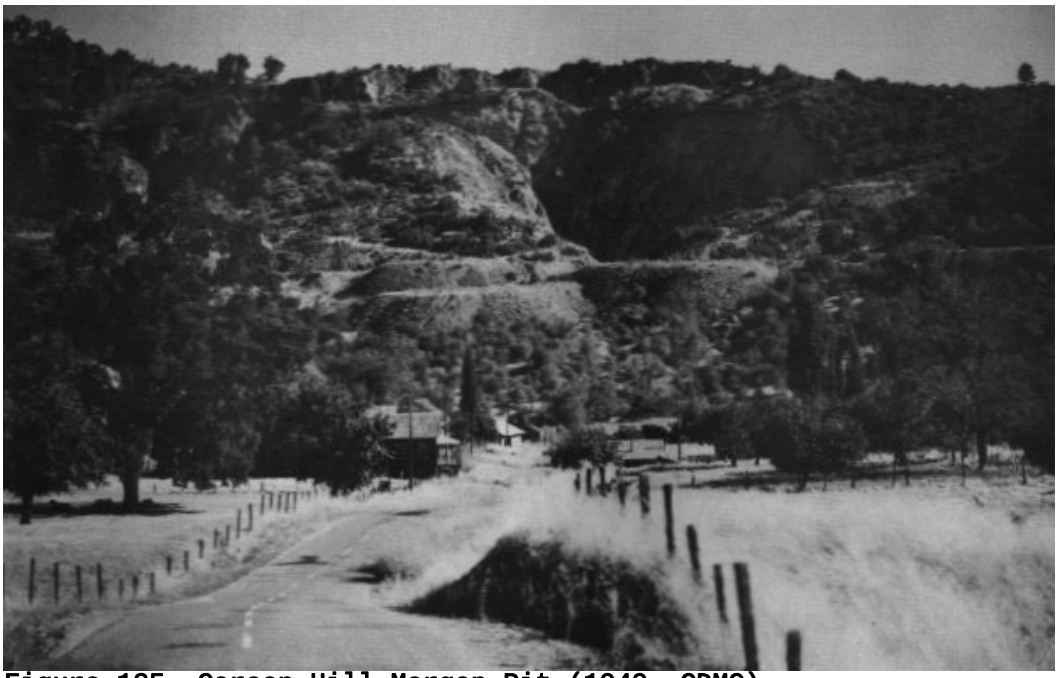


Figure 125. Carson Hill Morgan Pit (1949, CDMG)

Figure 126. Caron Hill stone building (1949, CDMG)

Two large surface working or glory holes can be seen on Carson Hill. One is on the southwest flank of the hill 1.5 miles from Melones. This is the Calaveras cut. It is one of the largest surface workings of “glory holes” in the Mother Lode and is on the Santa Cruz claim. The larger of the two is located on the north side of the hill about one mile south of the town of Carson Hill. This is the Morgan stope on the Morgan claim. The Morgan stope was exploited partly by steam shovels from the surface but most of the ore was taken out through tunnels from below. The Melones tunnel, the adit of which is close to Highway 49 just north of Melones, was the main ore-removal way from the Morgan claim. Some idea of the magnitude of the Carson Hill workings may be drawn from the tremendous size of the tailings dump to the east of Melones.

North from Melones, Highway 49 rises abruptly along the flanks of Carson Hill. An old segment of Highway 49, on the southwest flank of Carson Hill starts at the summit, leads east, and winds south, down to the lake in the vicinity of Melones. There are 3.5 miles of narrow switchbacks and sinuous mountain driving between Melones and the town of Carson Hill. The road cuts on Carson Hill expose a great many quartz-carbonate stringers or veinlets which are typical of the Mother Lode mineralization on its eastern spur from Jackass Hill to Angels Camp. The main thrust fault of the Mother Lode system lies considerably to the west and was not mineralized along this sector. State registered landmark 274 is in the settlement of Carson Hill. North from Carson Hill the route lies in rolling country which has been exploited both by placering and lode mining. Evidences of both are to be seen everywhere. Carson Flat, Frogtown, and Albany Flat were early day gold camps though little now remains at the old site which lay close to present day Highway 49. The Mother Lode Central, Marble Spring, Harris, and Waterman mines are all located close to the highway on its west side between Carson Hill and Angels Camp. None of them has been particularly productive as compared with Carson Hill or the mine of Angels Camp (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

A rejuvenation of the Carson Hill property using cyanide heap leaching technology was discontinued in 1991.

Carson Hill lies along a subsidiary fault, parallel and west of the Bear Mountain Fault Zone. It is near a fault block of ultramafic rocks that is intruded by small bodies of Mesozoic dioritic materials.

End of Side trip to San Andreas by way of Tuttletown and Carson Hill.

GEOLOGIC MAP 13

Columbia to Moaning Caverns
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934)

POINTS OF INTEREST BETWEEN COLUMBIA, VALECITOS, MURPHYS AND ANGELS CAMP ALONG PARROTS FERRY ROAD

For the next part of this field trip, this guidebook departs Highway 49 and follows Parrots Ferry Road through the town of Vallecito. After leaving the vicinity of Columbia, Highway 49 bends around the northern end of Table Mountain, follows its western base, then turns west into Tuttletown. An alternate route north from Columbia (to Highway 4 near Angels Camp) is described later. From Columbia, Parrots Ferry Road passes large marble quarries in limestone of the Calaveras Complex to the east and then descends the deep and spectacular canyon of the Stanislaus River. The canyon exposes a wide belt of granitic rocks and limestones. Table mountain Latite shows up prominently on the north side of the canyon, as well a the south, and as the road winds down through granitic rock, various fine scenes come into view. (Bowen and Crippen, 1949, modified by CGS, 1997).

0.7 Turn right on Parrot's Ferry Road. Go north toward Vallecito.

1.3 Marble quarry road. The quarry is in Calaveras limestones near a contact with Mesozoic dioritic rocks.

3.2 Quarry on left.

3.4 East end of Table Mountain. The Table Mountain Channel is exposed and eroded by the Stanislaus River Canyon.

3.7 Densmorden Mine on right (north).

3.8 Tuolumne River canyon on right with exposures of limestone. The contact between the granodiorite and the limestone has caused widespread mineralization in this area.

4.5 Old Parrotts Ferry Bridge (usually submerged) is exposed due only in times of drought.

Parrotts Ferry Bridge

4.8 New Parrotts Ferry Bridge (#66).

Where the road crosses the river at the flooded site of Parrotts Ferry, there are outcrops of Mesozoic granitic rocks with inclusions of earlier intruded rock bodies. Two stubs of severed Table Mountain latite are 1,000 feet (300 m) up the canyon walls. On the north side is a V-shaped cross section of the lava-filled channel cut in granitic rock. Before the uptilting of the Sierra Nevada, this lava occupied the sinuous course of what may have been the ancestral Stanislaus River. That river once flowed across this place, than at a much lower elevation. As the Sierra Nevada block rose and tilted slightly westward, the presently newly born Stanislaus River, flowing down the Sierran slope, cut and carved a canyon through the lava and the underlying rocks, keeping its course as the Sierran surface rose, and cutting deeply into the granite. Not only is this lava-filled channel cut in two, but also the earlier Columba channel is bisected. This channel, which was left just north of Columbia, is again encountered on the road as it reaches the old Sierran surface after the climb out of the canyon. A hiking trail with a 300 foot (90 m) change in elevation leads into the canyon west of Parrotts Ferry Road. At the bottom there are natural bridges, or remnants of limestone caverns through which Coyote Creek now flows. About 1.5 miles (2.4 km) north of the trailhead and 2 miles (3.8 km) south of Vallecito is the turnoff to Moaning Caverns.

MOANING CAVERNS

Moaning Caverns is a privately owned cave. It was discovered and enlarged by prospectors in the 1850's. The cavern had a vertical opening in antiquity and at the bottom of the cave shaft were a large collection of ice age bones. These were from mammals and birds. Some human remains were found also, including a partial skull of a 13-year old girl. This skull is radiocarbon dated to 12,000 BP. The cave has beautiful flowstone cave decorations.

5.1 Vista point turnout and historical marker on left.

5.6 Snake Gulch. This drainage follows a contact between Mesozoic diorite to the northeast and Calaveras Complex rocks to the southwest.

5.9 Calaveras limestone

Photo 9. View upstream of the Stanislaus River canyon from Parrotts Ferry Road. In the center are inactive quarries within dolomitic marble of the Calaveras Complex. On the right is part of a processing facility of a mine that currently produces high-calcium limestone from the same rock unit. On the skyline are a remnant of Table Mountain (left) and the gently rolling surface of the Tertiary landscape. *Photo by Chris Higgins.* CG 1997:94

Figure 127. View from Parrot's Ferry Bridge (1997, CGS)

Natural Bridge

6.2 Natural bridge (#67) trail head. The trail ends at a grotto-like limestone cave through which flows Coyote Creek.

8.5 Road to Moaning Cave Visitor's Center (#68) is on the left (west).

8.7 Vallecito Tertiary channel goes through the town of Vallecito.

GEOLOGIC MAP 14

(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934)

9.0/0.0 Intersection of Parrot's Ferry Road and Camp Nine Road. Turn right, go east on Camp Nine Road toward the Camp Nine Limestone Quarry.

SIDE TRIP TO CALAVERAS CAMP NINE LIMESTONE QUARRY

Camp Nine Quarry is site #69 on Map 14.

0.7 Nine Hill Tuff (similar to Valley Springs Formation, but of different age) capping Vallecito gravels.

1.3 Latite tuff ridge on left (north). This is a continuation of Table Mountain.

1.9 Saddle on Camp Nine Road.

2.4 Mehrten volcanics on left (north).

2.5 Limestone "Reef" on right (south).

2.8.1 Columnar jointing on right. The columns have been rotated from their original vertical position by soil creep.

3.0 Reforested area with juvenile Ponderosa Pine trees. This grove of replanted trees is the site of the 1992 discovery of the headless and handless body of a woman. Several months after this grizzly discovery, a hand was found along the banks of the Stanislaus River, a few miles south of this grove. Fingerprints from the partly decomposed hand lead to the woman's identification.

3.2 Fallen columns of latite on left.

3.4 Cattle guard.

3.6. Decomposed granite quarry on left.

3.6 Water storage tanks on left.

3 Camp Nine Quarry

Caliveras Cement Camp Nine Limestone Quarry

This idle limestone mine (#69) can be visited by contacting Calaveras Cement Company in San Andreas at (209) 754-4231. This mine will eventually be re-opened. It has a 15-mile slurry line that takes raw products to the San Andreas processing plant. The road continues northwest and downhill to the Tuolumne River and the town of Stanislaus. There is a hydroelectric plant at Stanislaus.

Return to Parrot's Ferry Road.

0.0 Intersection of Parrot's Ferry Road and Camp Nine Road.

0.4 Vallecito Tertiary Channel in road cuts on both sides of the road.

GEOLOGIC MAP 16

Vallecitos to Angels Camp
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et. al, 1955; Logan, 1934)

VALLECITOSTO SAN ANDREAS ON HIGHWAY 4

0.9 Intersection of Parrot's Ferry Road and Highway 4. Turn left, go south toward Angel's Camp. Turning right at this intersection will take you to Murphys. A description of the

geology of Murphy's and the Murphy's grade Loop, which starts in Altaville and ends in Vallecitos, is found in Appendix I.

Vallecitos

1.1 Vallecito

Vallecito (#70) is 2.5 miles southwest of Douglas Flat. At the town of Vallecito a road from Columbia joins Highway 4. This road starts north from Columbia, following the Eocene Columbia River channel, passing close to a large marble quarry in Calaveras limestone to the east, and then descending the deep and spectacular canyon of the Stanislaus River. On the way one may look up into this magnificent canyon and limestone. Table Mountain Latite shows up prominently on the north side of the canyon as well as the south and, as the road winds down through granite rock, various fine scenes come into view until finally the road crosses the river at Parrots Ferry. At the bridge built near the site of the old ferry landings are outcrops of granitic rock with inclusion of earlier intruded rock bodies. From the bridge you can look upward 1,000 feet higher to the two stubs of the isolated Table Mountain Latite. On the north side, high up on the canyon wall, may be seen the V-shaped cross-section of the lava-filled channel which was cut into granitic rock. This lava flow occupies the sinuous course of what may have been the ancestral Stanislaus River which flowed southward across this site when it lay at a much lower elevation. As the Sierra Nevada block was raised and tilted slightly westward, the present newly born Stanislaus River, flowing down the Sierra slope cut and carved a canyon through the lava and underlying rocks, keeping its course as the Sierra surface rose, and cutting deeply into the granite. Not only is this lava-filled channel cut in two, but also the earlier Columbia channel is bisected. A continuation of this channel which was left just north of Columbia is again encountered on the road as it reaches the old surface after the climb out of the canyon. The roads follows along this ancient channel and the edge of the present Coyote Creek canyon at the bottom of which, 300 feet lower in elevation, is a Natural Bridge or remnant of a limestone cave through which the creek now flows (Bowen and Crippen, 1949).

Figure 128. Vallecito rhyolite building (1949, CDMG)

Figure 129. Vallecito Wells Fargo building front door (1949, CDMG)

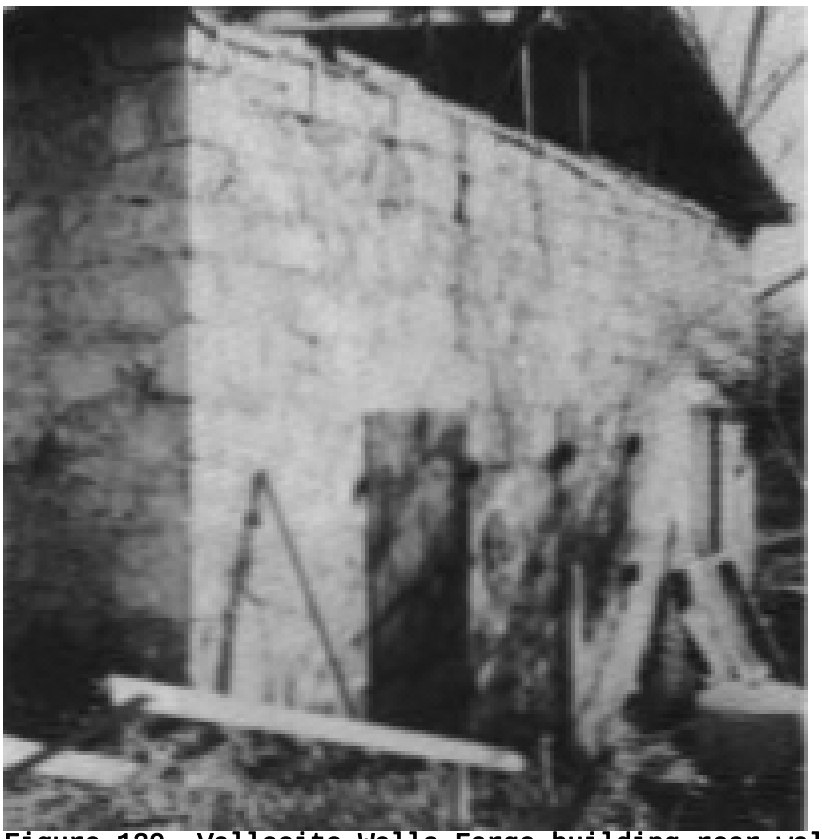


Figure 130. Vallecito Wells Fargo building rear wall (1949, CDMG)

Figure 131. Vallecito Wells Fargo stables (1949, CDMG)

1.9 Red Hill Road. Table Mountain on right (north). To the north is the Golden River Mine.

2.0 to 2.5 Auriferous Vallecito Tertiary channel in road cuts.

2.9 Ponderosa Road intersection on the right.

3.0 Six Mile Creek Road. Vallecito Western Placer Mine (#76) is 0.25 miles to the north past

a mass of ultrabasic rocks.

Between Six Mile Bridge and the Rollers Bypass, Highway 4 roadway approximates the contact between Valley Springs Tuff to the right (north) and Calaveras interbedded chert, graphic phyllite and schist to the left (south).

3.1 (MP 24.05) Six Mile Creek Bridge.

3.6 Massive rhyolite tuff of Valley Springs Formation

4.8 Angels Camp town limits in metavolcanic rocks of the Calaveras Group.

4.9 Rollers Bypass Road intersection on right. Between the Roller Bypass and the intersection of Highways 4/49, the roadway traverses pyroclastic rocks, chert, graphic phyllite and schist, Salt Springs Slate and Paleozoic green schist metavolcanics of the Calaveras Complex.

5.1/0.0 Junction Highways 49 and 4 at Angels Creek Bridge. Turn right, go north on Highway 49. Reset odometer.

Angels Camp

Angels Camp (#77), 3.0 miles (5 km) north of Carson Hill, was founded in 1848 by Henry Angel. It is modern up-to-date town with few buildings of historical interest remaining. Although its stream placers were rich, the lodes proved richer and more permanent. Some were exploited as late as 1920 (Bowen and Crippen, 1949).

Angel was a soldier who came to California during the Mexican War. In May, 1848 he and 90 other men reached Calaveritas Creek. Angel set up a trading post. Four years later, the camp had a population of 4,500.

Although the stream placers were rich and attracted miners to the area (including George Angle), the life, wealth, and performance of the district came from the lode mines. "In 1857 there were eight water-driven mills with seventy stamps and four steam mills with forty-eight stamps" (Gudde, 1975). The stamp mills were employed to break up the gold-bearing quartz to liberate the gold. The Utica Mine was the largest producer between Carson Hill and Jackson (Landefeld and Snow, 1990).

