ROADSIDE GEOLOGY AND MINING

HISTORY OF THE MOTHER LODE

PART 2: JACKSON TO GRASS VALLEY

GEOLOGIC FIELD GUIDE

Amador, Sacramento, El Dorado, Placer, and Nevada counties
Excursions along the Highway 49 corridor
March 15-17, 2007

Gregg Wilkerson and David Lawler

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

ROADSIDE GEOLOGY AND MINING HISTORY

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PART II: JAMESTOWN TO GRASS VALLEY

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Keywords: Geology, guidebook, gold, mining, Sierra Nevada, history, Amador County, Sacramento County, El Dorado County, Placer County, Nevada County.

Copies of this guidebook are available through

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This field guide and its maps can be downloaded from:

http://www.blm.gov/ca/st/en/fo/bakersfield/Programs/geology/fieldguide_motherlode_central.html

CONTENTS

INTRODUCTION ***6***

Mine Production Statistics **6**

Mileage Markers **6**

Maps **6**

Overview **7**

GEOLOGY MAP 23 ..... **8**
JACKSON 8
Zeile (Moore) Mine 11
SIDE TRIP TO CLINTON, INDIAN GRINDING ROCK, AND VOLCANO 12

GEOLOGY MAP 23A **12**

GEOLOGY MAP 23B **12**

GEOLOGY MAP 23C **12**
Clinton 12
Indian Grinding Rock 13
Volcano 13
SIDE TRIP TO KENNEDY WHEELS, JACKSON GATE, AND ONEIDA MINE 24
Kennedy Wheels 26
Jackson Gate 31
RESUME FIELD TRIP ON HIGHWAY 49 35
ARGONAUGHT MINE 35
KENNEDY MINE 37
MARTELL 42
THE EUREKA MINES 43
South Eureka Mine 43
Central Eureka Mine 43
Old Eureka Mine 44

GEOLOGY MAP 24 ..... **45**
SUTTER CREEK 45
KNIGHT FOUNDRY 48
LINCOLN MINE 51
SOUTH SPRING HILL MINE 55
KEYSTONE MINE 56
BUNKER HILL AND NEW CHICAGO MINES 59
AMADOR CITY 59
DRYTOWN 62

GEOLOGY MAP 25-A **65**
PLYMOUTH CONSOLIDATED: (PACIFIC AND EMPIRE) MINES 65

GEOLOGY MAP 25-B **67**
FIDDLETOWN (OLETA) 67
AMADOR STAR AND BAY STATE MINES 72
ENTERPRISE 73
BALLARD AND CRAWFORD 73
STRATIGRAPHIC SECTION AT THE CONSUMNES RIVER BRIDGE 73

GEOLOGY MAP 26 ..... **73**
NASHVILLE 74

GEOLOGY MAP 27 ..... **74**
MONTEZUMA MINE 74
UNION MINE 75
OPHIR AND POCAHONTAS MINES 75

GEOLOGY MAP 28-A **75**
LOST STONE BUILDINGS AND ARRASTRE STONES OF LOGTOWN 75
EL DORADO (MUD SPRINGS) 76
DIAMOND SPRINGS 84
PACIFIC QUARTZ MINE 87
PLACERVILLE (HANGTOWN) 88

GEOLOGY MAP 28-B **89**
SIDE TRIP TO GOLD BUG PARK 89
GOLD BUG MINE 90

GEOLOGY MAP 29-A **93**
COLOMA 93
NATIVE AMERICANS AND THE GOLD RUSH 99
LOTUS 99

GEOLOGY MAP 29-B **101**
SIDE TRIP TO GEORGETOWN DIVIDE 101
South Fork of the American River Canyon 101

GEOLOGY MAP 29-C1 ..... **102**
Garden Valley 102

GEOLOGY MAP 29-C4 ..... **103**
Taylor Mine 103
Greenwood 106
Green Mill Junction 108
SIDE TRIP TO SPANISH DRY DIGGINS AND CHEROKEE FLAT 109
Spanish Dry Diggins and Grit Mine 109
French Hill Mine 109
Sliger Mine 110
Cherokee Flat 110
RESUME LOOP TO GEORGETOWN 110

GEOLOGY MAP 29-C1 ..... **111**
Georgetown 111
Georgia Slide Mine 112

GEOLOGY MAP 29-C2 ..... **113**
SIDE TRIP: GEORGETOWN TO VOLCANOVILLE 113

GEOLOGY MAP 29-C3 ..... **113**
Tiedeman Placer Mine 113
Dutch Pit Hydraulic Mine 114
Volcanoville 115

GEOLOGY MAP 28-C **117**
GEORGTOWN TO PLACERVILLE: HIGHWAY 193 117

Black Oak Mine 117
Spanish Flat 117

GEOLOGY MAP 28-B 118
Kelsey and the Gray Eagle Mine 118
Chile Bar Slate Quarry 120

RETURN TO GEOLOGY MAP 29-A 122
RESUME ROAD LOG ON HIGHWAY 49 122

GEOLOGY MAP 30 122
LUYAMA COPPER MINE 123

GEOLOGY MAP 31 123
PILOT HILL 123
FOLSOM PLACER GROUNDS 124
Michigan City (Michigan Bluff) 124
COOL 129
Tiegert Limestone Mine 130
FOREST HILL DIVIDE 131

GEOLOGY MAP 32 131
BRIDGE OVER THE AMERICAN RIVER 131
AUBURN 131
OPHIR MINING DISTRICT 136

GEOLOGY MAP 33 139
HOTALING 139
BEAR RIVER BRIDGE 139

GEOLOGY MAP 34 140
HIGGINS CORNER 140
LIME KILN (JONES RANCH) 141

GEOLOGY MAP 35 141

GEOLOGY MAP 36 141
EMPIRE MINE STATE PARK AND VISITOR'S CENTER 146
EMPIRE-STAR MINES (Section 35) 146
NORTH STAR MINE POWERHOUSE 160
GOLDEN CENTER MINE 162
SPRING HILL MINE 162
IDAHO-MARYLAND MINES 163
TOWN TALK 167

REFERENCES 167

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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 an orange triangle (.mxp) or hash-mark (,pdf) 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 from the gold mines 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 veinletts, 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 all 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).

GEOLOGY MAPs 1 through 23 are described in Part 1 of the Mother Lode Guidebook Series: "Mariposa to Jackson, 2006 Edition."

GEOLOGY 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 1. Jackson three story red brick building, 2005

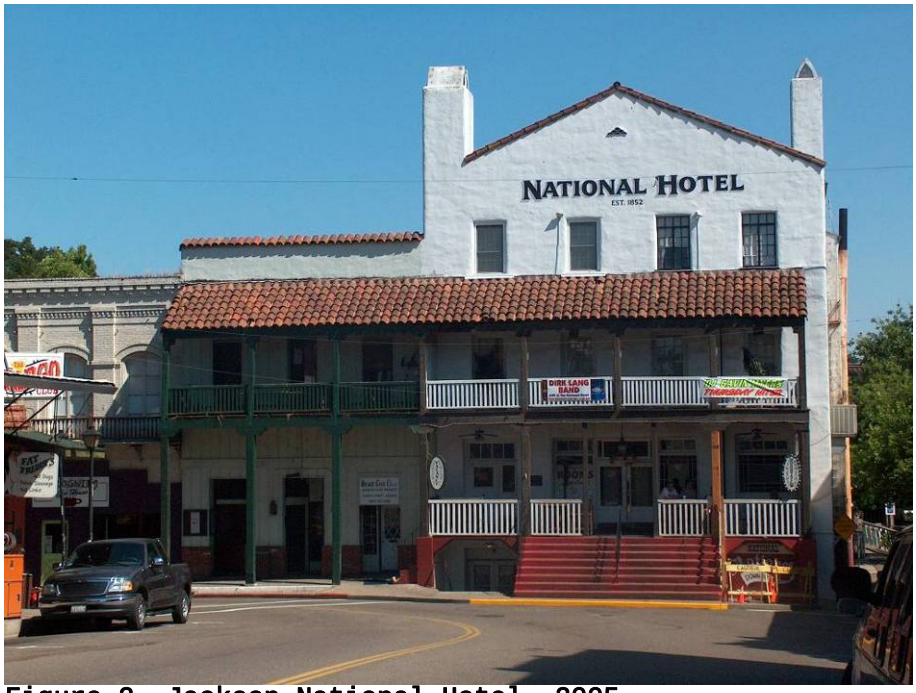

Figure 2. Jackson National Hotel, 2005

Figure 3. Jackson National Hotel (1949, CDMG)

Figure 4. Jackson Wells Fargo building (1949, CDMG)

Figure 5. Jackson Wells Fargo building, March, 2007.

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 Zeile Mine

The dumps and mine buildings of the Zeile 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 Zeile 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 Zeile has been more than 200,000 ounces (about $5,000,000; Bowen and Crippen, 1949).

Figure 6. 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 Zeile 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 Zeile 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

GEOLOGY MAP 23A

Jackson to Sutter Creek

GEOLOGY MAP 23B

Sutter Creek to West of Volcano

GEOLOGY MAP 23C

West of Volcano to 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).

In a village, the roundhouse served as the center of ceremonial and social life. Constructed in 1974, the Chaw se' roundhouse continues this tradition. With its door facing the east, towards the rising sun, four large oaks are the focal point of this sixty-foot-in-diameter structure. Today ceremonial roundhouses are the most significant architectural manifestation of the continuing Mistook spiritual heritage (California Historical Landmark No. 1001).

Figure 7. Chaw Se round house and visitor's center.

Volcano

A few miles beyond Pine Grove is Volcano. 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).

The spot was discovered in 1848 by Colonel Stevenson's men, who mined Soldiers Gulch in 1849. By 1853 the flats and gulches swarmed with men who named them picturesquely. Hydraulic operations, begun in 1855, brought thousands of fortune seekers to form a town of 17 hotels, a library, a theater, and courts of quick justice. During the Civil War, Volcano's gold served the Union - Volcano Blues smuggled the cannon 'Old Abe' in by hearse to quell rebels.

Figure 8. Replica of "Old Abe" cannon, Volcano, March, 2007.

Figure 9. Commemorative plaque of Old Abe volunteers, March, 2007.

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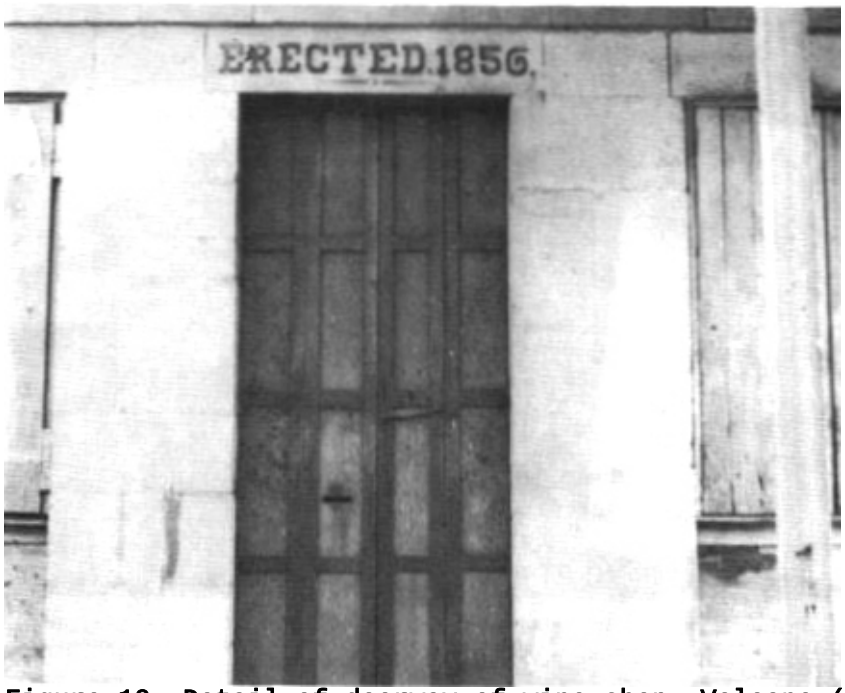

Figure 10. Detail of doorway of wine shop, Volcano (CDMG, 1949:137)

Figure 11. Entrance to Bavarian Brewery, March, 2007

Figure 12. Bavarian Brewery, March, 2007. Operated by Stolkon family, last of three brothers that helped maintain the spirits of the miners of the central Mother Lode.

Figure 13. Wineshop, Volcano (CDMG, 1949:137).

Figure 14 . Adams Express Company Building (CDMG, 1949:136)

Figure 15. Adams Express and Wells Fargo Building. The white building behind the Adams Express building, and connected to it, is the old IOOF Hall (now a Masonic Hall), March, 2007.

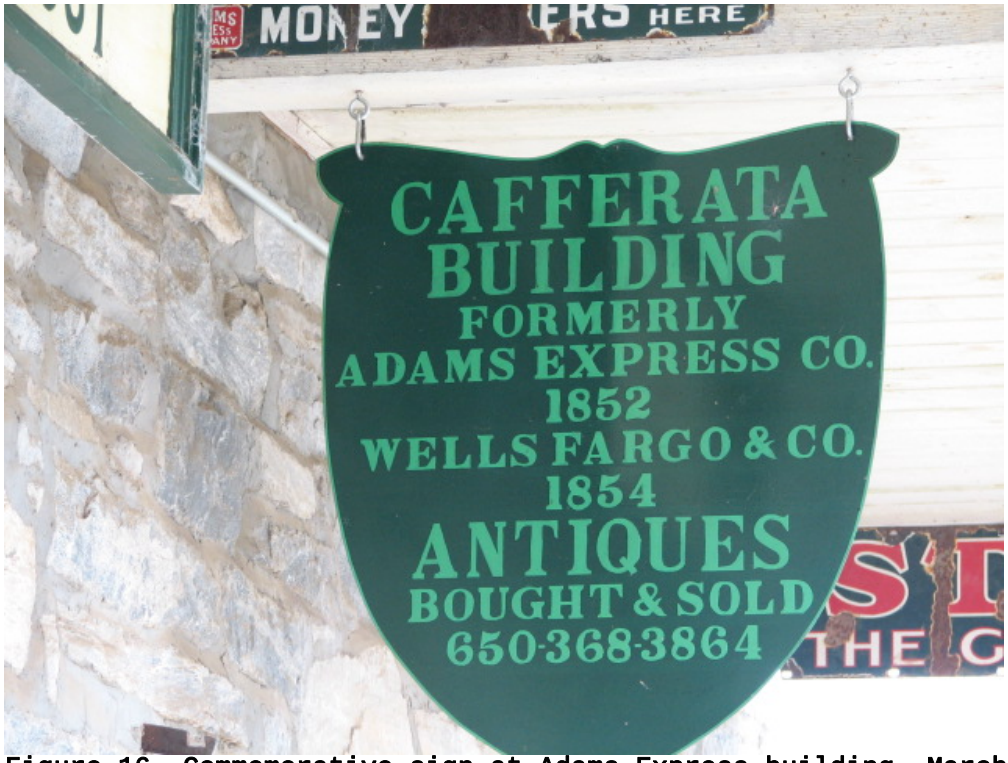

Figure 16. Commemorative sign at Adams Express building, March, 2007

Figure 17. I.O.O.F. and Masonic buildings, Volcano (CDMG, 1949).

Figure 18. Masonic Building, March, 2007.

Figure 19. Limestone building, Volcano (CDMG, 1949:135).

Figure 20. Limestone building, now facade for amphitheater, March, 2007.

Figure 21. Limestone building ruins, Volcano (CDMG, 1949:135).

Figure 22. Limestone building ruins, Volcano, March, 2007.

Figure 23. Main Street, Volcano, St. George Hotel on right (CDMG, 1949:134).

Figure 24. Main Street Volcano, March, 2007.

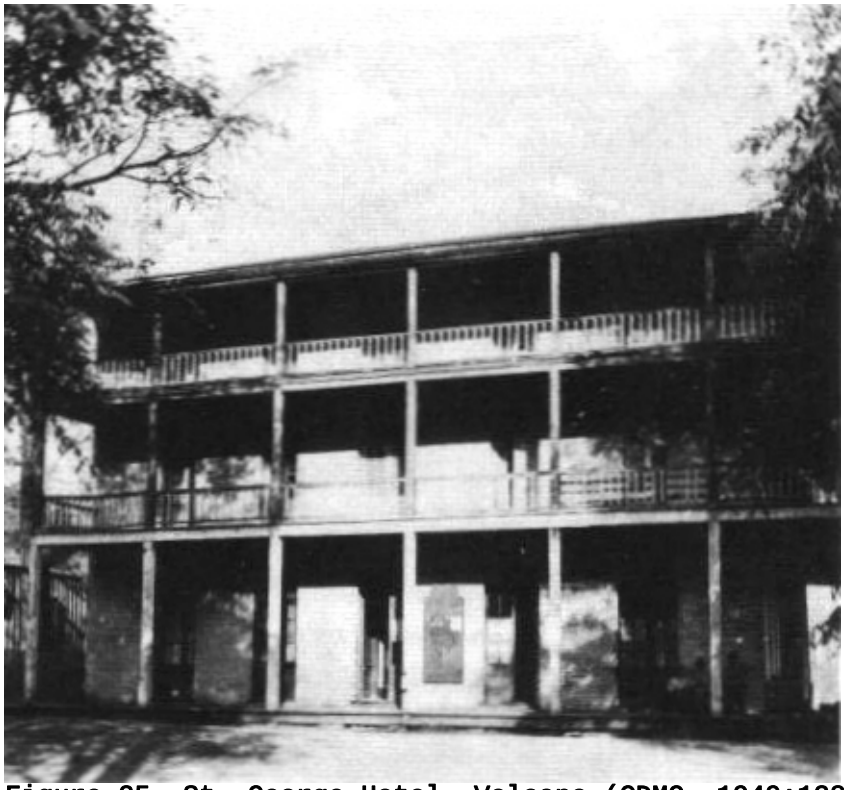

Figure 25. St. George Hotel, Volcano (CDMG, 1949:138).

Figure 26. St George Hotel, Volcano, March, 2007.

The Volcano placers were discovered early in the 1850’s and the town soon boasted a population of over 5,000. The town of Volcano, although partly in ruins, retains much of its early-day color. The town has not yet been modernized. There are several limestone caves in the vicinity. Ridge Road is an alternate access route to Volcano, and goes by Indian Grinding Rock State Historic Park (Bowen and Crippen, 1949, modified by CGS, 1997).

The Volcano placers were discovered early in the 1850’s and the town soon boasted a population of over 5,000. The town of Volcano, although partly in ruins, retains much of its early-day color. The town has not yet been modernized. There are several limestone caves in the vicinity. Ridge Road is an alternate access route to Volcanoville, and goes by Indian Grinding Rock State Historic Park (Bowen and Crippen, 1949, modified by CGS, 1997).

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).

In Volcano, California Landmark No. 715 relates that this was the site of the first amateur astronomical observatory in California. - On the knoll behind this marker George Madeira built the first amateur astronomical observatory of record in California. It was there that he discovered the Great Comet of 1861 with a three-inch refractor telescope.

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).

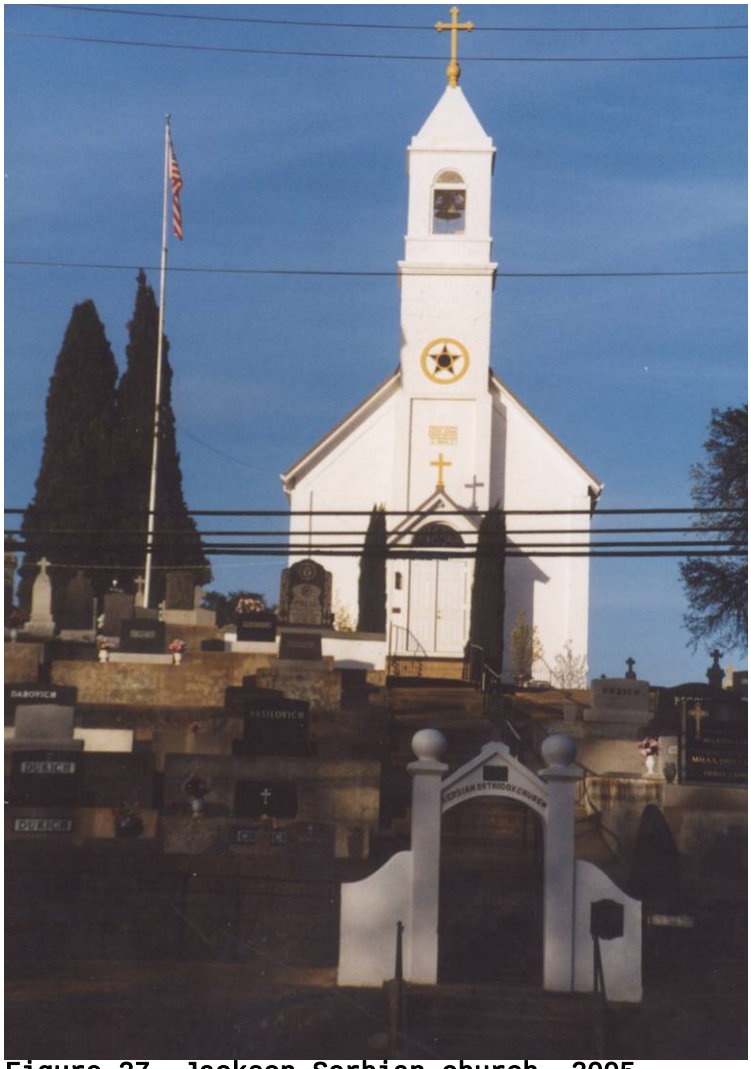

Figure 27. Jackson Serbian church, 2005

Figure 28. 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 whose agricultural lands were adversely affected by the tailings. The technology for these Wheels was imported from Europe.

Figure 29. 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).

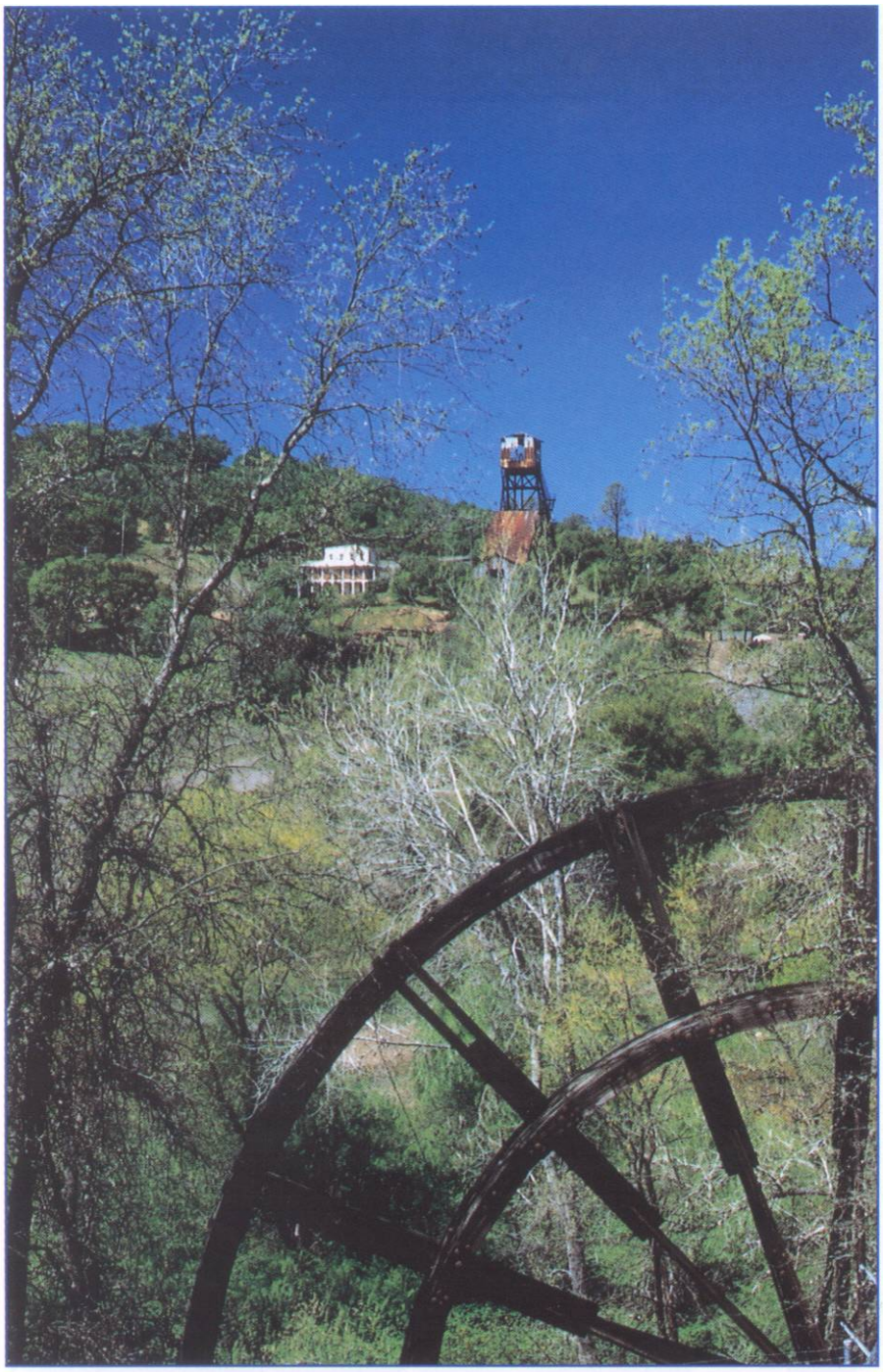

Photo 3. One of four tailings wheels near Jackson Gate, Amador County, with the Kennedy Mine headframe and superintendent's office near the horizon. *Photo by Max Flanery.*

Figure 30. Kennedy Mine headframe and wheel (1997, CGS)

Figure 31. Kennedy Wheels, southern 2005

Figure 32. Kennedy Wheels, northern 2005

Figure 33. 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).

Jackson Gate, on the north fork of Jackson Creek, takes its name from a fissure in a reef of rock that crosses the creek. In 1850 about 500 miners worked here and the first mining ditch in the county was dug here - its water sold for $1 per inch (California Historical Landmark No. 118).

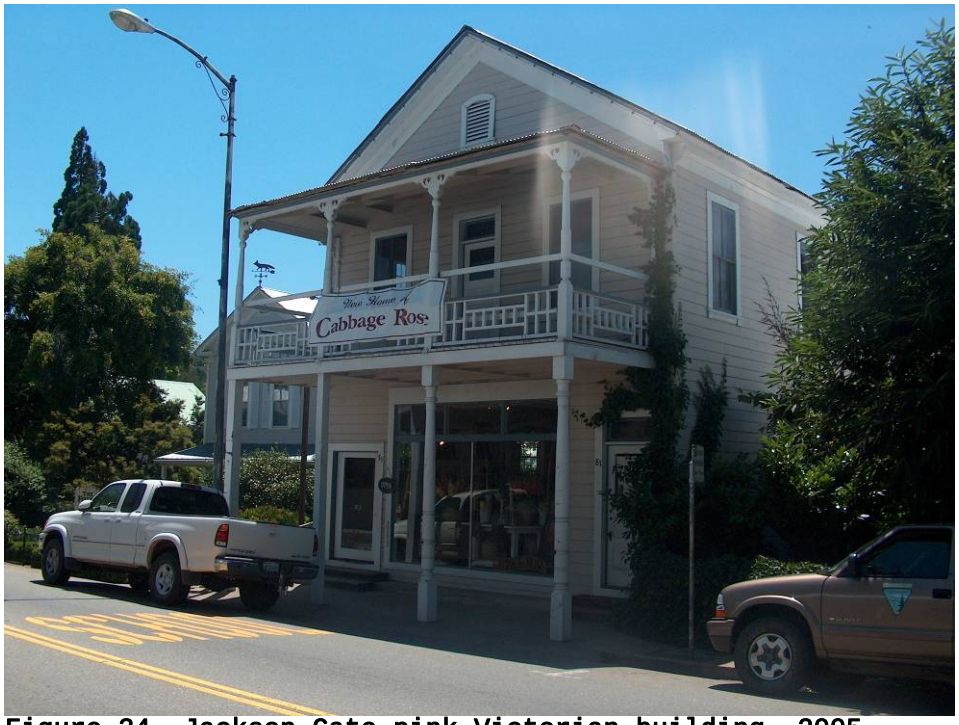

Figure 34. Jackson Gate pink Victorian building, 2005

Figure 35. Jackson Gate Chichizola store (1949:133, CDMG)

Figure 36. Chichizola Store, Jackson Gate, March 2007

Figure 37. Jackson Gate Hanford House, 2006

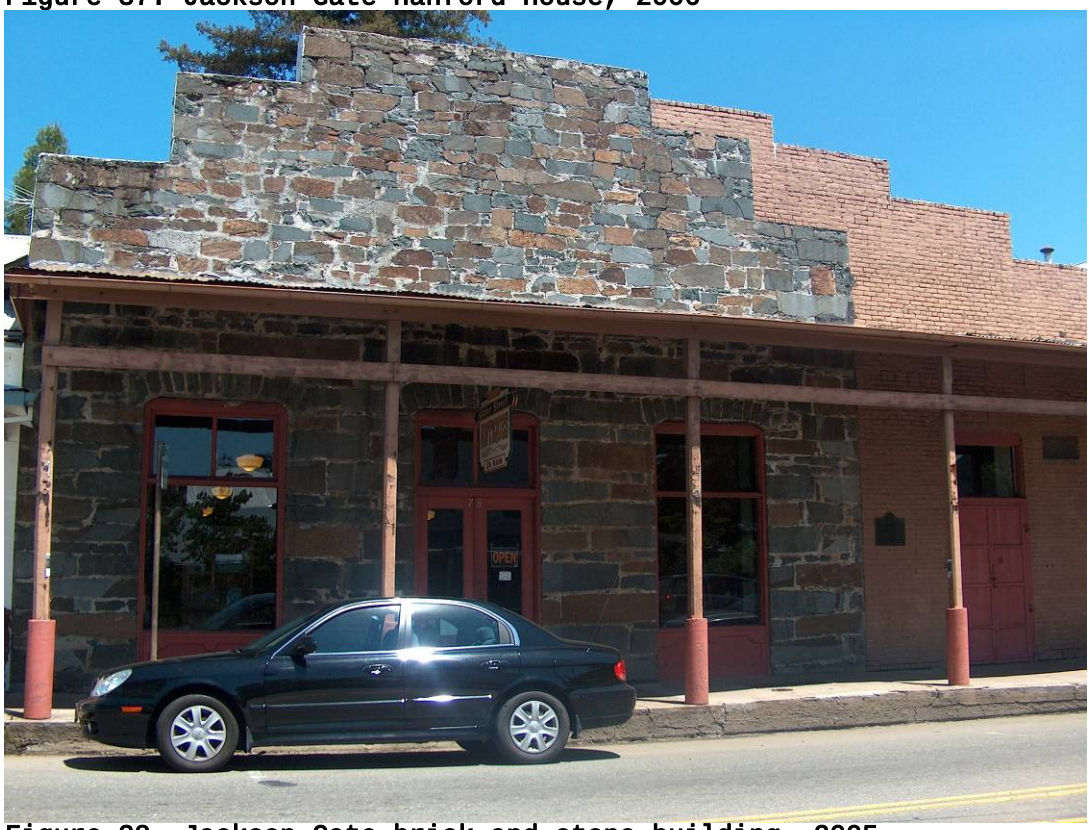

Figure 38. Jackson Gate brick and stone building, 2005

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).

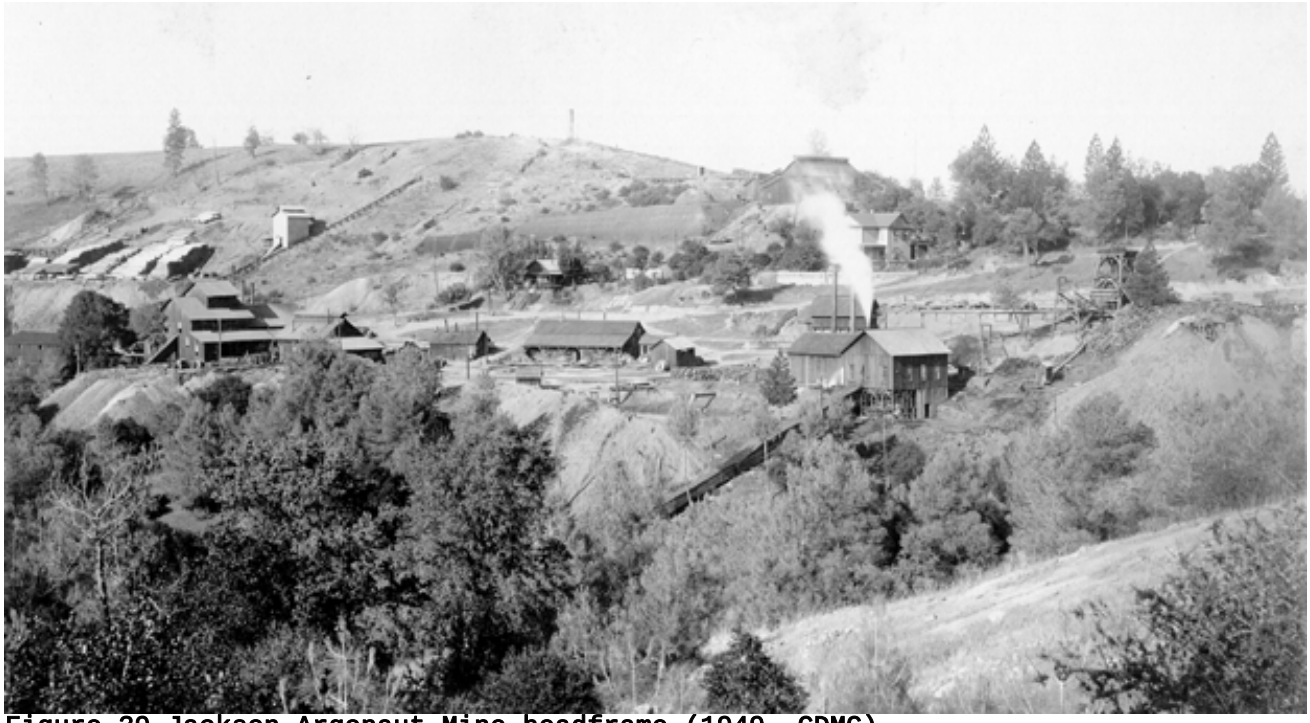

Figure 39.Jackson Argonaut Mine headframe (1949, CDMG)

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 40. 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).

