# A Historical Context and Archaeological Research Design for Mining Properties in California

Prepared by
The California Department of Transportation
Sacramento, California
2008

Caltrans

Cover Photos: Woman Miner at the Kendon Pit, Mono County, 1930;
African American Miners at the Andrade Dredge Mine, California;
Cornish Miners on Skip at the Empire Mine, Grass Valley, 1900
(used with permission, California State Department of Conservation, California Geological Survey).

Cite as: California Department of Transportation.
Historical Context and Archaeological Research Design for Mining Properties in California.
Division of Environmental Analysis, California Department of Transportation, Sacramento, CA. 2008.

For individuals with sensory disabilities, this document is available in alternate formats upon request.

Please call:
(916) 653-0647 Voice, or use the CA Relay Service TTY number 1-800-735-2929

or write:
Chief, Cultural and Community Studies Office
Caltrans Division of Environmental Analysis
P.O. Box 942874, MS-27
Sacramento, CA 94274-0001

# MANAGEMENT SUMMARY

The California Department of Transportation (Caltrans), in cooperation with the Federal Highway Administration, California Division, and the California State Historic Preservation Officer (SHPO), prepared this thematic study to assist with evaluating the information potential of mining properties in California, that is, for their eligibility for the National Register of Historic Places under Criterion D. To be eligible under Criterion D, National Register guidance states that a property must have, or have had, information to contribute to our understanding of human history or prehistory, and the information must be considered important. An integral part of this study is the development of a research design. The archaeological research design explicitly demonstrates the connection between the information a property contains and important research issues or questions associated with a particular property.

While this document provides a framework for evaluating most types of mining properties found in California, it is not a comprehensive history of mining in the state nor does it satisfy the requirements of site-specific research. This study is intended to serve as both an analytical tool and a methodological framework to interpret and evaluate properties associated with the theme of mining in terms of their ability to yield important information. Researchers should also consider carefully whether additional National Register criteria may apply to individual sites, although those other possible values are not discussed in this study.

The historic context presented here is a broad overview that addresses the major themes in California's mining history during the period from statehood in 1850 to circa America's entrance into World War II. Future researchers are encouraged to use this context as a starting point when assessing the National Register values of a mining property.

Archaeological evidence collected during previous studies suggests that mining properties have the potential to address the following research themes within a contextual or interpretive approach: technology, historical ethnography/cultural history, ethnicity and culture, women and family, economy, and policy. Research is not necessarily limited to these themes, however, and individual researchers may follow other theoretical approaches or find alternative research themes relevant to specific sites. In addition, this document includes an implementation plan that advocates specific methods to follow when assessing the information value of mining properties, in an effort to improve consistency and thereby facilitate better inter-site comparisons.

Any questions or comments on this study should be directed to the Chief, Cultural and Community Studies Office, Division of Environmental Analysis, MS 27, P.O. Box 942874, Sacramento, CA 94274-0001.

## ACKNOWLEDGEMENTS

An interdisciplinary team of consultants prepared the initial draft of this document. The Anthropological Studies Center (ASC) at Sonoma State University was the coordinating institution, with Mary Praetzellis acting as the project manager. The team consisted of Julia G. Costello of Foothill Resources, Ltd., Rand F. Herbert of JRP Historical Consulting Services, LLC (JRP), and Mark D. Selverston of the ASC, with contributions by Judith D. Tordoff of Caltrans. Shawn Reim of JRP also provided valuable assistance in preparing the initial draft of the review of recent articles on mining related topics. The study was prepared under the overall direction of Greg King, Chief of the Caltrans Cultural and Community Studies Office, with Anmarie Medin acting as the Project Manager assisted by Kimberly Wooten.

Because the contracted scope of work limited the breadth of the study, Caltrans staff augmented the consultant-prepared report. Primary authors for Caltrans included Dana Supernowicz, Richard Levy, and Anmarie Medin, with assistance from Julia Huddleson, Thad Van Bueren, and Kimberly Wooten. Ed Carroll and Tory Swim, Sacramento State Public History program graduate students, contributed to the second draft of this document.

The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716) state that historic contexts should be constructed by an interdisciplinary process that considers the comments of the interested public and scholars. To facilitate public comment and peer input, the authors presented their approach in symposia at the 2006 annual conference of the California Council for the Promotion of History. A similar presentation was made at the Society for California Archaeology's 2006 northern data-sharing meeting. A review draft was posted online and comments were received from professionals in the cultural resources field. The Mining HARD was also discussed in a session on thematic studies at the 2008 Society for Historical Archaeology conference.

Caltrans facilitated peer review by historians and historical archaeologists for both drafts, which included reviews by Steven Mulqueen of the California State Lands Commission and Margaret Hangan of the Cleveland National Forest. Caltrans staff reviewing this study included Dicken Everson, Blossom Hamusek, Julia Huddleson, Greg King, Richard Levy, Anmarie Medin, Steve Ptomey, Dana Supernowicz, Karen Swope, Judy Tordoff, Thad Van Bueren, Tom Wheeler, and Kimberly Wooten.

This mining study is the second in the Caltrans historical archaeology thematic studies series. At FHWA, Stephanie Stoermer oversaw the first efforts to establish this thematic studies series and Gary Sweeten continued to provide management perspective. At the OHP, Deputy SHPO Steve Mikesell has been involved from the project’s inception and project review unit staff members have provided valuable input throughout the process of compiling this set of thematic studies.

We would also like to thank geologist and educator George Wheeldon, for the use of his digital images of mining in California, and Gary Taylor, California Department of Conservation, California Geological Survey, for the use of digital images from the department’s “California Gold Mines: A Sesquicentennial Photograph Collection.”

## TABLE OF CONTENTS

## TABLES



## FIGURES

## APPENDICIES

# CHAPTER 1. INTRODUCTION

The purpose of this research design is to provide general guidance for evaluating historic-era mining sites, specifically their data potential. It includes a historic context outlining important periods of mining history in California, identification of property types, and important research themes and questions relevant to mining sites. Due to the range of natural resources in California, the scope of this document is necessarily limited to the mining of metals and related archaeological sites. Mining sites are defined here as those sites containing evidence of metals-mining activities.

The period of study is 1848 to circa 1940. The minor and spatially limited mining that took place during the pre-gold rush period in California is not the subject of this context. While this study is intended to help evaluate properties up to 1940, the historic context discusses minerals mining into the mid-century to provide some additional perspective. Examples of site types this study may help evaluate include, but are not limited to, mines, mills, shafts, adits, prospects, and placer-mining sites. These sites may include processing equipment, ruins of mine buildings and/or miners' habitations, scatters of equipment or mining debris, trash associated with the miners' occupation of the site, and other related items. Where standing structures are extant (mills, headframes, support buildings), they should be considered for both their potential contributions to research and for their eligibility under other criteria. These are properly considered as historic architectural resources that, in addition to being addressed as features of the mining operation, also need to be evaluated on Department of Parks and Recreation (DPR) Building/ Structure/ Object forms by a qualified architectural historian. These architectural resources may also have a historical archaeological component.

The property types addressed in this report are related to the processes associated with extraction and beneficiation of precious and non-precious minerals or metals. The focus of this study, however, is on those minerals whose properties were such that they were industrially mined and either individually or collectively assumed an important role in local, state, regional, or national economies. *Mineral Commodities of California* (Wright 1957b) lists a total of seventy-seven commodities which are present in California. Of the seventy-seven commodities, nineteen are the focus of this report.[1] They include barium (barite), borates, chromite, coal, copper, feldspar, gold, lead, limestone, manganese, magnesite, mercury, pyrites, silver, strontium, sulfur, talc and soapstone, tungsten, and zinc. Appendix A lists major mines in the state for focus commodities while Appendix B provides information on all 77 commodities.

[1] The following commodities occur in California, but their production was limited: aluminum, antimony, arsenic, asbestos, beryllium, bismuth, black sands, calcite, cobalt, fluorspar, graphite, iron industries, kyanite and andalusite, mica, nickel, nitrogen compounds, phosphate, thorium, tin, titanium, and vanadium. In addition, other mineral commodities were excluded because they were not produced commercially prior to 1940 and thus fall outside the scope of this study. These include uranium, pyrophyllite, quartz crystal (electronic grade), rare earth elements and molybdenum. Also excluded were commodities used primarily in the construction industry including asphalt and bituminous rock, cement, clay, gypsum, pumice, pumicite, perlite, volcanic cinders, quartzite and quartz, sand and gravel, expansible shale, crushed and broken stone, and dimension stone. Other commodities were excluded because they were recovered from salts and bittern, such as bromine, iodine, lithium compounds, salines, salt, sodium sulfate, sodium carbonate, and calcium chloride. Still others were excluded because they are byproducts of the refinement process, including cadmium and platinum. Some commodities were excluded because the processes by which they are recovered bear little resemblance to mining, such as peat, gem stones, natural gas, petroleum, abrasives, diatomite, and specialty sands.

This document is divided into five chapters:

- Chapter 1 consists of this introduction, which outlines the document's purpose, authorship, structure, and theoretical orientation.
- Chapter 2 contains the historic context, a synthetic narrative describing the significant broad patterns of mining development in California that may be represented by historic properties.
- Chapter 3 describes archaeological property types created by the processes presented in Chapter. These are the features that archaeologists encounter in the field.
- Chapter 4 consists of a review of current scholarship to identify scholarly themes and develop specific research questions that information from mining sites might be able to address.
- Chapter 5 offers an implementation plan that presents standardized methods that will enhance comparative research and guide evaluation under Criterion D. Data requirements and issues of integrity are addressed here.

## RESEARCH DESIGN SERIES

This study is one of a series of statewide, thematic archaeological research designs developed by the California Department of Transportation (Caltrans). Its purpose is to help archaeologists assess the importance of historic-era archaeological sites commonly encountered on Caltrans projects. Caltrans has produced, or is producing, other volumes in this series, cited throughout this study as *Agriculture*, *Townsites*, and *Work Camps* thematic studies. The Agriculture study was finalized in 2007 and is posted on the Caltrans Division of Environmental Analysis web page (www.dot.ca.gov/ser/guidance.htm#agstudy). The Town Sites and Work Camps studies are currently in draft form and are being finalized by Caltrans. Table 1 contains a list of historic-era archaeological features and indicates in which volume each is addressed.

The series grew out of Caltrans' long-term efforts to improve the process of site-specific research and evaluation as well as the California State Historic Preservation Officer's recommendation that the agency improve how historical archaeology is conducted in the context of Section 106 of the National Historic Preservation Act. This statute requires that federal agencies take into account the effects of their undertakings on properties listed on or eligible to the National Register of Historic Places (NRHP).

It is important to note that this Mining Sites Research Design is concerned with NRHP Criterion D, under which properties may be eligible for listing if they have "yielded, or may be likely to yield, information important in prehistory or history" (36 CFR 60.4[d]). The historic context approach to site identification and recommended procedures for recording mining sites should be useful to both historians and archaeologists.

## THE NATIONAL REGISTER EVALUATION PROCESS UNDER CRITERION D

To be eligible for listing in the NRHP, a mining property must be significant in American history, architecture, engineering, or culture and possess integrity of location, design, materials, workmanship, feeling, setting, and association. In addition, the mining property must meet one or more of the four National Register criteria:

A. be associated with events that have made a significant contribution to the broad patterns of our history; or
B. be associated with the lives of persons significant in our past; or
C. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possesses high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. have yielded, or may be likely to yield, information important in prehistory or history.

All researchers should carefully consider which of the other NRHP criteria in addition to D might also be applicable to the property they are evaluating. This document specifically addresses how to evaluate mining sites under Criterion D, incorporating five basic steps defined by Little and Seibert (2000:14):

1. Determine site structure, content, and classes of data it may contain.
2. Identify the appropriate historic context by which to evaluate it.
3. Identify important research themes and questions that the data it contains may be able to address.
4. Considering the property's integrity, structure, and content, assess whether the data it contains are of sufficient quality to address these important research issues.
5. Identify the important information that the property is likely to contain.

Archaeological properties are evaluated within an appropriate historic context defined by theme, place, and time period. Chapter 2 of this document presents a historic context for mining sites in California between 1848 and 1940, beginning at the gold rush and ending just before America's entry into World War II. It can provide the basis of a context statement for evaluation, but must be supplemented by property-specific research to provide the relevant focus. The National Park Service's Revised Thematic Framework, *History in the National Park Service: Themes and Concepts,* offers eight themes and many sub-themes that are useful for developing historic contexts for specific properties (NPS 1996). The historic context is linked to an individual property by property types—groupings of individual properties that have shared physical characteristics or associations. Property types are discussed in Chapter 3. To make the connection between specific archaeological resources and the property types identified in the historic context, Donald Hardesty (1988) developed the concept of "feature system:" a cluster of archaeological features that are the products of an identifiable process or activity. This approach focuses the evaluation effort onto historically significant units.

To be eligible to NRHP under Criterion D, a property must both contain information that can contribute to our understanding of some aspect of human history *and* the information must be considered important. Research themes and associated questions that can be applied to specific property types are specified in Chapter 4.

Archaeological facts are not intrinsically valuable; they achieve importance in relation to their ability to advance our understanding of human history. We can define what constitutes important information by reviewing current scholarship in disciplines such as history, geography, anthropology, and archaeology. As change in research orientation is a normal part of social science, important issues are moving targets that must be frequently reassessed. We recommend that historical archaeologists consider both the scientific and humanistic contributions of the discipline as they design and conduct their work. Some questions have definitive answers, such as those designed to gather base-line information about the structure, content, and integrity of a property. Some questions will have less conclusive or quantifiable answers, as they are designed to help incrementally reveal large-scale historical and cultural processes significant or important in our history. Individual properties often contribute by illustrating how a diversity of processes played out in specific contexts, deepening our understanding of their effects on Californians in the past.

To be eligible to the NRHP an archaeological site must be able to convey its significance to those for whom it has value. In the case of Criterion D, these are scholars and others who may seek to use the information the site contains. The ability of a property to convey this information is measured by assessing its integrity. The appraisal of integrity accompanies an assessment of significance: significance + integrity = eligibility. This topic is discussed in Chapter 4.

Applying the NRHP criteria for evaluation is a complex undertaking. It requires that researchers follow a set process and understand certain professional standards and practices. The NRHP Bulletin series is an essential reference. Of particular importance are Bulletin 15 *How to Apply the National Register Criteria for Evaluation* (NPS 1991) and Bulletin 36 *Guidelines for Evaluating and Registering Archeological Properties* (Little and Siebert 2000). Bulletin 42 *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties* offers essential information as well (Noble and Spude 1997). All are available online at http://www.cr.nps.gov/nr. Donald Hardesty and Barbara Little's book *Assessing Site Significance: A Guide for Archaeologists and Historians* (2000) offers practical advice and many informative case studies.

## THE CALIFORNIA REGISTER OF HISTORICAL RESOURCES

The eligibility criteria for the California Register of Historical Resources (CRHR) closely follow those of the NRHP, although some properties that are ineligible to the latter may qualify for the CRHR (Office of Historic Preservation 2001:ii). The Caltrans series of research designs may be used to help evaluate properties' eligibility to the CRHR for the purposes of CEQA within the requirements of the Register's implementing regulations at CCR Section 4850 et seq.

## USING THIS DOCUMENT FOR SECTION 106 CONSULTATION

Caltrans' ultimate goal in producing this document is to streamline eligibility determination consultations with the SHPO under Section 106. To that end, researchers are encouraged to cite relevant sections of this document and apply specific research questions that relate to the mining property being evaluated.

California SHPO staff reviewed early drafts of this study, commented on its fundamental scope, and find it provides useful guidance when assessing information values of mining-oriented historical archaeological sites. However, as with all guidance, the SHPO staff will review individual submittals for appropriate application of research questions contained herein as well as for appropriate application of the recommended methods. The individual researcher must explain how the selected research questions apply to the site being evaluated; that is, what information is contained within the individual site and why it is important. As stated elsewhere in this document, other theoretical orientations, research issues, or individual research questions not discussed herein may be identified as relevant to the site under study. If so, those other items would require an appropriate level of development for SHPO consultation.

## INDEX TO STUDIES

As an aid in using these documents, Table 1: Index to Property Types in Thematic Studies provides an index to many of the property types that appear in the thematic studies series Caltrans is producing. A number one in the table indicates the thematic study or studies where this property type is primarily discussed and the appropriate volume to turn to for research. A number two indicates a secondary discourse, where a property type is discussed, but perhaps to a lesser degree. As of the publishing of this mining study, both the *Townsite* and *Work Camps* thematic studies are in draft form.

**Table 1: Index to Property Types in Thematic Studies**

(Note: 1 indicates the highest applicability of a study to a property type; 2 indicates secondary applicability of a study to a property type).

| Property Type Category | Property Type | Agriculture | Mining | Townsites | Work Camps |
|---|---|---|---|---|---|
| Residential structure | House (e.g. basement, cellar) | 1 | 2 | 1 | 2 |
| | Boardinghouse | - | 2 | 1 | - |
| | Hotel | - | 2 | 1 | - |
| | Bunkhouse | 1 | 2 | - | 1 |
| | Lean-to/tent | - | 2 | - | 1 |
| | Improvised (e.g. boxcar, dug-out) | - | 2 | - | 1 |
| Vertical interfaces, hollow-filled features: Artifact caches (domestic, business, industrial) | Privy, pit, well | 1 | 2 | 1 | 2 |
| Horizontal interfaces, fill layers: Artifact accumulation (domestic, business, industrial) | Sheet refuse | 1 | 2 | 1 | 1 |
| Gardens, yards, landscapes (private) | | 1 | 1 | 1 | 2 |
| Activity buildings/structures | Line camp | - | - | - | 1 |
| | Shed | 1 | 2 | - | 1 |
| | Blacksmith shop | 1 | 2 | 1 | 2 |
| | Barn | 1 | - | 2 | 1 |
| | Corral | 1 | 2 | 2 | 1 |
| | Stable | 1 | 2 | 2 | - |
| | Bake oven/outdoor kitchen | 1 | 1 | - | 2 |
| Placer tailing piles | | - | 1 | - | - |
| Cut banks, channels, tailings | | - | 1 | - | - |
| River diversions | | - | 1 | - | - |
| Dredge tailings | | - | 1 | - | - |
| Equipment mounts/foundations | | - | 1 | - | 2 |
| Headframes (collapsed) | | - | 1 | - | - |
| Adits and tailings | | - | 1 | - | - |
| Retaining walls/platforms | | - | 1 | 2 | 2 |
| Tramways/tracks | | - | 1 | - | 2 |

**Table 1: Index to Property Types in Thematic Studies (continued)**

| Property Type Category | Property Type | Agriculture | Mining | Townsites | Work Camps |
|---|---|---|---|---|---|
| Prospect pits and surface vein working | | - | 1 | - | - |
| Waste rock piles | | - | 1 | - | - |
| Shafts and adits | | - | 1 | - | - |
| Underground workings | | - | 1 | - | - |
| Open pit mines | | - | 1 | - | - |
| Ore processing industrial structures/buildings | Arrastra, foundation, pad, machine mount | - | 1 | - | - |
| Ore processing tailings | | - | 1 | - | - |
| Transportation, private (activity specific) | Road, trail, railway | - | 2 | 2 | 2 |
| Transportation, intrasite | Road, trail, railway | - | 2 | 2 | 2 |
| Transportation, extrasite | | - | 2 | 2 | 2 |
| Water-conveyance systems, intrasite | Ditch, drain | - | 1 | - | 2 |
| Electrical utilities | Generation and transmission feature | - | 2 | - | 2 |
| Public infrastructure building | School, church, hospital | - | - | 1 | 2 |
| | Office, dining hall, cookhouse, showers, bunkhouse | 2 | 2 | 2 | 1 |
| Refuse dumps (municipal, not household/activity specific) | | - | - | 1 | 1 |
| Townsite creation features | Fill, levee, terrace, waterway | - | - | 1 | - |
| Townsite infrastructure features | Sewer, water, | - | - | 1 | - |
| Industrial buildings/structures | Forge, casting floor | - | 1 | 1 | 2 |
| Industrial processes byproducts | Waster, raw materials, refuse | - | 2 | 1 | 2 |
| Mercantile building | Shop, warehouse | - | 2 | 1 | - |
| Mercantile activities | Merchandise/stock | - | 2 | 1 | - |
| Service business building/structure | Laundry boiler/drying rack | - | - | 1 | - |
| Service business byproducts | Laundry boiler waste, food waste | - | - | 1 | - |

# CHAPTER 2. HISTORICAL CONTEXT

## INTRODUCTION

Metals mining fundamentally shaped California's early economy, culture, and politics. Gold and silver mines pumped millions of dollars into the state during the mid- to late-nineteenth century in a manner that was unique in the American west and central to the state's development. Later industries such as agriculture provided additional development of the state and its economy, but it was the gold rush and influx of people that transformed California from a Mexican province to a state important in the world economy. While it is recognized that mining was foremost an extractive industry that had disastrous effects on the environment, the remains of this industry provide archaeological data on a wide array of important research questions as well as providing a physical reminder of the state's history. Notwithstanding the negative effects created by California's mining industry, the state's mining history had a profound influence on immigration and emigration, and fostered the creation of numerous towns and communities.

The American mining frontier represents a mosaic of cultural and technological landscapes reflecting a diverse range of economic influences, from local to international. As historical archaeologist and mining historian Donald Hardesty explains:

> Mining colonies were financed, manned, and supplied from the urban centers of America and Europe. Despite their geographical remoteness and small size, the

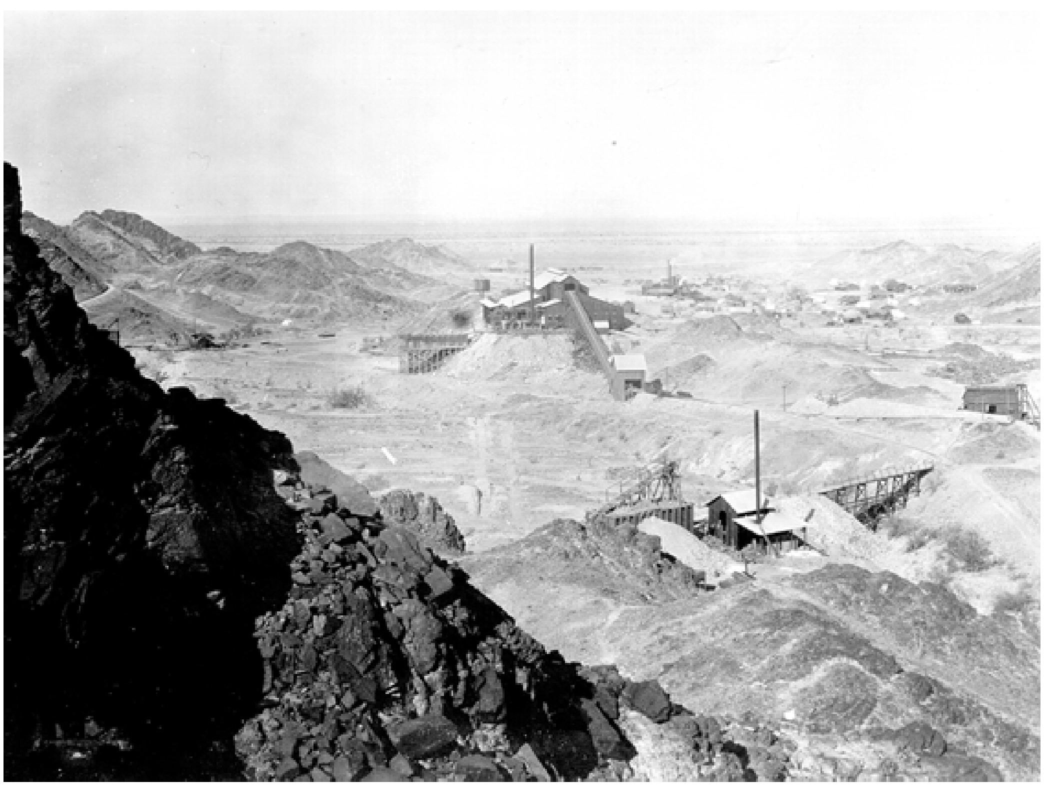

***Figure 1: Golden Crown Mine, Imperial County, 1900*** *(used with permission, California Department of Conservation, California Geological Survey).*

colonies were linked into a vast transportation, communications, demographic, and economic network on a national and international scale (Hardesty 1988:1).


**Figure 2:** ***Gold Bars and Mexican Guards at La Grange Mine*** *(used with permission, California Department of Conservation, California Geological Survey).*

Not only did California's mining industry shape the character of the state, it also had a significant effect upon the nation, increasing its wealth and sustaining economic growth. Virtually every county in California witnessed some degree of minerals exploration. This was in large part due to the state's diverse geological history. Oddly enough, serpentine, the metamorphosed remains of magnesium-rich igneous rock that contains asbestos and that holds little monetary value, is the official "state rock." Gold, rightly so, is the official "state mineral" (California Geological Survey 2007).

The state's mining history, and perhaps that of the western United States, is based upon the romanticized notion of "get rich quick" mineral discoveries. The reality of the industry was another thing, and the cyclical nature of the mining industry resulted in "boom and bust" periods, some of which were created through artificial means or, even worse, unscrupulous investment, and, in other cases, by depletion of the mineral reserves themselves. As John Muir aptly stated "mining discoveries and progress, retrogression and decay seem to have been crowded more closely against each other here [in California] than on any other portion of the globe" (Muir 1992:944).

The cyclical nature of mining was influenced by economic conditions both in California and the nation, as evidenced multiple times. The "Panics" of 1873, 1893, and 1907 had ramifications for the state's mining industry by deflating interest in mining investments and stocks. Too, the 1906 San Francisco earthquake shook the financial markets of the West Coast and briefly shut down the Pacific Stock Exchange. And the rise in the price of gold in 1934 resulted in a flurry of speculation, the reopening of hundreds of gold mines, and the migration of thousands of would-be small-scale placer miners to the gold regions of the state.

The mineral history of California spans nearly the entire state. However, when discussing the production of gold, there are two geomorphic provinces that deserve special attention: the Mother Lode region and the Klamath and Trinity river basins. Both of these geomorphic provinces witnessed unprecedented growth following the discovery of gold at Sutter's Mill in

January of 1848. Mining had a significant impact in both regions, particularly on indigenous peoples, but also on the regions' future economic development, including the expansion of other industries, such as agriculture.

Prior to 1848, gold was reportedly mined in the San Gabriel Mountains near Los Angeles, within Castaic, Paloma, Placerita, Santa Feliciana, and San Francisquito canyons. Additional discoveries of gold were made in the La Panza District located about 40 miles east of San Luis Obispo (Irelan 1888:531; Clark 1970:179, 1985:254)**.** Other precious metals mined in California besides gold include silver and platinum. Non-precious metals or commodity minerals, such as aluminum, antimony, arsenic, asphalt, black sands, bromine, boron, cadmium, cement, gypsum, mica, nickel, petroleum, pumice, salt, shale, titanium, to name just a few, were also mined in the state. The focus of this study, however, is on those minerals whose properties were such that they were industrially mined and either individually or collectively assumed an important role in local, state, or regional economies, including barium (barite), borates, chromite, coal, copper, feldspar, gold, lead, limestone, manganese, magnesite, mercury, pyrites, silver, strontium, sulfur, talc and soapstone, tungsten, and zinc. Each of these commodity minerals and/or metals was exploited for its economic value; each provided employment, and to different degrees, fostered the development of communities and transportation systems.

In his seminal book *California Gold: The Beginning of Mining in the Far West* (1947), historian Rodman Paul noted that the gold rush period spanned the years 1848 through the 1870s. Other scholars suggest that the gold rush era declined or perhaps ended in the mid-1850s, when the recovery rate of placer gold began to diminish (Clark 1970, Holliday 1981, Johnson 2000). In either scenario, by the end of the 1850s the character of the mining industry in California was quite different then it had been in the early 1850s.

Between 1849 and 1854, California's cultural landscape was transformed by population expansion, the creation of mining camps, and the development of associated industries. This transformation had devastating consequences for the state's indigenous peoples, as well as *Californios* whose lands were preempted by settlers. What followed the gold rush were sporadic discoveries of new placer gold deposits throughout the Mother Lode, expansion of hydraulic mining, the development of the hardrock or quartz gold mining industry, discoveries of new

***Figure 3: Hydraulic Mining at La Grange Mine, Trinity County, ca. 1940*** *(used with permission, California Department of Conservation, California Geological Survey).*

minerals, and a surge in new mining-related technologies.

**Figure 4*: Typical Gold Rush era Mother Lode Mining Town, circa late 1920s.*** *Note the abandoned storefronts (used with permission, California Department of Conservation, California Geological Survey).*

Improved techniques for hydraulic mining resulted in more capital-intensive forms of mining that required significant amounts of labor. While hydraulic mining was dramatically curtailed following the Sawyer Decision in 1884, it continued throughout portions of California, although at a much smaller scale (Kelley 1959). Mining other metals, such as lead, copper, and mercury, gained in importance throughout the late nineteenth century due to changing economic conditions and demand for products made from these minerals.

During the late 1890s, new technologies led to the invention of dredge mining, which spread throughout portions of California, particularly along the American, Sacramento, Feather, and Trinity rivers, where placer gold was still plentiful. Small drag line or “doodle-bug” dredges were used in the 1930s, allowing mining companies or miners to access and dredge remote locations. Dredge mining was cost-effective largely because of the scale on which the operations were conducted, but they nearly obliterated the natural landscape and left piles of tailings, some over 100 feet tall.

During the Great Depression (1929–1941), after a period of limited production or after sitting idle, a number of gold mines resumed their operations and unemployed workers, many from the state’s metropolitan areas, staked out claims throughout California. Many of the “small scale placer miners” moved into areas previously mined and reworked old diggings, sometimes adjacent to abandoned mining camps and gold rush era communities, or to isolated areas to take advantage of public lands such as national forests (Averill 1946).

## GEOMORPHIC REGIONS OF CALIFORNIA

Mining for precious and non-precious commodity metals or minerals occurred in California in almost all areas of the state, as California’s diverse geomorphology lent itself to a wide variety of mineral resources. The following is a brief description of each geomorphic province in relationship to minerals extraction and several of the principal mines in each province. The following descriptions draw heavily on Norris and Webb (1976).

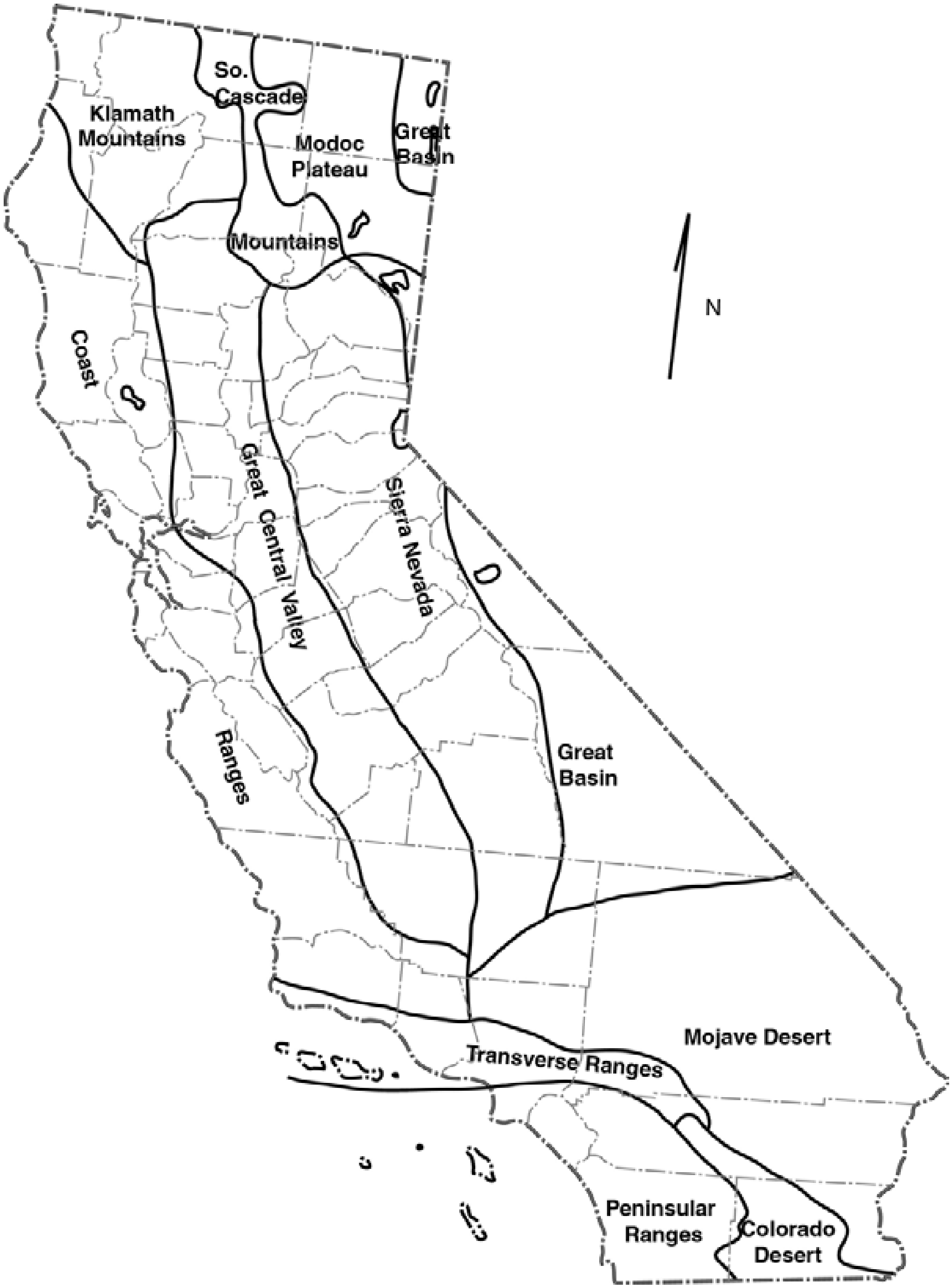


***Figure 5: Map of Geomorphic Provinces in California*** *(compiled by Caltrans from Beck and Haase 1974; Schoenherr 1992; and Johnson 1997)*

### KLAMATH MOUNTAINS

***Figure 6: Hydraulic Mining, Junction City, Trinity County, n.d.*** *(used with permission, California Department of Conservation, California Geological Survey).*

The Klamath Mountains cover an area of some 11,800 square miles in southwestern Oregon and northwestern California. Constituent ranges in California include the South Fork, Trinity, Trinity Alps, Salmon, Scott, Scott Bar, and Siskiyou mountains. The Klamath Mountains adjoin the Cascade Range on the east and the Coast Ranges on the west and south. Elevations range from sea level to the top of Thompson Peak in the Trinity Alps at 9,002 feet. Many upland summits range between 5,000 and 7,000 feet. The principal metals mined in the province include gold, barium-barite, chromium, copper, and to a lesser degree, silver, zinc, lead, pyrites, and coal. Most of the gold mining occurred in Trinity, Shasta, and Siskiyou counties. Chromium mines were located largely in Del Norte County, and copper mines mainly in Shasta County.

### CASCADE RANGE

East of the Klamath Mountains rise the volcanic peaks and lava rims of the Cascade Range. These mountains extend southward from British Columbia through Washington and Oregon, reaching 150 miles into California. The exposed rocks of the California Cascades are predominately volcanics of great variety and form. The principal metals extracted in the Cascade Range were sulfur and coal. The Supan Sulfur Works was the main producer in Shasta County, while the Rogue River District produced a considerable amount of coal.

### MODOC PLATEAU

The separation between the Modoc Plateau and the eastern border of the Cascade Range is indefinite in northern California because the fault systems and rocks characteristic of the two regions are intermingled. The Modoc volcanic platform is actually the southwestern tip of the Columbia Plateau that covers much of eastern Oregon, Washington, and southern Idaho. Topographically, the Modoc Plateau is a jumble of lava flows and fissures, ridges, small cinder cones, and basalt plains averaging more than 4,500 feet above sea level. Most of the mining in this region was concentrated along the Oregon border, comprised of small, shallow gold prospects and placer mines.

### Coast Ranges


***Figure 7: Dixie Queen (Big Four) Mine, Modoc County, n.d.*** *(used with permission, California Department of Conservation, California Geological Survey).*

The Coast Ranges, formed by a variety of ranges, mountains, and valleys, extend north-northwesterly along the Pacific Ocean, west of the Central Valley and Klamath Mountains, almost into Oregon. The Coast Ranges stretch some 550 miles from the Oregon border south to the Santa Ynez River. San Francisco Bay marks the division between the North and South Coast Ranges. Hills and ridges tend to be rounded in this range due to erosion, but some spectacular highland topography appears to the north. Peaks seldom rise above 6,000 feet. Where the mountains meet the sea is a dramatic and extremely rugged environment, much of which is marked by vertical sea cliffs and steep mountains at the seashore. The primary metals mined in the Coast Ranges include barium-barite, chromium, magnesite, manganese, mercury, coal, and to a lesser degree tin, sulfur, and pyrite.

### Great Valley


***Figure 8: Lower Gold Bluff Mine, Humboldt County, 1895.*** *Oregon tom (long tom) saving gold on bare boards (used with permission, California Department of Conservation, California Geological Survey).*

The Great Valley, drained by the Sacramento and San Joaquin rivers, extends almost 500 miles from north to south and averages about 40 miles in width. Much of the Great Valley is a level plain with elevations ranging from 30 feet above mean sea level near Sacramento to 400 feet near Bakersfield. The Sutter (Marysville) Buttes rise above this plain more than 2000 feet in elevation and constitute the only major igneous outcrop in the valley. Mining in the Central Valley has focused on clay, sand and gravel, and dredge mining for gold in gravel deposits. In addition, coal was mined in Placer and Amador counties.

***Figure 9: Tailings Wheels at Kennedy Mine, Amador County, n.d.***
*Tailings wheels (68 ft. tall) used to transport wastes for storage (used with permission, California Department of Conservation, California Geological Survey).*

### SIERRA NEVADA

The Sierra Nevada mountains extend approximately 400 miles from near Mount Lassen in the Cascade Range to the north to Garlock fault in the south. The Garlock fault forms the separation between the Sierra and the Tehachapi Mountains on the one hand and the Mojave Desert on the other. The Sierra vary between 40 and 100 miles in width. Elevations range from 400 feet above mean sea level on the west where it abuts the Great Valley to more than 14,000 feet in the southern Sierra. Extensive vertical movement on the Sierra Nevada fault system produced a precipitous eastern escarpment in the southern part of the range. On the west the Sierran basement terminates beneath the western margin of the Great Valley in contact with the Franciscan formation of the Coast Ranges. The rich mineral resources of the Sierra Nevada lie near the surface because ancient rocks have been exposed by erosion in deep canyons and on steep slopes. The ancient river channels are elevated above their original surroundings and provided many opportunities for drift mining of gold. Besides gold, silver and copper were mined in considerable quantities within this province. Other metals such as tungsten were also mined, but to a lesser degree.

### GREAT BASIN

The Great Basin province covers an immense area south of the Columbia Plateau, between the Cascade, Sierra Nevada, Cordillera, and Rocky mountains. Parallel north-trending fault block ranges (horsts) and intervening basins (grabens) give the region its particular relief. Surprise Valley in northeastern California and Owens Valley east of the Sierra Nevada are typical Great Basin valleys. The principal metal mined in this province was boron or borates, primarily in Inyo County. Other metals mining included gold, barium-barite, tungsten, molybdenum, copper, bismuth, silver, copper, sulfur, magnesite, talc-soapstone, feldspar, and lead.

### TRANSVERSE RANGES

The Transverse Ranges consist of many overlapping mountain blocks. The Transverse Ranges trend east-west in contrast to the northwest-southeast orientation of the Sierra Nevada and the

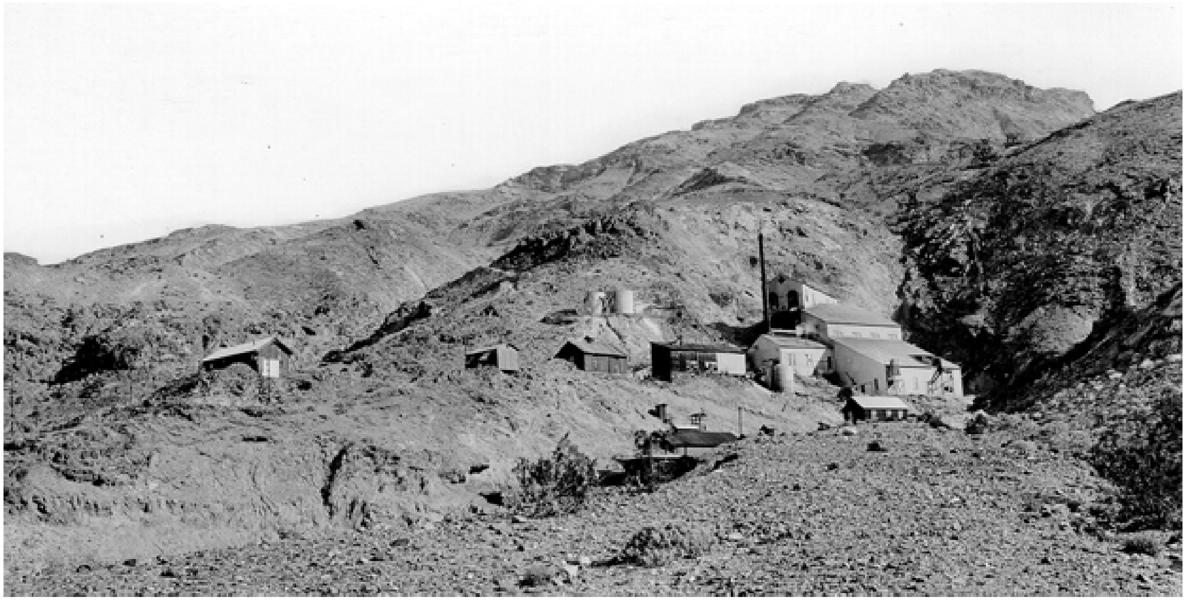

***Figure 10: Keane Wonder Mine, Inyo County, 1916.*** *Said to have produced $1,100,000 before closing in 1916 when ore was depleted (used with permission, California Department of Conservation, California Geological Survey).*

Coast Ranges. The major mountain ranges of the Transverse Ranges are the Santa Ynez, Santa Susana, Santa Monica, San Gabriel, and San Bernardino. Sediment-filled basins between these ranges are the Santa Ynez, Ventura, Ojai, Santa Clara, Simi, San Fernando, and San Gabriel valleys and the Santa Barbara Channel. Rising from the Mojave Desert in the east, near the Colorado River, the Transverse Ranges extend westward in a band towards the ocean, forming the islands of Santa Rosa, San Miguel, and Santa Cruz. Mining in the Tranverse Ranges focused primarily on boron or borates. The Lang Mine in Los Angeles County was one of the biggest producers of boron.

### MOJAVE DESERT

The Mojave Desert consists of about 25,000 square miles bounded by the San Andreas Fault and the Transverse Ranges, the Garlock Fault, the Tehachapi Mountains, and the Great Basin. It extends into southern Nevada and western Arizona. The Mojave is dominated by broad alluvial basins that receive erosional debris from the adjacent uplands. These aggrading basins are burying topography that was once more mountainous. Prominent ranges include Granite, Bristol, Providence, Bullion, Turtle, Maria, and Chocolate mountains. Mining has and continues to play an important role in the overall economy of the Mojave Desert. The principal metals mined include gold, barium, barite, borates, copper, feldspar, lead, and magnesite. Silver, manganese, strontium, and tungsten were also mined to a lesser extent.

### PENINSULAR RANGES

The Peninsular Ranges extend 125 miles from the Los Angeles Basin and the Transverse Ranges to the Mexican border, and beyond another 775 miles to the tip of Baja California. The width of the ranges varies between 30 and 100 miles. The ranges contain minor amounts of Jurassic rocks but are primarily composed of igneous rocks of Cretaceous age and plutonic origin. Typical igneous rocks of these ranges include gabbro, quartz diorite, and granodiorite. Mining in the Peninsular Ranges focused on barium-barite (Orange and Los Angeles counties), feldspar (Riverside and San Diego counties), lead (Los Angeles and Orange counties), strontium (San Diego County), sulfur (Imperial County), and tin (Riverside County).

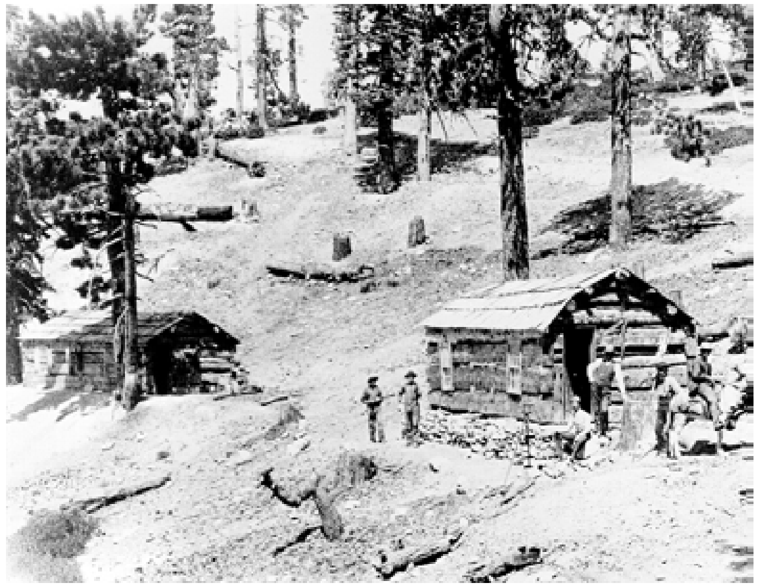

***Figure 11: Banks Wash San Bernardino County, 1895.** The road behind the cabins is now Lytle Creek Road (used with permission, California Department of Conservation, California Geological Survey).*

### COLORADO DESERT

The floor of the Colorado Desert lies at a low elevation, from 350 feet near the Colorado River on its northern edge, to 130 feet at Winterhaven near Yuma. The bulk of the Colorado Desert drains into the Salton Sea, an inadvertent artificial lake. The Salton Sea occupies the lowest parts of the Salton Trough, a large depression extending from Palm Springs to the Gulf of California. The basin occupied by the Salton Sea last received marine deposits in the Miocene and Pliocene. There are no major mines in the Colorado Desert region, although small mines operated along fringes of the desert floor.

### SUMMARY

Gold mining, by far the most widespread and ubiquitous mining property type, was undertaken in the Sierra Nevada, Cascades, Siskiyous, Tehachapis, San Gabriels, the mountains east of San Diego, and in wide areas of the Mojave Desert and its surrounding ranges. There was also a small, isolated gold-mining area within the coastal mountains of the Big Sur region in Santa Cruz County. The reason for this broad distribution is that gold and other precious metal ores are typically found in or near hilly or mountainous terrain; exceptions are limited to deposits or placers found in alluvial areas at the edge of the Great Central Valley, or along the northern coast of California in the form of black sands.

The Central Valley and coastal strip from San Diego to the Oregon border has experienced extensive mining activity, but almost all of it is based around construction materials and industrial minerals rather than precious or semi-precious metals. Industrial metals, such as manganese and chromite, were mined in the Coast Ranges and elsewhere. The most notable exception, mercury mining, was undertaken primarily in the coastal ranges west of the San Joaquin and Sacramento Valley, but for the most part relatively distant from the coast. A simplified visual representation of the location of mining areas in California can be found on

Maps 90 and 91 of the *Historical Atlas of California* (Beck and Haase 1974). A map showing "Locations of past-producing gold and mercury mines in California" is available through Minerals Availability System/Mineral Information Location System (MAS/MILS) database compiled by the former U.S. Department of the Interior Bureau of Mines (USBM), now archived by the USGS (Causey 1998). While there are many individual reports documenting specific minerals or metals, perhaps the most comprehensive report was the California Department of Natural Resources, Division of Mines and Geology's *Bulletin 176: Mineral Commodities of California* (Wright 1957b).

## MAJOR METAL OR MINERAL COMMODITIES IN CALIFORNIA

Scholars examining the history of mining in California have focused, perhaps not surprisingly, on mining of precious metals, such as gold and silver. These metals represented the greatest economic value and generated the most excitement. It was the lure of riches that drew the Argonauts during the gold rush, and it was the search for gold and silver that led prospectors to fan out across the state and the American West, in search of new mining discoveries. In a way, the search for gold, and to a lesser extent silver, captured the collective imagination of historians as well as miners. Of course, a wide variety of metals were mined in California between 1848 and 1940; some, like mercury (quicksilver), were used at first primarily in the gold-mining industry. Others, like lead, copper, zinc, tungsten, manganese, molybdenum, and antimony, were industrial metals and used for industrial processes or for industrial purposes, especially those that developed in the late-nineteenth and early-twentieth century. For example, tungsten became the metal of choice for use in electric light bulbs in the twentieth century; its high melting point also made it valuable in producing hard and sharp steel tools for machining steel and other metals (Jenkins 1950:355–361).These metals were often found in association with gold and silver.

During the 1910s through the 1930s, gold and silver mining, and to some extent copper, lead, and zinc mining, followed a patterns expansion and contraction. Other than state and federal mineralogist reports, relatively few published works focus on this period. The United States Bureau of Mines (USBM), for example, tracked production from placer and lode mines producing all five metals and provided statistics for the years 1903 through 1940; a chapter in the *Minerals Yearbook, Review of 1940* focused on gold, silver, copper, lead, and zinc in California.

The following summaries of the metals or minerals do not cover the entire spectrum of the history of each; instead the purpose is to provide a broad overview and document some of the most pertinent source material.

### BARITE (BARIUM)

Barite, the main ore of barium, is important in the manufacture of paper, glass, and rubber. A rich, white pigment is made from crushed barite. In more recent years barite has also been used in radiology for x-rays of the digestive system, and when crushed, it is added to mud to form barium mud, which is poured into oil wells during drilling. Barite is also a very popular mineral among mineral collectors, and fine specimens are greatly sought after. California's barite, which is quite common throughout the state, is almost completely obtained from bodies that have replaced limestone or filled fractures (Kundert 1957:71). California's most significant source of barite is in the El Portal area of Mariposa County west of Yosemite. Barite mining began in this region around 1910 (Boalich 1913:191; Bradley 1930:45).

In addition to Merced County, barite of differing qualities and quantities is also found in limestone replacement deposits throughout the state including Nevada, San Bernadino, Orange, Shasta, Los Angeles, Tulare, and Monterey counties. Notable mines include Nevada County's Democrat Mine, active during the 1920s, that was at one time California's leading barite producer. This 200-foot open-cut mine operated until 1930, when the mine's deposit of high-grade barite was depleted. The Spanish Mine, also located in Nevada County, operated from around 1930 until 1955 and produced over 35,000 tons of barite. Here the ore was crushed and trucked nearly 50 miles to Colfax's rail depot. Similar to the Democrat Mine, the Spanish Mine was mined by way of the open pit method until its final closure in 1955. Synthetic Iron Color Mine, another leading barite producer located in Plumas County, was mined with both open pit and underground methods (Kundert 1957:71-73). The nearby Savercool Mine was mined strictly with the underground method.

The principal barite mines of Plumas and Nevada counties were generally known as small quantity but high-grade mines, producing ore that, despite the high costs of excavation due to difficult accessibility and shipping, remained profitable ventures. The products of these mines and other lower-grade deposits were used largely in the petroleum, chemical, and glass manufacturing industries (Kundert 1957:73-74).

Further readings on the history of excavation and usage of barite in California include Walter W. Bradley's (1930) *Barite in California,* Charles V. Averill's (1937) *Mineral Resources of Plumas County California* and (1939) *Mineral Resources of Shasta County: California*, and W.B. Winston's (1949) *Barium*.

### BORATES

Borax (tincal), colemanite, and ulexite are among the derivatives of boron with commercial uses. Boron itself does not occur naturally as a free element and has limited industrial applications. Commercial uses range from porcelain enamels and ceramic glazes, soil nutrients for agriculture, to well-known household cleansers (Ingalls 1897). In desert regions, borate rich playas will form borate "crusts" a few inches thick that can be mined, reform over time, and be mined again. This discussion focuses primarily on early borate mining in Lake County, and later, more-developed mining in Kern, Inyo, and San Bernardino counties. These southeastern counties, which by 1950 contained the largest boron deposits in the world, supplied "over nine-tenths of the world's requirements" (Ver Planck 1957a:87).

The first commercial borax mine in the United States was California's Borax Lake Mine, operating from 1864 to 1868 at Clear Lake, Lake County. That operation, run by the California Borax Company, shifted its focus to the Little Borax Lake Mine from 1867 to 1873. Along with gold and mercury mining, the borax industry employed large numbers of Chinese. Chinese labor was critical to these early boron mining operations: "The operations caused a terrible stench, endured largely by Chinese Americans, who had been driven out of the gold mining areas and could not find other employment because of racial discrimination" (NPS 2004). Working as mine laborers, labor bosses, and support staff for both labor and company owners, the Chinese remained connected to borax mining before and after the passage of the 1882 Chinese Exclusion Act. Chinese labor figured prominently in not only Death Valley borax operations, in particular the gathering of dry borax, but also in many early surface operations.

Borate mining started in southern California and southern Nevada's desert valleys contemporaneously in the early 1870s, ending the financial profitability of the operations in Lake County. Francis "Borax" Smith initiated the region's "Borax Rush" with his discovery of a deposit at Teal's Marsh in Nevada in 1872 (Ingalls 1897). Similarly, Death Valley's saline lakes, marshes, and playas proved an ideal source of borates. Crustal mining operations, a process of scraping and refining surface borates, began at Searles Lake (or Marsh), San Bernardino County, in 1874. John and Dennis Searles formed San Bernardino Borax Mining Company, and produced 100 tons of borax per month. The company operated until 1895 (Ver Planck 1957a:89-90).

The opening of these new deposits in the 1870s caused the price of borax to decline from 32 cents per pound in 1873 to a decade low of 8.5 cents per pound in 1878. In the early 1880s international prices began rising, encouraging new ventures (Ingalls 1897:60). In the 1880s and 1890s borax mining was viewed as "one of the most promising industries" in California (Lindenmeyer 2000:185). Eagle Borax Works, founded by Frenchmen Isadore Daunet, began operations in Death Valley in 1882. Prominent Californian businessman William Coleman purchased Daunet's works in 1883, letting it fail. That same year, Coleman also started one of the most significant operations, the Harmony Borax Works (California Historical Landmark No.773) in Death Valley, near Furnace Creek. The company employed 40 men, primarily Chinese, and produced three tons of borax daily. The "cottonball" ore (ulexite) was scraped from the playa and hauled by the now-famous twenty-mule teams 165 miles to the railhead in Mojave. Coleman's operations near Shoshone, Amargosa Borax Works, also employed Chinese labor (NPS 2004).

The colemanite deposits near Calico, San Bernardino County, were discovered in 1882, and proved to be a cheaper source of borax than playa deposits (Ingalls 1897:60). Colemanite deposits also required a different mining technology than used on playas, employing incline shafts and open pits (Ingalls 1897:57-58). The development of borax mines had close ties to development of smaller railroad lines, such as the Tonopah & Tidewater Railroad and the Death Valley Narrow Gauge Railroad (Vredenburgh 2005). In 1890, Francis "Borax" Smith purchased Coleman's borax holdings—Coleman having gone bankrupt in 1888—and combined these with his own Nevada deposits into the newly founded Pacific Coast Borax Company. Smith followed up by developing other deposits in Borate, near Calico (1890), and Furnace Creek Ranch, Death Valley (1904). The site at Furnace Creek included waste tailings, a company town, 20-mule team wagons for transportation, rectangular iron-dissolving tanks, boilers, "machine rooms," "skimming piles," ore carts/track/transportation infrastructure and "several long rows of crystallizing vats with truncated cone shapes" (Ver Planck 1957a:88).

Mining of playa borates peaked around 1890, and with the financial panic of 1907, playa mining ceased in the state. In 1913, John Suckow discovered the largest borate deposit in the world—the Kramer deposits, near what is now Boron. In 1927, Francis "Borax" Smith began processing of the Kramer district sodium borates, making processing of colemanite deposits less economical (Ver Planck 1957a:89-90). That same year, the Borax Company built the Furnace Creek Inn with an aim towards attracting tourists to Death Valley. Many of Death Valley's old borax mines were closed and incorporated into Death Valley National Park in 1933, turning them into tourist destinations.

### CHROMITE

Chromite is an oxide of chromium and iron, which is utilized in furnaces as a refractory lining for smelting copper and steel. Chromite was discovered by gold rush miners, although its importance at that time was considered minimal. Today chromite's principal role is in the manufacture of hardened steel alloys. Use of this metal increased dramatically during the twentieth century with the introduction of automobiles, and in war-related technologies such as armor plating and armor piercing projectiles. (Browne 1867:224,198; Palmer 1992:29).