Figure 132. Angels Camp steam tractor (2003)

Figure 133. Angels Camp Angels Hotel (1949, CDMG)

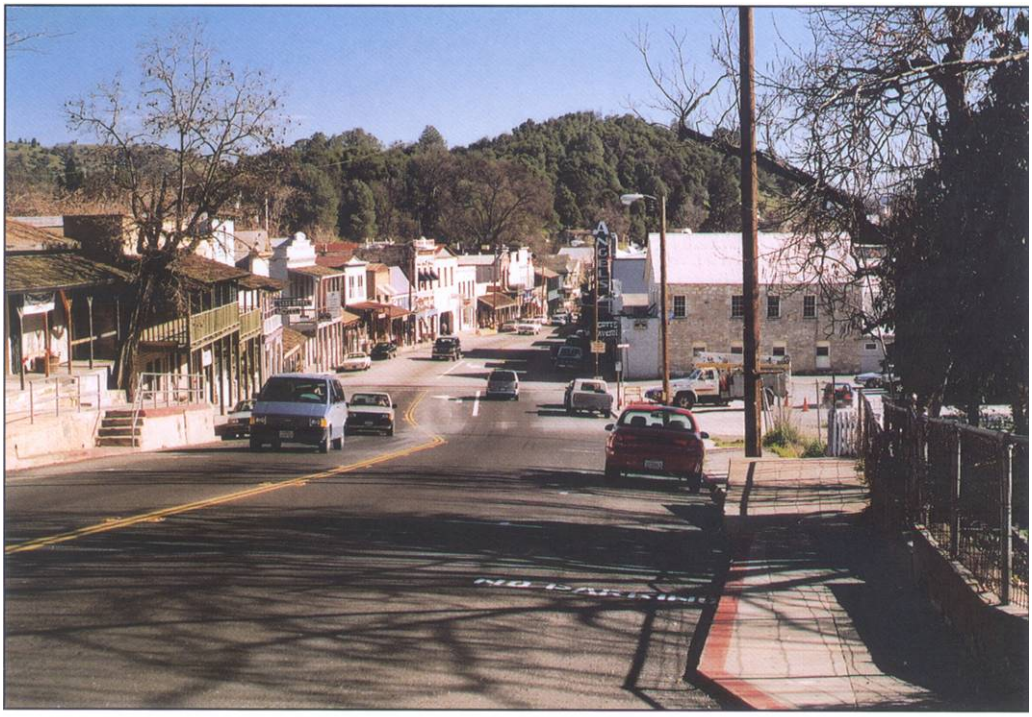


Photo 7. Highway 49 through Angels Camp, home of Mark Twain's famous jumping frogs of Calaveras County. View to south. *Photo by Max Flanery.*

CG 1997:92

Figure 134. Angels Camp main street (1997, CGS)

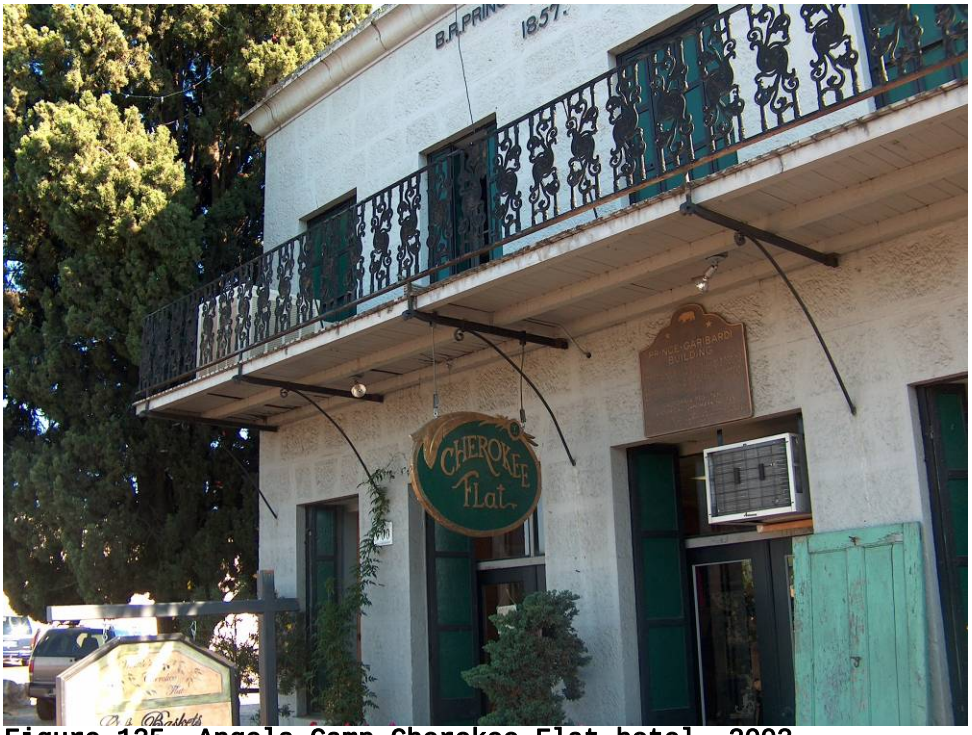


Figure 135. Angels Camp Cherokee Flat hotel, 2003

Figure 136. Angels Camp rhyolite on Eocene surface (1949, CDMG)

The district produced in excess of $27,000,000 worth of gold (approximately 1,340,000 ounces) mostly before 1920 (Clark, 1970). The Utica Mine production accounts for over 60% of that figure. There are three major zones of quartz veins and altered wall rock. The Utica Mine and the mines along Main Street are along the eastern zone. Gold Cliff mine is along the middle zone. There is a western zone as well. Schistose metavolcanic clastic rocks are the most common host rocks in the district. Carbonate-sericite-pyrite-rutile is the common alteration product owing to the abundance of mafic and intermediate metavolcanic rocks (Landefeld and Snow, 1990).

Figure 137. Angels Camp Gold Cliff Mine, 1880 (1998, CGS)

0.1 Angels Camp Historical Marker on left (west).

Utica Mine

0.15 Utica Mine City Park (#85) is on the left (west).

The Utica Mine, which was a consolidation of the Utica. Stickles, Raspberry, and six other claims, is by far the most famous mine between Carson Hill and Jackson. Although fires and cave-ins hampered production from time to time, the Utica produced gold to the amazing total of nearly 680,000 ounces ($17,000,000). The veins and hence the shafts are nearly vertical and the deepest part of the mine is 3,050 feet (930 m) below the surface via shaft and winze. The veins are faulted off on the south side of town and attempts to relocate the ore shoots south of the cross-fault have failed. The working shaft and adjacent stopes are located on the north side of town in an area now set aside as a Mark Twain city park. The depressed portion of the park is the result of the caving of the stopes beneath (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

0.2/0.0 Angles Creek bridge.

SIDE TRIP TO GOLD CLIFF MINE

Go slowly and turn left at the first opportunity after the bridge into Finnigan Lane.

0.3 Turn right onto Gold Cliff Road. Gate to Gold Cliff Mine (#86) is on the left.

0.5 Gold Cliff Mine. You must get permission from Cambior U.S.A. Corporation to visit this property.

Gold Cliff Mine

One half mile west of the Utica is the Gold Cliff Mine (#86), which was operated by the Utica Mining Company for about five years after the Utica closed down. It is on the main Mother Lode fault system whereas the Utica is probably on the same east spur as are the Carson Hill ore bodies. The vein averaged 45 in dip, and most of the ore came from above the 1,900 foot level. Between the 1,600 and 1,700 foot levels, the ore bodies are offset to the north by a nearly horizontal fault of several hundred feet displacement. A crosscut from the 1,500 foot level of the Utica mine connects with the Gold Cliff mine (Bowen and Crippen, 1949).

The Gold Cliff mine was a separate operation. It yielded 142,000 ounces (about $2,834,000) of gold from 1,400,000 tons of ore with an average grade of 0.1 ounces per ton gold. Ore from the Gold Cliff was mined from a small open pit and from workings which extend to about 2,000 feet below the surface (Landefeld and Snow, 1990).

Continue on Gold Cliff Road to Hill Crest Street.

0.9 Turn right on Hill Crest Street.

1.0 Turn left on West Street to Mark Twain Street, thence eastward to Highway 49.

1.4/0.0 Rejoin Highway 49, turn left toward Altaville. Reset odometer.

The major mines of Angels Camp, such as the Angels Mine, were at right about one-half mile to the south. The Angels Mine produced about $3,250,000 worth of gold (approximately 157,000 ounces, Clark, 1970). A detour to the Angels Camp museum is recommended. It is to the right, on the northeast side of the street (Landefeld and Snow, 1990).

SIDE TRIP TO CENTRAL HILL CHANNEL

0.0 Begin this loop at the intersection Highway 49 and Murphy Grade Road. Go east on Murphy Grade Road in Angel's Camp.

1.0 Intersection Murphy Grade Road and Rolleri Bypass Road. Go right on Rolleri Bypass Road. TURNOUT STOP. View of Calaveras Central Drift Mine headframe to northwest. Note also on east side of road is historic rhyolite tuff building stone quarry. Tuff unit is assigned to the Nine Hills Tuff unit of the Valley Springs Formation of Miocene age (22.2 million years).

The Tertiary age Central Hill Channel flowed northwesterly across the adjacent valley area encompassing the present Rolleri Ranch (to left), across the present Murphys Bypass and through the Central Hill Mine area (#80), past the Jupiter Mine area to meet the confluence of several major Tertiary Channel tributaries in the San Andreas area, some 12 miles northwest.

1.4 View of Angels Camp historic downtown district to right. Bear Mountain Fault Zone in background.

1.6 Tertiary Channel rim gravels exposed in contact with bedrock slate as roadway drops into the Angels Creek drainage.

1.8 Intersection of Rolleri Bypass and Highway 4. Proceed west on Highway 4.

2.8 Intersection Highway 4 and Highway 49. Proceed south on Highway 49.

RESUME FIELD TRIP ON HIGHWAY 49.

MILAGE FROM ANGEL'S CREEK BRIDGE (Intersection of Highways 4 and 49).

Between Angels Camp and Fourth Crossing, Highway 49 is in Paleozoic greenschists.

0.2 CHLORINATION PLANT (removed).

Two-tenths of a mile from the junction of Highway 4 and 49 in Angels Camp is the site where the old Chlorination plant. Chlorination was an early day method of recovering gold from concentrates before the process of cyanidation was discovered (Bowen and Crippen, 1949).

LIGHTER MINE

0.5 Lighter Mine on left (west).

0.7 Angels Camp museum.

0.9 Angels Camp Mine is 0.5 mile to the south of this point and produced over $3,250,000 (about 157,000 ounces) of gold (Clark, 1970).

ALTAVILLE

1.1 Altaville

Altaville (#79), located at the junction of Highways 49 and 4 one mile north of Angels Camp is, like its larger neighbor a modern town with but few remaining historical spots. Originally known as Cherokee Flat. Altaville was a crossroads point of supply for adjacent placer mines. A group of drift mines which has produced much placer gold is located to the east of Altaville and Angels Camp. The term drift mines is applied here to underground placer mines which reach the old buried river gravels by shafts and tunnels (Bowen and Crippen, 1949).

The Calaveras, Central, Slab Ranch, Golden River, and Vallecito Western are some of the mines in this region, all of which entered the Central hill gravel channel at different places on its course. This fossil stream channel lies about 300 feet (90 m) beneath the surface and is filled with gravel and volcanic ash. The Calaveras Central workings are extensive and reach the buried channel on a bend in its course from west to north. Coarse gold nuggets were found on the bedrock slate riffles where the Eocene gutters cut across and followed the structure. Huge boulders lie on the upturned edges of the slate. Rhyolitic lakebed ash containing fossil leaves lies upon this course gravel. Above this and filled to the surface is volcanic ash and stream gravel of all sorts. Many of these mines are between Murphys Grade Road, which runs east of Altaville and highway 4, which runs east of Angels Camp. See side trips to Calaveras Central and Murphy’s Grade loops (above) (Bowen and Crippen, 1949, modified by CGS, 1997).

1.2 Old Altaville school is on left. Murphy's Gade Road intersection is on the right.

Figure 138. Altaville Schoolhouse, 2006

Figure 139. Altaville foundry ruins, 2003

Figure 140. Altaville Prince Albert and Garabaldi store (1949, CDMG)

Figure 141. Altaville rhyolite quarry (1949, CDMG)

Altaville's Bret Harte High School on right. On the left, the route passes the Prince and Garabaldi store which was built in 1857 of Valley Springs rhyolite tuff. The tuff was quarried about a mile east of here. About 0.7 miles east of the school is the Calaveras Central Mine that exploited the Eocene (?) Central Hill gravel channel. This was one of a number of drift mines that mined the Central Hill Channel. This fossil stream channel lies buried about three hundred feet beneath the surface and is filled with gravel and volcanic ash. The workings of the Calaveras Central Mine are very extensive and are excavate the buried stream channel on a bend in its course. Gold nuggets were found directly on bedrock slate riffles where the Eocene gutters cut across and followed the structure (Bowen and Crippen, 1948; Landefeld and Snow, 1990). Information on the Calaveras Central and other mines east of Angels Camp and on a side trip through the Murphy's Grade Loop are described above and in Appendix I.

1.4 Intersection of Highways 4 and 49 Altaville Highways 4 and 49. Go straight on highway 49. Taking highway 4, to the left (west) will take you to Copperopolis. This area is underlain by Paleozoic greenstone metavolcanics. North of Altaville, there is little of geologic interest along Highway 49 until Calaveritas Creek is reached.

GEOLOGIC MAP 18

Angel's Camp to Fourth Crossing
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et al, 1955; Logan, 1934)

2.7 Road is parallel to cleavage in the metavolcanic rocks that is exposed in roadcut to the right. These are mafic volcanic sedimentary rocks of the eastern belt, and are probably equivalent to beds in the Logtown Ridge Formation or upper Mariposa Formation (Landefeld and Snow, 1990).

3.9 Calaveras Gem and Mineral Society meeting place on left.

4.5 Cosgrave Road.

5.4 (MP 12.51) Cross over San Domingo Creek.

Look right to see the remains of placers that were mined along creek. This area is underlain by Salt Springs Slate, a member of the Calaveras Complex. The Salt Springs is chiefly slate derived from siltstone, and it includes tuff, graywacke and petromict and polymict conglomerate.

6.5 Ruins on right (northeast). The Thorpe Mine is on the left (southwest). The Thorpe is also called the Big Four Mine.

THORPE MINE

The Thorpe Mine (#87) was one of several mines in this somewhat spread-out district between Angels Camp and San Andreas. Production figures are not available. The ore "consists of a zone of parallel quartz veins and stringers in amphibolite and chlorite schist [metavolcanic rock]. The veins contain pyrite, calcite,
and some ankerite....It was reported that the ore was mostly where the margins of the main fissures were cut by zones of oblique fissuring..." The main shaft extended to about 700 feet depth" (Clark and Lydon, 1962; cited in Landefeld and Snow, 1990)

FOURTH CROSSING

7.0 (MP 14.09) Fourth Crossing Bridge (#88) across San Antonio Creek.

GEOLOGIC MAP 19

Fourth Crossing to South of San Andreas
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934)

The Calaveritas Hill and Railroad Hill mines are eastward of this point, along San Antonio Creek. The Calaveritas Hill Consolidated Mine is located on a small body of Mehrten Formation. From Fourth Crossing to Willow Creek School, Highway 49 follows Willow Creek the location of which is controlled by a sliver of Salt Springs Slate.

7.7 Calaveras Group rocks on ridge at 11:00 o'clock position.

8.1 Calaveras Country Airport road intersection on left (south).

9.0 Union Mine (#88) is 0.5 miles to the west. To the west also are the Cherokee and Black Oak Mines.

CALAVERITAS CREEK

9.4 (MP 16.41) Calaveritas Creek

At Calaveritas Creek (#89), the gently rolling grazing land is probably much like the ancestral Eocene land surface. Remnants of auriferous gravels can be seen to the east of the road particularly between Calaveritas Creek and San Andreas. The bedrock is schist and greenstone of the Calaveras Complex. In several places along Calaveritas Creek, both southeast and southwest of San Andreas, limestone lenses occur in the Calaveras Complex which are suitable for use in making Portland cement. Although parts of the lenses are dolomitic and carry too high a magnesia content for cement, excellent bodies of cement-grade limestone occur in them and are being exploited at the present time. Crossing Calaveritas Creek and looking right we can see evidence of placer mining upstream to the right and east of the highway most of the way to San Andreas (Landefeld and Snow, 1990; Bowen and Crippen, 1949, modified by CGS, 1997).

Figure 142. Calaveras Creek railroad overpass, 2006

Figure 143. Calaveras Creek rock wall, 2006

Figure 144. Calaveritas adobe and brick house (1949, CDMG)

Between Calaveritas Creek and San Andreas, Highway 49 follows a fault line with Calaveras metasediments to the east and metavolcanic greenstones to the west.

GEOLOGIC MAP 20

San Andreas Area
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934)

9.4 Calaveras Cement Company "railroad" overpass in Calaveras Formation. The overpass was constructed to support a railway, but none was ever built here.

CALAVERAS CEMENT COMPANY PLANT

The Calaveras Cement Company's San Andreas Plant (#91) is 2.5 miles south of San Andreas. The plant is gradually being disassembled. When mining at the Camp Nine Quarry resumes, a new efficient limestone plant will be constructed. The historic Kentucky House is located nearby the Plant. A private road and overpass connects the plant to its eastern limestone quarries and crosses Highway 49 at the Calaveritas Creek Bridge (Bowen and Crippen, 1949).

The Calaveras quarries have filled with water and now are fresh water lakes (#90) that are stocked by the Calaveras Mining Company with trout. This is private property, and public fishing is not permitted.