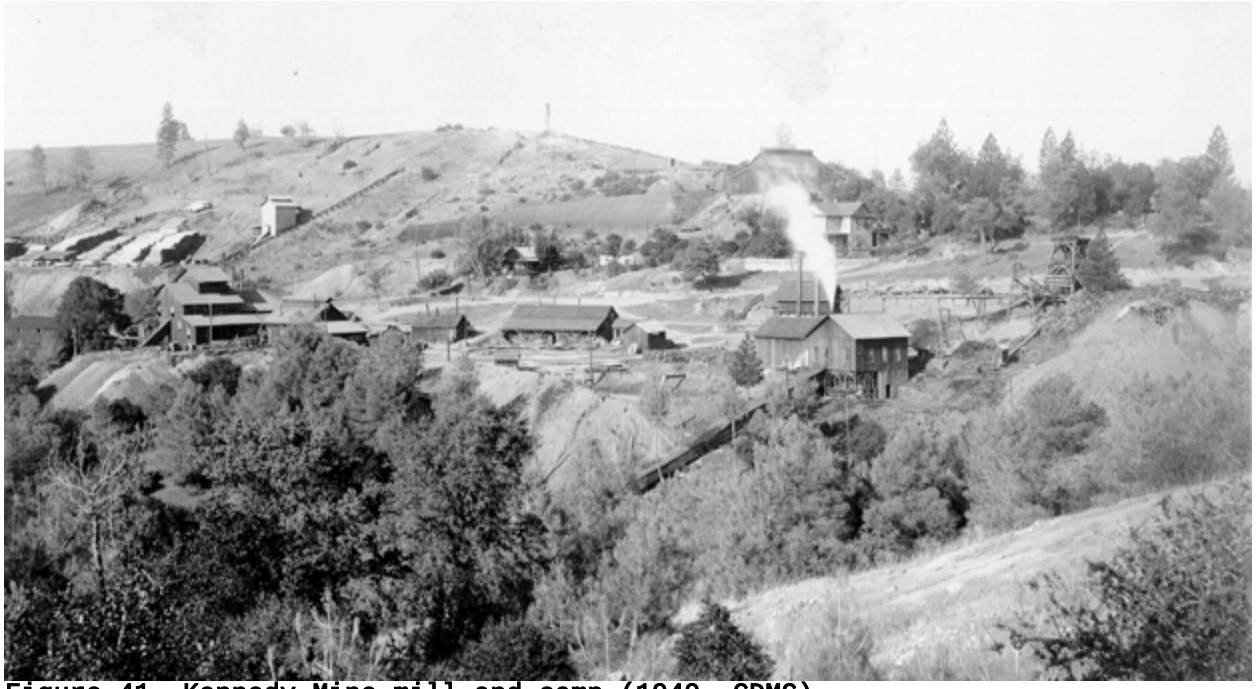

Figure 41. Kennedy Mine mill and camp (1949, CDMG)

Figure 42. Kennedy Mine headframe, 2005

Figure 43. Kennedy mine headframe, 2005

Figure 44. Kennedy Mill boiler foundations, 2005

Figure 45. Kennedy mill with lumber stockpile, 1900 (1998, CGS)

Figure 46. Ore bins and stamp mill foundations, 2006

Figure 47. Kennedy mill thickening tank, 2006

1.1-1.3 Cross through two members of the Mariposa Formation and one member of the Logtown 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 Logtown 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 Logtown 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).

Figure 48. Central Eureka headframe, March 2007

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).

Old 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.

GEOLOGY MAP 24

Sutter Creek to Plymouth
(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)

SUTTER CREEK

The town of Sutter Creek is underlain by Salt Springs (Black) Slate.

This town was named after John A. Sutter, who came to the region in 1846, and was the first to mine the locality in 1848. (California Historical Landmark No. 332). Although the gold rush ruined John Sutter's mercantile empire, he camped and mined here in 1849 with Indians and Kanakas (native Hawaiians) in his employ (Gudde, 1969; Landefeld and Snow, 1990).

There was little activity at Sutter Creek until 1851, when quartz gold was discovered. In 1932 the Central Eureka mine, discovered in 1869, had reached the 2,300-foot level. By 1939, it was the best-paying mine at Sutter Creek (California Historical Landmark No. 332).

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).

Figure 49. Remains of winery east of Sutter Creek (CDMG, 1949:133)

Figure 50. Meta-andesite field stone building on hill east of Sutter Creek (CDMG, 1949:133)

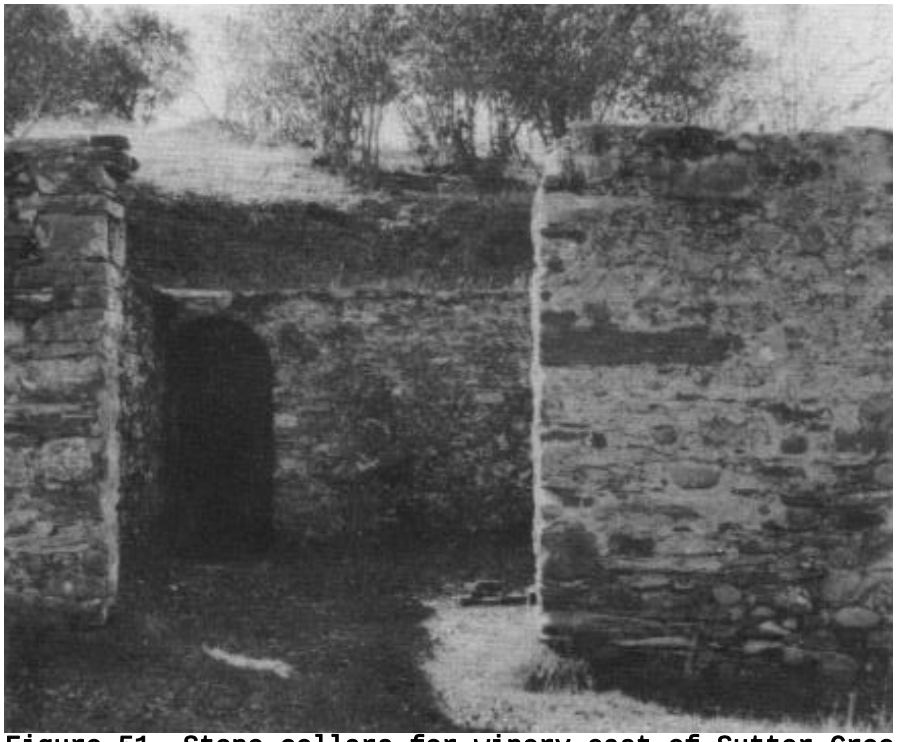

Figure 51. Stone cellars for winery east of Sutter Creek (CDMG, 1`949:134)

Figure 52. Ruins of winery, east of Sutter Creek, March 2007

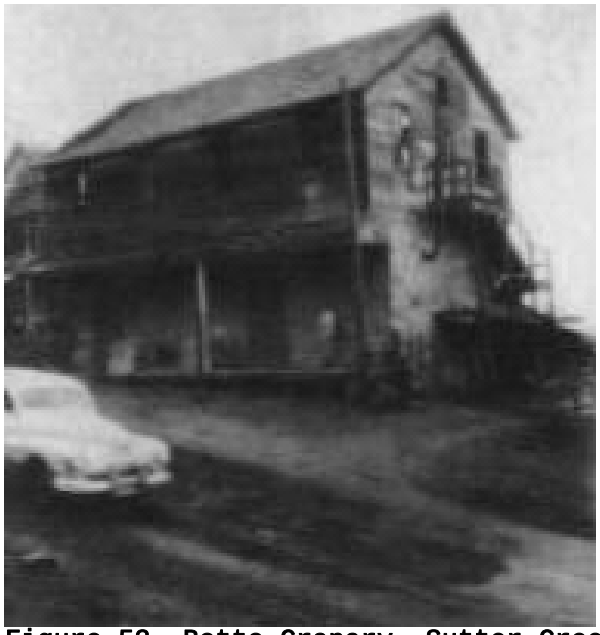

Figure 53. Botto Granary, Sutter Creek (CDMG, 1949:133)

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).

KNIGHT FOUNDRY

The Knight Foundry is California Historical Landmark No. 1007.

Knight Foundry was established in 1873 to supply heavy equipment and repair facilities to the gold mines and timber industry of the Mother Lode. Samuel N. Knight developed a high speed, cast iron water wheel which was a forerunner of the Pelton Wheel design. Knight Wheels were used in some of the first hydroelectric plants in California, Utah, and Oregon. This site is the last water powered foundry and machine shop in California. A 42-inch Knight Wheel drives the main line shaft, with smaller water motors powering other machines (California Historical Landmark No. 1007).

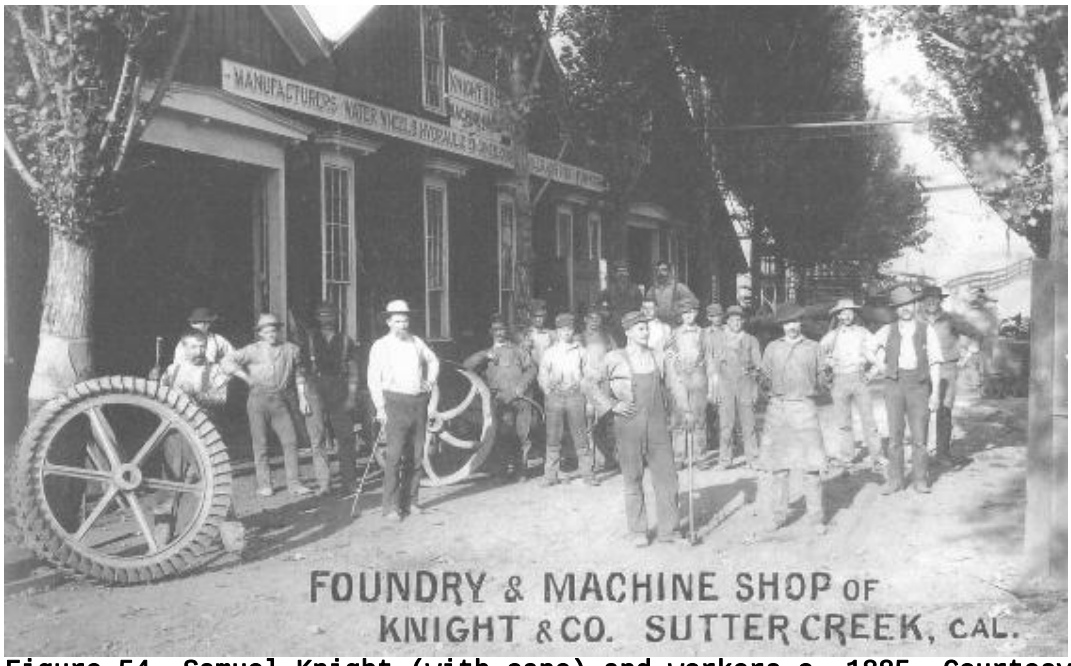

Figure 54. Samuel Knight (with cane) and workers c. 1885. Courtesy Amador County Museum.

The Knight Foundry in Sutter Creek has demonstrations of Mother-Lode era smelting technology. This foundry was powered by a water wheel.

Figure 55. Knight Foundry, March 2007.

Figure 56. Knight Foundry, March 2007.

Figure 57. Knight Foundry, March, 2007.

Figure 58. Knight Foundry, March, 2007.

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. Stay to the left, on Highway 49.

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 (or Logtown Ridge meta-andesite, CGS, 1997:123) to the east against Salt Springs (Black) Slate (or Mariposa Slate, CGS, 1997:123) 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. In June, 2006, the company was seeking permits to allow resumption of production underground mining.

Figure 59. Lincoln Mine Tour with vein, 2005

Figure 60. Lincoln Mine tour showing quartz vein, 2005

Figure 61. Lincoln Mine headframe, 2005

Figure 62. Underground mining equipment, Lincoln Mine, 2005

Figure 63. Lincoln Mine, quartz veins, 2005

Figure 64. Lincoln Mine drift, 2005

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.

SOUTH SPRING HILL MINE

3.1 South Spring Hill Mine

Immediately to the east of the Keystone (see discussion below) is the South Spring Hill mine (#169). It was discovered in 1851 and is located in the SE quarter of Section 36.The South Spring Hill shaft is 1,200

feet deep along a 60° incline. Before passing into the hands of the Keystone interests in 1920, the mine had been credited with a production of 43,700 ounces ($1,092,472) (Bowen and Crippen, 1949).

KEYSTONE MINE

3.5 Keystone Mine (#170).

Best known and most productive of the Amador City mines is the Keystone, located at the southeast edge of town in the NE quarter of Section 36. It dates from 1853, being a consolidation of several pre-existing claims. Ore from these had been milled in arrastres from 1861 to 1863. The main shaft is 2,680 feet (249 m) deep along an average incline of 52 degrees. Much of the ore taken from this mine was of sulfantimonide or sulfantimonide type which is somewhat unusual among Mother Lode ores. The total production of the Keystone is about 980,000 ounces ($24,500,000) between 1853 and its enforced closing by the War Order in 1942 (Bowen and Crippen, 1949).

The headframe for the Keystone mine is uphill on the right. The Mine House on the left was the head office building of the Keystone Consolidated Mine Company. Built over 120 years ago, it served as company office, assay office, melting room, and contained the gold storage vault. It is now a hotel (Landefeld and Snow, 1990).

Figure 65. Keystone Mine plaque, 2007

Figure 66. Keyestone Mill foundations, March, 2007

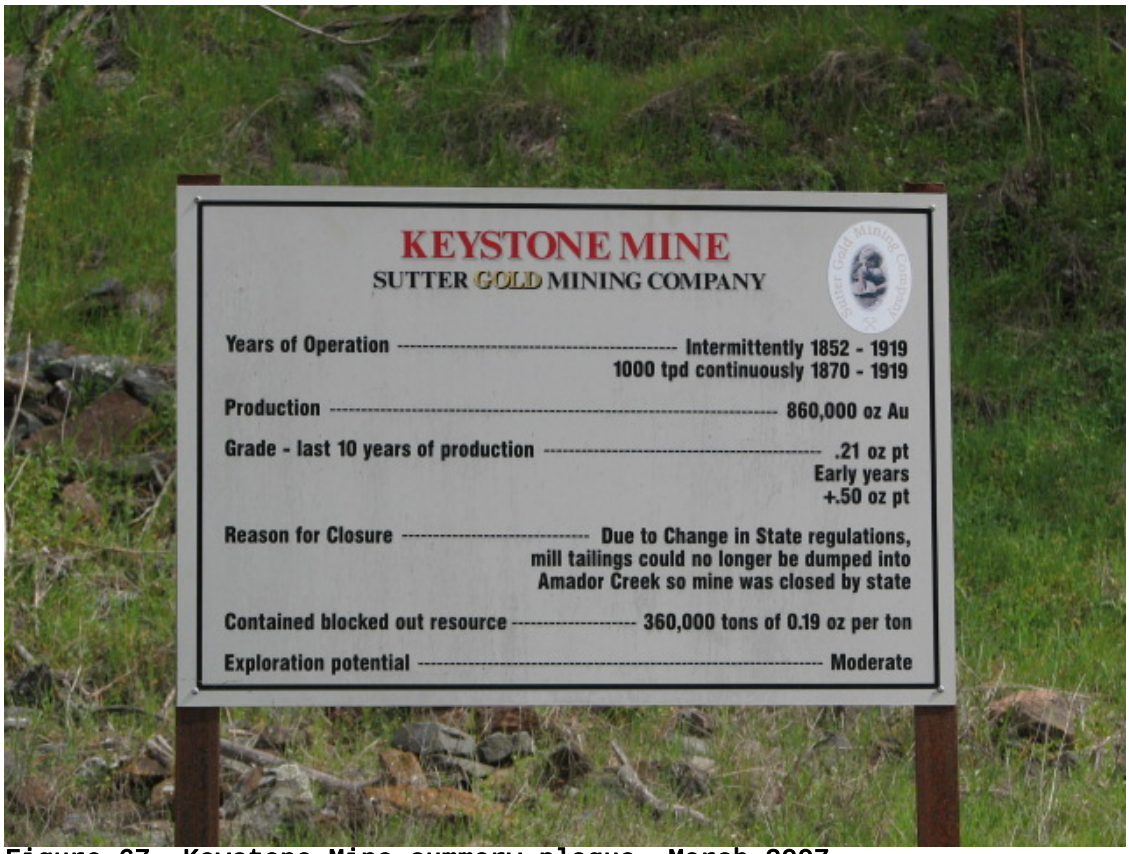

Figure 67. Keystone Mine summary plaque, March 2007

Figure 68. Keystone mill foundations with headframe in background, March, 2007

3.6 Cross Amador Creek Bridge at Water Street. The Spring Hill and Bunker Hill mines are to the east of this point. One fourth mile west of this bridge is a 300-foot wide zone of New Chicago (volcanic breccia greenstone) Member of the Logtown Ridge Formation.

BUNKER HILL AND NEW CHICAGO MINES

Bunker Hill Mine (#171) is north of the Amador Creek Bridge in the S1/2 quarter of Section 25 . It is about 0.5 miles north of Keystone on a N. 20° W. line. The line extended to the north-northwest from the Bunker Hill includes the Treasure, Fremont, Gover, and Italian Mines, all spaced about half-a-mile from one another (Landefeld and Snow, 1990).

AMADOR CITY

Amador City, 2.2 miles northwest of Sutter Creek, is the locus of another group of rich mines. The Amador Creek placers were located (discovered) in 1848 but were never very rich, and it was not until the first lode gold strike in 1851 that Amador City began to grow. Amador City has much the same setting and background as Sutter Creek which it resembles in many ways. Strangely enough, a Baptist minister made the initial discovery in Amador county, which was first known as the Minister's claim. Later it was developed into the original Amador Mine (Bowen and Crippen, 1949).

Figure 69. Brick building, Amador City, March, 2007.

Figure 70. Stone building, Amador City, March, 2007

Figure 71. Stone building, Amador City (CDMG, 1949:138)

Figure 72. Amador Hotel, 2002.

Jose Maria Amador, born in Yerba Buena and grantee of the Rancho San Ramon, camped and mined near here with several Indians in 1848 (Gudde, 1969). Yerba Buena became San Francisco when military governor General Stephen W. Kearney decided on its current name March 10, 1947 (Landefeld and Snow, 1990).

The original Amador Mine, in 1949 a consolidation of six claims, is a very complex working comprising over nine miles (14 km) of drifts, crosscuts, and raises. These open off from a 1,238-foot (377 m) inclined shaft. Estimated total production for this mine is 140,000 ounces ($3,500,000). The original Amador is located about a 0.25 (0.3 km) mile northeast of town. Highway 49 turns west at Amador City and follows Amador Creek for more than a mile (1.6 km) before turning north toward Drytown. The road cuts are all in metavolcanic rock of the Logtown Ridge Formation. A thick section of this formation is exposed along this sector of the highway (Bowen and Crippen, 1949; modified by CSG, 1997).

4.7 Plagioclase porphyry pillow lavas in road cut right.

This rock type is distinctive in that is found almost exclusively as lava flows in the Logtown Ridge Formation. These flows are in Duffield and Sharp's (1975) Pokerville Flat Member. This rock type is locally called "Chinese-writing rock" for the character-like random orientation of the 1-2-cm long phenocrysts. In

places, the phenocrysts are concentrically zoned (Landefeld and Snow, 1990).

5.0 (MP 12.15) Cross over Rancheria Creek.

Between this creek and Drytown, Highway 49 goes through Pokerville Flat and Goat Hill Members of the Logtown Ridge Formation.

As you proceed along Highway 49, notice the grape vines in fields. There are over 20 wineries in the foothills, including Stevenot Wineries in Murphys. Stevenot is an old mining name in Calaveras County (Landefeld and Snow, 1990).

5.5 Drytown Historic Marker in Logtown Ridge Formation. There is an east-west striking fault immediately north of Drytown with left-lateral separation of about 400 feet.

5.8 Jaira Ranch Road intersection.

DRYTOWN

6.3 Drytown (#172) is located in the SW quarter of Section 23.

Drytown was founded in the spring of 1848 when rich placer ground was discovered there. Its heyday was prior to 1857 before the placer diggings became exhausted. Drytown claims the distinction of being the discovery point of the first placer gold taken from Amador County. Division of Highway Historical Marker 21 is located near the junction of Highway 49 and the Drytown-New Chicago-Amador City road. The latter is paved and is an alternate route from Amador City to Drytown. Along this road are the old Mining camps of New Chicago (#173) and New Philadelphia and the productive Gover, Bunker Hill, Fremont, Italian, and Treasure (#174) mines. The former two are credited with producing over 200,000 ounces ($5,000,000) each. Such picturesque names as Lower Rancheria, Bloody Gulch, Rattlesnake Gulch, and Murderer's Gulch are connected with the placering in this vicinity (Bowen and Crippen, 1949).

Figure 73. Brick store, Drytown (left, CDMG, 1949:139; right 2002)

Figure 74. Drytown Hotel, 2005.

Figure 75. Drytown butcher shop, 2005.

Photo 5. Headframe of the Fremont Mine, near Drytown, Amador County. California poppies and volcanic rock "tombstones" are in the foreground. *Photo by Max Flanery.*

Figure 76. Freemont Mine Headframe (CGS, 1998).

Figure 77. Drytown jail, March, 2007.

Drytown was so named because the creeks that drain into this area did not furnish enough water for washing gold (Gudde, 1969). East of here a 10-meter thick bed of epiclastic, clast supported conglomerate is exposed. It appears to be part of 1.8 kilometer long, 0.3 kilometer thick channel near the base of the Mariposa Formation (Landefeld and Snow, 1990).

6.3 (MP 13.56) Dry Creek Bridge.

6.7 Evidence of placer diggings on the left.

7.5 Intersection of State Highways 16 and 49. Turn right and go west on Highway 49 toward Plymouth. The highway makes a sharp bend to the east for 0.5 miles before continuing northward into Plymouth. This highway intersection is near the Melones Fault which places Goat Hill Member of the Logtown Ridge Formation to the east against Salt Springs Shale (Slate Unit S2 of Duffield and Sharp, 1975) to the west. From this junction, 1.2 miles northwest of Drytown, Highway 49 bends sharply to the east for half a mile before continuing northward into Plymouth.

8.1 Augite-phyric volcaniclastic rocks on left. These rocks are part of the Logtown Ridge Formation.

8.2 to 9.5 "Tombstone" rocks in slate. Black slate and thin-bedded sandstone (Salt Springs Member) of the Mariposa Formation crops out on right (Landefeld and Snow, 1990).

9.6. Plymouth Consolidated Mines on the right (east)

GEOLOGY MAP 25-A

Plymouth to Consumnes River
(Wagner et al., 1981; Logan, 1935; Behman, 1978)
(Duffield and Sharp, 1975; Loyd et al., 1983)

PLYMOUTH CONSOLIDATED: (PACIFIC AND EMPIRE) MINES

The history of Plymouth (#175) is connected with the ups and downs of the lode mines nearby, which were discovered in the same vicinity. Like most other large Mother Lode mines, the Plymouth Consolidated (#176) is a merge of many old claims, and the most famous in the vicinity. The mine is in the center of Section 11. At least 16 claims or parts thereof were consolidated intone property. Most of the reported production has come from the Simpson, Aden, and Oaks claims which were merged by the Plymouth Consolidated Mining Company in 1883. Initially, the mines paid handsomely; by 1887 they had paid $2,800,000 in dividends (Wagner, 1970). The total production of the mine has been estimated at more than 5,900,000 ounces ($13,500,000). Mostly from quartz veins in lightly altered, very deformed black argillite plus minor siltstone, sandstone (Bowen and Crippen, 1949; Landefeld and Snow, 1990).

Figure 78. Stone and brick building on west edge of Plymouth (CDMG, 1949:139). Note interfingering of brick and stone.

Figure 79, Stone and brick building on west edge of Plymouth, March, 2007. A plaque on the building identifies it as a "Chinese store".

The deepest part of the Pacific Mine is at least 4,450 feet (1,356 m) along a shaft which is partly vertical and partly inclined. Although the veins are on a continuation of the same Gold Thrust on which the Amador City and Sutter Creek mines are situated, the wall rocks in the Plymouth Consolidated are confined to Salt Springs Black Slate Member of the Mariposa Formation. The Plymouth Consolidated is the most northerly of the major mines of the Mother Lode. Above Plymouth, the veins contain much more limited ore shoots and finally fray out into lodes of stringer quartz veins, veinlets, or vein stockworks. The workings in Georgetown, Garden Valley, Greenwood, and Spanish Diggins are of this type (Bowen and Crippen, 1949; Landfield and Snow, 1990).

9.8/0.0 "Downtown" Plymouth. Reset odometer at the intersection of Highway 49 and County Road E-16 (old Oleta Rd). County Road E-16 leads eastward to Fiddletown and River Pines (see discussion below). This area is underlain by (Black) Salt Springs Member of the Mariposa Formation.

GEOLOGY MAP 25-B

Plymouth to Fiddletown
(Wagner et al., 1981; Logan, 1935; Behman, 1978)
(Duffield and Sharp, 1975; Loyd et al., 1983)

0.25 A quarter miler west of Plymouth, the road crosses a north-south trending contact between Paleozoic carbonate and schist to the west and Mesozoic metavolcanics (Mzv) to the east.

1.0 A mile west of Plymouth, the road crosses a contact north-south trending contact between Mesozoic metavolcanic rocks (Mzv) to the west and Mesozoic granite (“Plymouth Pluton”) to the east.

2.8 Contact between Plymouth Pluton to the west and Paleozoic carbonate (Pz) to the east.

3.1 Road to De Porto marble quarry to the south.

3.8 Cross creek

4.8 Covered bridge on the left.

5.6 Fiddletown.

FIDDLETOWN (OLETA)

Settled by Missourians in 1849, Fiddletown was a trading center for American, Loafer, and French Flats, Lone Hill, and other rich mining camps. Called Fiddletown because residents "were always fiddling," the settlement became Oleta in 1878 but the original name was later restored. Bret Harte added to the community's fame in *An Episode of Fiddletown*. (California Historical Landmark 35; Bowen and Crippen, 1949).

Figure 80. Schalhorn smithy, Fiddletown (CDMG, 1949:141).

Figure 81. Schallhorn smithy, Fiddletown, March, 2007.

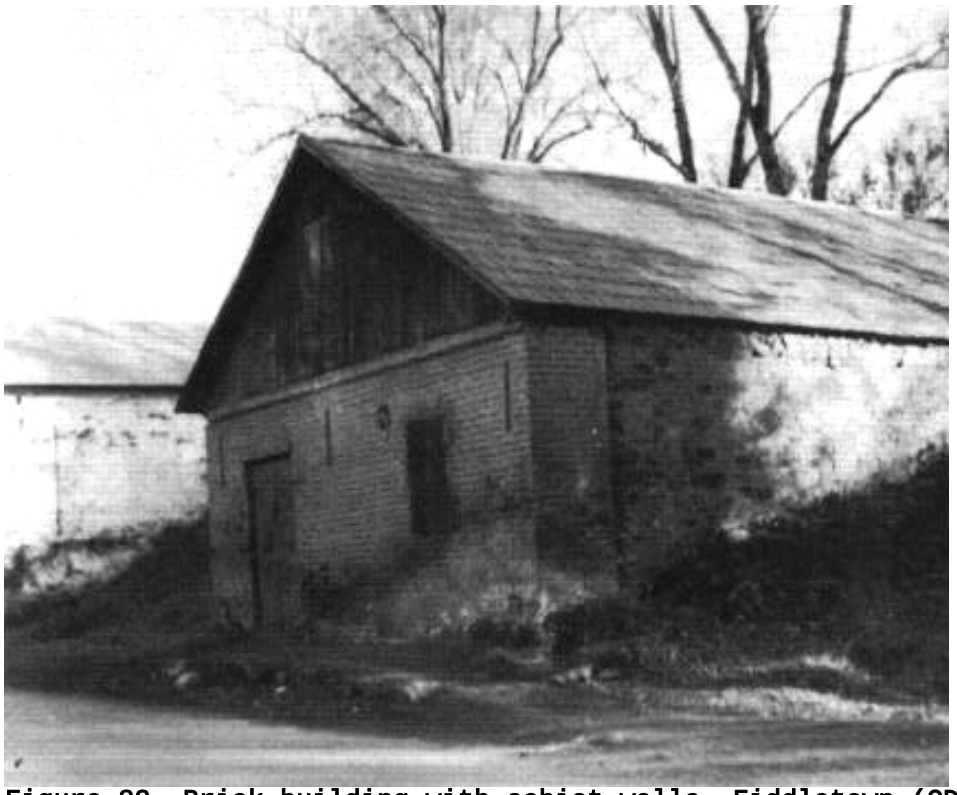

Figure 82. Brick building with schist walls, Fiddletown (CDMG, 1949:141).

Figure 83. Brick building with schist walls, Fiddletown, March, 2007.

Figure 84. Brick store, Fiddletown (CDMG. 1949:140).

Figure 85. Brick store, Fiddletown, March, 2007.Note crack, reinforcing boards, removed outer door and repositioned telephone pole.

Figure 86. Rammed-earth building, Fiddletown (CDMG, 1949:140).

Figure 87. Chew-Kee store, rammed-earth building, Fiddletown, March, 2007.

The "Plymouth pluton" can be seen 0.3 miles east from the Highway 49/County Road E-16 intersection. This is the western mylonitic edge of a granodiorite pluton that intruded rocks of the eastern belt before the Melones fault zone formed. It was subsequently deformed by the fault zone (Landefeld and Snow, 1990).

County Road E-16 approximates the position of an east-west striking fault in Salt Springs Black Slate. This fault does not extend eastward past the Melones Fault, 0.25 miles east of the Highway 49 intersection. The Melones strikes north-south at this point and places Bower Creek augite porphyry greenstone to the east against Salt Springs Slate to the west. Westward of the Melones is a 0.2 mile-wide strip of Salt Springs Slate which, at it's western edge, is in fault contact with granodiorite of the Plymouth pluton. This fault approximates the route of Highway 49 at this intersection (Landefeld and Snow, 1990).

Northbound from Plymouth, Highway 49 changes its northwesterly trend and goes almost due north for 12 miles (19 km). Over much of this distance the road lies in a narrow valley close to the watercourses of Big Indian Creek and the North Fork of the Consumnes River. A mile (1.6 km) above the old mining camp of Nashville, the highway crosses Logtown Ridge and drops into Logtown Ravine. The latter opens out onto low rolling meadowland in the vicinity of El Dorado. The land surface from Logtown Ravine on to Placerville has been resurrected by Quaternary erosion and the present topography is much as it was in late Cretaceous or early Eocene time. Bright red deeply weathered areas of the bedrock (paleosols) series and remnants of Tertiary gravels are evidence of the transformation (Bowen and Crippen, 1949).

1.7 View of Logtown Ridge on left (west). This ridge is the type locality for the Jurassic period rocks of the Mother Lode. Here the Highway 49 roadway is constructed on Salt Springs (Black) Slate Member of the Mariposa Formation.

1.8 Big Indian Creek follows a strike valley in the Mariposa Formation from here to Nashville. The Melones Fault is 0.4 miles to the east.

3.2 Indian Creek Bed and Breakfast road intersection.

3.4 The Plymouth Ditch can be seen on the right, about 170-feet in elevation above the road. It contours around the margin of this strike valley until it reaches the Consumnes River. It taps the river abut 3.6 miles east of where Highway 49 crosses it. Using man and horse power, some 730 different water companies dug almost 6,000 miles of ditch to bring water to the mines of the Mother Lode (W.W. Johnson, 1974). Water was required for sluicing in the early days, later it drove water wheels, and later pelton wheels which - either directly or by means of motors - powered the machinery that bailed, pumped, and hoisted water and ore from the mines. The stamp mills were also powered, directly or indirectly, by water (Landefeld and Snow, 1990).

3.5-3.8 Placer workings on right in Big Indian Creek.

3.8 Mill tailing and foundation on right (east).

3.9 Mine dumps on both sides of Highway 49 (NW Section 23).

AMADOR STAR AND BAY STATE MINES

The Amador Star and Bay State Mines (#178, formerly Golden Gate Mines of Logan, 1935) are in the vicinity of the old Enterprise schoolhouse site, four miles (6 km) north of Plymouth. These mines are located on the west side of the highway and only a few hundred yards from it. Remnants of mine dumps are on the east side of the highway. They are 40 years younger than the mines below Amador City and

are much less extensive. Production has been intermittent and unspectacular (Bowen and Crippen, 1949).

ENTERPRISE

4.0 The Enterprise townsite (#179) is in the NW quarter of Section 23. This area is underlain by Pokerville Member of the Mariposa Formation. Between Enterprise and Nashville, Highway 49 approximates the contact between the Logtown Ridge Formation to the west and Mariposa Formation to the east.

BALLARD AND CRAWFORD

4.5 The Ballard and Crawford mines (#180) are on the right (east) in the NW quarter of Section 14.

These mines are hosted within the Mariposa Formation, and did not produce much gold. They have been explored several times in the past decade (Landefeld and Snow, 1990).

4.75 (MP 22.12) Middle Fork of Consumnes River Bridge at Amador and El Dorado County line.

The Consumnes branches into two forks just above this spot, the South Fork cutting immediately across the ridge to the east and the North Fork flowing north for several miles parallel to the highway. West of the Consumnes River Bridge, also known as Huse Bridge (#181), the river flows in a deep canyon cut through Logtown Ridge Formation. Type sections of two members of the classically-defined Amador group, the Logtown Ridge meta-andesite agglomerate and the Consumnes metasediments composed of conglomeratic, sandy, and tuffaceous beds are exposed along the river (Bowen and Crippen, 1949; modified by CGS, 1997).