It was first mined in 1868, and between 1869 and 1889 1,500 to 2,000 tons of ore were obtained each year from mines in Del Norte County, as well as from smaller deposits in San Luis Obispo, Placer, Sonoma, and Lake counties. In 1950 the California Division of Mines reported that there were 1,200 deposits in the state, of which 46 mines had shipped at least 1,000 tons of ore each. At that time the mines were in the Sierra foothills and the Klamath Mountains, with a scattering in the Coast Range from San Luis Obispo to Tehama counties. Between 1921 and 1941, the state averaged only 500 tons of ore per year (Jenkins 1950:297–298).

### COAL

In 1858, W.C. Israel discovered coal deposits in Contra Costa County about six miles south of Antioch. A year later Francis Somers and James T. Cruikshank discovered a source of coal known as the Black Diamond Vein. Coal so close to San Francisco was vital to the growth of the California economy, providing a cheap, readily available source of energy needed to fuel foundries, mills, ferries, steamers, and other developing industries.

Because of the demand for coal by commercial and residential markets, several mining companies were formed, attracting a large number of miners to Contra Costa County. English and Welsh miners, as well as Americans who had gained experience in Pennsylvania coal mines, found their way to the Black Diamond Mines. Italians, Germans, and Chinese opened businesses in the burgeoning towns. Initially, single men came for work, later bringing their families when they were sure the mines would be operating on a long-term basis. Noah Norton opened the Black Diamond Mine and founded the town of Nortonville in 1861. While Welsh miners accounted for a majority of the populace, it soon evolved into a melting pot of diverse cultures (Clayton Historical Society 2002).

By 1860, there were six miles of mines stretching between the towns of Somersville and Nortonville and Judsonville and Stewartville. Clayton, only a few miles from the activity of the Mt. Diablo Coalfield, responded immediately to the demand for services and supplies. By 1861 Clayton had become the hub of activities in the area. Four million tons of coal were extracted during the brief history of coal mining in the Mt. Diablo Coalfield. The soft bituminous coal was of low quality. By 1902, the mining costs, competition from high quality Washington coal, and the advent of oil as an industrial power source drove most of the mines out of business. Many of the miners departed for Washington and Oregon where the hard coal, or anthracite, was being mined. Nortonville and Somersville ultimately became ghost towns and Clayton turned to ranching.

### COPPER

Copper is reddish with a bright metallic lustre. It is malleable, ductile, and a good conductor of heat and electricity (second only to silver in electrical conductivity). Its alloys, brass and bronze, are very important. The most important compounds of copper are the oxide and sulphate or blue vitriol (Winter 1993-2007). Table 2 lists major copper mines in the state and their county locations. Not surprisingly, the counties listed are among the most active mining counties in the state (Jenkins 1950:302).

Copper was first discovered in Southern California, but went largely unnoticed until 1855 when a deposit was found in Amador County's Hope Valley. Early on, copper, like many other minerals, was ignored as a by-product of gold mining. It was not until accessible placer gold deposits had largely played out toward the end of the 1850s that miners began to devote their attentions to copper mining rather than discarding it as a nuisance. In 1860 silver prospector Hiram Hughes accidentally discovered a large copper vein 35 miles southeast of Stockton in Calaveras County, near what became known as Copperopolis. Hughes had it assayed and learned its value was $120 per ton. Other miners rushed to this area in hope of establishing their own successful copper mines, and in 1861 five mining companies, including the Union and Keystone, controlled over 11,000 feet of lode. Hughes's mine, known as the Napoleon Mine, was incorporated as the Napoleon Copper Mining Company in 1862. Occupying over 2,700 feet of the lode, it emerged as the most successful, producing over 4,000 tons of copper ore during the next two years. While this production was diminutive in comparison to that of states with major copper mines (such as Arizona and Montana), copper ranked second only to gold in terms of its value as a metal, making even small operations profitable (Browne 1867:13-140, St. Clair 1999:204).

**Table 2: Important Copper Mines in California**

| Major Mine | County |
|---|---|
| Iron Mountain | Shasta |
| Walker, Engels | Plumas |
| Penn, Keystone | Calaveras |
| ***Other Significant Mines*** | |
| Copper Hill, Newton | Amador |
| Big Bend | Butte |
| Napoleon, North Keystone, Quail Hill | Calaveras |
| Copper King, Fresno | Fresno |
| Pine Creek | Inyo |
| Daulton | Madera |
| Spenceville | Nevada |
| Dairy Farm, Valley View | Placer |
| Superior | Plumas |
| Copper World | San Bernardino |
| Afterthought, Balaklala, Bully Hill, Hornet, Keystone, Rising Star, Shasta King, Sutro | Shasta |
| Blue Ledge, Gray Eagle | Siskiyou |
| Island Mountain | Trinity |

*Data Source:* Jenkins 1950.

Those who failed in Calaveras returned to their own mining districts throughout the state in search of their own copper deposits. In 1861 prospectors identified an immense belt of copper reaching from just north of Los Angeles and extending through Mariposa, Merced, Tuolumne, Stanislaus, El Dorado, Placer, Nevada, Yuba, Trinity, Plumas, and Shasta counties. Other major deposits were soon discovered at the base of Mount Diablo and Del Norte County. These discoveries and the high price of copper spurred the incorporation of numerous copper mining companies throughout California. Major mines during this time included those of the Copperopolis Table Mountain, Hope Valley, Newton, Cosumnes, Birdseye Mine, Buchanan, and Genesse Valley Mine (Browne 1867:141-143; Table 2)**.**

A smelter was constructed in Contra Costa County in 1862, and by 1868 nine smelters were operating in the Sierra foothills. Falling copper prices led to a period of inactivity in the industry until the mid-1890s, when a slow recovery began. Iron Mountain Mine in Shasta County resumed operations and erected a smelter near Keswick that operated until 1907 when the company built its major smelter at Selby, near Martinez in Contra Costa County. During the first years of the twentieth century, other mines, like the Afterthought, Balaklala, Bully Hill, and Mammoth, built smaller smelters on site. Problems with high levels of zinc in the ores, combined with lawsuits, led to the Shasta mines being idled by 1919 and in the years that followed there was only sporadic activity. California's copper deposits were mined with underground methods and the ores required fine grinding and use of flotation to form concentrates suitable for sending to the smelters (Jenkins 1950:305, 307).

The beginning of the twentieth century brought about a renewed demand for copper. Development of new technologies, especially advancements in electrical mine machinery, propelled copper to the top of the mining industry between 1900 and 1930, with the United States manufacturing over 65 percent of the world's copper supply during this period. With improved transportation, copper companies were able to ship lower grade ore, helping to transform copper mining from a selective to a more profitable non-selective endeavor. Ultimately, western mines produced a much lower grade of ore than the massive copper mines in Michigan's Lake Superior region, making it difficult for California companies to compete against their Michigan counterparts (Hovis and Mouat 1996:435-436).

Between 1897 and 1930, an average yield of 16,000 tons of ore per year was produced. Output dropped between 1931 and 1936, owing to a decline in the price of copper. Most of the production came from Shasta, Plumas, and Sierra foothill counties. By the end of 1946, 54 percent of the state's production came from Shasta county, while 26 percent came from Plumas county, and 12 percent from the Sierra foothill counties (of which Calaveras produced more than 80 percent of the total). The Iron Mountain Mine in Shasta County alone accounted for 42 percent of the state's total production, while the Walker and Engels mines in Plumas County and the Penn and Keystone-Union in Calaveras County produced 37 percent. All the other copper mines in the state represented 21 percent of production. The California Division of Mines reported that "only eight counties in the state have no recorded copper production. Those counties included Kings, San Francisco, San Joaquin, San Mateo, Santa Cruz, Solano, Sutter, and Yolo" (Jenkins 1950:300–307). The single best producer of copper at that time was the Walker Mine in Plumas County, which milled 437,450 tons of ore and produced 10,524,345 pounds of copper, along with 14,176 ounces of gold and 237,891 ounces of silver (USBM 1941:251). The gold and silver found in conjunction with the copper often provided the profit for the mining company, while the production and sale of copper simply met its mining expenses. Besides those mentioned above, 26 other mines produced significant amounts of copper (Jenkins 1950:302).

## FELDSPAR

Feldspar is mostly buff to cream-colored with local bluish-gray spots and streaks due to minute inclusions. As is usual in all feldspar quarries, most of the material marketed under the commercial name "feldspar" is an intergrowth of feldspar and quartz. The standard or No. 2 grade obtained at quarries consists principally of graphic granite with a subordinate amount of pure feldspar. Some No. 1 grade nearly free from quartz is also obtained (Bastin 1911).

One of the largest feldspar mines was the Mount Apatite, operated by Maine Feldspar Company in the early 1900s near Auburn. The workings consisted of a number of small pits 75 to 150 feet long, 50 feet in average width, and 10 to 20 feet in depth. These were either close together or partly connected and were located in a single mass of pegmatite (Sampson and Tucker 1931).

## GOLD

The history of gold in California is well documented in published books, journals, and photographs. Prior to 1848, gold's presence in California was known to its few settlers and natives, but the extent and quantity of gold in the state was unknown. While exact figures may never be known, from James Marshall's 1848 discovery in Coloma until 1954, California yielded over 106 million troy ounces of gold. Gold remained California's most valuable mineral commodity until 1942, when it was surpassed by tungsten, iron, and quicksilver over the following decade. Over time, high mining costs and difficult access to deposits contributed to gold's decline as a commodity (Clark 1957:215).

Gold can be found throughout the state, but is heavily concentrated in a few areas. The primary area of concentration, the western slope of the Sierra Nevada, is home to the famous Mother Lode and the Grass Valley-Nevada City gold district. The most productive area of the Mother Lode, a twelve mile stretch between the towns of Plymouth and Jackson in Amador County, encompasses many large deposits, including the Kennedy and Argonaut mines. The Mother Lode contains two main types of gold. The first, gold-quartz veins are generally found in its northern region, while the second, bodies of mineralized country rock, are found to the south (Knopf 1929:23, cited in Clark 1957:215).

Gold mining methods varied, but there are four basic types of extraction: placer, hydraulic, lode (underground), and dredging (Table 3). Eventually, lode mining replaced placer and hydraulic mining as the primary method of recovering gold. Besides providing the foundation for world currency systems, gold has many uses. It is widely used for gilding, plating, jewelry making and dozens of other industrial and domestic

**Table 3: Placer Gold Mining, Number of Mines in Selected Years**

| Type of Mine | 1910 | 1920 | 1930 | 1935 | 1940 |
|---|---|---|---|---|---|
| Placer / dredging | 41 / 72 | 25 / 41 | 21 / 31 | 99 / 114 | 363 / 259 |
| Hydraulic | 168 | 51 | 79 | 93 | 92 |
| Small surface placers (wet) | 184 | 61 | 688 | 1,132 | 282 |
| Small surface placers (dry) | 1 | 1 | 6 | 21 | 17 |
| Drift | 139 | 45 | 88 | 143 | 96 |

*Data Source*: US Bureau of Mines 1941:219-222.

applications (Clark 1957:221).

Gold mining is discussed extensively elsewhere in this document (refer to Gold Rush in this chapter). Additional sources include J.E. Doolittle's (1905) *Gold Dredging in California*, A. Knopf's (1929) *The Mother Lode System of California*, G.A. Joslin's (1945) *Gold*, Olaf Jenkins' (1948) *Geologic Guidebook along Highway 4*, and William Clark's (1970) *Gold Districts of California.*

### LEAD

Lead is a rare and malleable mineral of hydrothermal origin. California's lead ore is mainly recovered through typical underground mining methods. Once brought to the surface, the ore is shipped immediately or milled and then shipped, depending on its quality. It is further concentrated through flotation and then smelted for refinement (Stewart 1957a:285). Lead's malleability, high resistance to corrosion, and high specific gravity made it a useful component of alloys and chemical compounds.

Over 450 million pounds of lead have been recovered in California, with most of it coming from Inyo County. Lead was reportedly first produced by Mormon miners working silver deposits in the Panamint Range in 1859. The mines at Cerro Gordo were discovered and worked on a small scale by Mexican miners starting in 1862. The California Division of Mines reported that "American interests" took over these mines in 1869, and increased production. They erected a smelter at Cerro Gordo and another at Swansea, on the eastern shore of Owens Lake. The mill and smelter site at Swansea, California Historical Landmark No. 752, produced silver bars. Cerro Gordo's lead mines were substantially worked out by 1877, but interest revived after a railroad reached Keeler, just south of Swansea, and the mines were worked intermittently until the 1940s. Mines of the Cerro Gordo district produced more than $17 million in lead, silver, and zinc. Silver and lead mining peaked in the 1880s but there was a second boom for zinc in the 1910s (Stewart 1957a:281).

Inyo County has three major lead districts. The Cerro Gordo produced over 150,000 tons of ore from its 15 miles of underground workings (Stewart 1957a:281). The Darwin District, which first opened in 1874, was the principal source of California lead through the 1950s, with most of the ore being found in Pennsylvania limestone. The third lead district of Inyo County, the Tecopa District, operated from 1912 to 1928. In 1947 the several small mines that comprised the district included the Columbia which produced over 93,000 tons of ore from 1912 to 1928 (Stewart 1957a).

Other notable lead mines included the 1865 Gunsight Mine, which produced over 55,000 tons of ore between its peak years of 1912 and 1928, and the Santa Rosa Mine, a producer of lead, silver, zinc, and copper. Both were located at the southern end of the Inyo Range. Rich lead deposits, generally by-products of copper and gold mining operations, were found at the northern edge of Inyo County's Argus Range, the Sierra Nevada foothills, and the Klamath Mountains. Smaller deposits were worked in San Bernadino and Orange counties (Stewart 1957a:283-284).

Further suggested reading includes A. Knopf's (1918a) *A Geologic Reconnaissance of the Inyo Range and the Eastern Slope of the Sierra Nevada, California*, D.L. Davis and E.C. Peterson's (1949) *Anaconda's Operation at Darwin Mines, Inyo County, California*, L.A. Norman's (1951) *Mines and Mineral Resources of Inyo County*, and E.M. MacKevett's (1953) *Geology of the Santa Rosa Lead Mine, Inyo County, California.*

### LIMESTONE

Limestone is composed of sedimentary rocks that are made from the mineral calcite which came from the beds of evaporated seas and lakes and from marine shellfish remains. Limestone is the most abundant of the non-clastic sedimentary rocks. The main source of limestone is the limy ooze formed in the ocean. The calcium carbonate can be precipitated from ocean water or it can be formed from sea creatures that secrete lime such as algae and coral. Chalk is another type of limestone that is made up of very small, single-celled organisms.

While lime production in California predated the gold rush, the rush created an increased demand for building materials, ushering in the era of mass production of lime. Essential for producing mortar, plaster, and later cement, lime became indispensable to the construction of brick buildings and other structures. The flammable canvas and timber buildings of gold camps and cities were soon replaced with stone and brick materials, significantly increasing the demand for lime. Kilns in Olema in Marin County in 1850 and Santa Cruz in 1851 provide the earliest evidence of this period of limestone production. The forested areas of Santa Cruz County were soon dotted with kilns whose operators relied heavily on the local, slow-burning redwood for their fuel. Santa Cruz combined a readily available fuel source with abundant capital and labor along with water access for transportation and shipping, causing it to emerge by 1868 as the center of California lime production. The lime industry soon spread throughout the county to towns such as Davenport and Felton (Bowen 1948; Piwarzyk 1996:20).

The demand for lime for making mortar and other purposes, including plastering stone and adobe structures, resulted in significant production in the towns of Cool, El Dorado County, and Ione, Amador County (Jenkins 1949), to name two. In El Dorado County the owners of limestone quarries and kilns produced and shipped their product to locations along the Sacramento and Placerville and Central Pacific railroads in order to accommodate diverse markets. Kilns near present-day Cameron Park were employed to supply the region with lime and Marble Valley, situated near the railroad, shipped much of its lime to Sacramento (Sioli 1883).

The growing popularity of Portland cement in the early 1890s spurred further limestone quarrying with production in California peaking in 1904. Portland cement, which used limestone in conjunction with other added minerals, was a much stronger building material than traditional lime. As Portland cement gained popularity, large manufacturing companies systematically replaced the smaller concerns of the Santa Cruz area and the last of those kilns ceased operating in 1946 (Bowen 1948).

## MANGANESE

Manganese is a gray-white metal resembling iron, and while it is harder, it is very brittle. The metal reacts chemically and decomposes slowly in cold water. It is an important component of steel. Mining manganese varied in accordance with the size and shape of the deposit. Generally, wider deposits were mined by an open cut method, while narrower ore bodies were recovered through underground mining methods. The manganese ore was then hand sorted for milling purposes and separation. Separation techniques included flotation, fine grinding, spiral concentration, and magnetic separation. Used heavily in steel-making, manganese and its derivative chemicals, such as manganese sulfate, manganese acetate, and manganese chloride, were major components of many industrial products such as paint and varnish. Manganese sulfate, for example, was used with great success as a manganese spray supplement for walnut, apricot, peach, and citrus trees (Davis 1957:332-333, 337).

Manganese ore, first mined in California in 1867, can be found throughout the state. Some leading manganese producing counties include Humboldt, San Joaquin, Stanislaus, Imperial, Riverside, Trinity, Mendocino and San Bernadino. The largest percentage of ore is extracted from four areas within the Coast Ranges: the Diablo Range, spanning San Joaquin, Stanislaus, Santa Clara, and Alameda counties; the Mad River Valley in southern Humboldt and Trinity counties; Mendocino and Lake county ranges; and the western portion of San Luis Obispo County. California's desert region contained several productive manganese districts including Imperial, Riverside, and San Bernadino counties (Davis 1957:325, 329).

One of California's earliest and largest manganese mines, the Ladd-Buckeye in San Joaquin County, opened in 1867. At its peak, the Ladd-Buckeye Mine accounted for over 60 percent of the Coast Range's total production and one-third of California's entire manganese production. As with many of the state's mineral industries, wartime demand led to heightened production from California's manganese mines. Both world wars necessitated increased production for a variety of military uses. During World War I, the Ladd Buckeye produced 10,000 tons of manganese ore (Davis 1957:329-333).

Further information on manganese can be found in J.B. Hadley's (1942) *Manganese Deposits of the Paymaster Mining District, Imperial County, California,* and Olaf Jenkins' (1943) *Manganese in California.*

## MAGNESITE

Magnesite occurs as veins in ultramafic rocks, serpentine, and other magnesium-rich rock types in both contact and regional metamorphic terranes. It varies in color from white to gray, yellow, brown, or even clear. It is used in refractory bricks and cement. Most of California's magnesite deposits are associated with serpentine and are found in the Coast Ranges and the western foothills of the Sierra Nevada. Recovery is generally performed using underground techniques and some open cut procedures. To avoid dilution and a subsequent reduction of quality, the ore is generally hand-sorted (Ver Planck 1957b:313-316).

Magnesite was first recognized in Porterville in 1853, but the first large-scale mining operations began in Alameda County in 1886. Other early magnesite mining occurred in Napa County in 1886 and at Santa Clara County's Red Mountain Mine located on the border of Santa Clara and Stanislaus counties in 1899.These small operations marked the beginning of a large, statewide industry. Until 1917, the Porterville District produced all of America's domestic magnesium, accounting for nearly all of California's pre-1930 production (Ver Planck 1957b:313, 321).

Necessary for the manufacture of military equipment, magnesite production increased during the two world wars as dormant mines were reopened or production increased at working mines. Between the wars, magnesite production mainly occurred in the Porterville District as the Sierra Magnesite Company had established a large plant there in 1920 to produce oxy-chloride cement. Porterville's resources dwindled and by 1931 had all but played out, prompting the Sierra Magnesite Company to invest in Stanislaus County's Bald Eagle Mine. Other prominent mines included the Western Mine (1919-1931), Tulare County's Harker Mine (1923-1926); and the state's largest magnesite mine, the Red Mountain Mine (1922-1932). World War II created a huge demand for lightweight aircraft materials, prompting magnate Henry J. Kaiser to construct thermal reaction plants in San Mateo and San Joaquin counties. These operated between 1941 and 1953, with some temporary suspensions after WWII (Ver Planck 1957b:313, 321).

California had separate industries reliant upon different forms of magnesite, although they produced similar products. One type of operation was the commercial production of bitterns, a concentrated solution of magnesium chlorides and other chemicals extracted from evaporated seawater. This commercial refinement and production of magnesium began in 1880, when it was utilized by the dynamite industry as an absorbent. World War I brought about a world wide shortage in magnesium, prompting the opening of plants in Los Angeles, Alameda, San Diego, and San Mateo counties for the duration of the war. Uses of the finished product included rubber manufacturing, as well as high magnesium alloys for kiln linings and other high temperature furnaces (Ver Planck 1957b:319-322).

Suggested additional reading on magnesite includes the Lewis E. Aubury's (1906) *Magnesite. The Structural and Industrial Minerals of California*; F.L. Hess' (1908) *Magnesite Deposits of California* and J.B. Perry and G. M. Kirwan's (1942) *The Bald Eagle Magnesite Mine.*

### MERCURY

Historically, what we now commonly refer to as mercury was, in its raw form, called cinnabar, a composite mineral containing sulfur and mercury. The finished product was commonly referred to as "quicksilver." Although mercury mining in California predates the gold rush, the emergence of the industry was nevertheless closely tied to the discovery of gold. Spanish settlers near San Jose were aware of mercury sulfide deposits in the local hills in the 1820s. Large-scale mining for the ore in the area, however, did not begin until 1846. The New Almaden Mine opened that year, and from 1850 to 1870 it was the principal producer of mercury for both the state and the nation. New Almaden yielded 535,437 flasks (the flask being the standard unit of mercury measurement, roughly equal to 76 pounds) over this twenty-year period (Ransome and Kellogg 1939:359, 361).

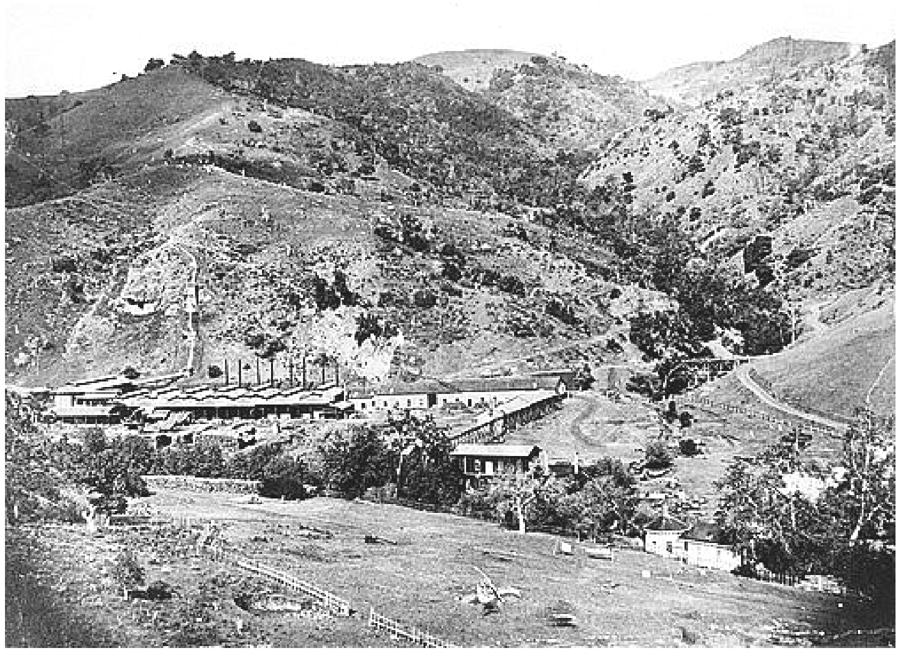

***Figure 12: New Almaden Quicksilver Mine, 1877*** *(Photo courtesy Library of Congress, Washington, D.C.)*

In 1851, the mine's first full year of large-scale production, it produced over 27,000 flasks at an estimated value of over $2,000,000. As with all mining techniques the process of producing quicksilver would undergo several changes and improvements over time due to advancements in transportation, engineering, and scientific knowledge. During the mine's early years, little machinery was used as workers hand drilled and blasted the ore from the tunnels of the mine (Schneider 1992:20-21). Eventually the mine expanded to over 7,800 acres as it accommodated new equipment and a large labor force (Browne 1867:173).

Initially, the New Almaden Mine relied on Native American and Mexican labor. Cornish miners, who were already well known for their hard rock mining expertise, also constituted a large portion of New Almaden's labor force (Schneider 1992:52). As mining activity increased, so did the site's infrastructure. By 1867, over 400 stores, workshops, and barracks served New Almaden's workers as the mine took on the appearance of a small town (Browne 1867:173).

During the nineteenth century mercury was shipped to China for use in paints. It was also used in preserving wood, developing daguerreotypes, silvering mirrors, and in hat making. Prior to the early-twentieth century, mercury was crucial to the extraction of gold in the United States. Most metals adhere to mercury through a process known as "amalgamation." Employing this physical principle, miners would pass gold ore down a trough coated with mercury, or otherwise mix the gold-bearing "pulp" with mercury. Any gold in the ore would then bind with the mercury, forming a gold-mercury amalgam. Miners would scrape off the mercury and separate it from the amalgam, usually through a retort to distill off the mercury, yielding higher-purity gold concentrates. Residual mercury from this process was often released into the environment, deposited in the earth, in streams, rivers, or lakes, contributing to a significant amount of environmental pollution that only worsened with the onset of hydraulic mining. Mercury pollution from the gold rush persists into the present (Alpers and Hunerlach 2000:1–6).

The shift to hydraulic mining and the discovery of the Comstock Lode in the late 1850s further stimulated mercury production in the state as gold and silver mining companies sought to maximize the extraction of gold ore. From roughly 1860 to 1870, a number of mines rich in mercury opened. The Knoxville and Manhattan mines both began production, as did the Manzanita Mine and a number of other smaller properties in and around Sulphur Creek and Wilbur Springs in Lake and Colusa counties. Cinnabar was discovered near Santa Barbara and San Luis Obispo as well, deposits that prompted the opening of the Oceanic and Klau mines (Ransome and Kellogg 1939:359–360).

Other mercury discoveries occurred between 1857 and 1875 in Napa, Sonoma, Colusa, and Lake counties, within areas of volcanic activity in which mercury commonly proliferates (Davis 1957: 348). The St. Johns, Aetna, and Guadalupe mines were all opened in this period; however, only the latter produced any mercury prior to the 1860s (Ransome and Kellogg 1939:359). Other mercury or cinnabar mines were located in Death Valley (Swope 1999).

The 1870s was the most significant era for mercury mining in California history. During this decade, the state produced a third of the world's mercury (Isenberg 2005:48). Of all California's mercury regions, the Mayacmas district—an area that encompasses much of the mountainous and volcanic areas of Lake, Napa, and Sonoma counties—was the single most important locale. Within the Mayacmas District, several new mines joined those already in production, including the Great Western, the Culver-Baer, the Cloverdale, and the Oat Hill. Existing district properties, such as the Knoxville, the Guadalupe, St. Johns, Aetna, and the Altoona mines, all reached record highs of production (Ransome and Kellogg 1939:359–360).

While mercury production remained an important component of California's geological economy into the mid-twentieth century-particularly with the onset of World War II-the industry as a whole largely stagnated from the 1880s onward. Gold beneficiation processes in the United States moved away from amalgamation, and although mercury remained important to a number of technological and medical devices, demand was easily met by existing reserves and by overseas production (Jenkins 1950:335; American Institute of Mining and Metallurgical Engineers 1953:325–332). After 1878, only two notable mercury discoveries were made in the state: the Mirabel Mine in 1887 and the Corona Mine in 1895 (Ransome and Kellogg 1939:360). The demand for mercury during World War II increased both its value and production level until 1944, when production tapered off dramatically (Davis 1957: 348).

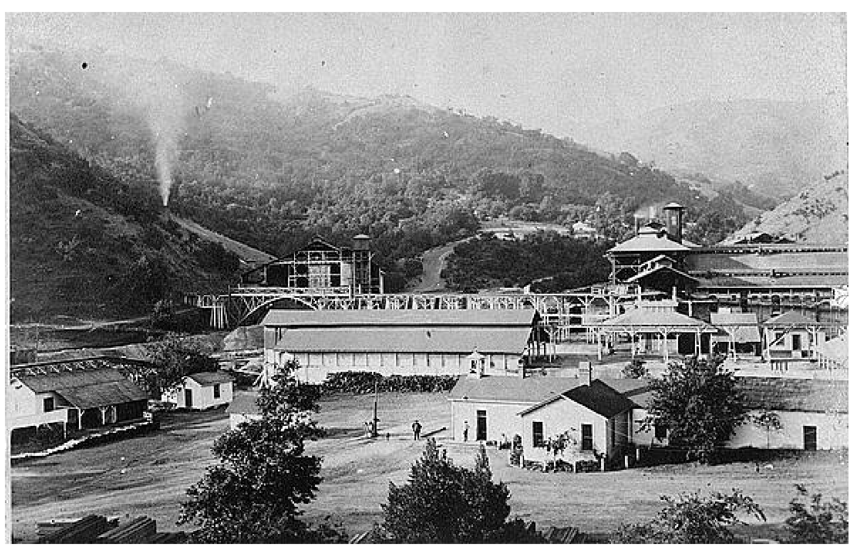

***Figure 13: View of New Almaden Quicksilver Mine Reduction Works*** *(Photo courtesy HABS photograph, Library of Congress, Washington, D.C.).*

## PYRITE

Pyrite, also known as marcasite by jewelers, is a brass-yellow mineral with metallic luster, employed to some extent for the purposes of ornament. It is widely distributed in the earth's crust and often mistaken for gold, hence its name "fools gold." The name pyrite is derived from the Greek word for fire, an allusion to the fact that, owing to its hardness, it will strike fire with steel. Brittle and heavy for its size, in large quantities it forms an ore of sulfur (Farrington 1903:212).

The mining of pyrite began in Nevada County's Spenceville Copper Mine in 1860, where it was derived as a by-product of copper mining. Since 1900, most of California's pyrites have been recovered from Shasta County's West Shasta Copper-Zinc District. Operated by the Mountain Copper Company, the Iron Mountain Mine and others located in this district account for California's chief source of pyrite production. At the Iron Mountain Mine, pyrite is extracted using open pit methods then crushed at an on-site mill before being shipped to manufacturers of sulfuric acid. Aside from Shasta County, Alameda County is the only other known producer of commercial pyrites. Alameda's principal mines, the Alma (1891-1920) and Leona (1895-1934), produced over 250,000 tons of pyrite during their years of operation (Chesterman 1957:419, 449-451).

Reports and Bulletins concerning pyrite in California include F.F. Davis' (1950) *Mines and Mineral Resources of Alameda County, California,* and A.R. Kinkel's (1951) *Geology of the Massive Sulfide Deposits at Iron Mountain, Shasta County, California.*

## SILVER

Pure silver has a brilliant white metallic lustre. It is a little harder than gold and is very ductile and malleable. Pure silver has the highest electrical and thermal conductivity of all metals, and possesses the lowest contact resistance. Silver is stable in pure air and water, but tarnishes when exposed to ozone, hydrogen sulfide, or air containing sulfur. It occurs in ores including argentite, lead, lead-zinc, copper, and gold found in Mexico, Peru, and the United States.

The history of silver production in pre-gold rush California is sparsely documented in comparison to other minerals. The materials and skills necessary to separate silver from its host rock were not fully developed in California until the late 1850s, when surface gold became scarce and attention turned to underground mineral resources. The 1856 discovery of silver at Shasta County's South Fork Mining District created a new awareness of potential silver deposits in California. The discovery of Nevada's Comstock Lode three years later resulted in extensive prospecting in Alpine, Mono, and Inyo counties. The success of these early operations, particularly in Alpine County, was limited due to the lack of advanced processing equipment needed to separate the silver from other elements. Notable mines during the beginning of California silver mining include Mono County's Blind Spring Hill (1862-1890) and two Inyo county districts, the Cerro Gordo founded in the 1860s, and the Darwin dating to the early 1870s (Stewart 1957b:529-532).

Statistics on silver mining in California were not collected by the state until 1888, but in the years between 1888 and 1950, 100 million ounces of the metal were produced, which represented 2.8 percent of the national total to that time. As noted, silver was most often found with other metals; only a few mines, such as those at Calico (1881–1896) and Randsburg (1895), had silver as the principal ore (Jenkins 1950:343–347).

Most of California' silver has been recovered from base metal ores, primarily in Inyo and San Bernadino counties. Two of California's principal silver districts, Calico and Randsburg in San Bernadino County, were developed at different times. Calico, a series of small mines founded in 1881, enjoyed its peak years from 1882 to 1896 and was mined sporadically thereafter. This mine, because of its unusual quantity of high-grade ore, was worked in an unsystematic fashion that left much of the lower grade ore untouched. In Randsburg, the Kelly Mine opened in 1919 and produced the largest silver output of any mine in California until its closure in 1942. Shasta, Calaveras, Kern, Mono, Nevada and Plumas counties also produced significant quantities of silver (Stewart 1957b:529-531).

Silver is mined with typical underground methods, and depending upon the purity and quality of the ore, undergoes several types of treatment. The pure ore, or silver chloride, in the Calico Mine District, is handled differently than base metal ores from other mines in which the silver must be extracted and separated. Silver is derived from these base metal ores the same way as copper, zinc, and lead; it is further separated by means of mercury amalgamation or smelting. Cyanide leaching, introduced in the 1890s, was another popular form of derivation. Smelting and cyanidation became common practices and were often preceded by concentration (Stewart 1957b:533-534).

For additional information on silver mining refer to H.G. Hanks' (1884) *Silver in California,* J.L. DeLeen's (1950) *Geology and Mineral Deposits of the Calico Mining District*, and Donald Carlisle's (1954) *Base Metal and Iron Deposits of Southern California*.

### STRONTIUM

Strontium is a soft silver-white or yellowish metallic element of the alkali metal group that turns yellow in air; it occurs in celestite and strontianite. Strontium and its compounds have but a few commercial uses. Some compounds are added to glass and ceramics to give them a beautiful red color. Compounds of strontium are also used to provide the red colors seen in a fireworks display. Celestite is the major source of strontium. Although celestite deposits occur in Arizona and California, domestic production of celestite has been small and sporadic. Much of the strontium demand is satisfied by imported ores from England and Mexico. Strontium nitrate is used in pyrotechnics, railroad flares, and tracer bullet formulations. Strontium hydroxide forms soaps and greases with a number of organic acids which are structurally stable, resistant to oxidation and breakdown over a wide temperature range.

First mined in San Bernadino County's Avawatz Mountains in 1911, strontium was a minor product of California's mining industry. Most California deposits of strontium are found in the southern part of the state, specifically in San Bernadino County, where two of California's three largest deposits are located. Strontium mining in California generally occurred during World

War I and II, when it was needed for flares, tracer bullets, signal rockets, and other related products (Ver Plank 1957c:607). It is also used heavily in the pyrotechnics industry. Several strontium-producing plants were constructed in California during these periods.

The largest known deposit of strontium is the Cady Mountain deposit, located on the southern slope of San Bernadino County. Work began on this low-grade deposit in 1916 at the onset of World War I when imported strontium from Germany and Britain became unavailable due to shipping and importing restrictions. With a few exceptions, the reintroduction of cheaper British and German strontium nitrate after the wars terminated strontium production in California. During World War II, the deposits of San Diego County's Fish Creek Mountain provided nearly 20 percent of the national strontium output. A third major deposit in the Mud Hill area near Barstow in San Bernadino County also contributed to war-time production (Ver Plank 1957c:607-611).

Studies of strontium in California include Adolf Knopf's (1918b) *Strontianite Deposit Near Barstow, California,* and Cordell Durrell's (1953) *Geologic Investigations of the Strontium Deposits of Southern California.*

### SULFUR

Sulfur is found in meteorites, volcanoes, hot springs, and as galena, gypsum, Epsom salts, and barite. Uses of sulfur are varied. Sulfuric acid is used widely for industrial explosives, petroleum refinement and chemical production. Industries that make use of non-acid sulfur include fertilizer producers and pulp and paper manufacturers. Sulfur production in California was ultimately hindered by low-grade product, high transportation costs and out of state competition (Lydon 1957:618, 622).

Sulfur has been mined in several California counties, including Alpine, Lake, Shasta, Colusa, Kern, Inyo, and Imperial. The Leviathan Mine, California's largest sulfur mine and located nine miles from Markleeville in Alpine County, was opened in 1863 for the purposes of mining copper and gold. It was abandoned shortly thereafter and reopened in 1894 for copper mining. The mine was opened again for sulfur production in the early 1930s by the Leviathan Sulphur Company. This mine was excavated using open pit and underground methods, in which the ore was drilled, crushed, and then sorted according to grade. The ore was often transported elsewhere for further refinement and treatment (Lydon 1957:613-614).

In 1906 the Leona Heights sulfur mines opened east of Laundry Farm Canyon in the Oakland hills. A bunker was built at the Car Barn site in Laundry Farm Canyon, which connected aerial cable tramways to the sulfur mines, and later rock quarries, in the hills above. The mines were the project of Franics Marion "Borax" Smith, who made a fortune in Oakland, but fell into bankruptcy in 1913. The sulfur mines frequently caught fire and had to be abandoned. With miles of tunnels, they were played out by 1929 (Mix 1999).

Inyo County's Last Chance Mine produced over one-third of the native sulfur in California. These deposits were accessed mainly by underground methods, although open cut methods were used on limited occasions. The region's peak period of production, 1928-1943, was curtailed due to lack of water near the mines along with difficult and expensive transportation methods to bring the mined product to refineries and markets (Lydon 1957:614-615).

Other significant California mines and deposits feature the Full Moon (1928) and the Coyote Mountain deposits in Imperial County. Both of these deposits were mined using underground and open pit techniques. Kern County experienced minor production in 1893 in the Sunset Oil District. Lake County's Sulphur Bank Mine, operated by the California Borax Company, experienced a brief period of production from 1865 to 1868, until high amounts of cinnabar complicated the refining process and hastened the demise of the operation. The Sulphur Bank Mine reopened in 1873 for the purpose of mining quicksilver (Lydon 1957:614-616).

For more information on sulfur, refer to E.D. Lynton's (1938) *Sulphur Deposits of Inyo County, California*, W.B. Tucker and R.J. Sampson's (1938*) Mineral Resources of Inyo County*, W.B. Tucker's (1942) *Mineral Resources of Imperial County*, and D.L. Everhart's (1946) *Quicksilver Deposits a the Sulphur Bank Mine, Lake County, California*.

### TALC AND SOAPSTONE

Talc or soapstone (also known as steatite) usually occurs in flaky, foliated or massive forms, and in plates that appear to be tabular crystals. It also forms with chlorite and a few other substances, and varies in color from white to greenish yellowish, red, and brown. All varieties are soft and all have a soapy feeling. Early California settlers used soapstone found in the Sierra Nevada for construction materials, furnace foundations and linings, and other domestic purposes. Ground talc or soapstone was also used for stoves, headstones for cemeteries, and in rare instances for building construction. In the twentieth century it was used extensively as a lubricant to line acid vats and laundry tubs as well as for table tops and sinks.

Talc mining techniques are primarily underground methods in which the rock, after being blasted, is fed into ore cars by gravity then crushed and ground. Talc is easily accessed to around 200 feet, and with increasing difficulty, and expense to around 500 feet. A variety of industries including ceramics, rubber and paper manufacturing, textiles, pharmaceuticals, and asphalt were reliant upon talc (Wright 1957a:631-633).

Most of California's talc is found in the southeastern part of Death Valley's Kingston Range, including parts of Inyo and San Bernadino counties. Smaller deposits have been found and mined on the western slopes of the Sierra Nevada range and Los Angeles County (Wright 1957a:623).

Mining of soapstone and talc was sporadic until 1912 when several mines, including the Talc City, Western, and Silver Lake, were opened in southeastern California. When foreign talc supplies were severed during World War I, these mines became essential sources of talc. In the 1930s, increased use of talc in tile and paint production and high frequency electrical insulators helped propel the industry to higher levels of production. Important mines during the 1930s and 1940s were the Alliance, Florence, White Eagle, and White Mountain Mines in the Inyo Mountain area; the Ibex, Monarch and Superior within the Death Valley Kingston Range; and several small, active mines in the Yucca Grove area. World War II helped sustain domestic need for talc which carried over into the post war era's construction boom (Wright 1957a:633).

For additional information on talc see L.A. Wright's (1950) *California Talcs,* R.S. Lamar's (1952) *California Talc in the Paint Industry*, T.E. Gay and L.A. Wright's (1953) *Geology of the Talc City Area, Inyo County, California*, and J.W. Lennon's (1955) *Investigation of California Talc Use in Wall Tile.*

### TUNGSTEN

Pure tungsten is a light gray or whitish metal that is soft enough to be cut with a hacksaw and ductile enough to be drawn into wire or extruded into various forms. If contaminated with other materials, tungsten becomes brittle and is difficult to work with. Tungsten has the highest melting point of all metallic elements and is used to make filaments for incandescent light bulbs, fluorescent light bulbs, and television tubes. As the hardest commonly used metal, tungsten is employed for a variety of industrial purposes including the construction of alloy steels, metal cutting tools such as knives, hacksaws and razor blades, armor plating, and rails (Stewart 1957c:665). Tungsten expands at nearly the same rate as borosilicate glass and is used to make metal to glass seals. Tungsten is also used as a target for X-ray production, as heating elements in electric furnaces. Tungsten is alloyed with steel to form tough metals that are stable at high temperatures.

The first tungsten mining reportedly occurred in California around 1905, the same year commercial production began. Tungsten was geologically connected with the formation of the Sierra granitic batholith, and deposits of the metal occurred along the slopes of the Sierra Nevada from Kern and San Bernardino counties north to Madera and Mono counties. It was mined underground like the metals with which it was found, then gravity or flotation methods were used along with concentration tables at most tungsten mills (Stewart 1957c:662). During the 1910s tungsten was extensively mined in Inyo County near Bishop, in an area known as the "Tungsten Hills." The Pine Creek Mine near Bishop in Inyo County was the principal producer of tungsten in both the state and nation, and held the largest known reserves. It also produced molybdenum, copper, silver, and gold. During World War I the demand for tungsten grew and consequently so did tungsten production. The demand for tungsten waned after the war and many of the Bishop mines closed or curtailed production during the 1920s. Between 1921 and 1922 there was no production at all, followed by peaks and lulls through 1940. Production of tungsten again increased during World War II and again decreased after the war (Tucker 1921:301-305; Norman and Stewart 1951:85-98). By 1950, some 40,000 short tons of 60-percent tungsten were processed (Jenkins 1950:355–361).

Additional information on tungsten can be found in K.B. Krauskopf's (1953) *Tungsten Deposits of Madera, Fresno and Tulare Counties, California,* and J.F. Partridge's (1954) *Tungsten Resources of California.*

## ZINC

Zinc is recovered through standard underground mining methods. Once extracted, the ore, depending on its quality and composition, is milled and smelted. Zinc concentrate is produced by means of selective flotation. Prior to 1915, the only commercial method of producing electrolytic zinc was the distillation process, in which the ore concentrate was roasted in a natural gas fired, circular, multiple-hearth roaster. Zinc's usage is varied, including military products, brass products, die castings, and as chief agent for galvanizing (O'Brien 1957:702; 706).

In California, zinc came from two major sources: lead and silver mines in the eastern California deserts, and as a by-product of the copper mines in the Sierra foothills and Shasta County. Although zinc had been detected during early gold and copper mining operations, it was not commercially produced in California until 1906. Between then and 1950 some 186 million pounds were produced. California counties producing zinc included Calaveras, Orange, Inyo, Shasta, and San Bernardino. In Shasta County, zinc ores were associated with copper. Between 1928 and 1943, virtually all of California's zinc production came from mines in the desert, as copper mining largely ceased in the rest of the state (Jenkins 1950:364–367). The primary uses of zinc during the twentieth century included galvanizing (which involves placing a thin layer of zinc on steel), making brass (using copper), die casting, as well as producing dry cell batteries, paint, and miscellaneous alloys (Palmer 1991:1).

Between 1911 and 1916, Orange County's Cerro Gordo District, noted primarily for lead, yielded high amounts of zinc. Until the outbreak of World War I, which heavily increased zinc production, zinc was mainly seen as a hindrance to copper production, causing much of California's zinc-rich ore to remain untouched. In 1915 General Electric constructed an electrolytic zinc plant in Shasta County, which was followed with a similar plant in 1917 by the Mammoth Copper Company and various smaller operations throughout 1918. By 1919 the end of the war had caused a sharp decline in zinc prices, inducing California's zinc operations to cease production (O'Brien 1957:699-702).

Zinc production resumed in 1925 with the construction of a large filtration plant on Santa Catalina Island utilizing seawater to treat locally produced ore. The brief resurgence of zinc production came to an end as Shasta County's zinc-copper operations and Catalina's treatment facility were shut down in 1927 and 1928, respectively. Most production during this period occurred in Inyo, Orange, and San Bernadino counties where it was derived from carbonate ores. World War II stimulated California's zinc industry as the U.S. government called for an increase in "strategic" minerals in 1942. In 1943 over ten plants were in operation, and by 1945 large filtration plants had been constructed to concentrate the ores extracted from mines in Butte, Mariposa, Shasta, and Calaveras counties (O'Brien 1957:701-702).

Bulletins and reports related to zinc production and usage in California include W.B. Tucker's (1927) *Mineral Resources of Santa Catalina Island*, William F. Kett's (1947) Fifty *Years of Operation by the Mountain Copper Company, Ltd. in Shasta County, California*, and R.B. Maurer and R.E. Wallace's (1953) *Gold, Silver, Copper, Lead and Zinc Production in California.*

## THE GOLD RUSH

Although gold was found in California prior to 1848, the discovery of gold at Sutter's Mill along the South Fork of the American River in January 1848 was, without question, the catalyst that led to the California gold rush. James Marshall was reportedly the first person to discover gold at Sutter's sawmill, as he recounts in "Marshall's Narrative," published first in *Century Magazine* in February and May of 1891 (Osborne 1968). While debate still continues as to who was first to discover gold at Sutter's Mill, the implications of the discovery were monumental to the future of the region.

Between 1848 and 1850, as word of the gold discovery reached the Eastern United States, South America, Hawaii, and later China and Europe, an ever-growing number of Argonauts entered California's mining regions. While the most enduring image of the gold rush is an eager, grizzled prospector kneeling alongside a stream with his pick and pan, in actuality most Argonauts who came to California were young and part of a company or partnership that generally mined together, pooling money to build coffer dams, flumes, ditches, sluice boxes, and other equipment needed to increase their chances of finding gold.

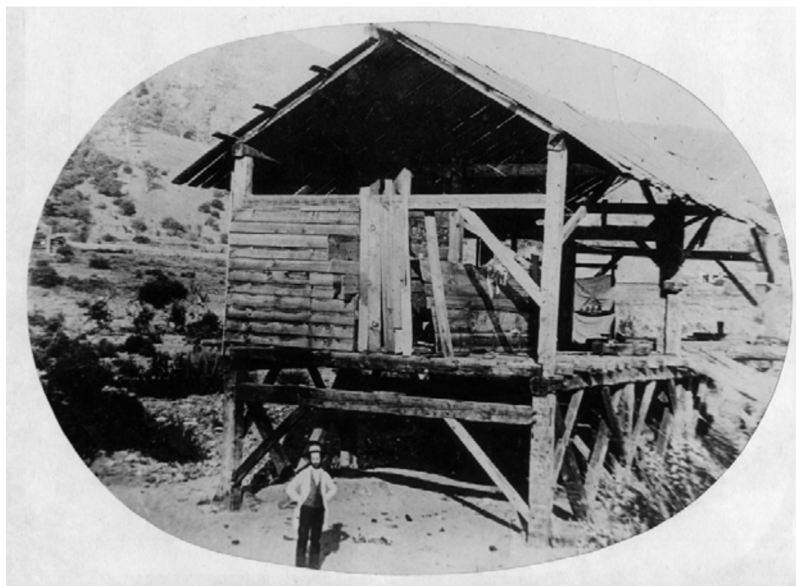

***Figure 14: Sutter's Mill Soon After Abandonment, Coloma, 1853*** *(used with permission, California Department of Conservation, California Geological Survey).*

As difficult as it was for many gold rush miners, some were successful and left the gold fields to pursue a career in many of the fledgling cities that had sprung forth along the Sacramento and American rivers or along the coast. As gold rush historian and author, J.S. "Jim" Holliday acknowledged:

> The California gold rush made America a more restless nation, changed the people's sense of their future, their expectations and their values. Suddenly there was a place to go where everyone could expect to make money, quickly; where life would be freer, where one could escape the constraints and conventions and the plodding sameness of life in the eastern states (Holliday 1981:451).

The first miners to reach the gold-bearing districts of California were generally poorly prepared to deal with the environmental and economic conditions they would find upon their arrival. The state's variable climate was certainly challenging, as was acquiring supplies needed for mining and survival. Long, hot summers in the Mother Lode region created water shortages, and wet, rainy winters resulted in high water and flooding. Without any dams to withhold streams and rivers, ditches, canals, and flumes were built to convey water to particular locations or drain bodies of water to allow access to the bedrock below the auriferous gravels in the center of the stream. Construction of elaborate earthworks took time and capital. While the first Argonauts to reach the gold mines generally found an abundance of gold lain in streams and rivers throughout most of the western slopes of the Sierra, the cost of food and supplies often consumed the profits earned through gold mining.

The gold rush is symbolic in its characterization of the ideas expressed in Manifest Destiny. Rooted in the ideology of wealth and freedom, the gold rush is physically manifest in towns, in the regional expression of vernacular architecture, and extensively documented in photographs, maps, and thousands of books and articles. Defining the gold rush is as challenging as studying its effects on culture and the environment. From an economic perspective, a rational argument can be made that the gold rush had largely ended by 1854-1855, when the bulk of the easy gold placers had diminished to a point that the recovery rate had dramatically decreased. At the same time, emigration into California's gold region had also diminished by 1855. The effects of the gold rush period, however, continued unabated through subsequent decades. As California's mining industry matured, new precious metals discoveries were made, and fledgling mining camps developed into towns and cities.

***Figure 15: Gold Miners Running a Long Tom Sluice at Spanish Flat, El Dorado County*** *(used with permission, California Department of Conservation, California Geological Survey).*

Besides several of the broad overviews mentioned in Chapter 4, perhaps the most important resource for studying the California gold rush is through personal accounts, such as diaries and journals. One of the most exhaustive journals was kept by Alfred Doten, who sailed for California on March 18, 1849 aboard the bark Yeoman (Clark 1973). Doten chronicled almost daily his experiences in the gold country, particularly among the mining camps in Amador and Tuolumne counties. Through Doten's journals a true sense of the gold rush emerges both as an epic event, but also as an ongoing struggle between self, family, and social institutions.

***Figure 16: Wing Dams along the Middle Fork American River, 1859*** *(Courtesy George Wheeldon).*

For many young men, as J.S. Holliday explained, "going west had offered an escape, a new life to farmers, frontiersmen, pioneers, settlers" (Holliday 1981:452). Most Argonauts seemed to have desired some order in California's rough and tumble mining frontier. To that end hastily devised committees or governmental bodies were formed, justice was often dealt in makeshift tents, and while many miners participated in the formation of a civil society during the gold rush, most gold miners spent the bulk of their time performing whatever tasks it took to extract the precious metal from auriferous gravels.

While the desire to attain gold remained strong, the reality of finding gold was countered by natural forces. As Stephen Wing recounts in his journal for January 17, 1853, "it has rained like 60 and blowed like 80 the live long day. I went to the reservoir, Water is howling down the ravines at a fearful rate and the ground is deluged with water" (Gernes 1982:15). Wing's description is particularly noteworthy because prior to the twentieth century when dam building efforts helped regulate water supply in Sierra rivers, natural flows either resulted in massive flooding or the rivers ran nearly dry during the summer months. This uncertainty played havoc for gold rush miners who expended a great deal of capital constructing elaborate flumes, earthworks, and mining machinery within or adjacent to rivers and creeks.

In 1894, David Leeper in his journal described the value of mining in partnership with others around Hangtown [Placerville]:

> Hangtown was, at this period, one of the most important mining camps in the State. Claims were limited to fifteen feet square; so the miners could not work long in a place. Two men usually formed the ephemeral mining partnerships, as by the methods of mining then in vogue that number could generally work together the most profitably. The best diggings I "struck" about here were on Hangtown Creek, a half mile below town, where my partner and I took out, for a while, with a long-tom, fifty to a hundred dollars apiece per day (Leeper 1894:102).

Before the advent of a reliable transportation system and localized agriculture production, miners made do with what was available from local merchants, and in the case of remote claims, only what equipment and food they could carry with them, either by pack animal or on their backs. Muleteers, many of them Chileans, transported products to and from the mining camps. Some mule trains had as many as 100 mules, each carrying around 300 pounds of equipment and supplies (Taylor 1850:281). Transportation of these supplies from shipping centers was expensive, with rates being 20 dollars per 100 pounds of freight (McNeil 1849:28), resulting in miners often paying up to 50 percent more for supplies than those living in more accessible areas (Taylor 1850:281)

Gold mining camps reflected the transitory nature of early placer mining, as miners often wandered from claim to claim in search of better prospects (Paul 1963:72). A few small dwellings often constituted a camp or settlement. These outposts, ranging from a few structures to over a hundred, provided a central meeting point for those working remote claims (Doble 1999:76). Symbolizing "civilization," these camps afforded the miner human contact and a chance to procure basic supplies (Paul 1963:78). Located near the sites of diggings and often found in gulches, atop hills, and other difficult-to-reach areas, early gold rush camps were often crude and in disarray, with little care given to appearance or convenience (Paul 1963:79).

Between 1849 and 1854, typical mining structures were built of logs and clay, crude semi-subterranean dugouts, canvas over a wooden framing, pine boughs, thatch, and stone. South American miners often used hides in place of canvas (Woods 1851:121). To supplement their income, some miners would chop oak wood intended for home construction, with house logs costing one dollar each and cords going for five dollars (Leeper 1894:92). Historic photographs taken in the 1850s vividly portray mining camps composed of timber frame cabins or commercial buildings with split cedar or pine clapboard siding fastened to the exterior walls, some with a chimney on one end made of stone, or wood with a riveted pipe in the center to draw the smoke. Stone was also used for construction, either for all four freestanding walls, or for semi-subterranean dwellings cut into banks.

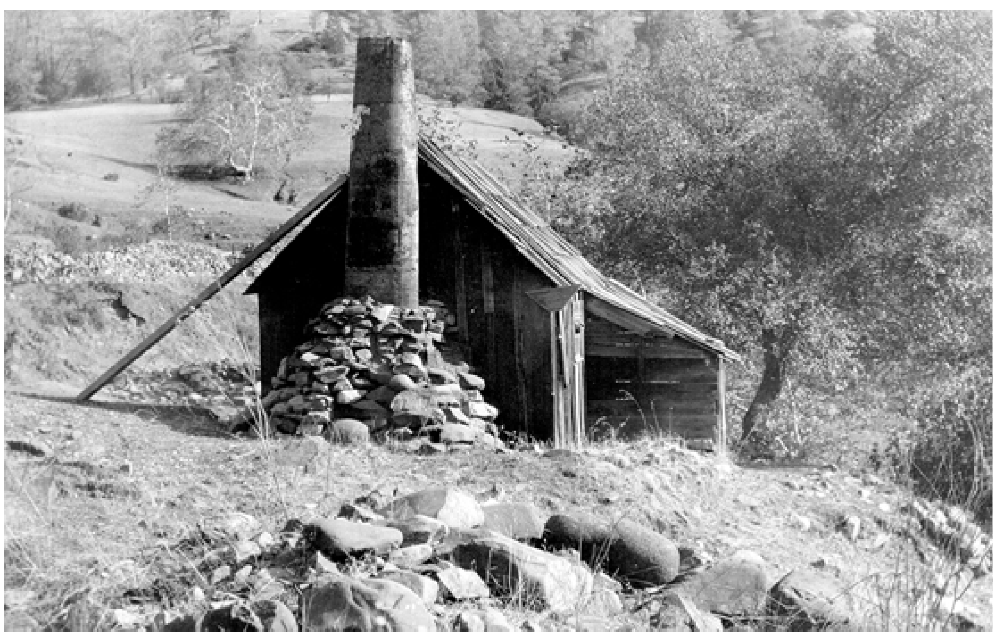

***Figure 17: Miner's Cabin near Bidwell Bar, Butte County, 1906**. Note the riveted pipe and crude stone used to form a chimney (used with permission, California Department of Conservation, California Geological Survey).*

Miners intending to

reside for longer periods of time, or through the harsh winters, built more permanent structures, often incorporating stone with timber. Construction materials included lumber for floors and framing, nails, locks, screws, canvas, clapboards, and an occasion a glass window.