11.1 Calaveras Cement Holland Mine to left (south).

Calaveras Cement Company operated the Holland Mine Limestone Quarry to the left. The limestone body is a pod in a tectonic mélange that also contains a large serpentinite body. The mélange had been mapped as a "western belt" of Paleozoic Calaveras Formation by Clark (1964) and earlier mappers. The mélange constitutes the Melones fault zone in this area (Landefeld and Snow, 1990).

11.7 San Andreas (#77) town limits. This town was established by Mexican prospectors in 1848.

11.8 Mountain Ranch road intersection.

SIDE TRIP TO LIMESTONE MINE LAKES

12.2/0.0 Flashing yellow light in downtown San Andreas at intersection of Church Hill Road. Turning right at this point would take us to the San Andreas Museum. We turn left and head south toward the Western Stone limestone/aggregate mine. Reset odometer.

1.1 Poole Station Road. Turn left, go southeast toward Western Stone Mine.

1.9 Water-filled quarry of Western Stone Products Company.

This man-made lake is accessible by permission from the mine owner. Western Stone is a subsidiary of Calaveras Cement Company. Here the company is processing "waste" rock from the discontinued limestone mining operations for decorative rock. Often times it is asked what happens to a mine when mining all the valuable material is excavated from it. While many excavations are backfilled and revegitated, some can be converted to riparian areas and other wetland uses. After seeing this water-filled quarry, we return to San Andreas and reset the odometer. Return to San Andreas

REGIONAL MAP 04

San Andreas to Sutter Creek
With Royal Mountain King Mine, Penn Mine, and Volcano Loop

SAN ANDREAS

0.0 Flashing yellow light at Highway 49 and Church Hill Road.

San Andreas (#77), as the name implies, was first settled by Spanish Californian miners in 1848 or 1849 (Landefeld and Snow, 1990). As usual they were persecuted and driven out of town whereas other minority groups, such as the Chinese, were allowed to remain. Present day San Andreas, the county seat, has buildings dating from as early as 1851, including well-preserved County Courthouse and County Museum buildings. The museum occupies one of the best preserved, oldest buildings in the town and contains rocks, minerals and artifacts (Bowen and Crippen, 1949, modified by CGS, 1997).

Joaquin Murieta

As the Yankees arrived in San Andreas and other mining communities, the Mexicans were

displaced or murdered. One Mexican who was hung by American prospectors was the brother of Joaquin Murieta. For this, his own beating, and the rape of his brother's wife, Joaquin became one of the Gold Country's most famous outlaws. All of the 21 miners involved in the murderer of his brother were "brought to justice". Nineteen of these died at the hands of Murieta himself. There are legends about Murieta robbing from the rich and giving to the poor. Truth is not as good as legend, but Murieta and his band are credited with several robberies and 24 murders from January to July, 1853. In May,1853 the Governor authorized Captain Harry Love with a warrant for Murieta's capture dead or alive. Love chased Marietta across the San Joaquin Valley to Coalinga where somebody thought to be Murieta was killed along with Manuel "Three Fingered Jack". The head of Murieta and the 3-fingered hand where preserved in brandy. Love got 17 affidavits that the head was indeed that of Murieta. The head and hand eventually went on display in Stockton and then San Francisco for $1.00 admission (Nadeau. 1992).

East of San Andreas, the terrain is underlain by a southeast-striking re-entrant of eastern belt metavolcanic rock. Its protolith is similar to rocks of the Logtown Ridge and Penon Blanco Formations. It is intruded by a Bothonian-age diorite pluton named the Old Gulch Pluton (U-Pb on zircon, Sharp, 1984) which has since been deformed and warped. The pluton is likely cogentic with the volcanic pile it intruded in a manner similar to the Horseshoe Bend Pluton (Landefeld and Snow, 1990).

GEOLOGIC MAP 20-A

Central Hill to Valley Springs
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1983)

1.1/0.0 Intersection of Highways 12 and 49.

SIDE TRIP TO THE PENN MINE

0.0 Intersection of Highways 12 and 49. Go left (west) on Highway 12 toward Valley Springs.

1.0 Pioneer Cemetery (#92) on left (south).

1.2 Cross north fork of the Calaveras River. Rocks to the east are Calaveras Formation, those to the west are Mariposa Slate.

2.1 Central Hill Road on right (north).

3.4 Central Hill Mine (#93) on right (north) with Tertiary gravels.

4.0 Double Springs Road on right (north). From Double Springs Road to Gillam Road, Highway 12 traverses Tertiary gravels.

4.4 Cross Haupt Creek (#93), underlain by Tertiary gravels.

4.5 Highway 26 intersection. Go straight (west) on Highway 12.

5.8 Gillam Road. From this point to Paloma Road, Highway 12 goes through serpentine and ultramafic rocks.

5.9 Dredge tailings in Valley Creek on the right (north).

7.1 Paloma Road on the right (north). From Paloma Road to Valley Springs, Highway 12 traverses Mariposa Formation and Quaternary alluvium.

7.9 Castle Rock is on the right (north), composed of Cretaceous Ione Formation.

Valley Springs

8.4/0.0 Junction of Highways 8 and 12 at Valley Springs (#95). Reset odometer. Turn right (north) one block, then right and go northeast toward Pardee Reservoir.

GEOLOGIC MAP 20-B

Valley Springs to Penn Mine
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1983)

0.4 Gravel pit on left (west).

0.9 Junction of Paloma Road and Watertown Road. Keep to the left (north) on Watertown Road. This intersection is underlain by Tertiary-Quaternary gravel.

1.5 Mehrten andesitic mudflows.

2.5 Old railroad cut in Tertiary-Quaternary gravel.

2.6 Cutoff to Pardee Reservoir. Go left (west toward Campo Seco).

3.0 Mining ditches on left (south).

Camp Seco

3.6/0.0 Campo Seco (#96). There are several historic buildings remaining in this area. It is underlain by Jurassic Gofer Ridge volcanics.

0.5 Road on right (north) goes to gravel pits in the Ione Formation.

0.7 Road to pipeline pump house on left (south). This pipeline takes water from the Pardee Reservoir, through the Pardee Tunnel into the Mokelumne Aqueduct.

Figure 145. Camp Seco tombstone rocks (1949, CDMG)

Figure 146. Camp Seco brick and stone oven (1949, CDMG)

Figure 147. Camp Seco Adams Express building (1949, CDMG)

Penn Mine

1.3 The Penn Mine (#97).

History

This copper mine is written about in environmental and mining textbooks as an example of acid mine drainage. The geology of this deposit and it's location in the Calaveras River drainage area are the basis for understanding the current condition of the area and of programs that are attempting to halt the acid drainage.

Figure 148. Camp Seco Penn Mine headframe (1949, CDMG)

The following discussion is extracted from Clark and Lydon (1962):

The Penn was one of the principle copper producers in the Western Copper Belt. It also produced zinc, lead, gold and silver.

Copper was discovered in 1867 (Browne, 1867). The principle claims were the Campo Seco, Hecla, Little Satellite and Satellite. In 1865 an 8-ton Welch-type smelter was constructed which yielded copper matte of 35% copper. After the Civil War, this operation closed down.

From 1883 to 1886 an adit expansion in the No. 1 Shaft (Lancha Plana claim, renamed the Satellite) yielded 1,000 tons of ore and mine dumps were leached (Aubery, 1908, p.239). Dumps at Camp Seco were roasted and leached at the Sunrise Placer Mining and Copper Reduction Works (Hanks, 1884). During this period of dump leaching, the mines were mostly flooded.

About 1886 the San Francisco Copper Company purchased the Satellite Mine. In 1887, the Penn Mine acquired the Campo Seco claim and began dewatering. They treated their newly-excavated ores by roasting and leaching (Irelan, 1888). 1n 1896 dump materials at all the mines were still being leached (Crawford, 1896).

Because of the proximity to the Calaveras River, the relatively low water table, the highly fractured nature of the area, and the mineralogical condition of the copper deposit acid water generation took place.

In 1899 a smelter was erected and operated almost continuously until 1919. (Tucker, 1916). This smelter produces a matte product with 50-60% copper (Heyl et. al, 1948, p. 64). Following World War I, smelting became uneconomic, but the high-grade chalcopyrite veins continued to be produced and dewatering (and acid water generation) continued through 1926. Between 1926 and 1928 the mines presumably filled with water again.

In 1928 the mine was leased by Mateo Mining Company and the No. 2 Shaft was dewatered to 700 feet. Only a small amount of ore was mined. Another short-lived operation was conducted in 1937 (Heyl et al., 1948, p. 64).

During World War II (1943 to 1946) a major redevelopment occurred by the Eagle-Shawmut Mining Company. Ore was trucked to the Eagle-Shawmut mill near Chinese Camp. Copper-zinc concentrates were produced there and sent to Utah for smelting. Several government reports were produced about the Penn Mine from 1942 to 1948 (U.S. Bureau of Mines, 1947; Heyl et al., 1948; Weibelt and Ricker, 1948).

In 1948 another redevelopment, and yet another dewatering of the upper mine levels (oxide ore?) occurred under lease to the Penn Chemical Company. During this redevelopment, zinc ores that had previously been avoided were produced. The mine closed in 1953. Additional exploratory drilling was done in the vicinity of the No. 3 Shaft between 1953 and 1954.

In the fall of 1955, the property was leased to the Standard Mining Corporation. The No. 3 Shaft was dewatered to the 400-foot level and a few crosscuts were developed. To additional leasing phases occurred between 1958 and 1959. Operations were suspended in late 1959. In 1962 the mine was owned by the New Penn Mines, Inc. of New York.

In 1952, total production was 973,784 tons of ore yielding 82,534,054 pounds of copper, 22,196,482 pounds of zinc, 1,225,798 pounds of lead, 67,773 ounces of gold and 2,150,304 ounces of silver (Heyl et al, 1948; U.S. Bureau of Mines, 1947-1952). This material was produced through about 10 miles of underground workings that may reach to depths of 3,000 feet. In 1994 all of the workings were flooded and most of the mine portals have collapsed.

A description of environmental challenges at the Penn mine is found in Wheeler (1994). The following information is adapted from that article.

Penn mine waters have a pH of 2.2. Drainage from the mine finds its way to the Mokelumne River. Flooding of the old mine dumps in between 1964 and 1978 resulted in the killing of 170,000 king salmon fingerlings at a fish hatchery build just below Comanche Reservoir. The poisonous water was traced back to the Penn mine. The acid mine water is cold and denser than the warmer waters of the Mokelumne River. The acid water flows along the bottom of the river with little mixing. The copper-and-lead laced acidic water entered the hatchery through a siphon near the base of the dam. The East Bay Mud Company was hired to mitigate the damage under contract with the Central Valley Regional Water Quality Control Board and the California State Department of Fish and Game.

The strategy had to keep acid water from flowing into the Calaveras River had two components: 1) erecting water diversions around the copper mine dumps, and 2) pumping acid waters that

were generated as rain soaked though mine dumps to a series of holding ponds. The idea was that evaporation would keep the acid on the mining claims. The ponds were not lined, and now percolation of acid water is reaching the ground water table. The re-cycling of the acid waters result in increased dissolution of sulfide minerals. When this occurs, further acid is generated. The current procedures being used at the Penn appear to some investigators to have enhanced the problem by creating a positive-feedback mechanism that increases the amount of acid water at the mine, in the groundwater and in the river.

Host Rocks

Rocks in the Penn Mine area are Mariposa slate, metavolcanic rocks of the Amador Group and intrusives. The Amador Group metavolcanics consist of a thick sequence of rhyolite and andesite tuff, felsite, basalt and agglomerate. These have been invaded by quartz porphyry sills and lens-shaped bodies. Heyl et al. (1948) describe the intrusive rocks as felsite, greenstone and trap. Ore bodies are lenticular sulfide deposits which were interpreted by Heyl et al. as replacement bodies in alteration zones. There are zones of sericitization, silicification and pyritization. The alteration is pervasive, being in both the metavolcanics and the intrusives. Today we would refer to these as a variety of "Volcanogenic Copper-Zinc Massive Sulfide" deposit.
The Jurassic-age metavolcanics are overlain by Cretaceous Ione Formation gravels. Today the Old River 5 Placer Mine is excavating and producing gold from these gravels. This is a significant development. It used to be said that all ancient placer deposits in California were of Tertiary age. Now we know that some of them are Cretaceous. The placer deposits are an interesting example of reverse topography. The hills are made of resistant gravel which once formed in streambeds. Now the area has been uplifted, and the more-easily-eroded Mariposa slate washes away leaving the gravels as sinuous ridges.

Ore Bodies

The Penn Mine deposits are made of pyrite, chalcopyrite, and sphalerite with small amounts of bornite, galena and some tetrahedrite. The ore bodies are lenticular in form with long axes plunge down-dip or steeply to the north and south. The lenses vary in size from a few to 1,000 feet in their longest dimension (Heyl et al., 1948, p. 79). The copper to zinc ratio varies considerably throughout the mining district. Thickness of ore bodies ranges from 4 to 30 feet. The sulfides are present in massive or banded forms as well as in stringers, irregular masses or as disseminations. Most pyrite is fine-grained. Chalcosite and covellite occur in upper levels of the mines. Barite inter grown with sulfides is locally abundant in some ore bodies. Gangue minerals are quartz, calcite, selenite. There is also some native copper. Plate tectonic models for this type of mineralization envision deposition of sulfides at spreading centers through underwater hot springs or "black smokers".

Controls on Mineralization

Heyl et al. (1948) identified four ore controls for the Penn Mine:

1) belts of sericitization and silification.
2) areas of bowing and buckling normal to schistosity.
3) intersections of high-angle schistosity faults with low-angle reverse faults.
4) small, tight, and unsystematically oriented schistosity folds.

Placer Mining Near the Penn Mine

In 1997 there was a placer mine in operation, just 1/4 mile east of the Penn Mine. This operation is on private and BLM lands. Much of the private lands were purchased at auction for unpaid taxes. The mining operation excavates ancestral Calaveras River gravels in the Ione Formation.

These gravels now form reverse topography: they occupy ridges that were once river valleys.

The Old River 5 Placer works gravels with white quartz cobbles that average 2 inches in diameter. The operator calls this the "Old River facies". Above this gold-bearing white gravel are younger, higher-energy gravels that contain larger boulders of. This is called the "Main Channel facies" and has an average clast size of 4 to 10 inches with boulders commonly 18 inches in diameter. The Main Channel cuts through the Old Channel and incorporates quartz clasts from it in the Main Channel sediments.

This road log continues on Map 20 at the intersection of Highways 12 and 49, north of San Andreas. From San Andreas, an old segment of Highway 49 called Gold Strike Road traverses 4 miles (6 km) or rolling grazing land of no particular geologic interest.

GEOLOGIC MAP 20

San Andreas Area
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934)

RESUME FIELD TRIP ON HIGHWAY 49

0.0 Intersection of Highways 12 and 49. Turn right to stay on highway 49 and reset odometer.

Between San Andreas and Old Woman Gulch, Highway 49 follows the eastern edge of a mass of Calaveras pyroclastic metavolcanic rocks.

0.2 Gottschalk Mine (#98). Quartz vein at left. Ore was mined from a large quartz vein and altered wall rock, a talc-pyrite schist (Landefeld and Snow, 1990).

GEOLOGIC MAP 21

San Andreas to Chile Gulch
(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934; Goldman, 1964; Bortugo, 1979)

0.5 Kate Hageman Mine (#99) on the left (west) in Calaveras pyroclastic rocks near a small body of serpentine and dunite.

KATE HAGEMAN MINE

The headframe and buildings of the Kate Hageman Mine (#99) are located near the bridge which crosses the North Fork of the Calaveras River, 2.2 miles northwest of San Andreas. The Kate Hageman was developed during the 1930's and considerable modern mill equipment was installed. Both open-cut and underground mining have been attempted there. The mine has been idle for some time. Wall rocks are greenstone and slate; a serpentine contact is close by to the west. The creek bottoms near the Kate Hageman have been worked for placer gold (Bowen and Crippen, 1949).

0.6 As can be seen by noting the sparse vegetation, the bedrock on both sides of the road is serpentine (Landefeld and Snow, 1990).

0.8 Murray Creek.

1.0 North Fork of Calaveras River (#103).

1.2 Serpentine

1.7 Gold Strike Road.

3.0 Calaveras Group rocks in roadcut.

3.1 Hydraulic mine worked Central Hill Channel on right (east).

3.2 Hill ahead is Golden Gate Hill. At the south end of this ridge is the Gold Hill Mine. This ridge is a hornblende biotite dacite dome of pre-Mehrten Formation or lower Mehrten age (15 to 10 million years). The Miocene-Pliocene Mehrten Formation was deposited around the dome (Rose, 1959; Landefeld and Snow, 1990).

3.3 Road cut through Tertiary ash of the Miocene-Pliocene Valley Springs Formation (Landefeld and Snow, 1990).

3.6 Tertiary gravels on left (west) and refuse disposal site.

4.1 Old McSorley house (#105) on right. This house is characteristic of older rural houses throughout the Mother Lode region (Landefeld and Snow, 1990).

4.3 Tertiary gravels on top of hill at bend in road.

4.5 Spring Creek.

4.6 Road cuts are metabasaltic pillow lavas of the eastern belt, similar to those at Priest Grade and Sullivan Creek (Landefeld and Snow, 1990).