STRATIGRAPHIC SECTION AT THE CONSUMNES RIVER BRIDGE

Under the bridge over the Middle Fork of the Consumnes River (#181), at the El Dorado county line, is a contact between Salt Springs (Black) Slate Member of the Mariposa Formation to the east and Pokerville Member of the Logtown Ridge Formation augite porphyry greenstones to the west. These exposures extend upstream for 1.1 river miles (about 0.7 mile of section; Landefeld and Snow, 1990).

A hike of a few miles down this canyon is well worth the geologist's time. Along the stream bed are exposed type sections of two members of the Amador group, the Logtown Ridge metaandesite agglomerate and the Consumnes meta-sediments composed of conglomeratic, sandy, and tuffaceous beds (Bowen and Crippen, 1949).

5.2 Logtown Ridge landform continues on left (west).

5.45 Gold Beach Resort on the right (east).

6.7 Nashville (Quartzburg) on right (east) in the north-central part of Section 2. The Tennessee-Nashville Mine is on the right. The mine is about 100 yards north of the Nashville Tavern.

GEOLOGY MAP 26

Consumnes River to Nashville
(Wagner et al., 1981; Logan, 1935; Behman, 1978)
(Duffield and Sharp, 1975; Loyd et al., 1983)

NASHVILLE

Two miles north of the Consumnes River Bridge is the old mining camp of Nashville or Quartzburg (#182). The site of Nashville was originally an old Indian camping spot or rancheria, and the mining camp was one of the first lode camps in the state. The Tennessee-Nashville mine, also known as the Havilah, claims to have operated the first stamp mill in California, and ore from the mine was crushed in arrastres previous to that time. The Tennessee-Nashville was the first lode mine in El Dorado County and one of the first in the state to have a stamp mill. The stamp mill was manufactured in Cincinnati and brought around the Horn of South America. Known production for the Tennessee-Nashville is in excess of 9,240 ounces ($231,000) but there are no records for several periods of activity. The mine is about 1,000 feet deep (305 m) (Bowen and Crippen, 1949).

At Nashville, the Melones fault zone is 0.5 miles to the east and parallels the roadway. Here it places Calaveras Formation against Mariposa Formation.

7.1 Montezuma lode mine (hidden in trees across river) is to the right (east).

GEOLOGY MAP 27

Nashville to Logtown
(Wagner et al., 1981; Logan, 1935; Behman, 1978)
(Duffield and Sharp, 1975; Loyd et al., 1983)
(Logan, 1934; Lindgren and Turner, 1894; Loyd et al., 1983)

MONTEZUMA MINE

North of the Tennessee-Nashville (#182) a distance of 0.3 miles are the dumps of the Montezuma Mine (#183A) in the NE quarter of Section 2, SW quarter Section 35. The Montezuma had considerable amount of elaborate mining equipment at the site in the 1930's but this has since been removed. The Montezuma has a history similar to that of the Tennessee-Nashville, with which much of the development work was associated. Immediately north of the Montezuma Mine the old and historic Kings Store Road leads off to the northeast, climbing up Logtown Ridge. This road connects with the Red Bird, Union (#183B), Martinez (#183C), and Crusader mines which are along Martinez Creek (Bowen and Crippen, 1949).

7.4 Logtown Ridge landform and Formation on the left. Route will cross Logtown Ridge to the west, leave the strike valley and enter Logtown Ravine which opens out onto low rolling meadowland in the vicinity of El Dorado. (Bowen and Crippen, 1948; Landefeld and Snow, 1990).

7.5 Sand Ridge Road. Granodiorite pluton contact area.

7.8 Union Mine Road to right. At this road intersection, Union Mine Road approximates the contact between Mariposa Formation metasediments to the east and Logtown Formation diabase and hornblende porphyry to the west. From this intersection, Highway 49 cuts through Logtown Formation toward the northwest.

UNION MINE

The Union Mine (#183B) , south of Tombstone Mountain, is situated in the SW quarter of Section 12. It was the largest lode producer in El Dorado County. It is credited with production in excess of $2,700,000 in gold (about 131,000 ounces; Bowen and Crippen, 1948; Landefeld and Snow, 1990).

7.9 Logtown Ridge Formation (Jurassic metavolcanics) exposed in road cuts.

9.0 Ridge of porphyritic volcanics of the Logtown Ridge Formation are on the right (east).

11.5 Evidence of placer mining in the drainage parallel to the road on the right.

10.8 Crystal Boulevard, at the crest of Logtown Ridge is to the west. Monitor Road is to the right. This is the present site of the hamlet of Logtown.

10.9 Begin decent down Logtown Ravine.

OPHIR AND POCAHONTAS MINES

11.8 The Opir (#184) and Pocahontas Mines are situated in the SW quarter of Section 11.

At the old townsite of Logtown on the west side of Highway 49 are two mines. The Pocahontas and the Ophir are located adjacent to Logtown Ravine. They are of interest to geologists because the veins are on the contact of Logtown Ridge meta-andesite and a quartz porphyry. They may not be related to the Mother Lode (Melones) Fault System. The quartz porphyry is closely associated with granodiorite in this locality and is either derived from it or intimately intruded by it. The Pocahontas is more than 1,000 feet (328 m) deep along a rather shallow dip of about 45 degrees (Bowen and Crippen, 1949).

Between the old site of Logtown and El Dorado, Highway 49 is mostly on Mesozoic quarts porphyry and granodiorite.

GEOLOGY MAP 28-A

Logtown to Placerville
(Wagner et al., 1981; Logan, 1934; Wagner, 1979)
(Lindgren and Turner, 1894; Loyd et al., 1983)

LOST STONE BUILDINGS AND ARRASTRE STONES OF LOGTOWN

Now vanished without a trace, Bowen and Crippen (1949) described the area of old Logtown as follows:

> "Two miles south of El Dorado several ruins of old stone buildings can be seen on either side of the highway. The best preserved of these is a partly dugout structure half of which is below ground level. A substantial part of the walls are made from granodiorite arrastre stones. Arrastres were used extensively in connection with the mines between Plymouth and Placerville and their partly shaped stones made good building blocks. The arrastre method of grinding ore was borrowed from the Spanish Californians but it is probable that those in the El Dorado district were "Yankee" made."

12.3 Granodiorite pluton outcrops to the right (east).

12.6 A stamp mill is visible in the front yard of a private residence on the left. The mill is not in its original location.

13.1 China Hill Road intersection. The Starlight Mine is in SE Section 3.

14.3 The El Dorado Townsite (#185) is at the intersection of Highway 49 and Pleasant Valley Road. Historical Marker #486 is on the walls of one of the buildings near this intersection. The town of El Dorado is underlain by Logtown Ridge Formation and dikes of quartz porphyry.

EL DORADO (MUD SPRINGS)

Originally known as Mud Springs, the camp of El Dorado (#185) was on the Carson Emigrant Trail long before gold rush days. The name was changed during the height of the gold rush at the time of the incorporation of the town. Although attractively situated in the midst of a lumbering, cattle grazing, and gold mining region, El Dorado has never gained the impetus toward growth enjoyed by its near-neighbor Placerville. A sawmill and lime plant are located close to town and many early-day buildings, both well preserved and in ruins, can be seen there (Bowen and Crippen, 1949)

El Dorado, 'The Gilded One,' was first known as Mud Springs from the boggy quagmire the cattle and horses made of a nearby watering place. Originally an important camp on the old Carson Emigrant Trail, by 1849-50 it had become the center of a mining district and the crossroads for freight and stage lines. At the height of the rush its large gold production supported a population of several thousand (California Historical Landmark 486)..

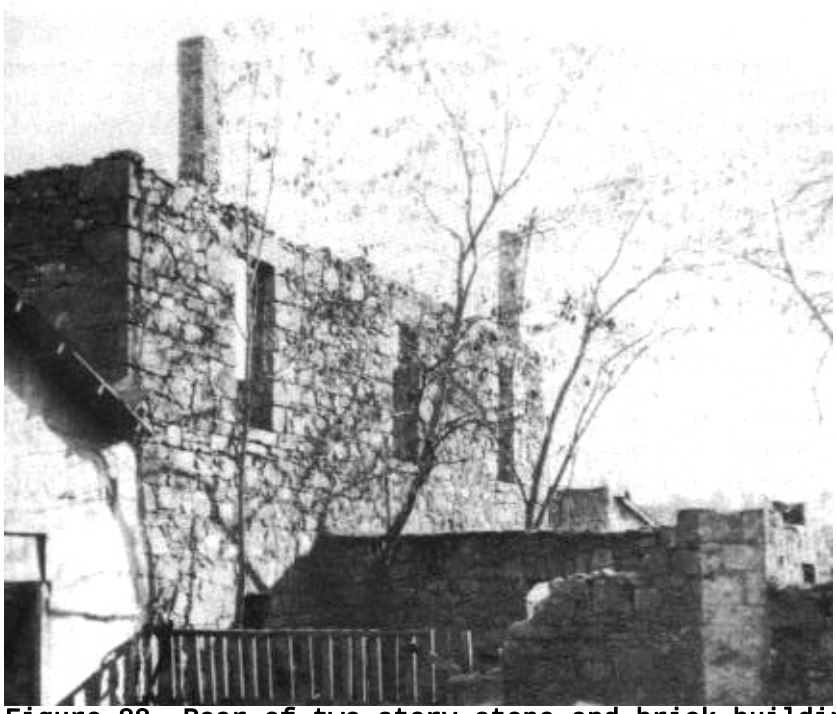

Figure 88. Rear of two-story stone and brick building (CDMG, 1949:143).

Figure 89. Rhyolite tuff and brick buildings, El Dorado (CDMG, 1949:142).

Figure 90. Rhyolite and brick buildings, El Dorado, now a café (red) and stores (white and light green), March, 2007.

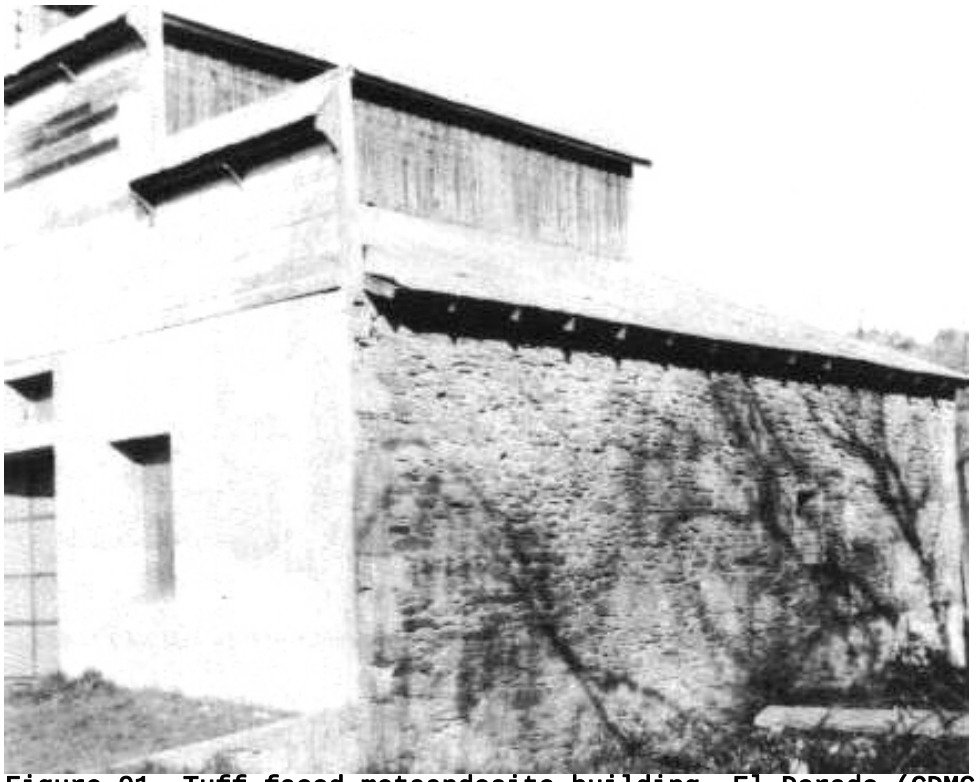

Figure 91. Tuff-faced metaandesite building, El Dorado (CDMG, 1949:143).

Figure 92. Mine buildings of the U.S. Lime Products Company lime plant at El Dorado (CDMG, 1949:46).

The town of El Dorado has spread out to the south and been built on the tailings from placer mining in the Logtown Gulch drainage, about 0.8 miles south of the town's main intersection (Landefeld and Snow, 1990).

Figure 93. El Dorado Post Office, March , 2007.

Figure 94. Red's Cafe, El Dorado, March, 2007.

Figure 95. El Dorado store, March, 2007.

Two prominent mines in El Dorado County were the Gentile Anne and Rustless Mines.

Figure 96. Track at portal of Gentile Anne Mine, 1890 (CGS, Photo C7432).

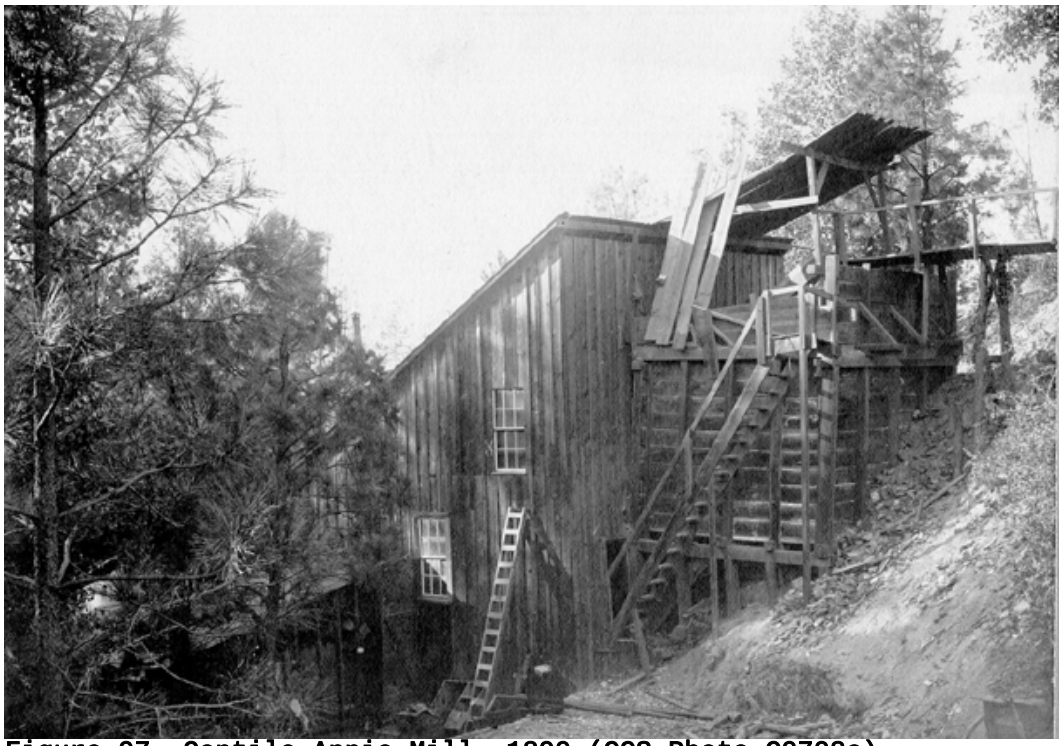

Figure 97. Gentile Annie Mill, 1890 (CGS Photo C0708c).

Figure 98. Rustless Mine hoist, 1940 (CGS, Photo A209f).

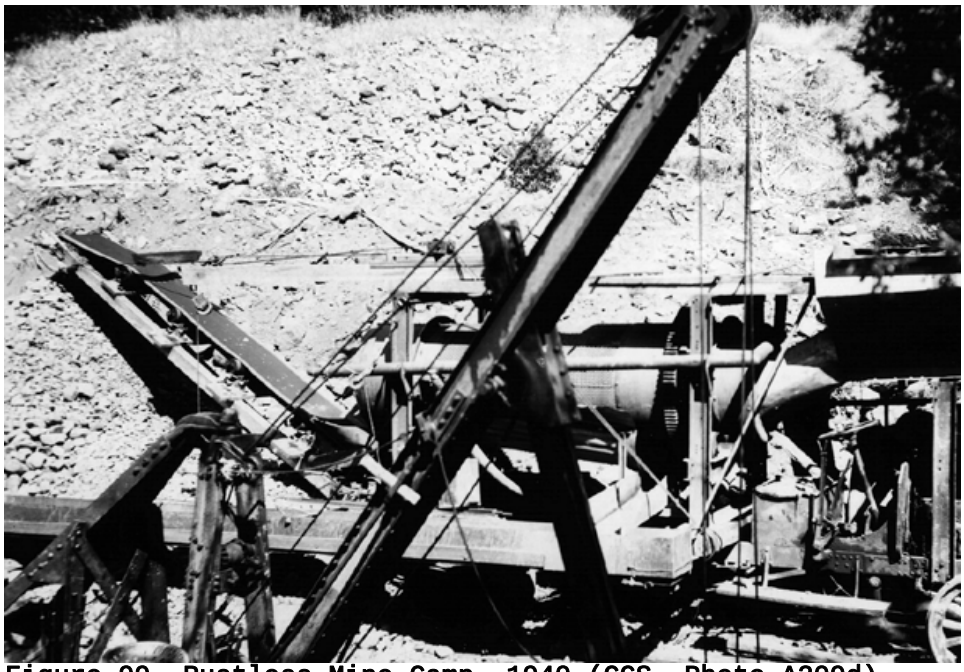

Figure 99. Rustless Mine Camp, 1940 (CGS, Photo A209d)

Figure 100. Rustless Mine stone kiln, 1949 (CGS, Photo A209k)

Figure 101. Rustless Mine separation table, 1940 (CGS, Photo C209j).

As we leave El Dorado we cross to the east out of the Logtown Formation and into granitoid rock which also cuts the Bear Mountain fault zone. The age of this pluton is not known. If it was, its age would help bracket the timing of movement on the Bear Mountain fault zone (Landefeld and Snow, 1990).

15.2/0.0Intersection on Highway 49 and Pleasant Valley Road.

Turn right and go east toward Placerville. Rocks in this area are Jurassic metavolcanics of the Logtown Ridge Formation. Between El Dorado and Diamond Springs, Highway 49 cuts across Logtown Ridge Formation, Mariposa Formation and quartz porphyry.

1.0 Stop sign at Paterson Drive.

1.5 Stop light. Enter Diamond Springs. Go straight (east) on Highway 49.

DIAMOND SPRINGS

Diamond Springs (#186) is located near one of the richest of the early day placer diggings in the vicinity of Placerville. Like El Dorado, it was an emigrant camp before the gold rush days. Both Diamond Springs and El Dorado are to one side of the Highway 50 cross-country route but were served by railroads and were active lumbering towns This town is underlain by quartz porphyry and granodiorite. Like El Dorado, Diamond Springs was an emigrant camp before the gold rush days (Bowen and Crippen, 1949).

This town, settled in 1848, derived its name from its crystal clear springs. Among the richest spots in this vicinity, its diggings produced a 25-pound nugget, one of the largest ever found in El Dorado County. Its most thriving period was in 1851 and, through its lumber, lime production, and agriculture, Diamond Springs has retained some of its early importance (California Historical Landmark No. 487).

1.8 Old stone building on left.

There are several buildings from the 1850's still in use in this area, many of which have fronts of dressed rhyolite tuff. Many of the stone buildings from south of El Dorado to here were made from blocks of granodiorite salvage from arrastres in the area. The Mexican Californians doubtless introduced the arrastre to grind gold-bearing quartz. The arrastre is a annular-shaped basin with an outside diameter of perhaps 10 feet. It was built of hard, tough stone. In this area granodiorite was used. A pivot pole is stood in the center. A horizontal pole extending beyond the perimeter of the grinding basin is rotated around the pivot by a horse. One or several stones, are connected to the midpoint of the horizontal pole by rope and dragged around the ring by a horse. Gold-bearing quartz is fed into the annulus and crushed by the drag stones, and the gold is mechanically liberated. The shaped stones used in the arrastres later made convenient building material.

Photo 6. Remains of a general store made of rhyolite tuff, Diamond Springs, El Dorado County. *Photo by Max Flanery.*

Figure 102. General Store, Diamond Springs (CGS, 1998).

Figure 103. General Store, Diamond Springs, 2005.

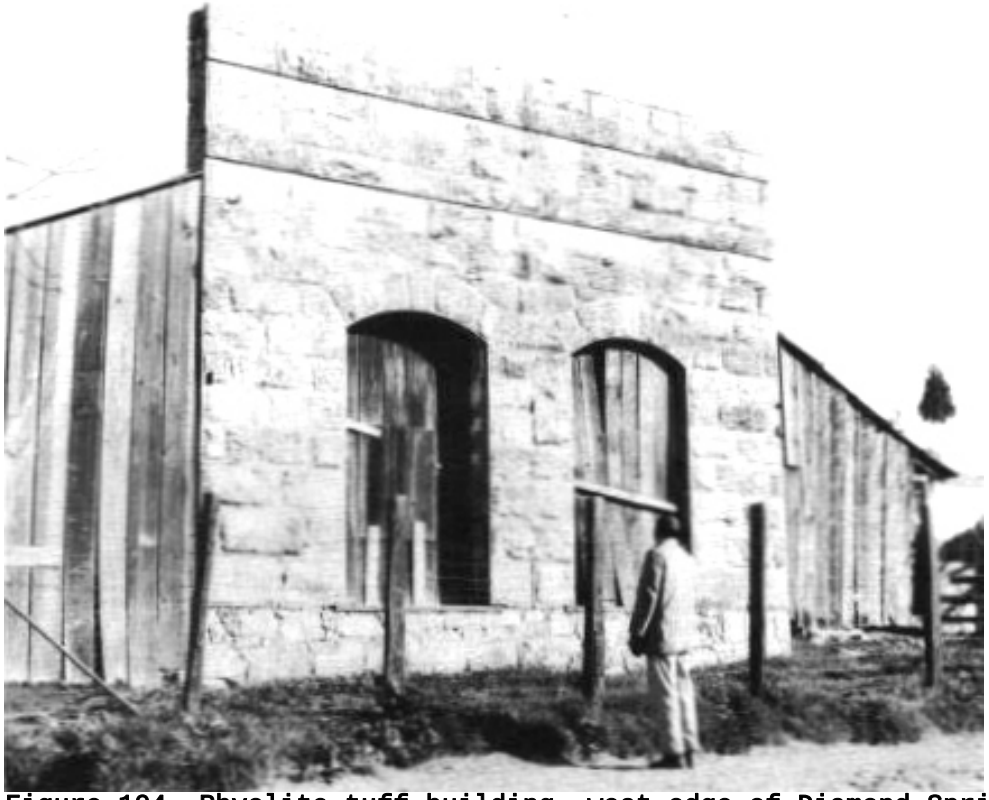

Figure 104. Rhyolite tuff building, west edge of Diamond Springs (CDMG, 1949:144).

Figure 105. Re-used block "P. Morrill" in general store building, Diamond Springs, March, 2007.

1.9 Diamond Springs Historical Marker (#186).

2.0 Diamond Springs Road in granodiorite.

2.2 Keep to the left on Highway 49 at stop sign and proceed toward Placerville.

2.5 Texas Hill Tertiary Channel is exposed on the left in a gravel pit. The auriferous gravel deposit lies on granodiorite bedrock.

3.1 Cross Weber Creek Bridge. Area underlain by Mariposa Formation.

As we cross Weber Creek, we ascend back up onto the Eocene surface. This is a good vantage point to view Sacramento valley off to the west (Landefeld and Snow, 1990).

PACIFIC QUARTZ MINE

3.5 The Pacific Quartz Mine (#186) is in the SE quarter of Section 7 and the NE quarter of Section 18.

In addition to the placer diggings, several lode mines were developed near Placerville. The most successful of these is the Pacific Quartz Mine (#186) situated on a hill on the south side of Placerville. It is about 2,000 feet (610 m) deep via vertical and inclined shafts and winzes. The ore is gold-bearing arsenopyrite containing considerable silver. Some ore bodies are in talc schist. The wall rocks are slate of the Mariposa Formation. There are intrusive bodies of serpentine near by which have been altered to talc-schist in some places. Such talc and serpentine rocks are exposed near the supermarket parking lot on the main street of Placerville, across from the County Courthouse. The Pacific Quartz Mine has a recorded

production of 29,400 ounces ($1,486,000) (Bowen and Crippen, 1949).

4.1 Coon Hollow portion of Tertiary channel hydraulic workings can be seen through the trees on the right (east). These workings are on the Texas Hill Tertiary Channel. The channel lies beneath Mehrten andesite lava which almost reaches the roadway.

4.2 Placerville City limit.

4.3 Crest of Sacramento Hill capped with Tertiary Mehrten volcanics (tuff/dacite) which overlie Tertiary auriferous gravels.

4.4 Hydraulic workings at the 12:00 o'clock position. The red scar in the hillside ahead is one of the many hydraulic scars seen from here north through Nevada and Sierra Counties. Hydraulic mining is one of the most efficient means of moving material ever developed. Water was directed by ditches to a site above the diggings. Utilizing hydraulic heads as great as 300 feet, water was conveyed to the mine site in pipes of decreasing diameter; thus the pressure was increased. The high pressure water was directed to the bank being mined by large (some are 15 feet long) nozzles called giants or monitors. The water was able to undercut banks, break up bedrock, and convey a slurry of gravel and even boulders to sluice boxes. These boxes, some made of wood and/or iron with a cross section of 6 feet wide by 4 feet deep, used beams of wood capped with iron, about the size of railroad track, as rifles to collect the gold.

4.9 Pacific Street. Turn right into old town Placerville. The Pine Hill Ultrabasic Complex, several miles to the west is a gabbro dome.

PLACERVILLE (HANGTOWN)

Placerville (#186) was founded in 1848 either by James Marshall or by a Consumnes River rancher named William Daylor. Both were there at different times in the spring of 1848. Placerville was known variously as Old Dry Diggins (no "g" between n and s) and Hangtown, but was incorporated as Placerville in 1854. Placerville was once the site of extensive placer and hydraulic mining projects. Gudde (1969) describes Placerville thus:

> "In 1850 the camp was named Placerville because the streets of the camp [and even within buildings] were almost impassible on account of the numerous placering holes"

This rich mining camp was established on the banks of Hangtown Creek in the spring of 1848. Millions in gold were taken from its ravines and hills, and it served as a supply center for mining camps and transportation terminus for the famous Comstock Lode. John M. Studebaker, Mark Hopkins, Leland Stanford, Phillip Armour, and Edwin Markham were among well-known men who contributed to Placerville's history, as did John A. 'Snowshoe' Thompson, who carried from 60 to 80 pounds of mail on skis from Placerville over the Sierra to Carson Valley during winter months (California Historical Landmark No. 475).

In the days of 1849, when this city was called Hangtown, vigilantes executed many men for various crimes. This was the site of Hay Yard, on which stood the 'Hangman's Tree.' The stump of the tree is under the building on which the plaque is placed (California Historical Landmark No. 141).

Gold rush town and western terminus of the Placerville-Carson Road to the Comstock, Placerville was a relay station of the Central Overland Pony Express from April 4, 1860 until June 30, 1861. Here on April 4, 1860, the first eastbound pony rider, William (Sam) Hamilton, changed horses, added an express letter to his mochila, and sped away for Sportsman's Hall. Placerville was the western terminus of the Pony

Express from July 1, 1861 until its discontinuance on October 26, 1861 (California Historical Landmark No. 701).

Figure 106. Wilcox warehouse, Placerville (CGS, 1949:145).

Placerville is the county seat of El Dorado County with lumber, railroad, and tourist interests. It is served by Highways 49 and 50 and by the Southern Pacific Railroad. The place is filled with old buildings and other spots of historical interest which have been adroitly preserved among the modern structures of the town. Many of the old buildings have been rehabilitated and house many types of business enterprise. Placerville is also justly proud of its newer structures such as the County courthouse building. Few places in California are as steeped in early-day history as Placerville. Old placer and hydraulic diggings surround the town on all sides and appear within its limits; fine old churches abound; and the pine-covered hills to the east of town form a fitting backdrop. J.M. Studebaker, who later founded an automobile empire, learned his trade in the blacksmith shops of Placerville. Although the gold of the vicinity has been largely dissipated, the timber and water resources remain and the county still flourishes (Bowen and Crippen, 1949). From Downtown Placerville, at Bedford road, a short side trip to the Gold Bug Mine is recommended.

GEOLOGY MAP 28-B

Placerville to Kelley Mine
(Wagner et al., 1981; Logan, 1934; Wagner, 1979)
(Lindgren and Turner, 1894; Loyd et al., 1983; Kohler, 1983)

SIDE TRIP TO GOLD BUG PARK

No trip to Placerville would be complete without a stop at the Gold Bug Mine and City Park (#188). The park is less than a mile (1.6 km) north of Highway 50, off Bedford Avenue, and east of Highway 49. This

mine is situated in Section 6. Above the Gold Bug is the Priest Mine. These are authentic quart-gold lode mines. They are lighted with cement walkways and hand rails. Entrance fee to the mine and the stamp mill is $5.00 per person. The stamp mill was renovated in 1995. The restoration of the Gold Bug mine and Stamp Mill won an award for outstanding volunteer achievement in 1996. After visiting the mine, return to Highway 50 and go 0.2 miles west to Highway 49.

0.0 From old town Placerville, go north to Bedford Avenue. Turn left and cross Highway 50.

0.3 Bedford Avenue and Highway 50. Turn left and then stay to the right. Follow signs to Gold Bug Park

GOLD BUG MINE

1.5 Gold Bug County Park

The Gold Bug Mine (#188) was excavated along a quartz vein in the Melones Fault Zone which brings Mariposa Formation to the west against Calaveras Formation to the east. This unpatented mining claim was conveyed to the City of Placerville under a provision in the Recreation and Public Purpose Act. The mine is an excellent place to learn about historic mining techniques. The hill south of the mine has quartz outcropping along the Melones Fault. It is relatively difficult and expensive (in the gold rush era and today) to sink a shaft. So the miners came down the hill and excavated a horizontal adit along the vein structure. The first few hundred feet of the mine has an arched back (top of the adit) and no drilling hole remnants on the ribs (sides of the adit). The adit is narrow. These features indicate that this portion of the Gold Bug was excavated in the 1850's to 1890's.At the south end, the adit stops where the vein is offset by a fault. A cross cut was made to the east in search of the offset vein. This activity was done at a time when rotary percussion drilling and blasting was possible, due to advances in pneumatic drilling and replacement of black powder with dynamite. The back of this portion of the mine has a square profile The ribs exhibit remnant portions of drill holes. These characteristics are indicative of mining practices after 1900. The cross cut did intersect the vein and it was explored for a few feet to the south. The Gold Bug is stopped upward to intersect with workings of the Priest Mine. Special tours of this mine are also available.

Figure 107. Gold Bug Mine and Museum, March, 2007.

Figure 108. Gold Bug Mine Adit, 2002.

Figure 109. Gold Bug Mine, quartz veins on roof of adit, 2002.

Figure 110. Gold Bug Stamp Mill, 2002.

0.0 Return to intersection of Highways 49 and 50. Reset odometer

5.1/0.0 Intersection of Highways 50 and 49.

Go straight (north) toward Auburn. The rocks at this intersection are of the Mariposa Formation. One-tenth mile east of this intersection (About half way to Bedford Avenue), Highway 50 crosses a contact of Mariposa Formation and Calaveras Formation rocks. One-tenth mile west of this intersection is a contact with the Logtown Ridge Formation.

From Placerville, Highway 49 resumes a northwesterly trend and soon leaves the Mother Lode to traverse an area almost lacking in lode mines and having but widely scattered placer camps. The relief steadily increases because of the proximity of the many forks and tributaries of the American River. The steeper canyon slopes are heavily wooded. In 1949, Bowen and Crippen described this area as “of the logged-off areas are covered with brush.” The huge amount of vegetation seen in the area today is second growth that has not burned due to decades of fire suppression policies of the Forest Service and Department of the Interior. For about four miles (6 km), Highway 49 traverses a bedrock of Mariposa slate, Logtown Ridge meta-andesite, intrusive quartz porphyry, and Calaveras schist; beyond that limit the bedrock is granodiorite for a distance of over eleven miles (18 km) (Bowen and Crippen, 1949).

0.8/0.0 Junction of Highways 193 and 49. Keep to the left and proceed toward Coloma on Highway 49. Reset odometer. Rocks here are Logtown Ridge Formation metadiabase and hornblende porphyry,

0.75 The road forks. To Coloma, stay to the left. To take a side-trip down to Big Canyon to the Chile Bar Slate Quarry (#189) at the South Fork of the American River, take the road to the right.

1.7 Outcrops of porphyritic volcanic rocks of the Logtown Ridge Formation.

1.9 Calaveras Group rocks exposed in road cut.

2.2 Granite Hill Road intersection.

2.4 Granodiorite exposures in road cut.

2.5-3.5 Mariposa Formation metasediments.

GEOLOGY MAP 29-A

Placerville to Coloma

(Wagner et al., 1981; Logan, 1934; Wagner, 1979)
(Lindgren and Turner, 1894; Loyd et al., 1983; Kohler, 1983)

3.6 Turnoff to Gold Hill (#189) on left (west). Rocks are Mariposa Formation. From this intersection southwestward toward Cold Springs Creek is granodiorite. The Gold Hill (#190) mine is on the ridge northwest of Gold Hill townsite.

The agricultural settlement of pioneer Japanese immigrants who arrived at Gold Hill on June 8, 1869-the only tea and silk farm established in California-had a promising outlook but failed tragically in less than two years. This was the initial Japanese-influenced agricultural attempt in California (California Historical Landmark No. 815).

4.6 Indian Creek to the right (north). This creek marks a lithologic contact between Mariposa Formation and Mesozoic granodiorite.

4.7 Cross a contact from Jurassic metavolcanic to ultramafic rocks.

5.2-6.7 Metavolcanic outcrops visible on Murphy Mountain to the north (right) across the South Fork of the American River canyon. View to the northeast of the 1,100 foot-deep canyon of the American River, and the low relief Eocene surface beyond the Canyon (Landefeld and Snow, 1990).