In 1851 D.B. Bates described a typical construction method used in the gold camp of Downieville, California:

> A building would boast of a very slight frame, not boarded, but split clapboard nailed on to the frame, and the outside was finished. Upon the inside, in lieu of laths and plastering, bleached or unbleached cotton cloth is stretched smoothly and tightly, and fastened to the frame. This cloth is then papered over, and it looks as nice as paper upon plastering. The ceiling overhead is nice bleached cloth, sewed together neatly, and stretched so tightly there is not a wrinkle observable. For partitions a frame is raised, and each side of this frame is cloth and paper, leaving a hollow space between the two partitions of cloth, about three or four inches in width (Bates 1857:184-185).

Toward the late 1850s, the early canvas structures gave way to more substantial buildings using milled boards with mortared stone or brick chimneys. Nearly every gold mining camp had merchants selling wares in anything from tents to newly built wood-frame, stone, or brick buildings. But even with improved living conditions, the harsh realities of living and working in the mines during the frigid winters and hot summers persuaded some miners to return home.

The gold rush's effects on mercantilism and commerce were profound. Between 1849 and 1851, virtually all merchandise was transported to California via ships around Cape Horn or through the Isthmus of Panama. Thus, the cost of acquiring both raw and finished products was dictated by the high costs of transportation and the added costs of middlemen and jobbers taking advantage of the new economy.

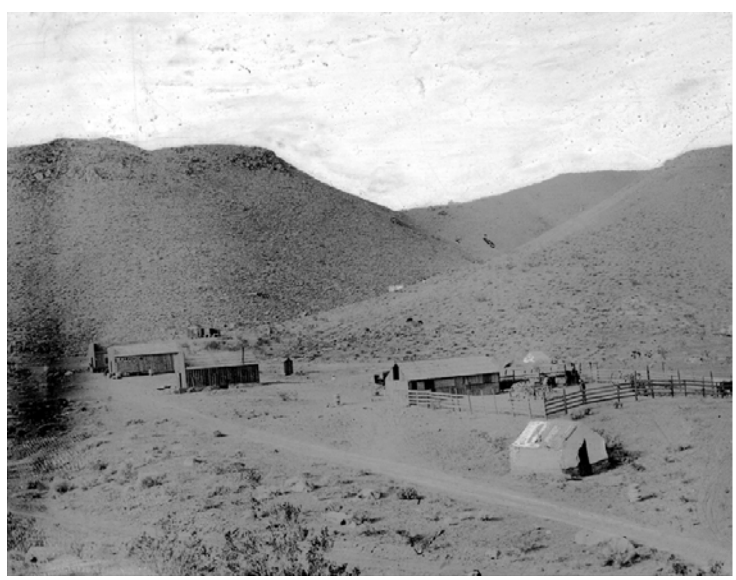

***Figure 18: View of Buildings at Randsburg, Kern County, 1896.*** *Note the canvas structure in foreground (used with permission, California Department of Conservation, California Geological Survey).*

Not only were import costs high, but so was transportation to and from the mines, as Edward G. Buffum noted in his diary:

> We paid three hundred dollars for the transportation, about fifty miles, of three barrels of flour, one of pork, and

> about two hundred pounds of small stores, being at the rate of thirty dollars per cwt. This was the regular price charged by teamsters at that time, and of course there was no alternative but to pay, which we did, although it exhausted the last dollar belonging to our party (Buffum 1850:58).

While the purchasing power of the average miner was being stretched, many business owners during the first few years of the gold rush were doing remarkably well, largely due to the strong demand for both perishable and non-perishable products. As Edward G. Buffum noted, dried beef was selling at "50 cents per pound; coffee 50 cents; shovels $10 each; tin pans $5 do.; crow-bars $10 do.; red flannel shirts $5 do.; common striped shirts $5 do.; common boots $16 per pair; and everything else in proportion" (Buffum 1850:xxiv). Table 4 provides a cost of living comparison to put these prices into perspective.

During the first years of the gold rush the availability of fresh foodstuffs was meager. Buffum describes accommodations and food while visiting Coloma in 1850:

**Table 4: Cost of Living Comparison: 1850 and 2007**

| 1850 | 2007 |
|---|---|
| $0.50 | $12.00 |
| $5.00 | $123.00 |
| $15.00 | $370.00 |
| $20.00 | $495.00 |

*Data Source*: www.westegg.com/inflation/

> We reached the mill [Coloma] about nine o'clock in the morning, a little too late to get a breakfast at one of the stores, where sometimes the proprietor was sufficiently generous to accommodate a traveller with a meal for the moderate price of five dollars. The only resource was to lay a cloth on the storekeeper's counter, and make a breakfast on crackers, cheese, and sardines. In order not to make a rush upon the trade, we divided ourselves into three parties, each going to a different store. Mac and myself went together, and made a breakfast from the following items;--one box of sardines, one pound of sea-biscuit, one pound of butter, a half-pound of cheese, and two bottles of ale. We ate and drank with great gusto, and, when we had concluded our repast called for the bill. It was such a curiosity in the annals of a retail grocery business, that I preserved it, and here are the items. It may remind some of Falstaff's famous bill for bread and sack.
>
> One box of sardines, $16 00
> One pound of hard bread, 2 00
> One pound of butter, 6 00
> A half-pound of cheese, 3 00
> Two bottles of ale, 16 00
> Total, $43 00 (Buffum 1850:81).

While drinking and gambling were reportedly pursued with vigor nearly equal to mining gold, gold rush camps often embraced the creation of religious and social institutions. As Doten commented in his journal, Sundays were generally set aside for leisure and attending to daily chores such as laundry or reading (Clark 1973).

By 1853-54, the halcyon days of the gold rush were quickly coming to a close. As the easily recovered placer gold deposits diminished, miners shifted their focus to quartz deposits that required greater capital to exploit. The cultural diversity of previous years gave way to ethnocentrism and racism, as Native Americans ultimately were extricated from their ancestral homes, and Latin American and Chinese miners were discriminated against. Miners arriving in the gold camps in the 1850s had mixed success at best. Many of those who failed to achieve wealth in California's gold fields relocated to the Bay Area or elsewhere in pursuit of other occupations while others migrated toward the rich silver mines of the Comstock Lode.

***Figure 19: Sunday Morning in the Mines.*** *From an 1872 painting by Charles Nahl. Original in the Crocker Museum, Sacramento (Digital image courtesy of George Wheeldon).*

Notwithstanding the important economic gains to California's economy as a result of the gold rush, the consequences to the state's natural environment were rapid and unprecedented. Bayard Taylor, who mined for placer gold in 1849 and traveled through much of northern California, revisited the state in 1859, and traced his route through Amador and Calaveras counties. Taylor describes the changes he witnessed since his first visit:

> I now began to look out for remembered landmarks; but after a time gave up all hopes of recognizing anything which I had seen before. In 1849, I had traveled this road on foot, plodding along through noble forests, which showered their suspended rain-drops upon my head, rarely catching a view of the surrounding hills. Now, the forests are cut away; the hollows are fenced and farmed; the heights are hot and bare; quartz mills shriek and stamp beside the road, and heavy teams, enveloped in dust, replace the itinerant miners, with wash-bowl on back and pick in hand (Taylor 1862:161).

While many Argonauts like Bayard Taylor returned home, others found employment in the bourgeoning cities of the Sacramento and San Joaquin valleys, and San Francisco Bay Area. Many of the early gold rush mining camps were abandoned, while others attempted to sustain the out-migration during the mid-to late 1850s by diversifying the local industry. Fires, floods and other natural calamities also took a toll on gold rush camps. The lure of gold remained strong in

California's gold regions even after the gold rush, and while mining abated in some areas, mining activity in many areas continued with larger, more capitalized mines increasing production. Small-scale mining also continued well past the gold rush, particularly by Overseas Chinese during the late 1860s and 1870s after leaving the work camps along the Central Pacific Railroad or along the newly built levees along the Sacramento River. The residual evidence of these post- gold rush era miners is present throughout California and forms an important chapter in the state's mining history.

## MINING TECHNOLOGY

A general knowledge of various technologies employed to mine specific minerals is crucial to correctly identifying and evaluating components of mining properties. Chapter 3 contains more discussion on mining technologies and their archaeological signatures.

Equally important is placing a mining property into its appropriate historic context. Simply because a mine was in existence for 100 years does not necessarily mean that its period of significance spanned the entire period of operation. In essence, mining technology was instrumental in defining production, efficiency, and ultimately profit. As underground mining developed during the late nineteenth century, mining technology was also related to mine safety, the stratification of jobs within the mine itself, and the experiences of individual miners and their families.

In many ways California's mining industry proved itself to be the ideal testing ground for new technologies. During the first decade following the discovery of gold in California, San Francisco quickly became a hub for manufacturing, particularly iron. During the early 1850s through the 1870s, San Francisco manufacturing firms such as Union Iron and Brass Works and Vulcan Iron Works, to name just a few, supplied the bulk of the mining machinery used both in California and on the Comstock Lode. By 1867 there were reportedly fifteen iron foundries in San Francisco (Paul 1982:14).

With the establishment of the San Francisco Stock Exchange Board in 1862, needed capital was infused into numerous mining ventures, including those in California and Nevada. This association was followed in January 1872 by the California Stock and Exchange Board, and on June 7, 1875, by the Pacific Stock Exchange.

***Figure 20: Working Gold Placers with a Long Tom or Sluice near Murphy's, Calaveras County, early 1850s*** *(Courtesy George Wheeldon).*

These organizations dealt only in mining stocks. The impetus for the organization of the stock exchange began in the mid-1850s, but it was not until the discovery of the Com-stock Lode in 1859 that the rapid increase of mines prompted their owners to go to San Francisco where they incorporated and issued stock. The exchange helped increase speculation and resulted in greatly increasing the wealth of a handful of mine owners and investors (Kahn 1969).

***Figure 21: Placer Mining on the American River, 1852*** *(used with permission, California Department of Conservation, California). Geological Survey),*

The evolution of mining technology clearly had its roots in the California gold rush, essentially beginning with simple methods of mining placer gold. There were four principal forms of gold placer mining; stream mining, drift mining, hydraulic mining, and dredge mining. Each of the different forms of mining applied specific technologies to extract and process the material to produce gold. All four types of gold mining shared common characteristics and in some cases actually overlapped one another in a practical sense. For instance, many of same tools used in stream mining were later applied in drift mining and hydraulic mining. The variety of tools and equipment used to remove the gold varied with geomorphology, degree of capital investment, and availability of labor and technology.

During the California gold rush, miners fanned out throughout the Mother Lode, southern Sierra Nevada, Siskiyou Mountains, Klamath Range, Tehachapis, and began prospecting in the Mojave Desert. Argonauts explored rivers and tributaries draining the Sierra Nevada and Cascades from the Kern in the south to the Pit and Feather in the north, as well as the major river basins of the northwest coastal mountains, including the Smith, Trinity, and Klamath. Often these areas were subject to minor “rushes” as news of potentially rich strikes leaked out. Even less significant discoveries drew considerable interest, such as the Kern River area and in the Transverse Ranges, as well as discoveries on the east side of the Sierra, including the region surrounding Lake Tahoe. The locations of these early mining areas, and the routes established to access them, laid the foundation for the development of much of the town and transportation patterns existing in the mining regions today.

Much of what is found at a mining site can be divided into two general categories: the infrastructure needed to extract and if necessary process the minerals; and the locations of human habitation, whether short or long-term. The infrastructure of mining properties may be simple or complex and includes features such as shafts, pits, adits, waste rock or tailings piles, ponds, tools, mining and milling equipment, structures, foundations, tramways, trails, and roads. Remains related to habitation may include standing dwellings or structures, rock or concrete perimeter foundations and pads, remnant landscaping, and domestic artifacts such as bottles, cans, ceramics, and personal items (Brereton 1976:286–302). These elements are discussed in more detail in Chapter 3. Property Types.

Understanding the development of mining technology and its requirements for labor and capital are particularly important. Obviously, different periods relied on different technologies and had the advantage of improving on earlier mining equipment. As historian Roselyn Brereton (1976) noted, "the story, then, of California mining techniques, is the elaboration of simple methods." Understandably, much of the original equipment used by gold rush miners, such as the gold pan, rocker, and sluice, continued in use through the 1930s.

Brereton acknowledged that the practical knowledge of precious metals mining had been known for centuries. The placer mining methods used in California were employed in Mexico and South America during the late eighteenth and early nineteenth centuries, and by miners in Georgia and North Carolina in the 1820s and 1830s. Not surprisingly, miners from those regions were influential in providing information about mining techniques (mostly by example) to the largely inexperienced miners of the early years of the gold rush (Brereton 1976:286–302). These included use of the familiar pan (*batea*), Chilean wheel, cradle (rocker), long tom, arrastra, and sluice box. Each was a refinement of the earlier—a cradle handled more auriferous material than did a pan (although a pan was often used as a final step), a long tom was more efficient than a cradle, and a sluice box more efficient (especially when linked in series) than a long tom. Each improvement required more water and capital and generally was more labor-intensive to develop. While refinements occurred throughout the nineteenth and into the twentieth century, miners in remote regions of California generally relied upon simple devices for gold extraction and beneficiation.

***Figure 22: Low-level Hydraulic Mining at the Hocumac Mine, San Bernardino County 1895*** *(used with permission, California Department of Conservation, California Geological Survey).*

### PLACER MINING

The early years of the California gold rush were dominated by placer mining. Placer mining refers to mining for gold that nature has freed from its associated rock and left in the form of nuggets, flakes, grains, or dust. Because this process was associated with erosion caused by water flow, gold found through "placering" was located in streambeds or in

***Figure 23: Using a Rocker or Sluice, 1935*** *(used with permission, California Department of Conservation, California Geological Survey).*

deposits left by ancient streambeds. Placer mining was largely dependent on manual labor and the use of water, so placer sites are typically found along streams, in river canyons, or in tributary canyons. Typical mining equipment included cradles, long toms, sluice boxes, and hand-held equipment (e.g., pans, picks, and shovels).

Among the earliest and most persistent methods of placer mining, particularly on a small scale, was "dry" placer mining, which did not use water in the process. In some cases placer material was stored until sufficient water became available to wash the material either through a pan or sluice. As the years passed, more elaborate methods of placer mining gradually replaced the miner with his pick and pan, including river mining with dams and water-driven pumps, ditch-fed sluicing systems, booming and other nascent versions of hydraulicking, and sinking drifts into ancient gravels.

The earliest instrument used in gold placer mining was the gold pan or *batea*. The gold pan was used in prospecting, cleaning gold-bearing concentrates, and hand-working deposits (Averill 1946:21). The earliest gold pans were generally made from several sheets of metal soldered together on both the base and side seams. Sizes varied from 15 inches to 18 inches in diameter at the top, and from two inches to two and a half inches in depth, with a side slope of about 30 degrees. When amalgamation was required, the pan was made of copper or had a copper base or bottom. Skilled placer miners could move half to one cubic yard through the pan in a 10 hour period (Averill 1946). The *batea* was successfully developed by Mexican and Chilean miners and brought to California during the gold rush. Generally made of wood, instead of a flat bottom, the *batea* had a convex bottom or cone shape. Some miners claimed the *batea* was better at holding fine gold, as opposed to metal gold-pans (Averill 1946:22). Because they were made of wood, the chance of finding a *batea* intact in an archaeological deposit is very remote.

The rocker is a machine designed to save or recover gold from auriferous sands and gravels by concentration, sometimes in conjunction with amalgamation. Besides the pan, the rocker was one of the most common tools used during the California gold rush, largely because it could easily be transported from one location to another, and was relatively simple to construct and repair when needed. While finding intact rockers on archaeological sites is extremely rare, it is not unusual to find components used in its construction, such as grizzlies made of metal sheets with perforated holes.

Another important recovery device is the sluice. From the California gold rush through the Great Depression, the sluice took on various iterations, including the long tom, puddling box, or dip box (Averill 1946:28-29). Sluicing involves washing auriferous gravels through the box with a fork, which looks like a hay fork with flattened teeth. The coarser gravel is removed when washed clean, which also keeps the sluice box from clogging. Clean-up generally occurred at the end of the day, or as often as needed to recover the gold. Sluice boxes may be as long as 12 feet with a slope from five to 18 inches. Riffles, made of wood or perhaps sheet iron, were placed at the bottom of the box to catch the gold.

E. Gould Buffum provides the following description of working gold placers along the Yuba River in 1850:

> The manner of procuring and washing the golden earth was this. The loose stones and surface earth being removed from any portion of the bar, a hole from four to six feet square was opened, and the dirt extracted therefrom was thrown upon a raw hide placed at the side of the machine. One man shovelled the dirt into the sieve, another dipped up water and threw it on, and a third rocked the "cradle." The earth, thrown upon the sieve, is washed through with the water, while the stones and gravel are retained and thrown off. The continued motion of the machine, and the constant stream of water pouring through it, washes the earth over the various bars or rifflers to the "tail," where it runs out, while the gold, being of greater specific gravity, sinks to the bottom, and is prevented from escaping by the rifflers.
>
> When a certain amount of earth has been thus washed (usually about sixty pans full are called "a washing"), the gold, mixed with a heavy black sand, which is always found mingled with gold in California, is taken out and washed in a tin pan, until nearly all the sand is washed away. It is then put into a cup or pan, and when the day's labour is over is dried before the fire, and the sand remaining carefully blown out. (Buffum 1850:50-52).

***Figure 24: Hydraulic Mining at Michigan Bar, Sacramento County 1860.*** *Waterfalls in background are ground sluices. Locomotive lamps to right of frame are for nighttime flood lights (used with permission, California Department of Conservation, California Geological Survey).*

Buffum's discussion of the art of using a rocker or cradle illustrates the attention that gold miners paid to the art of gold extraction. As the gold rush came to a close and new mineral discoveries drew the attention of California miners to other areas of the western United States, other forms of mining revolutionized the industry and created new opportunities for the expansion of mining into areas not yet exploited.

While the easy placer gold in most California streams had disappeared by the mid-1850s and placer mining declined throughout the late nineteenth century, placer gold deposits continued to be exploited well into the twentieth century. Although there have been numerous publications that address the development of placer mining in California, perhaps the most comprehensive study was carried out by Mining Engineer Charles Volney Averill, in *Placer Mining for Gold in California*, State of California Division of Mines *Bulletin 135*, October 1946. Of particular importance in Averill's study was a discussion of "small scale placer mining," focusing largely on the period between 1932 to 1937, following the increase in the price of gold from $20.67 to $25.56. During the late 1920s and 1930s, a wide variety of gold recovery machines were being advertised. They included the Bodinson Sampling Machine, Denver Mechanical Gold Pan, Denver Trommel-Jig Unit, and the G-B Portable Placer Machine, to name just a few.

### HYDRAULIC AND DRIFT MINING

**Table 5: Volume of Placer Gravels Processed by Mining Technique**

| Method | Number of Miners Required | Yards of Gravel Processed in a 10 Hour Day |
|---|---|---|
| Panning | 1 | 1-1.5 |
| Cradle | 2 | 3-5 |
| Long Tom | 2-4 | 4-6 |
| Hydraulic | 6-7 | 2,000-5,000 |

*Data Source*: Palmer 1992:14.

As the Argonauts learned the characteristics of buried placer deposits, they turned to other methods that were more efficient but had more pronounced effects on the landscape. Miners quickly learned that rich placer deposits might be found in the Tertiary gravels left in the bed of ancient rivers in the mountains. Millions of years old, the gravels were the remnant deposits of ancient rivers that had run through the region at angles to the modern streams and were marooned as the Sierra Nevada's granitic batholith was uplifted altering drainage patterns. Extracting these gold-bearing gravels required application of new technologies because they were overlaid with other deposits that required removal. The result was development of two different methods: hydraulic mining and drift mining. Table 5 illustrates the powerful nature of hydraulic mining vs. other forms of placer mining. The development of hydraulic mining was among the most important achievements in placer gold mining technologies of the nineteenth century. While hydraulic mining had the potential to improve rates of recovery, access previously buried deposits, and increase productivity, the technology had profound effects on California's environment, leaving lasting scars on the earth, debris in the canyons and rivers, and a complex network of canals and ditches that shifted water to mining areas remote from their sources.

Water conveyance systems were integral for successful hydraulic mining operations (for an in-depth discussion of water delivery systems in California, refer to *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures*, JRP Historical

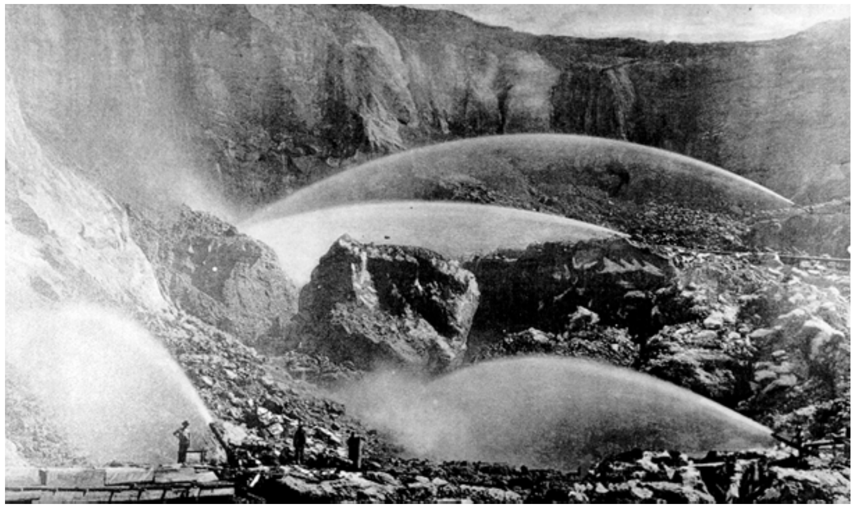

***Figure 25: North Bloomfield Mine (Malakoff Diggins), Nevada County, 1890*** *(used with permission, California Department of Conservation, California Geological Survey).*

Consulting Services [JRP] and Caltrans 2000). Hydraulic miners employed water under great pressure to wash away the overburden and to run gold-bearing gravels through elaborate systems of sluice boxes. The water cannons most often seen in historic photographs, called monitors, were used to remove the "waste" or overburden; smaller monitors were used to wash the gold-bearing gravels into the sluice systems. In large-scale hydraulic operations, substantial investment capital was necessary to carry out the diverse range of operations, including the construction of ditches and canals needed for the mine to be successful.

Hydraulic mining's heyday was from the 1860s until the mid-1880s, when one of the nation's first environmental lawsuits, *Woodruff v. North Bloomfield Gravel Mining Company*, and the subsequent *Sawyer Decision* of 1884, led to its strict control and effective end. The story of its development—the invention of the monitor by Edward E. Matteson, and the perfection of practical water delivery methods by builder and entrepreneur Antoine Chabot—in the early 1850s is an oft-told tale, in which Matteson adapted a canvas hose to use an iron nozzle to more efficiently work his claim, and Chabot made a fortune in developing dam and ditch systems to supply miners with water (May 1970).

***Figure 26: Men Astride Giants (monitors) at the La Grange Mine, Trinity County, n.d.*** *(used with permission, California Department of Conservation, California Geological Survey).*

Hydraulicking's rise led to mining canals feeding mines from Plumas to Tuolumne counties, as well as in the Siskiyous and Trinity mountains. Mining historian C.A. Logan (1981:194) noted, "in 1867, there were 5328 miles of main canals, with probably 800 miles more of branch ditches built at a cost of $15,575,400." The main ditches were typically eight to 15 feet wide at the top, four to six feet wide at the bottom, and three or more feet deep. Steep hillsides and deep ravines were traversed with wooden flumes and heavy iron pipes, 20 to 40 inches in diameter. These systems were often converted for use in the state's irrigation and hydroelectric generating systems after the hydraulic mining era passed (JRP and

Caltrans 2000:38–50). One of the most famous hydraulic mining sites has been preserved in the Malakoff Diggins State Historic Park; it is a stunning example, but is by no means the only one in the region.

Drift mining, a variant method of exploiting the ancient gravels on high, dry hillsides, involved driving tunnels or drifts into the gravel beds and then processing the extracted material. It was employed where the overburden was too deep for hydraulicking, or where water was less readily available. The Foresthill area of Placer County was among the most celebrated drift mining areas, although drift mines appeared throughout the state, including hill diggings in El Dorado County.

### DREDGE MINING

The final refinement of placer mining, which occurred largely after 1900, was dredging. Mining historian Clark Spence noted that "gold dredging would apply the mass production of Henry Ford's America to placer deposits, again enabling profitable working of ground heretofore untouchable" (Spence 1980:401–414). Successful dredges are largely a twentieth-century invention. Although unsuccessful efforts, particularly along the Yuba River, were made in the 1850s, attempts at dredging were largely abandoned in California by the 1880s. The first successful bucket or bucket-line dredges in the United States appeared in Montana at Bannack in 1895. Models began appearing in California in 1897, and by 1898 Wendell I. Hammon began dredging near Oroville. Dredge mining fields were generally located at low elevations, typically where rivers or major tributary streams emerged from the mountains, such as around Oroville, Marysville, Folsom, and Merced. Dredges were also employed at large placer fields in river canyons, such as along the Klamath and Trinity rivers. By the first decades of the twentieth century, dredging became efficient, profitable, and a big business; major investors in dredging companies were among the wealthiest individuals and corporations in the nation. Later, during the Depression Era, dragline or "doodle-bug" dredges came into use. These dredges used a dragline to gain access to gold bearing gravels, rather than the continuous line of buckets on earlier dry-land dredges. Dragline systems also had processing equipment separate from the digging mechanisms.

***Figure 27: American Gold Dredging Company, Shasta County, 1922*** *(used with permission, California Department of Conservation, California Geological Survey).*

Dredging was less financially risky and more profitable than most forms of mining because modern methods, such as test holes, could predict production levels with accuracy. A modern dredge would typically

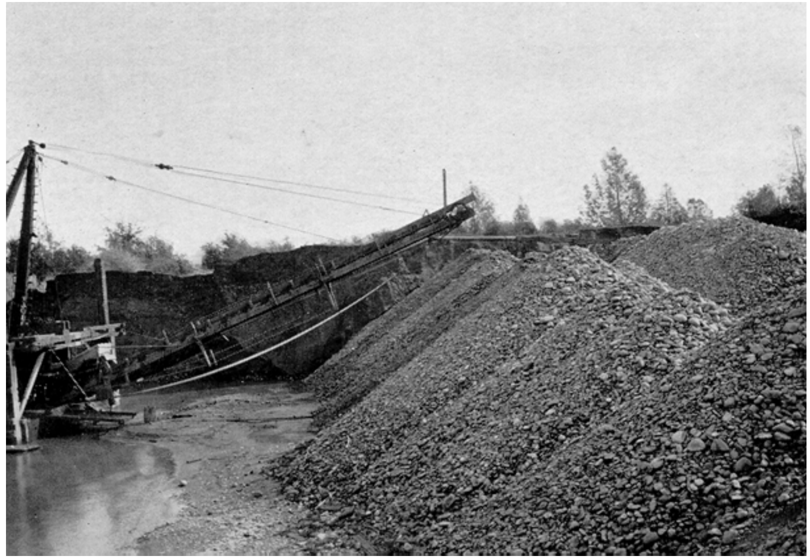

*Figure 28:* ***Dredge Tailings, Lava Beds Dredging, Butte County, 1901.*** *Note height of tailings pile (used with permission, California Department of Conservation, California Geological Survey).*

run 18 hours a day, seven days a week. The companies maintained machine shops to keep the massive equipment in repair (Spence 1980:404–414). By 1905 the dredges used a system of revolving screens and shaking tables to separate gold from sand and gravels. According to Logan (1981:194), "since then, this type of dredge has been put on practically every gold-bearing river in Northern California, but the most important fields have been Yuba River near Hammonton, American River near Folsom, and Feather River near Oroville." Placers exploited by the dredges were also the source of most of the platinum found in California; early placer miners had discarded the metal as worthless. The dredges in these locations operated into the mid-1960s. Logan reported that the capacity of a large modern dredge reached 125,000 cubic yards of gravel per year. In 1948 the modern dredge *Yuba No. 20* was 540 feet long, with a chain of 135 buckets of 18 cubic-feet capacity, able to reach gravels 124 feet below the water line. Yields of 10 to 15 cents of gold per cubic yard were mined at a cost of five to 10 cents. The modern dredge operated with a crew of only three or four men per shift. Prior to World War II, there were about 200 such dredges in operation (Jenkins 1950:343; Spence 1980:401–414; Logan 1981:194). To put the size of massive dredgers like *Yuba No. 20* in perspective, it was more than half the length of the famed ocean liner *Queen Mary*.

Such machines caused substantial damage to the environment. Mining historian Spence noted that the tailing piles in long rows were the signatures of the industry. He also observed that, because their operation was largely before the era of environmental regulation and its wastes tended to be confined within the mining claim, the industry largely escaped serious regulation. These tailing piles were often mostly sterile gravels and cobbles on which vegetation was slow to grow; requirements for "resoiling" were defeated in court and largely ineffective when attempted (Spence 1980:401–414). Dredging continued in California after World War II, but in very limited locations. Much of the older dredge mining equipment was disassembled and shipped to other gold fields around the world.

### LODE MINING

Miners during the gold rush were quick to realize that gold existed in quartz veins, and attempted to mine it. The importance of lode mining to California's economy was significant, particularly after 1857, when the recovery rates of placer gold had greatly diminished.

One of the earliest, and perhaps simplest inventions for processing ore was the arrastra. In situations where access was poor or capital was limited, or during the exploratory phase of development, an arrastra was built. In 1869 John S. Hittell provided a detailed description of this device:

> The arrastra is the simplest instrument for grinding auriferous quartz. It is a circular bed of stone, from eight to twenty feet in diameter, on which the quartz is ground by a large stone dragged round and round by horse or mule power. There are two kinds of arrastras, the rude or improved. The rude arrastra is made with a pavement of unhewn flat stones, which are usually laid down in clay. The pavement of the improved arrastra is made of hewn stone, cut very accurately and laid down in cement [clay and lime]. In the centre of the bed of the arrastra is an upright post which turns on a pivot, and running through the post is a horizontal bar, projecting on each side to the outer edge of the pavement. On each arm of this bar attached by a chain a large flat stone or muller, weighing from three hundred to five hundred pounds. It is so hung that the forward end is about an inch above the bed, and the hind end drags on the bed. A mule hitched to one arm will drag two such mullers. In some arrastras there are four mullers and two mules. Outside of the pavement is a wall of stone a foot high to keep the quartz within reach of the mullers (Hittell 1869a:278-279).

Thad M. Van Bueren's (2004) essay , "The 'Poor Man's Mill': A Rich Vernacular Legacy," in *IA, the Journal for the Society of Industrial Archeology,* provides a comprehensive history of the types of arrastras found in California and the West, how they were constructed and used, and their persistence through time.

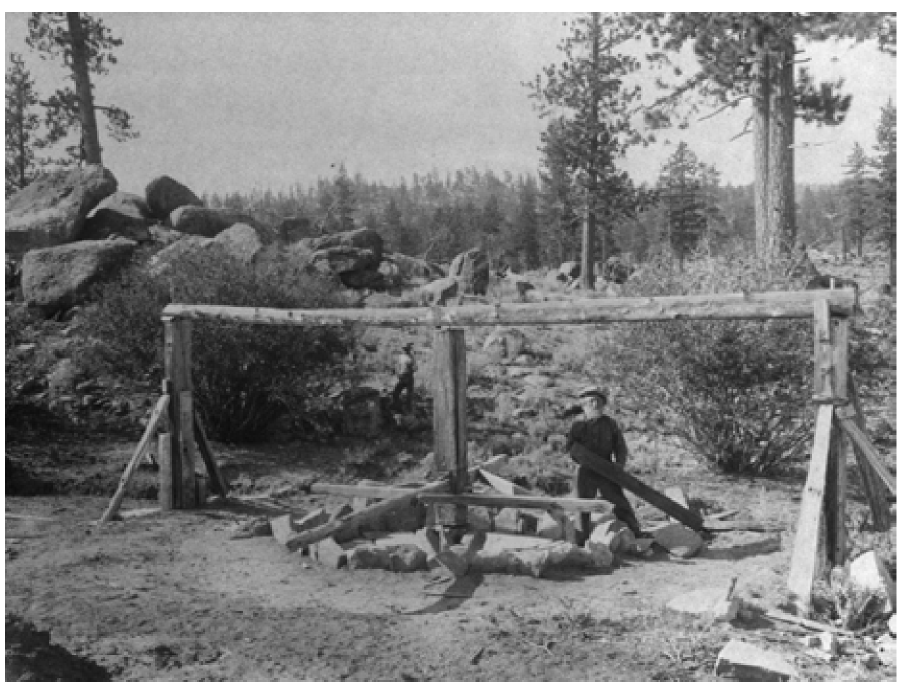

***Figure 29: Arrastra in the High Sierra, circa 1900*** *(used with permission, California State Department of Conservation, California Geological Survey).*

Underground mining had specific requirements that were lacking in simple placer mining. It required technical engineering expertise to design the requisite infrastructure above and below ground. While at first the basics of this knowledge were often self-taught, as the years went on and mines went deeper below ground, specialized technical expertise became more and more critical. Processing the ore involved the application of heavy equipment coupled with motive power. Ores had to be crushed to release their gold. Miners generated power for the crushers and for mining equipment by using high pressure water wheels, steam, and later, electricity.

The ore often required chemical treatment, through the application of mercury, acids, cyanide, and other solutions, to release the gold from the compounds in which it was found. Hard rock mines, particularly the larger ones, needed hired labor to operate; of course, this meant that the mine needed to meet payrolls no matter the day-to-day yield of the veins. As the years progressed, mining geologists became a requirement at major mines. Lastly, the need for technical expertise, heavy equipment, chemical plants, and labor meant that mine owners needed ready access to financial markets and investors to fund development and operations. Investors needed surety that a mine's claims were valid, and that its veins had sufficient potential yields to provide return on investment (Paul 1947). As mining historian Rodman Paul explains:

> Mining had started as an adventure in which men engaged with little capital and less knowledge. Gradually it had become a business conducted upon the basis of common sense rules that had been learned through practical experimentation. Now (in the early 1870s) it was being transformed into a modern industry in which the dominant figure was not the "honest miner" who dwelt in the Sierra's foothills, but rather the financier in San Francisco or London, and the highly paid consultant or superintendent who made of mining a science and a profession. With the attainment of that stage, the industrial revolution was complete. Then truly it could be said that mining had come into its full development— that it had passed from the disorganized splendor of its youth to the ordered stability of its maturity (Paul 1947:310).

***Figure 30: A Crew of Miners (Cornish) Ascends in Skips, Empire Mine, Grass Valley, 1900*** *(used with permission, California Department of Conservation, California Geological Survey).*

Underground mining did not experience a smooth upward path. In 1858 there were more than 280 stamp mills in California, each supplied by one or more veins. By 1861 only 40 to 50 were still in operation. Numbers fluctuated in the years that followed. Hand drills and black powder were common up to 1868, when miners and mining companies began converting to advancements such as power drills and nitroglycerine-base dynamite. It took decades before those became common. Rock crushers, like the Blake Crusher, were introduced in 1861. As mining historian C.A.

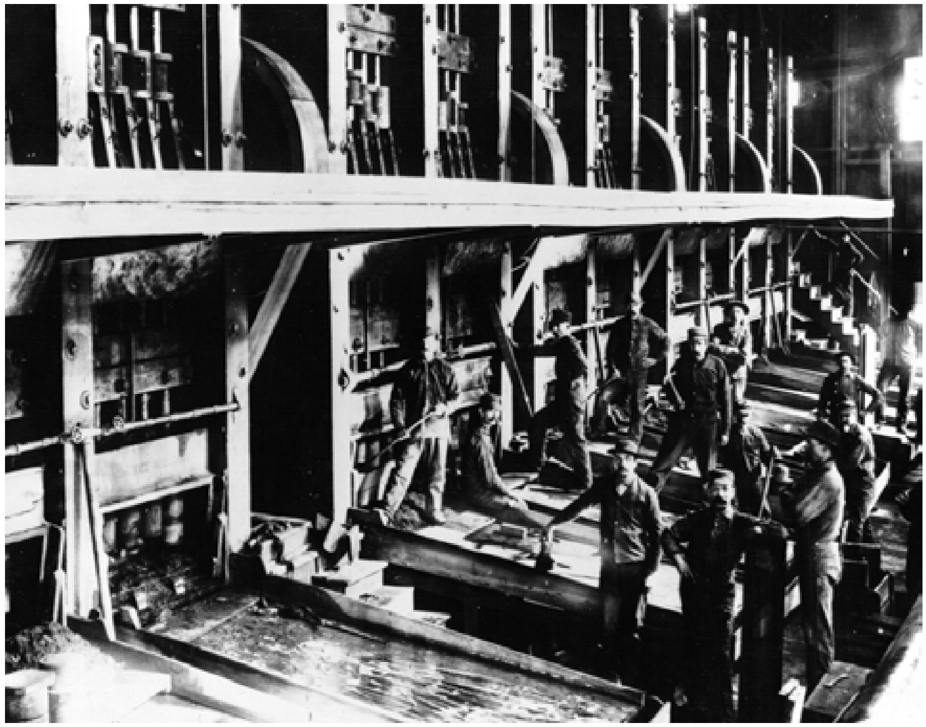

***Figure 31: Yellow Aster Mine Stamps, Kern County, 1912*** *(used with permission, California Department of Conservation, California Geological Survey).*

Logan remarked, "the self-feeder, the rock breaker, heavier stamps, and increased running speed gave the stamps greatly increased capacity" (1981:195–196).

Likewise, ore concentration methods became more technologically advanced as the years progressed. By the 1880s the Frue vanner and endless rubber belt vanners more efficiently concentrated the stamp mills' output, along with mercury tables, and other equipment. The development of chemical processes such as chlorination, used in conjunction with concentrators, increased the plants' efficiency further. Chlorination was predominantly used until 1896, when the cyanide process came into the industry (Logan 1981:195–196). Manufacturers in California and, after the completion of the transcontinental railroad, in eastern manufacturing centers, provided the machinery and equipment used at the mines. Historian Lynn R. Bailey's (1996) work, *Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850-1900*, is a valuable source for understanding not only the context of mining equipment manufacturing, but also the companies involved and the kinds of equipment provided. Naturally, the more complicated the mining equipment on site, the more necessary were technically adept mechanics and operators to keep them running.

An understanding of the processes and equipment used in mining and ore beneficiation is important in assessing a historic mining site, although it is rare when a survey includes a mine complete with equipment. Miners generally did not leave behind valuable items when they vacated a mining site, particularly because they would be useful at the next strike. In the 1930s and 1940s, at those idle mines located near enough to decent roads, abandoned machinery or other equipment (such as rails and ore cars) often fell prey to the scrap collectors who scoured the mining areas, or was otherwise appropriated, first for sale overseas, and later, for the war effort. The USBM *Minerals Yearbook* for 1940 indicates that iron and steel scrap (from all sources, prepared and unprepared) on hand in California in 1939 totaled 140,997 tons; in 1940 it had dropped to 86,733 tons (USBM 1941:506).While these numbers are statewide figures, and are not segregated as to source, they do indicate the magnitude of the scrap iron and steel industry in the state

## IMPROVED TECHNOLOGIES AND DIVERSIFICATION OF CALIFORNIA'S MINING INDUSTRY

The end of the California gold rush was marked by the transition to more capital and labor-intensive mining. This was true in hydraulic and lode mining, as well as the later innovation of dredging that became one of the more important technologies in the recovery of gold in the state during the nineteenth century. As modern innovations took hold, many counties emerged as important precious metal mining areas (Table 6).

**Table 6: Important Gold/Precious Metals Mining Counties, 1850-1940**

| | |
|---|---|
| Nevada County | 21% of the state's total output of gold, silver, copper, lead, and zinc; the county accounted for 22% of the state's total gold production, and 40% of gold produced from the state's lode mines |
| Sacramento County | 10% of the total, largely from gold dredging |
| Yuba County | 7% of the total, largely from gold dredging |
| Amador County | 8%, two-thirds from ore and one-third from placers |
| Calaveras County | 6% two-thirds from ore and one-third from placers |
| Plumas County | 5% of the total, mostly from gold and copper ores |
| Butte County | 5%, production was largely from placer gravels |
| Siskiyou County | 4%, production was largely from placer gravels |

*Data Source*: US Bureau of Mines 1941:217-225.

Technological innovations of the early twentieth century, such as compressed air tools, electrical power, and improved beneficiation methods permitted expansion of nineteenth century underground lode mines. Innovation made lower-grade ores more economical to exploit. Perhaps the most significant developments during the late nineteenth and early twentieth century were changes in the technologies employed in lode mining. By the turn of the century, quartz mining had steadily improved in efficiency and production. Advances in mining technology and skill enabled miners to locate new gold sources and maintain adequate production.

While the target metal may have differed, many of the aboveground manifestations of industrial metal mining sites are very similar to gold and silver mines in appearance. Of course, where beneficiation equipment (or sites where such equipment once stood) is extant, important differences can occur. For example, the surface plant at a mercury mine is far different from that of a stamp mill at a gold mine, although the shaft, headframes, and equipment used to move ores from the mine to the mill, may be very similar.

In 1911 the *Pacific Miner* reported that geologists could finally trace gold-bearing ledges displaced eons before by faulting. This resulted in the reopening of several formerly prosperous mines. In addition, shafts were sunk deeper than ever before, in a few cases extending more than 4,000 feet. Constant improvements in air drills and other similar equipment increased efficiency and production in deep mines (Dilsaver 1982:368).

Although technological improvements were introduced almost yearly in the late nineteenth century, mine operators and owners faced increased costs and unionization and with gold fixed in value, financially troubled companies with low production had difficulty maintaining profitable operations. After 1900, when many Mother Lode mines began working lower grade ores, supply costs per unit of gold increased substantially. During the period of World War I, from 1916 to 1918, prices for supplies rose 18 percent (Dilsaver 1982:369).

Between 1916 and 1929 the state's general prosperity led to a reduction in gold output, which only began rising again after the onset of the Great Depression when operating costs declined. Between 1933 and 1935 the price of gold rose from $20.67 to $35.00 per ounce, which in turn led to increased exploration and output. As shown in Table 7, by 1940 the state's output reached $51 million. Clark noted, "that this was the most valuable annual output since 1856. Thousands of miners were employed in the quartz mines at Grass Valley, Alleghany, Nevada City, Jackson, Sutter Creek, Jamestown, Mojave, and French Gulch. There were many active bucket line dredges, and dragline dredges became important producers of placer gold" (Clark 1970:8).

**Table 7: Gold Production in California, 1850–1940**

| Year | Fine Ounces | Value in Constant Dollars |
|---|---|---|
| 1850 | 1,996,586 | 41,273,106.00 |
| 1855 | 2,684,106 | 55,845,395.00 |
| 1860 | 2,133,104 | 44,095,163.00 |
| 1865 | 867,405 | 17,930,858.00 |
| 1870 | 844,537 | 17,458,133.00 |
| 1875 | 816,377 | 16,876,009.00 |
| 1880 | 968,986 | 20,030,761.00 |
| 1885 | 612,478 | 12,661,044.00 |
| 1890 | 595,486 | 12,309,793.00 |
| 1895 | 741,798 | 15,334,317.00 |
| 1900 | 767,390 | 15,863,355.00 |
| 1905 | 914,217 | 18,898,545.00 |
| 1910 | 953,734 | 19,715,440.00 |
| 1915 | 1,085,646 | 22,442,296.00 |
| 1920 | 692,297 | 14,311,043.00 |
| 1925 | 632,035 | 13,065,330.00 |
| 1930 | 457,200 | 9,451,169.00 |
| 1935 | 890,430 | 31,165,050.00 |
| 1940 | 1,455,671 | 50,948,585.00 |

*Data Source*: Clark 1970:4.

From 1915 to 1930, the average gold-per-ton of worked ore increased only slightly, from less than four dollars to nearly seven. As costs increased, mines that could avail themselves of richer ore were forced to do so, while lower grade mines ceased operations or were consolidated as part of larger mining enterprises (Dilsaver 1982:372). In 1929, the *Amador Ledger* reported that Amador County had the second largest gold production in the state, with $2,236,922 worth of gold having been extracted (*Amador Ledger*, 1929). The substantial increase in small surface placer mining between 1930 and 1935 reflects the return of a number of small-scale operators to the industry during the Depression; as the economy began shifting to war footing, many of these miners apparently abandoned their operations for occupations elsewhere. The Bureau of Mines did not provide a similar breakdown for lode mining over the same period. In the accompanying tables, the Bureau's authors noted that figures excluded "itinerant prospectors, snipers, high-graders, and others who gave no evidence to legal right to property" (USBM 1941:218). Such "snipers" were common in the desert and on private and public lands in the Sierra foothills, largely acting illegally as subsistence miners eking out a living from small mines, and are generally poorly documented.

The year 1934 was particularly important to the mining industry in the Mother Lode. On June 7, 1934, the *Amador Ledger* reported that "the rise in gold price has been a great aid to the Mother Lode" (*Amador Ledger*, June 7, 1934a). Gold at $35 an ounce enabled mines working lower grade ore to begin operations once again. The Kennedy Mine near Jackson took advantage of the rise in gold prices and built a cyanide plant in 1934, reported to be the largest in the world at the time and the only plant constructed solely of steel). In 1936 the Kennedy Mine was reported to be the deepest mine in the United States, with a vertical depth of 5,912 feet. By 1938 the plant had processed 950,000 yards of waste. Mine officials estimated that a total of 1,200,000 yards of mill tailings could be run through the plant (*Amador Ledger* 1938:5).

The surge in gold mining lasted through the beginning of World War II. In 1940 there were more than 1,866, active gold mines in California and 1,030 lode mines. The Bureau noted, "the total value of the gold, silver, copper, lead and zinc recovered from ores, old tailings, and gravels in California in 1940—$54,268,690—was greater than in any year since 1856. The increase over 1939, however, was only $1,350,678 or three percent. Most of the increase was due to the advance in gold and copper production" (USBM 1941).

Metals mining was always dependent upon supply and demand, consequently mining ebbed and flowed as companies expanded or curtailed operations. Mining was also influenced by economic recessions, depressions, and wars. Upturns or downturns in the economy led to shifts in minerals exploration and the specific types of minerals being mined. Wars created instability in certain metals and generally increased demand for specific metals, such as copper and chromite during World War I and aluminum, zinc, and iron during World War II.

Clearly, gold was the metal that received the most attention from the nineteenth century through World War II. As the nation industrialized between 1900 and 1940, the demand for more diverse base metals grew and the mining industry expanded into different provinces that required new and more sophisticated technologies for both extraction and beneficiation.

***Figure 32: Trinity Dredge, Trinity County, 1922.*** *View of sluice and manganese cast grid plates over Hungarian Riffles (used with permission, California Department of Conservation, California Geological Survey).*

## MINING LAW, REGULATIONS, AND GOVERNMENT

The discovery and subsequent explosion of mining claims in California beginning in 1848 resulted in, at least for a time, a relatively *ad hoc* set of laws and rules for how claims, mines, and water rights were to be administered. Because gold mining began even before California was ceded by Mexico in the Treaty of Guadalupe Hidalgo (gold was discovered in January 1848, the treaty was negotiated and signed in February 1848 and proclaimed on July 4, 1848), the military authorities then governing California allowed mining on public land to begin and to continue unhindered by federal regulation. Prior to the establishment of state and local governments, virtually no regulation existed for mining and use of water. Miners sought order and imposed it through unofficial means by establishing mining laws and ultimately mining districts, each with its own set of rules. A useful, if somewhat dated, work on this topic is John F. Davis's (1902) *Historical Sketch of the Mining Law in California*. County governments located in early-day mining districts recorded placer and quartz claims and their claim books may be important sources of information when documenting archaeological mining properties.

Beginning in 1866, a series of federal laws was enacted defining the nature of various types of mining claims. The laws were enacted precisely at the time that quartz mines in California were undergoing intensive development. The method of acquiring and holding a claim in California was derived from Spanish mining and English common law, with adaptations to local conditions (Dilsaver 1982:58). Three fundamental principals of the 1866 mining regulations were:

(1) That all the mineral lands of the public domain should be free and open to exploration and occupation;

(2) That the rights and rules that had evolved under the system of districts were valid and recognized by the government; and

(3) That titles to some of the mineral lands held by the old system of claims might be obtained permanently by their occupants with payment of five dollars per acre plus the costs of surveying and recording (Dilsaver 1982:61).

The Mining Act of 1866 also defined the width and length of lode claims. In 1872 an amendment provided that quartz claims were to be a maximum of 1,500 feet in length and 300 feet on each side of a mineral vein. In addition, the owners of a mining tunnel also received the rights to all veins or lodes within 300 feet of the mouth of the tunnel. The 1866 Act established both the worth and legal validity of the California mining district regulations and the subsequent right and ability of claim holders to acquire permanent title to tracts upon which they had invested heavily for quartz mining (Dilsaver 1982:61-62).

While mine laws and claims differed in many ways, some shared common features. Charles Howard Shinn's (1885) *Mining Camps: A Study in American Frontier Government* provides an analysis of the origins and types of mining camp governments established by the Argonauts. The Mining Act of 1866 replaced the older system of "tacit consent," whereby federal authorities allowed mining with minimal regulation. Justice Stephen J. Field, himself a Californian and an Argonaut, explained the situation in his opinion in *Jennison v. Kirk* (98 U.S. 453):

> The lands in which the precious metals were found belonged to the United States, and were unsurveyed and not open by law to occupation and settlement. Little was known of them further than that they were situated in the Sierra Nevada mountains. Into these mountains the emigrants in vast numbers penetrated, occupying the ravines, gulches and canyons and probing the earth in all directions for the precious metals. Wherever they went they carried with them the love of order and system of fair dealing which are the prominent characteristics of our people. In every district which they occupied they framed certain rules for their government, by which the extent of ground they could severally hold for mining was designated, their possessory right to such ground secured and enforced, and contests between them either avoided or determined.
>
> These rules bore a marked similarity, varying in the several districts only according to the extent and character of the mines; [with] distinct provision being made for different kinds of mining, such as placer mining, quartz mining, and mining in drifts or tunnels. They all recognized *discovery*, followed by appropriation, as the foundation of the possessor's title, and development by working as the condition of its retention. And they were so framed as to secure to all comers within practicable limits absolute equality of right and privilege in working the mines …. Nothing but such equality would have been tolerated by these miners, who were emphatically the law-makers, as respects mining upon the public lands in the State. The first appropriator was everywhere held to have, within certain well-defined limits, a better right than others to the claims taken up; and in all controversies, except as against the government, he was regarded as the original owner, from whom title was to be traced (Field, quoted in Davis 1902:15–16).

Davis noted that the legal scholars had differed on the origins of these concepts, some ascribing them to Mexican tradition (especially the importance of discovery and use), while others have pointed to Cornish, Southern (American South), or South American practices. All of these traditions seem to have included aspects of the mining laws that developed in California and the West. Davis observed, "may it not be simply another illustration of the fact that, with the same problem and the same environment, the human mind has in different ages often arrived at the same practical solution." By 1867 there were more than 500 mining districts in California (Davis 1902:17–20).

Because miners could not own the land, their claims were supported by boundary demarcations, proofs of labor, and rules related to periods of occupancy. Miners who did not work their claims, left them unmarked, or were absent from them for long periods, often found them seized by others. Even marked claims were sometimes jumped by unscrupulous miners taking advantage of other claimants who temporarily left their claims to get provisions or explore other areas. Poorly marked claims were often subject to conflicts among neighboring claimants. This concept—that claim, development, and consistent use were the measure of a right—carried over into the federal rules governing mining on the public domain after 1866. Prospectors would stake their claim, file a plat with the land office and local county, and then "prove up" by showing development and use. If a sufficient showing was made, including proof of naturalization, oral and written testimony, and examination by a representative of the local area Land Office, the federal government would issue a patent for the claim. Perhaps unsurprisingly, this process is similar to the prior appropriation concept that forms the basis of one important kind of water right in California, as described below.

Underground mines fell under the so-called “Law of the Apex,” which established a complicated system for apportioning ownership and control based upon which claim owned the “apex” (i.e., highest point) of the vein. While it cleared up a persistent problem in contests between claimants, the process of determining who held the apex engendered lawsuits; in fact, legal historian Davis (1902) noted that virtually all claimants of large, capitalized underground mines were forced to defend themselves in court against counter-claimants. Companies who had the means employed expert mining geologists and engineers who could help defend claims in court. It also resulted in careful designation of mining claims and their boundaries, and consequently a reliable track record that today provides archaeologists and historians with important documentary information (Davis 1902:49–58, 61–75).

Mining claims may have had a succession of owners, or might be subject to consolidation as the mining techniques in an area became more elaborate and extensive. An area covered by a number of simple, early placer claims, for example, could become subject to dredging or hydraulicking once consolidation of claims was sufficient to merit employment of more intensive and modern methods.

### WATER RIGHTS

As noted above the gold rush-era miners’ concepts of claims being based on discovery and development or use (sometimes shortened to the catch-phrase “use it or lose it”) extended to the complicated world of water rights. In particular, placer miners located at a distance from water sources needed a means to bring water to their mines, and competing water diversions among miners or ditch companies often led to legal wrangles. Perhaps naturally, the miners established a similar system of establishing water rights based on claim and development. Diverters filed claims with county recorders setting forth their points of diversion and amounts of flow; the date of the claim established a priority ranking in time. The original state constitution did not recognize this system, but the requirements for water in mining led to the system’s adoption through statute. In addition to the recent study of water resource history (JRP and Caltrans 2000), sources related to the history of the development of water rights laws in California and the West include Robert Dunbar *Forging New Rights in Western Waters* (1983), which provides an overview of water rights laws in the western states, including California. Douglas R. Littlefield’s (1983), “Water Rights during the California Gold Rush: Conflicts over Economic Points of View” in the *Western Historical Society Quarterly* summarizes the legal situation during the gold rush. Donald J. Pisani (1996) also addresses the interrelationship of mining and water law in *Water, Land, and Law in the West: the Limits of Public Policy, 1850–1920*, providing two case studies of water law development in California mining camps. Of course, it is this same concept—of claim, development, and use—that farmers, irrigation districts, and municipal systems use to establish their rights to water today.

For the purposes of this study, what is important is that diverters generally kept careful records of water rights claims, providing researchers with important clues related to when diversions to mining sites were planned, and by whom. In addition, the frequent legal contests over water rights have left a rich record in superior court files of the various counties (or, if appealed, in the case files of the California Supreme Court). These can contain sworn testimony regarding diversion and use, filings setting forth statements of fact related to the case, and trial exhibits such as maps, plans, and other valuable sources.

***Figure 33: Cornish Miner, Empire Mine, Grass Valley, 1900*** *(used with permission, California Department of Conservation, California Geological Survey).*

## CULTURE, RACE, AND ETHNICITY

In recent years historians and archaeologists have focused their attention on issues of ethnicity, race, and gender in the study of labor and industry in the United States. While research regarding historic mining properties has increased in the past two decades, only a handful of studies focus on culture and race in California's mining camps and communities.

Sonorans, Chileans, and Hawaiians were among the first Argonauts to arrive in the gold fields, followed closely by, among otheres, the French, British, Australians, Chinese, Croatians, Italians, Cornish, Germans, and Jews from various countries. African Americans (free and slave) formed another important, but relatively small, group. Hispanic and Chinese miners in particular were subject to official discrimination through imposition of the Foreign Miners' Tax of 1850. While written to apply to all non-citizen miners, it was unequally enforced and ultimately used to drive certain cultural groups from the mines. Of course, discrimination also occurred outside of the official realm; white American miners might ignore the British or Australians, focusing their antipathy instead on Mexicans, Sonorans, Chileans, African-Americans, and Chinese (See Chapter 4 for a discussion of scholarship related to ethnic groups, race relations, and gender issues during the gold rush and industrial mining periods).

Clearly, the California gold rush brought together diverse cultures. While many individuals returned to their home countries, others remained and assimilated into the larger population. Early Euroamerican miners may have been mesmerized by the exotic character found in the state's gold rush mining camps. Edward Gould Buffum vividly described a Marquesas Islander with a "broad piece of blue tattooing that covered his eye on one side, and the whole cheek on the other, and gave him the appearance of a man looking from behind a blue screen" (Buffum 1850:59). Buffum, like other Argonauts, witnessed first hand the diverse cultures operating in the California mining region during 1850s:

> The number of persons at present laboring in the various portions of the mining region is about one hundred thousand. Of these, at least one-third are Mexicans, Chilenos, Pacific Islanders, and Chinese, and the remainder Americans, English, French, and Germans; and I should divide their locations as follows: on the North, Middle, and South Forks [American River system], say twenty thousand; on the Stanislaus, Mokelumne, Tuolumne, Merced, Mariposa, and other tributaries of the San Joaquin, forty thousand; on Yuba and Feather Rivers, twenty thousand; and, scattered over the various dry diggings, twenty thousand more. During the past summer and autumn, I should estimate the average quantity of gold dug daily at eight dollars to a man; for although it is by no means uncommon for an individual to "strike a lucky" (Buffum 1850:131).