4.7 Gravel mine to west (left).

CALAVERAS CRYSTAL MINE

4.8 Calaveras Crystal Mine.

The Calaveras Crystal is a drift mine driven beneath the Valley Springs rhyolite opposite the Chile Creek placer diggings. It can be reached by a dirt road from Highway 49. The road joining Highway 49 comes to it from the east at a point 6.5 miles north of San Andreas or 2.5 miles south of Mokelumne Hill. The mine is on a branch of the Mokelumne Hill Channel System known as the Tunnel Hill Channel. The large quartz crystals (up to 100 pounds) have made the mine famous and are partly of optical and electronic grade. Considerable quartz for this purpose was marketed World War II. An adjoining mine on the McSorley Ranch operated by the Rough Diamond Mining Company also produced considerable quantities of optical-grade quartz. Although not so well known as the Calaveras Crystal, reserves of quartz crystals in this mine appear to be greater than those of its more famous neighbor (Bowen and Crippen, 1949).

5.6 Road follows Chili Gulch (site of the “Chilean War”).

Between the Lompard Ranch and Mokelulmne Hill, Highway 49 goes through Valley Springs Formation, Calaveras Complex rocks, Mehrten Formation and Mesozoic granitic rocks (Mokelumne Hill Pluton).

GEOLOGIC MAP 22

Chile Gulch to Jackson

(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934, 1935; Goldman, 1964; Bortugo, 1979)
(Loyd, 1983; Taliaferro et al., 1950; Dunffield and Sharp, 1975)

CHILI GULCH TO MOKELUMNE HILL

Two miles northwest of the Kate Hageman Mine, a rather extensive group of Tertiary deposits is exposed on both sides of the highway from the vicinity of Chili Gulch (#106) to Mokelumne Hill. The ancient Mokelumne Hill river channel once traversed this region in a southwesterly direction and was joined, in the Chili Gulch vicinity, by a tributary which entered from the direction of San Andreas. Remnants of the old channel gravels have been extensively worked for gold by hydraulic and other placer means. The lofty faces of the hydraulic pits are not visible from Highway 49 but some of the gravels are exposed in road cuts east of Chili Gulch. The gravels lie nonconformably on metamorphic bedrock (schists and greenstones of the Calaveras Complex) and are overlain by the rhyolite tuff of the Valley Springs Formation and the andesite and andesite mudflows of the Mehrten formation in that order. Unconformities exist between the Valley Springs (Miocene) and the Mehrten (Miocene-Pliocene, at least in part) itself. Cliffed outcrops of yellowish-gray tuff of the Valley Springs Formation are prominent in many places along the Mokelumne grade. Exposures of the Mehrten can best be seen a short distance west of the town of Mokelumne Hill along Highway 26. A quarter of a mile south of the Calaveras Crystal mine, the Calaveras bedrock has been intruded by diorite. Dioritic rocks form the basement on which the Tertiary rests over a large area in the vicinity of Mokelumne Hill (Bowen and Crippen, 1949).

The Central Hill Channel is dissected by Chili Gulch thus enriching it by material from the older, richer Tertiary placer deposits.

5.9 Chili Gulch historical marker.

From here to Mokelumne Hill, Highway 49 passes through Tertiary gravels overlain by rhyolite tuff of the Valley Springs Formation and andesite gravels of the Mehrten Formation. The gravels lie on schist and greenstone of the eastern belt. Remnants of the old channels have been extensively mined. The auriferous gravels are distinctive in this area owing to the abundance of well-formed quartz crystals. These were mined for electronics applications during World Wars I and II (Durrell, 1944; Landefeld and Snow, 1990).

6.0 Adit (horizontal mine entrance) on the right exploited Eocene-Oligocene gravels below the ash of the Miocene-Pliocene Valley Springs Formation.

7.0 Summit of grade at Mokelumne Hill in granodiorite.

MOKELUMNE HILL

Mokelumne Hill (#107) was founded in 1848 by ex-members of Stevenson's Regiment of Mexican War fame. A stone historical monument erected by the Native Daughters of the Golden West is located close to the three story I.O.O.F. building. This building was erected in 1854 and added to in 1861. It is the first three story building in the Mother Lode country. Mokelumne Hill and Jackson once engaged in a feud over the problem of which town should get the honor of being county seat. Originally, Double Springs, some miles to the west of Mokelumne Hill, had acted as county seat until rapidly growing Mokelumne Hill claimed the honor. Jackson finally "seceded" from Calaveras County and formed a county and county seat all its own, now Amador County. The present Amador-Calaveras County line follows the course of the Mokelumne River in this area.

San Andreas is now the county seat of Calaveras County. Highways 5 and 8 cross 49 at Mokelumne Hill, Highway 26 continuing on to the east to mining districts in the vicinity of Westpoint (Bowen and Crippen, 1949).

This camp was discovered in August, 1848 by veterans of Stevenson's Regiment. The place exploded when rich diggings were found along Jackson. In 1850, Calaveras County was established at Double Springs which had only one building. At the time, Jackson and Mokelumne Hill were larger, so a special election was called for relocation. Mokelumne, having a larger population won, but during congratulatory beer-drinking at Double Springs, men from Jackson stole the election records. By the time the county clerk, at the direction of Judge Smith, recounted the votes, Jackson was declared the winner. Then, in April 1852 another election (this time without theft of ballots) resulted in Mokelumne winning. Thereupon, Jackson and neighboring camps walked out and established Amador County (Nadeau, 1992).

Capitalistic excesses were expected in Mother Lode Camps, and monopolies were common. In Mokelumne, the owner of the only general store was named Flash and the "Hill" got the nickname "Flashville" (Nadeau, 1992).

One miner who used peon labor was Dr. Concha. His Chilean miners drove a party of Americans off some rich ground that resulted in the "Chilean War." As a result, a resolution was passed banishing Chileans from the diggings around Mokelumne Hill. Dr Concha went down to Stockton for a warrant for the arrest of the Americans. In December, 1849, his "army" of about 60 marched into Mokelumne Hill, killed two American miners and took 13 prisoners. A counter-force of Americans was mustered out of the Mokelumne area as was a company of Rangers from Stockton. The thirteen prisoners escaped and the Chileans were captured and taken to Mokelumne for trial. Three were hanged, thus ending the "War" (Nadeau, 1992)..

Yet another "War" happened at Mokelumne, this time with the French. A group of Frenchman had a rich claim, and American miners attempted to seize it. The Frenchman dug in, planting a French Flag. The Yankee miners stormed the "fort" and carried off the high-grade ore (Nadeau, 1992).

A theater was established at Mokelumne late in 1851. During a presentation of *Richard III,* when the actor said "My kingdom for a horse", a Mexican burro that had been smuggled under the stage answered with fearful braying. In the confusion a stage had raised the footlights and a candle caught Richard III on the nose (Nadeau, 1992).

Stone Hill Quarries

Near the junction of Highways 26 (formerly Highway 8) and 49, a group of underground rooms and quarries, from which rhyolite tuff building stone was taken, can be observed. Mokelumne Hill was fortunate in having so satisfactory a source of building material so close at hand (Bowen and Crippen, 1949).

Road cuts to the west of Mokelumne Hill along Highway 28 afforded close-up views of the late Tertiary volcanic sequence. Three miles from the junction of highways 28 and 49, a long cut exposes the trace of a low-angle thrust fault which cuts both the schist bedrock and the overlying Mehrten rocks. This is an unusual type of post-Pliocene faulting for this area, although the fault is probably not of major extent. The trace of this same fault can be seen in the undercut face of one of the volcanic plugs to be seen on the south side of the road three-tenths of a mile farther west. There are three volcanic plugs of horneblend andesite are in this vicinity, This group of plugs, including Golden Gate plug considerably farther west, are made up of a rock described as hornblende andesite. These supposedly are the vents from which the Mehrten volcanics were derived (Bowen and Crippen, 1949).

7.1 Intersection of Highways 49 and 26. Enter Mokelumne Hill.

The name is derived from a Plains Miwok village near the river of that name. The ending -umne means "people of" as in Cosumnes and Tuolumne. Some Native Americans were called Muquelemnes as early as 1817, and the name Sajon [ditch] de los Moquelemes was used for a land grant in 1844. The present spelling was used by Fremont in 1848 (Gudde, 1969; Landefeld and Snow, 1990).

Between Mokelumne Hill and the canyon of the Mokelumne River the terrain is hilly. The Tertiary gravel and volcanic series has largely been stripped off and the tributaries of the Mokelumne have badly dissected the old Eocene surface. Northwest from town, Jackson Butte, a lofty volcanics plug, stands out above the other hills. Far beyond and to the northwest the metal water tank of the Argonaut mine can be seen on the ridge top. The bedrock along the highway is diorite and related plutonics until well beyond the Mokelumne River. A few gravel remnants outcrop near the road within sight of Mokelumne Hill.

Paloma Road at left leads to the town of Paloma (Spanish for pigeon). The Mother Lode trend passes near the town through Rich Gulch. The $6-7 million worth of gold (approximately 300,000 ounces) produced from Rich Gulch prior to the 1920's, made it one of the largest gold producers of Calaveras County. It was one of the first gold-quartz mines to open in California. By 1887, a 60-stamp mill and a chlorination plant had been built to process ore. The Gwin vein (and the fault that hosts it) and altered wall rock are in the footwall of the Melones fault zone. The setting is similar to the southern and northern mines of the Jackson-Plymouth district. The Gwin fault is sub parallel to but cuts bedding of the Mariposa Formation. There are two simple veins, the east vein and a west vein, with some zones of wall rock cut by quartz stringers. The main vein strikes N.12o W, dips 60-75o NE, and contains two ore shoots developed by a vertical shaft 2,533 feet deep. Vein gold was coarse and free-milling; the ore was characterized by quartz gangue, pyrite, arsenopyrite, native gold, with minor chalcopyrite, galena, sphalerite, sericite, albite, and carbonate. Arsenopyrite commonly contained leafy gold (Clark and Lydon, 1962; Landefeld and Snow, 1990).

7.2 Quarry in rhyolitic ash of the Valley Springs Formation is on left (Landefeld and Snow, 1990).

7.3 At right is a turnoff to the old part of Mokelumne Hill. There are several buildings built in the 19th century that are worth seeing, including the Ledger Hotel. Many of the buildings are built with bricks of rhyolite tuff (Landefeld and Snow, 1990). Take this detour to the old town of Mokelumne Hill. Turn right to go through town.

7.4 Mokelumne Hill historical marker. The town site for Mokelumne Hill is underlain by diorite of the Mokelulmne Hill Pluton.

7.5 Highway (business) 49 and Center Street. Turn right on Center Street to return to Highway 49.

8.1/0.0 Intersection of west Center Street and Highway 49. Reset odometer.

0.1 Jackson Butte Andesite Volcanic Plug (#108) at the 3:00 o'clock position on north side of Mokelumne River.

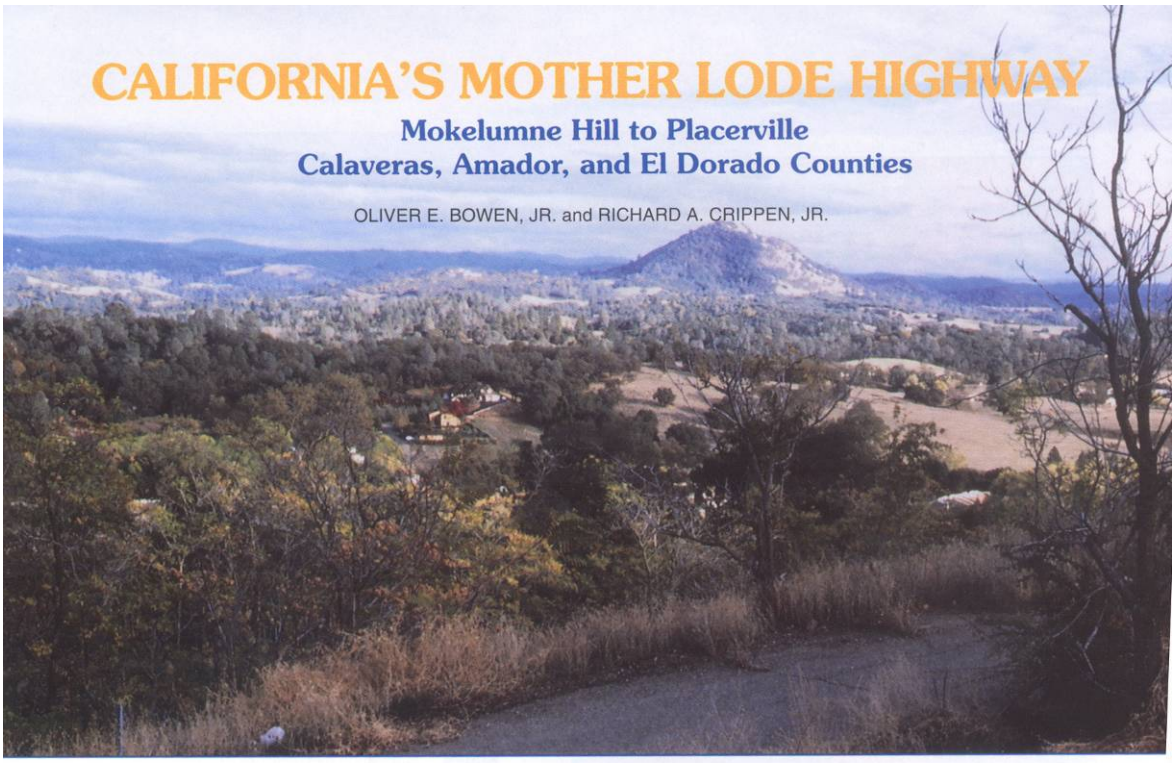


Photo 1. View southeast across Jackson to Jackson Butte and the old Eocene landscape, from rest area on Highway 49. *Photo by Chris Higgins.*

Figure 149. Jackson Butte (1997, CGS)

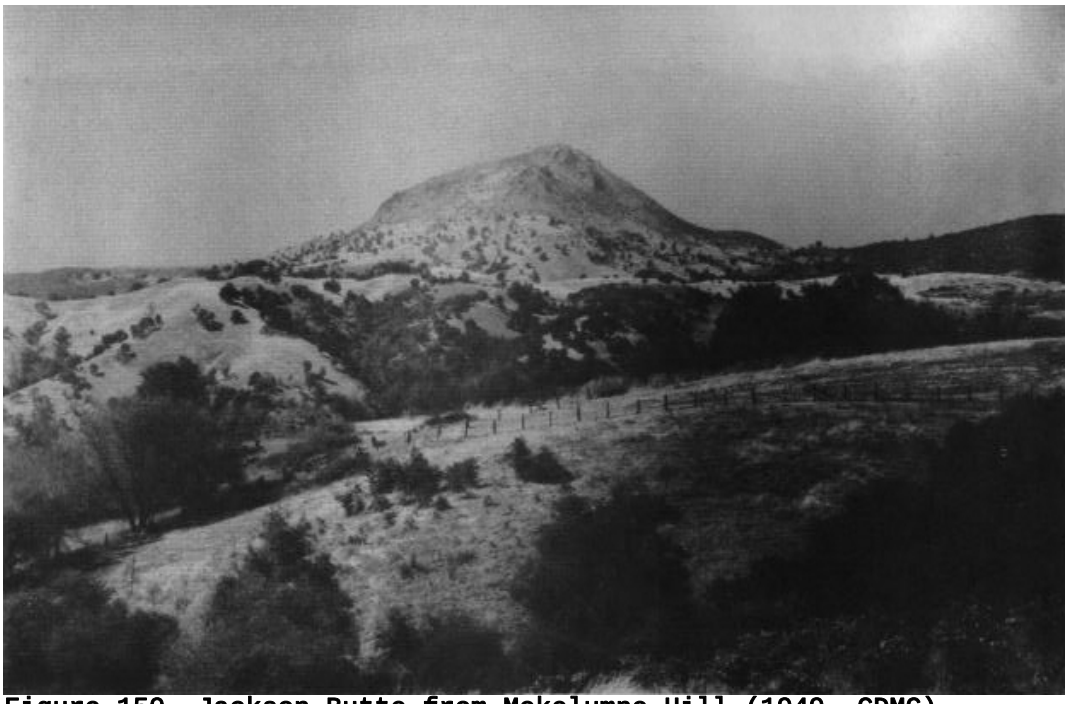


Figure 150. Jackson Butte from Mokelumne Hill (1949, CDMG)

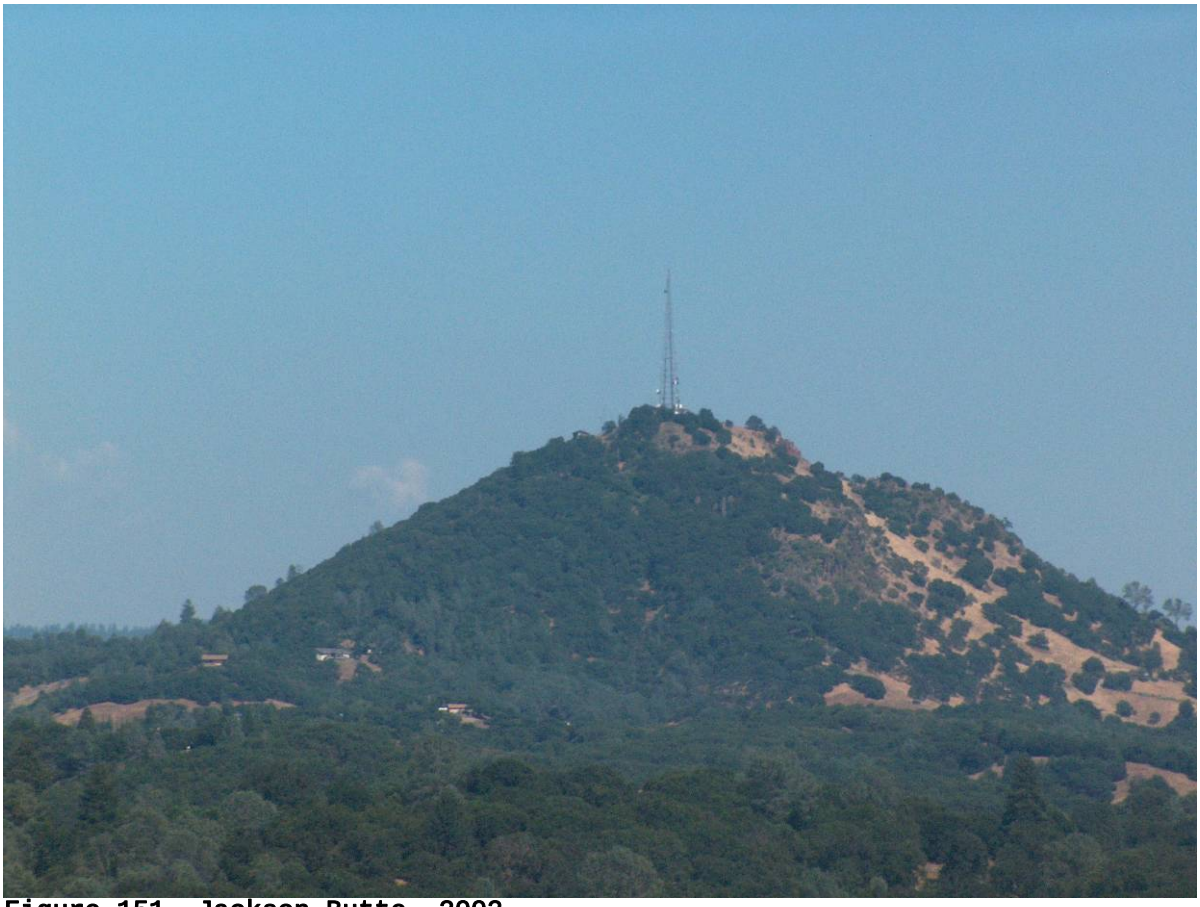


Figure 151. Jackson Butte, 2002

The metal water tanks of Argonaut Mine, described in the 1949 guidebook can't be seen today. Jackson Butte rises above a peneplain 3 miles northeast of Mokelumne Hill and 2.5 miles east of Jackson. Descend grade into Mokelumne River valley from the Tertiary peneplain surface, through Mokelumne Hill quartz diorite of an unknown age, but older than the Melones fault zone (Landefeld and Snow, 1990).