5.3 Granodiorite pluton contact.

6.3 Kidder Corner on Granite Hill Road. Note the white, deeply weathered granitic rocks in the road cuts. This is the same pluton seen at the townsite of El Dorado (Landefeld and Snow, 1990). Rocks here are quarts porphyry and granodiorite.

7.0 Coloma State Park boundary. Most of the Park is underlain by granodiorite and "quartz porphyrite" (Logan, 1935).

7.2 Marshal Gold Discovery State Park sign.

7.2 Visitor's Center (#191). Turn left (west) into parking lot. Each vehicle must pay a park entrance fee. Reset odometer.

COLOMA

7.3/0.0 Coloma State Park

Coloma (#191), site of Marshall's discovery of gold in 1848, lies in a valley traversed by the South Fork of the American River. The gravels from which Marshall washed the gold which made history are not the old Eocene deposits from which so much placer gold was taken, but rather are reworked Quaternary sands and gravels. The gold found along present day Sierran rivers is derived partly from recent erosion of older gold lodes but more generally from recent erosion of pre-existing stream deposits. The timberlands which first interested Marshall have, for the most part, been deforested, the gravels were soon exhausted and Coloma is largely a town of memories. The vicinity of Sutters' Mill and the hill which overlooks it to the southwest have been set aside as Marshall Gold Discovery State Parks. Centennial observances in 1948-49 resulted in the erection monuments and a now-refurbished museum and visitor's center (Bowen and Crippen, 1949).

Here in the valley of the Cul-luh-mah Indians, James W. Marshall discovered gold on January 24, 1848, in the tailrace of Sutter's sawmill. The old Coloma Road, opened in 1847 from Sutter's Fort to Coloma, was used by Marshall to carry the news of the discovery to Captain John A. Sutter. During the gold rush, it was used by thousands of miners going to and from the diggings. In 1849 it became the route of California's first stage line, established by James E. Birch. (California Historical Landmark No. 748).

In 1887 the State of California purchased the site for a monument to commemorate James Marshall, who in 1848 discovered gold near Coloma. Marshall's discovery started the 'gold rush,' that westward trek of Argonauts that marked a turning point in California history. The figure of Marshall atop the monument is pointing to the place of discovery on the South Fork of the American River (California Historical Landmark No. 143).

Figure 111. Coloma, 1905 (CGS, Photo A7221b and CG 50-149, 1997)

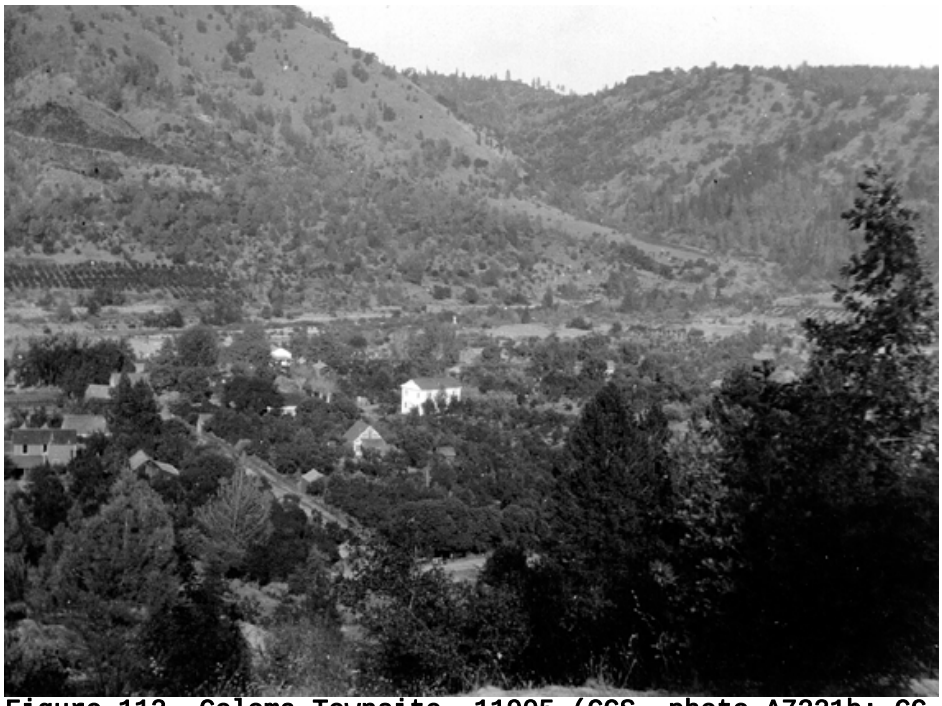

Figure 112. Coloma Townsite, 11905 (CGS, photo A7221b; CG 50-149, 1997)

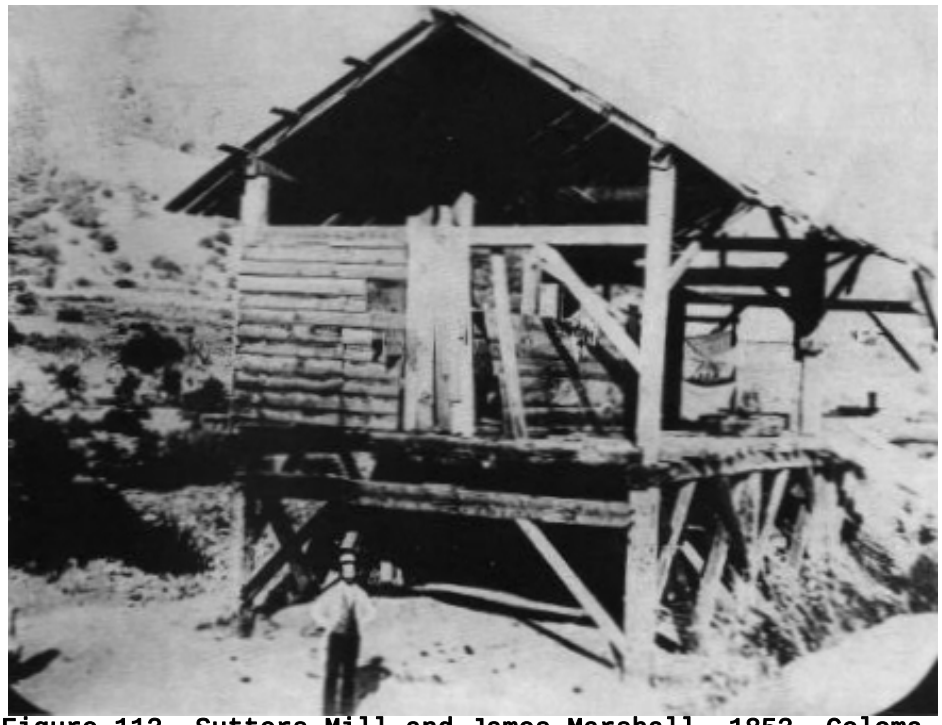

Figure 113. Sutters Mill and James Marshall, 1853, Coloma (CDMG, 1949:13)

Figure 114. Coloma Valley (CDMG, 1949:14).

The placer gold mined from the banks and bed of the American River at Coloma was most likely reworked gold from the alluvial deposits eroded from the Eocene surface as well as surface pocket lode deposits (Landefeld and Snow, 1990).

Figure 115. Bekeart's Store, Coloma (CDMG, 1949:149).

Figure 116. Cobblestone building with rhyolite tuff facing, Coloma (CDMG, 1949:148).

Figure 117. Granite jail, Coloma (CDMG, 1949:147).

Figure 118. Robert Bell store, Coloma (CDMG, 1949:148).

NATIVE AMERICANS AND THE GOLD RUSH

Beginning in 1839, John Sutter expanded the settlements at Sutter Fort largely by Indians who he hired in 1840, six of them were killed by Sutter's men for alleged horse and cattle theft. After the gold discovery at Coloma, Indians panning gold for the miners in their water-tight baskets and made up 50% of the mining work force in 1848. Later, conditions for the Indians worsened.

Information about the treatment and status of Indians following the gold discovery at Coloma come from various sources, including the recollections of persons such as Nancy Custino (1894-1987), whose grandfather worked for John Sutter:

> During the time that Sutter's Fort was being built, the Indians were used as slaves to carry the big rocks needed for constructing the foundation of some of the fort's walls. As the Indians were unwilling to transport the rocks, or anything else for Sutter, they were chained to do the work. If they became hungry, or happened to fall from being too tired, they were bull whipped.

William P. Blake relates the following in his book "Explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean", published in 1853-1854:

> During our stay at this camp [Fort Miller on the San Joaquin River], we purchased fresh salmon from the Indians who catch them in the river. It is probable, however, that they are not abundant, as the mining operations along the upper part of the stream and its tributaries sometimes load the water with impurities.

Mining soon overran the Native American communities, resulting in the murder, enslavement or displacement of many thousands. The valley ecosystems that supported their hunting-gathering way of life were transformed by placer mining and farming. Their fisheries were destroyed or damaged. Between 1849 and 1870, the U.S. government had a $200 bounty some Indian tribes. Within 10 years following the gold discovery, Indian populations were declined from about 600,00 (some historians claim 2 million) to about 6,000, mainly to introduced European diseases, starvation and malnutrition.

0.8 Lotus turnoff at left (south).

LOTUS

Downriver from Coloma a distance of 1.5 miles (2.4 km) is the placer camp of Lotus in Section 1. Lotus (#192) was first known as Marshall and then as Uniontown. It once had a population of 2,000, but this dwindled to a handful once the placers were exhausted. Two fine old brick structures remain on the site. A paved road connecting Lotus with Shingle Springs and Highway 50 passes through town and at its northern outskirts joins Highway 49. The Stuckslager Mine (#193) is located near this road one mile (1.6 km) south of Lotus. This pocket mine was unusual in that the gold was associated with the vanadium mica roscoelite. Roscoelite is a very rare mineral found in few other places in the United States. It occurred in fine greenish-brown or clove-brown scales associated with quartz and gold. None has been taken from there for some time (Bowen and Crippen, 1949). The bedrock here is granodiorite.

Figure 119. Meyer's Dance Hall and Saloon, just north of Lotus (CDMG, 1949:149).

Figure 120. Adam Lohry store, Lotus (CDMG, 1949:147).

0.9 (MP 1.2) Bridge over South Fork of the American River.

1.3/0.0 Turn off to Garden Valley on Marshall Road. Reset odometer.

GEOLOGY MAP 29-B

Coloma to Taylor Mine
(Wagner et al., 1981; Logan, 1935; Wagner, 1979)
(Lindgren and Turner, 1894; Loyd et al., 1983; Kohler, 1983)
(Aune, 1979, Logan, 1934)

SIDE TRIP TO GEORGETOWN DIVIDE

0.0 Junction Marshall Grade Road and Highway 49.near Lotus. Go east (right) on Marshall Grade Road.

Half a mile north of Lotus, a paved road turns northeast from Highway 49 which connects with Garden Valley. The latter is a very scenic part of the Mother Lode which will be discussed in later paragraphs. Two and a half miles beyond this junction is the ruin of Meyer's Dance Hall and Wine Cellar. This local "miners' delight" was built in 1855 and the scene of many a gay escapade. It has been marked as a historical site by the El Dorado County Chamber of Commerce. The route from Placerville to Cool via Garden Valley, Georgetown, and Greenwood is in most respects superior to that traversed by Highway 49 and might well be named an alternate to the highway (Bowen and Crippen, 1949; modified by CGS, 1997).

The Georgetown turnoff (State Highway 193) is 0.8 miles (1.3 km) from the center of Placerville and is a well paved, well marked road. The first three miles (5 km) toward Kelsey and Georgetown lie down a steep side of Big Canyon which is heavily timbered with incense cedar, Douglas spruce, and yellow pine. With the exception of a narrow belt of greenstone and occasional serpentine intrusion, the basement rocks along this road from Placerville to Georgetown are Jurassic metasediments, chiefly slate (Bowen and Crippen, 1949; modified by CGS, 1997).

0.1 Decomposed granite and aggregate quarry on right.

0.5 Contact between granodiorite and pyroxenite-rich serpentine.

South Fork of the American River Canyon

0.9 TURNOUT AND VISTA POINT (#194). South Fork of American River Canyon upstream view. Note that the river flats on South Fork represent gold-bearing gravel bars that had been repeatedly reprocessed by bucket line dredge operations in the 1920 to 1940 period and now are considered mine tailings.

Note also the mature "canyon stage" profile of erosional down cutting of the South Fork Canyon upstream of Coloma Valley compared to the broad "bowl" shape of the Coloma area.

1.0 West edge of the ultramafic rock zone consisting of serpentines and gabbroic rocks with occasional blocks of metavolcanic and metasediments.

1.5 Chromite prospects are visible on the hill slopes to the north.

3.0 Marshall Grade Road hillcrest. Continue through ultramafic rock zone which here include diabase and "hornblende porphyrite" (Logan, 1934). Between the hillcrest and Garden Valley, Marshall Road crosses the Melones Fault Zone which contains, in this area, narrow fault-bounded slivers of serpentine-pyroxenite, diabase, amphibolite schist, Mariposa Formation and Logtown Ridge Formation.

3.4 Prospector's Road intersection on left.

3.6 Abandoned serpentine road base rock quarry on left.

4.4 Veer Kamp Mine Road. Site of famous Veer Kamp lode gold mine (#195).

4.6 California Division of Forestry Fire Station. This building lies atop the Melones Fault which, trending northeastward, controls the position of Coloma Canyon.

4.8 Junction Garden Valley Road and Marshall Grade Road. Continue straight. We are at the outskirts of Garden Valley, a famous lode and placer mine district.

4.9 Fault contact between serpentine to the west and Mariposa Formation to the east.

5.0 Garden Valley Store on left. Historic building structure to right of store.
6.0

GEOLOGY MAP 29-C1

Coloma to Taylor Mine
(Wagner et al., 1981; Logan, 1935; Wagner, 1979)
(Lindgren and Turner, 1894; Loyd et al., 1983; Kohler, 1983)
(Aune, 1979, Logan, 1934)

Garden Valley

Garden Valley (#207) was originally named Johntown, a placer camp which later became a vegetable growing center, hence the present name. Garden Valley is 5.5 (9 km) northwest of Kelsey (#204). The entire area in which Garden Valley, Spanish Flat (#206), Georgetown (#205), and Greenwood (#198) are located is one of the most beautiful landscapes in California and is bound to find increasing favor as a recreational region. The broad rolling meadowlands are bordered by flowing streams and beautiful stands of coniferous trees. The primitive area of the Rubicon River northeast of Georgetown is almost untouched by the inroads of man in 1949 (Bowen and Crippen, 1949).

One and one half mile north of Garden Valley on the Cool-Garden Valley Road is the Taylor Mine (SW ¼ of Section 21).

5.1 Junction Greenwood Road/Marshall Grade Road. Go left on Greenwood Road.

This road parallels the Mother Lode vein system which is governed by the Melones Fault Zone. Along this section of roadway we pass numerous famous lode mines. There is a belt of mines which miners refer to as the "East Belt" which lies along the Melones fault. The fault extends from Kelsey northwestward through Garden Valley and Greenwood and hence northwestward to the Weimar Fault of the Forest Hill Divide. Between Garden Valley and Greenwood, the Greenwood Road is built on Mariposa Formation sediments.

5.7 Andy Wolf Road intersection on left (west).

6.5 Graybar Mine Road Junction on left. Continue straight.

GEOLOGY MAP 29-C4

Taylor Mine to Cherokee Flat
(Wagner et al., 1981; Logan, 1934: Wagner, 1979; Aune, 1979)

Taylor Mine

7.0 Taylor (#197, formerly Ivanoe) gold mine with mill building visible to south. Few historic gold quartz mills remain intact along this northern section of the Mother Lode. Continue northwest down grade.

Figure 121. Taylor Mine monitor, 1890 (CGS Photo C713b). Monitor is in right center part of photograph.

Figure 122. Taylor Mine, 1890, conveyor belt (CGS, Photo C7433).

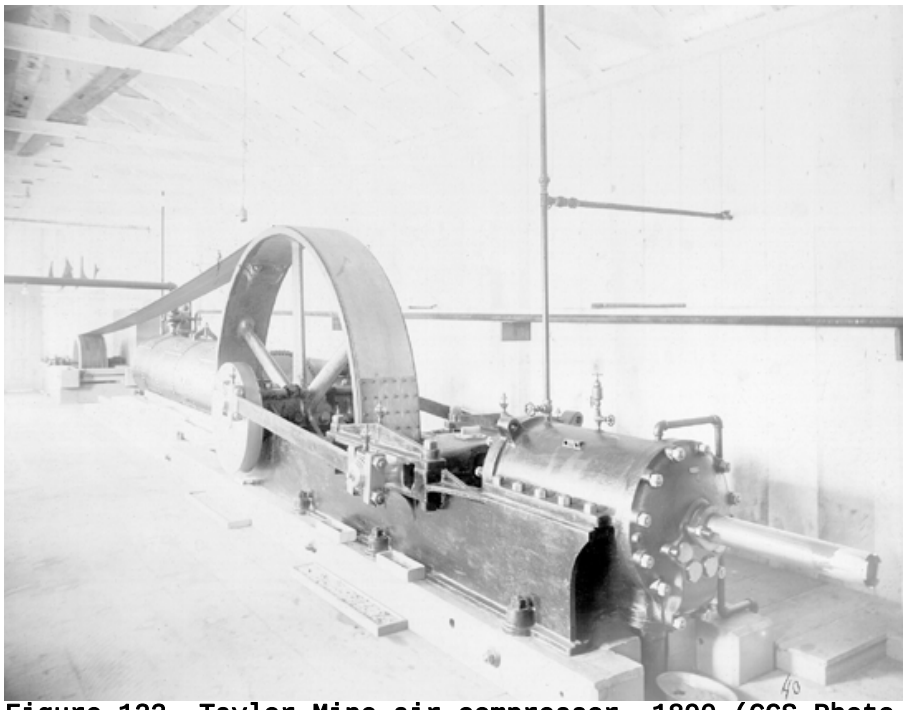

Figure 123. Taylor Mine air compressor, 1890 (CGS Photo C7434).

Figure 124. Taylor Mine blacksmith shop, 1890 (CGS, Photo C7435).

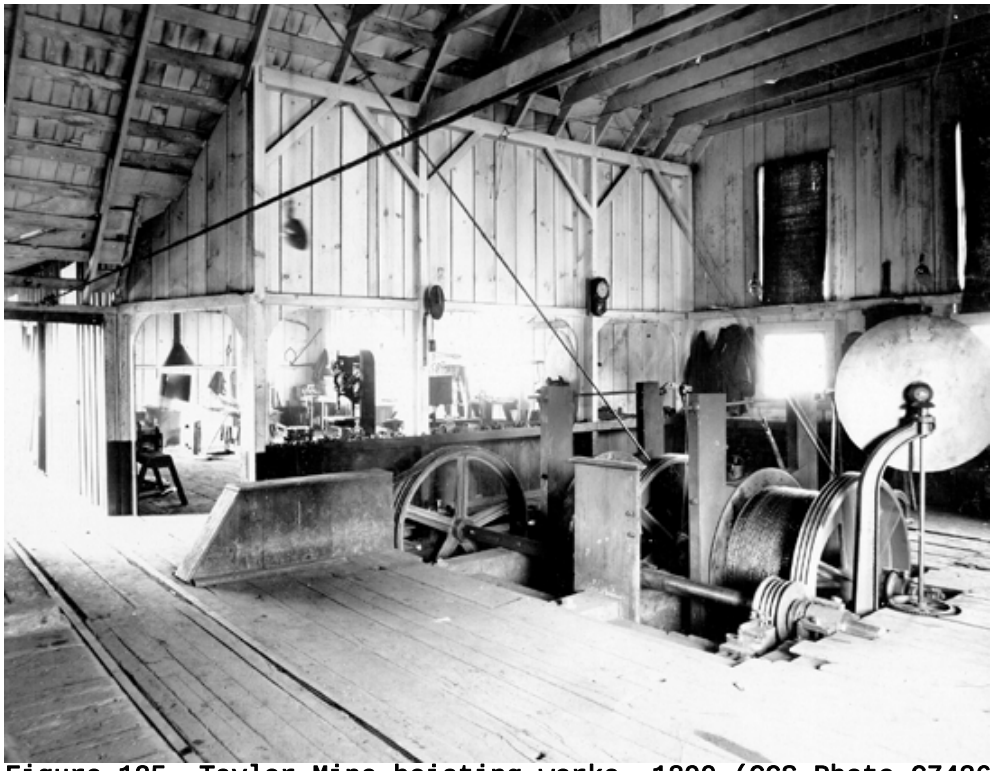

Figure 125. Taylor Mine hoisting works, 1890 (CGS Photo C7436).

Figure 126. Taylor Mine electric plant, 1890 (CGD Photo C0713).

7.9 Bottom of road grade. Note for the next 2 miles prominent forest covered ridge on left and low hills to right. Roadway is located within 1/4 mile wide Melones fault zone. This region is highly mineralized and famous for high grade precious metal pocket deposits. The small, high-grade nature of these deposits is due to the complex structural geology associated with the Melones fault.

9.3 First cement bridge crossing.

9.8 Second cement bridge crossing.

10.1 Historical marker for Greenwood (#198).

Greenwood

Five and one-half miles (9 km) northwest of Georgetown is the crossroads hamlet of Greenwood (#198)

John Greenwood, a trapper and guide who came to California in 1844, established a trading post here in 1849. The gold rush town of Greenwood boasted a theater, four hotels, 14 stores, a brewery, and four saloons. Among its illustrious citizens was John A. Stone, California songwriter, who was buried here in 1863 (California Historical Landmark No. 521).

Greenwood once boasted several wineries and was the supply center for many adjacent placer districts. Greenwood is situated in Sections 7 and 18. A large lumber yard is the principal activity now. Numerous placer and hydraulic diggings can be seen along road between Georgetown and Greenwood. The bedrock slate and greenstone along this section of the roadway is of uncertain age. There are few good exposures because of the deeply weathered nature of the bedrock and the soil mantle. The road is bordered by rank

growths of yellow-flowering Spanish Broom, an introduced plant (Bowen and Crippen, 1949).

Figure 127. Schist building foundations, Greenwood (1949:152).

Greenwood lies in a fault-bounded strip of Mariposa Formation slate. There are two belts of claims on east and west faults that define this strip. To the west of the western belt of claims is Paleozoic mélange terrain metavolcanics and metasediments. These rocks were formerly mapped as "Calaveras" by Logan (1935) and Bowen and Crippen (1949). To the east of the east belt of claims is Calaveras Complex metasediments and metavolcanics. Logan (1935) mapped rocks both east and west of the Mariposa Formation in this area as "Calaveras Formation".

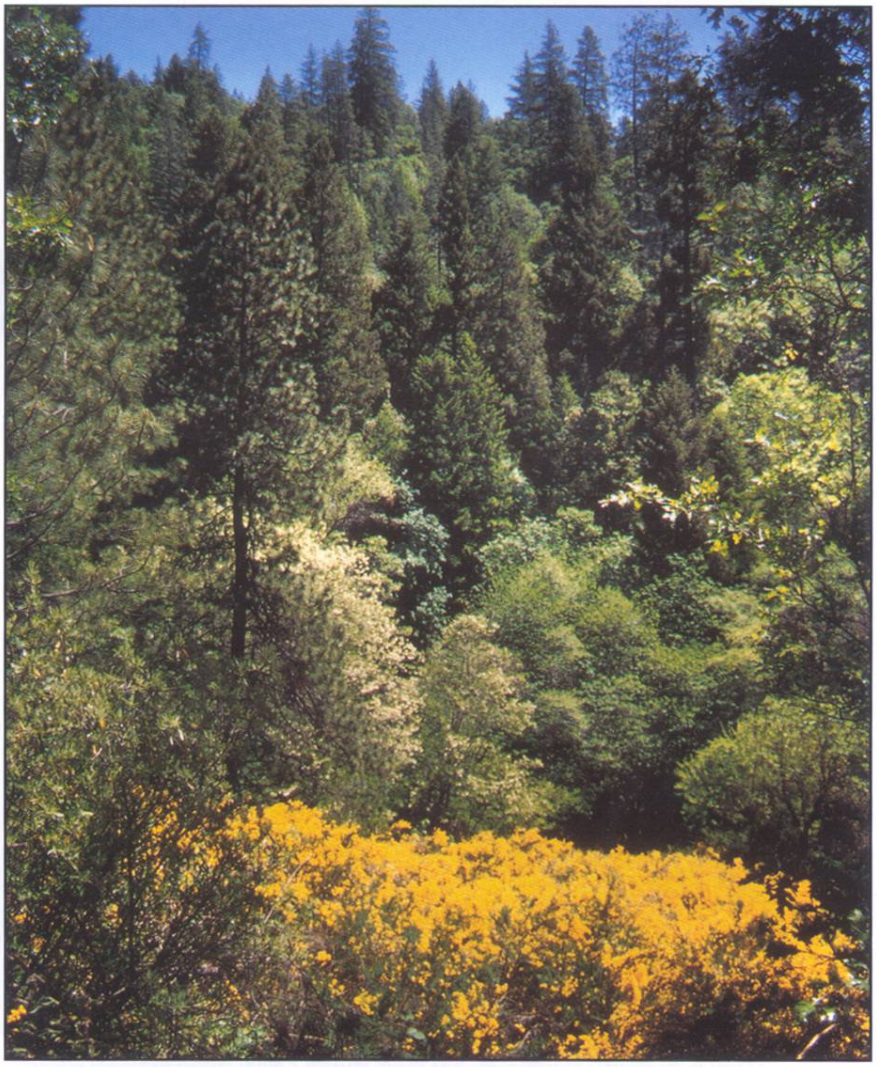

Photo 5. The yellow-flowering broom, an introduced plant, grows throughout the Mother Lode gold belt. *Photo by Max Flanery.*

Figure 128. Yellow Spanish Broom (CGS, 1999:151).

10.2 Junction Greenwood Road and Highway 193 (#199). Go to the left on Highway 193. The position of the American River Canyon in Sections 1 and 35 to the northwest is controlled by the fault contact described above (along which the west belt of claims are located). This fault places Paleozoic mélange terrain metasediments to the west against Mariposa Formation to the east. The fault lies under this roadway intersection.

Green Mill Junction

A mile north of Greenwood at the Greens Mill junction (# 199), are good exposures of well bedded Mariposa Formation slate. The relation of the bedding to the slatey cleavage can easily been there. A number of small folds within the Mariposa are evident in the road cuts along the Greens Mill road (Bowen and Crippen, 1949).

One mile west of the Greens Mill road junction, toward Cool, is a fault contact between Paleozoic mélange terrain metamorphic rocks and serpentine. The Paleozoic mélange terrain rocks exposed there is composed of mica schist, chert and basic intrusive such as basalt. Another small body of serpentine occurs at the Penobscot farm 1.3 miles to the southwest (Section 14). From the Penobscot farm west to Cool the basement rocks are mainly mélange terrain schist, chert, and meta-basalt and greenstones. These are intruded locally by small bodies of serpentine. The Penobscot farm is a picturesque, well kept property surrounded by orchards and grazing land and is the principal landmark between Greenwood and Cool (Bowen and Crippen, 1949).

10.9 Junction Sliger Mine Road and Highway 193 at Greens Mill Junction (#200) . About a mile (1.6 km) northwest of Greenwood is the Sliger Miner Road. To the north, this road leads to Spanish Dry Diggin's (#200) and ultimately to other old camps on the North Fork of the American River. Proceeding westward on Highway 193 will take you to Cool and Highway 49.

SIDE TRIP TO SPANISH DRY DIGGINS AND CHEROKEE FLAT

From the intersection of Sliger Miner Road and Highway 193, go right on Sliger Mine Road. Sliger Mine Road skirts American Canyon which is the location of a trace of the Melones Fault Zone.

12.0 Hoboken House historic site built in 1850. Lumber material was brought from Wisconsin around Cape Horn to California.

13.2/0.0 Junction Sliger Mine Road and Spanish Dry Diggings Road. Reset odometer and go left on Spanish Dry Diggins Road. Rocks are Calaveras Complex metavolcanics (amphibole schist of Logan, 1935).

1.0 Spanish Dry Diggins townsite.

Spanish Dry Diggins and Grit Mine

Spanish Dry Diggins (#200) was discovered by a group of Spaniards under General Pico in 1848. It is located in Section 30. The placer mines were soon superseded by the "seam" or stringerload mines such as the Grit or Littycote Mine. The Grit (#201) had an early production of over $500,000 (42,000 oz). Production from the Barr Mine was over $300,000 (25,000 oz). A mass of gold weighing 101 troy ounces was taken from the Grit Mine in August 1865. This was donated to the museum of the State Division of Mines in honor of Jules Fricot by his heir Mrs. Marie Fricot Berton and until 1992 was on exhibition in the Ferry Building, San Francisco. It is now on display at the California State Mineral Museum in Mariposa (Bowen and Crippen, 1949, modified by CGS, 1997).

1.2 French Hill Cemetery on left (south, in Section 36). This is a burial site of many miners from the 1850' to 1880's period.

1.3 Intersection of Spanish Dry Diggins Road and Foxgrove Road. Go straight on Foxgrove Road.

1.6 Intersection Foxgrove Road, Sanromo Lane and Sliger Mine Road.

French Hill Mine

Go left on Sanromo Lane.

(1.8) VISTA POINT at hillcrest and nearby residence. THIS IS PRIVATE LAND. YOU MUST OBTAIN PERMISSION FROM LOCAL LANDOWNERS TO BE IN THIS AREA. View of French Hill Lode Mine (#202, NE Section 36). This was one of a few very rich and very rare "seam diggins" deposits at the truncated end of the classic Mother Lode Vein System. The gold occurred in sheets and was produced using hydraulic mining techniques to remove the altered host rock and expose the thin sheets of gold. Turnaround and return to Foxglove Road. If you do not have permission to go to the French Hill overlook, proceed downgrade on Sliger Mine Road

2.6 Intersection Foxgrove, Sanromo Road and Sliger Mine Roads. Go west on Sliger Mine Road. There will be rough road for next 4 miles.

3.0 Vista Point. Excellent view (upstream and downstream) of the Middle Fork of the American River Canyon.

Sliger Mine

The Sliger Mine (#201) is visible on the left and represents a major trace of the Melones Fault zone. The Melones Fault system created the nearly linear north-south aligned stretch of river canyon between Poverty Bar and Rocky Chuck rapids recreation area. The famous Sliger Mine site can be seen below the road (the mine dump has created the flat area on the hillside below the road). Historic seam diggings hydraulic mine workings are visible in several places on the west side of the river canyon.

In this area, Sliger Mine Road approximates the location of the "eastern belt fault" with Calaveras Complex rocks to the east. To the west of the American River Canyon, along the western edge of Geology Map 28.2 is the Weimar Fault which is the continuation of the "western belt" of mines discussed below (Greenwood). West of the Weimar Fault are Paleozoic mélange terrain metavolcanics.

3.1 Junction of road leading to the Sliger Mine. Go straight ahead (north) toward Cherokee Flat. Two-tenths of a mile to the south along this road is a railhead to the Sliger Mine site.

One mile (1.6 km) beyond the Sliger Mine Road Junction is a fault contact between Calaveras rocks and serpentine. The Calaveras there is composed of mica schist, chert, and mafic intrusives such as basalt. Another small body of serpentine occurs 1.3 miles (2 km) farther west. From there, west to Cool, the basement rocks are mainly schist, chert, metabasalt and greenstones of doubtful age. These are intruded locally by small bodies of serpentine (Bowen and Crippen, 1949, modified by CGS, 1997).

Cherokee Flat

4.3 This historic mine site area of Cherokee Flat (#203) is in Sections 24 and 25.

Drive west to the vista point 100 yards west near the fruit tree grove. View of the bench placer gold deposits below along the west side of the river and adjacent to the seam diggins. These lode gold deposits were efficiently mined by hydraulic mining methods in the 1860's to 1870's period. Turn around and proceed back to the intersection of Spanish Dry Diggings Road and Sliger Mine Road in Section 31.

RESUME LOOP TO GEORGETOWN

0.0/13.2 Intersection of Sliger Mine Road and Spanish Dry Diggings Road in Section 30, Go southeast toward Georgetown.

0.3 La Lama Drive on right.

0.4 Road forks. Stay to the left on Spanish Dry Diggins Road. The right fork would put you on Reservoir Road. A short drive (0.3 miles) southward on Reservoir Road will bring you to a reservoir (SE Section 31) that is serviced by the Georgetown Divide Ditch.

0.9 Cross north-flowing tributary to Canyon Creek.

GEOLOGY MAP 29-C1

(Wagner et al., 1981; Logan, 1934)
(Wagner, 1979; Aune, 1979)

2.6 Junction Spanish Dry Digging Road and Georgetown Airport access road (Aerodome Way). Keep to the right.

3.4 Junction Spanish Dry Diggings Road and Reservoir Road. Continue to the east. Note the continuation of the Georgetown Divide Ditch (El Dorado County Irrigation water ditch) on right.

3.6 Junction Spanish Dry Diggings Road and Highway 193. Buffalo Center shopping complex on the left. Stay to the left and continue eastward.

4.3 "Downtown" Georgetown. Junction Georgetown Main Street and Highway 193. Reset odometer.

Georgetown

Georgetown, 7.3 miles (11 km) from Garden Valley, looks much as it did in the 1850's.

Founded August 7, 1849, by George Phipps and party from Oregon, Georgetown was nicknamed Growlersburg because of the heavy nuggets that 'growled' in the miners' pans. After the disastrous fire of 1852 the old town was moved from the canyon in lower Main Street to its present site, and, unique in early-day planning, Main Street was laid out 100 feet wide, with side streets 60 feet. The hub of an immensely rich gold mining area, Georgetown had a population of about three thousand in 1854-56 (California Historical Landmark No. 484)..