Buffum also witnessed first hand the evolution of California's cultural environment. His observations, along with others, are particularly important in discerning questions related to racism, assimilation, and acculturation in gold rush California as well as the post-gold rush years.

One of the most notable historical studies that addressed questions of race, assimilation and acculturation, was that of Ralph Mann (1982), whose book *After the Gold Rush: Society in Grass Valley and Nevada City, California 1849-1870,* carefully examines the social and economic history of Grass Valley and Nevada City. Mann makes several important observations. The first is that the rapid population expansion of the early 1850s was countered by nearly as rapid out-migration, coupled with an influx in the late 1850s of new immigrants (Mann 1982:31). The gold rush years were characterized by impermanence reflected in hastily built gold mining camps or towns. Businesses appeared nearly overnight, but also vanished or moved on as new mining discoveries were made or as new camps were established. This period of fluidity in population was punctuated by a diverse mix of cultures. When placer gold became scarce and the competition for claims increased, racism and ethnocentrism emerged among many of these groups. Mann further observed that the technological aspects of underground quartz mining created a need for skilled labor that was generally lacking in the United States during the late 1850s through the 1860s. Consequently mine owners sought skilled laborers from other countries, particularly Cornish miners, who had the requisite skills to carry out the tasks needed in the underground mines of Grass Valley and Nevada City.

Another characteristic of the evolution from placer to hardrock mining was an increase in families, particularly children. In general, skilled miners were older and often had a family that fostered the creation of social order, education, and religion. This is not to say that all miners were religious or attended church regularly, but the gold mining camps of the 1850s and 1860s shifted towards a more orderly society. Certain immigrant groups, however, were not always freely accepted in this new social order, particularly Latin Americans and Chinese.

The study of Native American miners during the California gold rush has been the subject of several scholarly studies, although in general, the degree to which Native Americans participated in the gold rush was seldom documented. Historian James Rawls suggests that Native Americans may have constituted more than one-half of all miners in California in 1848. While most were employed as laborers, some may have mined independently. Native American miners usually traded their gold for manufactured goods and food. That Native Americans did not place the same value on gold as whites did became a source of unfair advantage to whites. Independent Native American miners virtually disappeared by the 1850s because of the shift in mining from placer to hydraulic and quartz mining which did not favor the employment of Indian labor (Rawls 1976:28–45).

In 1848 thousands of Chileans and Peruvians came north to California's goldfields (Paul 1947:26). While prejudice and discrimination forced many from the state's mining regions during the early 1850s, others remained and made substantial contributions to the process of mining and mining camp culture. Having worked the silver and gold mines of their native countries, these miners had accumulated hundreds of years of hard rock and placer mining experience (Paul 1947:46-47). Armed with this knowledge, Chileans and Peruvians educated the inexperienced white miners in mineral extraction techniques and mining technology. They also brought mining customs and ordinances derived from their contact with the European influenced Spanish-American companies, resulting in the establishment of communal codes of conduct in California's mining districts. These regulations, along with those of the experienced Cornish and British miners, would prove to be useful in settling claim and boundary disputes and in the overall codification of California mining practices (Paul 1947:212). The 1849 "Chilean War," centered on a claim conflict between white and Chilean miners that permanently altered attitudes toward Chileans and other Latin Americans miners, and solidified white control of the mines (Johnson 2000:196). Those who did not return to their homelands found other ways to make a living in the diggings. Like the others groups expelled from the mines, such as the Chinese, Chileans, Sonorans and Peruvians turned to mercantile and service-related businesses to make their daily wages, such as becoming muleteers or teamsters. Often, these enterprises proved to be more financially rewarding than mining, affording these persecuted groups a semblance of stability in the mines (Johnson 2000:108).


***Figure 34: Mexican Miner Panning for Gold, La Grande, Trinity County, n.d.*** *(used with permission, California Conservation Department, California Geological Survey).*

The French also represented a large portion of California's foreign mining population. As the 1848 French Revolution dramatically altered French domestic and political life, the gold rush provided an incentive for the French to seek their fortunes in California (Paul 1947:27). Often traveling in organized companies, French prospectors remained in small groups, retaining their domestic customs and language. As with the Chinese and Latin Americans, the cultural isolation of the French angered many American miners and led to their severe persecution in the mining districts (Paul 1947:28). Further conflict over the foreign miner's tax created a deeper division between French, as well as the Chileans and Mexicans, and American miners (Johnson 2000:210). Diversifying their resources, many French followed the example of other maligned ethnicities and opened businesses rather than continuing to mine (Johnson 2000:217). Catholicism acted as an agent of unification, as Latin Americans, French and Irish found common ground in their spiritual beliefs (Johnson 2000:150). French contributions to daily life in the camps were extensive. Famous for their cooking and restaurants, the French also established kitchen gardens, gambling saloons and brothels, increasing their social integration with that of greater California (Johnson 2000:118).

***Figure 35: Andrada Dredge Mine, African-American crew with new lip applied to clam shell bucket, circa 1930s*** *(used with permission, California Department of Conservation, California Geological Survey).*

African Americans received a mixed reception in the mines due to the complex nature of the slavery issue, and opinions regarding the "African" presence in the mines were widely mixed. African Americans came to the mines in various ways. Many came as slaves with their masters, hoping to work an agreed upon amount of time in the mines, as many slave owners figured to obtain enough wealth to forego the need of slave labor (Johnson 2000:68). Others relied on their position on "free soil" to secure their liberty or the hopes of procuring enough gold to buy their way out of slavery (Johnson 2000:70,190). Another way African Americans found their way to the mines was in the employ of southern mining companies as cooks, miners, and servants (Savage 1945:38). What they encountered in California was a complex society deeply divided over not only the issues of slavery and African American presence, but also the uncertainties of everyday life in the mines. Contention between northern and southern whites in regards to African Americans in the mines played out in numerous dramas throughout the diggings (Johnson 2000:71). Some northerners  did little to help the African Americans, while others resolutely defended them against injustices (Johnson 2000:189). Some whites attempted to use slaves as free labor in the mines, therefore reducing the roles of white miners, but abandoned this idea in the face of widespread disapproval (Savage 1945:36). The creation of California's 1852 State Fugitive Law further reflected this mistrust between the north and south, while most evidence suggests that slaves remained loyal to their masters despite being in a free state (Johnson 2000:190).

Few slaves or free African Americans lived on their own, often residing with their masters or together in cabins lacking the means to afford an independent existence (Mann 1982:51). Prejudice and intolerance often drove African Americans toward the more tolerant urban areas in search of jobs in service industries, including hotels, restaurants, and barbershops (Savage 1945:41). Those who remained in the mining districts succeeded in establishing organized mining companies, businesses, and communities. Negro Bar, established in 1849, provided an enclave of relative tolerance toward its free and enslaved resident miners, while the existence of an African American mining company in El Dorado County illustrated their role as mine owners and prospectors (Savage 1945:34-42). In many towns African Americans could freely drink and gamble alongside whites but had difficulties finding friendly lodging and dining facilities. This fact led to the establishment of African American-owned and operated hotels throughout the camps and towns of the Mother Lode and Southern Mines, signifying what some believed may have been a limited integration into California mining society (Savage 1945:34-35). The end of the Civil War brought about more changes for African Americans as attitudes toward them relaxed, allowing the establishment of churches, social groups, and new found, although limited, support from the white community (Mann 1982:172-173).

Immigrants from the British Isles who immigrated to California during the gold rush occupied important social and labor positions in the mines and camps. Of the main groups of immigrants, the Cornish were the most central to the mining industry (Mann 1982:143). As mining in Cornwall sank into a deep economic depression, Cornish miners came west in search of better conditions. Arriving with extensive knowledge of hard rock mining techniques, they found ready employment in the ever-increasing number of lode mines in California and Nevada (Paul 1963:69). The Cornish played an important role in the quartz mines surrounding Grass Valley as well as influencing life and culture in the region (Mann 1982:142). Armed with superior mining skills, many Cornish rose to prominence as engineers, superintendents, and other positions of authority (Mann 1982:146).

South of San Francisco, the Cornish had a profound impact at Santa Clara's New Almaden quicksilver mine. Beginning in the 1860s, Cornish managers and miners lived and worked at the quicksilver mine, having been recruited by the mine's owners for their skill and work ethnic (Schneider 1992:48-51). During the 1870s, the Cornish established an large mining camp known as Englishtown, complete with a Wesleyan Methodist church, a school, and stores, allowing their cultural values to remain intact despite the distance from their native homes (Schneider 1992:84).

***Figure 36. Chinese and White Miners Sluicing at Auburn Ravine, Placer County, ca. 1852*** *(used with permission, California Department of Conservation, California Geological Survey).*

The Chinese represented one of the largest ethnic groups who immigrated to California during and after the gold rush. Having arrived in small numbers during the early 1850s, by the mid-1850s Chinese immigration to California dramatically increased, resulting in competition with white miners that often led to efforts to remove the Chinese from their mining claims. The anti-Chinese agitation lasted through the end of the nineteenth century (DuFault 1959:155-170). The Chinese were drawn to California not only by gold, but also in reaction to the travails of thirteen years of civil war in China. By the late 1850s there were more than 30,000 Chinese in California (Office of Historic Preservation 1988). More followed, and Chinese miners spread throughout California, Nevada, Oregon, and Washington, usually traveling in groups, which was an advantage when working claims. Historian Liping Zhu (1999) reported that the advent of hard-rock mining, and the Chinese Exclusion Act of 1882, forced many Chinese out of mining. Mining historian Randall Rohe suggested that foreign men replaced American miners after the initial rush, and in placer mining areas, the replacement miners were oftentimes Chinese (Rohe 1982:2-19).

Germans immigrants also constituted an important faction among California's newcomers. Like the French, German immigrants fled religious and political upheaval in their native country. Less known for their mining abilities than for their business and engineering skills, the Germans proved to be highly successful as merchants, scientists, and other non-mining occupations (Mann 1982:143). Although they retained strong cultural traditions, the Germans, including German Jews, became more integrated in gold rush society, unlike the Chinese, French, and Latin Americans who, in some occasions, chose to remain more isolated (Paul 1947:28). Because of their willing assimilation into camp life, American miners felt little threatened by this group, resulting in very little of the antagonism experienced by other nationalities (Paul 1947:28). Germanic immigrants often-times formed the majority of the artisan, professional, and merchant cores of the gold camps (Mann 1982:144).

## WOMEN AND FAMILIES IN THE MINES

Although it had often been thought that women were virtually nonexistent in the gold fields during the gold rush, scholarship over the past thirty years validates women's participation through diverse roles. Their experiences were not solely shaped by their gender, but equally by their race and class. Often, female roles transcended time and place as the majority of women provided services or home support, while small numbers of women prospected and mined. Regardless of their role, women have always actively participated in or contributed to the mining economy of the West.

Once arriving in gold rush California, women's experiences differed markedly from their eastern counterparts. First, the gender ratio was severely unequal. Their low numbers affected their options, the marketability of their services, and gender relations. Second, the transient, unpredictable, and mobile bust and boom cycles of the gold rush translated into lax morals and a class hierarchy that set the environment apart from the structured, established East Coast lifestyle. Third, there were legal options open to women wishing to end their marriages. Records demonstrate that women, in certain circumstances, chose the option of ending a bad marriage, and that the courts were often sympathetic to them. Furthermore, divorced women could take comfort in knowing they could put their domestic skills to use to support themselves (Griswold 1980). California's divorce rate in the mid-nineteenth century surpassed the rest of the nation. In early California divorce cases, women obtained more than two-thirds of the decrees. Not only did women take advantage of the option to divorce, but also a high number of women deserted their husbands, nearly at a rate that equaled that of male deserters (Riley 1999:446). A higher rate of divorce, a more disparate gender ratio, and unpredictable, mobile communities set the stage for women's experience in California to differ profoundly from life in the East.

As demonstrated in Table 8, during the gold rush and for the remainder of the nineteenth century, the male population greatly overshadowed that of the female (Fischer 1996:48). The gender ratio, which was most disparate early on and most apparent in the diggings, shaped the social, economic and political experiences of women.

According to the 1850 California State Census, women made up about 10 percent of the population (Riley 1999:445). Often, this disparate sex ratio translated into women receiving better, more respectful treatment from men (Fischer 1996:51). However, low numbers also contributed towards feelings of isolation and homesickness, and a vulnerability to violence. Also, gender relations depended on the woman's race. For example, while Mexican women earned money cooking, serving, or working as laundresses in Calaveras County, "Mexican women earned less than white women for comparable work, and they earned even less respect" (Limbaugh and Fuller 2004:129).

The arrival of women also brought several accompanying consequences. First, the increasing presence of women catalyzed permanent settlement (Fischer 1996:69). Also, as women arrived from the reform-minded East Coast, many brought with them Victorian values that disapproved of gambling, drinking and prostitution. Therefore, the arrival of some women who represented a more rigid class stratification directly affected the economic opportunity of some others, as is the case of prostitution (Hirata 1979:27; Johnson 2000). While prostitutes and other "hard luck" women are frequently portrayed, there were plenty of "proper" women in mining towns, and one study concluded, "only when women joined these men in California did a middle class begin to take root" (Johnson 2000:280).

Class also played a role in where women lived in proximity to the actual mining. Historical Archaeologist Don Hardesty identified two notable living patterns at the regional level, reflecting entire mining districts: first, women lived "in town, with families at outlying ranches, or at toll stations managed by families," while the male-dominated working class occupied satellite communities. Second, in regions dominated by company-controlled mines, working-class women also made up a disproportionate part of satellite towns servicing the mining work force (Hardesty 1994).

If class shaped the experience of women then undoubtedly so did race. A substantial percentage of women in California were foreign born (Fischer 1996:53). As Glenda Riley concluded, "Obviously, gold rush California meant many things to women…a woman's fate related more to her race, color, and ethnic heritage" (Riley 1999:448). Demography carried with it serious implications; it "gave an advantage to women of the right race (whites) and class—the middling sort and above. Poor

**Table 8: Comparative Growth of the Male and Female Populations in California, 1850-1890**

| | Female Population | Male Population |
|---|---|---|
| 1850 | 7,017 | 85,580 |
| 1860 | 106,657 | 273,337 |
| 1870 | 210,768 | 349,479 |
| 1880 | 346,518 | 518,176 |
| 1890 | 508,071 | 700,059 |

*Data Source*: Fischer 1996:48.

women took their chances. Women of color were among the ranks of the despised who were subject to the whims of individuals and the mob" (Hurtado 1999a:14).

As time passed the demographics of California continued to change, both in regard to the gender ratio and the demographics of the state. Although the period defined as the gold rush came to an end, mining continued and women's participation clearly continued in the service sector and probably grew in regard to actual mining.

Due to their scarcity, women could turn gender into a worthwhile commodity. Nowhere was the disparity in the gender ratio felt more strongly as in the diggings. With men obtaining most of the gold, women had to secure ways "to earn and extract [gold] from [men] in order to survive" (Taniguchi 2000:143). Women had opportunities to make money during the gold rush and found they were more than justly compensated for their efforts. Often, women turned to services that were typically female, such as the service industry, including cooking, laundry, or mending clothes, in addition to running hotels and boardinghouses (Zanjani 1997:29). Women gravitated to school teaching as the men who would be qualified to teach sought the prospects of mining (Smith 1968:94). Women also found opportunities in professions not traditionally open to them including owning businesses such as a theater, barber shop, photography studio, or mercantile (Woyski 1981; Levy 1992). Opportunity existed both for single and married women (Limbaugh and Fuller 2004:128).

Another promising trade was that of prostitution. The context of nineteenth-century women's work helps explain the high number of prostitutes in the American frontier. Few jobs were open to women, and those deemed socially acceptable offered low pay.

> These problems enlarged in a frontier environment that catered to masculine workers. Here women desired not only employment but some of the boom profits attached to the burgeoning frontier enterprises. From this combination of elements, a substantial prostitute population emerged on the American frontier (Butler 1985:16).

Whether prostitutes should be presented as victims or free agents continues to remain a divisive issue for scholars (Hirata 1979; Butler 1985; Rosen 1986; Tong 1994). Prostitutes have often been portrayed as well to do, but with few exceptions prostitutes generally were young and poor. Although California was not part of her study of prostitution in the western states, Anne Butler argued that "most prostitutes did not earn substantial sums, mainly because they drew their clientele from among other workers with little money" (1985:151). Additionally, it is important to recognize that "[p]rostitutes had personal lives and family ties, although the usual image of the prostitute did not depict that. Husbands, children, and co-workers influenced the daily lives of prostitutes" (Butler 1985:46).

Not only were there varying degrees of economic status among prostitutes (brothel dweller, saloon/dance hall worker, crib woman, and streetwalker), but ethnic divisions also persisted. Historian Susan Lee Johnson found in her study of California's Southern Mines (roughly present-day Amador, Calaveras, Tuolumne, and Mariposa counties) that the majority of female prostitutes were not Mexican, Chilean, or French women but Chinese women who lacked control

***Figure 37: Woman Miner along the North Fork American River near Rocky Bar or Estey, Placer County, 1915****. Note her companion with a full diving suit on (used with permission, California State Department of Conservation, California Geological Survey).*

of their labor and earnings (Johnson 2000:298). Although Chinese women had experienced a level of self-employment and "free competition" between 1849 and 1854 in California, organized trade dominated the years 1854 to 1925. While Lucie Cheng Hirata's study focused on Chinese prostitutes in San Francisco, she argued "prostitutes in mining camps served both Chinese and white clients and were often more harshly treated than their counterparts in San Francisco." Hirata later substantiates this conclusion by referencing one of the threats the Hip-Yee Tong, a predominant secret society in the trafficking of Chinese women in the late-nineteenth century, used against prostitutes who refused to pay weekly taxes to them: "banishment to brothels in the mining regions" (Hirata 1979:8-19).

In California's mining camps, even the traditionally male roles of miner were filled by women, and female Argonauts came to California looking for gold as well (Levy 1992). For example, the 1850 California census lists a significant number of "Hispanic women gold panners" (Zanjani 1997:25). Dame Shirley (Louisa Amelia Knapp Smith Clappe), whose letters are perhaps the best known primary source associated with a gold rush woman, described her first mining experience in an 1851 letter to her sister as a cold, dirty adventure she would not soon repeat (Shirley 1970:74).

While some women may have engaged in mining for leisure, others turned to it with economic motives in mind. Wives and children often worked mining claims with their husbands and fathers (Mann 1982:44-45). Women became involved in mining in a variety of capacities, such as investor, prospector, mine owner, miner, or mine operator. Between the years 1850 to 1950, 77 women are recorded as prospecting in Nevada, California, Alaska, Arizona, Colorado, Wyoming, Idaho, Utah, and Oklahoma, with 14 of the 77 prospecting in "several states and in some cases, nations, including Canada". Of the 77 women, 10 prospected in California; and an additional 19 women physically mined and may have also prospected (Zanjani 1997:301; 306). In addition, the marital status of these women varied. Of the 77 women, Zanjani found women of all marital statuses including those that were married, widowed, divorced, and single (Zanjani 1997:11, 308).

The lives of only a handful of early prospectors and businesswomen, such as the colorful Marie Suize known widely as “Madame Pantaloons,” are relatively well-documented; most were not. The number of women who prospected and owned/operated mines most likely surpasses what records suggest (Costa 1994:19-21; Zanjani 1997:25-26). Research by Zanjani and others seems to disprove the notion that women did not participate directly in mining or prospecting. For more detail about the lives and industry of women miners in the West, see Zanjani 1997, Belden et al. 2000, and Limbaugh and Fuller 2004.

Another source of information regarding women-owned mines comes from the Bureau of Land Management’s (BLM) land claims database. A representative sample was gathered from the database for San Bernardino, Siskiyou, and Tuolumne counties for placer mine patents between 1872 and 1938. Female ownership of mines was documented as a maximum of three, while partnerships with at least one woman participating were much higher, numbering between 11 in Tuolumne County to 23 in Siskiyou. While only a small sampling of California counties, it suggests that women indeed did own mines, both individually and collectively, particularly during the 1930s when the price of gold increased. The data do not indicate what role women mine owners actually played in the daily operations of the mine. Accessing the actual patent files, however, at the National Archives in Washington, D.C., may help address this question.

During Depression-era mining, women’s contributions mirrored those of the mid-nineteenth century. For example, Della Phelps, her husband Charles, and her daughter Merla lived at Desert Queen Mine in the Mojave Desert during the mid-1930s. While Mr. Phelps, “and two partners processed the waste rock dump,” Mrs. Phelps prepared meals without electricity or running water (Smith 2006:17). As in earlier times, women in Depression-era mining contributed through providing services and support to miners. Women and children were often found in the Dale and Pinon Mining Districts of the present-day Joshua Tree National Park of the Mojave Desert. “Families,” observed Jessica Smith, “instead of the single men from previous mining booms, inhabited both districts’ mines” (2006:68). Within the district’s mines, women took on traditional roles, such as cooking for mining crews as well as less traditional positions, such as mine ownership in the case of the woman co-owned Carlyle Mine.

Aside from prospecting, mining, and running successful boardinghouses or alluring bordellos, many women provided the necessary work to keep the home running and support their miner husbands. While the integral and economic role of mother as homemaker has often been taken for granted, mining camp mothers, regardless of the time period, took on the responsibility of schooling, caring for the home and children, and contributing to the family economy. Responsibilities that women in other rural situations faced were magnified significantly for those on the mining frontier: “The contribution of women’s labor to the economy of both the family and the community deserves more attention than historians have yet allowed it. Mothers not only maintained their dwelling places, they also added indirectly to family income by producing food and clothing that otherwise would have to be bought” (West 1987:186).

Even more than interpreting the role of women in the western mining frontier, the study of children has been pushed aside and neglected in historical discourse. In 1983, Elliott West called the child the “most neglected figure in the story of westward expansion” (West 1983:164). The lack of focus on children in western scholarship does not reflect the true demographics of the California's mining regions. West argued that childhood in the mining town was not what it is often assumed. A cursory reading of primary sources suggests that children were exposed to inappropriate behavior, acted more impulsively and rudely, and grew up too quickly. A deeper look, however, reveals that adults made strides to maintain traditional views and values. Undoubtedly, the environment shaped the childhood experience, but how adults tried to shape mining towns and battle the innate influences of such communities provides insight into what parents valued in regard to child rearing. For example, the strides made to establish educational institutions and the recognition of childhood as a unique and important preparatory period of life reflected a perception of childhood that had developed throughout the nineteenth century (West 1983:151-163).

One condition of mining town life that shaped the childhood experience was the demand for labor. Girls took on traditional roles and had to step into bigger shoes if their mother became incapable of filling her duties, whether through injury or death. In the West, young girls could not rely on the assistance of extended relatives, who generally still lived in the East. Some girls under 12 assumed household duties, caring for large families and becoming what Elliot West called "child housewives." Boys also filled the labor need and took jobs away from home, often by 12 or 13 working at unskilled jobs in town (West 1983:147-148).
In essence, growing up in mining towns was not always as simplistic as presented in primary sources from the time, such as travel writings that comment on the poor, wild behavior of children. For example, Eliza Farnham reported the corruptible youth who grew up all too quickly in her 1856 publication, *California In-doors and Out; Or, How We Farm, Mine, and Live Generally in the Golden State*. West takes into consideration the wide range of morally questionable influences the children grew up with. Again, he noted the concern that arose when a child's "observation" of certain behavior changed into "participation" (West 1983:152). West asserts that too often the anomaly has been taken for the typical. He concurs that the environment shaped the children but he emphasizes a shift of focus to what the residents attempted to hold onto and preserve. There is much that remains unknown regarding children's role in mining, including the extent of their labor and involvement in mining operations.

Whereas West wrote about the involvement of children in labor, Ralph Mann (1982:114), writing about Nevada City and Grass Valley between 1849 and 1870, claimed that "there simply were not jobs for children; the mining industry had no places for girls and very few for boys." A survey of child labor law, however, suggests that by the twentieth century child labor had become an important political issue. The first child labor bill was passed in 1916 (Keating-Owen Child Labor Act of 1916)

***Figure 38: Woman using a Rocker, Kendon Pit, Mono County, 1930*** *(used with permission, California Department of Conservation, California Geological Survey).*

though it was later determined unconstitutional by the Supreme Court. Therefore, children did not receive federal protection until the passage of the Fair Labor Standards Act in 1938. Reformers had long worked to end child labor and the 1900 U.S. Census sparked concern as it listed approximately two million children working in mines, mills, fields, factories, and other places of employment across America (National Archives and Records Admininstration 1916). Like the study of women, the study of children and their labor should not be viewed simplistically. Although child labor is often thought of in a negative light, Robert McIntosh's (2000) *Boys in the Pits: Child Labour in Coal Mines* challenges the view of child exploitation and argues that the boys working in the Coal Mines during Canada's Industrial Revolution wanted to work and fought for worker's rights (Tuttle 2001). The study of children applies not only to social, labor, and western history, but also to policy and legal history, and as such provides many opportunities for future research.

## ECONOMICS, LABOR, AND UNIONIZATION

The question of labor and class lies at the heart of establishing a cultural context for any industrial mining community or mining camp. Today, in the Western United States, mining communities are defined by economy, workforce, and cultural landscapes. Of particular importance are the miners, a culturally diverse group that held many common values.

When lode mining began in the 1860s, hard rock miners were making $6 to $7 per day. On the Comstock Lode, hard rock miners were soon receiving a standard $4, and "while this dropped slightly across the region in ensuing decades, it was usually no lower than $2.50 to $3, and frequently higher" (Wyman 1979:35). This contrasts greatly with the national daily average for non-farm labor of $1.04 to $1.57 per day, suggesting a fairly good standard of living existed for those who chose to work the mines. The higher wages in the West were in part a response to drawing laborers from as far away as Eastern Europe. Published books, newspapers, and fellow countrymen spread the word of high wages and plenty of work in the United States.

Unionization in the mining industry was largely a product of industrialization following the Civil War. New technologies required a larger work force, and a broadening market and ownership of mining properties with outside capital resulted in the organization of labor and ultimately the formation of unions. According to Wyman (1979), one of the earliest miners' unions was formed in Central City, Colorado, in April 1863. The Central City miners demanded higher wages, but their early attempts at unionization largely failed. Concurrent with the Colorado labor organizing efforts, miners on the Comstock Lode also organized in an effort to increase wages (Wyman 1979:152). While some success occurred through unionization, early attempts often-times resulted in bitter disputes between mine owners and laborers. It was not until the twentieth century that unions gained a foothold in the mining industry and played a role in shaping the character and politics of the industry.

Early California mining was of a solitary nature. Lone placer miners or small companies searched California's rugged terrain for precious metals without any official mining laws or regulations. Applying simple mining techniques, miners used little more than a pick or shovel and a pan in order to cull gold from the rich soil (Paul 1947:19). As mining transitioned from an individual or small group venture, concepts of labor and ownership emerged. California was far behind the rest of the country regarding property and labor regulation, leaving those in the remote mines to govern themselves (Paul 1947:211). Staunchly observed codes of conduct and property by those in the "diggings" were based on traditional regulations that existed in Iowa, Georgia, North Carolina, and other American mining centers. Miners from these regions sought to organize the concepts of mine ownership and labor regulation based on those of their native states (Paul 1947:210). In some areas, a new type of miner, one reliant upon a daily wage for income rather than a day's worth of diggings, slowly began to replace the itinerant prospector. Furthermore, by the late 1850s, miners who had brought their wives and children west now placed an even greater emphasis on regular wages and safety conditions (Paul 1947:314-315).

***Figure 39: Blasting at Empire Mine, Nevada County, 1900.*** *Miner is splitting (lighting) a fuse with a candle 2100-ft. underground (used with permission, California Department of Conservation, California Geological Survey).*

Underground mining and the technology used to support it required skill and experience, dividing the labor force into distinct categories. Foreign miners such as the Chileans, Welsh, Italians, and Austrians brought with them not only mining experience but a willingness to perform the hard labor required by lode or quartz mining. Many Americans, feeling themselves "above" this type of labor, gravitated toward machinery operation and supervision. With such drastic change, the industrial phase of California mining ushered in an era of organized labor and big business. The complexity of the new relationship between mine owners and the workers was precarious. The new class of miners stood together to protect their rights and wages, spurring an outbreak of disputes and labor strikes by 1869. Strikes were not unknown in California before the dawn of industrialized mining. During the late 1850s, disagreements between miners and ditch operators over the cost of water resulted in boycotts and subsequent negotiations over fair pricing. Because of severe losses on both sides from inactivity, these disputes demanded quick resolution, unlike the labor strikes that would follow in later years (Paul 1947:310-325).

Across the mountains in Nevada, the 1859 Comstock Lode strike sparked a growing union sentiment in western mining. Conflicts over living wages and mining techniques, the same issues that would manifest in California, deeply divided mine workers and owners. As the Comstock Lode "played out," many miners returned to California with new sets of mining skills applicable to underground mining. These miners also brought ideas of labor unionism with them. Due to the relatively unstable character of many of California's mining camps and towns, labor proved difficult to organize (Lingenfelter 1974:66, 131). In towns like Grass Valley, where large quartz mining operations promoted a more settled atmosphere, miners found the idea of unionism and guaranteed wages agreeable.

In 1869 a dispute over mining practices, the hiring of Chinese, and health concerns, led to the formation of California's first miner's union. Modeled after the Comstock's labor organization, this union sought to give a voice to Grass Valley's miners (Lingenfelter 1974:120). While the initial disagreement occurred in one particular mine, the majority of Grass Valley's miners stopped work in all of the area's mines until their demands for higher pay and safer conditions were met. The two-month-long strike resulted in a victory for the miners and the establishment of union sentiment in California's mines. The miners used their newfound organization to promote benevolent undertakings, such as the maintenance of a daily minimum wage (Lingenfelter 1974:86-90).

In 1871 miners and owners in Amador County, mutually distrustful of one another and at odds over wages, squared off in what became known as the "Amador War," at Sutter Creek. The Amador County Laborers' Association formed under the precept of protecting white labor at the exclusion of all others, opposed the wages and hiring practices of the Amador Mining Company, one of the area's richest mines. This dispute, lasting from May to July, marked the first time in western mining history that a state militia was summoned to end such a strike. Ultimately, the promise of a daily minimum wage and the demands for Chinese exclusion from the mines brought about the end of the strike. While Chinese exclusion was a minor factor in this strike, it was a theme to be repeated not only throughout Amador's mines, but across the entire state (Lingenfelter 1974:90-118).

As organized labor unions became instruments of leverage against wealthy mine owners and a growing industrialism, unions also developed in the hydraulic mining region known as the Inter-Yuba Ridge. Comprising North Bloomfield, French Corral and Smartsville, this region witnessed the first placer miners' union in March of 1876, the Miner's League. Mirroring the growing opposition to the Chinese presence throughout the state, this union focused its efforts on harassing and driving the Chinese out of the placer mines, just as the hardrock miners had done in Grass Valley. Subsequent unions were founded throughout the mines, and by 1877 the Inter-Yuba region had four unions, with a total membership of around one thousand men. Other unions of note were formed in Columbia and Bodie (1877), Nevada City (1879), Placerville (1882), and Allegheny (1883) (Lingenfelter 1974:118-121, 131).

Unlike the rest of America, the Far West mining frontier, particularly California, remained isolated from a larger scale of unification. The early strikes in Grass Valley and Sutter Creek were reactions to issues pertinent to the immediate communities, not state or nationwide, symbolizing strong support and sense of mutual dependency between the miners and the community. Ironically, the Comstock Lode had contributed greatly to the advancement of the workers rather than the owners, giving labor leverage against unfair practices and setting a precedent throughout the western mines (Lingenfelter 1974:103-106). The adoption of a rabid stance on Chinese set California miners apart from the original Comstock philosophy of inclusion, as various groups in California's mining regions methodically expelled the Chinese by the use of force and local politics (Lingenfelter 1974:122).

Excepting Chinese exclusion, the growth of early unions represented a more positive development, the introduction of a strong social and political structure in the once-inhospitable mining towns of the west. By the late 1870s, the bond between communities and miners strengthened. In towns such as Bodie, where at one time the Bodie Miners' Union was the strongest in California with over a thousand members (Lingenfelter 1974:130), the Union Hall became the center of the community. There, as in other towns, the miners' hall served as a meeting center for fraternal organizations, a hospital, saloon, dancehall, church, school, library and polling place, among other functions. The unions placed great emphasis on charity especially in cases of injury or bereavement within their community (Lingenfelter 1974:133). Clearly, belonging to a union did far more for a miner than just a guarantee for a minimum wage; it provided a sense of community and support. In an industry transitioning from individual labor to industrial complex and from transience to permanence, these attributes became central to miners' survival in often desolate and unforgiving regions.

By the 1890s the sentiment of mining unionism gripped the Western states. Safety in California's mining industry was a concern for most miners, although even with the best technology available underground mining was dangerous business. Records were spurious or non-existent at best regarding injuries and even deaths. One of the most dramatic mine disasters in California occurred at the Argonaut Mine in Amador County, where 47 miners were found dead in 1922 after weeks of fruitless efforts to reach them. The deadly incident, which was widely reported and even filmed, occurred when a fire broke out at the 3,350-foot level of the mine, trapping the miners deep in one of the shafts. Enlisting experts from all over California and after hours of debate on how to rescue the trapped miners, it was decided to tunnel from the Kennedy Mine, which had connecting shafts. It took 22 days to tunnel through and 46 miners were found dead. The 47$^{th}$ miner was found about a year later. The disaster had at least one positive outcome, bringing attention to mine safety issues and improving techniques for mine disaster relief efforts.

***Figure 40: Air Drill Operators, Empire Mine, Nevada County, ca. 1900.*** *Two miners drifting (that is, following the vein) with an air-driven machine drill 2100-ft. underground (used with permission, California Department of Conservation, California Geological Survey).*

During the twentieth century, the United Mine Workers of America (UMWA) played an important role in all aspects of wages and mine safety. The UMWA was founded in 1890 in Columbus, Ohio, by the merger of Knights of Labor Trade Assembly No. 135 and the National Progressive Union of Miners and Mine Laborers. The constitution adopted by the delegates to the first UMWA convention barred discrimination based on race, religion, or national origin. The UMWA founding fathers recognized the negative impact of discrimination at a time when racism and ethnic discrimination were accepted facts in some parts of American culture. Organizers from the UMWA fanned out across the country in 1933 to organize all coal miners after passage of the National Industrial Recovery Act. The law granted workers the right to form unions and bargain collectively with their employers. After organizing the nation's coal fields, the miners turned their attention to other industries, such as steel and automobiles, and helped those workers organize. Through the Congress of Industrial Organizations (CIO), nearly 4 million new workers were organized in less than two years (UMWA 2007).

The impact of the UMWA was much less within the West where unions were more fragmented among the various mining districts. Many of the achievements of the UMWA, such as the eight-hour work day, collective bargaining rights, health and retirement benefits, and health and safety protections, were also achieved, albeit slowly, by western miners.

A case study involving the Argonaut and Kennedy Gold Mines located in Jackson, Amador County, involves wages and class stratification, and serves as a model for interpreting other Mother Lode quartz gold mines. Between 1860 and 1900, the industrialization and capitalization of Jackson's hardrock mines changed the relationship of labor and class within the mines themselves. In Amador County, prior to 1880, unionization was viewed as deleterious to corporate profit and labor relations in the mines. Thus, mine officials balked at the idea of unionizing (Supernowicz et al. 2006). Up to 1880, the vast majority of mine employees in Amador County were of northern European extraction. An examination of the Kennedy Mining & Milling Company payroll ledgers between 1895 and 1922 provided important data regarding wages and ethnicity (Kennedy Mining & Milling Company 1895-1922). Based upon original ledgers, occupations at the mine included mucker, shoveler, topman, mechanic, carpenter, watchman, machinist, teamster, clerk, assayer, blacksmith, carman, night boss, shift engineer, and miner. In 1895 the majority of mill hands employed at the Kennedy Mine were of Anglo-European extraction, and wages varied from $2.25-$3.25 per day. The foreman of the mill received $175 per month, a good wage for the time compared to similar occupations across the United States. By 1900 at the Kennedy mill and chlorination works, Anglo-Europeans worked alongside Italians and a handful of Serbians (Supernowicz et al. 2006).

In 1904 payrolls dramatically increased at the Kennedy Mine, as did operations and development. In 1904 there were 17 employees in the mill, including three Italians and two Serbians. Out of the eight employees in the chlorination works, two were of Italian descent. Italians were the largest ethnic group working as skilled laborers in the mill operations. Perhaps one of the most important jobs was the hoist operator, who was in charge of loading and unloading personnel and material into the various shafts. At full production, both the Argonaut and Kennedy gold mines operated around the clock, seven days a week. A count of all employees, based on the Kennedy ledger for 1908, was 260. Approximately 157 of the workers were Italians and 35 were Serbians, while the remainder were of Anglo-European descent (Supernowicz et al. 2006). By 1909 most of the employees in the chlorination works were Italians and were making an average of $3.00 per day. Mine workers who boarded at the

Kennedy had 50 cents deducted each day from their paycheck. By 1919 wages per day for mill workers were $3.25 to $4.50, a good increase. Other skilled laborers had similar wages.

An examination of wage records suggests that the lower-paid and less-skilled employees were more transient (Skelensky 2002). For example, muckers stayed on the job an average of only a month. Therefore, employers such as the Kennedy Mine were more vigilant in recruiting new employees for the lower paying occupations. As the Kennedy and Argonaut hired more employees from Latin American countries and Serbia, boarding houses developed an ethnic character as mine laborers tended to congregate in the same dwelling. The ethnic composition of the mines was reflected in Jackson and its environs, where different ethnic groups boarded and in some cases established permanent residency.

The issue of high grading gold (stealing gold from a mine where the person is employed) at California mines was always a concern. To protect against high grading gold, many mines built "change houses," where miners removed their clothes after work and showered before putting on their street clothes. The miners were observed, and sometimes physically examined, to ascertain if any high-grade ore was being removed from the mine. In some mines, miners were still able to high grade enough gold to supplement the wages they received each week.

By the 1930s many of the Mother Lode gold mines were working under union contracts. Based on historic documents, it appears that miners, even at the lowest wage scales, actively participated in union events, and miner unrest occurred periodically among the laborers working in Mother Lode gold mines (*Amador Ledger* 1934b).

Interpreting the working conditions in California's mining industry is assisted through local county records and census data. Historic photographs often illustrate technological changes in the mining industry, including the use of headgear, carbide lights, and other safety and utility devices. Of particular importance are records related to mine safety, injury, and labor history. One group of records includes claims filed by employees or descendants of employees who suffered debilitating diseases or death, and requested monetary relief from the California State Insurance Compensation Fund that was created in 1911. Based on analysis of those records, it seems apparent that those miners who worked below ground, under the harshest of conditions, also suffered the most severe illnesses. The records also demonstrated the diversity of ethnic groups employed at the mines and the degree of transience. In mining communities throughout California, a hierarchy of labor developed. This hierarchy was based on ethnicity and skilled labor versus unskilled labor. The more skilled jobs were generally filled by individuals from Western Europe, particularly the Cornish and Welsh.

## SUMMARY

California's mosaic of historic mines, mills, and mining landscapes reflects a significant chapter in the history of the state, helping to foster economic expansion and leading to the formation of towns and cities with distinct cultural identities. While gold was the catalyst for the epic transformation of this state, many other mineral commodities helped sustain local and regional mining enterprises. The plethora of published accounts of California's mining history focus largely upon the gold rush. Geologic and mineral reports, however, provide a much broader, though often technical, context to interpret individual mines and mining districts. Clearly, the human experience as it relates to mining and its associated industries is paramount to this study. While males formed the core of the state's workforce in the mines, women also played critical roles. The state's mining history shares many parallels with the transition of culture and politics in California, as one culture was displaced and the void filled by another. In addressing these issues, archaeology and history share common threads, weaving together the pieces that characterize and form historic contexts. As historian Richard V. Francaviglia (1991) noted, one must learn to read the mining landscape, which requires an understanding of context, spatial knowledge, and an ability to interpret the physical manifestations of an industry that, depending upon the temporal period in which the mine was in operation and the demands required by the geological composition of the area, required the use of both simple and advanced technologies. While the authors of this study attempted to capture the broadest characterization of California mining history, it is clear that much work is left to be done. Both historians and archaeologists have much to contribute towards interpreting the complex nature of mining properties in California.

# CHAPTER 3. PROPERTY TYPES

## INTRODUCTION TO PROPERTY TYPE CATEGORIES

This chapter introduces types of archaeological resources associated with historic mining processes. These property types do not exist in isolation, but must be identified and interpreted within their functional and historic context. As used here, property types include the individual building blocks of mining sites such as prospect pits, shafts, mills, and tailings ponds. Simple sites may have only one or two property types while complex sites may have many, linked by function and time. These linked property types are what Donald Hardesty referred to as "feature systems" on mining sites in Nevada to distinguish "a group of archaeologically visible features and objects that is the product of a specific human activity" (1988:9). This is a useful way to tie together different features into a functional process. In general, site significance increases with the size, complexity, visibility, and focus of these systems: focus indicates the clarity with which the story of archaeological remains can be "read," while visibility refers to the quantity of remains present (Deetz 1996:94). The concepts of visibility and focus are discussed further in Chapter 5.

A similar, process-based approach to identifying property types is recommended in the National Park Service's *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties* (Noble and Spude 1997).

Accurate interpretation of property types and feature systems - establishing function and context - is critical. Determining whether a pile of rocks is the result of placer or hard-rock mining, or that it dates to the gold rush or Depression-Era, forms the basis for determining site significance. In addition, because many of these sites may be affected by development projects, this identification may constitute their last examination and recording by archaeologists and historians. It is important that our final record of this mining activity be accurate. Interpretation is made more difficult when mining occurs over a long span of years and subsequent mining overlays original development. For sites with several property types or feature systems, interpretation is facilitated by physically reconstructing deduced mining processes on a map, and perhaps in a flow chart, to ensure an accounting for all the potential resources and their relationships. For complex sites, a mining engineer and/or geologist can contribute much to this exercise.

The links between processes or activities and the common types of archaeological mining resources are drawn below, grouped under five categories:

1. prospecting and extraction;
2. ore processing;
3. intra-site ancillary facilities;
4. domestic remains pertaining to social, non-technological elements of mining; and
5. larger, regional linear properties, such as water conveyance systems that support the mining endeavor.

In this chapter, a description of the process that created the physical remains is provided, visual representations have been added to assist interpretation, and common tangible remains for each is summarized. Mining sites can contain multiple property types from multiple categories.

## PROSPECTING AND EXTRACTION PROPERTY TYPES

Mining involves locating and extracting minerals from naturally occurring deposits. Prospecting is the act of searching for new mineral deposits and testing or determining their potential value (Fay 1920:540). The two primary forms of deposits are lode and placer. Lode deposits are the original mineral occurrence within a fissure through native rock, also variously known as vein or ledge. Hard rock and quartz mining are two common terms referring to mineral extraction from lode deposits. Extracted lode minerals, especially those deep underground, generally require additional refinement, called beneficiation (discussed in Ore Processing Property Types below). Placer deposits are sedimentary formations containing minerals that have eroded from their parent lode into a variety of natural contexts, both shallow and deeply buried. The ubiquitous image of a 49er panning for gold along a gravel bar is well known, although hydraulic, drift, and dredge mining also targeted this type of deposit. Placer minerals are generally "free" from parent material and do not require additional refinement once separated from worthless sediment. Placer miners followed "color" up drainages looking for the source, or parent outcroppings of lode ore. They also discovered eroding ancient riverbeds, now elevated above the modern landscape, which contained naturally deposited placer gold as well. Later, geology played a larger role in locating minerals. Miners often used ingenuity and innovation to tailor their operations to local conditions for both lode and placer deposits. Prospecting and extraction technology differed for the two types of mineral deposits.

### PLACER MINING PROPERTY TYPES

Placer Mining Property Types include:

- Tailings Piles
  - Small Piles of Placer Tailings
  - Oblong Piles of Placer Tailings
  - Long Lines of Placer Tailings
  - Pits with Placer Tailings
  - Surface Exposures of Placer Rock
- Cut Banks, Channels and Placer Tailings
- River Diversion
- Dredge Tailings
- Drift Mining Remains

The primary means of separating free gold from auriferous sediments relies on water and gravity. Water flow is used to move and agitate gravel, and gold's specific gravity ensures that it naturally settles under proper conditions. Dry placering, such as winnowing, may have been used in the absence of water; here wind blows the lighter component to the side while heavier material drops. One of the most comprehensive references regarding placer mining is C.V. Averill's *Placer Mining for Gold in California* (1946), but there are many others (Wilson 1907; Boericke

1936; Peele 1941; Wells 1969; Rohe 1986; Silva 1986; Meals 1994; Tibbetts 1997; and Lindström et al. 2000).

The simplest placer prospecting is typically done with a metal gold pan, a round shallow dish with flat bottom and slanted sides sometimes improvised from common kitchen supplies; wooden *bateas* and baskets were also used in the earliest years. Panning involves swirling a small amount of dirt and gravel with water in a manner that allows the lighter material to rise to the top for removal while the heavier fraction, particularly the gold, concentrates at the bottom. Panning can be carried out at the location of a placer deposit, or auriferous sediment can be collected using a variety of hand tools and taken to a convenient panning location. For example, gravel can be scraped out of crevices, with various kinds of metal bars, into a bucket and taken to a bar along a creek where it can be easily panned. The method is limited to coarse gold, as fine particles tend to be lost with the gravel. The gold pan has endured, however, and metal and plastic versions can still be found in modern supply stores. Because of its simplicity, the pan is used for prospecting, as an extraction tool, and in combination with other technologies discussed below. Although widely used, evidence of panning in archaeological contexts is generally limited to the presence of the pan itself. Any evident changes to the ground surface would have been so minor that, combined with natural processes, they would have been erased. Hand tools such as picks, shovels, buckets, and wheelbarrows were the dominant method of extracting and transporting placer deposits to separating devices.

## Tailings Piles

The most distinctive indicator of a placer mining site is the waste rock, or tailings piles, left from prospecting or mining. These rock piles – located in creek drainages, along bars and riverbanks, or at locations of ancient, exposed river deposits – consist of water-worn rocks and a general lack of soil. Tailings piles come in different shapes and sizes, as noted below, depending on where they are on the landscape and how they were separated from gold-bearing gravels. Boulders and cobbles were often moved out of the way and piled or stacked to the side, while gravel and smaller cobbles were generally processed for gold. Water, necessary to wash the deposits, could, for small operations, consist of seasonal runoff or include short water diversions from nearby drainages. Large-scale mining might involve large ditch systems bringing water from afar. Both short- and long-term placer mining areas may include habitation sites or features. The complexity of these habitation sites or features is generally related to the duration of the mining operation, and the physical relationship of the mining operation to areas suitable for habitation.

**Small Piles of Placer Tailings**

**A placer deposit worked by a rocker or cradle exhibits an undulating ground surface formed of piles of uniform-sized gravel and cobbles where the hopper was emptied. Piled or stacked cobbles and boulders may also have been moved out of the gravel bed. Metal, perforated screens (riddle plates or grizzlies) are diagnostic artifacts that are typically square, and range "16 to 20 inches on each side with one-half inch openings" (Silva 1986:3).**

The rocker, or cradle, is one of the simplest mining tools and can be operated by one individual. Named for its likeness to a baby cradle, it is essentially a wooden trough with a screened hopper on top and a handle that allows the operator to rock the device. Auriferous gravel is dumped into the hopper and enough water poured in to transport the finer sediments through the sieve, across an apron, and through a series of riffles. "Dry washers" were similar devices that did not require the use of water. Cobbles and gravel caught in the screen are cleaned out and dumped to the side (Figure 41). The apron, which was historically made of a cloth-like material such as canvas or burlap, collects coarse gold and directs fine material to the head of the riffle-lined trough, where fine gold settles. Riffles are a series of parallel slats of various designs fixed to the bottom of collection troughs that "retard the gravel and sand moving over them, and so give the gold a chance to settle" (Boericke 1936:62). Material collected from behind riffles was typically panned. The entire device is relatively portable, typically two to five feet long, one to two feet wide, and less than two feet in height. It was popular in California by 1849, and although designs continue to circulate in modern mining books, they are no longer widely used.

***Figure 41: Rocker Clean-out Pile, Prairie Diggings Placer Mining District (PDPMD), Locus 20, Sacramento County*** *(courtesy Judith D. Tordoff).*

**Oblong Piles of Placer Tailings**

**The use of long toms leaves a landscape similar to that of rockers, although the rock and gravel removed from the longer troughs create linear or oblong piles of uniform-sized gravel and cobbles, as much as 15 to 20 feet long. Other associated artifacts may include the flared, perforated sheet-iron plate.**

The long tom operates much like a rocker. Gravel is dumped into an open, inclined trough and drains through a screen into another box fitted with riffles. Coarse gold settles into perforated sheet iron that lines the initial trough, while the finer particles are captured in the riffle box below the sieve. The device relies on a steady current of gravity-fed water to move material instead of rocking, and no pressure, or head, is necessary. The flow is controlled, and must be stopped during frequent cleanouts. Material collected from behind riffles was typically panned. Widespread adoption of long toms in 1851 depended upon development of a necessary water supply system (Rohe 1986:136). Perforated metal used in long toms may vary in dimensions, although designs generally include a flared riffle plate uncommon in other collection devices (Boericke 1936:60; Silva 1986:7; Lindström et al. 2000:68). As described by Wilson (1907:39), "the feed end of the tom is about 18 inches wide, while the discharge end is about 32

**Lines of Placer Tailings**

**The use of sluice boxes resulted in a landscape similar to that of a long tom, although straight linear piles of tailings usually exceeded 20 feet in length. Metal grates or angle iron riffles might be present. Steep cut banks are absent.**

inches wide, and terminates in a perforated sheet-iron plate." Common water systems include penstock, hose, flume, and ditch, or a combination of these.

***Figure 42: Ground Sluice Tailings, Alder Creek Corridor Placer Mining District (ACCPMD), Sacramento County*** *(courtesy Judith D. Tordoff).*

A box or board sluice is a wooden, riffle-lined trough that operates much like a long tom, although typically 12-foot sections were interconnected to construct much longer devices (Peele 1941:10–561; Rohe 1986:137; Figures 42 and 43). As with the long tom, the chain of sluice boxes was supplied with a controlled source of water, and was constructed to a suitable grade for collection, often requiring trestles. Water and gravel were introduced at the head, gold and heavy sediment collected behind riffles, and water and gravel—and fine minerals—exited the tail into a dump.

Flow had to be stopped periodically to clean out concentrate from behind the riffles. Material collected from behind riffles was typically panned. Gravel could be shoveled in manually, or brought to the feed sluice by wheelbarrow and then shoveled in. Various means were employed to

***Figure 43: Sluice Tailings, PDPMD, Locus 20, Sacramento County*** *(courtesy Judith D. Tordoff).*

**Pits with Placer Tailings**

**Small-scale prospecting of slope deposits resulted in an undulating landscape of depressions and mounds located on hill-sides and ridges formed of ancient river channels. The depressions are less than ten feet in diameter and cobbles and other river rock are piled adjacent. Abundant pits with large adjacent rock piles may indicate an area of coyoting.**

prevent clogging and damage by large rocks, such as a mud box fitted with a grizzly, or metal grate; "oversize material and boulders are forked out and thrown to one side after having been cleaned" (Boericke 1936:55). Undercurrents were used to increase collection of finer, gold-bearing sediments by diverting finer material through a grate along the bottom of the sluice to a large box designed to slow the flow of water enough to allow fine gold to settle. Sluice boxes were widely used by 1852 (Rohe 1986:137). Various metal grates or sieves were used to help screen gravel and riffles were generally wood, although there are some metal designs such as angle iron (Peele 1941:10–566; Silva 1986:7). A water conveyance system would be present, although exclusive use of the sluice box would not result in steep cut banks, which would indicate ground sluicing or hydraulic technology. Sluicing resulted in impressive, distinctive landscapes (Figure 44).

Hillsides composed of the eroding remains of ancient river channels could be prospected by surface prospecting and by ground sluicing (see below). Small, shallow pits were excavated into the ground surface, and the soils removed for processing in a pan, cradle, or other sorting device. Water did not need to be brought to these prospecting locations. The pits were usually less than eight feet in diameter and only a few feet deep. A pattern of small, deep prospects is called "post-holing." Archaeologically they survive as shallow depressions with small adjacent piles of stream-washed cobbles. Where buried gold deposits were located, either in exposed modern river bottoms or elevated ancient ones, prospects were enlarged by "coyoting" (mining in irregular

***Figure 44: Sluice-mining landscape created in the 1850s –1860s, McCabe Creek, Butte County*** *(Courtesy Anthropological Studies Center, image no. 27-03-D136-05).*

openings or burrows into the auriferous gravels; also see discussion below on Adits and Tailings). Dry placering employed this method as well. The work was considered quite dangerous as the ground matrix was unstable and cave-ins common. Archaeologically these prospects have collapsed and eroded and are distinguished from pit prospects only by the size of the adjacent tailings piles.


***Figure 45: Bedrock Drains in Ground Sluice System, PDPMD, Locus 19, Sacramento County*** *(courtesy Judith D. Tordoff).*

## Cut Banks, Channels, and Placer Tailings

Combinations of cut banks, channels, and stacked or piled rocks are the result of ground sluice or hydraulic operations, or a combination of these methods. Both processes of excavating auriferous deposits relied on collection technologies described above. Disposal methods for large quantities of water and waste material from the operations are evident in the archaeological remains. The feature systems resulting from sluicing and hydraulicking methods are similar.

A ground sluice is a channel or trough in the ground through which auriferous earth is washed. It may require carving into the bedrock to obtain the correct slope or grade for the bottom of the channel (Wilson 1907:40; Figure 45). Ground sluicing is also the act of caving-in and eroding the ground into a prepared channel using a steady stream of water and hand tools to remove overburden (Peele 1941:10–541). In all respects, what sets ground sluicing apart from box or board sluicing is the large quantities of water needed to excavate the ground. Booming is a variation in which the water was impounded nearby and released suddenly to cause a powerful gush of water against a bank or over a ground surface. A variety of material can be used for riffles in a ground sluice, including natural irregularities in the channel, cobbles, and wood poles. Cleaning out the concentrate from a ground sluice took place as needed. It involved removing all riffles and large stones, collecting all the sediment, and often extracting a few inches of bedrock; the result was an empty channel. The collected material would then typically be run through a board sluice, long tom, or rocker, and eventually the pan. It was also common to use board sluices at some phase of ground sluicing operations, including at the tail or in place of a ground sluice. Like the board sluice, ground sluicing became common in the early 1850s, and relied on dependable

**Cut Banks, Channels, and Placer Tailings**

**Ground sluicing and hydraulic mining produce similar landscapes characterized by substantial water conveyance features, and the presence of steep cut faces of varying heights at the edge of the worked area.**

sources of water.

***Figure 46: Stewart Mine Hydraulic Cut, Dutch Flat, Placer County*** *(I-80 in foreground) (courtesy Anmarie Medin).*

Hydraulic mining is a method in which a bank of auriferous material is washed away by a powerful jet of water and carried into sluices (Fay 1920:352). As the name suggests, an abundant water supply—and the means to build sufficient head, or pressure—is necessary. Water is typically conveyed from high on an adjacent hillside into a metal pipe (penstock) to build head, and then into canvas hoses fitted to a metal nozzle, or monitor, which directs the jet of water. In large operations giant monitors were hooked directly to penstocks to contain the high pressure. Gold was collected in extensive sluice systems, often similar to the ground sluicing described above (Figure 46).

Low-pressure models were developed in the 1850s, although substantial technological developments in high-pressure water wheels and delivery systems were accompanied by far greater gold production beginning in the early 1870s (Limbaugh 1999:34). Far greater dumping of processed waste sediment (i.e., mining debris) in waterways was another result. Judge Sawyer’s 1884 decision in Woodward vs. North Bloomfield led to the 1893 Caminetti Act, federal legislation controlling hydraulic discharge into public waterways. Large-scale operations that could not control their discharge for whatever reason began closing down.

Lindström et al. (2000:62) noted the difficulty in differentiating hydraulic and ground sluice operations in archaeological interpretation, particularly for small-scale operations. In large-scale hydraulic mines, pressurized water systems, steep cliffs, and abundant tailings in noticeable hydraulic pits and dumping grounds should be apparent. Typically small operations elevated a monitor on a stable platform to keep it dry and above flowing gravel and water. Archaeologically this looks like a flattened rock pile in front of a concaved bank; there is no equivalent need for such a feature in ground sluicing, whereby the water is delivered via a race, or ditch, above the cut face. Peele (1941:10–551) describes ideal monitor placement for larger operations.