0.2 Coral Flat Road.

0.3 Drift mine on right.

0.5 Tertiary gravels.

0.9 Mokelumne Canyon rim. At the point where Highway 49 starts to descend to the Mokelumne River, in Section 11, at the west side of the road is a fault trending north-south. This fault places diorite to the east against amphibole schist of the Salt Springs Slate to the west.

1.3 Jackson Butte (#108) at 12:00 o'clock position.

MOKELUMNE RIVER (BIG BAR)

2.3 (MP 0.14) Big Bar on the Mokelumne River (#109)

Workings on hill at 12:00 o'clock position. The center of the Mokelumne Bridge marks the Amador County line. The Melones fault zone is between 1 and 2 miles west of here. It is largely a mélange mixture of wall rocks, especially of eastern belt affinity. Much of the mélange is mylonite and phyllonite here. This character changes little for the next 20 or more miles north. From the area around San Andreas to the Mokelumne Bridge, serpentinite is an uncommon component in the fault zone. This suggests that the fault zone in this area is at a higher structural level of exposure than is observed along the southern Melones Fault Zone (between Coulterville and Mariposa; Landefeld and Snow, 1990).

West of the Melones fault zone, lies the eastward- younging Oxfordian/Kimmeridgian Mariposa Formation and the Callovian/ Oxfordian Logtown Ridge Formation. Rock types typical of the Logtown Ridge Formation and the lower part of the Brower Creek Member of the Mariposa Formation (Landefeld and Snow, 1990). At the Mokelumne Bridge, rocks are dioritic of the Mokelumne Hill Pluton.

2.4 As the route climbs out of the Mokelumne valley at Electra Road, there is Salt Springs Slate of the eastern belt in road cuts on either side of the roadway. The slate is cut by dikes from the Mokelumne Hill pluton (Landefeld and Snow, 1990)

2.5 Quartz diorite outcrop. After climbing out of the valley, the road passes through tuffaceous Tertiary gravels. These are part of the placer grounds around the Butte Store Bakery (#110). This structure, dangerously close to present Highway 49, waste in 1854..

BUTTE CITY MINING DISTRICT

3.5: Butte Store, Butte City Mining District Ghost Town and Historical Marker 39.

The store is built of phyllite. Placer gold was mined from a thick pile of tuffaceous gravels in the Butte City district just east of the highway (Landefeld and Snow, 1990).

Figure 152. Butte City Store (1949, CDMG)

Figure 153. Butte city Store, 2003

4.6 Cross Melones Fault Zone.

4.8 Middle Bar Road on left. This road leads to the mines along Hunt and Murphy Gulches at the southern end of the Jackson-Plymouth district. The mines are largely hosted by black slate of the Mariposa Formation, both in zones of stringer quartz and in large quartz veins. When compared to others in the district, not much gold (approximately 5,000 ounces, Clark, 1970) was produced form these mines (Landefeld and Snow, 1990).

To the northwest, on the left, of this roadway intersection is the site of the Amador Mine (#111).

MIDDLE BAR

Middle Bar Road Bridge over the Mokelumne River, approximates the old site of the Middle Bar placer camp (T.5 N, R.11W, Sec. 10). The river bottom is sometimes submerged by the waters backed up behind Pardee Dam. Middle Bar is commemorated by State Division of Highways Historical Marker #36 (Bowen and Crippen, 1949).

4.85 At right are road cuts of meta-augite porphyry volcaniclastic rocks in the Melones fault zone. The rock type is identical to that found in the Logtown Ridge Formation and Brower Creek Member of the Mariposa Formation about 0.2-0.3 miles of here (Landefeld and Snow, 1990).

4 Jackson City Limits.

GEOLOGIC MAP 23

Jackson to Sutter Creek

(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Logan, 1934, 1935; Goldman, 1964; Bortugo, 1979)
(Loyd, 1983; Taliaferro et al., 1950; Dunffield and Sharp, 1975)

JACKSON

Downtown Jackson has retained many buildings from the Mother Lode era.

Figure 154. Jackson three story red brick building, 2005

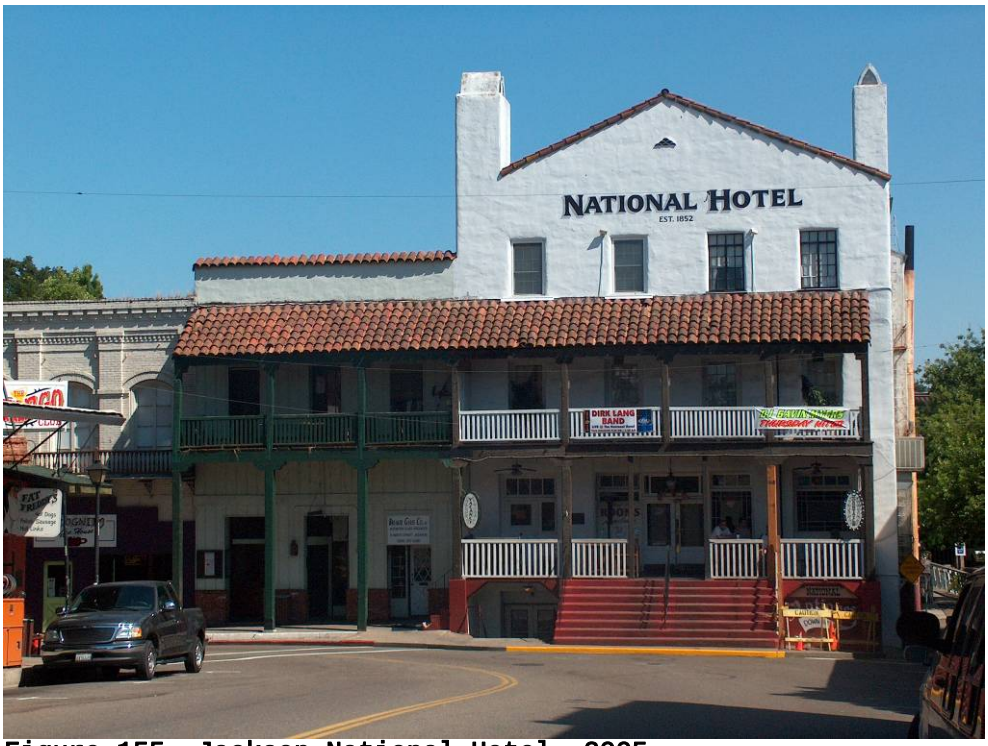


Figure 155. Jackson National Hotel, 2005

Figure 156. Jackson National Hotel (1949, CDMG)

Figure 157. Jackson Wells Fargo building (1949, CDMG)

Jackson, the county seat of Amador county, is a modern town combining the old with the new. Many of its old buildings have had their faces lifted so that one would hardly recognize their true vintage. Jackson bears the name of Colonel Alden Jackson who has also been honored by having the Tuolumne County town of Jacksonville named for him. Colonel' Jackson was a lawyer from New England who opened an office in the camp and became generally liked for settling quarrels out of court. The town dates from at least 1849 and probably before. Botilleas, the original name for the site, indicates that, like many other gold camps, Spanish Californians were the original settlers. It was called Bottilleas because of the many bottles which had accumulated near the spring where travelers stopped on the way to the southern mines Jackson is very proud of its one-time Congressman, benefactor, and native son, Anthony Caminetti, who did a great deal for Jackson and for Amador County in general. A monument to his memory has been erected beside Highway 49 immediately north of the business district (Bowen and Crippen, 1949; Gudde, 1969).

The Jackson-Plymouth district produced approximately 7,700,000 ounces of gold, 40% of which came from the Jackson area. The mineralization is for the most part continuous for 10 miles. The district has produced about 55% of the lode gold mined from the Mother Lode (Landefeld and Snow, 1990).

Zeile (Moore) Mine

5.6 Zeila Mine

The dumps and mine buildings of the Zeila Mine (#112) also spelled Zeile on the U.S.G.S. topographic map) are located close to Highway 49, 0.6 mile south of Jackson. The Zeila was first opened in the 1860's, was closed down during the latter half of the 70's and was a heavy producer from 1880 to 1914. The mine has an incline of 65 average dip. The ore occurs in quartz stringer in a gouge composed of decomposed rocks of several types. The veins lie on the

contact of Calaveras slate and schist and greenstones of uncertain age. One drift is over 3,000 feet long. Total production of the Zeila has been more than 200,000 ounces (about $5,000,000; Bowen and Crippen, 1949).

Figure 158. Zeile Mine (1949, CDMG)

The Moore Mine produced about $564,000 worth of gold (approximately 27,000 ounces; Clark, 1970) The veins are mostly hosted in schistose metavolcanic rock in the immediate footwall of the Melones fault zone. Although the most productive mines in the district produced ore from a narrow fault zone in the footwall of the Melones fault zone (in Mariposa and Logtown Ridge Formations), several mines in the south and east parts of Jackson mined ore within the Melones fault zone (Landefeld and Snow, 1990).

Northward from the Zeila Mine to the vicinity of Plymouth, a distance of about 12 miles, the Mother Lode has produced gold far in excess of 6,400,000 ounces ($160,000,000). This is by far the richest yield recorded along the Mother Lode for any sector of equal length. The prodigious gold production is exceeded in California only by the Grass Valley District of Nevada County. The geology of this highly productive strip is complicated both in structure and in lithologic similarities, and there are many diverse interpretations of the geology by those currently at work there. Most of the productive mines are on a branch of the Mother Lode Fault (Melones) which lies about a mile to the east of the Gold Thrust which is nonproductive along this sector. The strike of these two faults is roughly N.30°W. and parallels the regional trend of the structure for the most part. Other faults of similar type and trend occur several miles to the west of Jackson and are part of the Bear Mountains Fault Zone, a companion branch of the Mother Lode system. The Jurassic sediments and metavolcanics in this aria are badly deformed into a series of tight, overturned, isoclinal folds which have been further complicated by the several thrust faults mentioned above (Bowen and Crippen, 1949, modified by CGS, 1997).

5.7 Clinton Road to the right (north) to South Jackson and Zeila Mines. This road cuts through the Melones fault zone. The town site is about 6 miles to the east and is

accessible today by way of Highway 88 (see below).

SIDE TRIP TO CLINTON, INDIAN GRINDING ROCK, AND VOLCANO

Clinton

A mile north of the Clinton Road, Highway 88 leads eastward to the town site of Clinton near Clinton Peak (#122). The Clinton Consolidated and Clinton Bar are the best known lode mines of the district. Clinton was a placer district before the lode mines were developed. State Division of Highways Historical Marker 37 marks the turnoff to Clinton (Bowen and Crippen, 1949).

Indian Grinding Rock

The Indian Grinding Rock State Historical Park and Chaw'Se Indian Museum are near Pine Grove (#120). It is about eight miles east of Jackson on State Highway 88, and two miles northeast of Pine Grove on Pine Grove - Volcano Road. This park reportedly contains the largest site of mortars carved in bedrock in North America. The Miwok used the more than 1,100 grinding pits (Chaw'Se) at this site for food preparation. The mortars and more than 360 petroglyphs are carved in a 175 by 82 foot marble block within the Calaveras Complex (Landefeld and Snow, 1990). A few miles beyond Pine Grove is the placer camp of Volcano (#121).

Volcano

A few miles beyond Pine Grove is Volcano. In it's heyday (1855-1870), Volcanoville was known as a relatively lawless community. This is a reputation that it has held even to this day. The Georgetown Divide area has long been a recluse for drug use and cultivation (primarily marijuana). Murders per capita are the highest in the county. A few years ago there was a bar at Volcanoville with a heavy-set lady proprietor who insisted that customers leave their guns and knives outside the door before entering, a policy that was enforced with a sawed-off shotgun

Volcano was the first gold camp of Amador county and was settled by Yankee troops from the Mexican war. It was originally named “Soldier Gulch”. Early prospectors reported placer production of $100 per day. Working into crags of bedrock, the soldiers misidentified them as volcanic craters, hence the name. (Nadeau, 1992).

There are no volcanoes here. The Volcano placers were discovered early in the 1850's and the town soon boasted a population of over 5,000. The drive up Sutter Creek Canyon is scenic and the town of Volcano, although partly in ruins, retains much of its early-day color. In common with Murphys and Columbia, Volcano has not been modernized. There are several limestone caves in the vicinity (Bowen and Crippen, 1949).

The “Volcano War of 1849 is an example of early conflict between prospectors and native Americans. In Volcano, Indians were working (competing) with prospectors for gold, an interesting occurrence because heretofore the Indians did not have much interest in gold. A dispute over a stolen pick lead to the accidental killing of one prospector by Rod Stowell, a former Texas Ranger. The Indians prepared for retaliation and the prospectors said the Indians had attacked and murdered the miner. The Indian camp was attacked an they dispersed with at least one settler dead. When the truth came out, Stowell’s group was thrown out of town (Nadeau, 1992).

Road log resumes along Highway 49 at the southern junction with Highway 88 in Jackson.

0.3 Second flashing red traffic light.

SIDE TRIP TO KENNEDY WHEELS, JACKSON GATE, AND ONEIDA MINE

At the second flashing red traffic light, turn right and then immediately left on North Main Street. Continue on Main to the Kennedy Wheels City Park. A parking area will be on your right.

0.7 Kennedy Mine (#115) at 11:00 o'clock position.

0.6 On the right is Saint Sava (Serbian Orthodox) church (#114). It was built in 1874 and has a cemetery containing mostly Serbian settlers (Landefeld and Snow, 1990).

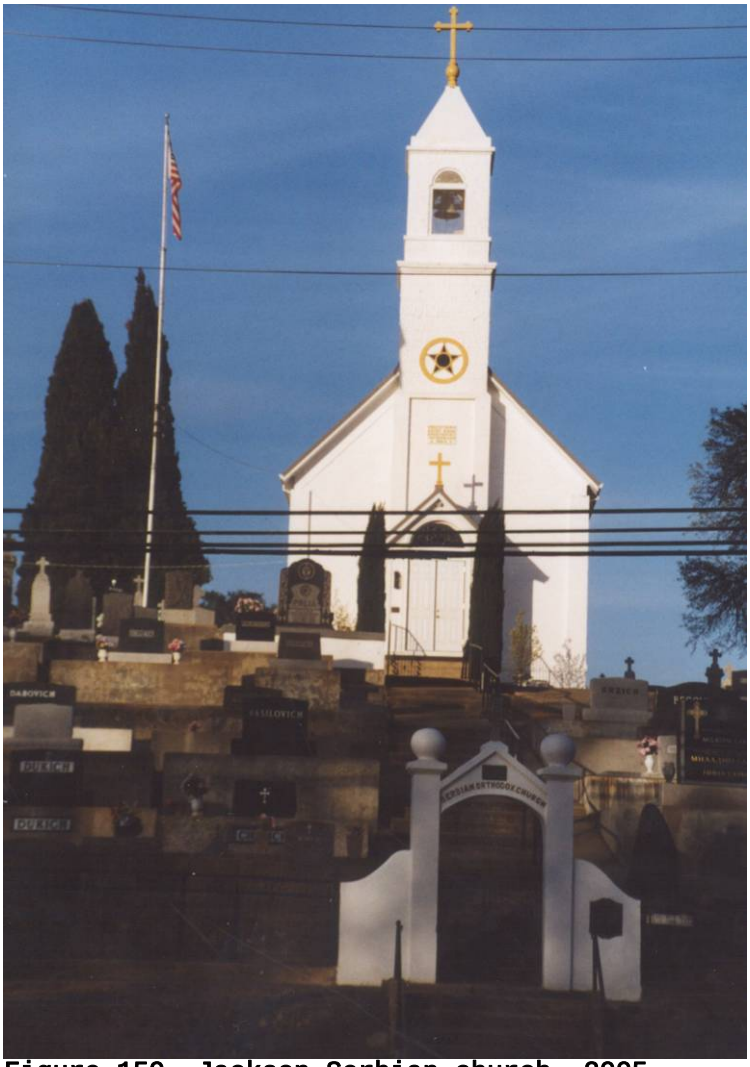


Figure 159. Jackson Serbian church, 2005

Figure 160. Jackson Serbian church and cemetery, 2005

1.0 Argonaut Mine (#117)at 12:00 o'clock position

1.1 Stop sign. Go straight.

Kennedy Wheels

1.3 Kennedy Wheels Park (#116)

Prior to 1912, the Kennedy Mine had been dumping its tailings (ground rock from which the gold has been extracted) into the tributary of Jackson Creek where the Kennedy Mine and mill were located. In 1912, California law requiring the impoundment of tailings was passed. The construction of the Wheels was ordered by the Debris Commission in response to complaints from farmers who's agricultural lands were adversely effected by the tailings. The technology for these Wheels was imported from Europe.