Several lode mines helped keep the town active after the placers were exhausted. Lumbering and fruit-growing are now the principal activities. The main street has many well preserved buildings such as the Masonic Hall erected in 1852 and the Balsar House dating from 1859. Edwin Markham taught school in Georgetown in the 1880's. Like those of many other Mother Lode towns, Georgetown's pioneers rallied to the Union side during the Civil War. An armory was built in 1862 which is still standing. The El Dorado County Chamber of Commerce has erected suitable historical markers at sites of special interest. The Alpine at the center of town and the Beebe at the northern edge are the best known of the Georgetown mines. The Alpine was first developed in the 1860's and was extensively worked during the 1930's. The Beebe (#208) is largely a twentieth-century development. Both produced occasional bonanza pay streaks but gold values were spotty. The Alpine shaft is less than 500 feet deep; the Beebe has a large open cut and a 500-feet shaft (Bowen and Crippen, 1949). The townsite of Georgetown is underlain by Calaveras Complex metasediments.

Photo 4. The Balsar House in Georgetown was built in 1859.
Photo by Max Flanery.

Figure 129. Balsar House, Georgetown built in 1859 (CGS, 1997:150)

Georgia Slide Mine

At the north-central edge of Section 3 (Geology Map 29-C1) is the Georgia Slide placer mine on Hudsons Gulch. This mine worked small, rich stringer veins in a combination of blast hole and hydraulic mining. Working from the edge of the ridge to the south, miners would drill and blast material to loosen it. Then hydraulic cannons, using water from the Georgetown Divide Ditch, would wash the material into large sluices. YOU MUST HAVE PERMISSION FROM THE MINE OWNER TO VISIT THIS MINE.

GEOLOGY MAP 29-C2

Georgetown to Tiedman Mine
(Wagner et al, 1981; Kohler, 1983)

SIDE TRIP: GEORGETOWN TO VOLCANOVILLE

0.0 Reset odometer at Junction of Main Street and Highway 193 in Georgetown.

0.3 Junction Main and School Street. Historical marker pertaining to Georgia Slide Mine on left.

1.2 Cross headwaters Dark Canyon, a tributary of the Canyon Creek drainage and the Georgetown Divide Ditch. Dark Canyon to the north and Traverse Canyon to the south mark a fault-bounded block of serpentine and gabbro which is about 1.5 miles wide.

1.5 to 2.1 Cross ultramafic rock belt visible in road cuts on right. Calaveras Complex rocks of Paleozoic age are exposed in road cuts for the next seven miles.

3.1 Buckeye Lodge Restaurant on right. It is built atop Calaveras Complex metasediments.

3.6 Georgetown Ranger Station on right - continue up road grade. Vertically aligned metasediments are visible on the left for the next 0.25 miles.

4.6 Balderson Road intersection on right.

5.0 Spring on right. Once used as a water source for Georgetown Divide travels, this spring is now abandoned.

5.4 Cross Canyon Creek headwater tributary.

5.5 Cross historic mine ditch on right (south).

6.4 Balderson Station - Camp Virnir townsite. Balderson road on right. This road provides access to the Darling Ridge area. The station is underlain by Mehrten volcanic rocks of Tertiary age.

6.9 Rock Creek Road on right. This is a historic stream placer area.

GEOLOGY MAP 29-C3

(Wagner et al, 1981; Kohler, 1983)

Tiedeman Placer Mine

7.1 Camp Chiquita store and restaurant area. Access point for the Tiedeman Placer Mine (#209). THIS MINE IS ON PRIVATE LAND. YOU MUST OBTAIN PERMISSION FROM THE MINE OWNER TO VISIT IT.

The geology of the Tiedeman is a classic example of buried Tertiary auriferous river channel. The mine is

a remnant of an Eocene gravel deposit that was laid down on Calaveras Complex metasediments. In the late Miocene-early Pliocene period, volcanic mudflows of the Mehrten formation buried the gold-bearing gravels. Cornish miners were brought over from England to mine these gold deposits. The ancient river gravels were mined by underground mining methods, similar to those used in underground lode mines.

7.3 Access road to Tiedeman Mine on left (north).

7.7 Old Georgetown Lumber Company headquarters on right.

8.2 Junction Wentworth Springs Road and Volcanoville Road. Go left on Volcanoville Road. Note outcrops of Calaveras Complex metasediments.

10.0 Otter Creek bridge crossing.

10.8 Junction Bear State Road and Volcanoville Road at County Fire Station (on left). This area is the site of the famous Bear Flag Republic that seceded from the United States in the early 1850's. At the Fire Station, rocks are Mehrten volcanics. Proceed westward on Volcanoville Road.

Between the County Fire Station and Volcanoville, the road runs parallel to a lithologic contact between Mehrten volcanics and Calaveras Complex metasediments. The contact is about 1/4 mile north of the Volcanoville Road, a few hundred feet below the canyon ridge. The volcanics rest atop the metasediments and are slightly more resistant to erosion. They "hold up" the ridge along which Volcanoville Road traverses on the south side of the American River Canyon.

11.2 School on right. The forest flats on this ridge area are underlain by the thick Mehrten Formation mudflows and in some places remnants of the early Tertiary auriferous channels.

11.8 Historic mine water ditch crossing road. This ditch probably conveyed water to the hydraulic mines in the Volcanoville - Missouri Canyon drainage areas.

12.1 Cross under power transmission lines.

12.2 Christmas tree farm on left.

12.7 Road to the Kentucky Flat Mine (#210) is on the left (west)..

13.2 Cassell Mine Road on the right (this is a private, gaited road).

13.6 Tim Ranch Road. 5.5 mileage marker on left.

13.9 Junction of Dutch Pit Mine Road with Volcanoville Road. Go right on Dutch Pit Mine Road. Park in flat open area away from the roadway.

Dutch Pit Hydraulic Mine

The road into the Dutch Pit (Mt. Hope, #211) area is in very poor condition due to many years of heavy winter runoff and limited use. This mine is in the NW quarter of Section 9. Four-wheel drive access is advisable. YOU MUST OBTAIN PERMISSION FROM THE MINE OWNER TO USE THIS ROAD OR TO VISIT THE MINE!

Mining at the Dutch Pit has produced adverse environmental effects on the landscape that can still be seen, even after 100 years of inactivity. The pit exposes over 50 feet of gravel and exhibits spectacular

sedimentary structures over this stratigraphic interval. This mine extracted gold from a gravel layer that lies between two different volcanic layers. The gravel is relatively young compared to the gravels north of this point.

13.9 From the junction of Volcanoville Road and Dutch Pit Road, continue right on Volcanoville Road.

14.9 Junction Paymaster Mine Road (USFS 13N56) with Volcanoville Road. Continue westward on Volcanoville Road.

15.4 Volcanoville historic townsite area.

Volcanoville

In it's heyday (1855-1870), Volcanoville (#212) 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.

Forgotten now are the thousand or more places where much of El Dorado County's history was written. In mining camps and towns such as Hell Roaring Diggings, Loafer's Hollow, Whiskey Flat, George's Town, and Poverty Flat. The names of other camps frequently told you much about who was mining there… Chile Bar (Chileans), Kanakatown (Hawaiians), Frenchtown, Alabama Flat, Texas Bar, Cooley Mine (Chinese), Indian Diggings, Mormon Gulch, even Puritan Camp. Forever consigned to the records of time each of these camps had it's own unique and often colorful history. One such place is the ghost town of Volcanoville where tales of it's past includes mining, and buried treasures (Tony Belli, March, 2007).

It was here during the days of the California Gold Rush when the Volcanoville boasted a lively population of thousands, including a large Chinatown. In the cemetery, two headstones remain which speak of the town's past. The tombstones tell of two 49ers interred here -- both youths had been murdered for their miner's poke by Gold Rush highwaymen (Tony Belli, March, 2007).

Located in N.W. El Dorado County, Volcanoville sits just south of the Middle Fork of the American River. Today telephone poles along Volcanoville Road mark the edge of progress - stopping just short of the old town site where few old buildings stand in defiance of encroaching development (Tony Belli, March, 2007).

One of a few remaining abandoned buildings left standing in the ghost town of Volcanoville [Photo by Tony Belli]

It was during the mid-1870's when Volcanoville saw a serious decline in mining as many quartz mines played out. With gold more difficult to find, anger and hate for all non-Anglos in the diggings became a hot subject. Most Chinese were now working in the larger cities in Northern California, for those who remained in the Mother Lode they suffered the most since they represented competition to White miners. Such was the case in 1874 when Chinese miners discovered a 10

oz. pure gold nugget on their claim at the Cooley (Chinese) Mine in Volcanoville (Tony Belli, March, 2007).

One evening a group of miners gathered at a local saloon where their conversation turned towards the dreaded Chinese. With enough liquor, words quickly turned to action leading to the massacre of at least 15 Chinese that night. The Chinese miners were rounded up by the drunks and herded into a cabin. With the Chinese locked inside, the cabin was set a fire. Those who died in the inferno were only spared a bullet; those who ran from the flames and thick smoke were quickly gunned downed in flight. None survived.(Tony Belli, March, 2007).

While many Chinese were mining along the Middle Fork of the American River one group of 12 from Volcanoville was buried alive in a cave-in during the 1890's. By the time aid reached the men they had died from suffocation (Tony Belli, March, 2007).

Another story from Volcanoville tells of a wealthy Chinese store owner who ran a thriving general store. He sold out to another China man and himself returned to China. For years he remained in his homeland before returning to Volcanoville. He claimed he returned to retrieve a cache of gold he'd hidden years earlier. A major fire had destroyed much of the town in 1879 which left the older former store owner with no landmarks to guide him to his treasure. He returned several times over the next several years looking for his lost cache but never found it (Tony Belli, March, 2007).

For years treasure hunters have sought to answer the question of the lost Chinese caches buried in and around Volcanoville. (Tony Belli, March, 2007).

Volcanoville was founded as a small trading post in 1851 but grew into a large prospering Gold Rush town by 1855. Other industry in the area included a steam driven sawmill and tannery at Mt. Gregory. Volcanoville became a voting prescient in 1854 and established it own Post Office in 1858. Mining became prosperous here again during the 1880's and remained so through the 1890's supporting a twenty-stamp mill. At that time the largest working quartz mine was the Josephine. As most of the town's residents were employees of the Josephine Mine, in 1895 the Post Office changed the name of the town from Volcanoville to Josephine. The Josephine Post Office operated until discontinued in 1917. The town saw two devastating fires, the first in 1879 then again in 1907. All of the remaining original buildings to survive the 1879 fire were destroyed in the 1907 fire. A small community re-established itself here but the town never recovered.(Tony Belli, March, 2007).

Somewhere I once read that "25% of all the precious metals and gems ever recovered have become lost". It is true during the era when global transportation was provided by the great sailing ships of the day much treasure went down the result of accident, piracy, or violent storms. The next cause has been laid to natural disasters. Finally the remainder is credited to the individual who acquires wealth and buries it for safekeeping. For whatever reason, the owner of the cache is separated from his wealth and is never able to recover it. It is said that a dozen or more of these buried Chinese caches is connected to the history at Volcanoville (Tony Belli, March, 2007).

Turn around and return to Georgetown.

GEOLOGY MAP 28-C

Kelsey Mine to Anderson Mine
(Wagner et al., 1981; Logan, 1934)
(Wagner, 1979; Aune, 1979)

GEORGTOWN TO PLACERVILLE: HIGHWAY 193

0.0 Junction Main Street - Georgetown - and Highway 193.Reset Odometer and go left (southeast) on Highway 193.

Between Georgetown and Placerville, on Highway 193, rocks are chiefly Mariposa slate. There is a narrow belt of greenstone and an occasional serpentine intrusion. The basement rocks along this section of roadway are Jurassic metasediments. Deeply weathered remnants of the old Eocene surface abound in the Kelsey-Georgetown area. Brilliant red soil and lateritic clays are exposed everywhere and much of the present land surface is a resurrection of that which existed at the beginning of the Tertiary period. Some of the gravel remnants which lay on this surface proved to be rich in gold. Kelsey's Ravine at the present site of Kelsey was one of these (Bowen and Crippen, 1949).

1.6 Junction Bear Creek Road/Highway 193. The famous Cove Hill Lode Mine is located 0.5 mile east of this intersection in Section 13.

3.4 Junction Black Oak Mine Road and Highway 193. The famous Black Oak Mine is located 0.7 mile west of this intersection in Section 27.

Black Oak Mine

The Black Oak Mine (#207), near Garden Valley (has been one of the best mines in El Dorado County, having produced over a million dollars in gold. The veins are on the contact of Mariposa slate and greenstone and are the same series as in the Alpine and Beebe mines to the north in Georgetown. The workings are rather shallow but the drifts and crosscuts are extensive (Bowen and Crippen, 1949).

5.0 Road to Spanish Flat on left (east).

Spanish Flat

More recently known as Louisville, Spanish Flat was one of a great many placer camps of the vicinity dating from about 1850. Spanish Flat is 1.3 miles (2 km) north of Kelsey. The Alhambra and Lost Lode mines are located close to the Louisville road. They are shallow open cut and tunnel workings in stringer lodes. Both have been idle since before 1949 (Bowen and Crippen, 1949).

6.7 Junction Garden Valley Road and Highway 193

8.0 Junction Baune Road and Highway 193.

8.2 Kelsey Church on right (west). Turn off here for a loop through the historic Kelsey townsite. Return to Highway 193 and continue south.

GEOLOGY MAP 28-B

Placerville to Kelsey
(Wagner et al., 1981; Logan, 1934)
(Wagner, 1979; Aune, 1979)

Kelsey and the Gray Eagle Mine

Kelsey was founded in 1851. James Marshall's last days were spent there. A building on the property of his Gray Eagle Mine once housed a pioneer museum but the exhibits have been move to Columbia and other places. Only a huge arrastre-stone remained of the old exhibits once displayed there in 1949 (Bowen and Crippen, 1949). The adit of the Gray Eagle lode mine is immediately behind the museum building. The Gray Eagle never paid, and Marshall died without ever having a hand in a really successful mining venture (Bowen and Crippen, 1949). From Kelsey, the roadway descends the narrow Kelsey grade to the American River, 1,100 feet (335 m) below. Deeply weathered remnants of the old Eocene surface abound in the Kelsey-Georgetown area. Brilliant red soil and lateritic clays are exposed everywhere and much of the present surface is a resurrection of that which existed at the beginning of the Tertiary period. Some of the gravel remains which lay on this surface proved to be rich in gold. Kelsey's Ravine at the present site of Kelsey (#204) was one of these (adapted from Bowen and Crippen, 1949 as modified by CGS, 1997:147).

Figure 130. Rolling exhumed Eocene land surface as seen to the northwest of Kelsey, El Dorado County (CDMG, 1949:51).

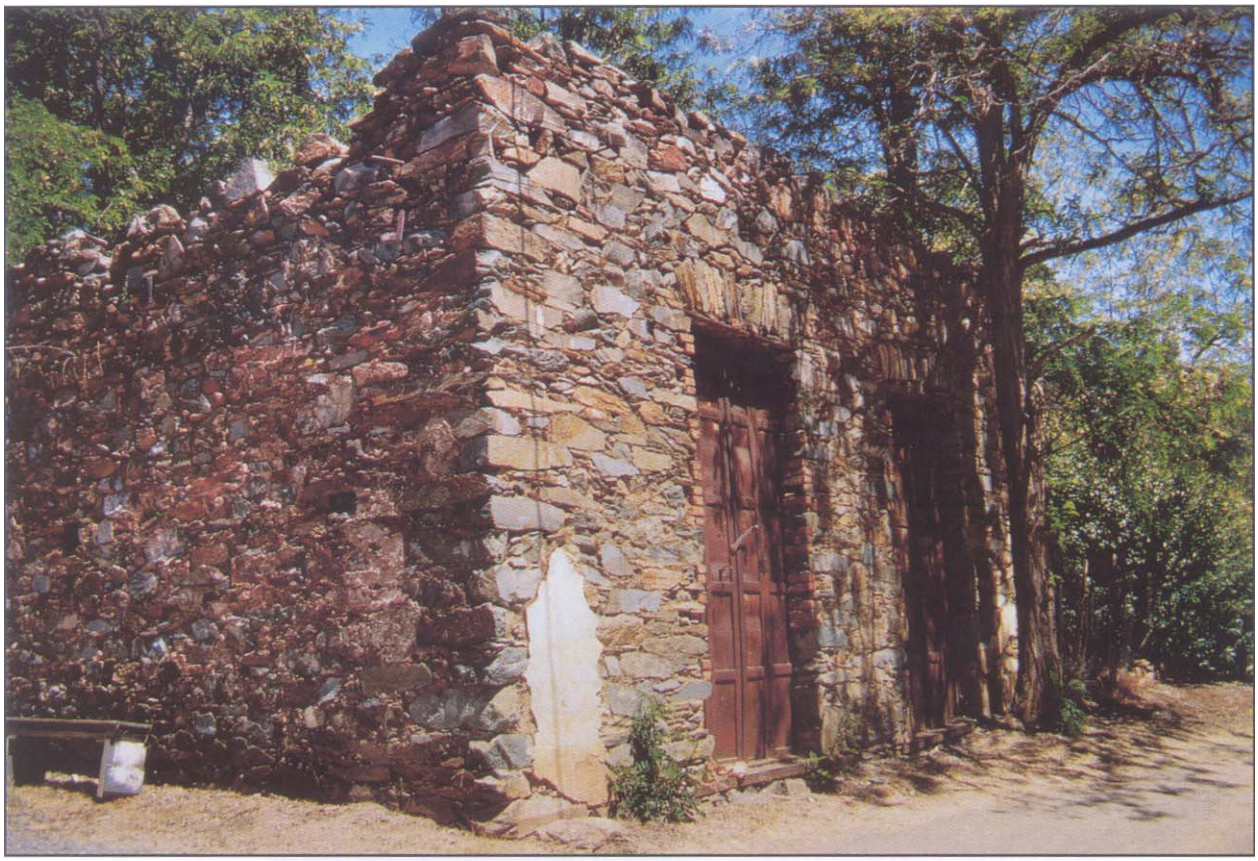

Photo 3. Remains of the mercantile building at Kelsey, El Dorado County. *Photo by Max Flanery.*

Figure 131. Kelsey mercantile building (CGS, 1997:149).

8.4 The ruins of James Marshall's cabin site to right (immediately north is a modern mobile home).

8.8 Junction Shoofly road and Highway 193 to left. Between this point and the Chili Bar bridge, the road crosscuts a thick folded and faulted sequence of metasedimentary rocks as well as an ultramafic complex.

8.8 Junction Rock Creek Road and Highway 193. Access point to upstream parts of the South Fork American River Recreation area.

9.1 Cross Texas Canyon Creek. Texas Canyon Road on the right and left.

10.6 Note excellent exposures of folded black slate of the Mariposa Formation (Salt Springs Member) to the right at the 12 o'clock position.

11.2 Slate quarry and buildings are visible across river. The dark slate rock is processed to make roofing materials and other industrial products.

12.0 Chile Bar Bridge over the South Fork American River. Chile Bar represents an alluvial river bar that was mined by Chilean miners working the river bar area during the 1849 - 1850 period. These deposits were not rich or extensive and the miners took up excavation slate instead.

Chile Bar Slate Quarry

This mine has the distinction of being the mine with the most continuous production in the State of California. Where gold mines came and went, slate production has been consistent at this mine since 1850. The slate was made into roof shingles and exported to mining camps around the Placerville and Georgetown regions. As transportation systems improved, slate was exported to Sacramento and hence throughout the western U.S. Used up to the 1980's for writing boards, pool tables and building stone, the slate at this mine is now processed into powders and used in a variety of adhesives and road making-repairing applications. Much of the slate has been used in the production of asphalt shingles. The current operator is Placerville Industries. Today the slate is mined for railroad ballast, decorative rock, and as a non-toxic sunscreen agent. YOU MUST HAVE PERMISSION FROM THE MINE OWNER TO VISIT THIS MINE. The miner manager, David Phillips can be reached at (916) 622-4234.

Figure 132. Adit and buildings of the Pacific Minerals Company slate mine on the South Fork of the American River, two miles north of Placerville (CDMG, 1949:52).

Photo 2. Chili Bar Slate Mine is on the east bank of the American River. Roadbed and decorative rock are mined here. *Photo by Max Flanery.*

Figure 133. Chile Bar Slate Quarry (CGS, 1997:148).

Figure 134. Chile Bar Slate Quarry, March, 2007.

13.5 Junction Highway 193 Highway 49. End of side trip.

RETURN TO GEOLOGY MAP 29-A

Placerville to Coloma
(Wagner et al., 1981; Logan, 1935; Wagner, 1970)

RESUME ROAD LOG ON HIGHWAY 49

0.0 Junction Marshall Grade Road and Highway 49 at Coloma. Go west on highway 49.

GEOLOGY MAP 30

Lotus to Homestead Mine (Pilot Hill)
(Wagner et al., 1981; Wagner, 1979)

1.2 Bacci Road (southeast end) intersection on right (north).

The strip of land between Bacci Road and Highway 49 was part of a patent issued under the Stock Raising Homestead Act of 1915. When this homestead patent was issued, title to the minerals was reserved to the U.S. Government. Throughout this parcel is evidence of past ground sluicing for gold. In

1993 the mineral rights were conveyed to the surface owner under provisions of the 1976 Federal Land Policy and Management Act. Absent such a conveyance, it is possible for anyone to stake claims on such land for minerals under provisions of the 1872 Mining Law. When this happens, a plan of operations is submitted to BLM by the operator who pays damages to the land owner for injury to stock raising improvements. BLM holds a reclamation bond until the land is restored to an environmentally acceptable level of utility.

2.1 Trail to the Sera Ardan National Area on the left (south).

2.2 Greenwood Creek Bridge crossing.

2.6 Bacci Road (northwest end) intersection on right.

2.8 Granodiorite boulders, highly eroded. Here Highway 49 parallels the American River which is on the left (west).

3.1 Luyama Road to right (north). This road makes a loop and intersects again with Highway 49 further to the west of this point.

3.5 Luyama copper mine on right (north) side of road.

LUYAMA COPPER MINE

The Luyama (or Lilyama) copper mine (#212) is located 5.4 miles (9 km) northwest of Coloma close to Highway 49 on the north side in Section 3. The Luyama is a minor working developed before World War I. It is one of the few contact-metamorphic copper deposits in the Sierra foothills. Copper values were in chalcopyrite associated with pyrite, magnetite, and a little gold and silver (Bowen and Crippen, 1949).

3.7 Bridge over Hastings Creek.

4.4 Bridge over Black Rock Creek.

4.7 Pedro Hill Road on left (south). This intersection is near the southern edge of a gabbro body. To the south of Highway 49 is Paleozoic mélange terrain metasediments.

5.1 Highway 49 crosses the Bear Mountain Fault Zone. Metavolcanics are to the west and metasediments to the east of the fault.

GEOLOGY MAP 31

Pilot Hill to Cool Limestone Quarry
(Wagner et al; 1981; Olmsted, 1971; Taylor, 1979)
(Aune, 1979; Kohler, 1984)

6.5 Pilot Hill Placer diggings in metavolcanics. These placers were historically exploited from an eroded portion of Tertiary channel. Metavolcanics and metasediments form weathered bedrock.

PILOT HILL

Eight miles beyond Lotus, in Section 6, the old landmark Pilot Hill (#214) marks the placer diggings and

town of that name. Pilot Hill is not on the American River and its diggings were in a remnant to Tertiary gravel which lies on a greenstone bedrock of uncertain age. Fremont and his men were reputed to be the first "Americanos" to visit the vicinity of Pilot Hill in 1844. Mining began there in 1849 but Pilot Hill was principally a jumping-off place for the mines which were higher in the mountains (Bowen and Crippen, 1949). The rocks at Pilot Hill are Paleozoic metavolcanic rocks and dike-like, elongated ultramafic bodies.

6.6 Red ranch house on left is underlain by Tertiary Pilot Hill Tributary gravels.

6.6 Folsom Lake turnoff.

FOLSOM PLACER GROUNDS

Michigan City (Michigan Bluff)

Founded in 1850 and first known as Michigan City, the town was located on the slope one-half mile from here. Leland Stanford, who gained wealth and fame in California, operated a store in Michigan City from 1853 to 1855. In 1858 the town became undermined and unsafe so it was moved to this location and renamed Michigan Bluff (California Historical Landmark No. 402).

Several miles downstream from this point are the placer grounds of Folsom along the American River. Michigan Bar was an active camp in Sacramento County during the gold rush (1860). In the early 1900's, the high grade placers were gone and low-grade dredging operations took their place. The Syndicate Dredging Company worked these placers in 1901 and the operated in 1917 by the Natomas #10 Dredge.

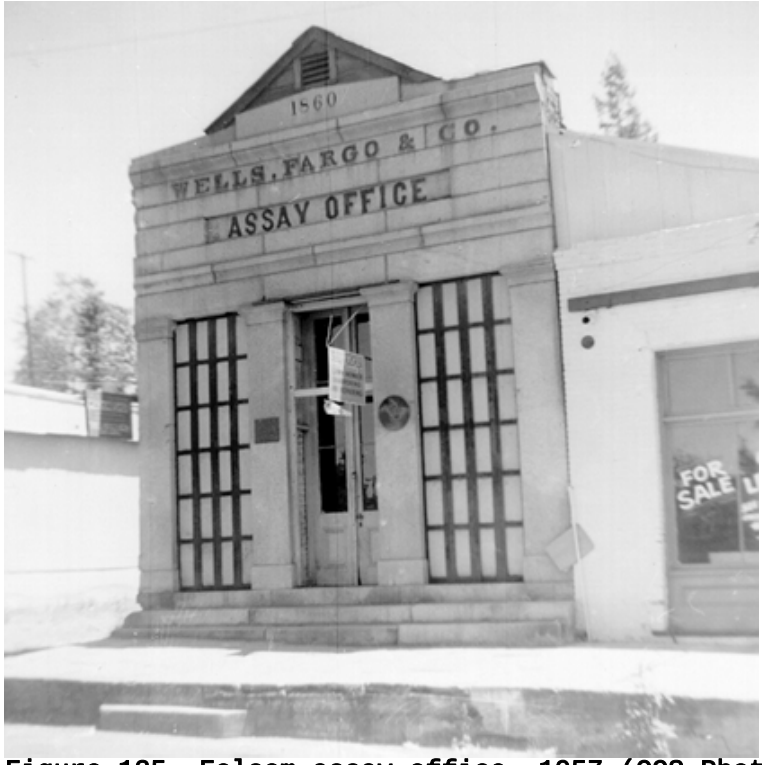

Figure 135. Folsom assay office, 1957 (CGS Photo A7133d)

Figure 136. Michigan Bar hydraulic mining, 1860 (CGS Photo A3754)

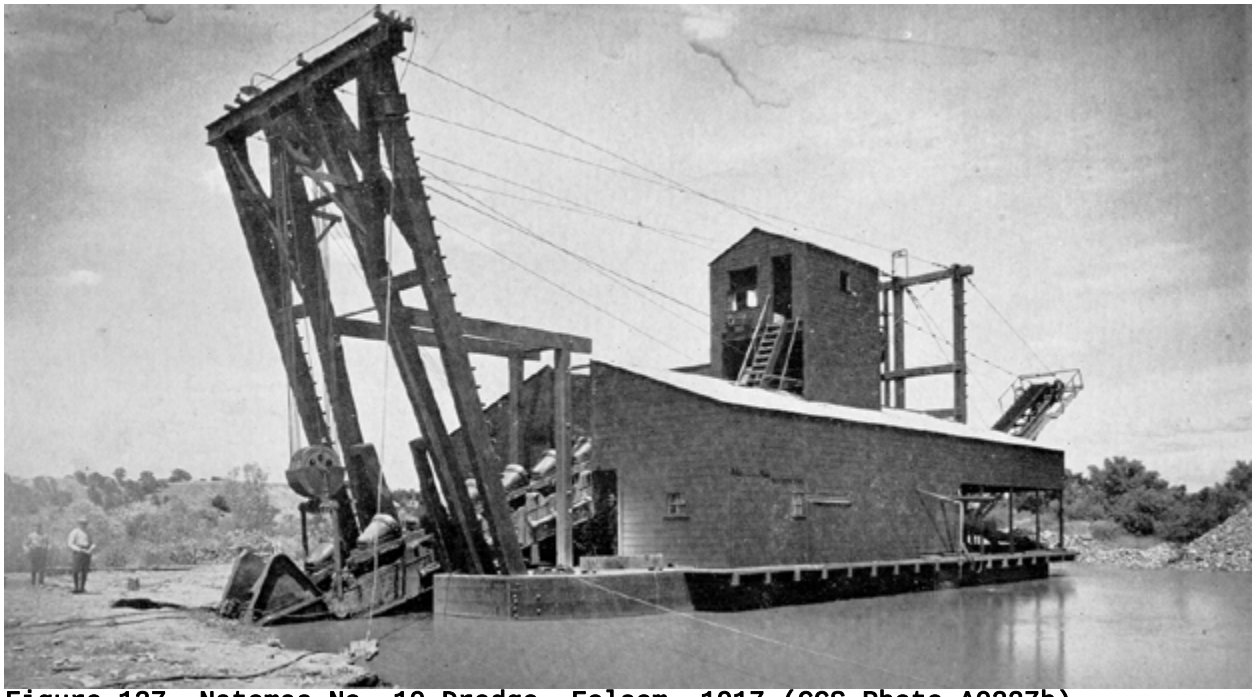

Figure 137. Natomas No. 10 Dredge, Folsom, 1917 (CGS Photo A0227b).

Figure 138. Syndicate Dredging Company, Folsom, 1901 (CGS Photo C7366)

Figure 139. Red Stone placer mill (CGS Photo C0708d).

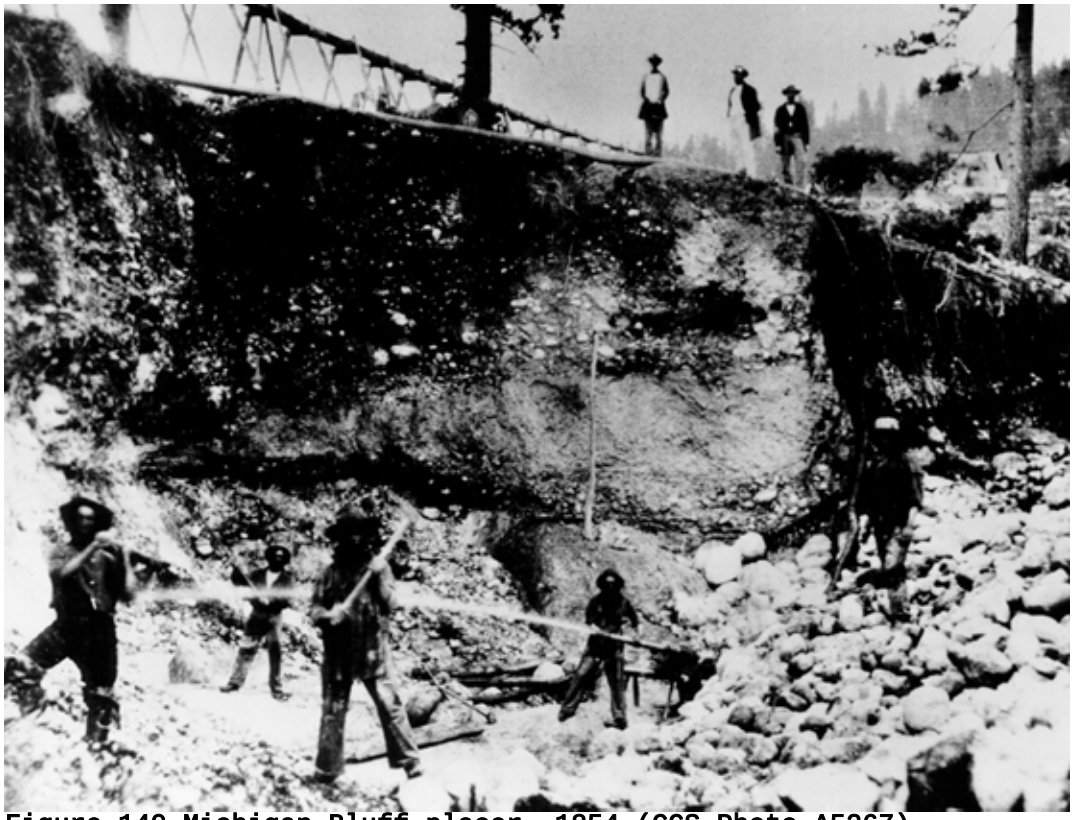

Figure 140.Michigan Bluff placer, 1854 (CGS Photo A5267).

Figure 141. Hobson monitor, 1890 (CGS Photo A7187).

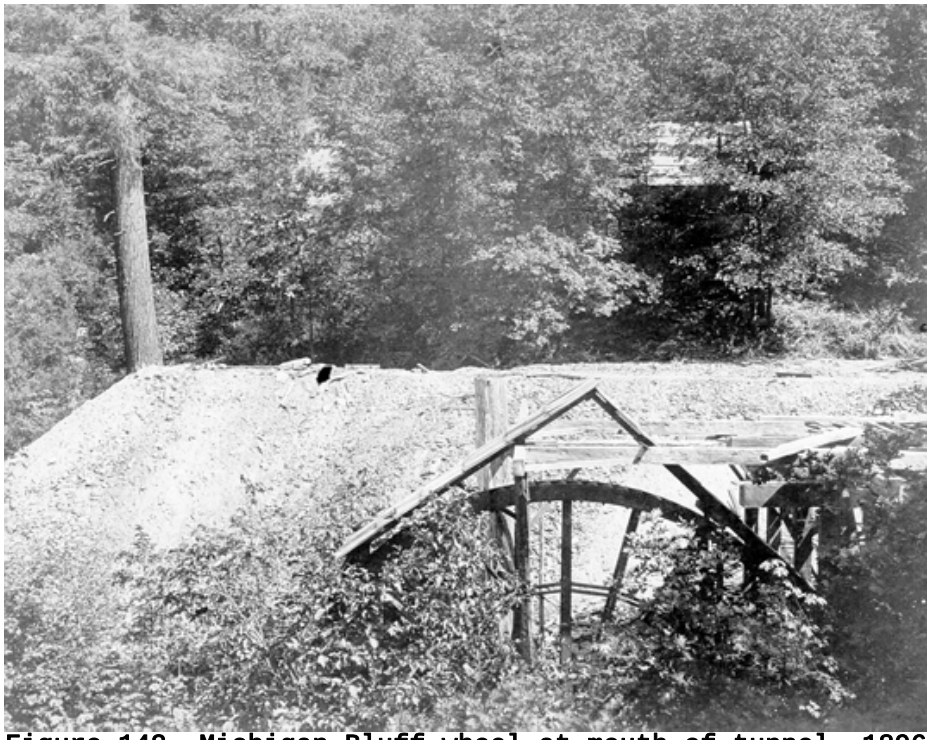

Figure 142. Michigan Bluff wheel at mouth of tunnel, 1896 (CGS Photo A7892).