## River Diversion

Mining the beds of rivers and streams required special techniques. One historically popular method involved turning a river from its bed in order to process the underlying gravels, popularly accomplished by wing dams, flumes, and channel diversion. A wing dam was constructed down a stretch of river, parallel to the bed, connecting upper and lower cross dams in a manner that would box a segment of riverbed (Figure 47). The flow that continued down behind the wing dam sometimes operated a pump (often called a Chinese pump) that would continue draining the contained portion of the riverbed in order to allow mining below the level of the river. Fluming involved construction of a head and tail dam, and a flume erected between them, thereby exposing an entire width of a river segment. In channel diversion, a parallel channel was made for the river alongside the natural one, and the river diverted into it. A stream course could be moved back and forth across a drainage over a period of mining. River mining was widely practiced in California beginning in the early 1850s (Rohe 1986:140), and reached its peak in the mid-1850s (Meals 1994:10), although miners used these methods as late as the 1880s.

***Figure 47: Remains of a wing dam along the Stanislaus River*** *(Courtesy Julia Costello).*

**<u>River Channel Diversion</u>**

**While a river will typically reclaim its course and obliterate evidence of this activity, some elements of the diversion means may survive along banks, such as dams and ditches. For smaller courses, evidence of parallel channels and stacked-rock retaining walls may indicate a temporary channel diversion. Sedimentation may have partially buried some elements.**

## Dredge Tailings

Dredge mining provided the means to access areas laden with deep auriferous gravels using amphibious vessels, and in turn allowed the profitable recovery of gold-bearing material that paid as little as five cents per cubic yard. Successfully used in California by 1898, and continuing into the 1960s, the bucket-line dredge consists of a "mechanical excavator and a screening and washing plant, both mounted on a floating hull" (Peele 1941:10–577). The dredge, anchored by a spud or post that could be raised or lowered at the stern of the hull, was floated in an artificial pond where it excavated a channel in deep gravel plains. Gravel was processed through a series of gold-saving devices, and the large volume of waste cobbles deposited by conveyor into a series of uniform tailings piles. The dredge would pull forward, following the excavated channel and leaving the tailings to fill in behind. Large-scale models were adapted to California's gravel plains, particularly where the Feather, Yuba, and American rivers, flowing from the Sierra Nevada, entered the Sacramento Valley (Figure 48).

**<u>Dredge Tailings</u>**
**Large, multiple piles of river cobbles with little or no soil covering, extending over a large area.**

**<u>Bucket-line</u>**
**Vast tailings fields with high, rounded, parallel rows of cobbles.**

**<u>Dragline</u>**
**Clusters of conical, or rounded, individual piles; a pond was once present.**

**<u>Dry-land dredge</u>**
**Clusters of conical, or rounded, individual piles; no pond present.**

*Figure 48:* ***Bucket-line Dredge Tailings, Yuba River*** *(courtesy Jim Woodward and Judith D. Tordoff).*

The dragline or doodlebug dredge was developed in the 1930s and operated for about a decade in California. The dredging unit consists of two parts: a shore-based power shovel equipped with a dragline bucket, and a floating washing plant, similar to but smaller than the one on a bucket-line dredge. The dragline works from the edge of the bank above the pond where the washing plant is floating. The bucket was cast into the pond, hitting the bottom teeth-first. Then it was rotated and filled by pulling it toward the power shovel with the dragline. When the bucket was hoisted up it was swung over the hopper on the washing plant and dumped; then the cycle started again. The bucket cut away the bank on which the dragline sat, so it had to move backwards as the pond and washing plant advanced toward it. Dragline dredges were "generally well suited to relatively small, shallow deposits which are too small to amortize a bucket-line dredge or too wet or low grade to be profitably worked by hand or other small-scale methods" (Wells 1966:12).

When the washing plant is mounted on wheels or skids, the dredge is called a dry land dredge (Wells 1966:13). These machines were only used in special situations such as places where the ground had to be put back to its original state by returning the tailings into the pit, leveling it over and planting it. The existence of very shallow deposits would also make it more appropriate because it could only dig about half as deep as the draglines. These dredges operated in California in the 1930s and 1940s.

***Figure 49: Bucket-line Dredge Landscape along the Feather River, Oroville, Butte County*** *(Courtesy Anthropological Studies Center, image no. 27-03-D30-14).*

The signal outcome of bucket-line dredging is vast tailings fields that encompass hundreds of acres (Figure 49). Tailings left by bucket-line dredges are distinctive in that they consist of high rounded rows of cobbles created by the arc of the stacker as the dredge pivoted on its spud. The rows angle away from the forward direction of the plant and each one represents a single pass. Ponds, dredge parts, and wire rope are also items that may be noted in an abandoned dredge field.

Dragline dredge tailings are deposited in large individual piles, rather than in continuous arcs. They are usually conical, unless they have weathered down to more rounded shapes. They are often in clusters, or in rows if the dredge was following a stream course. Because of their size, shape, and configuration, dragline dredge tailings are easily distinguished from bucket-line dredge tailings, but not from dry-land dredge tailings. Also found in clustered and conical piles, dry land dredge tailings can be confused with those from a dragline (Figure 50). The most reliable way to differentiate between the two would be by determining whether or not a pond was present, which would indicate the presence of a dragline. Mining company records would be helpful as well.

***Figure 50: Dry-land Dredge Tailings, PDPMD, Locus 3, Sacramento County*** *(courtesy Judith D. Tordoff). .*

## Drift Mining Remains

Accessing buried placer deposits using underground mining techniques of adits and shafts is called drift mining. Prospecting for bench or Tertiary placer deposits elevated above drainages or locked beneath ancient volcanic flows often results in a pock-marking of small pits spread over a hillside. When fertile ground was found, larger excavations included coyoting or drift mining into the old river channels (see discussion above on pits). The “paystreak” is reached through an adit or shallow shaft and wheelbarrows or small rail-cars may be used for transporting the gravel to a sluice on the surface. If large, the paystreak can be taken in a series of regular cuts or slices. Drift mining is more expensive than sluicing or hydraulicking and is consequently used only in rich ground (Thrush 1968:351). Substantial drift mines were operating across California by the mid-1850s (Rohe 1986:146–147). The method reached its peak in the 1870s, before virtually ceasing, only to be revived after 1933 (Peele 1941:10-606). Excavated sedimentary material deposited near a drift mine is distinguished from a lode mine's angular waste rock by its water-washed cobbles and gravels. Openings into the ground may be barely noticeable slumps, or extend into the slope a measurable distance and could include drifts, shafts, or adits (Wells 1969:127). Rail or hoist remains may be present. The facilities for processing gravel, most likely a sluice, could be on-site, or some reasonable distance away depending on the transportation methods and water source.

**Drift Mining Remains**

**Drift mines will be located in geological deposits containing old riverbeds. Waste rock will look like placer tailings, composed of cobbles. The adits and shafts may have caved in. Water is not required on site so ditches may not be present. Ore car routes may be evident.**

### HARD ROCK (LODE) MINING PROPERTY TYPES

Hard Rock (Lode) Mining Property Types include:

- Small Pits, Crosscuts, and Surface Vein Workings
- Waste Rock Piles
- Shafts, Adits, and Inclines
- Mills and other Processing Units
- Underground Workings
- Open Pit Mines

Lode refers to a mineral deposit located in fissures in country rock, and is nearly synonymous with the term vein as used by geologists. Lode deposits are tabular and clearly bounded, with orientations measured by their "dip" (angle from the horizontal) and "strike" (angle from the vertical). Although lodes may extend to the surface, they primarily lie underground and are accessed by excavations such as shafts and adits, or by open pit mines. Ore (mineral-bearing rock) extracted from the lode is usually processed first through crushing and then by physical or chemical separation devices. Lode sites produce waste rock (excavated rock that is not ore) and tailings (the discharge of unwanted processed material from mills and separators). Good discussions of lode technologies are found in Peele (1941), Hardesty (1988), Bailey (1996), Pearson (1996) Bunyak (1998), Limbaugh and Fuller (2004), and Twitty (2005).

Lode deposits, varying greatly, define the nature of the extraction and milling technologies applied to them. They are often grouped into geologic occurrences identified as zones, the most famous of which in California is the Mother Lode, extending through five counties. Lode deposits can vary greatly in depth and width, with some surface quartz leads pinching out within a few hundred feet of the surface while a few extended to a depth of more than six thousand feet with widths sometimes exceeding fifty feet. Most lode miners on the Mother Lode did not encounter major ore bodies until their workings reached five hundred or more feet in depth (Limbaugh and Fuller 2004:42–43).

Lode mining tends to be more complex than placer mining, requiring advanced technologies, skilled personnel, and substantial capital investment. Also, unlike placer gold, extracted ore requires processing to free its minerals. Surface ore was naturally oxidized and its values could often be retrieved through simple crushing and physical separation. As veins extended deeper into the earth, however, gold was typically chemically bound with sulfides and other mineral compounds. Miners developed various chemical processes to separate them (discussed below in Section 2: Ore Processing). Although extraction and processing technologies evolved over time, older techniques continued where newer ones were too expensive or inappropriate for the scale of the effort. What was the state-of-the-art in the industry was not necessarily what was practiced on the ground. As pointed out by Mother Lode historian Ronald H. Limbaugh and geologist Willard P. Fuller:

> It must be remembered that many goldmines on the Mother Lode and most of those on the adjacent belts were small operations too poorly financed to afford trained staff and the most recent improvements in mining machinery. In general, California mines probably modernized slower than those in other western districts, partly because of the size and cost factors, and partly because of a traditional conservatism among Mother Lode mine owners and operators that persisted down nearly to the present day (2004:183–184).

Many hard-rock miners worked only seasonally, on weekends, or between jobs. The ingenuity and inventiveness of these frugal miners also produced unique solutions to mining problems. One example includes Rancher James D. McCarty who set up a two-stamp mill on his Defiance claim in 1910, putting a tractor-boiler up on blocks to supply steam power (Figure 51).

The range of hard rock technologies is vast and complex and will not be detailed in this section; instead, a description of the types of features commonly present on sites is described and some examples provided. Examples of mines from the Copperopolis district in Calaveras County, recorded for the Historic American Engineering Record (HAER), are available online (HAER 2007).

## Small Pits and Surface Vein Workings

Surface vein workings are among the oldest evidence of hard-rock mining in California. During even the earliest years of the gold rush, placer miners were following "color" (gold) up gulches and encountering outcrops of quartz veins. Although "bull" veins (those without ore) were the most common, traces of gold were evident in some outcroppings and prospectors learned to search these out. Float, mineralized rock broken out from eroding veins, indicated a nearby source, and 'gossans' – surface mineralizations of iron-heavy deposits- signified mineral veins underneath. Prospecting tools included picks, bars, and shovels and, in larger operations, wheelbarrows and ore cars to move ore and waste rock.

**Small Pits and Surface Vein Workings**

**This includes pits with adjacent quarried rocks (not stream cobbles), or exposures of uplifted strata of country rock with excavated-out veins. Adits and other evidence of hard-rock mining and exploration will likely be in the vicinity. On larger workings, an arrastra or small mill might have been located nearby.**

***Figure 51: Tractor-boiler that Supplied Power to Two-stamp Mill at Defiance Claim*** (*Library of Congress, HAER Photo by Alice Olmstead*).

Typically, an exposed vein was simply followed down into its outcropping, leaving an exposed rock stratum with its center gouged out like a cavity in a large tooth. The sides of these excavations are usually uneven as digging simply ceased at the limits of the ore. The floors of these workings have generally filled in over the years with silt and natural debris, but larger examples often exhibit an "exit" on a downhill side for removal of rock, or a platform for a windlass or hoist in deep excavations. Waste rock will be conveniently disposed of near the workings. Included in the waste rock may be chunks of bull quartz, a good sign that the excavators were following a vein.

Some kind of crusher was required to pulverize the recovered ore to release the gold or other minerals. This might have been a small stamp mill (two to five stamps) or an arrastra (see discussion below). The facility might have been near the vein workings, or next to a source of water with the ore transported to its location. If the mining is productive, and the vein deepens, there might be an adit driven in on the lode further down the hillside. At Carson Hill, on the Stanislaus River, the original 1850s surface vein workings that led to nearly a century of rich mining operations are still extant on the crest of a ridge.

## Waste Rock Piles

Perhaps the most visible evidence of underground workings is waste rock. In following a vein, the vast majority of excavated rock is that surrounding the ore, and this waste rock is discarded immediately at the opening to the mine, allowed to accumulate in a downhill, gravity-formed mound or dump. Piles of waste rock not only indicate the location of uphill shafts and adits (which may be caved in and therefore not easily identifiable), but the size of the pile reflects the extent of the underground workings. Waste has also been used for roadbeds and other improvements, however, so the size of the pile should be viewed with caution.

**Waste Rock Piles**

**Country rock dumped into gravity-formed piles with little or no topsoil and vegetation. Their presence indicates the locations of mine portals and under-ground workings.**

***Figure 52: Waste rock Pile in Canyon, San Bernardino County, with Cabin Ruins in Foreground*** *(Courtesy, JRP Historical Consulting Services).*

Waste dumps are visible as unnatural contours on hillsides and for the lack of soil development and vegetation. For larger operations, waste-rock piles may be formed by dumping rock from ore cars, producing a long, flat-topped ridge that begins at the mine portal and is extended as the workings deepen. Mines that operated for a long time often incorporated waste rock dumps into later development, terracing them for placement of buildings or other facilities (Figure 52). As mineral-recovery techniques improved over time, old waste rock with low mineral values was (and still is) processed to extract its values.

## Shafts, Adits, and Facilities in their Vicinity

The entrance to underground workings is called a portal, and opens into either a shaft or an adit, providing access to the lode. Shafts sink down into the ground from the surface and can be vertical or on an incline, while adits are driven horizontally into hillsides (adits are often referred to as "tunnels," however, among miners this latter term is reserved for horizontal passages that have an entrance and an exit, as along roads and railroad grades). Shafts and adits vary according to the size of mining operation and the nature of the surrounding rock. Portals will often be first identified by their associated waste-rock piles (see discussion above) as their openings may have caved in or been closed by dynamiting. Shaft-like openings that do not have any associated waste rock are likely air vents connected to deeper workings, or daylight stopes (where ore excavations break the surface). When cut into a stable matrix, shafts are typically square while adits may have a curved ceiling. Where the surrounding rock is unstable, square shoring is used to reinforce the sides.

**Shafts, Adits and Facilities in their Vicinity**

**Shafts are square (or caved in) holes in the surface and may have surrounding footings for head frames and hoists. An adit's entrance into a hillside may be evident, or appear as a caved-in trench. Shafts and adits are accompanied by waste rock piles on their downhill sides. Shafts without waste rock may be air vents or daylight stopes.**

Shafts and adits require mechanisms for removal of underground waste rock and ore, and remains of these facilities are commonly present around the openings. Adits most frequently have ore cars running on tramways, or just a dirt path for wheelbarrows on smaller operations. Shafts require a hoisting device to raise the excavated material. While small shafts may operate with hand-run windlasses, larger operations require head frames with cables, buckets, and drum hoists (Figure 53). Footings for head frames straddle the shaft opening and remains typically consist of concrete bases topped with metal plates or bolts. Adjacent to these would be similar footings for the hoist drum. As mines deepened, devices such as Cornish pumps were installed to both ventilate and de-water the underground workings. Hoist power was provided by animals, steam, water, fossil fuel, and, later, electricity. Evidence for the power source might be found in massive boiler footings, a compressor, or engine mounts run by imported electricity or a generator.

The openings to deep shafts were usually collared with timbers and planks (Figure 54), or concrete (after the 1880s) to stabilize the work area, although collapse of these openings after abandonment often makes them appear as large craters. In ranchlands, abandoned shafts are often surrounded with fencing to keep out livestock. ***The bottoms of these large depressions are very unstable – often consisting of only a thin soil developed over fallen timbers and tree limbs – and should never be entered.***

***Figure 53: Small Head Frame with Chute, Inyo County*** *(Courtesy JRP Historical Consulting Services).*

**Underground Workings**

**Examination of underground workings is very dangerous and is prohibited by Caltrans. Indicated by shafts, adits, and waste rock dumps, they are NOT to be explored but must be studied through documents.**

### Underground Workings

***Figure 54: Isolated Shaft Collar, Inyo County*** *(Courtesy, JRP Historical Consulting Services).*

Shafts and adits are built to access underground workings, a series of excavations providing access to the lode. Drifts (horizontal connectors) link various parts of the mine while mining the ore body itself is frequently referred to as stoping. Underground miners sort the material they are sending to the surface into waste rock and ore so those at the top can handle each ore car lode efficiently. The size, nature, and surrounding geology of mines are vital to understanding their history. This information may be most efficiently found in documentary records.

### Open Pit Mines

**Open Pit Mines**

**Large pits excavated in stepped layers with haul roads. They may have facilities nearby. Glory holes remove ore and rock underground from the center of the pit.**

Low-grade ores located near the surface could be mined through an open pit system, much like a large quarry where rock is removed systematically in stepped benches. Excavation is generally by controlled blasting, the ore separated and hauled to the mill and the waste disposed of nearby. In modern times both ore and rock are typically loaded with large shovels and carried out by truck. Support facilities include a road system, machine shop or garage, and office. Some open pit mines used a leaching system to extract gold, and such ponds may be located nearby. Pit excavations are also sometimes called "glory holes," although this term more accurately indicates surface excavations where the rock and ore are gravity-fed out from the bottom, as in a funnel, and removed through an adit. In that case, waste rock, milling, and transport systems will accumulate near the adit portal and not the excavation area.

## ORE PROCESSING (BENEFICIATION) PROPERTY TYPES

Once ore has been removed from a mine, valuable minerals must be separated from the gangue (undesired minerals). Beneficiation is a broadly applied term and can include crushing, stamping, screening, flotation, amalgamation, and smelting (Cowie et al. 2005:13–24). The technology of beneficiation developed diverse and sophisticated processes over past centuries and only those most commonly found on sites in California are discussed below. Milling sites often contain innovative and complex technologies that were added to and modified over time. Interpretation of these site types should rely upon official mining reports and documents or those solicited by the mining company, and frequently requires the help of mining engineers.

**ORE PROCESSING PROPERTY TYPES:**

- Arrastras
- Mills: Industrial Foundations, Pads, and Machine Mounts
- Mill Tailings

## Arrastras

An arrastra (or arrastre) is a shallow circular pit, rock-lined on its sides and flat bottom, in which broken ore is pulverized by drag stones (Figure 55). These are attached to horizontal poles fastened to a central pillar and typically rotated by use of animal or human power, although later machine-powered examples can be found. The base or floor stones are usually of a hard material such as marble and exhibit a polished surface. The upper drag stones also have a polished, smooth undersurface and evidence of a bolt attachment imbedded on top. Although not commonly encountered in the field, these simple grinding devices are significant indicators of early mining activities and were also used into the twentieth century in remote areas of the state or where capitalized mining was not prudent or cost-effective (Figure 56).

Introduced by Mexican miners (arrastrar = to drag), they could be constructed with materials at hand and were quite effective in reducing ore to a powder, from which gold could be recovered by amalgamation or other simple separation processes. This type of milling is most productive for surface vein workings, where the ore has been naturally oxidized and does not require chemical processes for mineral recovery. Arrastras are rarely found intact as, upon abandonment, the floor stones were typically pulled up and the underlying soils panned to retrieve gold that sifted between the cracks. Discussions of arrastras are found in Kelly and Kelly (1983) and in Van Bueren (2004).

**<u>Arrastra</u>**

**A shallow, flat-bottomed circular depression typically less than 20 feet in diameter, lined on its edges and floor with stones. The base and drag stones are of a hard quality and exhibit polished surfaces.**

***Figure 55: Remains of Twentieth-century Arrastra, Inyo* County** (Courtesy JRP Historical Consulting Services).

***Figure 56: Remains of Arrastra Floor, Amador County*** *(Courtesy Thad Van Bueren).*

## Mills: Industrial Foundations, Pads, and Machine Mounts

Mills are not necessarily constructed adjacent to mine portals, although they may be. Mills require a power source and a steady supply of water, and it may be more expedient to locate the mill in the best place to access those requirements and transport the ore. Mills may also be centrally located to serve a series of mines.

The first step in ore processing at a mill is crushing the rock into a powder that can be treated. The most common technology for accomplishing this was the stamp mill, where ore was fed into a cast-iron mortar box located under a battery of heavy vertical rods (see also discussion of arrastras above). Through use of overhead cams, the rods were repeatedly raised about six inches and then allowed to fall, their heat-treated shoes falling on the mortar dies. The camshaft was rotated eighty to one hundred times a minute

**Mills**

**The remains of these sites generally appear as large terraces on hillsides, the size reflecting the number of stamps present. The stamp terrace has a large back wall to stabilize the stamps, and footings for the batteries may be evident. The lower terrace is for concentrating the pulp, and mill tailings will be found below. Various pads and machinery mounts around the mill reflect necessary support devices. A water source and method of transporting ore to and from the mill may be evident.**

by a belt-driven bull wheel, powered initially by water or steam (Limbaugh and Fuller 2004:65). Small, mobile, one- or two-stamp mills were effective on small sites, although batteries of five stamps were soon found to be the most effective. Stamp mills often grew in increments of two five-stamp batteries as operations expanded, resulting in some large mills of 100 and 120 stamps.

Archaeological evidence of mill sites increases with their size and permanency. Small, early mills were relatively ephemeral and temporary, leaving few traces. Unless the stamp mill itself was abandoned—leaving cast-iron shoes, cams, rods, and hopper-mortars in place—their short-term operations may not be identified. Larger stamp mills can involve large excavations of earth and leave distinctive terraces, often with equipment mounts or foundations (Figure 57). They were nearly always built into hillsides, taking advantage of gravity feed to move ore through the stages of processing. At the uppermost level, ore was delivered to the facility by tram or other vehicle, stored in bins and then fed into the hopper of a primary crusher where it was reduced to a uniform size. Jaw crushers were initially preferred, later largely replaced by ball mills (Figure 58), where ore was rotated with iron balls in large barrel-like devices (worn iron balls often mark these locations). Crushed ore was then fed through a grizzly (screen) into the stamps, where it was pulverized with the controlled use of water, creating pulp. The number of stamps is documented by footings for the batteries, grouped into five or ten per footing. The width of the stamping floor often defines the width of the mill building itself.

Below the stamps, the lower level of the mill contains the amalgamation or concentrating tables. Here the discharged pulp, with the addition of small amounts of mercury ("quicksilver"), was processed to recover the gold. This level has drains to carry off excess water from the wet processing area. Below the amalgamation level, pulp may be further processed in chlorination or cyanide tanks, or other innovative device, for final recovery. After 1870, various devices were introduced to improve this process and maximize the recovery of free gold in the concentrates, the vanner being among the most important (Limbaugh and Fuller 2004). The amalgam was then retorted to drive off (and then recapture) mercury, with the resulting gold "sponge" shipped to a mint or smelter; sometimes ingots were prepared on site. The final discards were dumped downhill as tailings.

*__Figure 57: Remains of the Royal Consolidated Mill__ (Library of Congress, HAER Photo by Alice Olmstead).*

Simple amalgamation worked well with free-milling gold, but not with refractory ores where gold was tightly bonded with other metallic minerals. In these, while gold was often clearly visible in ore samples, milling and the use of mercury did not permit its recovery. It took years of experimentation before solutions were found, and many tailings piles from early mills were later reworked to recover their gold or silver with improved processing. In the 1870s, chlorination was the first breakthrough, but even this was expensive and relatively ineffective and was only productively used on large ventures. Cyanide was used with some success in the early 1900s, applied to reground slimes from ore initially treated with chlorination. Later flotation methods subjected the treated pulp to a frothing agent which separated the minerals in cell-like devices. Heap leaching of chunk ore was also sometimes successful in recovering values from low-grade ores. No single recovery method worked in all mills, however, because of the different composition of local ores.

***Figure 58: Hendy Ball Mill at Mountain King Mine** (Library of Congress, HAER Photo by Alice Olmstead).*

For most mines, the final step was smelting through the application of heat. Prior to 1863, copper was shipped to the east coast or Swansea, Wales, for smelting; after that time it was sent to a facility at Antioch and later to the only West Coast smelter in Tacoma, Washington. California's only major smelter (for gold, silver, copper, lead and zinc) was started in San Francisco but soon moved to Selby, immediately east of Martinez along the margin of Suisun Bay. The Selby smelter was the only one operating in 1940 (USBM 1941:230; Limbaugh and Fuller 2004:66–67, 80, 176–191).

In the early years, mills were run by steam, produced in boilers or furnaces, and by water-powered impulse wheels, modeled on those made by Pelton and Knight. Impulse wheels revolutionized the industry by creating an inexpensive power source for air compressors, which ran machine drills, mills, hoists, pumps, and other equipment (Limbaugh and Fuller 2004:181). Remains of boilers may be evident adjacent to mill sites and are distinguished by rectangular platforms of brick or other refractory insulating material which encompassed large, iron horizontal-boilers. Furnaces also powered steam plants and compressors and their remains may be accompanied by a below-grade slot, or "well," to accommodate the fly wheel. Pelton-type wheels were often installed along the side of a mill where they would turn a bull wheel. They required heavy foundations and mounts, and a "well" to accommodate the wheel's rotation. A steady stream of pressurized water, delivered by an adjacent ditch or canal, blasted "buckets" at the end of the spokes, and remains of these devices will include channels for runoff.

In the 1890s electrical power plants began to be built, sometimes by independent entities and sometimes by the mining interests themselves. Engine mounts in mills are characterized by raised concrete footings topped by heavy bolts. Evidence of electrical power may also be evident in wire conduits, switch boxes, and insulators. In later years, on remote sites, local generators may also have been used.

## Mill Tailings

The undesired portion of the ore discharged from mills is identified as tailings. They were generally in the form of slurry, and for most of the nineteenth century were allowed to run down adjacent creeks and gullies. A federal anti-debris law, the Caminetti Act of 1893, prohibited miners from dumping their waste into rivers and streams. While aimed primarily at hydraulic mining debris, this act also addressed lode mine tailings. As a result, mills began constructing impound areas. These tailings ponds were typically formed by constructing a dam across a downstream ravine and allowing the tailings to build up behind it. Heavier portions of the tailings settled into flat, meadow-like formations while the water portion ran over a spillway. Abandoned with their mills, the dams for these holding ponds were typically breached in later years, allowing the stream to cut through the accumulated tailings and reach its bed once again. These breached ponds can be identified by the cliff-like sides of the stream exposing mineral-colored fines unlike the surrounding soils, and remnants of the flat pond surface preserved along the sides of the drainage.

Tailings could also be carried as slurry to neighboring ravines and pond locations some distance from the mill. This is the case in Jackson, where the unique Kennedy Tailing Wheels lifted mill tailings to a retention pond over an adjacent ridge. Mill tailings contain high levels of minerals and are often distinguished not only by their coloration but by an absence of vegetation. At the New Melones Reservoir at low water a valley filled with stark white tailings from the Carson Hill Gold Mines mill is visible from Highway 49 (Figure 59). Many modern reclamation efforts are designed to contain old tailings and prevent water from leaching their often toxic contents into waterways.

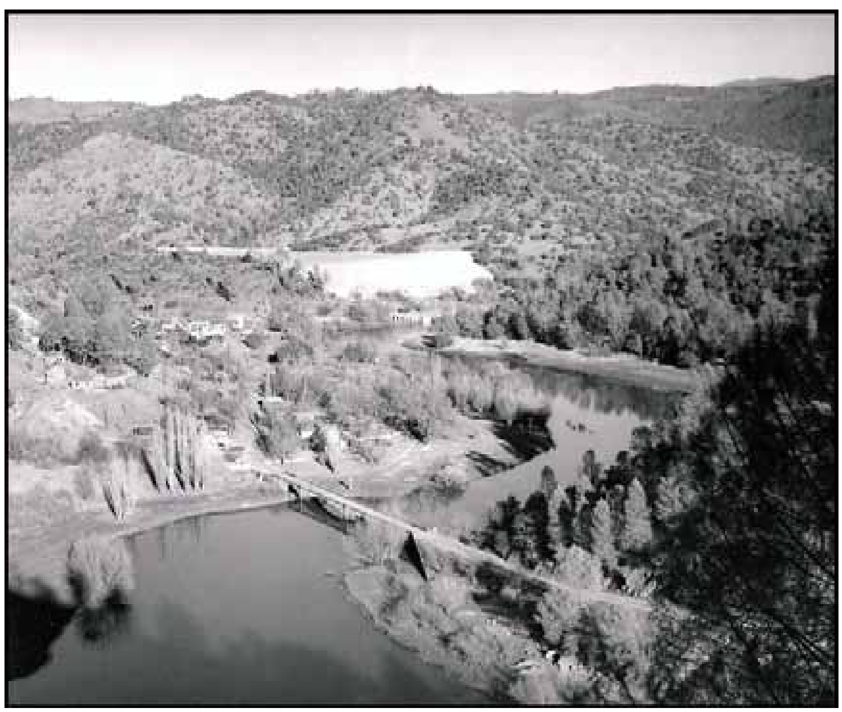

***Figure 59: Tailings at New Melones Reservoir,Stanislaus River Drainage****.* *The mill tailings were slurried to a neighboring valley resulting in the white fill visible in background.* (Courtesy Calaveras County Historical Society).

## ANCILLARY MINING PROPERTY TYPES

These are other site-specific facilities and systems that are commonly found in association with extraction and beneficiation activities. They represent important internal components assisting mining and milling operations.

### ANCILLARY MINING PROPERTY TYPES:

- Structural Remains (ruins)
  - Office
  - Change Room
  - Blacksmith/Mechanic Shop
  - Shed/store/warehouse
  - Garage
  - Stable/corral
- Site-Specific Transportation Features (ruins)
  - Ore car routes, trestles, tramways
  - Trails, paths, walkways
  - Roads, haul roads
  - Railways
- Site-Specific Water Conveyance Systems
  - Dam/reservoir
  - Ditch/flume/conduit/siphon/penstock
  - Tanks/cisterns
  - Drains

### Structural Remains

Mining sites may contain a myriad of buildings related to their mining and milling operations. Although some may be identifiable by distinctive artifacts, construction techniques, or locations, identification of most is achieved through comparing documentary records (mine inventories, photographs, and maps) with remains on the ground. Long-operating mines periodically upgraded or revamped their operations, and over time buildings may have been moved, demolished, or changed in function. Every building or structure in evidence on a site may not have been functioning at the same time.

Building remains may be from offices, sheds, storage buildings, stables and shops, locations of which may be indicated by concrete or stone foundations or simply leveled pads and retaining walls. Wooden structures were often covered with metal sheeting and may be evidenced by lumber, cut or wire nails, building hardware, or fragments of window glass. Assay offices may be distinguished by the remains of furnaces or retorting facilities, as well as fragments of crucibles and cupules.

Change rooms, where company gear and workers' personal equipment could be stored, are located next to mine portals or mills and later may have featured concrete floors and piped water for showering. These facilities were installed not only for the convenience of the workers, but to prevent high-grading (theft) of ore by employees

**Other Structural Remains**

**Foundations or pads located around mining or milling sites represent various functions, some of which may be evident from the related artifacts. Those with domestic artifacts are discussed under Mining Community below.**

Powder houses stored the mine's explosives and were usually located some distance from other structures. These were usually small windowless rooms, often semi-subterranean (commonly built into a hillside) and featured thick walls of stone, brick, or concrete.

Blacksmith shops maintained a mine's equipment and vehicles, and their former locations may contain various pieces of worked metal, raw materials, coal or coke, and slag from forging; the remains of the forge may also be evident. One of a mine blacksmith's principal duties was sharpening miners' drills. Nineteenth-century mines had stables and corrals for livestock used to haul ore cars and wagons. Stone foundations and wood posts with wire fence lines may be evident. At the Empire Mine, mules were stabled underground. More recent mines required a garage and shop which may feature tanks for oil and gasoline, grease pits, and vehicle parts. Structural remains with domestic artifacts (ceramics, bottles, and cans) are discussed below under "Mining Community."

## Site-Specific Transportation Features

Within a mining site, transportation systems were needed to move ore, waste rock, and people. On the simplest sites, hauling was done by the miners themselves or by pack animals on single-track trails. Even modest development, however, had to address how to remove waste rock from lode mines and deposit it out of the way. Ore cars were often utilized within underground workings to move excavated material toward the surface. For adit portals, tramways for ore cars commonly ran out the entrance along a level grade to the adjacent waste rock dump, both being extended as the mine deepened. Tramways were also used to haul ore to mills for processing, either run along prepared grades or on trestles. The ore cars could be powered by animals, gravity, fossil fuels, or electricity. One of the earliest gravity-fed trams in use during the 1860s, was at Hite's Cove along the South Fork of the Merced River. In the 1890s before the Royal Mill was constructed, tram mules followed ore cars downhill from the Royal shaft to the Pine Log Mill, returning on their own with empty cars for a ration of oats (HAER 2007: Document No. CA-81). Tramways can be recognized by their uniform grades and the presence of rails and ties. Overhead tramways with buckets suspended on cables connected mines in inaccessible locations to mills or transportation facilities (Figure 60).

**Trails, Roads, and Tramways**

**These linear features are visible as continuous grades leading to critical areas of the mine or mill. Tramways feature rails and ties. Aerial tramway sites where artifacts have survived are typified by cables, head frames, and buckets.**

Roads were always present to connect mine facilities, and grew in importance when trucks replaced tramways for hauling both ore and waste rock.

### Site-Specific Water Conveyance Systems

*Figure 60: Tramway Header, Star of the West Mine, Inyo County* *(Courtesy JRP Historical Consulting Services).*

Water played an important role both in placer mining and in processing lode ore. For placer mining, refer to its role in the placer extraction section above. Water was required for all types of milling; conveyance and storage systems will also be present on sites. Reservoirs, cisterns, and water tanks may be found above mills to allow for gravity feed while distribution may have been done in pipes. Remains of old riveted penstock systems may be present. Drains and methods to direct run-off from the mills will also be in evidence.

Water conveyance systems bringing water to a mill from distant sources (outside of the site boundaries) are recorded separately as individual sites. They may have tapped resources many miles away and served several mines or communities in the vicinity. These are discussed below under Inter-Site Mining Support types. Water conveyance systems for mines are also described in detail, with recordation methods and registration requirements, in the JRP/Caltrans publication *Water Conveyance Systems in California* (JRP and Caltrans 2000).

**Water Conveyance Systems**

**Reservoirs, cisterns and tanks are located uphill of mills to allow for gravity feed. Ditches, pipes and penstocks were used to move water around the facility. Drains removed spent water from the mill area.**

### MINING COMMUNITY PROPERTY TYPES

Miners often lived at the mines, and this property type addresses facilities related to the domestic residential activities of the miners, the mine's support staff, and their families. Although often marked by impermanence, mining-camp residents created distinct communities that are integral to the study of the mining site (Douglass 1998:106). The domestic property types discussed below must be physically and historically associated with prospecting, extraction, or milling activities. Resources related to mining-site residences, if present, are generally found integrated within or adjacent to mineral operations. Metal detection can help identify associated sheet refuse useful for interpreting foundations. There may be numerous remains of structures on mining sites, especially more developed ones that generally fit the architectural remains described below (see Structural Remains under Ancillary Mining Property Types). However, the residential property types addressed here must be distinguished by one or more of the following:

1. presence of sufficient quantity of domestic artifacts (e.g., more than a few),
2. distinctive domestic features such as hearths or baking ovens, or
3. identification as residence-related in documents.

In many respects the mining community reflects a work camp composed for mining. Communities brought together primarily for the mineral industry may also grow into townsites, with diminished connections to their mining roots. Modern towns along the Mother Lode's Highway 49 amply demonstrate this evolution. Mining community resources can resemble types discussed in the Work Camps and Town Sites Research Designs, and additional discussions of these types of resources may be found in those companion documents. Isolated residential sites may also be found along water conveyance, transportation, or utility lines, as well as in areas of agricultural development. Such sites should be addressed by research designs appropriate to those topics, although they may share many attributes of Mining, Work Camp, and Townsite properties.

**MINING COMMUNITY PROPERTY TYPES:**

- Domestic Structural Remains (residential and/or service)
  - Earthen pads
  - Foundations
  - Cuts/dugouts
  - Chimney/oven
- Domestic Artifact Deposits
  - Sheet refuse
  - Hollow-filled features
- Domestic Landscape Features

## Domestic Structural Remains

The simplest temporary dwelling form is the tent, or lean-to with a canvas or shake-roof. An improvement was a half-walled version where the lower sides of a one-room dwelling were made of logs, milled lumber, or fieldstone, and if a canvas roof was employed, the roof could be rolled down to close the walls. Another version was a semi-subterranean space cut into a hillside with a superstructure covered by canvass, brush, or split logs. Located on natural earthen flats or leveled pads, these simple dwellings required only modest site improvements and the canvas and wood members could easily be transported to another mining location. A tent flat may be barely noticeable if located on a naturally level area but on slopes may be distinguished by a small retaining wall (as minimal as one row of stones) on the downhill side. Improved earthen pads may be surrounded on one or more sides by a shallow ditch created by building up the pad; these also provided drainage. Where semi-subterranean features are identifiable, hill slopes were dug by hand and often supported by rubble fieldstone walls. Sparse sheet refuse is usually found on the location of the tent or cabin pad, sometimes extending downhill away from the shelter. In many cases the only

> **Earthen Pads**
>
> **Located close to placer mining remains, these leveled pads may have a downhill retaining wall and a stone hearth. They are characterized by a sparse scatter of domestic artifacts as sheet refuse.**

**Foundations**
**All the types below are associated with domestic artifacts or have been identified as domestic facilities through historical research. Any may be located on natural level areas or on prepared structure platforms with retaining walls and may have evidence of fireplaces. Structures over 30 feet long may be bunkhouses or dining halls.**

**Stone Piers or Perimeter Foundations**
**Arranged symmetrically to support a frame building.**

**Stone, Adobe, or Rammed-Earth Walls**
**Collapsed or partially standing stone building; adobe or rammed-earth may have "melted," leaving an earthen berm.**

**Concrete Piers or Perimeter Foundations**
**Generally post-dating 1900, they have bolts, sill boards, or other devices to affix the overlying frame building.**

feature visible is the collapsed remains of a fieldstone chimney or fireplace.  Metal detection can help identify associated sheet refuse. The presence of a few large stones may indicate a U-shaped hearth or fire ring. These hearths may consist of flat stones set on end to form firebreak, or a few courses of stacked local rock. Stone oven remains have also been found associated with placer mining tent pads (see discussion below). These types of dwellings are generally found in close proximity to small-scale placer mining remains (more extensive placering and hard-rock mining required greater investment in developing the mine and housing was similarly more permanent).

More substantial dwellings employed stone foundations to raise wooden walls and floors above ground level; these can include stone piers to support posts or floor joists as well as complete stone perimeter foundations. Flat stones used as post footings on a flat, such as those used for simple cabins like the ubiquitous, two-room miners' cottage, can be barely noticeable (Bell 1998:31). Post-and-pier construction was used into the early-twentieth century for frame dwellings as well as for bunkhouses and dining halls found on some mining sites. Domestic structures with stone masonry walls, or of adobe or rammed-earth, may also be present (Figure 61). A full or partial cellar, typically reinforced with stone masonry, may have been incorporated. Roofs were commonly of metal or wood. Supervisors or managers may have resided on-site in large or unique structures, possibly higher in elevation or across from the housing of common laborers.

***Figure 61: Star of the West Mine, Inyo County: Partially Standing Stone Cabin*** *(Courtesy JRP Historical Consulting Services).*

Later, poured concrete slabs and perimeter foundations were used for housing. Concrete constructions are common on well-developed mining sites after 1890. Board-formed poured foundations date to after the First World War, although smaller sites may have continued using simple stone technologies. Sites dating to the twentieth century show increasing evidence over time of off-site utilities for electric lighting, telephone, and domestic water supply.

**Cuts/Dugouts**

**Commonly appear as collapsed cuts into the hillside, or basement-like areas, possibly stone-lined, associated with domestic house-hold artifacts.**

On more extensive mines, evidence of large foundations (exceeding 30 feet in length) in association with personal domestic debris may represent bunkhouses or other collective housing. Community dining halls and kitchens will be distinguished by large refuse piles containing tablewares; large quantity cans, bottles, and jars; and faunal remains.

A dugout describes an open, often rock-lined cavity in a hillside, usually the size of a single room (Figure 62). In the mining community these generally served the same functions as discussed above for foundations: they were used as dwellings as well as for other functions such as storage. Most simply they can appear as a single slumped-in cut into the hillside. Better-developed examples were fully excavated and may have been lined with stone, poured concrete, or milled lumber framing, and supported metal or wood roofing. Wood construction elements, if not entirely decayed, will likely be collapsed within. Dugouts are typically at least partially filled-in, often burying structural elements and living surfaces. For large dugouts, the removed fill should be visible around the structure.

***Figure 62: Remains of a Masonry-lined Dugout, Butte County*** *(Courtesy Anthropological Studies Center, image no. 27-03-D136-05.).*

***Figure 63: Large Stone Oven, Chili Junction, Calaveras County.*** *The 1850s mining camp of Chili Junction was populated by miners from Chile (Courtesy Julia Costello).*

Some mining residence areas may contain cooking features, and any of the features described below may be found on domestic mining sites. Simple hearths are discussed above under "earthen pads." More developed residences may contain evidence of a stone fireplace with a chimney. The hearth itself was typically made of stone, and the chimney of stone, mud-and-stick, or pipe. Similarly, a separate area for preparing food or a more formal cookhouse may have contained a dome-shaped bake oven. Where collapsed, these appear as roundish piles of stones, about 10–15 feet in diameter, with the centers collapsed into a cavity and stones typically resting at steep angles (Figure 63). In the Mother Lode, these are most commonly associated with Italians, although they were also constructed and used by French, German, and Hispanic residents (Costello 1981; Wegars 1991). In later years, they incorporated modern materials such as brick, concrete, and cast-iron doors. A distinctive curved free-standing wall – an asado – was used by Chileans and Peruvians to cook flayed cattle. Overseas Chinese also constructed U-shaped stone hearths in the vicinity of their diggings (Tordoff and Seldner 1987; Tordoff and Maniery 1989; Medin 2002) identified by the presence of ceramics and other artifacts from their homeland. Often these suspected piles of stone must be carefully excavated to reveal their original forms and functions.

## Domestic Artifact Deposits

Domestic artifact deposits are also discussed in the *Agricultural*, *Work Camps* and *Townsites* thematic studies. The examples below identify those commonly found on mining sites.

**Domestic Sheet Refuse**

**Domestic artifacts found in the vicinity of a dwelling, conveniently deposited on the surface by the occupants.**

Domestic sheet refuse describes a horizontal scattering of discarded items typically found around a dwelling, and is one of the most common types of domestic artifact deposits on rural mining sites. Artifact accumulation results from unintended loss as well as intentional waste disposal such as casting debris away from a dwelling. Sheet refuse may be found throughout the living area of a dwelling, or as deposit located adjacent to and downhill from the residence area. Disposal of debris into natural features such as gullies may create vertical interfaces similar to the "hollow filled features" discussed below. Metal detection is helpful in identifying boundaries of discrete surface deposits.

In both situations, sheet refuse may retain a form of horizontal stratigraphy that represents unique activities or episodes; one occupant may have discarded debris one direction, while another may have tossed debris in another, thereby creating distinguishable deposits. Don Hardesty (1987:85) noted this quality on mining sites, recognizing that some site components may be organized horizontally instead of vertically. The implications of this for research and integrity have been recognized as an important element of evaluations (Cowie et al. 2005:62).

**Hollow-Filled Feature**

**Concentrated deposits of artifacts disposed of in features such as trash pits, prospects, privies, cellars, or other abandoned features.**

Developed mines with sedentary communities that resemble a town more than a camp may exhibit more intentional methods of refuse disposal, such as designating a communal dump. Artifact deposits are found buried or partially eroding from features such as trash pits or prospect pits, or from privies, wells, dugouts, cellars, or ditches abandoned at the time of disposal. It should be noted that artifacts found in abandoned features, such as basement depressions, likely reflect activities after the facility was abandoned, not the period of use. These hollow-filled features potentially offer a rich assemblage of artifacts with traditional vertical stratigraphy. Many of these types of features are buried, however, and must be explored through excavation or use of documents. The location and excavation of these types of features is discussed in the Town Sites Research Design.

### Domestic Landscape Features

Besides improvements to the physical characteristics of the mines themselves, miners and members of the mining community attempted to create a domestic environment for themselves by planting vegetable gardens and ornamentals. Surviving features may include ornamental ground cover, shrubs, and trees. Vinca major, roses, black locust, and *ailanthus*, or Chinese Tree of Heaven, are particularly common throughout the Mother Lode region. In certain instances miners terraced hillsides, built fieldstone retaining walls, and walkways.

**Plantings**
**Exotic plantings that can survive untended such as bulbs, trees, and rose bushes.**

**Stonework**
**Lined paths, retaining walls, and terraces.**

## INTER-SITE MINING SUPPORT PROPERTY TYPES

These are separate, distinct sites that may extend many miles, creating a link between the mining site and the outside world. They represent linear systems for delivery of services or access and are recorded as individual and distinct entities. The nexus of these common property types with a particular mine, however, is a contributing element of that mining site.

**INTER-SITE MINING SUPPORT PROPERTY TYPES:**

- Inter-site Transportation Features
    - Trails
    - Roads

- Inter-site Water Conveyance Systems
  - Ditch, Canal or Flume
- Inter-site Utilities

## Inter-site Linear Transportation Features

Early access to mines was by way of single-track trail, such as the network of mule trails that quickly developed to service mining camps during the first years of the gold rush. Such trails are narrow and often have stone masonry retaining walls; their width is most accurately measured at switchbacks and outcrops. Segments of trails are often completely erased by later activities. Wagon, freight, and stage roads replaced portions of these systems as some areas grew into viable settlements. These typically have stone masonry and a berm on the downhill side from grading, and often replace the steeper grades of trails with longer routes. Over time, additional road improvements such as oiling, macadam, or paving, became a standard practice. Earthen and paved roads form a network across the rural landscape. Mining operations patched into existing transportation networks or financed their own service connections. Large, capitalized operations, in particular, typically improved road systems linking to the larger transportation network. Byrd (1992a) provides a general history of road development to 1940, while Bethel (1999) offers an overview specifically for nineteenth-century gold mining.

**Trails and Roads**

**Trails were narrow and often marked with downhill rock retaining walls on hillsides. Wagon roads were wider and less steep, and later roads for motorized vehicles were often paved.**

## Inter-site Water Conveyance Systems

Water is necessary for many aspects of mining, and when an intra-site supply was not developed (see discussion above for intra-site, ancillary mining property types), operations depended on an inter-site water conveyance system for its delivery. The mining company may have developed its own water supply and storage system by buying up and improving on earlier claims and systems or purchasing water from the owner of a ditch system. These linear systems can be quite large, extending for miles beyond a mine. Typical components include catchment or take-out, storage, and delivery features. Elements are discussed at length in the JRP/Caltrans (2000) report on water conveyance systems, and by Shelly Davis-King (1990); both documents provide the general features of mining ditches. Intra-site water conveyance systems typically took water from an inter-site system, often first directing water into the mine's own storage feature via a ditch, flume, or penstock. The history of a mining site's water system is vital to understanding its development, and the source of water should be identified for each operation.

The primary feature that will be archaeologically visible in the vicinity of a mine is an earth-berm ditch, possibly with associated stone or concrete masonry or penstock. Ditch segments may be filled with sediment, or in places entirely eroded away. As the grades of ditches remained steady, their routes can be determined across a landscape even when large segments are no longer extant. Natural gullies were often used to move water quickly to a lower elevation, where it would be picked up again by a lower section of ditch.

Remains of parallel ditches are often found in close proximity and may represent water from the same source being taken to different destinations, or an improvement in the grade of a ditch at a later period of time. Small side-hill ditches – long, narrow reservoir-like hillside features – caught seasonal surface runoff and supplied mining operations below. Flumes of any antiquity are usually in disrepair if extant at all; more likely they exist as an alignment of fasteners. Remains of gates, pipes, or penstock may survive as ferrous metal and poured concrete reinforcement. During World War II many abandoned segments of riveted pipe were collected for scrap and shipped to coastal shipyards. Water storage features were developed in concert with ditches or canals. The storage reservoir was generally built upslope from the mine or mill and through penstocks and gravity water pressure was generated to power a variety of machinery.

**Ditches**
**Paths of streams of water excavated across the landscape on contours; downhill berms are typical and may be reinforced with rock.**
**Reservoirs**
**Dams were typically made of stone and earth.**
**Flumes**
**Often no longer extant, may be indicated by missing segments of ditches over creeks or steep hillsides.**
**Pipes**
**Riveted iron pipe carried water down hillsides, or siphoned over creeks.**

### Inter-site Utilities

Some mining operations required utilities, particularly electricity. The development of electrical generating plants in the 1890s was pioneered by mining companies to supply their needs as they had both capital and incentive (Limbaugh and Fuller 2004:182). Power companies supplied mines with electricity to operate head frame hoists, compressors, underground lights, etc. As telephone companies expanded their service beyond the principal metropolitan areas of California, mines and other industrial facilities established telephone communications at their facilities. Utility poles might be present, although lines were often hung from existing trees fitted with insulators. The mines near Copperopolis, Calaveras County, were, in 1901, linked by a telephone service run partially along the barbed wire of fences (Fuller et al. 1996:69).

**Poles**

**Cut or standing poles and glass and ceramic insulators.**

# CHAPTER 4. CURRENT RESEARCH THEMES

## INTRODUCTION TO MINING RESEARCH

This chapter explores research themes for mining resources important to both historians and archaeologists. They are:

1. Technology: mining and technological development.
2. Historical Ethnography/Cultural History: stories of mining sites and their populations.
3. Ethnicity: studies of distinctive cultural groups and ethnic interactions.
4. Women and Family: the roles of women and children.
5. Economy: market development, consumption, and class.
6. Policy: law, regulation, and self-governance.

These themes are integrated through references and examples with the historic context and property types presented in earlier chapters. Under each research topic are questions designed to establish base-line knowledge useful toward advancing the themes discussed. The questions may be addressed via archival sources, oral history, and archaeological records. Some questions are essentially building blocks, such as what type of mineral was mined and when, and answering those alone would not constitute the level of importance necessary for National Register eligibility under Criterion D. The final chapter will discuss how these themes can be linked to the evaluation of mining sites, and provide appropriate mitigation measures.

The history of mining in California, particularly the gold rush period, is one of the most documented and studied aspects of the state's history. Trade publications, industry journals, government publications and reports, and other sources have documented the chronological development of the mining industry. The preceding historic context chapter draws upon many of those sources to explain important trends in California's mining history. It is the purpose of this chapter to summarize extant research as it relates to the archaeological or scientific value of historic mining. The following themes focus on some of these articles and the questions raised by them.

### SIGNIFICANT SOURCE MATERIAL

Interpreting California's diverse metals mining industry requires the examination of both primary and secondary sources. Primary source material may include journals, diaries, letters, ledgers, photographs, newspapers, and government documents, including, maps, deeds, and reports. Secondary sources may include published or unpublished histories, case studies, and grey literature, including cultural resource studies.

The historiography of metals mining can be divided into four broad categories: social/cultural/institutional studies; the study of mining technology; geological history; and production and statistical data primarily found in company records or government publications. In some cases oral history has provided an important source of information, particularly through the stories of mine owners or laborers.

While an in-depth discussion of the numerous publications related to historic mining is beyond the scope of this report, the following is a brief list of sources that may be considered when developing historic contexts for specific mining properties (also refer to Chapter 4 for additional discussion pertaining to source material, particularly related to historic archaeological mining studies).

The California gold rush is, without question, the most extensively researched topic related to California's mining history. One of the first and most important works to chronicle the gold rush was Edward Gould Buffum's (1850) *Six Months in the Gold Mines: From a Journal of Three Years' Residence in Upper and Lower California, 1847-48-49*. Other works followed, including Bayard Taylor's (1850) *Adventures in the Path of Empire*, followed by Taylor's (1862) *Travels: At Home and Abroad*, John Doble's (1851, reprinted 1999) *Journal and Letters from the Mines*, J.D. Borthwick's (1857) *Three Years in California*, and Hubert Howe Bancroft's (1882-1890) seminal work, *The History of California* to name just a few. The government also joined in, documenting the gold rush through reports prepared by the Department of Treasury, such as J. Ross Browne and James W. Taylor's (1867) *Reports Upon the Mineral Resources of the United States*. It was not until the twentieth century that the gold rush was reinterpreted by authors such as Rodman W. Paul's (1947) *California Gold: The Beginning of Mining in the Far West*; John Walton Caughey's (1948) *The California Gold Rush*; Walton Bean's (1968) *California: An Interpretive History*; J.S. Holiday's (1981) *The World Rushed In;* Ralph Mann's (1982) *After the Gold Rush*; Michael Kowalewski (1997) *The Gold Rush: A Literary Exploration*; Malcolm J. Rohrbough's (1997) *Days of Gold: The California Gold Rush and the American Nation*; Holiday's (1999) *Rush for Riches*; and Susan Lee Johnson's (2000) *Roaring Camp*. All the above mentioned histories provide general narratives regarding the California gold rush and, as in the case of *The World Rushed In*, specific narratives regarding the first-hand experiences of individual miners.

Another large body of literature includes publications that deal with specific mining camps or districts. Of particular importance is the California Division of Mines and Geology's Bulletin 193, William B. Clark's (1970) *Gold Districts of California*. Clark provides a comprehensive list of districts and mining camps in California, although the focus is on hardrock mining rather than the many ephemeral mining camps that came and went. Several other descriptive listings of mining camps include Erwin G. Gudde's (1975) *California Gold Camps*; Remi Nadeau's (1992) *Ghost Towns & Mining Camps of California: A History and Guide*; and Sandy Nestor's (2007) *Silver and Gold Mining Camps of the Old West: A State by State American Encyclopedia*. One of the most important publications addressing life in the mines from a woman's perspective are the collected letters of "Dame Shirley" (Louise Amelia Knapp Smith Clappe), first published in 1854 and republished in 1933 with an introduction and notes by Carl I. Wheat as *California in 1851: The Letters of Dame Shirley* (Shirley 1933).

Mining technology has been a topic of considerable interest among historians and archaeologists. Of particular importance are historian Phillip Ross May's (1970) *The Origins of Hydraulic Mining in California*; Otis E. Young, Jr's. (1970) *Western Mining: An Informal Account of Precious-Metals Prospecting, Placering, Lode Mining, and Milling on the American Frontier from Spanish Times to 1893*; Lynn Bailey's (1996) *Supplying the Mining World: The Mining*

*Equipment Manufacturers of San Francisco, 1850–1900*; Lynn Bailey's (2002) *Shaft Furnaces and Beehive Kilns: A History of Smelting in the Far West, 1863–1900*; and Twitty's (2005) *Riches to Rust*. Robert Kelley's seminal work (1959) *Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley* on the effect of hydraulic mining in California, is not a technological history, but provides an important discussion about the controversy between farmers and hydraulic miners during the 1860s through the 1880s.

Government and governance, while briefly discussed in a number of published works mentioned above, is the focus of Charles H. Shinn's (1885) *Mining Camps: A Study in American Frontier Government*. Shinn documents the transformation of the unstructured governance of the frontier, to an organized, civil form of government that was integral in the transition of mining camps into mining communities.

County histories are also valuable sources of information regarding mining, although often dated or limited to the nineteenth and early twentieth centuries. In California, county histories were published independently, or combined with adjacent counties into a single volume. Thompson & West, publishers from Oakland, were responsible for publishing many of the county histories beginning in the 1870s through the 1880s, which in some cases include detailed descriptions of mining camps as well as illustrations of specific mines. While there are numerous repositories that own, curate, or manage primary and secondary sources regarding mining history, there are a number of institutions or federal agencies in particular that house large collections. Institutions in California include the Bancroft Library, University of California, Berkeley; Huntington Library, San Marino; California State Library, Sacramento; California Geological Survey Library, Sacramento; and the Bureau of Land Management, Sacramento. Of particular importance are the National Archives in Washington, D.C., which maintain the physical records leading to mineral patents in the United States, while local government offices, such as Recorder's Offices, retain the final patent information as well as claims (but not the preparatory documents related to the final patent).

In regards to physical objects, local museums often house collections related to historic mining, including Marshall Gold Discovery State Park in Coloma, which includes a replica of Sutter's sawmill and the gold discovery site; Death Valley National Park with exhibits in their museum about mining, and also numerous physical sites that are fully or partially interpreted; the Mariposa County Historical Museum which includes a working gold stamp mill; and the El Dorado County Museum, Placerville, with a gold rush camp display and numerous mining implements. The California State Mining Museum, located in Mariposa, includes a wonderful exhibit of gold taken from various mines in California along with many examples of mining machinery and tools. The Empire Mine State Park in Grass Valley, Nevada County, includes an underground mining exhibit, along with numerous pieces of mining equipment, historic buildings, structures, and interpretive displays, while the Malakoff Diggins State Park, also in Nevada County, encompasses a historic mining town along with exhibits related to the area's massive hydraulic mining industry. While a number of county or city-owned museums exhibit gold specimens, Ironstone Vineyards at Murphys, Calaveras County, has on display a 44-pound gold nugget, believed to be the largest specimen of crystalline gold in the world.