Figure 161. Kennedy headframe and wheels (1949, CDMG)

The Kennedy Mine site was enclosed by topography and a dramatic solution was required for the mine to remain in operation. The wheels are the key element in the system that worked without interruption from the day it began operating in 1914, until the mine closed in 1942. The tailings systems handled the 850 toms of waste discharged from the 100 stamp mill every 24 hours (Wagner, 1970; Landefeld and Snow, 1990).

Waste material from the Kennedy Mill was moved by gravity as a slurry through flumes from the mill, some 2,200 feet distant, to these wheels. The wheels lifted the tailings 48 feet is elevation so they could flow by gravity through the saddle of the ridge east of the wheels into the valley on the other side in which a dam had been constructed to receive them. Because a lot of water was required to make sure the slurry, water was purchased from a ditch company that brought water in a system of canals from exit park (Landefeld and Snow, 1990).

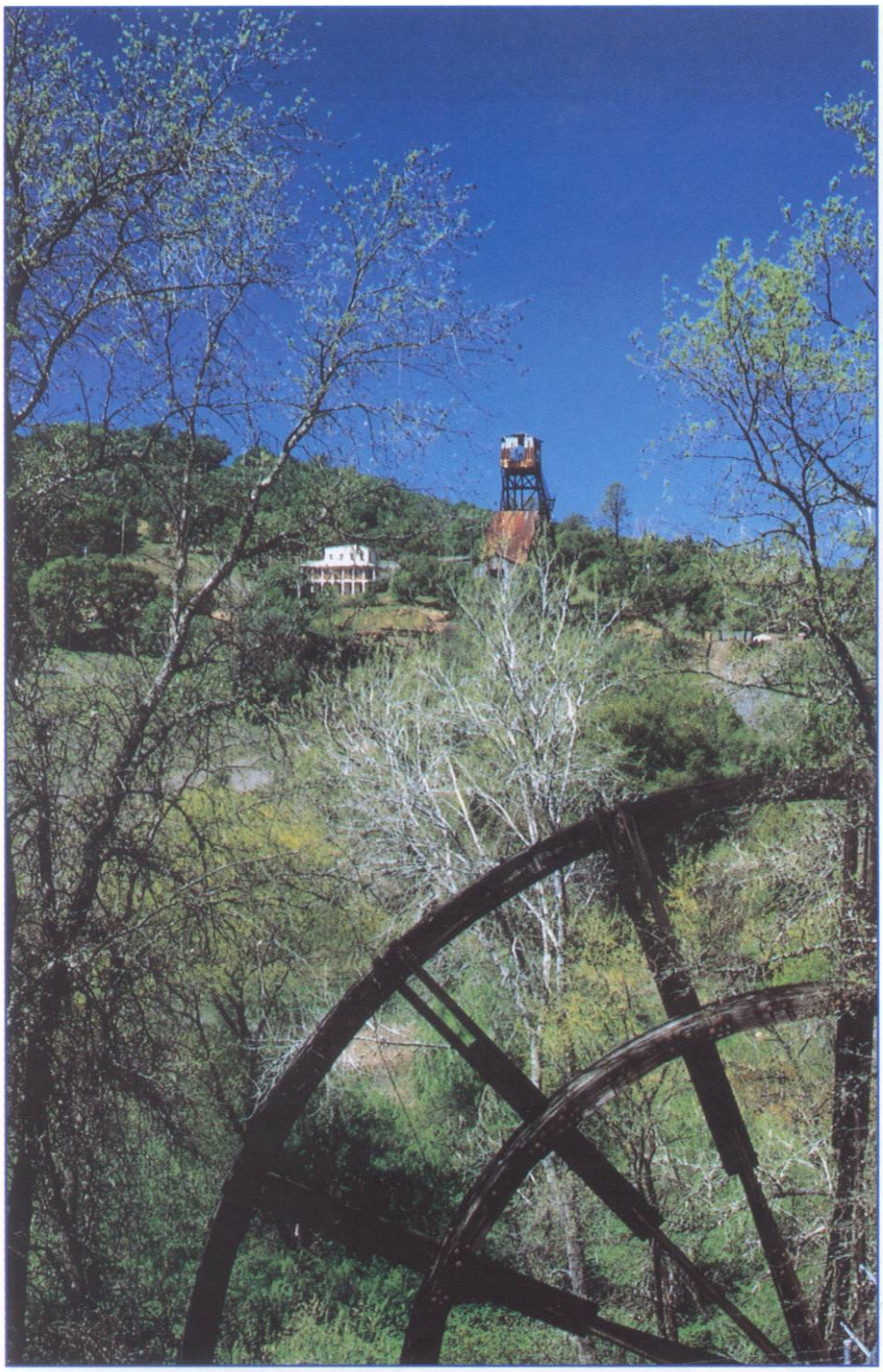


Photo 3. One of four tailings wheels near Jackson Gate, Amador County, with the Kennedy Mine headframe and superintendent's office near the horizon. *Photo by Max Flanery.*

Figure 162. Kennedy Mine headframe and wheel (1997, CGS)

Figure 163. Kennedy Wheels, southern 2005

Figure 164. Kennedy Wheels, northern 2005

Figure 165. Kennedy Wheels, 2005

Built in 1912-1914 and now partly dismantled or collapsed, the each wheel was equipped with a circle of 2085 buckets, a belt drive, and an electric motor. The four huge wheels were 68 feet in diameter and raised the tailings a vertical distance of 58 feet (18 m)each. The tailings elevators connected gravity flumes in which the tailings flowed from mill to dump. Sheet metal buildings once housed each wheel but these were removed for scrap during World War II (Bowen and Crippen, 1949).

Continuing northeast past Kennedy Wheels Park takes you to Jackson Gate.

Jackson Gate

0.6 Jackson Gate

This “suburb” of Jackson has several interesting buildings. During the Gold Rush, Jackson Gate was a small town located 1.5 miles north of Jackson which was reached by roads from either Jackson or Martell. It has now been assimilated into Jackson. Although small, Jackson Gate was picturesque and was the possessor of a group of very interesting relics of the past mining ventures (Bowen and Crippen, 1949).

Figure 166. Jackson Gate pink Victorian building, 2005

Figure 167. Jackson Gate Chichizola store (1949, CDMG)

Figure 168. Jackson Gate Hanfornd House, 2006

Figure 169. Jackson Gate brick and stone building, 2005

0.7 Oneida Mine (Section 17)

The old Oneida Mine (#123) was situated close to the northeast of the present site of Martell. It is not visible from present Highway 49. Only the mine dumps mark the site, the Oneida having been idle since 1913. It was one of the richest of the early-day lode mines, ore averaging as high as $40 (2 ounces) per ton in the early 1860's. The Oneida has a 2,280 foot (695 m) vertical shaft and several shallower inclined shafts. An inclined winze sunk 250 feet (76 m) from the 2,280 foot (760 m) level gives a total vertical depth to the mine of about 3,500 feet . The total production of the Oneida is something in excess of 100,000 ounces ($2,500,000; Bowen and Crippen, 1949).

0.8 Mafic volcanic sandstone of Goat Hill Member of the Logtown Ridge Formation in outcrop on right (Landefeld and Snow, 1970)

Return to downtown Jackson on North Main Street. Returning from the Kennedy Wheels you will see signs directing you to the Amador County Museum (#113), an excellent stop for any visitor. They have a large scale model of the Kennedy Mine, and give a memorial description of the Kennedy mine disaster.

RESUME FIELD TRIP ON HIGHWAY 49

0.0 Leave downtown Jackson at flashing red light at Highway 49 and Main Street.

0.8 Headframe of Kennedy Mine at left (east).

0.9 Argonaut Mine on left side of roadway adjacent to Highway 49, 0.4 miles south of Martell. A road side rest area is adjacent to the mine complex. The headframe is 0.15 miles to the south.

ARGONAUGHT MINE

Two of the greatest mines on the Mother Lode, the Argonaut (#117) and the Kennedy (#116), are located slightly more than a mile northwest of Jackson. These were exceedingly large operations, both above and below ground and are famous landmarks along Highway 49. The Argonaut Mine, across Highway 49 and to the northwest of the Kennedy, used to be identified for many miles in all directions by its lofty water tank. The Argonaught was first worked in 1850. Between 1850 and 1876, it had only been developed to a depth of 150 feet (46 m). Except for two one-year periods, when operations were suspended because of fires, the Argonaut operated continuously from 1893 to 1942 when, like most other Mother Lode mines, it was closed by the War Order Act in 1843. In October 8, 1942 the Federal Government issued order L-208 closing all gold mines as not essential to the war effort (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

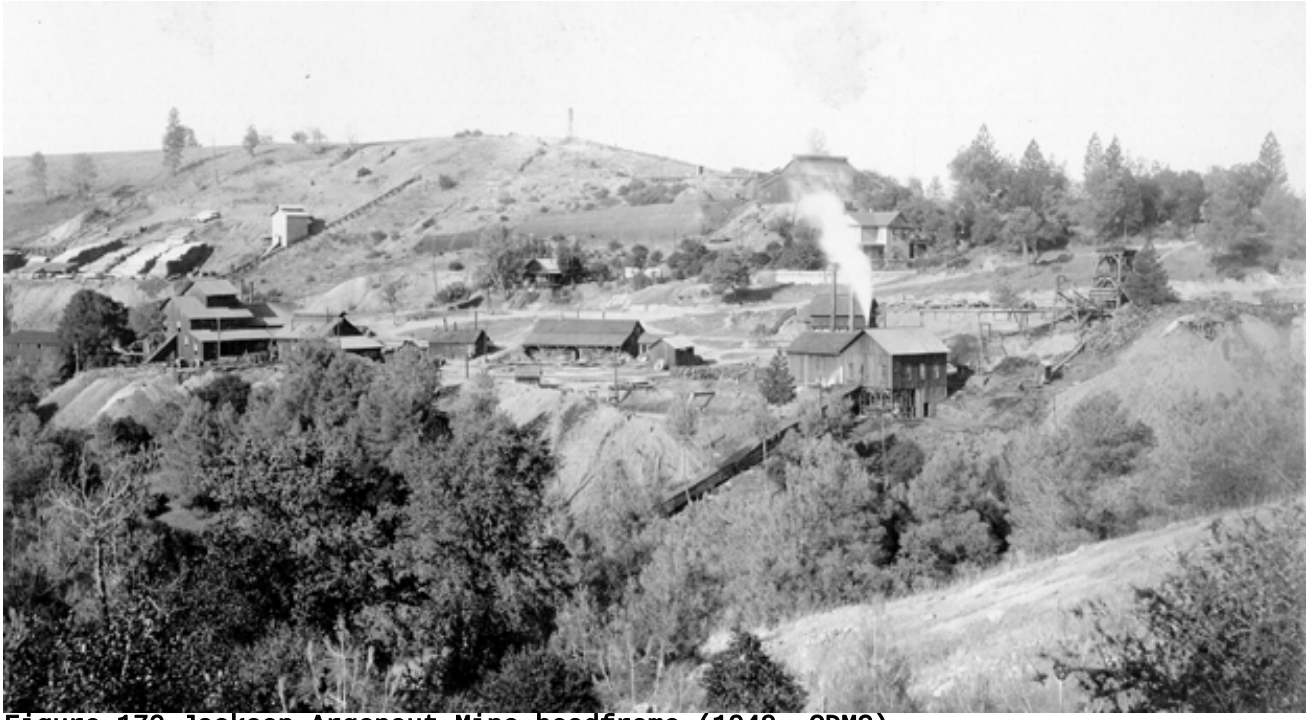


Figure 170.Jackson Argonaut Mine headframe (1949, CDMG)

Photo 4. Headframe of the Argonaut Mine, Jackson-Plymouth District. Connected at depth, the Argonaut and Kennedy were plagued by serious fires and embroiled in lawsuits over mining ground. *Photo by Chris Higgins.*

Figure 171. Jackson Argonaut mine headframe (1997, CGS)

The veins of the Argonaut are largely eastward-dipping continuations and splays of those on the

Kennedy property and the geology is similar. The mine was worked through inclined shafts to a depth of 6,300 feet (1,920 m) along the dip for 5,570 feet (1,698 m)vertically. There are 8 miles (13 km)of drifts and crosscuts, 4 miles (6 km)of raises (interior shafts driven, raised, from below), and 50 miles (80 km)of stope (rooms from which ore has been removed) floors. Production to the end of 1943 was $25,179,160 (Clark, 1970). The most recent operators of the Argonaut dissolved their organization in February 1948. The mine has been idle since 1942 (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

1.1 Vista Point. This turnout has exhibits about the Kennedy and Argonaut mines. The area is underlain by tuffaceous greenstones of the Bower Creek Member of the Mariposa Formation. The hill to the west (toward the headframe of the Argonaut Mine) is capped by volcanic rocks of the Mehrten Formation. A view toward the east of the Jackson District and the Kennedy Mine across Highway 49 can be had at this point.

KENNEDY MINE

The Kennedy Mine (#116), with its lofty headframe and huge sheet-iron-enclosed mill, lies a short distance to the east of Highway 49. The original Kennedy claim was located in 1856 and has since been consolidated with several others. It was a minor working until 1871 and had an inactive period between 1875 and 1885. From that time until final closing in 1942, the mine was operated continuously and on a major scale. The Kennedy was worked largely through vertical shafts to a vertical depth of 5,912 feet (1,802 m), making it the deepest gold mine in the United States at the time. There are approximately 150 miles (240 km)of underground workings as well as extensive surface equipment which once included the Jackson Gate elevator wheels and the miles of flumes which once connected with them. A fair cross section of the history of gold mining and milling equipment may be gleaned from past reports of the Kennedy operations. The workings are in Mariposa slate and Logtown Ridge (Bower Creek Volcanics) metavolcanics. Minerals described from the Kennedy include gold, quartz, pyrite, galena, fluorapatite, strengite (hydrous iron phosphate), sphalerite, chalcopyrite, ankerite, and other carbonates. The total production of the Kennedy Mine calculated on 1949 price of gold is 1,800,000 ounces ($45,000,000). Recalculated to fit various price changes in gold, the production figure is approximately $34,280,000. This figures to be about 1,290,000 ounces, worth $516 million at a gold price of $400/ounce (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

Figure 172. Kennedy Mine mill and camp (1949, CDMG)

Figure 173. Kennedy Mine headframe, 2005

Figure 174. Kennedy mine headframe, 2005

Figure 175. Kennedy Mill boiler foundations, 2005

Figure 176. Kennedy mill with lumber stockpile, 1900 (1998, CGS)

Figure 177. Ore bins and stamp mill foundations, 2006

Figure 178. Kennedy mill thickening tank, 2006

1.1-1.3 Cross through two members of the Mariposa Formation and one member of the Lodgetown Ridge Formation.

At the Vista Point (mile 1.1), Bower Creek Member (tuffaceous greenstone) of the Mariposa Formation was exposed. One-tenth mile east of the Highway 49/88 intersection in Martel is a 300 foot-width exposure of the Black Slate Member of the Mariposa Formation. Westward of the Black Slate is the Pokerville Member of the Lodgetown Ridge Formation (augite porphyry greenstone flows).

MARTELL

1.3 Martel (#119).

Martell, situated two miles northwest of Jackson, is the terminus of the Amador Central Railroad. In addition to its railroad facilities, Martell boasts lumber mill and curing yard. The logs are fed to the mill from an artificial pond. Trucks bring the logs to the pond from timberlands higher in the mountains.

1.5/0.0 Northern intersection of Highways 88 and 49. Sutter Hill.

Turn left, head north past the Martell lumber yards. Reset odometer. This intersection is 200 feet west of a contact between two members of the Lodgetown Ridge Formation. The Pokerville Member is to the east and interbedded massive volcanic-breccia greenstone of the Goat Hill member is to the west.

THE EUREKA MINES

Three very productive mines are located near the junction of Highway 49 and 88 on the east flank of Sutter Nill.. These are the South Eureka (#124), Central Eureka (#125), and Old Eureka (#126). Headframes of the latter two could be seen from Highway 49 in 1949, but today only the headframe for the Central Eureka remains, and it has been converted to a communications tower.