Figure 143. Rocky Bar of Estey. Diver in old style diving suit, 1915 (CGS Photo A4322).

6.7 Old Bailey House Historical Monument underlain by metavolcanics.

7.3 Vista of rolling terrain that represents exhumed early Tertiary topography.

7.5 Free-standing chimney on left (west).

8.6 Cross through fault-bounded Ultrabasic mass. Passing out of the ultrabasics, Highway 49 is underlain by metasediments and limestone (marble) masses.

8.9 Cave Valley Road. This marks the southern end of the Cool limestone body. This road leads toward the Lukens Mine.

9.9 Grand Fir Circle Road.

9.9/0.0 Cool townsite and intersection of Highways 49 and 193. Go straight (north) toward Auburn. Reset odometer.

COOL

Slightly more than four miles north of Pilot Hill, in Section 18, is the crossroads known as Cool. This was an early-day placer camp. The village is underlain by Paleozoic mélange terrain metasediments.

From Cool to Auburn, Highway 49 goes through serpentine and then along a narrow belt of limestone which is bounded on both sides by greenstones of possible Jurassic age. An enormous thickness of green metavolcanics is exposed between the limestone quarries and Auburn. An enormous thickness of green metavolcanic rocks is exposed between the limestone quarries and Auburn. This metavolcanic series may be a northern facies of the Logtown Ridge meta-volcanics. The North Fork of the American River has cut a tremendous gorge into this rock and the exposures in the river bed and the road cut leading down to it are excellent (Bowen and Crippen, 1949, modified by CGS, 1997).

0.9 to 1.1 Cool Limestone Quarries

A mile and a half (2.4 km) north of Cool, a group of limestone quarries can be seen on the north side of the highway. Limestone was first quarried and burned there about 100 years age (c. 1849) and up to the 1920's by the Cave Valley Lime Company. One of the old kilns can be seen close to Highway 49 near the abandoned quarry, a quarter of mile (400 m) south of the road turnoff to the main workings. The kiln walls were made of limestone lined with greenstone. Local wood was used to fire the kilns. The present operators of the quarry, the Tiedeman (formerly Spreckles Company and before that the California Rock and Gravel Company) quarry and crush the limestone for conversion into lump lime but do not produce either lime or cement themselves. In 1997 the limestone was mined and converted to "sugar rock" for sugar refining and as a source of aggregate (Bowen and Crippen, 1949, modified by CGS, 1997)

The Cool Quarries (#215) excavate bodies of limestone that are surrounded by metavolcanic rocks. The limestones represent carbonate platform deposits (reefs) on ancient seamount landforms and islands in oceanic crust (Jones, 1996). Paleomagmetic and microfossil studies of these rocks suggest that they originated in an area of the globe which is now Japan. They were rafted to their present position by eastward migration of the Pacific Plate and afterwards attached to the North American Craton through subduction. The rocks were later elevated to their current elevations by thrusting associated with formation of the Sierra Nevada (Landefield and Snow, 1997).

Figure 144. Lime kilns near Cool (CDMG, 1949:151).

Tiegert Limestone Mine

This open pit mine (#215) was originally operated as a room-and-pillar underground mine. Later, the near-vertical cliffs of limestone were blasted into a "glory" hole and the material taken out to the American River by the underground access tunnel. This method of mining required drillers to hang from a cable to drill and lode the dynamite charges. There were 153 deaths at this mine between 1900 and 1945. The portal along the American River has been closed by the Bureau of Reclamation in preparation for flooding by the now-discontinued Auburn dam project.

The mine excavates Paleozoic marbles within a Jurassic mélange terrain of other metasediments.

1.4 Active open pit limestone quarry on right (northeast).

1.9 Descend into the Middle Fork of the American River Canyon.

A mile beyond the limestone quarries, Highway 49 winds down to the bottom of the canyon of the North Fork of the American River. An enormous thickness of green metavolcanic rocks is exposed between the limestone quarries at Cool and Auburn. Both branches of the North Fork are deeply incised into these metavolcanics. The erosional state of the incision, based on transverse profiles, appear youthful. However, an aerial view of the course of the river shows a series of broad entrenched meanders indicating that the pattern has been superimposed from an ancestral land surface and that the V-shaped transverse profile is produced by rejuvenation. Half a mile (0.8 km) from the bridge, the junction of the North and Middle Forks of the American River may be seen (Bowen and Crippen, 1949).

2.5 Warrner Ravine stream canyon. The road is blocked by boulders.

FOREST HILL DIVIDE

3.0 Forest Hill Divide Bridge is on the right (north).

3.4 Junction of North and Middle Fork of the American River at the 2:00 o'clock position in Paleozoic mélange terrain metavolcanic rocks. One quarter of a mile to the west of this confluence is a lithologic contact with Paleozoic mélange terrain metavolcanics to the west and Paleozoic mélange terrain metasediments to the east. This contact controls the location of the North Fork of the American River in Section 1.

GEOLOGY MAP 32

American River Bridge to Dry Creek
(Wagner et al., 1981; Taylor, 1979)
(Aune, 1979; Kohler, 1984)

BRIDGE OVER THE AMERICAN RIVER

3.5 American River Bridge

The American River Bridge (#216) is at the El Dorado-Placer County line is in the SW quarter of Section 1. The river is both wide and deep at this point and the effect of deep green water against green rocks is striking. The massive greenstones strike diagonally across the river and have been planed off and polished below the high water mark. The remnants of the railroad bridge and roadbed of the Pacific Portland Cement Company Railroad can be seen close to the old Highway 49 bridge. This railroad formerly connected the limestone quarries along the American River with the Southern Pacific tracks at Auburn. The rails were removed during World War II. Beyond the bridge, Highway 49 begins the ascent up the canyon wall and continues into Auburn (Bowen and Crippen, 1949).

Today the remains of the old Highway 49 bridge can be seen to the west of the present bridge. After crossing this bridge, turn left and go west toward Auburn. Between the American River and Gasoline Alley (Section 4), Highway 49 cuts through mélange terrain metavolcanics, ultramafic rocks and Paleozoic metavolcanics that are not mélange-related.

3.5 to 6.0 The drive up the north side of the American River canyon exhibits outcrops of andesite porphyry greenstone and other Paleozoic mélange terrain metavolcanic rocks.

5.1 Highway 49 crosses the Bear Mountain Fault Zone.

5.3 Auburn city limits. At this point we cross the Bear Mountain Fault again. Ultrabasic rocks are to the west and metavolcanics to the east. There is a series of faults running north-south through the section of roadway between the American River Bridge and Auburn. The Bear Mountain Fault merges into the Wolf Creek Fault north of Auburn.

AUBURN

Placer County was created from a portion of Sutter County in 1851. It has the distinction of serving for a time as the county seat of both Placer and Sutter counties. Present day Auburn (#217) consists of Old Auburn, with its “roaring” 50’s look and numerous historical spots, and new Auburn a modern and growing

town (Bowen and Crippen, 1949, modified by CGS, 1997:150).

Gold was discovered near here by Claude Chana on May 16, 1848. First known as 'North Fork' or 'Woods Dry Diggins,' the settlement was given the name Auburn in the fall of 1849. It soon became an important mining town, trading post, and stage terminal, and also became the county seat of Sutter County in 1850 and of Placer County in 1851. It was destroyed by fires in 1855, 1859, and 1863 (California Historical Landmark No. 404)

Auburn has always been a transportation center and large lumber and cattle interests have long been connected with it. The former DeWitt army hospital is located north of town. Highway 80, which connects with Reno and other transcontinental points, passes through Auburn. The city is served by the Southern Pacific Railroad which reached it in 1860. Interstate 80, which connects Reno with other transcontinental points, passes through Auburn (Bowen and Crippen, 1949, modified by CGS, 1997).

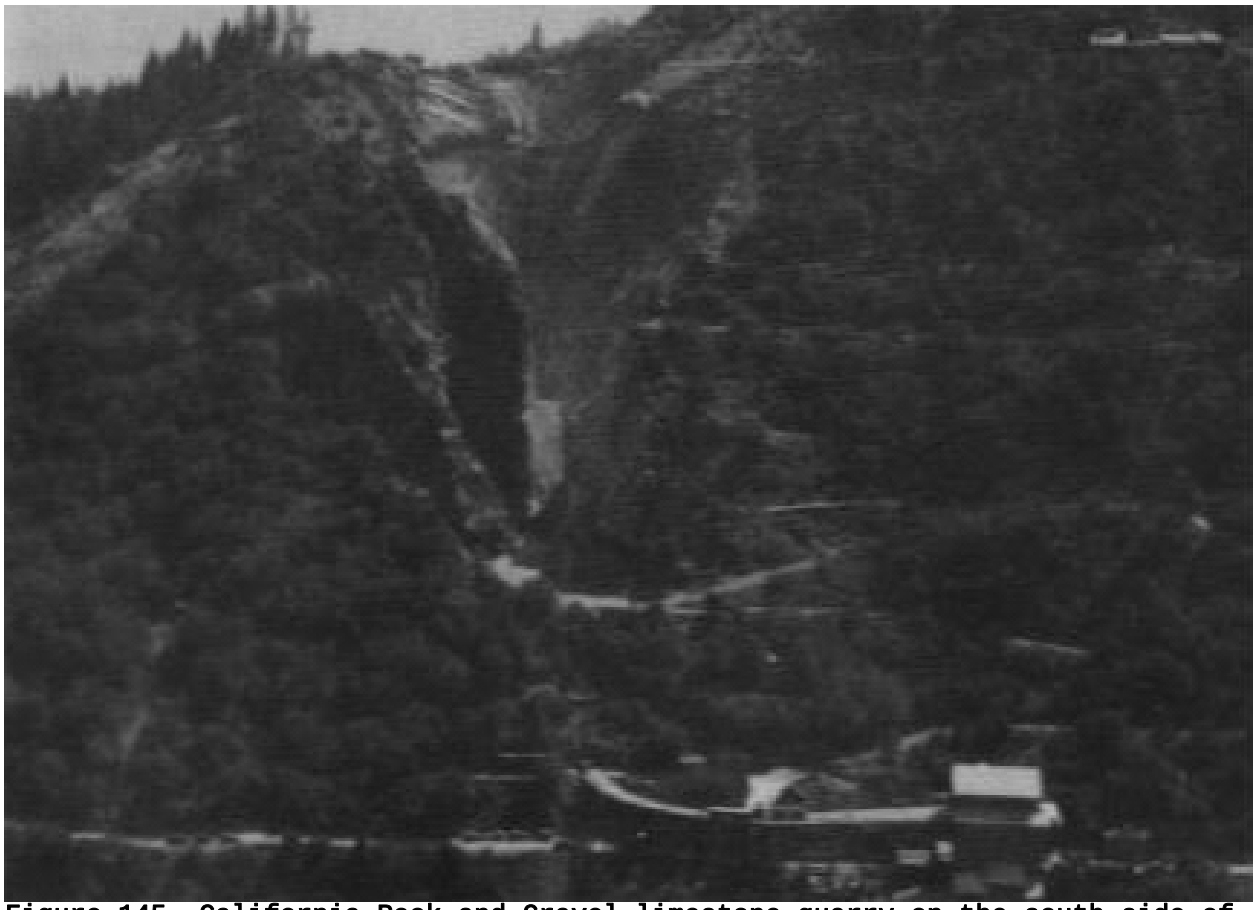

Figure 145. California Rock and Gravel limestone quarry on the south side of the Middle Fork of the American River east of Auburn (CDMG, 1949:80).

Figure 146. Auburn Electric Co. Building, Auburn (CDMG, 1949:153).

Figure 147. Placer Herald and other brick buildings, Auburn (CDMG, 1949:141).

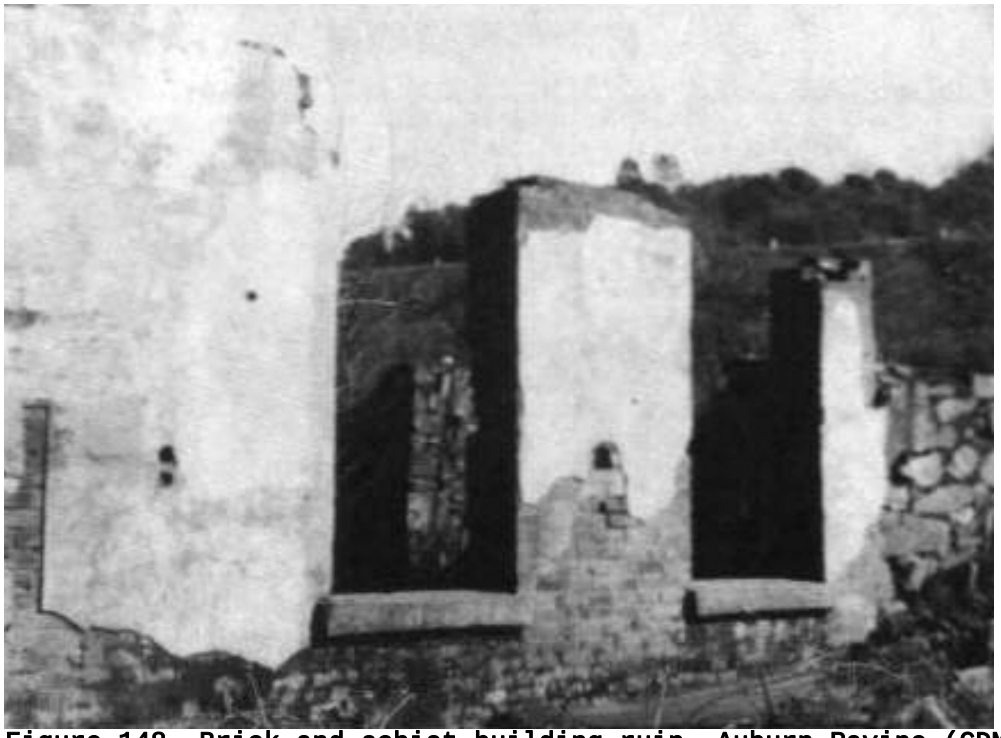

Figure 148. Brick and schist building ruin, Auburn Ravine (CDMG, 1949:152).

Figure 149. Schist building on Court Street, Auburn (CDMG, 1949:154).

Figure 150. Union Bar, old town Auburn. State Capitol dome in background (CDMG, 1949:153).

Figure 151. Auburn Ravine sluice with white, black and yellow miners (CGS Photo A3282).

Take highway 49 through Auburn to the Placer County Courthouse and the Placer County Mining Museum at the Placer County Fairgrounds using the following route:

6.0 Lincoln Way and Highway 49. Go straight toward courthouse.

6.4 High Street and Lewis Street. Go straight (south) through traffic light on High Street.

6.9 Auburn County Fairgrounds gated entrance on left. The Gold Country Museum at the Fairgrounds is a must for any explorer of the Mother Lode. After visiting the Museum a tour of Old Town Auburn and the Placer County Courthouse (formerly the State Capital) is recommended.

Between Auburn and the Bear River, Highway 49 traverses rolling open grassland broken here and there by patches of brush and scrub trees. The somewhat monotonous landscape to the north of Auburn gives no inkling of the splendid scenery soon to be in evidence from Grass Valley to the end of Highway 49. The bedrock between Auburn and Grass Valley is mainly green metavolcanics of possible Paleozoic or Mesozoic age which have been intruded by irregular bodies of serpentine and by mafic (basic) dikes of several types. Between the forks of Dry Creek a narrow belt of Calaveras metasediments begins which rather closely parallels Highway 49, on its west side, as far north as Rattlesnake Creek. The Calaveras rocks are mainly mica schist, chert, and limestone. There are large granodiorite intrusions near Grass Valley and the bedrock from Nevada City to North San Juan is principally of plutonic igneous rock approaching granodiorite in average composition. All the Quaternary stream and bench gravels have been worked for gold. Tertiary gold deposits are absent between Auburn and Grass Valley along the route of Highway 49. There are no mines of any consequence south of the Grass Valley district until Auburn Ravine. In the Grass Valley District, the Bullion claim of the Idaho-Maryland Mines Company, Ltd. is the southernmost of the northern lode gold mines (Bowen and Crippen, 1949).

OPHIR MINING DISTRICT

Ophir Mining District (#218) is 3 miles (5 km) west of Auburn near Interstate 80.

Founded in 1849 as 'The Spanish Corral,' Ophir received its Biblical name in 1850 because of its rich placers. The most populous town in Placer County in 1852, polling 500 votes, Ophir was almost totally destroyed by fire in July 1853 but later became the center of quartz mining in the county (California Historical Landmark No. 463).

Three miles west of Auburn near Highway 80 is the Ophir Mining District. Ophir, was one of the main placer camps of Auburn Ravine and, after 1853, became the main gold-quartz mining center of Placer County. Although little is left of the town, the orchard and vineyard landscape is attractive. State Registered Landmark no 463 is on Bald Hill Road near the intersection with Lozano Road (Bowen and Crippen, 1949, modified by CGS, 1997).

Figure 152. Eclipse Mine mill and trestle, 1895, Ophir (CGS Photo A0913a)

Figure 153. Gold Blossom Mine mill, 1895 (CGS Photo A0913d).

Figure 154. Gold Blossom Mine, 1895 (CGS Photo A0913d).

0.0 Highway 49 underpass with Highway 80. Head north toward Grass Valley on Highway 49. The rocks in this area are greenstones, serpentine and schist. They were formerly mapped as "Calaveras" formation, but now are identified as Paleozoic-Mesozoic metavolcanics of the Lake Combie Complex.

0.3 Fulweller Road to right. To the right (east) is an Ultrabasic mass. On the immediate right (east) is metavolcanic rocks of the Lake Combie Complex and to the west are metavolcanic rocks of the Smartville Complex. The two units are separated by the Wolf Creek Fault upon which Highway 49 is built.

3.2 DeWitt Center. The road cuts for the next 3 miles expose metavolcanic and metasedimentary rocks of the Pine Hill Intrusive Complex. Between the Lone Star School (NE Section 7) and DeWitt Center, Highway 49 approximates the northward extension of the Bear Mountain-Wolf Creek Fault Zone and juxtaposes Lake Combie Complex metavolcanics to the west and ultramafic rocks with mélange terrain metavolcanics of the Smartville Complex to the east.

3.2 Bell Road to airport.

4.2 Elder's Corner at Dry Creek Road. An Ultrabasic mass on the right (east) lies between Bell Road and Dry Creek.

4.4 Marguerite Mine Road to small lode mine.

4.9 South Fork of Dry Creek (#219). At this point there is serpentine to right (east) and Smartville Complex rocks to left (west) along the Wolf Creek Fault Zone that runs parallel to Highway 49.

GEOLOGY MAP 33

Dry Creek to Higgins Corner
(Wagner et al., 1981; Kohler, 1984; Taylor, 1979)
(Saucedo and Wagner, 1982; Springer, 1981)
(Beard, 1985, Tuminas, 1983)

HOTALING

6.0 The mining camp of Hotaling (#220) was also known as Clipper Gap. It is situated in the SW quarter of Section 10.

Six miles northeast of downtown Auburn at Hotaling. It lies between Highway 49 and Clipper Gap on Interstate 80. Hotaling was were one of the earliest iron mining operations in California was located. Clipper Gap and Hotaling can be reached via Highway 20 east from Auburn. The Hotaling iron mine was discovered in 1857 but no ore was shipped until 1869. The deposit was in the form of lenses at the contact of Mesozoic granodiorite and a Lake Combie Complex metavolcanic rocks of probable Paleozoic age. The ore minerals were magnetite and hematite containing from 40% to 65% iron. A blast furnace was operated on the property between 1880 and 1885 using charcoal made locally and limestone mined near by. It produced thirty to thirty-five tons of pig iron daily. Although red and yellow ocher were shipped from the vicinity in the late 1920's for mineral paint, no attempt to exploit the lower grade ores for their iron content has been made since the turn of the century (Bowen and Crippen, 1949).

The Honor Camp No. 7 iron mine (#221) is northeast of Hotaling in Section 10, T.13N, R.8E.

6.2 North Fork Dry Creek in Calaveras Group rocks.

Between the site of Lone Star School and Cherry Creek Acres, Highway 49 follows the trace of the Wolf Creek Fault Zone.

BEAR RIVER BRIDGE

8.2 Bridge over the Bear River (#222)

Highway 49 crosses the Bear River and the Placer-Nevada County line 8.7 miles (14 km) north of Auburn. The vicinity of the Bear River bridge is of considerable geologic interest (although overgrown with vegetation) and is an attractive spot for fishing enthusiasts and pleasure seekers. It is overgrown with vegetation. A major thrust fault (the Wolf Creek Fault) diagonally crosses the Highway in a NW-SE direction and the crumpled rocks along its trace are an interesting study. The thrust zone is expressed as a sheared and crumpled zone of metavolcanicts west of the bridge, along the northern bank of the river. In places, a latticework of silicat-carbonate veinlets occurs in the fault zone. This fault in a northward continuation of the Bear Valley Fault and merges northward into the Big Bend Fault. It marks a major tectonostratigraphic boundary between the Smartville Complex to the west and the Central Belt metamorphic rocks (Slate Creek and Lake Combie Complexes) to the east. West of the bridge, along the bank of the river, the sheared and crumpled metasedimentary rocks of Paleozoic or Mesozoic age are. Discontinuous, irregular bodies of serpentine appear along the fault contact, and the crumpled volcanics include fragments of chert and limestone. A few hundred yards east of the bridge, the massive greenstones contain amygdaloidal horizons and represent quiet lava flows of the metavolcanic facies of the Lake Combie Complex in contrast to the pyroclastic beds of the Smartville Complex seen further to the west. North of the Bear River bridge vicinity, the highway follows the eastern edge of the Wolf Creek Fault

zone for about 9 miles (14 km) (Bowen and Crippen, 1949, modified by CGS, 1997).

10.1 U-name-it ranch with placer workings.

10.3 Combie Road in metavolcanics in road cut.

10.6 Pillow basalt metavolcanic rocks in road cut.

10.7 Serpentine in road cut.

11.8 South Fork of Wolf Creek with Overland Emigrant Trail Historical Marker #799.

12.0 Higgins Corner with Combie Road leading to Combie Dam on the right (east). Highway 49 lies atop the Wold Creek Fault. To the west are Lake Combie Complex metasediments and gabbros and to the east are Lake Combie Complex metavolcanic rocks.

GEOLOGY MAP 34

Higgins Corner to Mayben Ditch
(Wagner et al., 1981; Kohler, 1984; Taylor, 1979)
(Saucedo and Wagner, 1992; Springer, 1981)
(Beard, 1985, Tuminas, 1983)
(Lindgren, 1900; Lindgren and Turner, 1995)

HIGGINS CORNER

Two miles (3.2 km) north of Bear River is Higgins Corner in the NW quarter of Section 28, T.8N, R.23E. A road connecting with the hamlet of Wolf leads off to the west and another to the east leads to the Combie Dam and Reservoir (Lake Combie) on Bear River.(Bowen and Crippen, 1949(

12.5 Vertical bed of Lake Combie Complex chert in road cut (#226).

A prominent outcrop of Lake Combie Complex (formerly mapped as Calaveras Complex) chert forms a reef just west of Highway 49, 2.3 miles (3.7 km) north of the south fork of Wolf Creek. This reef is almost vertical in attitude and is associated with greenstones of uncertain age. This is one of the few exposures of chert to be seen close to Highway 49 south of the Yuba River (Bowen and Crippen, 1949)

12.6 Carriage Road goes to Cottage Hill.

13.5 Contact between green metavolcanics and granodiorite (#228).

14.0 Cherry Creek Road and Holcomb Road in Lake Combie Complex metavolcanics. The Stockton Hill Mine is on the left. This intersection marks a point were Highway 49 leaves the Wolf Creek Fault Zone. At this point the Wolf Creek juxtaposes Paleozoic metasediments and an Ultrabasic mass.

14.1 Donner Party emigrant trail.

15.3 Lime Kiln Road

LIME KILN (JONES RANCH)

The Lime Kiln (formerly Jones Ranch, #227) was the site of a series of limestone quarries and kiln where lime for mortar was prepared at a very early date. Traces of the old workings have been almost obliterated, but partially burned limestone marks the old kiln sites. The limestone bodies are small and are now largely masked by the soil mantle. Chemical analysis of the limestone shows it to be of excellent grade. The Lime Kiln Ranch is located three miles (5 km) west of Highway 49. The turnoff is 5.3 miles north of Higgins Corners and is marked by a white sign (Bowen and Crippen, 1949). The limestone bodies are in a thin belt of Lake Combie Complex metasediments on the west side of the Wolf Creek Fault. Modern development has obliterated the kilns, but limestone outcrops can still be seen. The limestone bodies are small and are now largely masked by the soil mantle (CGS, 1977:151).

15.6 Mayben Ditch (#228)

GEOLOGY MAP 35

Mayben Ditch to North Star Mine
(Saucedo and Wagner, 1992; Beard, 1985; Tuminas, 1983)

18.6 Forest Springs Drive.

18.7 Granodiorite intrusive contact (#229)

Three miles beyond the cherty limestone reef at Lime Kiln, the greenstone bedrock is invaded by Mesozoic quartz diorite. The contact is plainly visible in a road cut on the west side of the highway. The dark minerals in the quartz diorite near the contact have been altered to chlorite and green amphiboles, and the quartz diorite is almost as green as the Lake Combie meta-andesite which it invades. A feldspar porphyry is present close to the contact which does not appear to be related to either the metavolcanic series or the quartz diorite, and may have been brought up from below by the intrusion. The porphyry is composed of abundant large plagioclase phenocrysts averaging 0.1 inch (3 mm). in diameter set in a fine-grained black groundmass (Bowen and Crippen, 1949).

20.1 Quartz diorite in road cut at Bethel Way.

20.4 Bypass to LA BARR MEADOWS on right (east). This area is underlain by quartz diorite upon which grows thick woodlands of manzanita and ponderosa pines. The change in bedrock from metavolcanics to quartz diorite is almost immediately reflected by the vegetation.

20.5 Deep weathering profile of granitic rocks.

GEOLOGY MAP 36

North Star Mine to Nevada City
(Saucedo and Wagner, 1992; Lindgren et al., 1986a)

21.2 Hansen Brothers Gravel Operations.

21.7 **GRASS VALLEY** city limit.

Grass Valley is one of the most beautiful historic mining town in the Northern Sierra. Mining camps the

world over are notoriously ugly and uncomfortable places to live, but Grass Valley is set in a well watered coniferous forest of great beauty. Many stands of large trees have been spared the loggers axe and tower in dark green borders about broad meadowlands. The entire aspect of suburban Grass Valley is park-like. Even the mine dumps and buildings are more or less masked by trees so that the scenery suffers little by their presence. The business district of town is much like that of other Sierran towns (Bowen and Crippen, 1949).

23.9 Grass Valley is connected to the overland route through Reno via Highway 20 which joins Highway 49. A railroad once connected Nevada City and Grass Valley to the transcontinental route of the Southern Pacific but the tracks have been removed. Aside from explorations of Spanish Americans of which there is no record, Grass Valley was first visited by French emigrants in 1846. Gold miners from Oregon spent considerable time there in 1848 but the first permanent settlers who were emigrants from the east arrived in 1849. Historical spots in Grass Valley are numerous. The careers of such famous names as Lola Montez and Lotta Crabtree are closely associated with the history of the town. Its lode mines constitute the most productive group of gold properties in California and rank among the richest in the nation (Bowen and Crippen, 1949).

PHOTO LINK: Grass Valley Mill building (1949:157)

PHOTO LINK: Grass Valley Club Cafe side wall (1949:157)

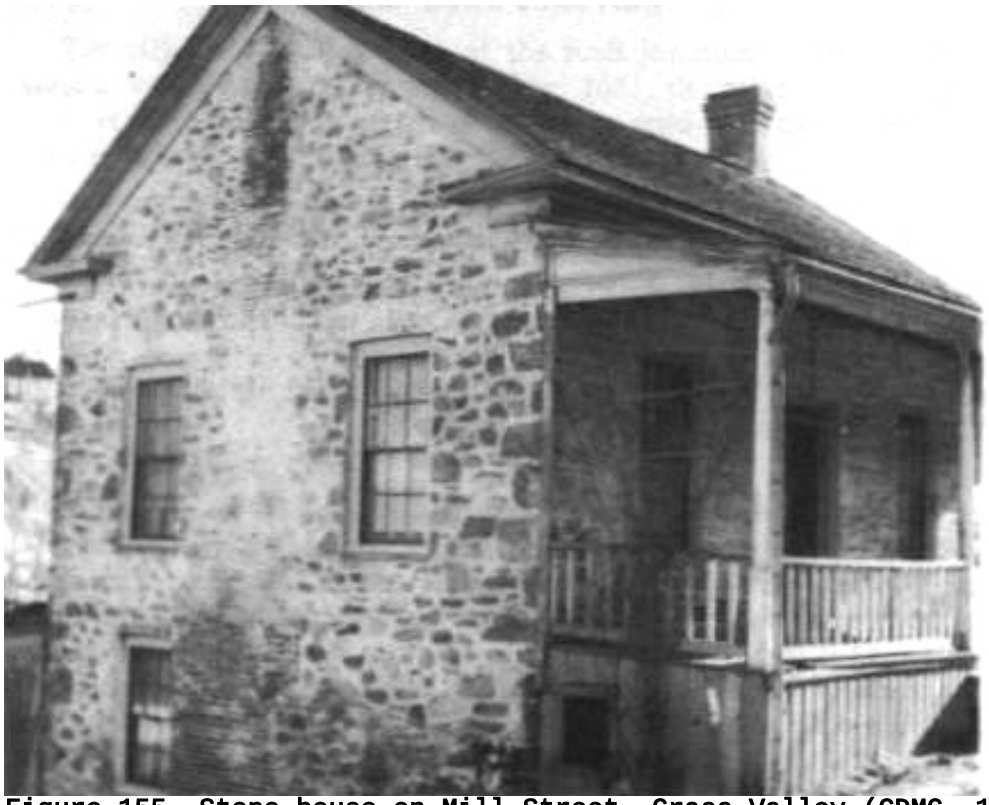

Figure 155. Stone house on Mill Street, Grass Valley (CDMG, 1949:158).

Figure 156. Boston Mine monitor, 1895 (CGS Photo A4445).

Figure 157. Providence Mine, Grass Valley, 1893 (CGS Photo CDMG Photo C6651).

Figure 158. Scotia Mine, Grass Valley, 1877 (CGS Photo A7138a).

Figure 159. Stewart Mine, Gold Run, Grass Valley, 1896 (CGS Photo A7877).

The geology of the Grass Valley mines differs greatly from that of those between Auburn and Mariposa. Very little large scale faulting is in evidence in the Grass Valley district. The Mariposa slate and Calaveras Complex are largely absent, replaced by the Lake Combie Complex and other and metamorphic terrains. The host rocks in the Grass Valley District are generally Paleozoic-Mesozoic massive diabase which has been intruded by Mesozoic quartz diorite. The main veins dip on an average of 35 degrees whereas most Mother Lode veins are steeply dipping . The minor cross veins are usually not mineralized except at their intersections with main veins. The wall rocks of the Idaho-Maryland (#232) and Spring Hill (#233) mines are principally gabbro and serpentine; those of the Empire Star (#231) and Golden Center (#234) are quartz diorite, meta-andesite, diabase, and Lake Combie Complex schist. Vein forming minerals from the Grass Valley district include ankerite, native arsenic, arsenopyrite, chalcopyrite, chromite, epidote, galena, gold, magnetite, mariposite, pyrite, pyrrhotite, sphalerite, and rarely molybdenite, scheelite, hessite, and altaite. The latter two are tellurides of gold and lead respectively. Wall rocks in the district are heavily watered above the 1,500 foot level and water flowed constantly into the lowermost workings necessitating use of elaborate pumping systems. Pumps which handled 3,000 gallons per minute were used in the wettest spots. Although exceedingly humid, Grass Valley mines were among the coolest in the world. The temperature increase or geothermal gradient below ground is less than 1 degrees Fahrenheit per 100 feet (30 m) of depth (Bowen and Crippen, 1949).

22.5 Highway 20 East turn off to West Empire Mine Street.

22.7 West Empire Mine Street. Turn right at the stop sign and go east on Empire Street to the intersection of South Auburn Street and West Empire Mine Street.

23.0 The Empire Market is on the SW corner of the intersection. Go straight (east) toward the Empire Mine. The rocks in this area are metavolcanics and granodiorite.

23.8 Borne Mansion on the right (south).

EMPIRE MINE STATE PARK AND VISITOR'S CENTER

EMPIRE-STAR MINES (Section 35)

The Empire Mine State Historical Park is on the East Empire Street, east of Highway 49.

The Empire Mine (#231) was originally located by George D. Roberts in October 1850. In the spring of 1854, the Empire Mining Company was incorporated and in 1865 new works, including a 30-stamp mill, were erected. In 1869 Wm. B. Bourn, Sr. purchased the Empire, when he died, Wm. B. Bourn, Jr. took over its management (California Historical Landmark No. 298).

The Empire-Star Mines Company, Ltd became the largest mining operation in Grass Valley. The Empire-Star is a consolidation of the major North Star, Pennsylvania, and Empire mines and a host of lesser workings. The Empire began operations in 1851 and was in continuous operation through 1956, except when forced to close during World War II. During this period, most of the shafts were shut down. The mine working faces had gold in them at the time of closure, and they soon filled with water and have remained so ever since. The underground workings of the Empire-Star total more than 367 miles (589 km) in length making it one of the most widespread mines in existence. It has been mined to an inclined depth of more than 11,000 feet (3,350 m) or a vertical depth of over a mile (1.6 km). The total production of the Empire-Star group has been in excess of 5,800,000 ounces ($120,000,000). For the locations of the various shafts of the Empire-Star and other Grass Valley mines see the accompanying map in this guidebook (Bowen

and Crippen, 1949).