## SELECTED ARCHAEOLOGICAL LITERATURE

Some of the earliest and most comprehensive cultural resource studies that included mining resources were conducted in preparation for large dam projects during the 1960s and 1970s. Initial "salvage archaeological reconnaissance" along the American River, for example, identified 45 historic-era sites, 18 of which contained foundations and 14 had clearly mining-related elements (Childress and Ritter 1967). Most had shafts, adits, and several had arrastras. Subsequent work on 34 of the sites investigated for the never built Auburn Dam project, however, noted that, "when artifacts are absent and there is no associated cultural deposit, there seems little basis for additional archaeological work" (True 1976:6).

Development of New Melones Reservoir led to extensive cultural resource studies between 1968 and the early 1980s along the Mother Lode's Stanislaus River drainage. Of the 442 recorded historic-era resources, more than 60 percent were mining sites (Moratto et al. 1988:v). Multiple phases of work were carried out by teams of historians and archaeologists, only a portion of which are documented in reports (Fitting et al. 1979, Moratto et al. 1988). One approach examined the results within Frontier (self-sufficiency), Victorian, and Dependency theoretical frameworks (Greenwood 1982; Greenwood and Shoup 1983). Here, contrasting cultural characteristics of placer and lode gold miners, it was postulated that placer miners exhibited a mixture of "Frontier" and "Dependency" models exhibited by labor-intensive partnerships, and using simple technologies; whereas lode mining was evidenced by imported and expensive industrial technologies, a large wage-labor force, and financing and management by "metropolitan based corporations" (Greenwood and Shoup 1983:273).

The Cottonwood Creek Archaeological Project in Shasta and Tehama counties provided additional comparable data on gold mining resources (Johnson and Theodoratus 1984a; 1984b). Between 1848 and 1870 the Cottonwood Creek area was heavily placer mined, initially by Euroamericans and later by Chinese. Within the 45,000-acre project area, 405 cultural resources were documented, 89 of which related to gold mining. Of these, over 70 percent of the placer mining sites were considered potentially eligible to the NRHP: 54 contributed to the proposed Gas Point Historic Mining District; 9 were "evaluated as a group;" and another particularly large site spanning over 50 acres (CA-SHA-1330H) was considered a "complete mining system" (Johnson and Theodoratus 1984a:333). The 13 historic sites selected for additional archaeological testing represented temporary habitations adjacent to placer mining (Tordoff and Seldner 1987). Research questions addressed issues related to chronology, water use, mining organization, ethnicity, and social interaction. Of special interest were Chinese miners and their relationship with Euroamericans in the context of the project. The study of Chinese mining sites has achieved special recognition in archaeology owing in large part to the presence of distinctive imported artifacts manufactured in China (see Theme 3 below). Addressing research questions was hampered, however, by the lack archival data, mixing of Euroamerican or Chinese mining habitation sites and features, as well as poor historical associations (Tordoff and Seldner 1987:221). The researchers concluded that, "Given the nature of these sites as demonstrated by this and other recent projects, careful recording can result in obtaining, at the survey level, much of the data necessary to identify the system and its parts, settlement patterns, and some information on ethnicity" (Tordoff and Seldner 1987:248).

Rising gold values in the 1980s led to a resurgence of commercial mining which, combined with new environmental regulations, fueled archaeological studies of mining sites (Spude 1990a:3). In 1982 the South Dakota State Historical Preservation Center (SDSHPC) determined that mining sites “had received insufficient research, interpretation and preservation attention” specifically in response to the Homestake Mining Company’s proposal to reopen a large mine (Torma 1987:1). In 1987 SDSHPC and the State Historical Society sponsored a workshop to pull together their findings on historic mining resources in order to define research questions for evaluation and preservation (Buechler 1987). The multi-disciplinary team summarized a variety of advances made in mining research and included perspectives from social and industrial history, mine engineering, geology, cultural geography, and historical archaeology. The idea that mining properties should be considered part of a feature system instead of isolated elements (Hardesty 1987; Spude 1987:55), the concept of mining landscapes (Alanen 1987:61), horizontal stratigraphy in mining contexts (Hardesty 1987), and the notion that mining history benefits from archaeological resource-based analysis (Miller 1987:31), were all addressed at this workshop.

Cultural geographer Arnold Alanen’s workshop findings are particularly useful for interpreting the physical remains and social behavior correlates of a mining landscape. He offered a typology of mining communities and several social comparisons, recognizing that archaeological investigations can reveal much about daily life that is otherwise difficult to obtain from historic documents and oral history (Alanen 1987:63–67). Landscape historian Richard Francaviglia (1991) also documented the distinctive imprint of mining on the land. He interpreted these sites as representing more than technological processes, but also reflecting the opposing forces of culture and the environment, and the traits of “competitiveness, risk taking, male identity and power, and dominance over nature.”

Donald L. Hardesty, of University of Nevada, Reno, who has a long and extensive record of documenting historic mining properties in the intermountain West, suggested that sites be measured against a “significance evaluation matrix” of seven topics—environment, technology, diet and consumption, social organization, demography, ideology, and chronology. Each topic could be addressed on any of three scales: world systems, mining district, or feature systems (Hardesty 1987:88). Hardesty (1988) compiled two decades of compliance-based mining archaeology in Nevada for the Society for Historical Archaeology’s publication *The Archaeology of Mining and Miners: A View from the Silver State*. Using the state’s extensive lode gold and silver mining history between 1860 and 1930, Hardesty’s monograph employed case studies to illustrate various property types, historic contexts, and potential research avenues. Hardesty distinguished between historical archaeology and industrial archaeology, noting that limiting studies to “detailed architectural and engineering descriptions of surviving machinery and buildings” does “not seem broad enough to take advantage of the information contained in the archaeological record of mining sites” (1988:17).

The National Park Service added to this growing dialogue by sponsoring a week-long historic mining conference in 1989, the first of its kind, to improve the management of mining resources. The resulting proceedings covered topics on historic context, inventory and evaluation measures, compliance and management considerations, views on interpretation, the use of Historic American Engineering Record (HAER) forms, and provided several case studies (Barker and Huston 1990). Several participants (including Feierabend, Huston, and Spude) reinforced the view that abandoned mining regions should be evaluated as distinct landscape districts, while case studies by Rogers and Waters demonstrated the advantages of interpretation at this scale. Ronald Reno (1990:56) reminded fellow conference attendees that “the mining district has been recognized by most researchers as an ideal study unit for mining activities.”

Hardesty (1990:41) applied the term “historical ethnography,” citing Schuyler (1988), to the reconstruction of past lifeways using site-specific particulars as an interpretive approach to mining resources. An excellent example of this is found in George Teague’s early study of the Reward Mine and two related camps inhabited in part by Papago miners from the 1880s to the 1920s (Teague 1980). The detailed integration of historic context and artifact analysis provided an intimate picture of the mining sites as well as illuminating their place in the emerging nation. His observations on the evolution of camp buildings document “an aimless alignment in the earlier years, and a rigid, symmetrical, and parallel arrangement after the turn of the century,” leading him to postulate an essential human tendency to move toward order and homogeneity, demonstrated in the region’s transition from a frontier setting to an industrial community (Teague 1980:152–153). How did the Papago integrate into the socio-cultural context of the mining camp?

The technology of mining is featured prominently in Robert Gordon and Patrick Malone’s (1994) *The Texture of Industry*. In this overview of industrial archaeology the authors stressed the development of technological processes and how workers used space and adapted to changing work environments, citing numerous examples. Archaeological studies of the social fabric of mining sites are presented in *Social Approaches to an Industrial Past: the Archaeology and Anthropology of Mining* (Knapp et al. 1998). Mining communities are addressed, as well as the role of women in these male-dominated settlements. These studies, and many others, are combined with works by historians in the following thematic discussions.

## THEME 1: TECHNOLOGY

The theme of technology addresses all phases of mining from prospecting to extraction and beneficiation. National Register Bulletin 42 (Noble and Spude 1997:14) advocated interpreting the layout of industrial feature systems to elucidate the nature and sequence of industrial development, emphasizing the identification of variability and change in the study of mining technology and mining landscapes. It suggested looking at “conditions under which innovations in mining technology take place and are accepted or rejected,” as well as the “characteristics and evolution of mining landscapes” (Noble and Spude 1997:17). Just as interesting as innovation is the persistence of older and simple techniques in the face of more modern alternatives.

Historian Phillip Ross May’s (1970) *The Origins of Hydraulic Mining in California* explored the origins of that mining technique. The technologies of mining and beneficiation, particularly in lode mining, are the subject of a number of works, including Lynn Bailey’s (1996) *Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850–1900*, Dawn Bunyak’s (1998) interesting *Frothers, Bubbles and Flotation: A Survey of Flotation Milling in the Twentieth Century Metals Industry*, Bailey’s (2002) *Shaft Furnaces and Beehive Kilns: A History of Smelting in the Far West, 1863–1900*, and Eric Twitty’s (2005) *Riches to Rust*.

H.M. Smith's (1903) *Overland Monthly* article, "Placer Mining," discussed the fact that while much was written about the abundance of gold in El Dorado County, few articles addressed changes in mining technology. Smith's article gave an account of one instance where miners in El Dorado County concentrated first on placer mining, picking up all the gold they could wash out of the gold-bearing soils. Only when this gold began to peter out, Smith reported, did they expend energy on the considerable gold they knew was in local quartz deposits. This pattern was repeated throughout the mother lode region.

On any site where evidence of mining activity is visible, it is essential to identify the metal or metals being mined, the site's geomorphology, and what technologies were employed to extract and process the metal. The archaeological remains provide clues to these processes, and from this foundation the story of the site can be developed.

One of the few large-scale studies of gold placer mining landscapes was Neville Ritchie's (1981) development of a typology for placer tailings in the Clutha Valley of New Zealand. Ritchie's study was conducted over a period of years in response to a large reservoir project. Over 500 mining sites were recorded and divided into 11 types representing the most successful mining methods developed by 1880, along with possible regional preferences. By mapping out the process, Ritchie found that the organization of the placer tailings, ditches, and cuts varied depending on mining techniques and the type of placer deposit. Although habitation areas, and issues of chronology and ethnicity, are not investigated in this study, Ritchie suggested that future studies could incorporate these elements into the typology, rendering an even more useful tool for extracting important information from these sites.

A landscape approach that involves seriating related features is useful to help place mining features in chronological order. While most of this information will come from mining documents and identification of mining systems, excavation of processing or recovery devices, such as arrastras, may also enhance this relative dating exercise. Inter-site comparisons may help elucidate technological development of entire mining districts in the same manner. A good example of this is the reconstruction of the evolving landscape in the long-lived Felix-Hodson copper mining district near Copperopolis. Six maps of the district drawn between 1848 and 1986 illustrate the changing locations and numbers of mines and habitations, and assist in interpreting the interdependency of mining, water, and communities (Fuller et al. 1996).

Rohe (1986:154) noted that "the often described progression of mining methods (pan, rocker, tom, sluice, hydraulic, dredge) from simple to advanced is both an overgeneralization and misleading for most areas of the West." Tordoff and Maniery (1986:1–12) compared two small Chinese mining camps in Butte County dating to the 1870s–1880s that consisted of stone hearth features and artifact concentrations on terraces above mined-out areas and placer tailings. Mining features included "nearby small tailings piles and water conveyance ditches" and artifacts recovered include penstock fragments, shovels, and picks (Tordoff and Maniery 1986:63). While the authors concluded that the Chinese relied on gold pans and rockers, supporting the common image, the oblong tailing piles and attendant water system also indicated that the more ambitious long tom or sluice was utilized.

Because they are simple and inexpensive to build and can be operated by a single miner, older technologies often persist well beyond their initial popularity (Van Bueren 2004:8). Kelly and Kelly (1983:93) observed that “as a technological method and concept, arrastras outlasted other means except panning and sluice boxes, but without much change in form.” Arrastras were still used after 1950, often identifying the location of a “part-time” miner. For instance, in 1880, Guiseppe Torre acquired a substantial ranch near Sutter Creek on which he built four arrastras by 1884 (Van Bueren 2004:17–21). Calaveras County’s pioneering Fischer family developed cattle ranches around Mokelumne Hill, but a small arrastra of cemented stone situated next to Highway 26 is a reminder of their efforts to earn some extra money during the Depression of the 1930s (Hoeper 1995:19).

In recent years archaeologists and historians have become more interested in Depression-era mining. The simple technological methods used during the California gold rush were also practiced in the subsequent century by Depression-era miners. The second all-time high of gold production, totaling $50.9 million, occurred during this period (Clark 1979:6). Oral history can be a strong component of any research into this era, though less so with each passing year. The archaeology of two small habitations associated with Depression-era gold mining in Siskiyou County suggested a lifestyle characterized as “self-sufficient poverty,” whereby gold provided a means for acquiring the basic essentials, namely food and shelter. Both sites consisted of cabin remains and artifact deposits surrounded by mining features; one site featured large “prospect holes” resulting from pocket mining (a typical small-scale form of lode mining) and the other contained evidence of ground sluicing (Winthrop et al.1987:34). Evidence from these kinds of sites, which are generally poorly represented in the archival records, demonstrated the persistence of simple technologies requiring little investment.

Researchers have discovered innovative and vernacular technologies, notable adaptations unique to a site or region. Often these indicate a lack of capital funding, or perhaps the thrifty and creative nature of miners or mining companies, causing the mining operation to turn to inventive solutions. At the Defiance mine and mill near Copperopolis, built by local rancher Jackson D. McCarty in 1910, power for the two-stamp mill was supplied by a converted tractor boiler, set up on blocks with its wheels pulled off (Figure 51). The mill ran until as late as 1938. Workers at many early- to mid-twentieth-century mining sites employed gas or diesel engines to power equipment.

Van Bueren’s (1998:32–35) study of the small mine in Amador County mentioned above, demonstrated the benefits of framing research around both industrial and social elements of a mining site. The Canone Mine was a circa 1880–1892 small-scale, owner-operated lode mine employing multiple arrastras for processing. Besides the remains of arrastras, the site included water conveyance systems, modest surface workings, and “meager evidence of occupation” (Van Bueren 1998:54). Archaeological data helped interpret how the arrastra operated and, with the documentary research, linked the technology, scale, duration, and success of the operation with the ethnicity (Italian), class (low-income and single), and residence of the operator (living at the mine). By looking at the overall use of arrastras in California and the West, Van Bueren concluded that arrastra technology was marginalized by the industry because of cultural preference. Its association with Mexican miners during the gold rush established its image as a "poor man's" tool, shunned by "modern" miners who embraced newer technologies even though they could be more costly and less efficient (Van Bueren 2004).

### Questions

- What type of mineral (or minerals) was mined?
- During what time period (or periods) was the mine worked?
- Who owned, managed, or operated the mine (e.g., individual, joint stock, corporate investment, etc.)?
- Was the mine operated periodically (e.g., seasonally)? Why?
- What mining processes are evident on the site? How did they operate/function, and how did they change over time?
- How were processes adapted to specific conditions?
- Is there evidence of equipment reuse or replacement? Are the technologies older than those common during the time period that the site was active?
- Is there evidence of vernacular innovation? Under what conditions did this innovation occur?
- Why were certain mining methods selected (e.g., labor expenses, cost constraints, limited equipment availability, cultural preference, innovations)?
- Do mining processes evident on the site agree with or differ from those documented in historic records or through oral history? If different, what might be responsible for such differences?
- How was water for industrial and domestic uses delivered? Did miners satisfy their water needs (both domestic and industrial) by developing water sources on site or tapping into a larger system?
- Who made up the labor force? How did it change with time?
- Did changes in technology or management practices influence the layout of the mine, operations, or the workforce (e.g., sale of property, rise of labor unions, reduction of laborers, changes in hiring practices)?

## THEME 2: HISTORICAL ETHNOGRAPHY / CULTURAL HISTORY

This type of research focuses on compiling a detailed story - or culture history - of a given mining settlement or individual, and is conducted by historians and historical archaeologists. Robert Schuyler (1988:39) first applied the term historic ethnography to the practice of compiling culture history at the community level using archaeological and textual data equally. Ethnographic and oral history are also key ingredients, if applicable. Hardesty (1990:41) suggested using the concept for developing questions specifically about mining and miners: "Questions that are important to historical ethnography have to do with the geographical and historical context of community, household, ideology and world view, ethnicity and ethnic relations, social geography and structure, political organization, economics, and technology and the workplace, among other things." Historians have produced considerable literature regarding specific mining camps and miners, most of which rely on journals, diaries, and technical studies, such as minerals reports, for data. Studies of archaeologically definable households, commonly carried out for cultural resources management projects, provide intimate glimpses of the site's occupants. The following examples are grouped under settlement, individuals, and households and community.

### SETTLEMENT

The concept of "settlement" relates to the first attempts to establish mining camps and ultimately mining communities. Settlement can be seen as an active or fluid process and as a static process whereby a mining camp is ultimately formed. Of particular importance is how the settlement process takes place, and the sociological or cultural, economic, and political forces that shape the settlement. There are numerous published works documenting mining camps or districts. Some focus on remote locations or romantic stories, such as L. Burr Belden's (1985) *Mines of Death Valley*. Others, like Robert Palazzo's (1996) *Darwin, California*, or Leland Fetzer's (2002) *A Good Camp: Gold Mines of Julian and the Cuyamacas*, described the development of small mining towns and population composition. Such specialized books can be found for many mining camps or towns throughout the state, and should not be overlooked when researching a specific mine or camp. Other works, like Remi Nadeau's (1992) *Ghost Towns & Mining Camps of California: A History and Guide*, are collections of short histories of mining camps around the state. Similarly, Erwin G. Gudde's (1975) *California Gold Camps*, presented a comprehensive bibliography and brief description of each camp, much of the information collected from primary sources found at the Bancroft Library. Kate Willmarth Green (2001a, 2001b) wrote her works, *Like A Leaf Upon The Current Cast: An Intimate History of Shady Flat, Neighboring Gold Rush Landmarks & Pioneer Families Along the North Fork of the Yuba River Between Downieville & Sierra City, California*, and *Like A Leaf Upon The Current Cast: Supplement to 2nd Edition: Chapter 9; Additions & Corrections*, to fill a gap in the history of Sierra County. To this end, the books examined the history of the little settlement of Shady Flat and its relationship to the other such settlements along the Yuba River. Green saw Shady Flat as a "cross-section of the invading people who came to settle these parts and the events that were played out in the gold camps of California." She discussed its formation, the various ethnic groups that lived there, and early politics of the area, and also looks at settlements down- and upriver of Shady Flat. Of course, among the most famous contributions to our understanding of women's lives in the early years of mining in California are the collected letters of "Dame Shirley" (Louise Amelia Knapp Smith Clappe), first published in 1854 and republished in 1983 with an introduction and noted by Carl I. Wheat as *California in 1851;The Letters of Dame Shirley*.

County histories are also valuable sources, although many were written in the late nineteenth and early twentieth centuries. W.A. Chalfant's *The Story of Inyo* (1933), for example, had a number of chapters on mines, mining camps, prospecting, small smelters, and other mining-related subjects. *Calaveras Gold: The Impact of Mining on a Mother Lode County* was a comprehensive study of mining in this county, written by University of the Pacific historian Ronald H. Limbaugh and mining engineer Willard P. Fuller (2004). It recounted the story of individual mines but also puts this local history in the context of national and international economic events and technological innovations.

Malcolm Rohrbough (2000), in his *California History* article "No Boy's Play: Migration and Settlement in Early Gold Rush California," addressed the accounts of men and women who poured into California in search of gold. Rohrbough sought to clarify patterns of migration and settlement, noting that most miners did not form permanent settlements as they intended to get rich and go home. Only later in the gold rush did permanent settlements begin to emerge. The late J.S. Holliday's (1998) *California History* article "Reverberations of the California Gold Rush" noted that the historic record was filled with accounts of men flocking to the gold rush in California, but not with the words of men yearning to return home. Holliday reported on the transitory nature of most of the early settlers in California, and his article was filled with accounts of wives calling their husbands home and husbands' explanations why they could not yet leave. He celebrated the free and transitory nature of early California settlement and the inventive and industrious nature of early inhabitants. Holliday compared reminiscences of California's gold rush to those of the Civil War in the south. Both have been romanticized, both invoked pride, and both created a sense of a shared experience.

Archaeology tends to focus on specific sites or districts, presenting an opportunity to examine settlement at a variety of scales. In the Logtown Historic Mining District study, Tordoff (2005) took a broad approach examining the social, economic, and industrial history of the mining district. Most of the 95 historic-era features and feature concentrations identified in the project area were in the boundaries of four patented gold mines. Thirty-eight percent were industrial, while 49 percent were determined to be domestic or commercial. Excavations of two buildings between the Pocahontas and Ophir mining claims - in the densest cluster of features that is now Logtown - were associated with several different phases of mining technology. Artifacts from the larger structure indicate a business along the road, possibly a boarding house, that started serving the town when its lode mining industry began to develop; apparently a Victorian-style family household continued occupation of the place during the industry's decline. The other building nearby, set farther back from the road, and incorporating discarded arrastra stones into the hearth, was erected when the local mines were in full swing, likely by a quartz miner with, judging from the assemblage, a chronic ailment or perhaps simply a propensity for "patent" medicines (Tordoff 2005:72); interestingly, both medicine and liquor were absent in the boarding-turned-townhouse. Research showed that miners who also practiced agriculture resided in the district the longest.

The story of the Felix-Hodson mining district was documented by mining engineer Bill Fuller, historian Judith Marvin, and archaeologist Julia Costello (1996). The history of mining districts was described as one of problem solving: how to remove the ore from the ground and separate the precious metal from the gangue. Over a century and a half, this district struggled with these problems. Archaeological excavations were carried out at the Maltos' 1893–1930s adobe store and at the 1863–66 store and saloon owned by James Howard. In addition, human remains from a ranch cemetery were exhumed for relocation and reinterred, and HABS recordings were completed on the mill site. The story of the mining district and its occupants was published as *Madam Felix's Gold* (1996). The authors noted, "the history of a mining district, however, can be richer than the value of its ore," acknowledging that the personalities and activities of district residents can profoundly influence the course of local mining development. All of the ranchers, their employees, and retainers at some time or another dabbled in mining, allowing the local population to weather mining's turbulent tides, producing a particularly long-lived mining history (Fuller et al. 1996).

Gold mining in the Castle Mountains, in the Mojave Desert, was chronicled by 15 years of research related to recent expansion by the Viceroy Gold Corporation (Swope and Hall 2000). Nestled among the mines were the ruins of Hart, a short-lived, early twentieth-century mining town. Investigators recognized that no comprehensive history had ever been compiled for the town or for Hart Mining District. The authors believed that archaeology would refine and expand knowledge on "the sequence of events that took place at the settlement including, but not limited to, periods of occupation, community disasters (e.g., fire), town abandonment and decay, subsequent reclamation of structural and artifactual materials, and more recent industrial development of the locality" (Swope and Hall 2000:27). The investigation succeeded in filling many of the historical gaps and corrected some of the archival documents' inaccuracies (Swope and Hall 2000:335).

### INDIVIDUALS

A variety of articles by historians described the personal stories of gold rush miners, or miners in the period after the gold rush. For example, Charlotte Davis and Bernice Meamber's (1980) *Siskiyou Pioneer* article "Henry Levi Davis - Early Builder in Montague" provides a detailed account of Henry Levi Davis, a successful miner/carpenter/investor in the town of Montague near Yreka. The article covered his accomplishments from his arrival in Yreka to his death sixty-three years later. Others addressed the experiences of a variety of miners in much the same way as J.S. Holliday (1981) did in *The World Rushed In*. "Life In The Diggin's" (Odall 1972, 1973) provided a number of first-hand accounts of life in the mines useful for developing an understanding of the period. This journal article was a collection of letters from miners in Tuolumne County to their families back home, relaying their experiences down to the smallest detail. The first letter was an account of the writer's environment, the situation in the mines and the Indians around him. The second focused mainly on mining techniques used by the letter writer. Both offer glimpses of life as a miner. Michael Janicot's (1990) "The Weissbein Brothers of Grass Valley and San Francisco: Banking, Mining and Real Estate," in *Western States Jewish History*, provided a brief history of the professional lives of the Weissbein brothers in Grass Valley. By contrast, Jane Apostol's (2000) *Southern California Quarterly* article "Augustin W. Hale: Hard-Luck Argonaut" noted that while letters from the mines abound, there are comparatively few existing comprehensive journals kept by miners. Hale's was one such example, and Apostol's article recounted Hale's experiences in California and documented his chronic bad luck. The article was composed from Hale's journals and letters home and provided a personal look at the life of a less-than-successful miner.

Historical archaeology contributes depth to the culture histories of particular individuals when a site's material remains can be linked to the people who worked and lived there. While it is not always possible to link a site to a particular individual, there are numerous published accounts of miners, such as Seth and Asa Smith, brothers who left Baltimore to join the gold rush, who staked claims in 1854 along McCabe Creek, a tributary of the South Fork Feather River. A series of unpublished letters combined with mining and water claims, other archival sources, and numerous mining and habitation features and artifacts, told a strikingly rich history of their mining endeavors, and their interactions with partners and competitors (Praetzellis et al. 2006).

## HOUSEHOLDS AND COMMUNITY

The household represents an archaeologically definable unit of measure, whether attributable to a specific individual, group, or family, or only associated with a specific event (e.g., nearby mining feature systems). Attributes of domestic units can be compared between different mining households and residence types.

Early miners (circa 1849-1850) were generally transient, carried no more then a bedroll, shovel, and pan, and their hastily built dwellings frequently left only faint traces. Small leveled pads on hillsides may be the only visible vestiges of tent locations with stone hearths or collapsed chimneys as the only indications of dwellings. A few stones in alignment may suggest piers for a wooden floor, although upper walls and roofs were often of canvas. Artifact deposits are similarly sparse. Archaeologists who excavated early placer-miners' cabin sites at Cottonwood Creek noted few material remains, and found that multiple occupations made identification of a specific household difficult (Tordoff and Seldner 1987). For more permanent mining habitations, the artifact record increases.

Sites of mining settlements that have multiple remains of structures hold greater potential for more complex artifact deposits. Two important studies of gold mining properties along Butte Creek in the northern Sierra Nevada were carried out as Master's thesis projects. Daniel Elliot (1995) focused on subsistence and diet in a small mining camp ("Forks of Butte") in Butte Creek Canyon. The seven-acre placer mining complex consisted of multiple structures and pads built directly upon and surrounded by placer diggings on both sides of the creek. Excavations focused on a single 1850–1860 deposit from what appeared to be a saloon that had been constructed directly on top of a large placer tailing pile. The deposit yielded over 26,000 artifacts. Questions addressed in the study include age of the deposit, the activity that produced it, consumption practices, consumer behavior, commodity flow, availability and range of goods, and comparisons with urban deposits.

Jarith Kraft (1998) carried out an exhaustive academic investigation of a second mining site along Butte Creek, at the 10-acre mining camp named Butte Creek, located across from the town of Centerville. This study focused on eleven mining community property types adjacent to an extensive placer mining landscape of which only a small portion was mapped. Most cultural deposits were less than six inches thick; one feature was a burn pit about 25 inches deep, while the rest were either shallow artifact deposits or rock alignments. The remains at each feature were organized differently, but all three contained disposal areas away from the living area. Analysis of the artifact collection from three loci dating from the 1850s to the early 1900s indicated one locus to be a Chinese occupation, while the residents of the other two appear to have been Euroamerican. Historical research and cross-referencing mining and water claims produced a list of possible associations. The study succeeded in providing a broad characterization of this small-scale, "fringe" mining community that played a "secondary role relative to other larger regional settlements" (Kraft 1998:501).

Additional discussions of the interpretive potential of mining sites' residences can be found in the *Agriculture, Townsites,* and *Work Camps* thematic studies.

### QUESTIONS

- What activities/events took place on the site?
- What time period or periods are represented? Was there one occupation or many?
- Is temporal variation evident within or between loci or feature systems?
- Was settlement exclusively associated with mining, or did other types of services develop to support the mine and the miners?
- Who lived on the site (numbers, gender, ethnic or cultural group, class, age, known individuals) and did the demography change through time? If so, how and why?
- What was the duration of occupation and mining activity?
- Are cycles of occupation and abandonment evident?
- Is the migration or settlement pattern evident (early transitory or long-term)?
- Is variation in population groups (e.g., family, groups of men, single; class or ethnic segregation) evident within discernable households?
- How did people at this site respond to local, regional, statewide, or national events? Is it possible to distinguish causal relationships with larger societal trends from the archaeological remains?

## THEME 3: ETHNIC AND CULTURAL GROUPS IN THE MINES

Popular among scholars of both history and historical archaeology, research under this theme examines multiple facets of ethnicity and discrete culture groups in a mining context. National Register Bulletin 42, *Identifying, Evaluating, and Registering Historic Mining Properties* (Noble and Spude 1997), also recognizes "ethnicity and ethnic relations" as important themes.

Of all subjects related to mining addressed in recent periodical scholarship by historians, articles related to ethnicity and race are the most numerous single group. A survey of periodical literature revealed more than 50 articles on the subject, the most common being related to the experience of Chinese (13), Mexican/Hispanic (6), and African American (5) miners. In addition, articles recounted the experiences of foreign miners. Ten articles focused on the experiences of the French, three on the Cornish, and four on Jewish miners and merchants. Other articles examined the Welsh, Germans, Belgians, Croatians, and Italians. Two addressed the roles of Native Americans, including Cherokee miners, while another looked at the experience of Hawaiians (Kanakas). The articles examined groups or individuals, and while often offering little specific information about particular aspects of their lifeways (i.e., cultural practices, diagnostic artifacts, etc.) they did provide valuable contextual information related to the variety of ethnic, racial and national groups that made up California's mining community.

Historians have addressed social equality and the role of race, class, and gender in articles over the last 70 years. Of particular importance was "Unequal Opportunity on a Mining Frontier: The Role of Gender, Race, and Birthplace," by George M. Blackburn and Sherman L. Richards (1993), published in *Pacific Historical Review*. The authors noted that while previous historians had examined the demographics of early mining towns to determine the degree of development and changes in social structure, they (Blackburn and Richards) used the same information to determine the opportunities available for social and economic advancement. The authors found that the potential for advancement was, to a large degree, limited by birth, and that the fields of employment open to women, Chinese, African Americans and Native Americans, were limited. Even white men faced barriers. They showed that Chinese and African American men tended to live in town, as did the majority of women, while most white men were scattered throughout the surrounding countryside. Euroamerican men owned the majority of property and were often lawyers, doctors, and merchants, while occupations were limited for Chinese and black men, and further limited for women.

Charles Wollenberg's (1971) *California Historical Society* article "Ethnic Experiences in California History: An Impressionistic Survey" provided an overview of early California race and ethnic issues. His article was a brief overview of the types of discrimination the main ethnic minority groups (Indian, Chinese, Japanese, Mexican, and African American) experienced in California. Dennis E. Harris's (1984) valuable *Pacific Historian* article, "The California Census of 1852: A Note of Caution and Encouragement," noted the census' shortcomings as well as its strengths and provided a description of what the census covered. The federal census originated as a means to re-align the House of Representatives, and historians have often turned to it to confirm the existence of individuals. Harris showed that the special California census in 1852 quickly became a tool to develop a demographic profile of California and suggested this tool is still valuable today. The article is a reminder that the California census, the only complete one done during this early period, is a valuable and available research tool.

In "Kanaka Colonies in California," written for *Pacific Historical Review,* Richard H. Dillon (1955) examined the contributions of Hawaiians, also referred to as Kanakas, to the early history of California. Such immigrants were often treated with the same distrust and disregard as the Chinese and *Californios*, even though some had been in California before the discovery of gold in 1848. Dillon's article focused on the treatment and experiences of the Hawaiians in California during the gold rush, and makes special note of their role as missionaries to the Indians. He also observed that Hawaiians quickly assimilated and lost much of their culture.

Racial and ethnic issues were explored in William R. Kenny's (1973) article "Nativism in the Southern Mining Region of California" for *Journal of the West*. Kenny noted that it was commonly known that Mexicans were the subjects of anti-immigrant sentiment in the southern mines, but what was less understood was that they were not the only group subject to this treatment. He focused on the anti-foreign attitudes prevalent in the southern mines, recounting that Chinese and Native Americans faced discrimination along with Mexicans in the area.

Patricia Nelson Limerick's (1998) *California History* article "The Gold Rush and the Shaping of the American West" stated that miners' interaction with, and removal of, Native Americans was an important factor in shaping the West. Limerick also found that the truly American trait of claiming ownership of the land with complete disregard for those who had already settled the area (Mexicans) or other groups (Chinese) who arrived at the same time as white Americans was another important factor.

The study of culture and culture change is of primary interest to archaeologists, and the enormous diversity of nationalities and ethnic groups pouring into the gold mining regions of California provides rich material for study. Minority groups are often poorly documented and therefore information gleaned from their sites may prove important for understanding their history. Distinctive archaeological remains and artifact types may identify the presence of these population groups. Discussed in more detail below, archaeological indicators may include mining technologies, domestic cooking features, imported artifact types, and residence patterns. Once the sites or features are identified, archaeologists can address topics related to cultural continuity and change.

For example, the presence of imported cultural artifacts may suggest perseverance of homeland traits or preference for traditional foodstuffs and commodities, while non-traditional activities and artifacts may suggest acculturation or perhaps pragmatic adaptations to the new environment. An example of this is found in Chinese artifact assemblages, demonstrating primary reliance on foreign markets, and selective use of locally or regionally produced products. Distinctive traits of ethnic groups may also change over time, particularly as second and third generations identify themselves as “Californians.” The gradual disappearance of the distinctive stone ovens of the Italian immigrants was dependent not only on acculturation, but on the availability of store-bought bread (Costello 1998:72). Deborah Tibbetts (1997) developed a context specifically for early California gold mining that offered “ethnic markers” for various culture groups.

### NATIVE AMERICAN MINERS

A number of articles examined the role of Native Americans in mining. For example, Patricia Cleland Tracey’s (2000) *Journal of the West* essay “Cherokee Gold in Georgia and California” contrasted the experiences of Cherokee miners in California with those who had mined earlier in Georgia. While the article was primarily a comment on the experience in Georgia and the gold excitement that began there in 1829, Tracey made references to California to compare the Georgia experience with a better-known event. “Gold Diggers: Indian Miners in the California Gold Rush,” a *California Historical Quarterly* article by James J. Rawls (1976), noted that while it was common knowledge that California Native Americans were present during the gold rush and that some were miners, the extent of their involvement in mining was less known. Rawls addressed this gap in our understanding of the relationship between whites and Native Americans in the historic record (discussed in Chapter 2).

In Arizona, George Teague (1980) studied two locations of circa 1900 Papago occupation: a locus at the Reward Mine and a small encampment nearby. Papago were known to have been employed at the mine as laborers and one of Teague’s research questions addressed the level of adaptation or acculturation experienced by both Indian and European people. The surprising results demonstrated very little by either group. Found at the Papago sites was a “complex of artifacts and features virtually indistinguishable from those found at precontact aboriginal sites in the region” including camp layout, building styles and materials, hearths, domestic ceramic assemblage, and stone working techniques (seven tools were of glass). Adopted traits included a taste for canned meat and soft drinks, although these contributed little to the diet (Teague 1980:146–147). The Papago showed a remarkable stability for this turn-of-the-century time period, particularly as their mining wages would have allowed greater participation in the modern economy. Teague also noted that the American miners similarly adopted only a few of the many indigenous practices which would have made their stay in the arid southwest more comfortable, including the ocotillo corral, adobe bricks, and the use of Papago ollas for water storage and cooling.

> It is as if the mines and their facilities were transported wholesale and intact from Michigan or Appalachia to the heart of the American Desert, and this is probably a fair statement of what happened. The result was a raw outpost of mainstream America, expensive to build, and wasteful to maintain (Teague 1980:148).

### EUROPEAN AND NORTH AMERICAN MINERS

The largest group of published works focuses on Euroamerican miners. Articles addressing the experience of a variety of European national groups include Mary Powell Flanders' (1983) "From Wales to Manzanita Hill: Eleven Boats, A Wagon and A Mule," published in *The Californians*. In the article Flanders cited from her great-grandfather's diary and provided background from other historical sources. Similarly, George Metcalfe, M.J. Lowry and J.A. Bauer's (1921) *Western States Jewish Historical Quarterly* article "A Memorial for A Blue-Collar, Bavarian-Born, San Francisco Forty-Niner" noted that most accounts of Bavarian-born immigrants focused largely on successful merchants. By contrast, the subject of this biography was an only modestly successful house and sign painter, and sometimes miner. Belgian miners were the subject of "A Belgian in the Gold Rush: California Indians," consisting of the gold rush writings of Belgian Dr. J.J.F. Haine, translated by Jan Albert Goris and published in *California Historical Society Quarterly* (Haine 1959). While firsthand accounts of the California gold rush are not rare, Goris offered Dr. Haine's view, from a Belgian perspective, as an addition to the historic record. His ideas tracked with many other accounts of the mining experience. Haine devoted much of his account to a description of local Native American tribes and focused on living conditions and wars.

C. Michael McAdams (1977) examined Croatian culture in "The Croatians of California and Nevada," which appeared in *Pacific Historian*. McAdams stated that the historical record acknowledged that miners from many countries came to California before and during the California gold rush, but these studies mainly concentrated on the experiences of the Spanish, Mexicans and Americans. McAdams provided some of the history of the Croatian experience. The article briefly described the history of Croatians in California, their settlement patterns, similarities of California and Croatia, and the many names they had for themselves. Likewise, Patricia H. Rhodes' (1988) "The Italians of Tuolumne County," in *Chispa*, addressed the Italian experience in the mining communities of that county. She noted that among the volumes of literature on the origins of gold miners, little had been said about the ethnic groups who settled there. Rhodes' research suggested that early Italian immigrants to California were primarily merchants in medium-to-large towns, miners, and later, farmers. Ongoing economic crises forced Italians to emigrate to other countries, but the discovery of gold drew them to California with its promise of quick wealth. Most often, Italian men came to California with the intention of going back to Italy. Those that planned to stay, however, came alone and sent for their wives and families after they were settled and financially stable. These families settled near one another and relied on one another for news and support from home.

Cornish were adept at hard-rock mining, at least those who mined in their native country. The Cornish brought a variety of innovations to California including the Cornish pump, vital for removing water and introducing fresh air into deep workings. However, archaeologists have not yet identified key artifacts or features to identify their living or working areas. The contributions of Cornish miners in California and the west was the subject of Paul Friggens' (1978) "The Curious 'Cousin Jacks': Cornish Miners in the American West" in *American West*. Believing that the historical record showed little of the Cornish experience in America, their contributions, their customs and their private lives, Friggens noted that Cornish immigrants were predominately miners and introduced or perfected many hardrock mining methods used in America. Elmer E. Stevens' (1964) "The Cornish Miner (from the *Nevada County Historical Society Quarterly*)," presented in *California Historian*, provided a history of Cornish miners in a specific area, in this instance, Nevada County's Grass Valley. The author attributed the success of the community of Grass Valley to Cornish miners. He claimed that General John C. Fremont brought Cornish miners to the area to "mine" their expertise. Shirley Ewart (1981) also wrote about Cornish miners in her article for *The Pacific Historian*, "Cornish Miners in Grass Valley: The Letters of John Coad, 1858–1860." Ewart noted that when one thinks of the California gold rush, one usually thinks first of Americans crossing the continent to reach the gold fields and then of men from other countries and races. She provided the perspective of the Cornish in Grass Valley at the end of the gold rush, emphasizing the role of the Cornish family man.

Among the most discussed cultural groups in gold rush California were the French. More than 70 years ago, Rufus Kay Wyllys' (1932) "The French of California and Sonora," in *Pacific Historical Review*, sought to explain why the French were more influential and respected than other immigrant groups. The article discussed both California and Sonora, Mexico. When the French began to come to California from France, they usually came as part of a joint venture company in which they had bought shares. Wyllys discussed this and detailed the most famous company, the *Societe du Lingot d'Or*, or the Society of the Golden Ingot. French members of this society were commonly known as "lingots." In addition, there was a large number of French who came on their own to California and by 1851 the state had a sizable French population. Wyllys (1929) also wrote "The French in Sonora (1850–1854);" a chapter from this work provided a brief history of the French in California. Bereniece Lamson's (1978) *Pacific Historian* article "The Frenchmen's Dream" addressed their role in early California history. Lamson discussed French motivations for immigration. More than the allure of gold drew the French to California; they also were drawn by potential economic and political opportunities. Opportunities such as these had all but disappeared in France. California was viewed as a paradise where land-starved French could prosper, even if they never found gold. "The Lucky Frenchmen of the Yuba," Claudine Chalmers' (1994) article for *The Californians*, gave a detailed account of the lives of three particular Frenchmen who had three very different experiences in California, providing evidence that the California experience varied greatly for French immigrants. Chalmers explained that the success of her subjects was caused in large part by the low number of people working the Yuba area for gold and the willingness of Native Americans to assist with the labor. Chalmers also prepared an introduction to the journals of Alphonse Antoine Delepine, presented in *The Californians* as "'A Soul Lost in the Wilderness': Tales of a French Argonaut, Part I" (Delepine 1988a) and "'Among an Eminently Warlike People': Tales of a French Argonaut, Part II" (Delepine 1988b). Chalmers' introduction provided a short history of both the French in California and Delepine's experiences. W.W. Kallenberger's (1954) "The French in Nevada

County's Early History" for *Nevada County Historical Society* examined the gold rush endeavors of six Frenchmen and one Belgian. Nevada County had a large population of French. Many were miners who specialized in hard rock mining. He noted the particular skills in mining and engineering that these men displayed, and concluded that the reason the French were primarily miners and not farmers was because of the organization of societies in France that recruited miners rather than farmers. Gilbert Chinard (1943), in "When the French Came to California: An Introductory Essay," written for *California Historical Society Quarterly*, suggested that historians up to that point seldom investigated the reasons why men migrated to California. He used the example of one society organized for emigration to explain some of their motivations, Chinard pointed out that after the fall of France's July Monarchy in 1848, organizations formed to provide orderly direction of undesirables of every class and profession to French colonies. When the news of the gold discovery reached France, California became a destination as well. An aspect of California that was particularly appealing to early immigrants was the lack of organized government, a factor that led the French to hope they could carve out a portion for themselves.

The experience of African Americans during and after the California gold rush is another major topic for historical research. In "The Negro on the Mining Frontier," written for *Journal of Negro History*, W. Sherman Savage (1945) noted that much of the scholarship on the California gold rush stated there were few African Americans in the mining camps. Savage showed that there were, in fact, many African Americans in the California gold rush and later. He provided examples of free and slave African American miners in California, and discussed the prejudice and cooperation they encountered. Savage commented that many African Americans did not work in the mines, but remained in camp or in town and found work there. Albert S. Broussard's (1985) "Slavery in California Revisited: The Fate of a Kentucky Slave in Gold Rush California," in *The Pacific Historian*, found that the historic record did not focus on slavery in California gold mines. Broussard showed that California was not seen as a land of freedom and opportunity by slaves brought there by their masters. He maintained that in the west they found a lack of community as few African Americans, free or slave, were in the mining camps. The independence that slaves were granted in California was also not taken as a change in their status. Rudolph M. Lapp (1966) noted this view two decades earlier in the *California Historical Society Quarterly* article "Negro Rights Activities in Gold Rush California." Lapp found that there had been only limited historical discussion about African American rights activities before the Civil War, and less about African American civil rights activities in California. Lapp's article discussed these activities to illustrate that African Americans were, in fact, active in securing their rights. Additionally, Lapp recounted the hurdles they surmounted to obtain and preserve their freedoms. He pointed out that not only were there many free African Americans in California fighting for legal freedom, there was also cooperation between whites and blacks. The article covered issues such as the Fugitive Slave Act, the First Colored Convention in 1855, organization in 1852 of the Franchise League that sought to change laws prohibiting African American testimony, the 1858 attempt to bar African American immigration, and the African American exodus to Victoria, Canada, in 1858. Lapp closed with the positive shift in fortune for African Americans who remained in California. Recently, Leonard L. Richards, in *The California Gold Rush and the Coming of the Civil War* (2007), examined the national repercussions of the slavery issue in California. While more a political than social history, Richard's book discussed the controversy of Southerners having slaves work their claims.

Historian Otis E. Young (1980) addressed the impacts on the mining experience of U.S. immigrants in his *Southern California Quarterly* article “The Southern Gold Rush: Contributions to California and the West,” which explored the advances in California mining made by miners from the southern states. Young’s article contained a number of brief accounts of discoveries of gold across the country, and discussed skilled southern miners’ influence on California mining, now largely forgotten, by examining the census statistics of states last resided in and the names of mining camps.

Three articles addressed the role of Jewish merchants and immigrants in the gold rush. While not directly related to mining, both Muriel Weissberg’s (1986) “Pioneer Jewish Merchants of the Gold Rush Period In and Around Shasta,” in *Covered Wagon,* and Dr. Robert E. Levinson’s (1971) “The History of the Jews of Grass Valley, Nevada City and Vicinity,” in *Nevada County Historical Society*, discussed the role of Jewish merchants in mining communities. In addition, Levinson’s article described Jewish societies and organizations, and the role they played in the county. Al Weissberg’s (1985) *Covered Wagon* article “Pioneer Jewish Families of Shasta County,” provided an account of the first Jewish settlers of Shasta County.

With a few exceptions, archaeological sites of Euroamerican miners do not carry distinctive archaeological markers that allow researchers to distinguish particular ethnic or national sub-groups. Stone bread-baking ovens, however, have provided a key to identifying cultural groups adhering to the Mediterranean tradition of baking bread in domed ovens. Without specific documentary and oral-history associations, however, the attribution of archaeologically found ovens to specific groups is dependent on determining which group was most populous in the area at the time the ovens were constructed.

Italian domestic sites were identified in the Mother Lode by Julia Costello (1981, 1998) using oven remains as clues. Excavations of the habitation sites of the placer miners along Angels Creek in Calaveras County unfortunately yielded meager artifact assemblages. The presence of Italian immigrants was documented from the census records, thereby providing linkages between specific site locations and artifacts, and providing information on households and relative occupation dates. The clustering of these late-coming Italian miners along a creek demonstrates the propensity of foreigners to band together and use simple placering technologies to extract the limited economic resources of this locale.

The association of stone bread ovens with Italians is not exclusive, however. Of 55 documented stone ovens in Amador, Calaveras, and Tuolumne Counties, 42 were associated with Italian immigrants. The remainder represented the French (5), Chilean (4), Mexican (2), Corsican (1), and German (1) nationalities (Costello 1998:72). The bias toward Italians is due to the unusual concentration of those immigrants in this region. In other parts of the state, where other nationalities with cultural roots to the Mediterranean are more numerous, stone ovens may indicate the presence of other ethnic groups. Priscilla Wegars (1991) associated ovens alongside the railways in Idaho with an Italian workforce verified in documentary records. Ovens associated with Mexican miners are discussed below.

Newland et al. (2006) used mining and water claims and the population census to attribute circa. 1860s domestic and placer mining feature systems to Portuguese immigrants. Although not part of the California gold rush, these so-called New Immigrants (like the Chinese discussed above) used similar methods decades later, including sluicing and small-scale hydraulicking, to help secure a livelihood in the placer mines along the Feather River. The investigation further demonstrated that contemporary American miners upstream sluiced in a different manner, resulting in a different tailings configuration.

Patrick Martin (1987) used years of experience examining heavily capitalized mines in Michigan's Copper Country to show how archaeology exposes information about ethnicity and daily life. Evidence in the domestic artifact assemblage demonstrated ethnic segregation of a Swedish mining community working for the Quincy Mining Company. The types of pipes and pottery used in Swedetown indicated to Martin that ethnic conservatism is often evident in the area of foodways (Martin 1987:98).

### LATIN AMERICAN MINERS

The role of Latin American miners has been the subject of a wide variety of articles. For the purposes of this discussion, articles regarding the role of *Californios* in the gold rush are included with other works related to Sonorans, Mexicans, and Chileans. Many of the articles focused on relations between miners from these areas and those from the United States.

Duane Hale (1979), in "California's First Mining Frontier and Its Influence on the Settlement of that Area," published in *Journal of the West*, addressed the small-scale mining that went on in California prior to the gold rush. Hale noted that gold was discovered in small quantities numerous times from the Bear Flag Revolt to Marshall's discovery of gold in 1848, but little attention was paid to it.

Carlos U. Lopez's (1988) "The Chilenos in the California Gold Rush," in *The Californians*, examined the effects of gold fever on Chilenos, many of whom came to California early in the gold rush. The majority worked as miners, while others became muleteers and merchants. Chileno miners, bringing with them a wealth of experience from home, are credited with adapting their customary mining practices to the California gold regions. Lopez claimed that Chilenos were hated by American miners because of their refusal to be intimidated. This stubborn resolve evoked competing feelings of fear and respect. Though more than half of the Chilenos returned home by the 1850s, many remained in California.

The contentious relations between Mexican and American miners was addressed by Richard Henry Morefield's (1956) *California Historical Society Quarterly* article "Mexicans in the California Mines, 1848–1853." Finding that much of the scholarship about the conflict between Mexicans and Americans in the mines centered on the experiences of Mexicans immediately before and after the passage of the Foreign Miners' Tax, Morefield examined what led to the passage of the tax, in addition to its effects on Mexicans in California. He stressed that the national concern for establishing the rights of American citizens in California led to passage of the Foreign Miners' Tax and fostered anti-Mexican attitudes in the mines. Morefield claimed the primary goal was to ensure that a large portion of California gold remained in the U.S. and the rush of foreigners to the mines threatened the success of this policy. He provided an interesting contrast in the view of Americans and foreigners as seen from the perspective of merchants. Merchants preferred foreigners to Americans because foreigners, primarily Mexicans and Chileans in this account, spent their newfound wealth freely, while Americans spent as little as possible and left the state with it as soon as they could. While couched in the framework of anti-Mexican sentiment, the article is really about anti-foreign sentiment. A similar article in *Journal of the West* by William R. Kenny (1967), "Mexican-American Conflict on the Mining Frontier, 1848–1852," noted that scholarship regarding conflict in the mines usually focused on racial tensions and failed to address the reason why certain ethnic groups preferred one mining region to another. Finding a clear difference between what happened in the northern (i.e., north of the American River drainage) and southern (i.e., the Cosumnes River drainage south to Mariposa) mines, Kenny stated that the northern mines usually had a predominance of Anglo-European and American miners with relatively few foreigners. The southern mines, in contrast, had a greater percentage of Hispanic miners. Kenny hypothesized several reasons for this, including the region the miner came from and its relation to the mines, preferences in climate, and the reception by miners already in the area.

Historian Richard H. Peterson wrote three articles that bear on the often-contentious relations between Mexican and American miners. His 1976 *Pacific Historian* article, "The Foreign Miners' Tax of 1850 and Mexicans in California: Exploitation or Expulsion?" noted that discrimination suffered by Mexicans in California during the gold rush was well-documented. He stressed how the Foreign Miner's Tax reinforced this discrimination, and posed two reasons why it passed: to expel, or exploit, Mexican miners. Peterson contrasted the view that the tax was designed to exploit foreign miners and protect Americans by blocking foreign capitalists, with the view that the tax was designed to expel foreign miners, namely Mexicans. He maintained that the latter view had the strongest evidence; Mexicans were skilled miners and thus were oftentimes more successful than American miners, who feared that gold would run out and also feared the large population of Mexican miners. In Peterson's view, these factors fueled anti-Mexican sentiment and strengthened the movement to expel them from the mines. His 1980 article for *Southern California Quarterly*, "Anti-Mexican Nativism in California, 1848–1853: A Study of Cultural Conflict," noted that while most scholarship about Mexicans in California mines focused on local economic conditions and conflict, these issues were a result of pre-existing anti-Mexican attitudes. Finally, his 1985 article in *The Californians*, "The Mexican Gold Rush: 'Illegal Aliens' of the 1850s" added to our understanding of the relationship between American miners and Mexican miners by discussing the experience of Mexican miners after the passage of the Foreign Miners' Tax in 1850. Peterson described the initial effect the tax had on Mexican miners, the continued effect it had after its repeal one year later, and the results of its reinstatement the next year. Other factors included the ease with which the Mexican-American War was won, the poor treatment of Americans in Mexico, and the belief that white Americans were racially superior.

Historian Otis E. Young's (1965) "The Spanish Tradition in Gold and Silver Mining," in *Arizona*, noted that history often remembers the Spanish as conquerors searching for the gold mined by others. Young pointed out that the Spanish were skilled miners and later American miners benefited from these skills. Spanish miners were skilled and hardworking, but sought gold and silver that was relatively easy to obtain given their limited technological base. They relied heavily on Indian labor and tended to abandon mines when the metal began to run out. Young's article discussed mining techniques, purification techniques, and treatment of Indian laborers.

One of the most extensive studies of Mexican mining sites was the thesis completed by Trish Fernandez (2001): *Mexican Miners in the California Gold Rush: a Historical and Archaeological Study*. She provided a context and summarizes archaeological studies on these and similar mining sites. The majority of Mexican miners worked in the Southern Mines, along the Mokelumne, Stanislaus, Tuolumne, and Merced River watersheds. Arriving in force from Sonora in 1848, their numbers peaked in 1850 and then declined rapidly following implementation of the oppressive Foreign Miners' Tax. Her study of Mexican mining camps in "Lower Calaveritas" in Calaveras County, consisted primarily of archival research, oral histories, and field survey and recording.

As part of the New Melones project studies, historians W. Turrentine Jackson and Stephen D. Mikesell (1979a, 1979b) identified the Mexican town of Melones (namesake for subsequent mines and reservoirs). Archaeologists verified its location along the flanks of gold-rich Carson Hill, recording arrastra stones from their milling operations (Costello 1983:12–18). Later, evidence of Mexican miners was found within the residential district of the riverside mining town of Melones (distinct from Mexican Melones discussed above). The residence area for Mexicans in the workforce was suggested by an artifact collection recovered from a privy and cellar, dated from 1890–1910, and containing two shards of Mexican Tlaquepaque Polychrome, a 1903 Mexican centavo, and a bottle of liniment "ACEITE/MEXICANO" (Fitting et al. 1979; Greenwood and Shoup 1983:59; Fernandez 2001:47).

In the farthest corner of southeastern California, in the Cargo Muchacho Mountains, Mexican family neighborhoods were identified in association with Hedges/Tumco and American Girl mines. Operating from the 1890s through the 1930s, tailings from milling gold ore filled the valley floor. Extensive study of the Hedges/Tumco mining site was carried out by Michael Burney, Stephen Van Wormer and others (1993). A segregated Mexican neighborhood called "Adobe Ridge" was identified as being made up of primarily adobe and *jacal* (posts with twined branches packed with mud) structures, with some stone buildings. The jacal structures are distinctly Mexican, additionally having typical packed earth or adobe floors or adobe pavers and roofs of earth packed over branches. Artifact collections indicated that the occupants adhered to traditional dietary practices, distinct from their Euroamerican neighbors. This pattern was also seen in an adjacent Mexican mining camp at the American Girl mine, excavated by Susan Hector, William Manley, James Newland, and Stephen Van Wormer (1991). In general, at the Mexican camps less canned milk was consumed, countered by higher use of pepper sauce and spices. Ceramics include significant quantities of Native American buffware and lead-glazed Mexican wares. The preferred meat was beef—boiled or stewed—and bones were more apt to be cleaver-cut than hand-sawn (Fernandez 2001:63–64).

While domed stone ovens may be associated with several Mediterranean-based cultures, the *asado* may be distinctly related to early miners from Chile and other Spanish-speaking locales. It consists of a semi-circular stone wall about 10 feet across, 7 to 10 feet high, and nearly 5 feet deep. Serving as a type of barbecue, sides of meat were leaned against the wall, roasted and smoked by a small fire built against its base. One of these has been identified along with a domed oven and camp site next to placer-mining remains on the Calaveras River (Marvin 2005). The feature is common today in the ranchlands of Argentina, and may be the purpose of the enormous “fireplace wall” identified at a Basque adobe at Los Vaqueros Reservoir (Ziesing 1997:101–103, 200).

Arrastras and Chilean Mills were imported by Mexicans and Chileans and adopted by other miners as low-cost milling tools that could be constructed out of materials at hand. Their *prima facie* association with Mexican mining cannot be made unless other evidence supports this conclusion, as with the arrastra at Mexican Melones mentioned above.