South Eureka Mine

The South Eureka Mine (#124), located only 100 feet southeast of Highway 108, was discovered at an early date but was not developed until 1891. Much of the development and maintenance of this mine was integrated with operations in the Central Eureka, as was that of the Old Eureka, since 1924. The South Eureka has been worked to a depth of 4,100 feet (1,250 m) and has produced 212,000 ounces of gold ($5,300,000; Bowen and Crippen, 1949).

0.8/0.0 Reset odometer and then turn right on Ridge Road.

After 100 yards, at a fork, turn left onto Sutter Creek Road.

0.1 Historical Marker. After a few hundred feet, there will be an Amador County Historical Marker on right. It describes how Amador County was carved from Calaveras and El Dorado Counties in 1854 (Landefeld and Snow, 1990). A few hundred feet north of the historical marker is another cross-road.

0.2 Stop sign. The headframe and dumps of the Central Eureka are on the right (east; Landefeld and Snow, 1990).

Central Eureka Mine

The Central Eureka Mine (#125), located north of the South Eureka across Highway 108, was discovered in 1855 and was called the Summit Mine in its early days. It had a small production prior to 1865 but major exploitation took place after 1896. The Central Eureka and Old Eureka are among the few Mother Lode mines which survived wartime limitations on gold mining (because of its silver production) and the rising cost of operation. With the exception of one year shut down, the mine operated profitably until the War Order of 1942. In 1908, a vein system was found in the footwall at about the 3,700 foot level. From 1908, until the mine closed over 900,000 tons of ore were mined (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

The Central Eureka shaft is 4,965 feet (1,513 m) deep along an average dip of 70 degrees or about 4,650 feet (1,417 m) deep vertically. The headframe for this shaft can be seen east of Highway 49 near the intersection of Ridge Road. The wall rocks are Mariposa slate and graywacke and greenstone of the Bower Creek Volcanics, all of Jurassic age.. The surface rocks have been mapped as Consumnes and Logtown Ridge members of the Amador group, also of Jurassic age. Authorities disagree on the early production figure for the Central Eureka. It may have been 680,000 ounces ($17,000,000; Bowen and Crippen, 1949).

The Central Eureka shaft lies in a 300-foot wide belt of Mariposa Formation Black Clay-Slate (Salt Springs Member). To the east of this belt, and in fault-contact with it is Bower Creek Member of the Logtown Ridge Formation. To the west of the belt, also in fault contact, is the Pokerville Member of the Logtown Ridge Formation.

Continue north and downhill on Sutter Hill Road.

0.9 Dumps of the Old Eureka Mine are on the right (east).

South Eureka Mine

The Old Eureka Mine (#126), 0.5 miles (0.8 km) north of the Central Eureka, is an early day consolidation of the Eureka and Badger claims and had a very high early-day production. The mine was opened in 1852 and was developed to a depth of 4,150 feet on an incline of 53 degrees east. The vertical depth of the mine was 3,500 feet (1,067 m). The acquisition of this mine by the Central Eureka gave the company a 4,400 foot-long mineralized structure on this part of a Mother Lode vein system. All of the production from the joint operation after 1930 came from the Old Eureka. The Central Eureka Group produced a total of 1,600,000 ounces of gold or 22% of the total Jackson-Plymouth production (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

At the time of closing in 1942, the mining company was in strong financial condition. The mine was reopened in 1946, but the high costs, deterioration of the underground workings, and a fixed gold price contributed to more than a million dollar loss in the next several years. The mine showed a profit in 1949, but finally closed on 1958 as the fixed gold price made mining unprofitable (Wagner, 1970; Landefeld and Snow, 1990).

Like the Central Eureka, the Old Eureka shaft is in Salt Springs (Black) Slate Member of the Mariposa Formation.

1.0 Stop sign. Rejoin highway 49 and turn right (northeast) toward Sutter Creek.

1.2 Sutter Creek City Limits (Sutter Hill Mine).

1.3 Daffodil Road on right (east). This road leads to the mining camp of Volcano.

1.4 Cross Sutter Creek.

SUTTER CREEK

Although the gold rush ruined John Sutter's mercantile empire, he did try a little gold mining himself. He first visited here in 1846, then camped and mined here in 1849 with Indians and Kanakas (native Hawaiians) in his employ (Gudde, 1969; Landefeld and Snow, 1990).

Sutter Creek (#127) is a rather harmonious blend of older frame and stucco buildings nestled among low hills. A continuous row of gold quartz claims located along the Gold Thrust passes through the heart of Sutter Creek. Aside from the aforementioned Eureka group south of Sutter Creek, the most productive mines in this vicinity were the Wildman, Mahoney, and Lincoln now grouped together under the name Lincoln Consolidated (Bowen and Crippen, 1949).The Knights Foundry in Sutter Creek has demonstrations of Mother-Lode era smelting technology.

In Sutter Creek a gambler stabbed a man and was given 75 lashes while his victim was alive. A miner’s court hung him the next day when the poor man died (Nadeau, 1992).

The town of Sutter Creek is underlain by Salt Springs (Black) Slate.

1.5 Turn 70 degrees to the left on Amador City Road which becomes Old Sutter Creek-Amador City Highway. The road to the right goes northeastward up Gopher Gulch.

LINCOLN MINE

2.8 Lincoln Mine (#128) (North Star Mine and Wildman Mine, NW Section 6)

The Lincoln Consolidated mines were discovered in 1851 and were worked both separately and together at various time throughout their history. The Lincoln shaft, which was the deepest of the three, was sunk on an average angle of 63 degrees to a depth of 2,000 feet (610 m), giving a vertical depth of about 1,760 feet (536 m). Ore bodies of Old Lincoln Mine between Sutter Creek and Amador City are mainly at the fault contact of Mariposa slate and Logtown Ridge meta-andesite. North of the Wildman Mine, the veins were as wide as 45 feet (14 m)near the surface. Combined production of the Wildman and Mahoney was slightly less than 200,000 ounces ($5,000,000); the Lincoln Mine is credited with 88,000 ounces ($2,200,000) of gold production (Bowen and Crippen, 1949).

The mine works a faulted segment of vein which was discovered by detailed structural mapping of the surface and still-accessible portions of the older mines in this area. Where old mines were caved, some surviving engineering and geologic maps helped develop a geometric model of the faulted vein structures which lead to the reopening of this mine (Landefeld and Snow, 1990).

The mine lies on the Melones Fault and places Bower Creek tuffaceous greenstone to the east against Salt Springs (Black) Slate to the west.

The Lincoln Mine Exploration Project is operated by Meridian Gold Company, a subsidiary of Burlington Resources. Surface drilling has indicated three ore shoots within a little-prospected strip of the Mother Lode just north of Sutter Creek, California. Meridian Gold drove an exploration decline ramp which paralleled the strike of the veins as indicated by drilling in 1991-1992. Further exploration and ore definition drilling, test mining, and bulk sampling will be conducted from the underground ramp. The objective of the Lincoln Exploration Project is to develop an underground mine, capable of producing 500 tons per day of ore containing a minimum of 0.230 ounces of gold per ton (Landefeld and Snow, 1990). The Lincoln Mine has daily underground tours for the public.

A side trip from Sutter Creek to the old placer and hydraulic mining center of Volcano, described above, along Highway 88, can also be made via the Sutter Creek Road.

APPENDIX I: MURPHY'S GRADE LOOP AND CALAVERAS CENTRAL AND OTHER MINES

GEOLOGIC MAP 16

(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et. al, 1955; Logan, 1934)

CALAVERAS CENTRAL AND OTHER MINES

The Calaveras Central (#80), Slab Ranch, Golden River, and Vallecito Western (#76) are some of the mines located in this region, all of which entered the Central Hill gravel channel at different places on its course. This fossil stream channel lies buried about 300 feet beneath the surface and is filled with gravel and volcanic ash. The Calaveras Central Mine was being rehabilitated early in 1948, but is now closed. Its workings are very extensive and reach the buried bedrock upon which lies a coarse auriferous gravel. Rhyolitic lake bed ash containing fossil leaves overlies the gravel (Bowen and Crippen, 1949).

These mines are located between Highway 4, running east from Angels Camp, and the Murphys Grade Road which runs east from Altaville. the side trip from Altaville to Murphys and back to Angels Camp is one which no visitor to this part of the gold country should miss (Bowen and Crippen, 1949).

MURPHYS GRADE LOOP SIDE TRIP

This side trip goes from Altaville to Murphys Grade and Back to Angels Camp.

0.0 Murphy's Grade Road and Highway 49 at Altaville (#79). Turn right (east).

0.5 Valley Spring Formation at the 1:00 o'clock position, above Tertiary gravels and metavolcanic rocks.

2.2 Turn off to Calaveras Central Mine (#80) and north side of Bald Hill.

3.4 Utica Pitch (Flume, #81)) on left (west). This flume has a long history of litigation regarding water rights.

Traveling east from Altaville the quarried outcrops of grayish-tan rhyolite tuff of the Valley Springs formation can be seen in rounded hills above a surface of lesser relief. The tuff overlies the gravel channels in many planes and it is beneath this material that the drift mines have been driven. The tuff has been extensively quarried for use as a building stone because of its accessibility, durability, and workable properties.

The Calaveras Central Mine is located on the north side of Bald Hill the turnoff to which is 0.6 mile east of Altaville. As seen from the south, the name Bald Hill is a misnomer, that side of the hill being brushed over. Bald Hill is the site of the famous "Calaveras Skull" hoax, perpetrated on geologist J.C. Whitney and others in the 1860's in which an Indian skull was placed as a practical joke at the bottom of a shaft which was sunk in the Tertiary steam gravels. A few miles beyond Bald Hill the road locally known as Murphys Grade begins a gradual ascent up the park-like canyon of Angels Creek to Murphys, one of the best preserved and most beautiful of the old towns which date from the gold rush. Very little modernization has been done there. Looking down its main street with its fine old buildings and overhanging trees is like turning back the pages of history nearly a hundred years. A 44-pound crystalline gold specimen from the

Jamestown Mine, discovered in 1995, is on display at the museum at Ironstone Vineyards. Murphys used to be the starting place for visiting Mercers Cave, a limestone cavern privately owned but open to the public. It was also a staging area for access to the Sheep Ranch Mining District, Murphys Mining District, and the high Sierra of Ebbetts Pass (Bowen and Crippen, 1949, modified by CGS, 1997).

GEOLOGIC MAP 15

(Wagner et al., 1981; Clark et al., 1963; Clark, 1970)
(Eric et. al, 1955; Logan, 1934)

The lode mines of the Murphys district, located on Highway 4 a few miles northeast of the town of Murphys, differ from most other gold deposits in the vicinity of the Mother Lode in that the veinlets or stringers are in limestone country rock instead of metavolcanic or metaclastic rocks. The mines were discovered in 1848 but were never sensational producers (Bowen and Crippen, 1949).

4.5 Murphy's Grade up Angel's Creek.

MURPHYS

4.7 Murphy's mining town (#82).

Murphys retains many well-maintained buildings from the gold rush era.

SIDE TRIP TO THE IRONSTONE WINERY

0.0 Intersection of Main Street and Algears Street in Murphys. This is the location of the Murphy’s Hotel. Go south on Algears road, past the gazebo in Murphy’s park to Six Mile Road.

0.2 Six Mile Road. Turn right and to south.

1.3 Ironstone Winery

This winery has a museum. Inside the museum is the Kautrz Nugget. This nugget weighs 44 pounds (1,568 oz). It was discovered in a pocket of the main Harvard vein on December 26, 1993. It has delicate gold leaf plates separated by fine layers of clay.

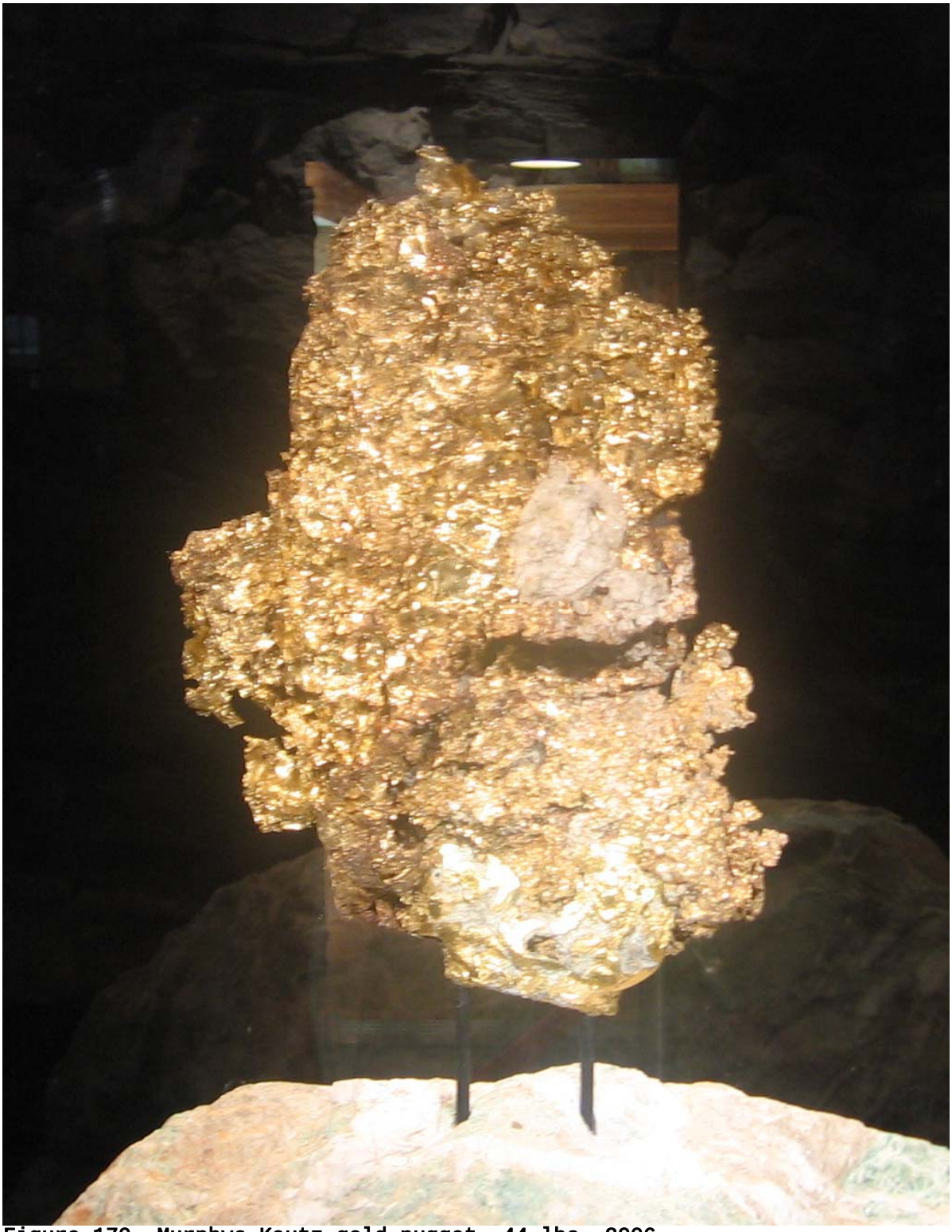


Figure 179. Murphys Kautz gold nugget, 44 lbs, 2006

Figure 180. Murphys Jones apothecary shop (1949, CDMG)

Figure 181. Murphys main street (1949, CDMG)

Figure 182. Murphys Valente building

Figure 183. Murphys Mitchler hotel (1949, CDMG)

Figure 184. Murphy-Speary Hotel, 2006

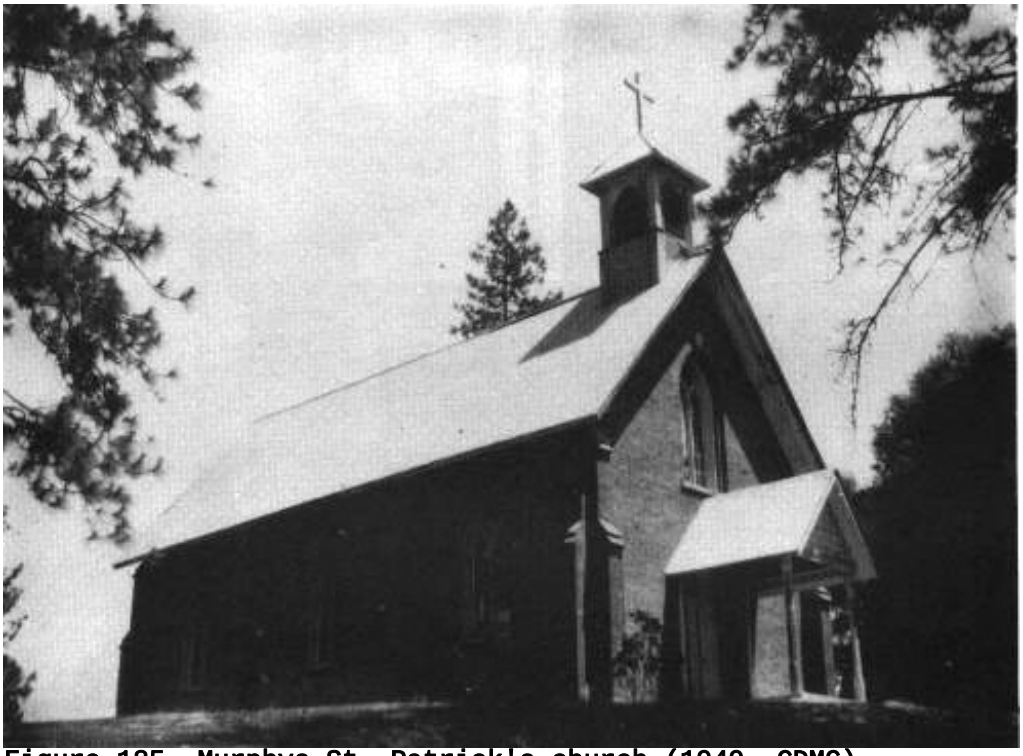


Figure 185. Murphys St. Patrick's church (1949, CDMG)