Guided tours of the Empire Mine are available and highly recommended.

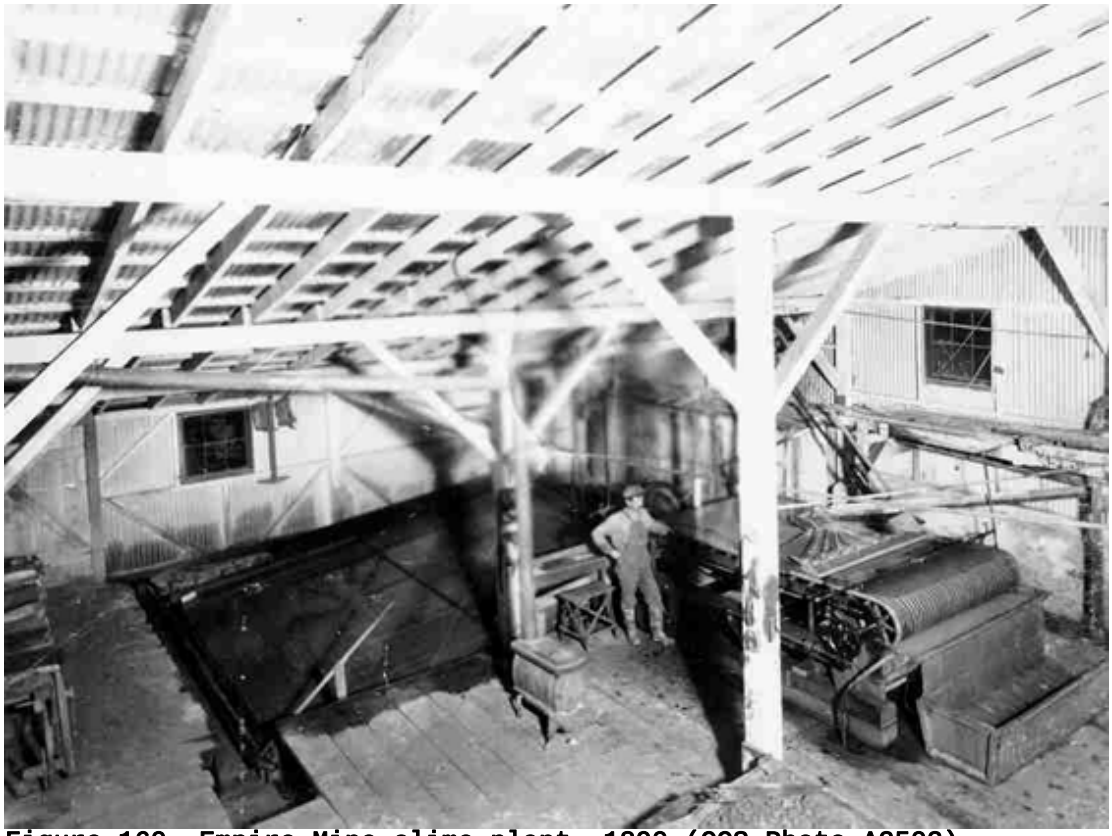

Figure 160. Empire Mine slime plant, 1890 (CGS Photo A3503).

Figure 161. Empire Mine, twin skips with men, 1890 (CGS Photo A3489).

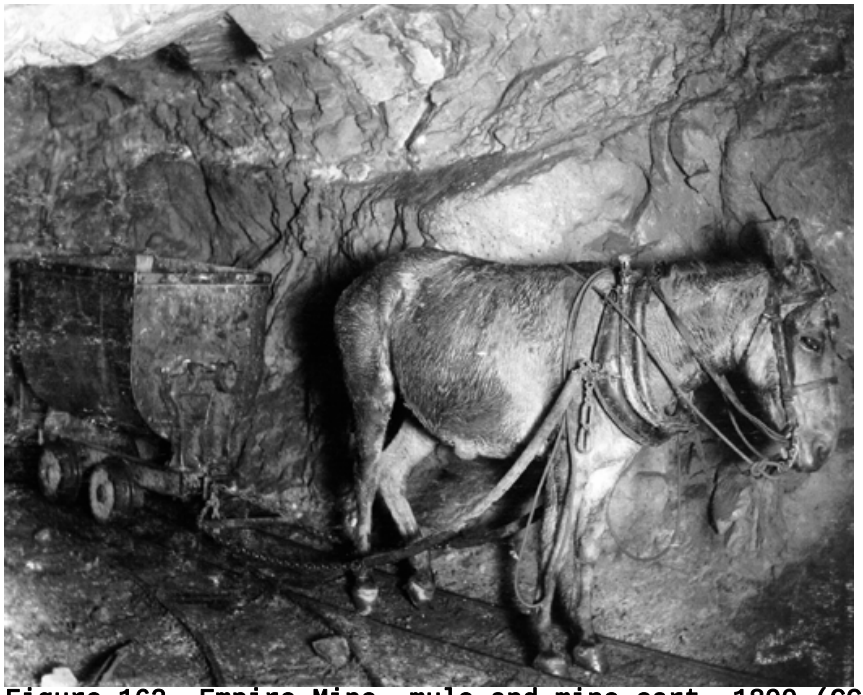

Figure 162. Empire Mine, mule and mine cart, 1890 (CGS Photo C5154).

Figure 163. Mercury amalgam cleanup, Empire Mine,1900 (CGS Photo C5168).

Figure 164. Cornish miner, Empire Mine, 1900 (CGS Photo A5188).

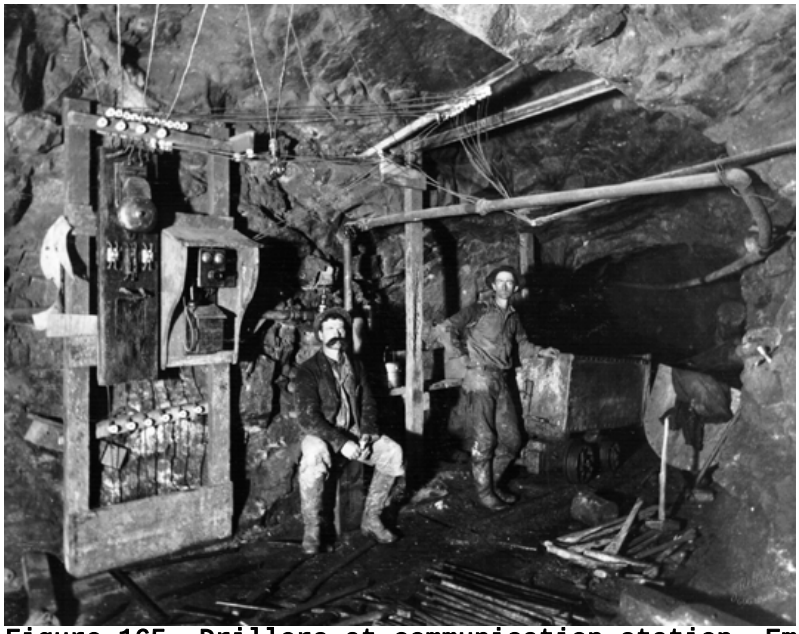

Figure 165. Drillers at communication station, Empire Mine, 1900 (CGS Photo C3500).

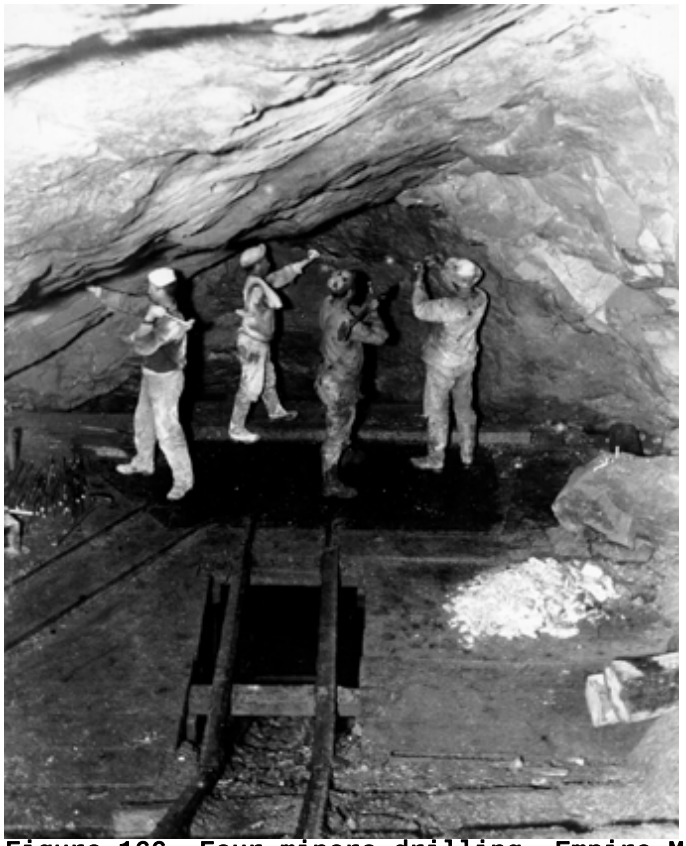

Figure 166. Four miners drilling, Empire Mine, 1900 (CGS Photo C3504).

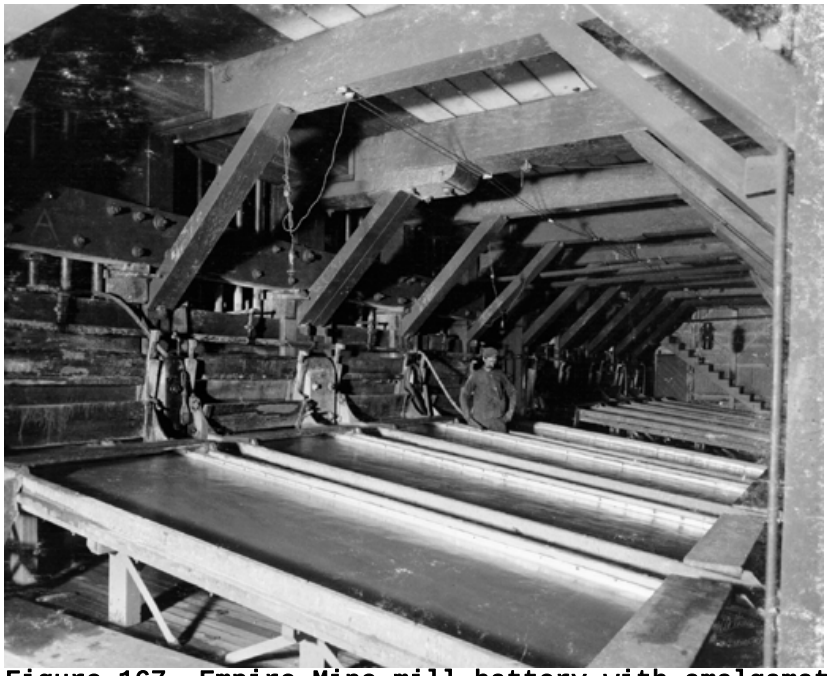

Figure 167. Empire Mine mill battery with amalgamation plates (CGS Photo C5163).

Figure 168. Miner lighting fuse, Empire Mine, 1900 (CGS Photo C5163).

Figure 169. Miner with candle and single jack drill, Empire Mine, 1900 (CGS Photo C3501).

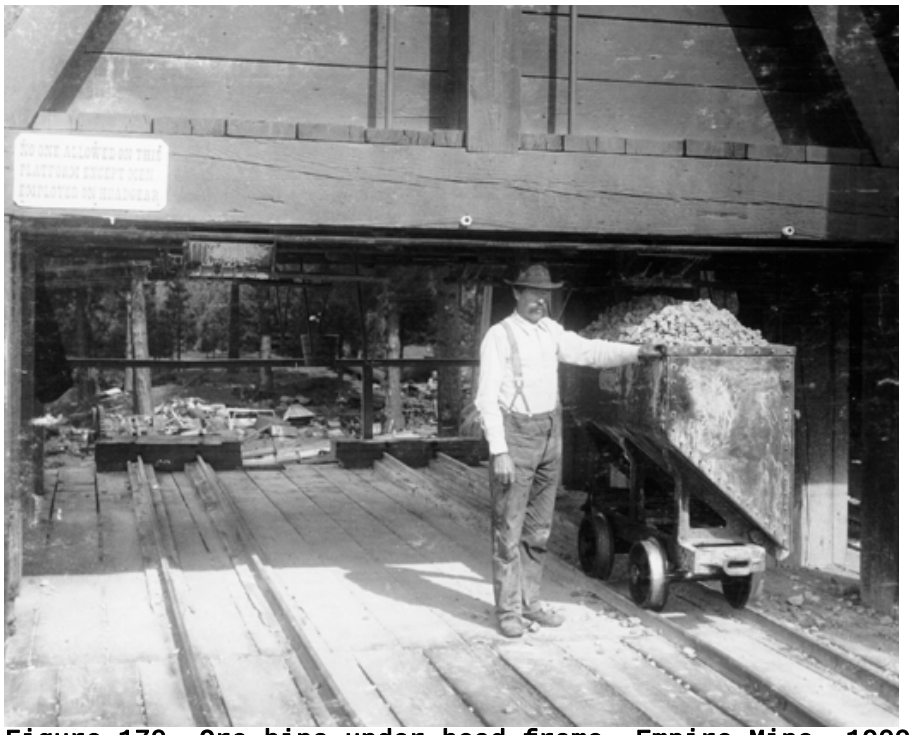

Figure 170. Ore bins under head frame, Empire Mine, 1900 (CGS Photo 5162).

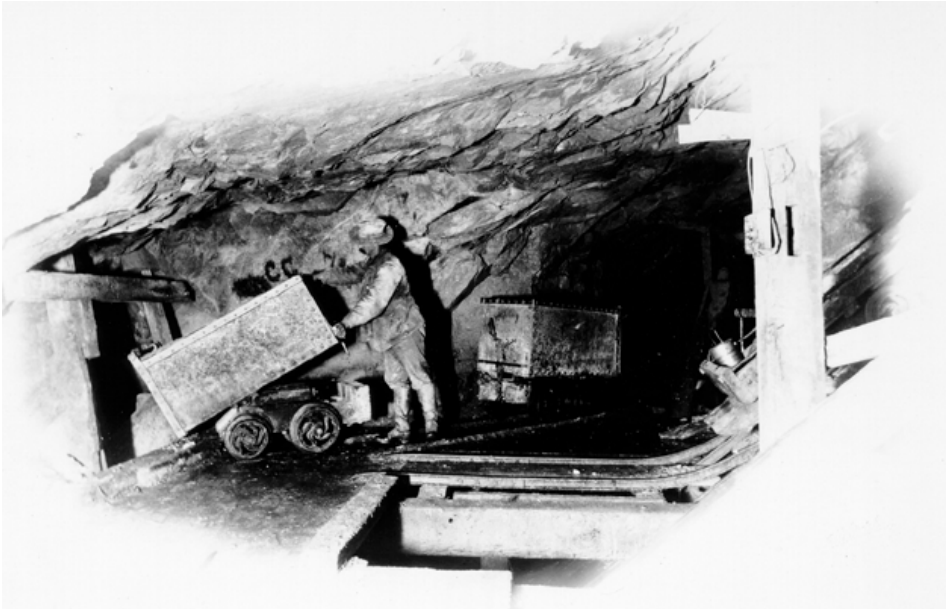

Figure 171. Dumping ore from cart into ore shoot, Empire Mine, 1900 (CGS Photo A3501).

Figure 172. Ore pass, Empire Mine, 1900 (CGS Photo C4084).

Figure 173. Pneumatic drill and two drillers, Empire Mine, 1900 (CGS Photo A7151).

Figure 174. Oscillating gold recovery table, Empire Mine, 1900 (CGS Photo A3526).

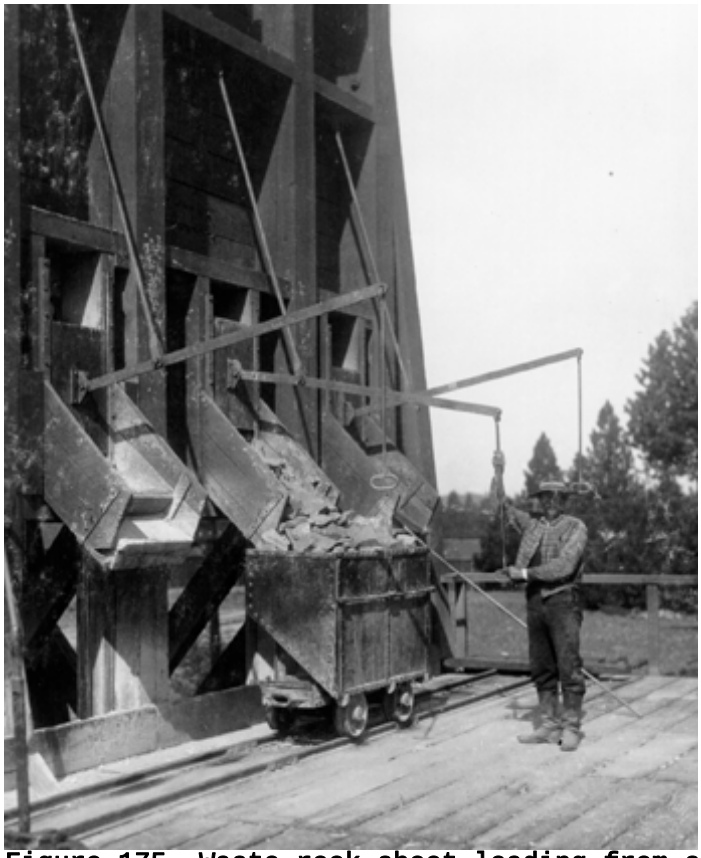

Figure 175. Waste rock shoot loading from storage bins below head frame, Empire Mine, 1900 (CGS Photo C5159).

Figure 176. Empire Mine Mill, 1949.

Figure 177. Blacksmithing demonstration, Empire Mine,2002.

Figure 178. Secondary headframe, Empire Mine, 2002.

Figure 179. Core from ventilation shaft drilling program, Empire Mine, 2002.

Figure 180. Superintendent offices, Empire Mine, 2002.

Figure 181. Stamp mill foundations, Empire Mine, 2002.

Figure 182. Superintendent's Office, Empire Mine, 2002.

Figure 183. Smelting furnace, Empire mine, 1900 (CGS Photo C5177).

Photo 9. Shop buildings at the Empire Mine, Grass Valley District. The mine property is now part of the Empire Mine State Historic Park. *Photo by Max Flanery.*

Figure 184. Shop building, Empire Mine (CGS, 1997:155).

Return to Highway 49. Reset odometer

Between the Empire Mine and Nevada City, Highway 49 crosses Mesozoic quartz diorite, Lake Combie Complex diabase, ultramafic rocks and gabbro, Miocene-Pliocene volcanics and Jurassic granite.

0.0 Highway 49 and West Empire Mine Street. Go straight over the Highway 49 overpass to Mill Street.

Mill Street turnoff. Take the turnoff and circle back to the right to North Star Powerhouse Road.

NORTH STAR MINE POWERHOUSE

The North Star Powerhouse Museum is southwest of the intersection of highways 49 and 20. It was built by A. D. Foote in 1895, was the first complete plant of its kind. Compressed air, generated by Pelton water wheels, furnished power for the entire mine operation. The 30-foot Pelton wheel was the largest in the world, and was in continuous use for over 30 years (California Historical Landmark No. 843).

The North Star Power House Museum has a display of the 30-foot Pelton wheel and a reconstructed Cornish pump used to dewater the mines.

Figure 185. Pelton wheel, North Star Powerhouse Museum (photo from their web site, March, 20007).

Photo 6. At 30 feet in diameter, this is the largest Pelton wheel ever constructed. The wheel was used to generate hydro-electric power for mining operations in the area; it is displayed at the North Star Mining Museum in Grass Valley. *Photo by Max Flanery.*

Figure 186. 30-foot diameter Pelton wheel, North Star Powerhouse Museum (CGS, 1997:153).

Figure 187. Cornish pump, North Star Powerhouse Museum (photo from their web site, March, 2007).

Photo 7. This Cornish pump assembly provided a means of dealing with one of mining's biggest problems—the removal of water. This was actually a pumping system; a way to drive numerous pumps at various depths within the mine. This assembly is now displayed at the North Star Mining Museum in Grass Valley. *Photo by Max Flanery.*

Figure 188. Cornish pump, North star Powerhouse Museum (CGS, 1997:153)

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0.4 Turn left at stop sign to go through Old Town Grass Valley.

GOLDEN CENTER MINE

The Golden Center Mine (#234) is located in the heart of the business district of Grass Valley. Although the surface extent of the Golden Center property is not great, the mine was rich and ore worth more than 100,000 ounces ($2,500,000) was taken from it before litigation forced a shut down. The Golden Center is currently idle. The deepest shaft is 1,900 feet (580 m) as measured along the incline (Bowen and Crippen, 1949).

SPRING HILL MINE

(SW Section 23)

The Spring Hill Mine (#233) northeast of Grass Valley is a small but promising operation which was active in 1949. It was one of the neatest, best maintained properties in the gold county and its headframe and mill have been photographed repeatedly for various publications. The main shaft is about 1,900 feet deep in diabase and serpentine wall rocks. The recorded production, most of which has been between 1928 and 1948, is 120,000 ounces (about $300,000; Bowen and Crippen, 1949).

1.0 Downtown Grass Valley. Turn right on Main Street east to Business Highway 49.

1.2 Stop sign. Go straight toward Nevada City.

1.6/0.0 Go under Highway 49 then take the on-ramp that curves to the right. Get on freeway, head north toward Nevada City. Reset odometer. To the east of the on-ramp is Idaho Maryland Road.

IDAHO-MARYLAND MINES

(NE Section 26)

Another major gold mining operation in Grass Valley active in 1949 was that carried on by the Idaho-Maryland Mines Corporation (#232). Its holdings include the Old Brunswick, New Brunswick, Idaho, and Eureka mines and many smaller workings. The New Brunswick shaft is 3,450 (1,050 m) feet deep and the Idaho is 2,700 feet (823 m) deep via shaft and winze. A successful attempt at shaft sinking by core drilling was made by the Idaho-Maryland. Part of the core can be seen at the Museum and in downtown Grass Valley. The Idaho No. 2 shaft was sunk 1,000 feet into serpentine by this method using a Newsom drilling machine developed at the Idaho-Maryland. The drill cores are five feet in diameter and weigh several tons each. Many of these cores were piled about the entrance to the shaft, but have since been removed. Although the Idaho-Maryland is not as large an operation as the Empire-Star, it is still among the six largest gold mines in California, and has a recorded production of 2,570,000 ounces (about $64,240,543). Ore-treatment plants at one time connected and served both the Idaho-Maryland and Empire-Star mines (Bowen and Crippen, 1949). When the Idaho-Maryland closed, there were 40 mine working faces that had visible gold protruding from them at the time they were flooded. The Emperor Gold Company began dewatering the mine in 1998. When completed it plans to refurbish the access shaft and conduct an exploration program to study the feasibility of reopening the mine.

Figure 189. New Brunswick ore bins and lumber, Idaho-Maryland Mine, 1977 (CGS Photo A7132).

Figure 190. Cores from the No. 2 shaft, 1000 foot-level cores, 1949 (CDMG photo).

Figure 191. Core samples, Idaho-Maryland mine exploration project, 2002. G. Wilkerson, M. Payne and D. Lawler.

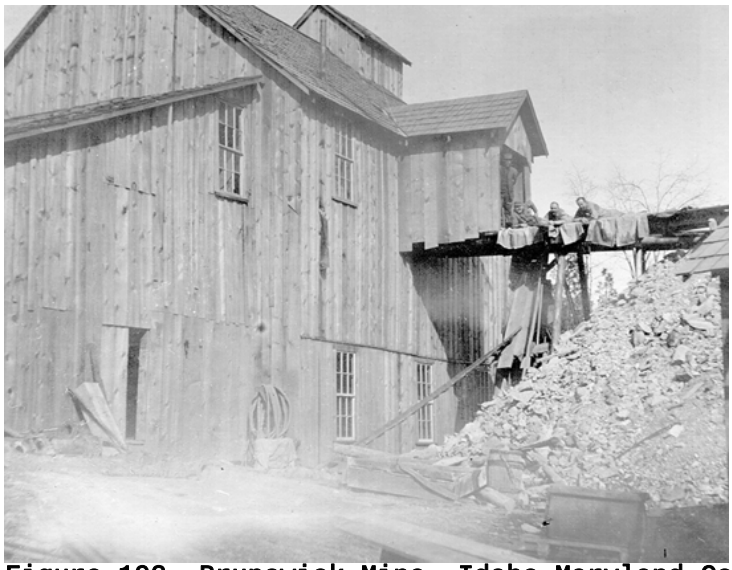

Figure 192. Brunswick Mine, Idaho-Maryland Company, 1895 (CGS Photo A0855c).

Photo 8. Miners descended into the Idaho-Maryland mine in this man skip. The shaft entered the mine at a 72 degree angle and had a depth of 1500 feet; the descent took about 2 minutes. The man skip is now displayed at the North Star Mining Museum in Grass Valley. *Photo by Max Flanery.*

Figure 193. Miner's skip, Idaho-Maryland Mine (CGS, 1997:154).

0.9 Brunswick Avenue exit to Town Talk.

TOWN TALK

(S1/2 Section 13)

Midway between Grass Valley and Nevada City was the old mining camp of Town Talk (#235). Little remains to mark the site because it has been overrun by urban development of Grass Valley. Historian Glasscock has it that Town Talk came about partly as an act of God and partly as a practical joke. An old saloon sign bearing the words Town Talk is supposed to have been stranded in the vicinity of the camp by flood waters of Deer Creek. Someone fished the sign out and stuck it up on the hill and the camp was thereafter known by that name.

2.0 Gold Flat Road.

REFERENCES

Most of the references for this volume were provided by Dr. Art Barabas of California State University, Fresno.

Allgood, G.M., 1990, Geology and operations at the Jamestown mine, Sonora Mining Corporation, California, in Landefeld, L.A., and Snow, G.G., eds., Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p.147-154.

Allgood, G.M., 1990, The Jamestown mine--Its history, geology and operations: Society for Mining, Metallurgy, and Exploration, Inc., Preprint Number 90-400, 8 p.

Allgood, G.M., Allgood, R.W., and Pradenas, J., 1987, Gold occurrences in Tuolumne County, California: Mineralogical Record, v.18, no.1 (January-February), p.41-45, 62-64.

Anon, 1882, A history of Tuolumne County: San Francisco, B.F. Alley, 509 p.plus 48 p. appendix.

Anon, 1983, The Mother Lode: Los Angeles, Automobile Club of Southern California, 72 p.

Aune, Q.A., 1979, Geologic reconnaissance of the Greenwood 7.5
minute quadrangle: unpublished field study for the State Map Project, scale 1:24,000. In part after Turner, H.W. and W. Lindgren, 1894, Geologic Atlas of the United States, Placerville Folio: U.S. Geological Survey Folio 3, scale 1:125,000.
Baird, A.K., 1962, Superimposed deformations in the central Sierra Nevada foothills, east of the Mother Lode: University of California Publications in Geological Sciences, 42:1:1-70, Figure 2.

Barabas, A.H., and McAllister, C.A., 1991, Historical ore trends in the Mother Lode and their relationship to advances in mining technology, as illustrated by the Pine Tree and Josephine mines, Mariposa County (1850-present): Paper presented at "California's Gold Rushes: Past and Present", 44th Annual California History Institute, The John Muir Center for Regional Studies, University of the Pacific, Stockton, CA, April 18-21, 1991, 3 p.

Bartow, J.A. and E.J. Helley, 1979, Preliminary geologic map of Cenozoic deposits of the Auburn quadrangle, California: U.S. Geological Survey Open File Report 79-386, scale 1:62,500.

Bartsch, J.A., 1990, California State Mining and Mineral Museum, Mariposa, California: Rocks and

Minerals, v. 65, January-February, p. 42-48.

Bateman, P.C., 1987, Pre-Tertiary bedrock geologic map of the Mariposa 1° by 2° quadrangle, California: U.S. Geological Survey Open File Report 87-670, scale 1:200,000.

Bateman, P.C and K.B. Krauskopf, 1987, Geologic map of the El Portal quadrangle, west-central Sierra Nevada, California, U.S. Geological Survey, Map MF-1998.

Beard, J.S., 1985, The geology and petrology of the Smartville intrusive complex, northern Sierra Nevada foothills, California, Ph.D dissertation, 356 p., plate 1, scale 1:62,500. Aldo Beard, J.S., 1981, Geology of some plutonic and hypabyssal rocks in the Smartville block, western Sierra Nevada: unpublished maps and report for the Division of Mines and Geology Data Base Augmentation Program, scale 1:24,000 and 1:62,500. Tertiary geology near French Corral from Yeend, 1974.

Behrman, P.G., 1978, Paleogeography and structural evolution of a middle Mesozoic arc-continental margin: Sierran Nevada foothills, California: University of California, Berkeley, unpublished Ph.D. thesis, 301 p., scale 1:12,000.

Belli, Tony, 2005, Volcanoville, http://www.co.el-dorado.ca.us/stories/Volcanoville.html, March 11, 2007.

Berquist, J.R., 1986, Geologic map of the East Yuba and West Yuba Roadless Areas, Plumas and Sierra Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map, scale 1:48,000.

Best, M.G., 1963, Petrology of the Guadalupe igneous complex, southwestern Sierra Nevada foothills, California: Journal of Petrology, v. 4, part 2, p. 223-259.

Blake, M.C., Jones, D.L., and Howell, D.G., 1982, Preliminary tectonostratigraphic terrane map of California: U. S. Geological Survey Open File Report 82-593.

Bobbitt, J.B., 1982, Petrology, structure and contact relations of part of the Yuba Rivers Pluton, northwestern Sierra Nevada foothills, California: University of California, Davis, M.S. thesis, 160 p., plate 1, scale 1:62,500. Tertiary geology from Yeend (1974) and Lindgren and Turner (1895)

Bogen, N.L., 1983, Studies of the Jurassic geology of the west-central Sierra Nevada of California: Columbia University, Ph.D dissertation, map scale 1:24,000. Modifications for Sonora Fault in Schweickert and Bogen (1983) and fault in southwest part of area from unpublished maps by Paterson, S.R. and O.T. Tobisch, University of California, Santa Cruz, scale 1:62,500.

Bohlke, J.K., and R.W. Kistler, 1986, Rb-Sr, K-Ar, and stable isotope evidence for the ages and sources of fluid components of gold-bearing quartz veins in the northern Sierra Nevada foothills metamorphic belt, California: Economic Geology, v. 81, no. 2, p. 296-322.

Bortugno, E.J., 1979, (with field assistance from G.J. Saucedo), Geologic reconnaissance of the Mokelumne Hill 15-minute quadrangle: unpublished field study for the State Map Project, scale 1:62,500; geology modified from Turner, H.W., 1894, Geologic Atlas of the United States, Jackson Folio: U.S. Geological Survey Folio 11, scale 1:125,000.

Bowen, O.E., 1969, Maps of the Coulterville and El Portal 15-minute quadrangles and parts of the Indian Gulch, Mariposa, Sonora, and Tuolumne quadrangles: Unpublished maps, scale 1:62,500.

Bowen, O.E., 1969, Geology of the Coulterville 15- minute quadrangle: California Division of Mines and Geology unpublished mapping, scale 1:62,500.

Bowen, O.E and R.A. Crippen, 1948, Geologic maps and notes along Highway 49: California Division of Mines Bulletin 141, p. 35-86.

Bowen, O.E., and C.H. Gray Jr., 1957, Mines and Mineral Deposits of Mariposa County, California Journal of Mines and Geology, v. 53, no. 2, p. 34-343

Braasch B., 1972, Gold rush country: Menlo Park, California, Lane Publishing Co. (Sunset), 128 p.

Browne, J.R., 1868, The Mariposa estate: Its past, present, and future: New York, Russell's American Steam-Printing, 62 p.

Burchfiel, B.C., and G.A. Davis, 1981, Triassic and Jurassic tectonic evolution of the Klamath Mountains-Sierra Nevada geologic terrane, in Ernst, W.G., The geotectonic development of California, Rubey Volume 1: Englewood Cliffs, New Jersey, Prentice-Hall, p. 50-70.

Burnham, C.W., 1979, Magmas and hydrothermal fluids, in Barnes, H.L., ed., Geochemistry of hydrothermal ore deposits (2nd ed.): New York, John Wiley and Sons, p. 71-136.

Burstow, W.D., 1985, Surfacial geology of the Pine Tree Project Mariposa County, California: ABM Inc. unpublished report, 11 p, map, scale I :2,400.

California Division of Water Resources, 1963, Aerial geology of Sierra, Mohawk and Humbug Valleys ground water basins, *in* Northeastern counties ground water investigation: Bulletin 98, 224 p. v.2, plate 17, scale 1:125,000.

Chaffee, M.A., and R.H. Hill, 1989, Soil geochemistry of the Mother Lode-type gold deposits in the Hodson mining district, central California, U.S.A.: Journal of Geochemical Exploration, v. 32, p. 53-55.

Chamberlain, N.D., 1972, The call of gold: True tales on the gold road to Yosemite (revised 2nd printing): Santa Cruz, Western Tanager Press, 187 p.

Clark, L.D., 1960, Foothills fault system, western Sierra Nevada, California: Geological Society of America Bulletin, v. 71, no. 4, p. 483496.

Clark, L.D., 1964, Stratigraphy and structure of part of the western Sierra Nevada metamorphic belt, California: U. S. Geological Survey Professional Paper 410, 70 p.
Clark, L.D., 1976, Stratigraphy of the north half of the western Sierra Nevada metamorphic belt, California, U.S. Geological Survey Professional Paper 923, 26 p. Plate 1, scale 1:316,800.

Clark, L.D. and N.K. Hubar, 1975, Geologic observations and sections along selected stream traverses, northern Sierra Nevada metamorphic belt, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-690, scale 1:62,500.

Clark, L.D., A.A. Stromquist and D.B. Tatlock, 1963, Geologic map of the San Andreas quadrangle, Calaveras County, California, U.S. Geological Survey Quadrangle Map GQ-222, scale 1:62,500.