Some adits of Mexican miners have reportedly been identified with carved niches in their walls for religious icons. At Carson Creek in Calaveras County two niches (18 × 18 inches × 5 inches deep) were found 8 and 10 feet from the entrance, approximately 3 feet above the ground (Greenwood 1982:61). They correspond to a description by Borthwick of a nearby mine at Carson Hill: “Numerous small wooden crosses were placed throughout the mine, in niches cut in the rock for their reception, and each separate part of the mine was named after a saint who was supposed to take those working on it under his immediate protection” (Borthwick 1997:74 in Fernandez 2001:46). Similar niches were found at the New Almaden mine at the location of Mexican workings (Fernandez 2001:241).

### CHINESE MINERS

Overseas Chinese miners are one of the cultural groups generating a great deal of research by both historians and archaeologists. David V. DuFault’s (1959) “The Chinese of the Mining Camps of California: 1848–1870,” in *Historical Society of Southern California Quarterly* was one of the earliest on this subject. DuFault noted that strong movements to remove the Chinese from their mining claims began in earnest in 1852 and continued through the end of the nineteenth century. Miners often feared loss of their employment to Chinese who would work for less, according to DuFault, as well as fearing an unknown culture and religion, and that mass immigration that would overpower Americans in California. He also provided a brief history of the lives of the Chinese in mining camps: their penchant for gambling, preferred foods and entertainment, religious beliefs, and conflicts within the group. Liping Zhu’s (1999) article in *Montana*, “No Need to Rush: The Chinese, Placer Mining, and the Western Environment,” pointed out that while it is well known that the Chinese were among the many ethnic groups flocking to the west during the gold rush, little is known about the contributions made by them at that time. Zhu examined the Chinese in California as an example, concluding that the Chinese were drawn to California not only by gold, but in reaction to the ravages of thirteen years of civil war in China.

The voyage across the Pacific generally took six weeks, and by the early 1850s there were reportedly more than 30,000 Chinese in California. In the ensuing decades more followed and Chinese miners spread throughout California, Nevada, Oregon and Washington. Zhu reported that the advent of hard-rock mining, and the Chinese Exclusion Act, forced many Chinese out of mining. In a similar vein, Shih-Shan Henry Tsai (1988) in *The Californians*, wrote “The Chinese and ‘Gold Mountain’,” an examination of Chinese immigrants who came to California as well as those who traveled beyond California to work for wages. After the Civil War, southern plantation owners recruited Chinese immigrants in the hope they would replace the newly-freed slave population. Railroad builders hired them as cheap labor. Chinese immigrants worked willingly, but Tsai showed they were quick to leave if they feared they were not being dealt with honestly or they would not be paid. Because most Chinese immigrants could not speak English, their employment was arranged through a broker. The broker was paid directly and he distributed the wages to the workers. Tsai noted the Chinese persevered despite anti-Chinese laws, such as the Foreign Miner's Tax and the Chinese Exclusion Laws, and came to be regarded as honest hard workers.

The extensive body of literature on the experience of the Chinese includes studies of specific locations that include mining among other subjects. For example, Dolores Yescas Nicoline, Richard Yescas and Roberta M. McDow's (1972) "Chinese Camp," in *Pacific Historian*, sought to document the little town of Chinese Camp. The authors discussed the elements of the town that could still be viewed in 1972, and recounted settlement of the town by Chinese mining in the area and the development of a permanent settlement.  Beverly Barron's (1974) "The Celestial Empire," in *Chispa*, provided a collection of anecdotes about the Chinese in California and in Tuolumne County. Included were accounts of mining, cooking, living conditions, entertainment and persecution, and the reminiscences of two long-time residents who remembered the Chinese in the county. In a brief *Nevada County Historical Society* article, "Nevada County's Chinese in Two Parts: Part I-Prior to 1900," Patrick Tinloy (1971) described the arrival and early history of the Chinese in Grass Valley and the attitudes toward them.

Andrew Johnston (2004), in "Quicksilver Landscapes: The Mercury Mining Boom, Chinese Labor, and the California Constitution of 1879" (*Journal of the West*), described the legal difficulties faced by some employers by the violation of an article in the California Constitution of 1879 that prohibited corporations from hiring Chinese or "Mongolian" workers. Tiburcio Parrott, president of the Sulphur Bank Quicksilver Mining Company, was arrested for employing one Chinese worker, an act done to challenge the provision in the new state constitution. Johnston uses this example to discuss the battle over cheap Chinese labor, which eventually became a national issue and culminated in new, restrictive Chinese immigration laws.

Finally, a summary of the Chinese mining experience was found in Randall E. Rohe's (1982) *Montana* article, "After the Gold Rush: Chinese Mining in the Far West, 1850–1890." Rohe suggested that the historic record addressed the predominance of white Americans in mining camps but paid little attention to the Chinese in these camps. Rohe discussed the role of Chinese miners in the mining regions of the West, focusing his article on the role of foreign miners in the California gold rush. He averred that foreign men replaced American miners after the initial rush, and in placer mining areas replacement miners were usually Chinese. Rohe claimed that historians' common emphasis on discrimination in the mines obscured the importance of Chinese miners on the frontier. He examined documentary evidence to demonstrate that the Chinese complemented white miners and slowed population decline in mining areas abandoned by others, spent a large portion of the gold they found in their local economies, and paid their share of taxes. A later Rohe article contested the conception that Chinese miners "consisted entirely of small-scale, primitive mining techniques," and suggested that archaeology is in a position to help investigate the extent of mining habits by various groups (Rohe 1994:73).

Roberta Greenwood (1993) summarized the status of archaeological studies of Overseas Chinese at the time in a chapter of Priscilla Wegars' (1993) edited book *Hidden Heritage, Historical Archaeology of the Overseas Chinese*. Greenwood described how previous studies had primarily focused on identification of Chinese material culture and reconstruction of Chinese lifeways in the land known as *Gum San* (Golden Mountain, or California). She called into question the assumption of a linear process of "acculturation", as well as the characterization of Chinese in California as "sojourners," or temporary workers who planned to return to homelands. This oversimplified a complicated history where many Chinese returned home because they were driven out by discrimination, simply chose to return to China, or remained to begin new lives.

Sundahl and Ritter (1997) investigated two miners' habitation sites situated in heavily mined areas near Redding. One site contained the remains of a cabin with a collapsed chimney and stone footings; the other site contained a substantial hearth-like feature. The assemblages indicated 1865–1870 and 1870–1880 occupations by Chinese placer miners "cleaning up the auriferous remains from high grading Euroamerican miners who were also in these drainages" (Sundahl and Ritter 1997:67). The authors discussed the possibility that the earlier site represented Chinese placer miners reusing an existing Euroamerican cabin, while the post-1870 site represented a more traditional Chinese settlement. Peter Bell (1998:33) found hearth-like features like the one from the Sundahl and Ritter representing traditional Chinese sites, describing them as "knee-high structures of earth and stone, one to each hut," only on post-1870 Chinese mining settlements in Australia. He linked the feature types to a substantial increase in Chinese immigration. Before 1870 the Chinese in Australia made up between 15 and 25 percent of the mining population, while after 1870 it was over 50 percent, and at times over 70 percent. He noted that earlier Chinese miners "lived exactly as European miners did: at first in tents, then mostly in sawn timber huts with iron roofs" (Bell 1998:33). Bell attributed the absence of the hearth features typical of later decades to earlier abandonment of traditional practices. The pattern suggested to Bell that "there is a threshold proportion of population below which a particular ethnic group is lost in the background, but above which the group can successfully preserve its material culture" (Bell 1998:33).

Tordoff and Seldner (1987) investigated 13 sites in Shasta and Tehama Counties that, like those of Sundahl and Ritter (1997), demonstrated perhaps the major problem in distinguishing artifact assemblages of Chinese miners: that the Chinese tended to re-occupy not only the diggings but the habitation sites of the Euroamerican miners. Due to the short time periods of occupation, the artifacts from both groups were generally merged into one stratum of sheet refuse around the dwelling, impossible to separate. The artifact collections from the 13 sites at Cottonwood Creek revealed a typical repertoire of Chinese items, particularly ceramic tablewares and food jars indicating use of traditional foods. Opium-related items, gaming pieces, and medicines were also imported from China. American ceramics, can fragments, nails, horse tack, liquor bottles, and mining tools were also present. While the Chinese were clearly identified by their artifacts, the non-Chinese artifacts could have been used either by them or by earlier Euroamericans. The same problem of overlapping occupations was noted by Tordoff and Maniery (1986) on other mining sites in California. Sisson's (1993) work with Chinese mining sites along the lower Salmon River in Idaho ran into similar problems identifying habitation sites with exclusively Chinese occupants. His study of vernacular Chinese architecture indicated that miners' dwellings might be distinguished by rammed-earth construction, chimneys near doorways, or rock-wall enclosed rock shelters (Fernandez 2001:36).

A distinctive “hairpin” shaped stone stove appeared to be exclusively related to Chinese sites and has been identified in both the Mother Lode (Costello et al. 1998) and on abalone fishing sites on San Clemente Island (Berryman 1995). The stove consisted of two long, parallel arms of stacked stones between 3–11 feet in length spaced about two feet apart with the fire in the enclosed trough; a chimney might be located at one end. Cooking vessels would span the arms. A gold rush era sketch depicted its use in a mining camp (De Long 1929:349). More precision in describing stone features on sites may help identify additional examples of these unique Chinese cooking stoves. Other distinctive Chinese cooking features - wok ovens and cylindrical roasting ovens - are indicative of established Chinatowns in urban areas (Costello 1999; Medin 2002; Costello et al. 2004).

Jeffrey LaLande (1983) addressed a popular notion reiterated by Rohe (1986:150) that Chinese placer miners followed after expedient Euroamericans and meticulously reworked abandoned claims. Although this historic pattern is generally true, a common misconception is that all neat and tidy stacked-rock placer remains were created by Chinese miners (e.g., McGie 1956:78). These have become commonly called “Chinese walls” across the West. A number of archaeological investigations have refuted this persistent notion, suggesting the rock walls were built by a variety of cultural groups (Limbaugh 1999:30). LaLande (1983), for example, studied thirteen large documented hydraulic mining sites in the Siskiyou Mountains of Oregon and confirmed Euroamerican and Chinese associations for three and six of them, respectively, based on archival documents and artifact classes. Finding that both Chinese and Euroamerican miners produced neatly stacked rock walls and amorphous piles, he argued that they “should not be taken as prima facie cultural evidence” (Lalande 1983:6).

Archaeological excavations at a 13-acre placer mining complex in Sacramento County provided data on the site’s placer miners (Maniery and Brown 1994). Surface features included placer tailings, ditch segments, rock alignments, six circular stone hearths, and artifact deposits. Three spatially discrete, historic-era occupations were defined, including an 1850s gold rush-era component, a Chinese occupation beginning in the late 1860s, and a Euroamerican presence starting a decade or so later. Although archival documents showed large numbers of Chinese miners in the region through the 1880s, the material culture at this site showed that here Euroamerican placer miners edged their Asian competitors off potentially rich deposits in the mid-1870s, in conjunction with the rise of anti-Chinese sentiments. Field data also showed the enduring use of sluice technologies long after the gold rush.

### QUESTIONS

- Is there documentary evidence of ethnic/cultural occupation of the site or the vicinity?
- Is there a historic context for the presence of this group and identification of their immigration and work history?
- What links were in place with the homeland (for example: immigration papers, naturalization papers, Chinese Tongs, chain migration)?

- What is the time period of occupation? Were there multiple occupations of the site, and/or periods of abandonment in between?
- Who mined the site? Did different groups occupy the site, either together or sequentially (e.g., Chinese re-working previously-mined deposits)? Is there evidence of their interaction, and how did those relations play out?
- What does the archaeological evidence indicate about occupation (reflected in domestic features)? Does it provide information on population demographics not captured in documentary sources?
- Are there archaeological markers of an ethnic/cultural group occupying the site (distinctive features or artifact types)?
- Is there archaeological evidence for how space was organized: sleeping areas, cooking areas, work areas, refuse disposal? Is there evidence for the type of structures that may have been present? What does that evidence indicate about ethnic behaviors?
- Is there other evidence of this ethnic group in the vicinity or region? Was the site isolated or part of a community?
- How does the evidence for ethnic groups on this site compare to similar sites? How does it compare to Euroamerican sites of the same time period? What continuities of traditional culture are evident? What has been adapted from the dominant Euroamerican or other cultures?
- Are ethnically distinct mining methods or technological innovations present?
- Does this site help distinguish types of mining methods that were employed by distinct groups through time, by region, and for different mineral types?
- Were the site occupants independent workers or employed by a mining company/enterprise?
- How did the miners organize themselves?
- How did organization change through time for various groups of miners?

## THEME 4: WOMEN, FAMILIES, AND GENDER

The study of women's history began to emerge in American historiography in the 1970s, which heretofore traditionally ignored women. Whereas most existing scholarship focused on women and their participation in the California gold rush, the history of women in California mining spans the second half of the nineteenth century and the twentieth century.

A seminal volume has not been produced chronicling the history of California women and their role in mining. Perhaps the most well-known and referenced work on women in gold rush California is JoAnn Levy's (1992) *They Saw the Elephant: Women in the California Gold Rush*. A more recent look at women in gold rush California that used the interpretive models of race, class and gender was Nancy J. Taniguchi's 2000 chapter, "Weaving a Different World: Women and the California Gold Rush," in *Rooted in Barbarous Soil: People, Culture, and Community in Gold Rush California*. Other works included: Ralph Mann's (1972) "The Decade after the Gold Rush: Social Structure in Grass Valley and Nevada City, California, 1850-1860" in *The Pacific Historical Review*; Margaret Woyski's (1981) "Women and Mining in the Old West," *Journal of the West*; David A. Comstock's (1984) "Proper Women at the Mines—Life at Nevada City in the 1850s"; Albert Hurtado's (1999b) "Sex, Gender, Culture, and a Great Event: The California

Gold Rush," in *The Pacific Historical Review*; Glenda Riley's (1999) brief "Feminizing the History of the Gold Rush," in *The Western Historical Quarterly*; and Susan Lee Johnson's (2000) *Roaring Camp*: *The Social World of the California Gold Rush.*

Writings of women from the gold rush period have often been published or included within edited works. Mary Ballou, Dame Shirley (Louise A.K.S. Clappe), and others were well known for their letters sent back East to share their gold rush experiences. Some noteworthy compilations of primary sources included Christiane Fischer's (1977) *Let Them Speak for Themselves: Women in the American West 1849-1900* and Ruth Barnes Moynihan, Susan Armitage and Christiane Fischer Dichamp's (1998) *So Much to be Done: Women Settlers on the Mining and Ranching Frontier.* Dame Shirley's (1970) letters have been compiled into a collection with an introduction written by Richard Oglesby in the book, *The Shirley Letters*. While living at the Rich Bar mining camp, Dame Shirley (Clappe) wrote 23 letters to her Massachusetts-residing sister between 1851 and 1852.

For the post-gold rush period, secondary works concentrating on women are not so abundant. Studies that examine women and mining in the twentieth century are especially rare for California. Though not directly focusing on women, Jessica L.K. Smith's (2006) dissertation "A Land of Plenty: Depression-Era Mining and Landscape Capital in the Mojave Desert, California" examined depression-era mining and finds women participating in roles both typical and atypical: wife, mother, cook, mine owner. Sally Zanjani argued in her 1997 publication, *A Mine of Her Own: Women Prospectors in the American West, 1850-1950* that women prospectors and miners were less of an anomaly in the American West than generally has been thought.

Local histories often tell stories of Californian women and twentieth century mining. For example, Valerie Budhig-Markin's (2004) book *Nellie E. Ladd: Mining Camp Photographer of the Trinity Alps 1859-1922* took a close look at the photography of wife, mother and hobbyist photographer Nellie Ladd. Through the photographs and accompanying history, the stories of women and their experiences in Northern California's upper New River mining camps of Old Denny (New River City), Marysville and White Rock (Coeur) emerged. Women filled companionate and familial roles, but Budhig-Markin also wrote of female teachers, innkeepers, and one prospector and mine co-owner. Another regional history by Burr L. Beldon, Mary Dedecker, Wayne Benti, and Burr Belden (2000), *Death Valley to Yosemite:" Frontier Mining Camps and Ghost Towns: The Men, The Women, Their Mines & Stories,* again examined the roles of women in mining.

Key historiographical articles or review essays on women in the West included: Susan Armitage (1980), "Western Women's History: A Review Essay," *Frontiers: A Journal of Women Studies*; Joan M. Jensen and Darlis Miller (1980) "The Gentle Tamers Revisited: New Approaches to the History of Women in the American West" *The Pacific Historical Review*; Elizabeth Jameson (1988), "Towards a Multicultural History of Women in the Western United States," *Signs*; Susan Armitage (1996), "Here's to the Women: Western Women Speak Up," *The Journal of American History*; Elizabeth Jameson (1996), "Frontiers" *Frontiers: A Journal of Women Studies*; and Vicki L. Ruiz (2001), "Shaping Public Space/Enunciating Gender: A Multiracial Historiography of Women's West 1995-2000" *Frontiers: A Journal of Women Studies*.

Studies examining the role of women in mining communities in states other than California during the twentieth century included: Nancy M. Forestell (1994), "All that Glitters is Not Gold: The Gendered Dimensions of Work, Family, and Community Life in the Northern Ontario Goldmining Town of Timmins, 1909-1950;" Carol A.B. Giesen (1995), *Coal Miner's Wives*; Shaunna L. Scott (1995), *Two Sides to Everything: The Cultural Construction of Class Consciousness in Harlan County, Kentucky*; Marat Moore (1996), *Women in the Mines: Stories of Life and Work*; Randall Norris and Jean-Philippe Cypres (1996) *Women of Coal*; Mary Murphy (1997), *Mining Cultures: Men, Women, and Leisure in Butte, 1914-41*; and Nancy Forestell (1999), "The Miner's Wife: Working-Class Femininity in a Masculine Context, 1920-1950." A seminal work for the nineteenth century that included the early twentieth century is Ronald M. James & C. Elizabeth Raymond (1997) *Comstock Women: The Making of a Mining Community*.

Archaeologists also began writing about gender issues in the 1980s. Alexy Simmons' (1989) *Red Light Ladies: Settlement Patterns and Material Culture on the Mining Frontier* was the first comprehensive study of women in the West. Simmons studied the growth and changes in the industry using examples from Jacksonville, Oregon; Silver City, Idaho; Virginia City, Nevada; Helena, Montana; and Cripple Creek, Colorado. Particularly, using documentary records, she mapped the location of these businesses as they related to overall town development. This study importantly linked changing attitudes toward prostitutes to the maturing of the frontier and evolving social and moral attitudes of the country.

In his summary of the mining archaeology of gender, and its nexus with class and ethnicity, Donald Hardesty (1994:129) argued, "Gender is one of the principles that structure the social and cultural organization of human groups and that must be considered in interpreting the documentary and archaeological records of the past." He structured his own analysis of multiple mining community sites throughout the West at the household, community, and regional scales. Assemblages of family households were consistently dominated by alcohol-related artifacts, while all-male boarding houses contained few, demonstrating the social habits of the two groups, or at least where they did their drinking (Hardesty 1994:138). At the community level, Hardesty explored neighborhood divisions with regard to brothels and family households that were visible in deposits. Two notable patterns were observed at the regional level reflecting entire mining districts: first, women lived "in town, with families at outlying ranches, or at toll stations managed by families," while the male-dominated working class occupied satellite communities; second, in regions dominated by company-controlled mines, working class women also made up a sizeable part of satellite towns servicing the mining work force.

Deborah Tibbetts (1997:64) provided a discussion of female markers, noting that men would have used much of the material culture often associated with women in their absence, and concluding that the best indicators are clothing, adornments, and cosmetics. Penni Carmosino (1998) formulated hypotheses regarding men, women, and children to examine the relationship of family and household structure to Victorian ideology. Both case studies demonstrated the presence of women in separate mining community households in the Sierra Nevada, one the placer mining camp of Harrison Diggings and the other the lode mining town of Forbestown. Carmosino specifically drew from archival documents and artifact deposits to demonstrate the presence of women and children within a 1890s household, and to examine what impact that had on the material expression of a middle-class American family influenced by Victorian ideology.

The most comprehensive study of women in mining camps, particularly in saloons and brothels, was conducted by Catherine Holder Spude (2005) in her article *Brothels and Saloons: An Archaeology of Gender in the American West*. Seven of her eight artifact collections were from mining towns and camps, and she demonstrated the ability of the archaeological record to distinguish these two enterprises. Like Tibbetts, she argued for classifications of artifacts generally lumped into “personal” categories into female- and male-specific items. Female items included fancy buttons, hairpins, earrings, pendants, makeup and cosmetic containers, corset stays, thimbles, douching paraphernalia, and curling irons. Male-specific items included pocket knives, suspender buttons, watch fobs and chains, collar stays, cuff links, shaving mugs, straight razors, and large belt buckles. Spude’s statistical comparison of artifact categories related to gender, alcohol consumption, medicines, tobacco, household items, armaments and other topics by site type included control assemblages from all-male camps and both temperate and drinking domestic households. Her interpretation provided important discussions on women’s lives and, perhaps more significantly, a method for distinguishing saloons and brothels in the archaeological record. Structures with large number of bottles in poorly documented mining camps are commonly labeled as saloons where this occurrence is also typical of brothels. Until an effort is made to “pry gender from the discards of the past,” this important story of women’s western history will remain untold.

Susan Lawrence (1998) took a feminist approach in her community studies of gender at Dolly’s Creek, a placer gold-mining community in the Australian gold fields occupied during the third quarter of the nineteenth century. Lawrence found households that included women contained decorative items suitable for a parlor, further substantiating the notion of “maintaining a proper household environment as women’s work” (Lawrence 1998:50). The households without evidence of women in the assemblage lacked diversity, and represented “basic goods necessary for subsistence in a short-term diggings camp” (Lawrence 1998:53).

As archaeologist Donald Hardesty argued in writing about gender and archaeology in Nevada’s Comstock Lode: “Ultimately…comparative studies in archaeology and history are needed to understand how the lives of women on the nineteenth-century Comstock differed from and were similar to those of women in other mining communities and other urban settlements” (James and Raymond 1997:302).

Children also are rarely targeted as a topic for mining sites by archaeologists. While certainly not numerically significant during the gold rush, their numbers grew with those of women. During the 1870s at the mining town of Melones, between the rush of the 1850s and the hard rock boom to come, children appear to have outnumbered the adult male population until the arrival of the mining companies in the late 1890s (Costello 1986:26). The character of a town is affected not only by women but also by the presence of youths and evidence for them should be sought both in documents and in the ground.

### QUESTIONS

- Is it possible to distinguish the presence of women or children at mining sites in the archaeological record?
- What roles did women and/or children fulfill in mining and support services? How is that reflected in the archaeological record? Is it possible to extrapolate those indicators to sites without known associations?
- How did mining households or communities containing women and/or children differ from those without? Is it possible to distinguish cultural or behavioral themes in such differences?
- As a mining camp evolves, is there a correlation for relationship between numbers of females and stability? Is it possible to distinguish driving forces for stability, and might women be the force historically attributed to them?
- Is there a gender disparity in proximity of domestic occupation to diggings? What does that indicate about the nature of female participation in settlement patterns. Does it differ by mineral?
- What were the challenges facing women who became the sole owners of mines in California? Can the archaeological record expose differences between female-owned mines to those mines owned by men?
- Is the capitalization of solely woman-owned mines different then male owned mines? In essence, could women finance mining operations through stocks or banking institutions, or through other creative means?
- Were woman-owned mines related to specific minerals or precious metals?
- Did women who were the sole owners of mines participate in the daily operations of the mine? How might that participation appear in the archaeological record?

## THEME 5: ECONOMY

This theme explores the economics of mining at various scales, from the household to the world system. National Register Bulletin 42 reflects this emphasis by recognizing issues of “production and consumption of commodities in the mining frontier marketplace” as important topics (Noble and Spude 1997:17). This research theme takes into account the rate at which broad cultural trends and technological innovations reached the mines. Historians and historical archaeologists often explore these themes in broad, generalizing terms, comparing archival and archaeological data and observing contradictory or complimentary patterns.

Theodore S. Solomons (1938), in his *California History Nugget* article “Making Money in Early California,” noted that before the government established a mint in California, private mints or jewelers made gold coins with their value stamped on their face. These coins were used in place of the gold dust which had become an increasingly impractical method of exchange. The need for a regularized system of currency led to the establishment of the federal mint in San Francisco. In his *California Historical Society Quarterly* article “The Founding of the San Francisco Mining Exchange,” Charles A. Fracchia (1969) noted that there are only a few accounts about founding the San Francisco Mining Exchange in spite of the fact that it played a crucial role in the development of Comstock mines and in the growth of San Francisco. Robert

A. Weinstein's (1970) article, "Gold Was for the Young," (*California Historical Society Quarterly*) described the requirements for safe storage and shipment of gold and precious metals, and noted that banks were formed to provide this. One bank that survives today is Wells Fargo & Co.; Weinstein used illustrations and photographs to tell the history of the bank and depict the physical structures it used.

The injection of foreign investment capital in California mining was the subject of Clark C. Spence's (1961) article for *New Mexico Historical Review*, "British Investment and the American Mining Frontier, 1861–1914." Noting that the amount of British investment in California during the gold rush had been described as "… a lake of money, bank full and running over" he nonetheless urged a skeptical view of this statement. Although there was a great deal of British investing during the gold rush, Spence showed that these investments were often not as extensive as they may have seemed. Many investors were non-British (often Americans), and many of the shares remained unsold when investors lost interest. He also demonstrated how British investment in America was part of a larger investment in mining all over the world, and levels of investment in California were in direct competition with commodities investments abroad.

Insight into a mine's financing can be gleaned from the physical evidence of specific technologies: generally, well-capitalized mining operations tended to purchase newer and more advanced equipment, while poorly capitalized enterprises often rely on simple inexpensive techniques that have been in use for considerable time. For example, the first 60 stamps of the Royal Mill at Hodson, an operation well-financed with money from abroad, were constructed in 1898 of the newly popular Portland cement (Fuller and Costello 1990b); similarly the first electric power plants in Calaveras County opened in 1895 near Murphys to serve the Utica Mine in Angels Camp, expanding by 1903 to reach the mines of Sheep Ranch, Hodson, and Carson Hill (Limbaugh and Fuller 2004:149). Numerous historic documents, particularly gold rush journals and diaries, provided evidence that placer miners also engaged in mining that required large capital outlay for the development of complex mining systems.

Elliot (1995) demonstrated how archaeologists link objects to their sources to study how local mining economies changed as the West developed. Hardesty also examined this issue, specifically showing how artifact source data can contrast sharply with documentary evidence; although he stresses both are important elements of understanding the prevailing interaction spheres (Hardesty 1988:3). Archival documents shed light on Nevada's reliance on a Western-dominated distribution network, particularly for its heavy machinery, while the archaeological imprint demonstrated the mining state's dependence on Eastern manufactures, especially for its bottles and cans.

Historian Robert A. Burchell's (1989) "The Faded Dream: Inequality in Northern California in the 1860s and 1870s," in the U.K.-based *Journal of American Studies* noted that while there was a substantial body of scholarship on the instant wealth of the gold rush, there was little on the fluid nature of class. Burchell's article illustrated that inequality was as much the norm in California as it was elsewhere in the United States. Using data for distribution of property, wealth and income, he showed there was substantial inequality in California.

Spatial organization of households may also convey economic status. At large mining sites, the owners and management were located higher on the hillsides and farther from the mills than the workers. Richard Francaviglia (1991:99–105) discussed the social geography of mining settlements where residence locations depend on ethnic as well as economic status. Hardesty described the stratification of homes in Virginia City:

> On the upper streets of the town were the large and luxurious houses of mine and mill owners and wealthy merchants. The commercial and governmental districts were on B and C streets just below, along with “working class” residences. Below C Street in descending social and geographical order were the “red light” district and Chinatown. And at the very bottom scattered around the mill tailings were the Native American residences (Hardesty 1988:14).

This spatial arrangement of residences occurred in mining communities of all sizes. Similar spatial arrangement of dwellings was noted at the townsite of Melones (Costello 1986:47–48) and at the small settlement around the Edel Consolidated Quartz Mining Claim (Walker et al. 2006). At the latter site, plat maps depicted a supervisor’s residence across the street and higher on the hill than a workers’ boardinghouse. Fieldwork at these locations discovered additional dwellings at these locations that followed the same pattern. Francaviglia (1991:107–108) also noted that mining camp residents lowest on the social ladder often were not directly employed in mining; actually, many were employed in mining at the lowest wage scale, generally as muckers or in support industries. Archaeologists can take advantage of this stratified residential pattern to look for both recorded and unrecorded minority settlements in marginal areas of mining sites. They can then compare the household assemblages from these segregated households to reveal additional aspects of class and/or ethnicity.

Randall E. Rohe (1985), a historical geographer, has written extensively on the mining industry of the West. His article, “Feeding the Mines The Development of Supply Centers for the Goldfields” in *Annals of Wyoming*, showed that miners devoted as little time as possible to gathering and preparing the food necessary to sustain them. Local traders who met their needs were, in turn, restocked through quickly established supply routes.

Archaeologists use a variety of material indicators to infer class. Schmitt and Zeier (1993) contrasted two classes of artifacts - ceramics and faunal material - to examine the socioeconomic status of households in the historic mining town of Grantsville, Nevada. The community grew from a small mining camp in 1877 into a medium-sized town, but when ore output declined by the 1890s, so did the town. The value of ceramic assemblages and simple quantity and variety of faunal bone were found to accurately convey the diversity of household economic means. These assumptions may be explained by what was available at the local level, food preferences, and income levels. Meat quality, typically relied on to identify class, reflected more about market access in mining contexts. “Fresh meat purchases were dictated by what the butcher had on hand,” the principal customers being large volume consumers like boarding houses or restaurants. The “inhabitants of small, isolated communities such as Grantsville were restricted to products offered by local suppliers, and households could not as readily or consistently express their status through high-quality cuts.”

The period after the gold rush has been discussed in a variety of works. Particularly helpful was an article by Larry M. Dilsaver (1985) entitled "After the Gold Rush" in *Geographical Review*. Dilsaver reported that most scholarship on the gold rush focused on the transitory nature of settlement, implying movement to other sites left behind abandoned camps, mines, and ghost towns. He demonstrated that primary economic activity began to shift from mining to agriculture and other functions during the gold rush and continued through the 60 years that followed. This shift was marked by changes in patterns of settlement, the replacement of mining camps with settlements devoted to other industry, and the concentration of settlement in fewer areas. Dilsaver showed that while mining towns in placer areas declined, new towns less directly related to mining emerged near railroad lines. Most of this shift occurred between 1855 and 1914. Dilsaver's article was based on his 1982 Louisiana State University dissertation, *From Boom to Bust: Post Gold Rush Patterns of Adjustment in a California Mining Region (Volumes I and II)*. The dissertation examined the change that California underwent from a nearly exclusively gold-mining economy to a more diverse structure, especially with the decline in mining. Miners who left California were replaced by other settlers, and the economy, sparked by the railroad, shifted to lumber, agriculture and tourism.

Mining has filled a variety of economic niches as a primary means across income levels: self-employed members of a joint company, wage-workers at a mine, the mine superintendent, local and distant investors. It also supplied supplemental income in various survival strategies. Tordoff's (2005:83) Logtown report documented residents who "combined mining with agriculture or ranching…these are the people who resided the longest."

Limerick's (1998) *California History* article "The Gold Rush and the Shaping of the American West" focused on factors important during the gold rush in forming the American West. She included areas of uneven population distribution (the precursors for urban centers), poor sanitation, the heavy reliance on food from outside sources, and the struggles between valley farmers and miners over water rights and the damage to crops created by mining debris.

Hardesty (1986, 1990) argued that the physical record of mining must be viewed in the context of world system phenomena, today referred to as international trade globalization. The study of this topic can focus on linkages or networks between various components, mining systems being one (Wolf 1982). Self-sufficiency, a central component of the Frontier Model (Greenwood 1982:11), is relevant to the analysis of gold mining communities. Early placer miners, for example, have been characterized as young single men imbued with strong laissez faire individualism (Hardesty 1988:103), who were generally egalitarian and anti-corporate (Cornford 1999:87; Jung 1999:53; Zerbe and Anderson 2001:122). The level of self-sufficiency in a mining community is a common theme; Jenson (1980) and Tordoff (2005) synthesized archaeological data within the Self-sufficiency model.

Greenwood (1982:246) argued that the gold-mining frontier is not explained well using the Self-sufficiency model; instead she found mining sites "not economically independent or self-sufficient; they were closely connected with the outside world, and they focused on rapid exploitation of the environment rather than on permanent development." In contrast to self-sufficiency is the measure of dependency of a frontier on the homeland. Shoup (1983a:7) highlighted key aspects of the Dependency model, including reliance for material culture, reproduction of labor force, social values, resource ownership, decisions, and capital. Tordoff (2005:37) has recently supported this characterization for mining sites, noting that “the focus is on dominating the environment in order to extract whatever wealth is available; often most of that wealth is exported to absentee owners.”

Winthrop and others (1987) explored Self-sufficient, Dependency, and Metropolitan models developed by Shoup (1983b) and Robbins’ (1986) “plundered province” thesis in their study of Depression-era mining sites in Northern California. They recognized a pattern to the region’s industrial history associated with a shift in investment from urban entrepreneurs to the federal government prior to World War II (Winthrop et al. 1987:50), a pattern that can be examined throughout the West. They termed one aspect of the pattern “self-sufficient poverty” typically characterized by small, self-sufficient farmsteads, but during the Depression also including large numbers of single men who relied on gold mining to get by. Hardesty (1998b) incorporated this concept in his exploration of power in mining communities of the West. In this context mining was portrayed as supplemental income balanced with other seasonal occupations such as wage labor or ranching; consumption was dominated by hunting, gardening, and barter, with gold providing a small cash income for manufactured goods. Miners were seen as resilient during the Depression since they depended little on the national economy.

## Questions

- Who invested in the mine (the miners, joint-stock company, outside capital)? Was the mining venture heavily capitalized?
- Is there evidence of expensive and/or imported materials and/or technology?
- What types of access to markets was available during different periods?
- What types of changes are evident (mining machinery, goods) following the completion of the transcontinental railroad?
- At what pace did industrial infrastructure develop?
- What role did the mine (or mines) play in the region’s growth and economic development?
- What other businesses were present, and in what phase did they develop?
- Are a variety of socio-economic classes evident at the site? Is class segregation evident?
- How does the material culture of different mining classes compare? How does the socio-economic profile of households and the site change through time?
- What were the labor patterns in the region?
- Was there competition for labor or a strong labor pool, and how did these dynamics change through time?
- Was mining only a facet of a more complex survival strategy, in which other pursuits such as farming or wage labor also played roles?
- Where did the miners get their food and other goods and services (supply networks, local vendors, self-sufficient gardens and hunting/fishing, company store)? How did this change through time?
- Did miners invest much time preparing food at home, or did they eat away from their residences? Did they reside in rooming houses and eat at boarding houses?

- How did the role of mining change over time for individuals, households, communities, or regions?

## THEME 6: POLICY

This theme explores the nature of federal, state, and local regulations regarding historic mining. In California, this theme has often been examined at the local or mining district level, although federal and state governments created laws and regulations that influenced the development of all mining in the state.

Articles addressing issues of law and governance in California, particularly during the gold rush, tend to focus on three major topics: crime and criminals, the development of mining law and water rights systems, and the relationship of the state government to federal government. Perhaps unsurprisingly, archaeologists have contributed little to this theme.

Violence and crime in the mines has been the topic of several articles. Clare V. McKanna, Jr.'s (2004) *Pacific Historical Review* article "Enclaves of Violence in Nineteenth-Century California" described the ongoing debate about whether or not California gold rush towns were actually violent. McKanna's article offered a system of measuring violence to assist historians in deciding if gold rush towns actually were violent or not. The key element in his system was determining the existence of a sense of community and the degree it was felt by townspeople. He believed that towns that had a large population of permanent settlers, primarily families, had a greater sense of community and were therefore less violent. In contrast, towns with a predominately single male population that was transient and ethnically diverse had high levels of violence. Of course, this system is equally useful for archaeologists measuring violence since the contrasting communities would produce distinguishable signatures. McKanna asserted the difference was caused by a lack of local systems of control, or local government. Boomtowns, mining camps and other temporary settlements often lacked such systems. Added to this were rapid population growth and a culture of alcohol and gun use, creating a climate of violence. He concluded that while much of the American West was relatively non-violent, some parts of it were extremely violent.

In a similar vein, Roger D. McGrath's (2003) "A Violent Birth: Disorder, Crime, and Law Enforcement, 1849–1890" in *California History* added to the historic record with an account of violence in gold rush California. The author gave a lively account of two bands of outlaws that terrorized the West: Joaquin Murieta and his band, and the so-called "Hounds" of San Francisco. He also described the vigilante violence that was commonplace in the west. McGrath included accounts of individual outlaws, the often limited action taken by formal law enforcement institutions, and the formation of vigilante committees to uphold the law. He believed that the root of this violence was a code of honor that made men duty bound to fight when insulted or wronged. Martin Ridge's (1999) *Montana* essay "Disorder, Crime and Punishment in the California gold rush" focused on lawlessness and violence as well. He reported that while many believed California mining towns were lawless, violent places, they were neither, as long as person and property were respected. His article was primarily an account of the lawlessness in California, with several locations cited as examples, contrasted with the lawfulness of California, using the same locations as examples. Common throughout was the idea that lawlessness was ignored when one was only bringing injury upon him/herself. Should one injure an innocent party, either physically or financially, punishment ensued.

Some historians have assumed there was no pressure to establish government in gold rush California as national attention at the time was focused elsewhere. Other historians have disagreed and shown that miners and settlers were interested in establishing a government from the start of settlement. William A. Bullough (1991), in the *California History* article "Entrepreneurs and Urbanism on the California Mining Frontier: Frederick Walter and Weaverville, 1852–1868," agreed with the latter view and offers Weaverville in Trinity County as an example. He recounted the rise of Frederick Walter from a child in Trinity County to the head of a thriving business and a civic leader. Bullough set this story in the framework of the "settling down" of Weaverville and its transition to a more civilized town.

Richard O. Zerbe Jr. and C. Leigh Anderson (2001) took a wide-ranging view of the development of government institutions and cultural norms in their *Journal of Economic History* article, "Culture and Fairness in the Development of Institutions in the California Gold Fields." They noted:

> …earlier accounts of the creation of property rights in the California gold fields ignored culture and are incomplete. We argue that culture matters in solving collective-action problems. Such problems in the California gold fields were solved though reliance on cultural focal points…. Focal points included individualism, equality, respect for property, and rewards commensurate to work. Cultural concepts of fairness served to create norms and institutions that miners were willing to defend, which included majority rule, election of officials, trial by jury, allocation of a first-come, first-served basis, and rules for working claims (Zerbe and Anderson 2001:114).

In a somewhat more focused article, western historian Donald J. Pisani (1991) described how water law concepts adopted in western states were influenced by the mining experience. His article "The Origins of Western Water Law: Case Studies from Two California Mining Districts" in *California History* pointed out that western water law is commonly examined from the perspective of state legislation. He sought to examine the origins of water law from the perspective of miners, their views, values, and ideals. Pisani suggested the doctrine of "prior appropriation," the policy that those with the earlier claims to the water source have priority of use, emerged slowly and in response to the rise of private corporations and new mining techniques. Prior appropriation meshed well with the American ideal of limited government and had the added benefit of requiring no bureaucracy to manage it.

Tordoff and Seldner (1987:13) hit on this topic inadvertently in their archeological investigations of mining sites in the Cottonwood Creek drainage, southwest of Redding, when they asked "how were the miners organized, and what was their source of capital? What types of claims to water and mining land were taken? To non-mining land?" However, they found the archaeological record poorly suited to address these questions.

Federal–State relations were the subject of Robert J. Chandler's (2003) "An Uncertain Influence: The Role of the Federal Government in California, 1846–1880," in *California History*. Chandler reported that the popular myth of the origins of California is one based on rugged individualism. He found, however, that California was heavily dependent on federal aid during the period he studied, demonstrating that the federal government played a large role in the establishment of a California government. From the beginning of U.S. control of California, the federal government provided leadership in the form of military officers, a daily mail service, and crucial aid in building the transcontinental railroad. The federal government also promoted conservation and civil rights in California. The article covered policy setting, federal patronage, the establishment of federal agencies in California, and the prevention of a secessionist movement in California during the Civil War.

The effects of mining on the California environment, particularly the relationship between destructive flooding, agriculture, and hydraulic mining, have been widely discussed in the historical literature. Among the first to address this issue was pioneering public historian and University of California, Santa Barbara, history professor Robert L. Kelley. His seminal book on the subject, *Gold Versus Grain*, was written in 1959. In 1956 he wrote "The Mining Debris Controversy in the Sacramento Valley," for the *Pacific Historical Review*. Kelley reported that as farmers began to outnumber miners and ranchers, legal controversies emerged focusing on the deleterious effects of hydraulic mining debris on agricultural lands downstream from the mines. His article was a commentary on the struggle, in court, between the miners and the farmers of the northern Sierra and Sacramento Valley. Kelley explained how the annual flooding of the valley on tailings from hydraulic mines that washed downriver: rainfall pushed the debris and mud down from the mines and caused the rivers and streams to flood, ruining thousands of acres of once-rich farmland. In response, local farmers formed the Anti-Debris Association of the Sacramento Valley to fight for protection. The miners organized the Hydraulic Miners Association to fight back. The controversy led to a long and expensive legal battle that resulted, for all practical purposes, in the end of hydraulic mining by 1884. A somewhat different view was offered four years later by Kenneth Thompson (1960), in "Historic Flooding in the Sacramento Valley," published in *Pacific Historical Review*. Thompson believed historians misunderstood the clash between hydraulic miners and farmers in the late-nineteenth century, arguing that the extent to which hydraulic mining caused flooding in the Sacramento Valley has been poorly understood. In the article he described pre-gold rush flooding in the Central Valley and provided first-hand accounts of flooding from inhabitants and visitors in the area as well as an extensive analysis of geography and weather patterns. Thompson, however, was hesitant to relieve miners of the burden of flooding the valley, and acknowledged they were part of the problem.

Other writers have taken a more global view. Waverly B. Lowell's (1989) article, "Where Have All the Flowers Gone? Early Environmental Litigation" in *Prologue* asked: "Is a civilization worthwhile if its material needs destroy the natural world?" Lowell provided examples of early environmental litigation and a brief legal history of early environmental law in California, focusing primarily on cases that dealt with water pollution from mining operations. Another wider-ranging examination of environmental problems caused by mining can be found in Martin D. Mitchell's (1994) *Geographical Review* essay "Land and Water Policies in the Sacramento-San Joaquin Delta," which addressed the questions of how and why water policies in the Sacramento-San Joaquin area emerged. Mitchell examined the role of wetlands, policy conflicts, and the mining debris controversy: the use of waterways to convey mining debris and its effect on agriculture and navigation. He identified the federal Caminetti Act of 1893 as crucial legislation that helped establish later state-federal cooperation in flood control and other areas.

Similarly broad was David Beesley's (1996) "The Opening of the Sierra Nevada and the Beginnings of Conservation, 1821–1900," in *California History*. Today, environmentalists believe that the main cause of environmental damage to the Sierra Nevada is civilization's constant encroachment. Beesley stated that the need for environmental protection and preservation began when gold was discovered, a historical element lacking in many modern environmental studies. He noted three phases that led to development of a preservation movement in the Sierra. In the first phase starting in the 1820s, the mountain range was seen as a dangerous obstacle to cross as quickly as possible. As a result, there was little or no lasting damage done to the region. In the second, beginning in 1848, the mountains were seen as a source of valuable resources. Finally, in the third phase, after the early 1900s, preservationists looked upon the ravages of mining, ranching and logging with concern. These activities damaged the mountain lands and threatened the valley below. This threat led to pressure to protect and preserve the Sierra Nevada, and in the decades Beesley studied, the federal and state governments acted to manage and protect the area.

Raymond F. Dasmann (1998), in "Environmental Changes before and after the Gold Rush," written for *California History*, noted that the early environmental damage of California was usually blamed on miners. His study found that there were other factors contributing to this damage; fur trappers, cattle ranchers, and fishermen came to California along with, and sometimes before, the miners and did their share of damage. According to Dasmann, much of the damage was already done when gold was discovered. The "cattle rush," "fur rush," and introduction of foreign grasses began the work of depleting the resources of California, which the gold rush later sped along. Similarly wide-ranging is John W. Caughey's (1992) *California Historical Quarterly* piece "The Californian and His Environment," which broadly addressed the relationship of man to the environment in California, beginning with pre-history and following through to the early 1970s.

### QUESTIONS

- Is the site within a known mining district? Are the mining codes for the district known?
- How do sites within and outside of formal mining districts differ?
- What was the size of the mining claim? Can the size of the claim be determined from either field or archival sources (e.g., boundary markers, extent of mine activity, legal descriptions)? How does the claim compare to mining code standards? How does physical evidence of the claim correspond to changing claim regulations over time?
- What environmental changes are visible at the site and can those changes be attributed to a specific phase of occupation or specific occupants?
- Is there evidence of responses to increasing government regulation of mining such as increased environmental restrictions?
- Is there evidence of adaptation to changing water policies, such as reliance on water conserving technologies?

- How many miners worked the mine and how were they organized? How did the organization (variety, distribution, density) of miners change through time?
- Is there evidence of corporate or individual responses to increasing government regulation of mining such as increased safety requirements?
- Can changes in company policy be correlated to changes of technology or social behavior at the site?
- Is it possible to distinguish violence or trauma in the archaeological record? If so, what can that violence be attributed to? Was one type of community more violent than the other? Does one type have a larger density of munitions than the other? Do levels of violence or trauma change over time, and is it possible to identify causal factors such as increasing social order and regular law enforcement? Was anything done at the local level to prevent crime? How do sites with variable crime rates compare archaeologically?
- What type of social order is evident at the site?
- Does the site exhibit a sense of organized community (e.g., a large population of permanent settlers, primarily families)? Or, was it predominantly an ethnically diverse transient male population?
- Were social boundaries established or enforced based on ethnicity, class, or other social or political factors? Is there evidence for social inequality?

# CHAPTER 5. IMPLEMENTATION PLAN

The preceding historic context and review of scholarly research themes are intentionally broad in scope. They provide the essential foundation that is impractical for most archaeological investigations to develop. This chapter offers guidance on how to implement the foregoing in order to identify and record mining sites, and evaluate a particular property's research potential under NRHP Criterion D. The reader should keep in mind, however, that mining sites may also be determined significant under other NRHP criteria.

A five-step process for identifying an archaeological property's eligibility under Criterion D was presented in Chapter 1 (Little and Siebert 2000:14). For simplicity, this study divides that process into two phases for mining sites:

**Phase 1: Identification and Recording of Mining Sites**

1. Determine the property's structure, content, and the classes of data it may contain.
2. Identify the appropriate historic context by which to evaluate the property.

**Phase 2: Evaluation of Mining Sites under Criterion D**

3. Identify important research themes and questions that might be addressed by the site data.
4. Considering the property's integrity, structure, and content, assess whether the data it contains are of sufficient quality and quantity to address these important research issues.
5. Identify the important information that the property is likely to contain.

The numbered steps within each phase generally occur as part of an iterative process, and not necessarily sequentially. Particular aspects of these steps are discussed below, followed by a step-by-step approach that illustrates their application. Throughout this volume, the term structure refers to the property's attributes, spatial areas, and characteristics, rather than actual standing structures since those have rarely survived to present.

This implementation plan is focused on the remains of the mining activities themselves. While this research design addresses the importance of domestic deposits for advancing the research themes discussed herein, it does not detail their evaluation. For assistance in determining the data potential of these domestic resources the researcher should consult the *Agriculture, Townsites,* and *Work Camps* thematic studies (see Chapter 1 for explanation of these studies).

Following the steps recommended in this volume will result in an eligibility determination that will need to be reviewed by the SHPO for Section 106 compliance. The benefit of this process is that it establishes clear expectations that will help streamline SHPO review and concurrence.

## PHASE 1: IDENTIFICATION AND RECORDING OF MINING SITES

Step 1. Determine the property's structure, content, and classes of data.
Step 2. Identify the appropriate historic context.

The initial identification and assessment of a mining site is dependent on accurately identifying the remains present on the ground and the mining processes represented, then associating these with the correct historic period. Accurate identification of features is crucial to successfully evaluating the significance of any property, but even more so when employing the approach recommended in this volume. Researchers should use the property typology in Chapter 3 to correctly determine whether the pile of rocks being recorded is placer tailings, waste rock, dredge tailings, and so forth. Researchers who are unfamiliar with mining features should consult a knowledgeable historical archaeologist or mining engineer to ensure they are accurately establishing the function and time period of property types and feature systems.

Remains of mining technologies are generally visible on the surface and excavation is rarely necessary to identify and record them. Excavation may be required, however, to obtain enough information to evaluate more complex features. It is typical of mining sites that evidence of earlier operations will be covered over or destroyed by later workings. These buried remains, however, are usually not recommended as subjects of excavations as the information recovered rarely justifies the efforts expended. This is particularly true of waste rock and tailings piles, but does not apply to habitation remains or early workings. Due to safety concerns, identifying underground mining features should be undertaken through archival research rather than physical inspection.

The historic context presented in Chapter 2 provides a basic foundation for placing sites in a statewide context. Each property, however, will require site-specific documentary research. Prior to archaeological survey and recording of a site, background documentary research is needed to identify the general mining practices common in the region for different time periods. Historic maps and other base-line sources (discussed below) should be consulted prior to fieldwork so that archaeologists can anticipate the types of resources they will find. For *Simple Mining Sites* (see below, Chapter 5) this is often all the research that will be needed. It should be noted at this stage of research, potential eligibility under other NRHP criteria may become apparent.

The researcher must ascertain which activities identified in Chapter 3 (placer mining, beneficiation, habitation, etc.) were carried out at the site. Research should focus on addressing basic questions such as who, what, when, where, and how. One of the goals of historical research is to help establish the property's period of significance, defined in National Register Bulletin 36 as "the time range during which the property was occupied or used and for which the property is likely to yield important information" (Little and Siebert 2000:34). Defining the period of significance gives temporal focus to the context in which the site will be evaluated. There can be more than one period of significance and they can be discontinuous. Sites with longer histories have the potential to address important diachronic questions, provided archaeological remains are associated with the appropriate period(s) of significance.

To evaluate a more complex mining site or a site with associated domestic features, however, more in-depth, site-specific archival research must be conducted. Primary documents, secondary sources, and oral accounts may all contribute to providing details of site history. The plan for historical research should specify cost-effective sources of information. A complete title search, for example, may not be necessary if adequate data can be obtained more readily from maps or other available sources. Secondary sources are often most useful for general background information while primary sources speak to specific times and places.

It should also be noted that due to the characteristic of mining sites to cover broad spans of land, complex sites are often recorded as districts: “Most potentially eligible mining properties do not consist only of a single resource, but rather will include a discrete historical area containing a grouping of functionally related resources that all played a part in the extraction, refinement, and production of minerals” (Noble and Spude 1997:22). This complexity can be compounded by the shift in technologies within the district over time.

Whether mining resources are recorded as a series of features within a site or a number of sites within a district depends on the complexity and size of the enterprise, as well as association, temporal period, and mineral being extracted. Discontiguous districts may also be appropriate where elements of a site are spatially separated and discrete, and where the space between them does not contribute to the significance of the district (Noble and Spude 1997:22). It is important to note whether a site or feature may be a contributing element of a district where individually it might not meet eligibility criteria.

## PHASE 2: EVALUATION OF MINING SITES UNDER CRITERION D

- Step 3. Identify important research themes and questions.
- Step 4. Considering the property’s integrity, structure, and content, assess whether the data it contains are of sufficient quality to address these important research issues.
- Step 5. Identify the important information that the property is likely to contain.

At this point the researcher has identified the property types that exist, or are likely to exist, on the site through a combination of archaeological fieldwork and historical research, and has related these to both statewide (this document) and local historical contexts. The next step is to determine appropriate research themes and questions that the properties may be able to address. Chapter 4 contains reviews of central research themes in history and archaeology, concluding with a list of some of the important research questions. These lists - which are not exhaustive - may be used to derive other research themes and questions relevant to sites under evaluation. Researchers are encouraged to use these questions as a basis for developing additional themes and not as fixed canon.

Key to identification of appropriate themes is an understanding of the data that are available from each site to answer these questions. The data come from both the archaeological and archival/documentary records and are the base on which all interpretations are made. Simple sites with limited data, such as an isolated prospect shaft with a waste rock pile, will have little to contribute to complex themes. Large industrial sites, with extant foundations and surface workings, along with corresponding mining records, photographs, and maps, have the potential to provide much more information and address more complex themes.

Assessing the appropriateness of research themes is arguably the trickiest part of the evaluation process for it requires the researcher to assess the relationship between a site’s physical characteristics and a more abstract dimension - its contribution to substantive research. The NRHP uses the concept of integrity to bridge this conceptual divide.

## INTEGRITY

National Register Bulletin 15 defines integrity as the "ability of a property to convey its significance." A site must have integrity to be eligible for listing on the NRHP. The NRHP Criteria for Evaluation recognize seven aspects of integrity - location, design, setting, materials, workmanship, feeling, and association - and a resource must maintain several of these aspects to maintain integrity (Table 5.1). Every evaluation of NRHP eligibility must discuss the aspects of integrity that are relevant to the important qualities of the site being assessed.

Archaeological sites are usually evaluated under Criterion D, under which a mining property's significance depends on its ability to provide important data, measured by its potential to contribute toward research themes in a significant way. In general, archaeological properties should retain integrity of location, design, materials, and association to be important under Criterion D. There is usually no need to address setting and feeling as these characteristics rarely affect a site's information value, thought these aspects are important for assessment of integrity under other criteria. A site may be physically altered, but still retain an ability to address important research themes. Because mining properties are often made up of feature systems, a disturbed site may still retain integrity if enough components survive to provide important information or otherwise convey significance.

It is also common for a site such as a small prospect to have excellent integrity and yet lack sufficient information to satisfy Criterion D. While such features may provide incremental information that becomes important when analyzed on larger scales, individually they are rarely eligible. National Register Bulletins 15 and 36 as well as Hardesty and Little's *Assessing Site Significance* (2000) provide detailed, practical guidance on how each of these aspects of integrity should be applied. National Register Bulletin 42 also specifically addresses integrity of mining sites. The following discussion addresses how aspects of integrity generally apply to mining sites.

**Table 5.1. Aspects, or Qualities, of Integrity (NR Bulletin 15)**

| **Aspect/ Quality** | **Definition** |
|---|---|
| **Location** | The place where the historic property was constructed or the place where the historic event occurred |
| **Design** | The combination of elements that create the form, plan, space, structure, and style of a property. |
| **Setting** | The physical environment of a historic property. Setting includes elements such as topographic features, open space, viewshed, landscape, vegetation, and artificial features. |
| **Materials** | The physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property. |
| **Workmanship** | The physical evidence of the labor and skill of a particular culture or people during any given period in history. |
| **Feeling** | A property's expression of the aesthetic or historic sense of a particular period of time. |
| **Association** | The direct link between an important historic event or person and a historic property. Under D it is measured in the strength of association between data and important research questions. |

### Location

While the location of a mine is fixed, the equipment used to mine and process the ore was frequently modified, improved, relocated, or scrapped as ores were depleted. The integrity of historic mining equipment relocated from another contemporary historic mine to the one that is the focus of an evaluation would not be diminished provided it is comparable. If the same equipment was relocated to a modern mine (less than 50 years old), its integrity would be diminished.

### Design

The second aspect of integrity is design, which refers to the layout of the site and the design of its structures and buildings. As discussed before, new developments in mining and milling technology introduced new equipment to mining sites as well as changing the methods that mines were worked. Improved methods often led to revisiting old sites where tailings could be processed a second time. Just as the surface plant might change, so too could the size and scope of the mineral excavations. Because of the evolving nature of mining operations, a mine does not have to maintain its original site plan to have integrity. The changes should demonstrate the mine's evolution, and should have taken place at least 50 years earlier. Changes within the last 50 years, or the modern period, would reduce the integrity.

Another aspect of design is the completeness of the site. Does the site retain all of the surface plant or stages of ore milling and processing? Few mines possess a complete surface plant, but if there are sufficient artifacts remaining to explain the process of reducing ore to the target mineral, then the mine could retain a measure of this aspect of integrity. Similarly, if a placer mine conveys the actual process that was used to mine, whether a single event or many over time, it retains integrity of design. A common mining site might consist of a shaft and a collapsed adit, scattered artifacts, and a large waste rock pile. Even if archival information indicated that the shaft ran deep and that considerable time was spent developing the mine, it can be argued that the remaining objects do not convey a sense of the mine's operation. Lacking structural remains or artifacts that provide evidence of the mine's operation, the site does not retain integrity of design. Underground workings are part of the mine's overall design, but since underground workings are unstable, inspecting them for integrity is not necessary.