Figure 186. Murphys St. Patrick Church, 2006

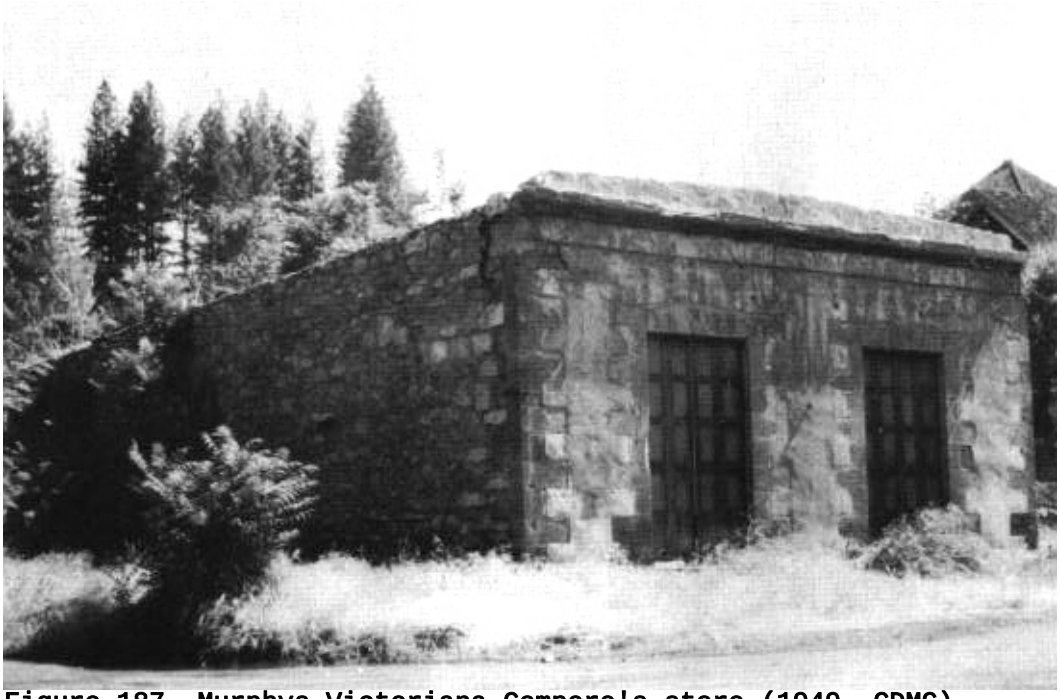


Figure 187. Murphys Victoriana Compere's store (1949, CDMG)

Figure 188. Murphys Compere's Store, 2006

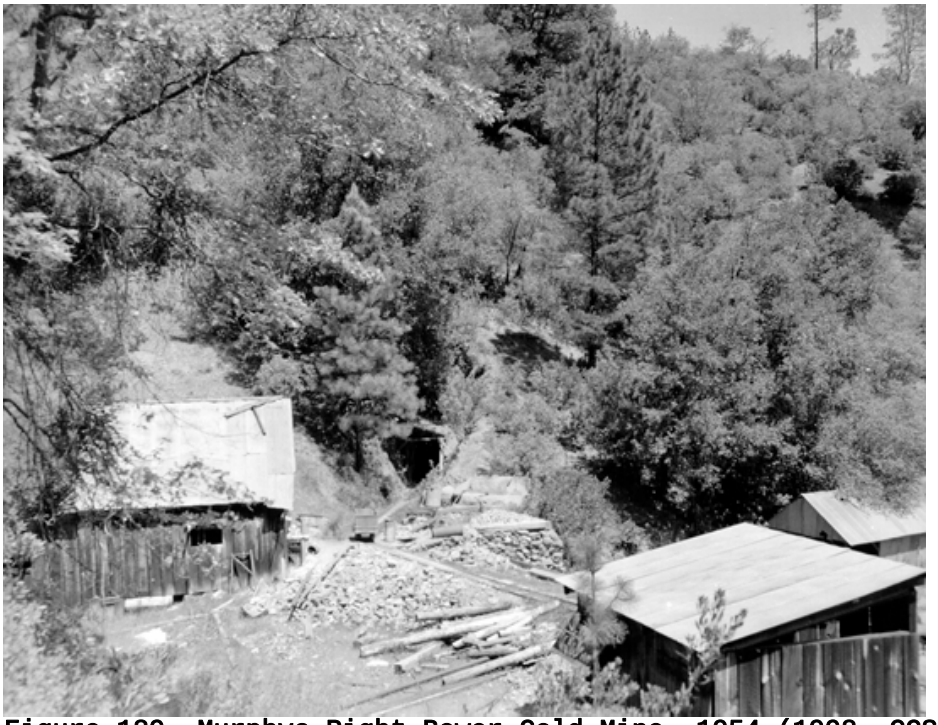


Figure 189. Murphys Right Bower Gold Mine, 1954 (1998, CGS)

Figure 190. Murphys Congregational Church, 2006

6.7 Mercer's Cavern turn off.

6.8 Murphy's historical Marker #139

7.2 Intersection Murphy's Grade and Highway 4. Turn right on Highway 4 toward Vallecitos and Angels Camp.

DOUGLAS FLAT HYDRAULIC DIGGING

8.0 Douglas Flat (#83)

Doubling back on Highway 4 toward Angels Camp, the hydraulic diggings of Douglas Flat are evident to the northwest of the road. This is one of the most southerly of a great series of immense hydraulic diggings which are scattered from Calaveras to southern Plumas County. Above the face of the Douglas Flat pit it a black lava-breccia cap, the edges of which are fluted by weathering, and have the false appearance of columns. This jointing pattern resembles the columnar jointing which is characteristic of the solid lava of the Table Mountain Latite near Jamestown. The lava cap's edges are fluted by weathering and give the appearance of jointed columns. (Bowen and Crippen, 1949, modified by CGS, 1997).

8.0 Turn off to modern gravel pit. Turn left (east).

0.0 Return to Highway 4. Reset odometer

0.3 Pseudo-columnar jointing.

0.7 Holiday Mine Road in Calaveras Group limestone.

1.5 Workings to right (north).

MOANING CAVE

1.7 Moaning Cave is to the left (south).

Moaning Cave (#68), a limestone cavern privately owned but open to the public, is located on the opposite side of Coyote Creek Canyon and may be seen from the road. It is also two miles from the junction in Vallecito.

11.0 Parrot Ferry road to Columbia in granitic Rocks.

11.3 Vallecito.

12.4 Ridge of volcanics to right (north.)

13.3 Six Mile Road.

13.7 Roadcut in tuff of Valley Springs Formation.

15.1 Golden River Vallecito Western and Slab Ranch Mines to right (north).

GOLDEN RIVER, VALLECITO WESTERN AND SLAB RANCH MINES

As one travels west into Angels Camp on Highway 4 the head frames of the Golden River, Vallecito Western (#76), and Slab Ranch mines are seen to the north of Highway 4. These drift mines are now all idle and filled with water. Though the geology of the Tertiary channels is not very well known, it is possible that the Central Hill Channel may be part of the same stream system as the Columbia River Channel which was bisected by the Stanislaus River. The site of an old chlorination plant is 0.2. (320 m) east of the junction of Highway 49. Chlorination was an early-day method for recovering gold from sulfide concentrates before the process of cyanidation was discovered (Bowen and Crippen, 1949).

GOLD HILL-WAGON RUT MINES

Two mining districts of considerable interest lie to the west of Altaville along Highway 4. Dumps and prospect holes of the Gold Hill pocket mining district can be seen a short distance to the north of the road.

The Wagon Rut mine was the best known of the Gold Hill mines. The headframe of the Belmont-Osborne mine is situated half a mile southwest of the Gold Hill group and can also be seen from the road.

APPENDIX II: SIDE TRIP TO HORNITOS, MERCED FALLS AND LA GRANGE

GEOLOGIC MAP 1-A

Mariposa to Mt. Bullion
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

0.0 From the intersection of Highway 49 and the 140, north of the fairgrounds at south end of the town of Mariposa, go southeast on Highway 140.

0.8 The roadway makes a 180 degree turn from southeast to northwest. Along the apex of this curve, Highway 49 traverses a band of fault-bounded ultramaphic rocks.

3.6 Carson Creek Bridge.

Carson Flat

4.0 Carson Flat, Site of Carson (#144). Yaqui Gulch Road is to the left (south).

4.5 Agua Fria Road.

7.2 Mt. Bullion cut-off road on right (north).

GEOLOGIC MAP 1-B

South of Mariposa to Cathy's Valley
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

7.6 Barrel Springs (#145)

8.2 Valley overlook turnout.

8.5 Owens Creek (#146)

Cathy's Valley

9.1 Cathy's Valley town limit

9.5 Trower Road on right (north)

10.7 Trower Road

10.9 County Park

11.6/0.0 Cathy's Valley (#127)

0.0 Reset odometer. Turn right, go north on Hornitos-Cathey's Valley Road

GEOLOGIC MAP 1-C

Cathy's Valley to Bluelead Mine
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

0.8 Cathy's Valley Cemetery

1.2 McCay Rd.

2.7 Raster Gulch (#147)

3.5 Bear Creek Gauging Station (#148)

5.0 The "Old Toll Road" (#130) from Mt. Bullion is crossed just before the creek.

Wellman Orchard

7.0 Olive Orchard (#150). This grove was planted by Bob Wellman for the Stockton and Buffman ranch in the early 1900's Olive oil production from the grove won prizes in 1917 World Fair in San Francisco (Phillips, 2002). The Bluelead mine is to the west.

GEOLOGIC MAP 1-D

Bluelead Mine to Hornitos
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

8.0/0.0 Mt. Gains Road (#131) reset odometer.

Ruth Pierce Mine and CC Pierce Dredge Site

8.0 Ruth Pierce Mine (#129). South of the Hornitos Road, near the intersection of Slate Gulch

Road and the Hornitos Road is the Ruth Pierce mine. It is located on the hill to the left (south). About $600,000 (24,000 oz) of gold have been produced from this mine.

8.1 Pierce Dredge Site (#131). This dredge site is on Corbet Creek which is crossed by the Horitos road 0.1 miles west of the Slate Gulch 4-way intersection. It contained 100,000 yards of gravel yielding approximately $10,700 in 1943 (237 oz).

10.1 Elk Horn Ranch Site (#130)

10.3 Givens family cemetery (#132). The graves are marked from 1853 to 1960.

10.4 Indian Gulch Road to the left (south)

Martinez Mine

10.5 Martinez Mine (#133). Located on the west side of Hornitos Road, near the intersection of the Indian Gulch Road. This mine opened around 1870 and produced quartz crystals, gold and silver. It closed in 1939.

Duncan Mine

10.5 Duncan Mine (#134). This mine is located next to the Martinez mine, north of the Indian Gulch Road intersection. It had a 2 to 5 foot wide quartz vein. It produced quartz crystals, gold and silver. It opened prior to 1870 and closed in the 1930's. It was 325 feet deep.

10.6 Turner family Ranch on north side of road

11.0 Placer workings on right (north).

13.2 Campedoncia Family Orchard (#135). The Campedonica family was an early Hornitos pioneer family. The orchard still produces today.

Hornitos

13.2/0.0 Hornitos (#6)

From the Plaza at Hornitos, going north on the Hornitos-Bear Mountain Road will take you to the Crocker-Huffman Mine, Washington (Jenny Lind) Mine, Mount Gains Mine, Badger Mine, Number Five Mine, Number Nine Mine, and Barker Group Dredge Grounds. These places are described in this road log under Maps 03-A and 03-B.

GEOLOGIC MAP 1-E

Hornitos to Merced Falls
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

HORNITOS TO LA GRANGE

0.0 Hornitos

From Hornitos, go west on the Hornitos-Merced Falls Road

0.2 Gauging Station road is to the south. It leads to the Red Bank Mine

2.5 La Paloma Road is on the left (south).

3.9 Pond on the left (south)

4.1 Merced-Mariposa County Line

5.9 Table Top Mountain (#151) to the left (west) at 12:00

6.0 Cemetery Hill (#152) to the right (east).

GEOLOGIC MAP 1-F

Merced Falls to Snelling
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

Merced Falls and Snelling

6.0 Cross the Merced River

7.1 Hornitos Road, turn left and go south

7.6 Merced Falls Dam (#153)

8.4 Snelling placer dredge tailings (#139)

GEOLOGIC MAP 1-G

Snelling to Tuolumne Dredge Site
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

12.9 Henderson Park

13.4/0.0 Snelling-Merced Falls School (#154). Turn right, go north on county road J49. Reset odometer

South Fork Merced River

2.3 House built on Ione Fm (Cretaceous) to the left (wet).

3.7 Dry Creek (#155)

3.9 South Fork of Merced River (#155)

6.4 Stanislaus County Line\

8.7 Tuolumne Dredge Tailings (#140) on the left (west).

9.7 Dawson Lake

10.7 Intersection with flashing red light. La Grange Road and Highway 132. Turn left and go

east on La Grange Road.

GEOLOGIC MAP 1-H

Tuolumne Dredge Site to Four Corners
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)

La Grange Dredge Site

11.3 La Grange dredge site is accessible by a bike path (#142) from La Grange.

Figure 191. La Grange Tuolumne Dredge, 2002

Figure 192. La Grange Tuolumne Dredge and pond, 2002

La Grange

11.3 La Grange (#141)

Figure 193. La Grange bucket monument, 2002

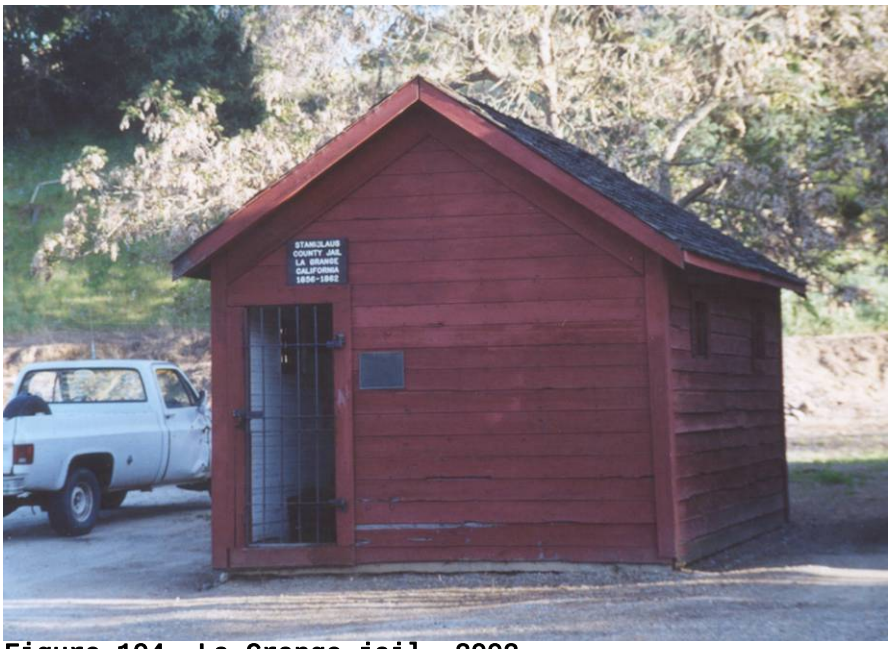


Figure 194. La Grange jail, 2002

Figure 195. La Grange trading post sandstone building (1949, CDMG)

Figure 196. La Grange Trading Post, 2002

GRANGE TO COULTERVILLE

0.4 La Grange Arch Bridge of 1918 over the Tuolumne River.

1.4 Beltz lake

2.3 Visard Creek (#157).

3.3 Confluence of Visard Creek and Dunn Creek

4.4 The juncture of Tuolumne, Stanislaus, Merced and Mariposa counties (#158) is 0.3 miles to the south.

GEOLOGIC MAP 1-I

Four Corners to Granite Springs
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)
(Evans and Bowen, 1977; Wagner et al. 1990)
(Bowen, 1969; Bogen, 1983)

5.0 Mariposa County Line

5.4 Road on the right (south) leads to the settlement site of Hayward (#159)

6.0 Hayward Creek (#160)

7.4 Jalpo Way

8.1 Tuolumne County Line

8.2 Bonds Flat (#161)

9.0 Don Pedro Reservoir

9.6 Roger Creek (#162) localized along a fault zone.

10.9 Merced Falls Road

12.2 Mariposa County Line

12.4 Piney Creek (#163) localized along a fault zone

Whiskey Flat

13.3 Whiskey Flat (#164). The Butt (Burr ??) mine is to the west of Whiskey Flat.

13.3 Granite Springs Cemetery (#165) is to the northwest of Whiskey Flat.

14.8 Granite Springs (#166).

15.1 Granite Springs Road.

GEOLOGIC MAP 1-J

Granite Springs to Coulterville
(Krauskopf, 1985; Strand, 1967)
(Bateman et al., 1987; Logan, 1934)
(Evans and Bowen, 1977; Wagner et al. 1990)
(Bowen, 1969; Bogen, 1983)

16.1 Willow Creek is to the right (south)

16.6 Spring Gulch road

17.0 Bull Pine Mine (#167) along Spring Gulch is to the north.

17.9 Wheeler Gulch (#168)

18.7 McClure Lake Reservoir is to the right (south).

19.6 Maxwell Creek (#169) at the Burr (Miles) mine.

Coulterville

21.3/0.0 Coulterville (#120). Reset Odometer

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