Clark, W.B., 1960, Skin diving for gold in California: California Division of Mines and Geology Mineral Information Service, v. 13, no. 6, p. 1-8.

Clark, W.B., 1970, Gold districts of California: California Division of Mines and Geology Bulletin 193,186 p.

Clark, W.B., 1978, Private mints in California: California Geology, v. 31, no. 3, p. 56-57.

Clark, W.B., and P.A. Lydon, 1962, Mines and mineral resources of Calaveras County: California Division of Mines and Geology, County Report 2, p. 32-93.

Crampton, C.G., 1941, The opening of the Mariposa mining region, 1849 to 1850, with particular reference to the Mexican land grant of John C. Fremont: Unpublished Ph.D. dissertation, University of California, Berkeley, 327 p.

Crawford, J.J., 1894, Tuolumne County: California Mining Bureau [State Mineralogist's] Report 12, p. 298-307.

Cutter, D.C., 1990, The discovery of gold in California, in Landefeld, L. A., and Snow, G. G., eds., Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 75-78. (originally published in Jenkins, 1948).

D'Allura, J.A., 1977, Stratigraphy, structure, petrology, and regional correlations of metamorphosed upper Paleozoic volcanic rocks in portions of Plumas, Sierra, and Nevada Counties, California: University of California, Davis, Ph.D dissertation, 338 p., plate 1, scale 1:24,000.

Dalrymple, G.B., 1964, Cenozoic chronology of the Sierra Nevada, California: University of California Publications, Bulletin of the Department of Geological Sciences, v. 47, p. 1-41 .

Dodge, F.C.W., and R.C. Loyd, 1984, Gold deposits of the western Sierra Nevada: Field trip guide, Society of Economic Geologists, March 1-5, 1984, U. S. Geological Survey Open-File Report 84-169, 25 p.

Dohms, P.H., R.D. Hoagland and G.M. Allgood, 1984, Geology of the Jamestown mine area, Mother Lode gold belt, Tuolumne County, California: Unpublished report and fieldtrip handout, 6 p., maps and sections, scales 1:1,200, 1:600.

Duffield, W.A., and R.V. Sharp, 1975, Geology of the Sierra foothills melange and adjacent areas, Amador County, California: U. S. Geological Survey Professional Paper 825, 30 p.

Durrell, C., 1976a, Geologic maps of the Mt. Ingalls, Grizzley Valley, and Blairsden 7.5-minute quadrangles, Plumas County, California: Unpublished mapping, scale 1:24,000.
Durrell, C., 1976b, Geology of the region around the Plumas-Eureka State Park, Plumas County, California: Unpublished mapping, scale 1:36,000.

Eddy, C.A., 1985, Petrology and geochemistry of the Yuba Rivers pluton, northwestern Sierra Nevada foothills, California: University of California, Davis, M.S. Thesis, 126 p., plate 1, scale 1:62,500.

Edelman, S.H., 1986, Structure across an ocean-continent suture zone in the northern Sierra Nevada, California, and its implications for ocean accretion processes and regional tectonics: University of California, Davis, Ph.D. dissertation, 311 p., plate 1a-h, scale 1:24,000, figure 2, scale 1:98,425. Also Edelman, S.H., 1981, Geology of part of the central belt of northern Sierra Nevada metamorphic terrane, California: Unpublished maps and report for the Division of Mines and Geology Data Base Augmentation Program, scale 1:24,000.

Egleston, T., 1887-90, The metallurgy of silver, gold, and mercury in the United States: New York, John Wiley & Sons, 2 volumes, 558 and 920 p.

Eisenhauer, R.C., 1934, Report on the Pine Tree and Josephine Mine, Bear Valley, Mariposa County, California: Unpublished report for Pacific Mining Company, San Francisco, June 1934, p. 22

Eric, J.H., A.A. Stromquist, and C.M. Swinney, 1955, Geology and mineral deposits of the Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, California: California Division of Mines and Geology Special Report 41, Plate 2, scale 1:24,000.

Evans, J.R., 1966, Nephrite jade in Mariposa County: Mineral Information Service, v. 19, no. 9, 13 p.

Evans, J.R., and O.E. Bowen Jr., 1977, Geology of the southern Mother Lode, Tuolumne and Mariposa Counties, California: California Division of Mines and Geology Map Sheet 36, scale 1:24,000

Florin, L., 1973, Ghost towns of the West: New York, Promontory Press, p. 164-166.

Frederick, F.H., 1935, Topographic and geologic map, Pine Tree and Josephine vicinity: Pacific Mining Co. unpublished map, scale 1:4,800.

Frederick, F.H., 1935-1940, Geologic maps of the Pine Tree-Josephine mine: Pacific Mining Co. unpublished map, 1:480 scale.

Gillette, C.E., 1916, The Mariposa Grant, Mariposa County, California: Mariposa, Mariposa Gazette Press, 16 p. (reprint).

Goldman, H.B., 1964, Tertiary fluviatile deposits in the vicinity of Mokelumne Hill, Calaveras County, California: University of California, Los Angeles, unpublished M.A. thesis, scale 1:24,000.

Gudde, E.G., 1969, California place names (3rd ed.): Berkeley, University of California Press, 416 p.

Gudde, E.G., 1975, California gold camps: Berkeley, University of California Press, 467 p.

Gustafson, R., 1977, Mining history of the southern Mother Lode: Far Western Section, National Association of Geology Teachers, Fall Meeting Guidebook, October 9, 1977, 11 p.

Hacker, B.R., 1984, Stratigraphy and structure of the Yuba Rivers area, central belt, northern Sierra Nevada, California: University of California, Davis, M.S. thesis, 125 p., plate 1, scale 1:24,000. Tertiary stratigraphy from Lindgren (1900).

Hart, E.W., 1959, Geology of limestone and dolomite deposits in the southern half of the Standard quadrangel, Tuolumne County, California, Califorinia Division of Mines and Geology Special Report 58, plate 1, scale 1:24,000.

Haydock-West, M.D., 1988?, Mineralogy and petrogenesis of dikes associated with the Mother Lode gold-quartz vein, Harvard mine, Jamestown, California: California State Polytechnic University, Pomona, unpublished senior thesis, 42 p.

Heizer, R.F., and Fenenga Franklin, 1948, Survey of building structures of the Sierran gold belt, 1848-70: California Division of Mines Bulletin 141, p. 91-164.

Hershey, O.H., 1916, Geologic report on Harvard Mine: Unpublished report, 16 p.

Hershey, O.H., 1934, Geologic report on the Pine Tree and Josephine Mines: Unpublished report for Bullion Gold and Silver Mining Company, May 23, 1934, 19 p.

Herzig, C.T., 1985, Jurassic rocks east of the Melones fault zone, central Sierra Nevada foothills, California: Unpublished M.S. thesis, S.U.N.Y. Stony Brook, 88 p., scale 1:316,800.

Heyl, G.R., Stromquist, A.A., Swinney, C.M., and Wiese, I.H., 1955, Mines and prospects of the Sonora quadrangle: California Division of Mines and Geology Special Report 41, 4 plates, scale 1:24,000.

Hietanen, A., 1976, Metamorphism and plutonism around the Middle and South Forks of the Feather River, California: U.S. Geological Survey Professional Paper 920, 30 p., plate 1, scale 1:48,000. Fault modifications and additions from: Hietanen (1981). Additions and modifications in the south 1/2 of the Moorville Ridge 15-minute quadrangle from Edelman (1986) and Murphy (1985).

Hietanen, A., 1981a, The Feather River area as part of the Sierra Nevada suture system in California: U.S. Geological Survey Professional Paper 1226-B, 13 p., plate 1, scale 1:125,000 in Hietanen, Anna, Petrologic and structural studies in the northwestern Sierra Nevada, California, U.S. Geological Survey Professional Paper 1226.

Hietanen, A., 1981b, Geology west of the Melones fault between the Feather and North Yuba Rivers, California: U.S. Geological Survey Professional Paper 1226-A, 35 p., plate 1, scale 1:48,000 in Hietanen, Anna, Petrologic and structural studies in the northwestern Sierra Nevada, California, U.S. Geological Survey Professional Paper 1226.

Hunerlach, Michael P , James J. Rytuba, and Charles N. Alpers, 1999, Mercury Contamination from Hydraulic Placer-Gold Mining in the Dutch Flat Mining District, California, U.S. Geological Survey Water-Resources Investigations Report 99-4018B, p.179-189

Huntington, G.L., 1990, Soils of the Mother Lode region: Roadside pedology, Merced to Mariposa, Yosemite Valley to Mariposa, and Mariposa to Coloma, in Landefeld, L. A., and Snow, G. G., eds., Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 105-116.

Imlay, R.W., 1961, Late Jurassic ammonites from the western Sierra Nevada, California: U. S. Geological Survey Professional Paper 374-D, 30 p.

Jackson, D.D., 1980, Gold dust: New York, Alfred Knopf, 361 p.

Jackson, J.H., 1941, Anybody's gold (The story of California's mining towns): New York, Appleton-Century, 468 p.
Jenkins, O.P., ed., 1948, Geologic guidebook along Highway 49 - Sierran gold belt, the Mother Lode country (Centennial Edition): California Division of Mines Bulletin 141, 164 p.

Jennings, C.W., 1979 (with field assistance from G.J. Saucedo), Geological reconnaissance of the Columbia 15-minute quadrangle: unpublished field study for the State Map Project, scale 1:62,500; geology modified from Turner, H.W. and F.L. Ransom, 1898, Geological Atlas of the United States, Big Trees Folio: U.S. Geological Survey Folio 51, scale 1:125,000.

Julihn, C.E., and Horton, F. W., 1938, Mines of the southern Mother Lode region, Part I Calaveras County: U. S. Bureau of Mines Bulletin 413, 139 p.

Julihn, C.E., and Horton, F. W., 1940, Mines of the southern Mother Lode region, Part IICTuolumne and Mariposa Counties, California: U. S. Bureau of Mines Bulletin 424, 173 p.

Kerrick, D.M., 1970, Contact metamorphism in some areas of the Sierra Nevada, California: Geological Society of America Bulletin, v. 81, no. 10, p 2913-2938

Kistler, R.W., Dodge, F C. W., and Silberman, M. L., 1983, Isotopic studies of mariposite-bearing rocks from the south-central Mother Lode California: California Geology, v. 36, no. 9, p. 201-203.

Knopf, A., 1929, The Mother Lode system of California: U. S. Geological Survey Professional Paper 157, 88 p.

Kohler, S., 1983, Mineral land classification of the Georgetown 15 minute quadrangle, El Dorado and Placer Counties, California, Cal. Division. Mines and Geology, Open File Report 83-35, Plate 1, scale 1:62,500

Kohler, S., 1984, Mineral land classification of the Auburn 15 minute quadrangle, El Dorado and Placer Counties, California, Cal. Division. Mines and Geology, Open File Report 83-37, Plate 1, scale 1:62,500

Krauskopf, K.B., 1985, Geologic map of the Mariposa Quadrangle, Mariposa and Madera Counties (15 min)., U.S. Geological Survey Map GQ-1586.

Kruckeberg, A.R., 1984, California serpentinites: flora, vegetation, geology, soils, and management problems, University of California Press, Berkeley, 180 p.

Kuhl, T.O., and Garmoe, W. J., 1989, Geology of the Royal-Mountain King Mine, Hodson District, California Bureau of Mines Bulletin 424, 173 p.

Kuhl, T.O., 1990, The Royal-Mountain King Project, Calaveras County, California, in Landefeld, L. A., and Snow, G. G., eds., Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 155-156.

Lamarre, R.A., 1977, Geology of the Alabama-Crystalline mines, Mother Lode gold belt, California: Unpublished M.S.. thesis, University of Western Ontario, 108 p.

Land Deed, 1851, Mariposa County.

Land Deed, 1963, Mariposa County.

Landefeld, L.A., 1990, The geology of the Mother Lode belt, Foothills metamorphic belt, Sierra Nevada, California, in Landefeld, L. A., and Snow, G. G., eds., Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 117-124.

Landefeld, L.A., and G.G. Snow, 1990, Road logs and maps, in Landefeld, L.A., and G.G. Snow, editors, Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 3-68.

Landefeld, L.A., and G.G. Snow, eds., 1990a, Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California, with articles on operating mines in the Mother Lode, land use and permitting, history and natural history of the Sierra Nevada: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, 200 p.

Lechner, M.J., 1990, Geology of the Royal-Mountain King Mine, Calaveras County, California: California Gold Symposium 11, California Division of Mines and Geology, 10 p.

Lechner, M.J., and T.O Kuhl, 1990, Geology of the Royal Mountain King mine: Paper presented at the

Northwest Mining Association Convention, Dec. 5, 1990, 11 p., 8 figures.

Leonardos, O.R., Jr., 1966, Serpentinite contact relations in the Moccasin Quadrangle, California: Unpublished M.A. thesis, University of California, Berkeley, 42 p.

Leonardos, O.R., Jr. and Fyfe, W. S., 1967 Serpentinites and associated albitites, Moccasin Quadrangle, California: American Journal of Science, v. 265609-618.

Lindgren, W., 1984a, Geological Atlas of the United States, Placerville Folio: U.S. Geological Survey Folio 3, scale 1:125,999

Lindgren, W., 1984b, Geological Atlas of the United States, Sacramento Folio: U.S. Geological Survey Folio 5, scale 1:125,000. Modifications from Wagner, D.L.(1979), Clark, L.D. (1964, 1976).

Lindgren, W., 1897, Geological Atlas of the United States, Truckee Folio: U.S. Geological Survey Folio 39 scale 1:125,000. Modifications from G.J. Saucedo, 1985.

Lindgren, W., 1900, Geological Atlas of the United States, Colfax Folio: U.S. Geological Survey Folio 66 scale 1:125,000. Modifications to Tertiary geology from: Yeend (1974). Faults and additional modifications from Clark (1976) and Clark and Huber (1975).

Lindgren, W. and H.W. Turner, 1895, Geologic Atlas of the United States, Smartsville Folio,: U.S. Geological Survey Folio 18, scale 1:125,000. (Additions and modifications by G.L. Saucedo, 1985).

Logan, C.A. 1935, Mother Lode Gold Belt of California: California Division of Mines and Geology Bulletin 108, 240 p.

Logan, C.A., 1948, History of mining and milling methods in California: California Division of Mines Bulletin 141, p. 31-34.

Loyd, R.C., 1983, Mineral land classification of the Sutter Creek 15 minute quadrangle, Cal. Division. Mines and Geology, Open File Report 83-36 SAC, Plate 1, scale 1:62,500.
Loyd, R.C., 1984, Mineral land classification of the Folsom 15 minute quadrangle, Cal. Division. Mines and Geology, Open File Report 84-50SAC, Plate 1, scale 1:62,500.

Loyd, R.C., 1986, Mineral land classification of the southern half of the Bald Mountain/Brows Flat gold mining district, Sonora, Tuolumne County, Cal. Division. Mines and Geology, Open File Report 86-12SAC, Plate 1, scale 1:62,500.

Loyd, R.C, and S. Kohler, 1987, Mineral land classification of the Camino and Mokelumne Hill 15 minute quadrangles, El Dorado, Amador, and Calaveras Counties, California, Cal. Division. Mines and Geology, Open File Report 87-2 SAC, Plate 1, scale 1:62,500.

Loyd, R.C, T.P Anderson and M.M. Bushnell, 1983, Mineral land classification of the Placerville 15 minute quadrangle, El Dorado and Amador Counties, California, Cal. Division. Mines and Geology, Open File Report 83-29SAC, Plate 1, scale 1:62,500.

MacVeigh, J.G., and H.D. Meade, 1987, The Blue Moon - American Eagle deposits, in Johnson, J. L, ed., Bulk mineable precious metal deposits of the western United States, Guidebook for field trips, Geologic Society of Nevada, p. 178-196.

Martin, D. and B. Martin, 1990, The Best of the Gold Country: Walnut Creek, California, Pine Cone Press, 208 p.

Mathieson, S.A., 1981, Pre- and Post-Sangamon glacial history of a portion of Sierra and Plumas counties, California: California State University, Hayward, M.S. Thesis, 258 p., plate 1, scale 1:24,000.

McAllister, C.A., 1985a, A reconnaissance study of CO2-bearing fluid inclusions in the Mother Lode belt, California: California State University, Fresno, Geology 290 Independent Study Project, Fall Semester, unpublished manuscript, 170 p.

McAllister, C.A., 1985b, An overview of the Mother Lode system of California: California State University, Fresno, Geology 290 Independent Study Project, Spring Semester, unpublished manuscript.

McAllister, C.A., 1990, The Pine Tree and Josephine mines of the southern Mother Lode, Mariposa County, California: Mining history, geology, and a fluid inclusion study applied to gold exploration: M.S. thesis, Department of Geology, California State University, Fresno, 265 p.

McAllister, C.A., and A.H. Barabas, 1990a, Geology, ore deposits, and modern mining history of the Pine Tree-Josephine property, Bagby District, southern Mother Lode, California, in Landefeld, L.A. and G.G. Snow, editors, Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 125-145. p.

McAllister, C.A., and A.H. Barabas, 1990b. History of the Las Mariposas Grant and the Pine Tree and Josephine mines (1850-1933), in Landefeld, L.A. and G.G. Snow, editors, Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 83-86.

McLaughlin, D.H., 1933, The Pine Tree and Josephine Mines, Mariposa County, California: Unpublished report to B. M. Baruch, October 17,1933.

McNeal, D.W., 1990, Vegetation of the central Sierra Nevada Foothills with comments on the San Joaquin Valley and Yosemite, in Landefeld, L.A., and G.G. Snow, editors, Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 95-103.

Meyer, C., and J.J. Hemley, 1967, Wall rock alteration, in Barnes, H. L., ed. Geochemistry of hydrothermal ore deposits: New York, Holt, Rinehart and Winston, Inc., p. 167-235.

Miller, J., 1982, Stratigraphy, structure, and metamorphism of the Calaveras complex in part of Amador and Calaveras counties, California: Unpublished M. S. thesis, University of California, Santa Cruz, 94 p, map, scale 1:24,000.

Morgan, B.A, 1976, Geology of Chinese Camp and Moccasin quadrangles, Tuolumne county, California: U. S. Geological Survey Miscellaneous Field Studies map MF-840, scale 1:24,000.

Murphy, T.P., 1985, Structure and stratigraphy of the Clipper Mills area, northern Sierra Nevada, California: University of California, Davis, M.S. Thesis, 223 p., plate 1, scale 1:24,000.

Nadeau, R., 1965, Ghost towns and mining camps of California: A history and guide: Santa Barbara, Crest Publishers, 278 p.

Nadeau, R., 1974, The real Joaquin Murieta: Corona del Mar, California, Trans-Anglo Books, 160 p.

Nokleberg, W.J., 1975, Structural analysis of a collision between an oceanic plate and a continental plate

preserved along the lower Kings River in the Sierra Nevada: Geological Society of America Abstracts with Programs, v. 7, part. 3, p. 357-358.

Nokleberg, W.J., 1983, Wall rocks of the central Sierra Nevada batholith, California: A collage of accreted tectono-stratigraphic terranes: U. S. Geological Survey Professional Paper 1255, 28 p.

Norris, R.M., and R.W. Webb, 1990, Geology of California (2nd ed.): New York, John Wiley and Sons, 541 p.

Northgate Exploration Limited, 1988, Annual Report.

Olmsted, F.H., 1971, Pre-Cenozoic geology of the south half of the Auburn 15-minute quadrangle, California, U.S. Geological Survey Bulletin 1341, 30 p., Plate 1, scale 1:48,000. Modifications in Cenozoic deposits from Bartow J.A. and E.J. Helley (1979).

Pacific Mining Company, 1934a -1941, Annual Reports (First through Eighth).

Pacific Mining Company, 1934b, Plan map of Josephine Mine, tracing of 1901 map: Unpublished map, scale 1:480.

Palmer, A.R., 1983, The decade of North America geology 1983 geologic time scale: Geology, v. 11, p. 503-504

Paterson, I.A. and T.F. Redfield, 1984, Finite strains and structures across the Melones Fault zone near Moccasin, California, Geological Society of America Abs. w. Programs. v. 16: 619.

Paterson, S.R. and W.D. Sharp, 1991, Comparison of structural and metamorphic histories of terranes in the Western Metamorphic belt, Sierra Nevada, California, in Sloan, D., and Wagner, D. L., eds., 1991, Geologic excursions in northern California: San Francisco to the Sierra Nevada: California Division of Mines and Geology, Special Publication 109, p. 113-130.

Paul, R.W., 1947, California gold: The beginning of mining in the Far West: Lincoln, University of Nebraska Press, 380 p.

Phillips, C.C., 1942, Coulterville chronicle: The annals of a Mother Lode mining town: San Francisco, The Grabhorn Press, 275 p. (Republished, 1978, by Valley Publishers, Fresno).

Pinkerton, S. and L. Radanovich, 1989, Mariposa County Courthouse: Mariposa, Mariposa Heritage Press, 92 p.

Preston, W.L., 1981, Vanishing landscapes: Land and life in the Tulare Lake basin: Berkeley, University of California Press, 278 p.

Prichard, W.A., 1904, Observations on Mother Lode gold deposits, California: American Institute of Mining Engineers Transactions, v. 34, p. 454-466.

Ransome, F.L., 1898, Some lava flows of the western slope of the Sierra Nevada, California: U. S. Geological Survey Bulletin 89, 74 p.

Ransome, F.L., 1900, Mother Lode District Folio, California: U. S. Geological Survey Atlas of the United States, Folio 63, 11 p., scale 1:63,360.

Raymond, R.W., 1869, Mineral resources of the states and territories west of the Rocky Mountains, 1st

Annual Report for 1868: Washington, D.C., U.S. Treasury Department of Statistics of Mines and Mining, U.S. Government Printing Office, p. 12-15.

Raymond, R.W., 1871, Mineral resources of the states and territories west of the Rocky Mountains, 1st Annual Report for 1870: Washington, D.C., U.S. Treasury Department of Statistics of Mines and Mining, U.S. Government Printing Office, p. 29-33.

Rolle, A.F., 1963, California - A History: New York, Thomas Y. Crowell, 649 p.

Saleeby, J.B., 1982, Polygenetic ophiolite belt of California Sierra Nevada: geochronological and tectonostratigraphic development: Journal of Geophysical Research, v. 87, p. 1803-1824.

Saleeby, J.B., Geary, E. E., Paterson, S. R., and Tobisch, 0. T., 1989, Isotopic systematics of Pb/U (zircon) and $^{40}Ar/^{39}Ar$ (biotite-hornblende) from rocks of the central Foothills terrane, Sierra Nevada, California: Geological Society of America Bulletin, v. 101, no. 11, p. 1481-1492.

Sangwan, B., 1986, The complete Gold Country guidebook: Tahoe City, California, Indian Chief Publishing House, 136 p.

Sargent, S., 1976, Mariposa County guidebook: Yosemite, California, Flying Spur Press, 37 p.

Saucedo, G.J. and D.L. Wagner, 1992, Geologic Map of the Chico Quadrangle, California Division of Mines and Geology, Map 7A.

Schweickert, R.A., 1981, Tectonic evolution of the Sierra Nevada Range, *in* Ernst, W.G., ed., The geotectonic development of California, Rubey Volume 1: Englewood Cliffs, New Jersey, Prentice-Hall, p. 87-131.

Schweickert, R.A., 1988, Pre-Cretaceous crustal evolution in the Sierra Nevada region, California, *in* Ernst, W. G., ed., Metamorphism and crustal evolution of the western United States, Rubey Volume Vll: Englewood Cliffs, New Jersey, Prentice-Hall, p. 823-864.

Schweickert, R.A., and N.L. Bogen, 1983, Tectonic transect of Sierran Paleozoic through Jurassic accreted belts: Society of Economic Paleontologists and Mineralogists, Pacific Section, Volume and Guidebook, 22 p.

Schwickert, R.A. and R.E. Hanson, 1984, Geologic map of the Sierra City 15-minute quadrangle, Sierra and Nevada counties, California: U.S. Geological Survey (in preparation), scale 1:62,500. Additions and modifications in the Clio 7.5-minute quadrangle from: California Department of Water Resource (1963). Minor additions in the Gold Lake 7.5-minute quadrangle from: Varga (1980). Modifications to glacial deposits from Mathieson (1981).

Schweickert, R.A., C. Merguerian and N.L. Bogen, 1988, Deformational and metamorphic history of Paleozoic and Mesozoic basement terranes in the western Sierra Nevada metamorphic belt, *in* Ernst, W. G., ed., Metamorphism and crustal evolution of the western United States, Rubey Volume Vll: Englewood Cliffs, New Jersey, Prentice-Hall, p. 789-822.

Schweikert, R.A., D.S. Harwood, G.H. Girty and R.E. Hanson, 1984, Tectonic development of the northern Sierra terrane: an accreated late Paleozoic island arc and its basement (Field Trip 5), in Lintz, J., Jr. (editor), Western Geological Excursions: Geological Society of America Annual Meeting, Reno, v. 4., p. 1-65, figure 2, scale approximately 1:520,000, figure 5, scale approximately 1:272,000.

Sharp, W.D., 1980, Ophiolite accretion in the northern Sierra: EOS (American Geophysical Union Transactions), v. 61, p. 1122.

Sharp, W.D., 1984, Structure, petrology and geochronology of a part of the central Sierra Nevada foothills Metamorphic belt, California: Unpublished Ph.D. thesis, University of California, Berkeley, 183 p.

Sharp, W.D., 1988, Pre-Cretaceous crustal evolution in the Sierra Nevada region, California, in Ernst, W. G., ed., Metamorphism and crustal evolution of the western United States, Rubey Volume Vll: Englewood Cliffs, New Jersey, Prentice-Hall, p. 823-864.

Sharp, W.D., and Spangler, R., 1985, New constraints on the origin and nature of the Melones fault zone: Geological Society of America Abstracts with Programs, v. 17, p. 361.

Sheeks, D.I., 1977, Geologic map of a portion of the Quincy, Spring Garden, Onion Valley, and Blue Nose Mountain quadrangles, Plumas County, California: University of California, Davis, unpublished mapping, scale 1:24,000. Thrust fault and melange unit within the Shoo Fly Complex from Schweickert et al. (1984).

Slavik, G., editor, 1985, Geologic cross section across the southern Mother Lode belt (Harvard Mine, Royal-Mountain King Mine, Gold Cliff Mine): Geological Society of Nevada, 1985 Spring Meeting and Field Trip Road Log, 56 p.

Smith, T.K., R.C. Loyd and H.W. Schull, 1987, Precious metal deposits of the central California Coast Range and Sierra Nevada Foothill region, in Johnson, J. L, ed., Bulk mineable precious metal deposits of the western United States, Guidebook for field trips, Geologic Society of Nevada, p. 178-196.

Snow, G.G., 1990, Some elaboration on the story of the Gold Rush, in Landefeld, L.A. and G.G. Snow, editors, Guide to Yosemite and the Mother Lode gold belt: Geology, tectonics, and the evolution of hydrothermal fluids in the Sierra Nevada of California: Pacific Section, American Association of Petroleum Geologists, Guidebook 68, p. 78-81.

Spence, M.L., and D. Jackson, editors, 1973, The expeditions of John Charles Fremont, v. 2. The Bear Flag Revolt and the court-martial: Urbana, University of Illinois Press, 519 p.

Spence, M.L., ed., 1984, The expeditions of John Charles Fremont, v. 3. Travels from 1848 to 1854: Urbana, University of Illinois Press, 641 p.

Springer, R.K., 1981, Geologic report on the Ber River area, northeast of Auburn, California: Unpublished maps and report for the Division of Mines and Geology Data Base Augmentation Program, 26 p., scale 1:24,000.

State of California, Dept. Parks and Recreation, 1985, Columbia State Historic Park, 11 p.

Stern, T.W., P.C. Bateman, B.A. Morgan, M.F. Newell, and D.L. Peck, 1981, Isotopic U-Pb ages of zircon from the granitoids of the central Sierra Nevada, California, U.S. Geological Survey Professional Paper 1185, 17 p.

Stinson, M.C., 1961, Reconnaissance geologic map of the Sierraville 15-minute quadrangle, California: California Division of Mines and Geology unpublished mapping for the State Map Project, scale 1:62,500. (Additions and modifications by G.J. Saucedo with field assistance from C.W. Jennings and J.D. Morganthaler, 1983). Other modifications and additions from California Department of Water Resources (1963).

Storms, W.H., 1900, Mother Lode region of California, California Mining Bureau Bulletin 18, p. 154.

Strand, R.L., Geology of a portion of the Blue Nose Mountain Quadrangle and adjacent areas, Plumas and

Sierra counties, California: University of California, Davis, M.S. thesis, 86 p., plate 1, scale 1:24,000.

Stromquist, A.A. and D.B. Tatlock, 1963, Geologic map of the San Andreas quadrangle, Calaveras County, California, U.S. Geological Survey Geologic Quadrangel Map GQ-222, scale 1:62,500.

Taliaferro, N.L. (and summer field classes), 1950, Geologic map of the Sutter Creek quadrangle, University of California, Berkeley, unpublished map, scale 1:62,500; Modified to conform with stratigraphy of Clark, L.D. (1964).

Taliaferro, N.L, F. Frederick, M.W. Cox and J. Lorenz, 1930, Geologic map of the Indian Gulch quadrangle, California: unpublished mapping of U.C. Berkeley field classes, scale 1:62,500. Modifications for Sonora Fault from Schweickert and Bogen (1983). Fault in southwest part of area from unpublished maps by Paterson S.R. and O.T. Tobisch, University of California, Santa Cruz, scale 1:62,500.

Taliaferro, N.L. and A.J. Solari, 1949, Geology of the Copperopolis quadrangle, California, Cal. Division. Mines and Geology Bulletin 145, Plate 1, scale 1:62,500

Taylor, B., 1949, Eldorado or adventures in the path of empire: New York, Alfred Knopf, 375 p. (originally published in 1850)

Taylor, G.C., 1979, Geological reconnaissance of the north half or the Auburn 15-minute quadrangle: unpublished field study for the State Map Project, scale 1:62,500; geology modified from Lindgren and Turner (1894, Placerville Folio) and from Bartow and Helley (1979).

Tobisch, O.T., S.R. Paterson, J.B Saleeby, and E.E. Geary, 1989, Nature and timing of deformation in the Foothills terrane, central Sierra Nevada, California: its bearing on orogenesis: Geological Society of America Bulletin, v. 101, no. 3, p. 401-413.

Tucker, W.B., 1915, Tuolumne County: California Mining Bureau [State Mineralogist's] Report 14, p. 132-172.

Turner, H.W., 1894, Geological Atlas of the United States, Jackson Folio, California: U.S. Geological Survey Folio 11, 6 pages and 4 plates, scale 1:125,000.

Turner, H.W., 1897, Geological Atlas of the United States, Downieville Folio, California: U.S. Geological Survey Folio 37, scale 1:125,000. (Modifications to Quaternary contact in the Quincy 7.5-minute quadrangle by G.J. Saucedo, 1985).

Turner, H.W. and F.L. Ranson, 1987, Geologic Atlas of the United States, Sonora Folio, California: U.S. Geological Survey Folio 41, scale 1:125,000.

Twain, Mark, 1913, Pocket mining, *in* Roughing It: New York, Harper and Brothers, p. 179-184.

Varga, R.J., 1980, Structural and tectonic evolution of the early Paleozoic Shoo Fly Formation, northern Sierra Nevada Range, California: University of California, Davis, Ph.D. dissertation, 248 p., plate 1, scale approximately 1:17,124.

Viola, H.J., 1987, Exploring the West: Washington, D.C., Smithsonian Books, 256 p.

Wagner, D.L., 1979, Geologic reconnaissance of the Georgetown 15-minute quadrangle: unpublished mapping for State Map Project, scale 1:62,500. Geology modified form Lindgren and Turner (1894, Placerville Folio) and Woodward-Clyde Consultants (1977).

Wagner, D.L., E.J. Bortugno and R.D. McJunkin, 1991, Geologic map of the San Francisco-San Jose quadrangle, Cal. Division. mines and Geologic., Map 5A.

Wagner, D.L., C.W. Jennings, T.L. Bedrossian and E.J. Bortugno, 1981, Geologic map of the Sacramento quadrangle, Calif. Division. mines and Geologicl., Map 1A.

Wagner, J.R., 1970, Gold mines of California: San Diego Mines and Geology Bulletin 145, Plate 1, scale 1:62,500.

Wagner, J.R., 1970, Gold mines of California: San Diego, Howell-North Books [now Bakersfield, Howell North-Darwin Superior], 259 p.

Weir, R.H., Jr. and D.M. Kerrick, 1987, Mineralogic, fluid inclusion, and stable isotope studies of several gold mines in the Mother Lode Tuolumne and Mariposa Counties, California: Economic Geology, v. 82 no. 2, p. 328-344.

White, B., 1968, JC students dig into 110 year-old fort mystery: The Modesto Bee, January 7, 1968, p. C4.

Whitmore, D.R.E., L.G. Berry, and J.E. Hawley, 1946, Chrome micas: American Mineralogist, v. 31, p. 1-21.

Woodward-Clyde Consultants, 1977, Earthquake evaluation studies of the Auburn dam area, v.2, Appendix B, Figure B-2, "Fault in SW1/4 of Georgetown 15-minute quadrangle."

Woodward-Clyde Consultants, 1978, Stanislaus nuclear project site suitability and site safety report prepared for Pacific Gas and Electric Company, v.6, Appendix C, fig. C. 4-4. Minor modifications by Wagner, D.L. 1984.

Yeend, W.E., 1974, Gold bearing gravel of the ancestral Yuba River, Sierra Nevada, California: U.S. Geological Survey Professional Paper 772, 44p., plate 1, scale 1:65,500. Modifications from Lindgren (1900), and Lindgren et al. (1895).

Young, O.E., Jr., 1970, Western mining: An informal account of precious metals prospecting, placering, lode mining, and milling on the American frontier from Spanish times to 1893: Norman, University of Oklahoma Press, 342 p.

Zimmerman, J.E., 1983, The geology and structural evolution of a portion of the Mother Lode Belt, Amador County, California: Unpublished M. S. thesis, University of Arizona, 138 p.