### Setting

Setting, the third aspect of integrity, reflects both the grounds of the mine and its surrounding environment. Mines in the desert areas of the state often have been relatively untouched (despite being picked over by relic hunters), and their surrounding environment has been left largely undeveloped. Mines in the Sierra foothills, or in Shasta and Siskiyou counties for example, have more frequently been surrounded by modern buildings and structures that may adversely affect their setting. Under Criterion D setting is less important, but setting can be important to an archaeological property if Criteria A, B or C apply.

### MATERIALS

Integrity of materials requires that the resource be constructed with materials that date to the property's period of significance. Research potential depends on materials having not been altered beyond interpretability. For an archaeological deposit, "integrity of materials is usually described in terms of the presence of intrusive artifacts/features, the completeness of the artifact/feature assemblage, or the quality of artifact or feature preservation" (Little and Seibert 2000:41). Modern renovations of a mine property may not only alter or destroy earlier evidence, but also introduce new materials and structures that can reduce the integrity of the property.

### WORKMANSHIP

Workmanship pertains to the physical evidence of the crafts of a particular culture or people during any given time period in history. It would apply to a mining site where mining methods or construction techniques employed by various culture groups contribute to the site's significance.

### FEELING

Regarding the aspect of "feeling," Bulletin 42 states:

> As abandoned industrial properties are generally located in isolated areas, the sites of historic mining activity often evoke a strong sense of feeling when viewed by contemporary observers… The feeling of a deserted historic mine can help reflect the character of the boom and bust cycles of mining regions. The loss of this feeling of isolation and abandonment due to encroaching modern development can diminish the integrity of a mining property [Noble and Spude 1997:21].

Generally speaking, feeling, like setting, has little bearing on an archaeological property's research potential, but can be important if Criteria A, B, or C apply.

### ASSOCIATION

For archaeological deposits evaluated under Criterion D, "integrity of association is measured in terms of the strength of the relationship between the site's data or information and the important research questions" (Little and Seibert 2000:42). Archaeologists frequently use the concept of association to refer to the degree to which specific archaeological features and deposits can be linked to specific mine operators and other occupants (the labor force). Some mines had successive phases of use by different operators and the ability to distinguish remains from those different periods might be necessary to address some research topics. A good historical "association" enhances the potential significance of the site's data potential.

James Deetz used the concepts of archaeological "visibility" and "focus" to address integrity and assess the research potential of archaeological sites. For Deetz (1977:94), "*focus* means the degree to which a [feature] can be 'read' clearly... *Visibility* means the actual amount of physical remains, however clearly or ambiguously they might be perceived." To elaborate, focus refers to the level of clarity with which remains at a site can be determined to represent a particular historical phenomenon such as an activity or building remnant. Remains that represent a number of activities or consist of components that cannot be separated from one another are said to lack focus. A site with poor focus has lower integrity and is thus less useful for addressing important research topics.

Bulletin 42 also notes that integrity of association "will exist in cases where mine structures, machinery, and other visible features remain to convey a strong sense of connectedness between mining properties and a contemporary observer's ability to discern the historical activity which occurred at the location" (Noble and Spude 1997:21). This applies mainly to mining sites with substantial structural remains that are significant under Criteria A, B, and C, rather than D. Even sites that retain buildings may not have enough evidence of the mining operation to illustrate a working mine under Criteria A, B, or C. The integrity will still depend on the degree to which the overall mining system remains intact and visible.

## SIGNIFICANCE EVALUATIONS

### CRITERION D: RESEARCH POTENTIAL

At this point the history of the mining site has been established, its data sources have been identified, the integrity of the property has been evaluated, and applicable research themes and questions have been noted. The formal evaluation under Criterion D makes clear what important information the property is likely to contain that can address one or more questions related to research themes. Two conclusions are possible:

1. The site may be deemed not eligible to the National Register, either because it lacks integrity or because it has no important data to be recovered.
2. The site may be deemed eligible to the National Register for its potential to contain important information.

For most simple and smaller industrial mining sites (defined below), the appropriate documentary research and recording necessary to identify and record the site collects what information the site has to offer. Careful recording, including documenting archival research results, also documents the absence of information-bearing archaeological deposits. Caltrans acknowledges that there is useful historic information inherent in knowing that this mining resource was present and active at a specific time using specific processes. The key point here is that once this is known, there is no more important information to be obtained from studying the site further. For many simple mining sites, this threshold may be reached with basic documentary research and a careful initial recording of the site. For more complex industrial sites, more detailed documentary research and field studies may be necessary to recover this site information.

Mining sites with associated domestic deposits require an additional level of analysis. Many of the research themes and questions presented in Chapter 4 focus on the site's residents, and information concerning those people may be found in their household refuse. The association of the site with specific population groups (ethnicity, gender, age, social class) sometimes may be inferred by an analysis of material remains. However, if there is no information about the people who occupied the site, while the archaeology may hint at the composition of groups present there, any interpretation will remain speculative at best and requires careful consideration. The integrity and value of these domestic components will need to be evaluated in conjunction with *Agriculture, Townsites,* and *Work Camps* thematic studies, depending on the nature of the domestic component. Similarly, these companion volumes present methods for recovering and interpreting significant data.

### OTHER CRITERIA

As noted above, mining properties may be determined eligible under other National Register criteria, and these should be kept in mind when studying and evaluating a property.

***Criterion A.*** Criterion A is associated with events that have made a significant contribution to the broad patterns of history. This is the criterion most commonly applied to mining sites. Fifteen themes are suggested in Bulletin 42, any of which may apply to mining sites. Particularly appropriate is the theme of engineering, especially, but not exclusively, for late-19th and early-20th century sites. The bulletin states,

> After 1890, many mining complexes featured components designed by mining engineers. This would include water and transportation systems built to serve mining operations. Noteworthy examples of mining engineering would fall under this area of significance. The ascendance of the mining engineer over the skilled craftsperson was a gradual process. Many mining properties can demonstrate the nature of the change and provide evidence of the intermediate steps in the process of change (Noble and Spude 1997:15).

The above statement is true of California, but the 1890 date applies more to Colorado and Idaho. In California's mother lode region, the ascendance of the mining engineer and formalization of water and transportation systems happened relatively early and is one of the transitions demarking the end of the gold rush.

***Criterion B***. Criterion B is associated with the lives of persons significant in our past. A mining property would not only have to be directly associated with an important historical person to meet Criterion B, but also be a resource that best exemplifies his/her significance. So, for example, although George Hearst, a famous mining engineer and 19th-century tycoon, may have owned a particular mine, research would need to indicate that it was the very mine that earned Hearst his fame or fortune, or represented a turning point in his career. In general, most mines are very unlikely to meet Criterion B.

***Criterion C.*** Criterion C embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, possess high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction. Those mining properties found eligible under Criterion C are often assessed under the categories of architecture and engineering.

*Architecture:* Mining complexes occasionally contain cabins, storehouses, and workshops, as well as other, more mining-specific structures as mills, hoists, and processing sites. Though these structures are often in ruins, architecture found in these complexes can reflect common building trends or demonstrate innovative use of materials. While the vestiges of surface plants on mining sites may yield information regarding the engineering and working aspects of mining, they would need to represent the work of master architects or builders, or have high artistic value.

*Engineering:* The methods and technology of mining, like most technical industries, continues to evolve. Mining properties can illustrate these changes through the remnants of machinery and structures. Structures such as the head frame, tower and riggings for an aerial tramway, mill foundation and other equipment provide an understanding of how a mine operated during the period of its activity, and can give the visitor a strong sense of time and place. Generally there are few mining properties that have enough remaining features to fulfill Criterion C under the theme of engineering, largely because the majority of mines either had the equipment removed after operations ceased or the remaining equipment was scavenged for scrap during the First or Second World Wars. The removal of equipment for reuse elsewhere or for scrap value was a common practice that raises the value of what little does remain at mining sites. Sites that retain equipment related to mining, or for mills, processing or moving ore provide information regarding the operation of the mine and processing methods.

Sites may also be determined eligible under Criterion C for engineering features that are entirely manifested on the landscape, devoid of any machinery or structures, such as the Natomas Ground Sluice Diggings (Lindstrőm 1988), the acres of dredge piles at Prairie City (Lindstrőm 1989; Tordoff 2004), and the Malakoff mine’s cliffs and tailings piles produced by large-scale hydraulic mining near North Bloomfield (Felton et al. 1979; Lindstrőm 1990).

## METHODOLOGICAL CONSISTENCY

One of the keys to successful implementation of this mining thematic study is collecting data in a manner that facilitates comparison, therefore the following section offers guidance on methods that will encourage such standardization. Federal regulations specify that one expend a “reasonable level of effort” to determine eligibility. To that end, the following methods are provided as steps to employ. It is up to the individual researcher to determine the appropriate scope of effort.

### BASIC RESEARCH

The first step in any archaeological survey is to conduct prefield research in order to develop expectations for archaeological sensitivity. Where there is a likelihood that mining was conducted in the project area vicinity, some documentary research should be conducted prior to surveys so that the field crew can better understand what they encounter – that is, determine historical associations and identify features.

- Review BLM Mineral Survey Records to identify if any mines were claimed in the township. Information will include mine claimant, mine name, and year of claim. BLM land patent maps and claim details are on the web at www.blm.gov/ca/forms/mtp/search.php.

- Review historic maps, including Government Land Office (GLO) maps, Master Title Plats (MTP), historic topo quads, county survey maps, and Caltrans as-builts, as appropriate. Many libraries have extensive on-line collections that can be readily accessed for research and downloaded for inclusion in reports and site record forms.
- Review county mining claims as they may have different information than the BLM.

### DETAILED RESEARCH

Once a mining property has been identified, additional site-specific research is necessary. As implied, "detailed research" is oriented towards obtaining more information on specific property history as well as contextual history that will inform the final evaluation. Research needs to answer who, what, when, where, and how. At industrial sites, it usually will require a higher level of effort because these sites commonly generated a substantial volume of both public (i.e., tax and assessment, patents, etc.) and unpublished records. Not all archival sources need to be examined for every property. Researchers only need to obtain enough information to make an assessment as to information potential.

- Review county assessment and title records as necessary to determine occupation and land use history. A full title search is rarely necessary since such information is usually available from other mining-related sources.
- Review state mining reports for the area under study. The California Geological Survey Library in Sacramento has a complete collection of State Mineralogists reports, as well as indexes for industry and trade journals from the 19$^{th}$ and early 20$^{th}$ century such as *Mining and Scientific Press* or *Engineering News Record*. Once the mine name or claimant is known, it can be researched in this valuable collection. If the mine is documented in these holdings, it probably doesn't qualify as a simple site.
- Review applicable secondary materials. More detailed research will be necessary should the property prove to have a domestic component or be a more complex industrial site. Secondary materials might include county histories, local historical society records, photographs, probate records, court records of ownership disputes or other business conflicts, mine business records, personal diaries, census records to obtain information on miner population, and even contextual information on mineral extraction methods.
- Conduct oral history if the site's former occupants can fill information gaps about what happened at the site and when. Properly conducting an oral history can be challenging; therefore, formal oral histories should only be collected by trained experts. Informal interviews, however, can provide substantial data with only short time investments.

### ARCHAEOLOGICAL RECORDING

- Construct a map of mining remains, showing all features. Correlate archaeological features to historic uses where possible by identifying the feature's former function. More complex sites might require drawings of individual features or specialized graphics to depict specific feature systems.

- Write a physical description of the mining remains. Record features in the English (feet and inches) system of measurement where appropriate, keeping in mind other measurement systems may have been used depending on ethnic identity of the miners.
- Take overview and feature photographs.
- Minimally, complete a DPR 523 Primary Record and file with a location map at the appropriate Information Center; an Archaeological Site Record is always beneficial and is necessary for more complex sites or those with domestic deposits.

For more complex sites, the participation of an industrial archaeologist or mining historian is likely to be useful to correctly identify specific feature systems. Descriptions will likely be more detailed for these sites given their more substantial nature. It should be easier to correlate archaeological features to historic functions and identify systems than at simple sites given the larger sites' more standardized nature and presence of more documentary information on historic activities conducted at the property.

### ARTIFACT SAMPLING

Where a domestic component is indicated by the presence of artifactual remains, the site may be subjected to either a surface Systematic Sample or a Selective Inventory. Systematic Samples involve stringing off a rectangular unit and collecting and recording all artifacts larger than approximately 1/2-inch within that area. The number and size of sample units is subjective, but should reflect the density of the entire deposit. Enough units should be recorded to obtain a representative sample of the whole. Photograph the sample unit before the inventory – both close-up and in relation to the whole deposit. After the inventory, the artifacts are photographed in one layout (by categories) and returned to the unit. Systematic Sample inventories produce a less biased record of the artifact collection than Selective Inventories, which consist of lists of diagnostic or datable artifacts noted within a deposit. Both methods assist in deducing activities, historical associations, and date ranges represented by the artifact deposits.

Excavation may be necessary at sites where information-bearing deposits are suggested by documentary evidence or work at comparative sites and those deposits cannot be avoided. While there is no hard-and-fast rule on how much excavation is necessary to determine eligibility, in the context of taxpayer-funded research archaeologists should conduct the minimum necessary to determine eligibility and assess effects.

### ARTIFACT ANALYSIS

In general, analysis of materials from each artifact type should be conducted using the following professional standards or best practices. The minimum number of items (MNI) or minimum number of vessels (MNV) should be calculated, as should the proportion of the class (see Table 7) each type represents. Glass materials should be sorted by functional category, color, and type following methods developed by Parks Canada. Ceramics should be sorted for functional type, form, fabric, and decorative elements, with special attention paid to makers' marks. Where appropriate, analysis might determine date of deposition using methods such as South's mean dating, and relative cost of the collection using methods such as George Miller's economic scaling. These two methods are less effective on later sites, particularly where there is rich documentary record on site occupation. Faunal remains should be sorted by taxon, element, side, butchering cut, age, and weight. Butchering cuts may be analyzed according to late 19th century retail values established by Schulz and Gust.

Analysis of historic-era artifacts provides information on past lifeways such as consumer behavior, general health, and evidence of social display in the form of decorative items. The information gained from artifact analysis allows the archaeologist to make comparative statements about purchasing power and consumer choice, among other things, at the household level. Food bone may be used to study retail and home butchering, ethnic foodways, consumer behavior, and adaptive strategies within rural settings.

### Functional Categorization of Artifacts

Consistent classification of artifacts is crucial if meaningful comparisons are to be accomplished. Since one goal of this thematic context is to promote such comparisons, a standardized approach to the classification of observed materials is strongly recommended. The approach suggested here categorizes materials according to functional groupings. Stanley South first introduced the concept of functional groupings in 1977. Since then, archaeologists have expanded the concept with groupings modified for use in Western U.S. and later-period sites. Table 9 suggests groupings for specific materials. This system has already been widely used to catalog materials from hundreds of urban and rural sites in California, thus, comparative information is already available. The groupings may and should be modified where appropriate to reflect site-specific activities more accurately. If modifications are made, explain the rationale.

### MNI or MNV

Calculation of MNI for artifacts is important for the analysis and interpretation of the site. Furthermore, it is crucial to inter- and intra-site comparison. While there are many ways to estimate MNIs (e.g, weight, shard counts, estimating), most methods do not adequately allow for variables such as differing artifact size and archaeological preservation. This document recommends calculating MNI by reconstructing artifacts as much as possible, then calculating the remaining MNI by analyzing distinctive elements.

Erica Gibson, Laboratory Director at the Anthropological Studies Center at Sonoma State University, compiled the following guidance (with applicability on all historical archaeological sites) for staff working on Caltrans' Cypress I-880 project in West Oakland. Gibson offers the following specific methods for determining MNI or MNV:

- Each intact/complete/reconstructable item receives an MNV of 1.
- If after sorting there are a number of bases/rims that cannot be definitely associated with one another (but may be), count the number of each and use the higher figure for the MNV. For example, if you have 5 bases and 3 rims, there are at least 5 forms present (possibly as many as 8), thus MNV=5.
- Do not include body fragments in the MNV counts unless they clearly do not belong to bases/rims elsewhere in the context.

**Table 9: Artifact Functional Categories and Subclass Examples**

| Group | Class | Subclass Examples |
|---|---|---|
| Activities | Collecting | stalactites, coral |
| | Commerce | coins, banks, scale pans |
| | Communication | newspaper, telephones |
| | Entertainment | musical instruments |
| | Firearms | Guns, ammunition |
| | Games | checker pieces, dominos |
| | Painting | brushes, containers |
| | Pets | bird feeders, dog collars |
| | Tools | axes, files, rulers |
| | Transportation | carriage parts, horse shoes, harness parts |
| | Writing | pens, pencils, ink bottles, slate |
| Domestic | Clothing Maintenance (sewing) | needles, darning eggs, bluing balls |
| | Food Preparation & Consumption | kitchen (e.g., baking pans, skillet), serving (e.g., platters, teapots), tableware (e.g., plates, forks), drinking vessels (e.g., stemware, tumblers) |
| | Food Refuse | bone, edible seeds/nuts, edible shellfish |
| | Food/Food Storage | canning jars, crocks, retail food containers |
| | Furnishings | furniture, flower pots, vases |
| | Heating | stoves, coal |
| | Lighting | lamps, light bulbs, candles |
| Indefinite Use (Items with more than one potential original use) | - | identified items with more than one potential original use |
| | Bead | beads with more than one potential original use |
| | Bottles & Jars | bottles, jars cans with unidentified contents |
| | Closures | closures associated with contents of indefinite use |
| | Metal Items | hardware, metal (e.g., wire, sheet metal, tubes) |
| Industrial | Beneficiation | stamps, assay crucibles |
| | Lighting | carbide lamps, candle holders, light bulbs |
| | Machinery | machine mounts, monitors, boilers |
| | Storage Containers | cyanide cans |
| | Tools | picks, shovels |
| | Transportation | Ore carts, mule shoes |
| | Waste Products | waste rock piles, clinker |
| Personal | Accoutrement | purses, eyeglasses, jewelry |
| | Clothing | garments, buttons, buckles |

- If there are crossmends across stratigraphic layers, only the deeper layer will receive the MNV count.

Recognizing crossmends requires the laboratory staff to physically reconstruct bottles and dishes from the many broken shards in a feature. While time consuming, tracking crossmends is important for analyzing site integrity and depositional phases.

## CONTEXTUAL ANALYSIS AND EVALUATION

This step involves reconstructing mining site processes using documentary and archaeological data, then determining which of the Research Themes identified in Chapter 4 is appropriate for the site. This is the analytical step in the evaluation process that leads to the final eligibility determination.

All the above information is analyzed collectively to determine the mining property's eligibility. Evaluating the anticipated contributions of material remains must be done in relation to the availability and accuracy of information in historic records.

The assessment process involves four interrelated decision factors:

1. Whether surviving materials are present in the condition that will allow important research topics to be addressed. This is assessed by comparing the characteristics of the data present at the resource to the data requirements for each topic defined in Chapter 4.
2. The likelihood that material remains will significantly supplement, alter, or perhaps even contradict the available historic record (not simply confirm it). This requires critical comparison of the material record with historical sources, but it is the materials that must be able to tell us something important, not the documents.
3. The relative scarcity of the resource type. Determining rarity involves putting the property in a comparative framework. Less frequent types of associations may, because of their scarcity, contribute important information despite limited data values.
4. The magnitude of the contribution. This is subjective, but gets to the heart of Criterion D. The more important the research contribution, the easier the case for eligibility.

### "AIMS-R"

The simple mnemonic AIMS-R is useful for assessing whether an archaeological property contains important information. Historical archaeologists Adrian and Mary Praetzellis have refined a set of principles designed to assess archaeological research potential of a specific property or feature that is informative for this study. This technique may be used on a feature-by-feature basis to determine contributing or non-contributing elements, or may be used to determine eligibility of the site as a whole. The mnemonic AIMS-R captures the following set of principles:

1. *Association* refers to the ability to link an assemblage of artifacts, ecofacts, and other cultural remains with an individual household, an ethnic or socioeconomic group, or a specific activity or property use.
2. *Integrity* addresses the physical condition of the deposit, referring to the intact nature of the archaeological remains. In order for a feature to be most useful, it should be in much the same state as when it was deposited. However, even disturbed deposits can yield important information (e.g., a tightly dated deposit with an unequivocal association).
3. *Materials* refers to the number and variety of artifacts present. Large assemblages provide more secure interpretations as there are more datable items to determine when the deposit was made, and the collection will be more representative of the household, or activity. Likewise, the interpretive potential of a deposit is generally increased with the diversity of its contents, although the lack of diversity in certain assemblages also may signal important behavioral or consumer patterns.

4. *Stratigraphy* refers to the vertically or horizontally discrete depositional units that are distinguishable. Remains from an archaeological feature with a complex stratigraphic sequence representative of several events over time can have the added advantage of providing an independent chronological check on artifact diagnosis and the interpretation of the sequence of environmental or sociocultural events.
5. *Rarity* refers to remains linked to household types or activities that are uncommon. Because they are scarce, they may have importance even in cases where they otherwise fail to meet other thresholds of importance (McIlroy and Praetzellis 1997:277).

Archaeologist Julia Costello, building on the Praetzellis' work, uses the mnemonic QIVA which stands for Quantity, Integrity, Variety, and Association (Meyer, Gibson, and Costello 2005:114). Similar definitions may be applied to Costello's system with quantity and variety being extensions of the materials category in AIMS. This second acronym is provided here to clarify for researchers reading the gray literature that they essentially encompass the same criteria.

The researcher should keep in mind that smaller, incremental contributions at a mining property may collectively inform important research issues and thus a small site might still be eligible under Criterion D. The archaeologist's professional expertise and own research interests should inform that somewhat subjective threshold.

## STEPS FOR ASSESSING THE RESEARCH POTENTIAL OF MINING SITES

The following sections present the steps used to assess the research potential of mining sites (Criterion D). Sites are categorized by complexity.

- Simple Mining Sites.
- Simple Mining Sites with Domestic Deposits.
- Industrial Mining Sites.
- Industrial Mining Sites with Domestic Deposits.

The steps for each category of site include:

1. procedures for identifying and recording.
2. identification of data required for significance (data requirements).
3. categories for assessment and evaluation of significance.

The researcher should factor in all aspects of the historic context, including mineral type, era, number of miners, length of time at the site, and regional context to determine which category applies. Where less information is known, eligibility may be more likely provided there are archaeological data to address important information gaps.

## SIMPLE MINING SITES

As defined here, Simple Mining Sites display evidence of basic, low-capital mining technologies, often the product of an individual miner, or perhaps a handful of people working together. They contain no domestic remains and no evidence of complex, capital-infused mining (defined here as Industrial Mining Sites*)*. Examples of such Simple Mining Sites abound in California's Mother Lode and desert regions. Among the most typical mining sites is an adit and tailing/waste rock pile or a few placer tailing piles in a ravine. The features of these simple sites are usually situated close together while features of more complex industrial sites may be spread over many acres. Boundaries are often difficult to determine, but if the mining features extend very far, the property likely does not fall into this category. Many of these sites were never recorded as claims or developed in any substantive fashion. Property types from Chapter 3 that might belong in this category include any combination of prospecting and extraction features, ore processing features, ancillary properties, and inter-site support properties such as transportation features or water conveyance features. The point when a mining property goes from simple to complex or industrial is neither uniform nor hard-and-fast; the individual researcher must categorize the site under evaluation based on data obtained by following the steps discussed below.

Some of California's earliest mining sites were low-capital, basic technology sites, such as arrastras or placer diggings.  Simple, as used in this definition, does not immediately connote an inability to address important research questions.

Particularly excluded from evaluation are those Simple Mining Sites exempt under Attachment 4 of Caltrans' Section 106 Programmatic Agreement [Exhibit 1.1, Caltrans Environmental Handbook, Volume 2 (Caltrans 2004)]. These exempt sites are not, however, excluded from recordation and "may be documented, if documentation is warranted, at a level commensurate with the nature of the property (e.g., Primary Record form, Location Map, Memo to File, or GIS cultural database)" (Caltrans 2004). They include:

- isolated mining prospect pits;
- placer mining features with no associated structural remains or archaeological deposits.

Note that properties that have any potential to be associated with a larger property (i.e., part of a district) are not exempt and need to be evaluated. Thus, for example, tailings piles associated with Natomas Ground Sluice Diggings near Folsom, a National Register eligible district, would not be exempt even if only a small portion of tailings piles were to be affected by the project.

### Procedures for Identifying and Recording Simple Mining Sites

Simple Mining Sites by their very definition will require less effort than more complex sites. Basic research following the guidance above should focus on determining who, what, when, where, and how. Detailed research may be less fruitful since Simple Mining Sites often were not patented or otherwise registered and they may not appear in documents. Recording will involve determining the types of features present and documenting them on the appropriate DPR 523 forms. For Simple Mining Sites, a Primary Record and Location Map may be sufficient.

## Data Required to Evaluate Simple Mining Sites

Documentary data on a site are usually sufficient when they provide information necessary to address archaeological research questions, that is, knowing historical associations for the property. For a Simple Mining Site, it may not be possible to determine who did the mining nor when. Where a reasonable level of effort in archival research fails to identify any historic association, it may be possible to conclude the site is not eligible due to an inability to address important research questions because a lack of historical association limits data potential. Where archival research reveals detailed information about the mine's operations, more interpretive potential exists and the site may be historically significant.

Archaeological data are sufficient when it is possible to distinguish the techniques used at the site. The archaeological remains should retain sufficient integrity to indicate the mineral extraction methods employed at the site, such as whether it was a lode or hydraulic mine, and layout of the mining system. Mining equipment was often moved and reused elsewhere, and its absence does not automatically preclude a site's ability to contribute important information. Mining features should be identified by systems, reflecting their role in extraction and beneficiation processes. Also, the site may contain evidence indicative of a distinct time period or identifiable group and therefore may address previously unidentified research themes.

## Evaluation of Simple Mining Sites

**Not Eligible**

1. If either documentary data or archaeological data are insufficient, the site is not eligible. This conclusion is supported by documenting the archival research conducted, particularly negative results that document absence of historical association, as well as recording the archaeological remains and documenting compromised integrity.

2. This conclusion is also appropriate when the archaeological remains do retain integrity and documentary data are available to determine the site's historical associations and uses, but despite this the information at the site is rudimentary and information has been gathered by recording. The key to this conclusion is that the National Register requires information to be <u>important</u> for eligibility under Criterion D. This conclusion is supported by documenting absence of additional research potential at the site, usually because recording has exhausted all the physical evidence and there are no information-bearing subsurface archaeological deposits.

**Eligible – Contains <u>Important</u> Information**

The site has evidenced data potential, beyond that recovered by its identification and recordation described above, to address questions under the Research Themes presented in Chapter 4. Should the site meet this standard, additional work is usually necessary. This conclusion may be supported by documentary research and surface archaeological recording with no excavation, provided the archaeologist explains what physical data are present at the site and how the data might address the relevant research themes.

Figure 64 contains a decision tree to guide researchers through the above analysis and resulting determination of eligibility for isolated tailings piles and waste rock.

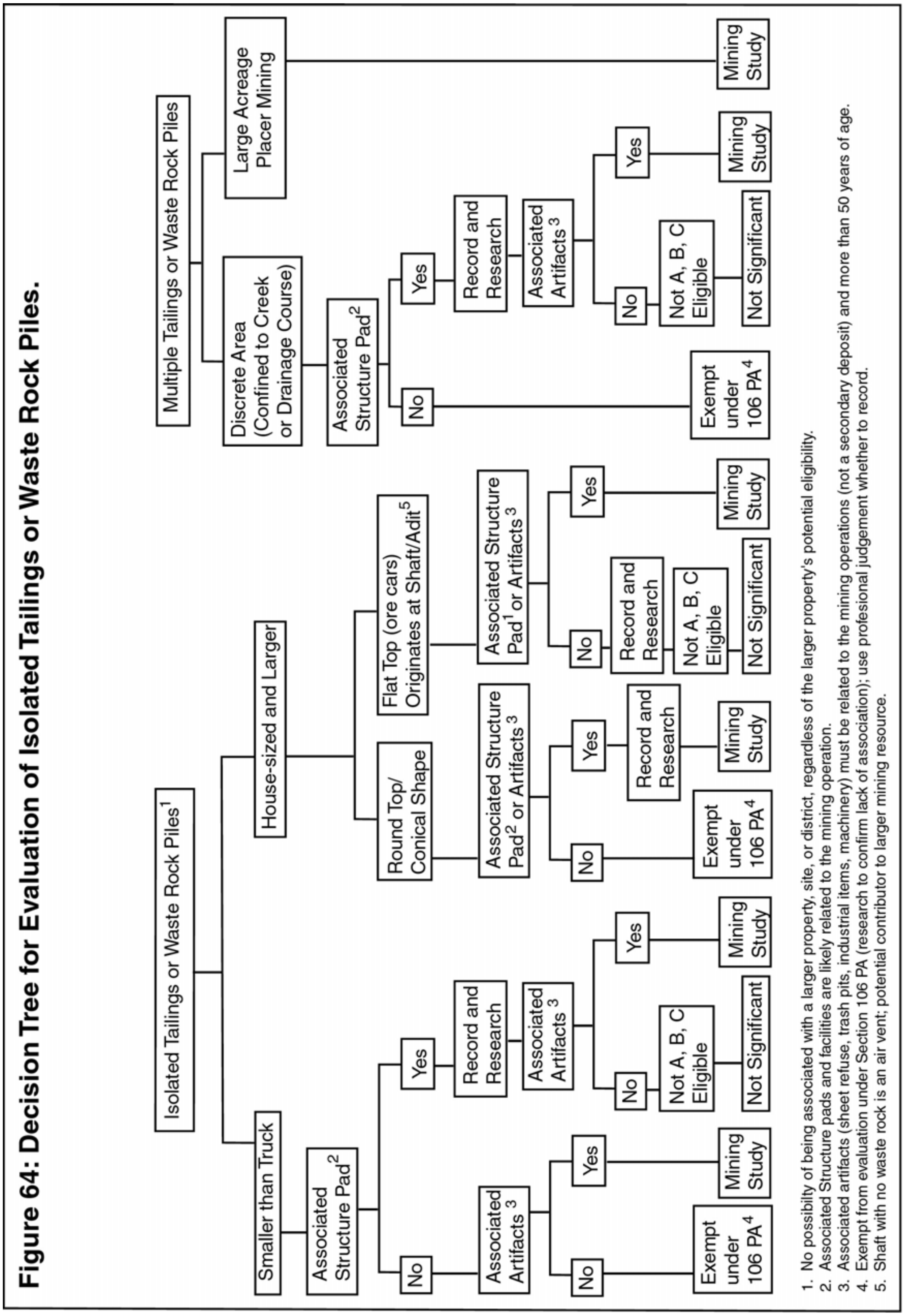


*Figure 64: Decision Tree for Evaluation of Isolated Tailings or Waste Rock Piles.*

## SIMPLE MINING SITES WITH DOMESTIC DEPOSITS

In addition to displaying only non-industrial mining techniques, these sites will be distinguished by one or more deposits of domestic artifacts and/or elements of clearly domestic architectural remains (dwellings, hearth, stone baking ovens, etc.). The procedures are the same as for Simple Mining Sites, with some additions.

### Identifying and Recording Simple Mining Sites with Domestic Deposits

Archival information on sites in this category are likely to be limited, but given the evidence of habitation more effort is required to discern whether it is possible to determine the site's association.

The main difference for this site category is the presence of artifacts that must be recorded according to methods described above. Sheet refuse should be systematically sampled while the site as a whole should be selectively sampled. An archaeological site record form should be completed. Include an assessment of the potential for information-bearing subsurface deposits given knowledge of activities identified at the site and post-occupation history (integrity).

### Data Required to Evaluate Simple Mining Sites with Domestic Deposits

The documentary and archaeological data requirements discussed above apply equally to this site type. The main difference is that the domestic deposit should be distinguished and described in more detail. Diagnostic artifacts should be analyzed to permit correlating the domestic deposit with a specific phase of occupation at the site. The archaeologist must assess whether the domestic deposit contains sufficient artifactual data to address the research themes applicable to the site. There are no absolute calculations on the quantity of materials necessary to obtain important information from a site. Rather, the archaeologist must make that calculation, usually supported by discussion of realized research value, or lack thereof, at similar site types. The *Agriculture*, *Townsites,* and *Work Camps* thematic studies contain more information on research themes appropriate to domestic deposits and should be examined to identify additional applicable research areas.

### Evaluation of Simple Mining Sites with Domestic Deposits

**Not Eligible**

1. As discussed above, if either documentary data or archaeological data are insufficient, the site is not eligible.

2. This conclusion is also appropriate where recording has documented the absence of archaeological deposits that contain important information. The research potential of the domestic deposit at a simple mining site may very well be exhausted by a thorough recording that identifies all the data sets present in the assemblage. This conclusion would be appropriate where the domestic deposit is relatively small, solely a surface component, and all artifacts can be inventoried during field recording. For larger deposits sampling may be able to document the data potential; however, the validity of any conclusions derived from sampled data would need

to be rigorously supported by a thorough description of methods. Research potential should also be considered according to procedures identified here as well as in the *Agriculture, Townsites,* and *Work Camps* thematic studies.

**Eligible – Contains <u>Important</u> Information**

As above, if the site has evidenced data potential, this conclusion may be appropriate. Again, the archaeologist must explain what physical data are present at the site and how the site retains the potential to address the relevant research themes presented in Chapter 4, or as identified for domestic deposits by the *Agriculture, Townsites,* and *Work Camps* thematic studies.

### INDUSTRIAL MINING SITES

These sites display evidence of substantial capital investment in industrial processes of extraction and/or beneficiation as evidenced by large or numerous facilities. That complexity distinguishes them from the simple sites discussed above. These sites will be most common after ca. 1880 (depending on mineral type) with the boom in hard-rock mining, and may even have been used into modern times. Earlier industrial sites are present, however, and may be significant for their relative rarity as well as the technologies evidenced. Property types from Chapter 3 that might belong in this category include any combination of prospecting and extraction features, ore processing features, ancillary properties, and inter-site support properties such as transportation features or water conveyance features. No domestic remains are associated with this category. The level of both documentary research and archaeological recording will be guided by the size and complexity of the site.

## Identifying and Recording Industrial Mining Sites

Industrial Mining Sites, by their very definition, are more complex than Simple Mining Sites and care should be taken during recording to correctly identify individual features and their place within the larger property. Feature drawings may be appropriate to capture important structural details or document relationships of features to one another. Boundaries may be difficult to define, therefore researchers should know something about the land use history when assigning individual features to larger systems. For example, water conveyance systems may connect the beneficiation area to ponds and other features far distant.

An archaeological site record form should be completed for all properties in this category. Include an assessment of the potential for information-bearing subsurface deposits given knowledge of activities that occurred at the site and post-occupation history (integrity).

## Data Required to Evaluate Industrial Mining Sites

More specific archival and contextual data will be necessary to evaluate an Industrial Mining Site as compared to a Simple Mining Site. At Industrial Mining Sites, it will usually be possible to identify mine name, owners, workers, period(s) of use, technologies employed, etc. through archival research. Documentary data on site layout will be crucial to address issues such as technological changes or policy implementation. Site specific information will be important to determine the larger physical and historical context in which the site fits, as well as determining a period of significance for the property. Again, there is no hard-and-fast rule about how much information is enough, but sufficient effort should be expended to demonstrate how the archaeological data relate to the known historic record and therefore how the site can address important research issues.

Archaeological data required to evaluate an Industrial Mining Site hinge upon integrity. The site must at some level demonstrate the techniques used, even if machinery and structures are no longer extant. The physical remains must retain attributes that indicate a time period or association with a group. It should be possible to identify features by function, that is, their place within the larger system that reflects their role in extraction and beneficiation processes.

## Evaluation of Industrial Mining Sites

### Not Eligible

If there is no important information held by the Industrial Mining Site, the site is not eligible under Criterion D. This conclusion will require more explanation at more complex sites, but still is appropriate if the site's available data have been fully analyzed and interpreted and there are no unexamined data sets such as subsurface archaeological deposits.

### Eligible – Contains Important Information

As above, if the site has evidenced data potential, this conclusion may be appropriate. Again, the archaeologist must explain what physical data are present at the site and how the site retains the potential to address the relevant research themes presented in Chapter 4.

### INDUSTRIAL MINING SITES WITH DOMESTIC DEPOSITS

In addition to evidence of industrial mining, these sites will be distinguished by deposits of domestic artifacts and/or clearly domestic architectural remains (hearth, stone baking ovens, etc.). Since these industrial sites were occupied for longer periods of time, the domestic deposits may be quite substantial and must be carefully recorded to tease out any distinctions that might address the research themes (e.g., different phases of occupation, or different groups). The procedures are the same as for *Industrial Mining Site* with some additions. Property Types from Chapter 3 that would be present in this category include any combination of all the property types, with components of the Mining Community Property Type standing out as distinguishable entities.

## Identifying and Recording Industrial Mining Sites with Domestic Deposits

The main difference for this site category is the presence of artifacts that must be recorded according to methods described above. Sheet refuse should be systematically sampled while the site as a whole should be selectively sampled. An archaeological site record form should be completed. Include an assessment of the potential for information-bearing subsurface deposits given knowledge of activities that occurred at the site and post-occupation history (integrity).

Properties falling in this category are much more likely to require archaeological testing to determine their information potential. The *Agriculture, Townsites,* and *Work Camps* thematic studies contain sections on standardized methods that should be employed at historic-era sites in California and those reports should be consulted for methodological details.

### Data Required to Evaluate Industrial Mining Sites with Domestic Deposits

Documentary data required to evaluate Industrial Mining Sites with Domestic Deposits is highly variable depending on the nature of the deposits. Ideally, it should be possible to determine the site inhabitants and distinguish any differences among those inhabitants (e.g., age, gender, race, socioeconomic status, etc.). Furthermore, documentary data on site layout will be crucial to address issues such as settlement, policy implementation, and economics. In essence, documentary data are sufficient when they provide enough information to address archaeological research questions. Again, there is no hard-and-fast rule about how much information is enough, but sufficient effort should be expended to demonstrate how the archaeological data relate to the known historic record and therefore how the site can address important research issues.

As for archaeological data requirements, the main difference for this category is that artifacts retain sufficient depositional integrity to permit determining their historical association. If the site was occupied over several decades, distinguishing dumping episodes that represent sequences of occupation and mining is critical to eligibility. In addition, the materials must be of sufficient quantity and variety to permit logically valid interpretations. The domestic deposits, therefore, must meet the AIMS-R criteria discussed above.

### Evaluation of Industrial Mining Sites with Domestic Deposits

#### Not Eligible

If there is no important information held by the Industrial Mining Site with Domestic Deposits, the site is not eligible under Criterion D. This conclusion will require more explanation at more complex sites, but still is appropriate if the site's available data have been fully analyzed and interpreted and there are no unexamined data sets such as subsurface archaeological deposits.

#### Eligible – Contains Important Information

As above, if the site has evidenced data potential, this conclusion may be appropriate. Again, the archaeologist must explain what physical data are present at the site and how the site retains the potential to address the relevant research themes presented above in Chapter 4, or as identified for domestic deposits by the *Agriculture*, *Townsites*, and *Work Camps* thematic studies.

## SAFETY CONCERNS

Mining sites can be dangerous places, and field crews should be cautious while working around them. In addition to standard safety precautions relevant to all field situations such as natural hazards (poison oak, rattlesnakes, hanta virus) and man-made hazards (trips and falls, cuts on rusty metal, illegal dumping, unstable structures, drug lab refuse, etc.), mining properties possess several specific safety issues by their very nature. It is important to follow strict safety procedures in order to investigate them safely. Among the basic rules are:

- Never enter adits or shafts.
- Stay away from collars of shafts, as they may be unstable.
- Do not go into depressions on the ground, as these may be thinly covered shafts.
- Ponds may be open leaching pits containing dangerous chemicals, or simply flooded adits or shafts, but there is also the hazard of “quicksand” since fine pulverized rock and water can create unstable ground.
- Keep in mind that there may be dangerous chemicals present, such as mercury, cyanide, or arsenic, and appropriate precautions should be taken when excavating or handling soil or artifacts. Such chemicals may have been left by miners or may be illegally dumped trash and may be present in the soil or in unmarked containers.
- Field crews should become familiar with the appearance of explosives such as fuses, blasting caps, and dynamite. Unfamiliar artifacts should be examined with caution.

Should it become necessary to excavate at a mine, hazardous materials soils testing should precede the archaeological fieldwork and results factored into any site-specific safety plan. In some cases the soils may be so contaminated that archaeological fieldwork is not prudent and there is no way to stabilize or curate contaminated artifacts. Consultation with a Certified Industrial Hygenist may be appropriate if unique contaminants are present or specific field protections must be employed.

## CONCLUSIONS

This chapter has presented practical methods for identifying and evaluating mining resources. Phase 1 involves two interlinked processes: a) identification and recording of the physical attributes of a site (property types, discussed in Chapter 3); and b) placement of the site in its statewide historic context (provided in Chapter 2) and local setting using historical documentary sources. During Phase 2 the site is evaluated for its research potential under themes and questions presented in Chapter 4. Key to this second phase is identification of the site as a Simple Mining Site, where recording may obtain enough data to determine that the site does not contain <u>important</u> information, or an Industrial Mining Site where additional documentary and archaeological research is often required. If there is a domestic component to the mining site – remains of dwellings or a workforce’s camp – relevant research themes and questions are presented in the *Agriculture, Townsites,* and *Work Camps* thematic studies.

# BIBLIOGRAPHY

Adams-Graf, John
1995 In Rags for Riches: A Daguerreian Survey of Forty-Niners' Clothing. *Dress* 2:59–68.

Aiken, Katharine
1999 Working and Living: Women and Mining Communities. *The Oral History Review* 26(1):119-125.

Alanen, A. R.
1987 The Cultural Geographer's Perspective. In *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*, Jeff Buechler, editor, pp. 61–76. South Dakota State Historical Preservation Center, Vermillion, SD.

Allen, E. John B.
1990 Research Notes, Document Skis in Gold Rush California. *Journal of Sport History* 17:347–353.

Alpers, Charles N., and Michael P. Hunerlach
2000 Mercury Contamination from Historic Gold Mining in California. *United States Geological Survey Fact Sheet FS-061-00.* May 1–6. Sacramento, CA.

*Amador Ledger*
1929 No title. *Amador Ledger*, 26 September.

1934a No title. *Amador Ledger*, 7 June.

1934b No title. *Amador Ledger*, 4 October.

1938 No title. *Amador Ledger*, 3 February, page 5.

American History
1994 California Gold. *American History* 9(4):44–57.

American Institute of Mining and Metallurgical Engineers
1953 *Modern Uses of Nonferrous Metals*, 2nd edition. AIME, New York, NY.

Anderson, Karen
1992 Work, Gender, and Power in the American West. *The Pacific Historical Review* 61(4):481-499.

Andrist, Ralph K.
1962 Gold! *American Heritage* 14(1):6-27, 90-91.

Apostol, Jane
2000 Augustin W. Hale: Hard-Luck Argonaut. *Southern California Quarterly* 82(2):145–168.

Arbuckle, Clyde.
1944a Coloma's Gold Discovery of 1848: Testimony of Cousin Belle Dampman. *Pony Express*, H. S. Hamlin, editor, 11:3-4, 11.

1944b January 19th or 24th? *Pony Express*, H. S. Hamlin, editor, 10(8):8,10.

Archer, Myrtle
1996 The Nearly Forgotten Emperor of Staging. *Journal of the West* 35(1):79–85.

Armitage, Susan
1980 Western Women's History: A Review Essay. *Frontiers: A Journal of Women Studies* 5(3):71-73.

1985 Women and Men in Western History: A Stereoptical Vision. *The Western Historical Quarterly* 16(4):381-395.

1996 Here's to the Women: Western Women Speak Up. *The Journal of American History* 83(2):551-559.

Aubury, Lewis E.
1906 Magnesite. The Structural and Industrial Minerals of California. *California Mining Bureau Bulletin* 38:327-334.

Averill, Charles Volney
1937 Mineral Resources of Plumas County: California. *California Division of Mines Report* 33:92. San Francisco, CA.

1939 Mineral Resources of Shasta County: California. *California Division of Mines and Geology Report* 35(2):79-143. Sacramento, CA.

1946 Placer Mining for Gold in California. *California Division of Mines Bulletin 135.* San Francisco, CA.

Bailey, Lynn.
1996 *Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850–1900***.** Westernlore Press, Tucson, AZ

2002 *Shaft Furnaces and Beehive Kilns: A History of Smelting in the Far West, 1863-1900.* Westernlore Press, Tucson, AZ.

Baker, Douglas C., and William R. Morrison
1999 Development of Property Rights on the Canadian and American Mining Frontiers. *American Review of Canadian Studies 2*9(3):431–446.

Bancroft, Hubert Howe
1882-1890 *History of California*. Vol. 18-24 in *Works of Hubert Howe Bancroft.* A. L. Bancroft & Company, History Company, San Francisco, CA.

Barker, L. R., and A. E. Huston (editors)
1989 *Death Valley to Deadwood; Kennecott to Cripple Creek: Proceedings of the Historic Mining Conference, Death Valley National Monument.* National Park Service, San Francisco, CA.

Barron, Beverly
1974 The Celestial Empire. *Chispa* 13(4):453–460.

Bastin, Edson S.
1911 Geology of the Pegmatites and Associated Rocks of Maine, Including Feldspar, Quartz, Mica and Gem Deposits. United States Geological Survey *Bulletin 445*, Washington, DC.

Bates, D. B.
1857 *Incidents on Land and Water, or, Four Years on the Pacific Coast : Being a Narrative of the Bburning of the ships Nonantum, Humayoon and Fanchon, together with many startling and interesting adventures on sea and land*. J. French and Co., Boston, MA.

Baur, John E.
1949 The Health Factor in the Gold Rush Era. *Pacific Historical Review* 18(1):97–108.

Bean, Walton.
1968 *California: An Interpretive History.* McGraw Hill, New York, NY.

Beck, Warren A., and Ynez D. Haase.
1974 *Historical Atlas of California.* Oklahoma University Press, Norman, OK.

Bedford, R. H., and F. T. Johnson
1946 Survey of Tin in California. *U.S. Bureau of Mines Report Investigations* 3876. Washington, DC.

Beesley, David
1996 The Opening of the Sierra Nevada and the Beginnings of Conservation, 1821–1900. *California History* 75(4):322–337.

Bekeart, Philip Baldwin.
1924 Previous Gold Discoveries. *Society of California Pioneers Quarterly* 1:84-95.

1924 The Lump of Gold Known as the Wimmer Nugget. *Society of California Pioneers* 1:79-83.

Belden, L. Burr,
1985 *Mines of Death Valley*. La Siesta Press, Glendale, CA.

Belden, L. Burr, Mary Dedecker, Wynne Benti, and Burr Belden
2000 *Death Valley to Yosemite: Frontier Mining Camps & Ghost Towns: The Men, the Women, Their Mines & Stories.* Spotted Dog Press, Bishop, CA.

Bell, Peter
1998 Fabric and Structure of Australian Mining Settlements. In *Social Approaches to an Industrial Past: The Archaeology and Anthropology of Mining*, A. Bernard Knapp, Vincent C. Pigott, and Eugenia W. Herbert, editors, pp. 27–38. Routledge, New York, NY.

Bellamy, Marion. The Discovery of Gold in California.
1898 *Overland Monthly*, Second series 31:161-164.

Bennett, James Gordon
1976 The Industrious Miner: A Tale of California Life. *American West* 13:39-35.

Berglund, Barbara
2003 The Days of Old, The Days of Gold, The Days of ’49: Identity, History and Memory at the California Midwinter International Exposition, 1894. *The Public Historian* 25(4):25–49.

Berry, Thomas Senior.
1976 Gold! But How Much? *California Historical Quarterly* 55:246-255.

Berryman, Judy Ann
1995 *Archival Information, Abalone Shell, Broken Pots, Hearths, and Windbreaks: Clues to Identifying Nineteenth-Century California Abalone Collection and Processing Sites. San Clemente Island: A Case Study.* Doctoral dissertation. University of California, Riverside.

Bethel, A. C. W.
1999 The Golden Skein: California’s Gold-Rush Transportation Network. In *A Golden State: Mining and Economic Development in Gold Rush California*, James J. Rawls and Richard J. Orsi, editors, pp. 250–275. University of California Press, Berkeley, CA.

Bieber, Ralph P.
1948 California Gold Mania. *Mississippi Valley Historical Society* 35:3-28.

Blackburn, George M., and Sherman L. Richards
1993 Unequal Opportunity on a Mining Frontier: The Role of Gender, Race, and Birthplace. *Pacific Historical Review* 62(1):19–38.

Blake, Anson Stiles
1947 The California Centennials: 1948, 1949, 1950. *California Historical Society Quarterly* 26(2):97-106.

Blodgett, Peter
1999 *Land of Golden Dreams: California in the Gold Rush Decade, 1848-1858*. Huntington Library, San Marino, CA.

Boalich, Edwin Snow
1913 Mineral production for 1912. *Bulletin No. 165*. State Mining Bureau, Division of Mines and Geology, Sacramento, CA.

Boericke, William F.
1936 *Prospecting and Operating Small Gold Placers*, 2nd edition. John Wiley & Sons, New York, NY.

Boron Mine.com
2008 <Boron Mine. http://www.boronmine.com/boromine/boron>. Accessed January 2008.

Borthwick, John David
1857 *Three Years in California*. William Blackwood and Sons, London.

1948 *Three Years in California*, expanded and revised from 1857 edition. Biobooks, Oakland, CA.

Bowen, O. E., Jr.
1948 Lime and Limestone. *California Division of Mines Bulletin* 156:171-176. San Francisco, CA.

Bowman, J. N.
1949 The First Authentic Placer Mine in California. *Quarterly of the Historical Society of Southern California* 31(September):225-230.

Brace, Charles Loring
1868 The New West: or California in 1867-1868. G.P. Putnam and Sons, New York.

Bradley, Walter W.
1930 Barite in California. *California Division of Mines Report* 26:45-57. Sacramento, CA.

Bray, A. F.
1938 Mt. Diablo Coal and the Fight between the Railroads. Contra Costa County, California Broadcast Station KLX, Oakland, CA. Number 119, August 22 1938.

Brereton, Roslyn.
1976 Mining Techniques in the California Goldfields during the 1850s. *Pacific Historian* 20:286-302.

Briggs, Carl.
1985 Mt. Gaines: 135 Years of Mother Lode Mining. *The Californians* 3:40-42.

Broussard, Albert S.
1985 Slavery in California Revisited: The Fate of a Kentucky Slave in Gold Rush California. *The Pacific Historian* 29(1):17–25.

Brower, Maria Fields.
1997 California's Sesquicentennial and the Gold Rush. *Heritage Quest* 72:89.

Brown, Charles.
1930 Early Events. *Society of California Pioneers Quarterly* 7:35-47.

Browne, Ross J., and James W. Taylor.
1867 *Reports Upon the Mineral Resources of the United States*. Government Printing Office, Washington, DC.

Budig-Markin, Valerie
2004 *Nellie E. Ladd: Mining Camp Photographer of the Trinity Alps 1859-1922*. Naturegraph, Happy Camp, CA.

Buechler, J.
1987 Priorities for Future Research. In *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*, Jeff Buechler, editor. pp. 131-134. South Dakota State Historical Preservation Center, Vermillion, SD.

Buffum, Edward Gould
1850 *Six Months in the Gold Mines: From a Journal of Three Years' Residence in Upper and Lower California, 1847-48-49*. Lee and Blanchard, Philadelphia, PA.

1959 *Six Months in the Gold Mines: From a Journal of Three Years' Residence in Upper and Lower California, 1847-48-49*, revised and expanded from 1850 edition, John W. Caughey, editor. Ward Ritchie Press, Los Angeles, CA.

Bullough, William A.
1991 Entrepreneurs and Urbanism on the California Mining Frontier: Frederick Walter and Weaverville, 1852–1868. *California History* 70(2):162–173.

Bunyak, Dawn
1998 *Frothers, Bubbles and Flotation: A Survey of Flotation Milling in the Twentieth Century Metals Industry.* National Park Service, Intermountain Support Office, Denver, CO.

Burchell, Robert A.
1989 The Faded Dream: Inequality in Northern California in the 1860s and 1870s. *Journal of American Studies* 23(2):215–234.

Burgess, Sherwood D.
1995 The Water King's Empire. *The Californians* 12:1:30-31.

Burney, Michael S., and Stephen R. Van Wormer
1993 *The Results of Historical Research, Oral History, Inventory, and Limited Test Excavations Undertaken at the Hedges/Tumco Historic Townsite, Oro Cruz Operations, Southwestern Cargo Muchacho Mountains, Imperial County, CA.* Report prepared for the P. M. DeDycker and Associates, Lakewood, CO, from Burney and Associates, Boulder, CO.

Bussert, Wendell
1978a Before the Gold Rush. *Siskiyou Pioneer* 5:1:5. Yreka, CA.

1978b The Winter of 1852. *Siskiyou Pioneer* 5:1:6-9. Yreka, CA.

Butler, Anne M.
1985 *Daughters of Joy, Sisters of Mercy: Prostitution in the American West.* University of Illinois Press, Chicago, IL.

Butruille, Susan G., and Kathleen Petersen
1998 *Women's Voices from the Mother Lode: Tales from the California Gold Rush.* Tamarack Books, Boise, ID.

Byerly, Edward A.
2000 The Politics of Topographic Mapping: J. D. Whitney, C. F. Hoffman, and the California State Geographical Survey, 1860–1874. *Southern California Quarterly* 82(4):343–364.

Byrd, David S.
1992a Roads and Trails in the Tahoe National Forest: A Contextual History, 1840–1940. *Tahoe National Forest Report Number 39.* USDA Forest Service, Pacific Southwest Region, Vallejo, CA.

1992b California Cookery: Pioneer Sustenance. *The Californians* 10:48–50.

1987 California Cookery: Pioneer Sustenance. *The Californians* 5:5

California Department of Transportation (Caltrans)
2004 *Standard Environment Reference, Environmental Handbook, Volume 2 – Cultural Resources (Archaeological and Historical)*. California Department of Transportation, Sacramento, CA.

2007 *A Historical Context and Archaeological Research Design for Agricultural Properties in California.* California Department of Transportation, Sacramento, CA.

California Geological Survey
2007 Mineral Resources. On-line. <www.consrv.ca.gov>. Accessed 2007.

California Gold.
1994 *American History* 29:44-57.

*California History*
1997 A Portfolio of Exhibitions. 76:Supplement:10-29.

*California History Nugget*
1924 The Golden Nugget: The Story of the Discovery of Gold. *California History Nugget* 1:3-6.

1930 The Marshall Monument. *California History Nugget* 3:72-76.

California's Gold Rush Sesquicentennial
1998 *International California Mining Journal* 67(7):7.

Campbell, John Carden
1982 California Houses of Gold: Elegant Homes Tamed the Mining Frontier. *American West* 19(March/April):56-63.

Campbell, Robert B.
1999 A Business Man's Revolution. *American Quarterly* 51(3):657-683.

Carlisle, Donald, Dudley L. Davis, Malcolm B. Kildale, and Richard M. Stewart
1954 Base Metal and Iron Deposits of Southern California. *California Division of Mines Bulletin* 170:41-49. Sacramento, CA.

Carman, William E.
1963 Empire Mines of Grass Valley: 'A Sage of the Gold Country'. *Nevada County Historical Society* 17:1-3.

Carmosino, Penni L.
1998 Victorian Culture and Women at CA-BUT-1298-H, Forbestown, California. Master's thesis, Anthropology Department, California State University, Chico, CA.

Carter, Henry
1966 Mines and Miners of Shasta, Trinity and Siskiyou Counties. *Covered Wagon* 1966:22-33.

Caughey, John Walton.
1948 *The California Gold Rush.* University of California Press, Berkeley, CA.

1949 Rushing for Gold. *Pacific Historical Review* 19:1-2.

1992 The Californian and His Environment. *California Historical Society Quarterly* 51(3):195–204.

Causey, J. Douglas
1998 MAS/MILS Arc/Info Point Coverage for the Western U.S. (excluding Hawaii). *Open-File Report* 98-512. U.S. Geological Survey, Spokane, WA.

Chalfant, W. A.
1933 *The Story of Inyo*. Piñon Book Store, Bishop, CA.

Chalmers, Claudine
1994 The Lucky Frenchmen of the Yuba. *The Californians* 11(6):30–35.

1999 Francoise, Lucienne, Rosalie: French Women-Adventurers in the Early Days of the California Gold Rush. *California History: The Magazine of the California Historical Society* 78(3):138-153.

Chandler, Robert J.
2003 An Uncertain Influence: The Role of the Federal Government in California, 1846–1880. *California History* 81(3/4):224–272.

Chapman, Charles E.
1917 History of Mining in California. *Grizzly Bear* 21(September):4, 20; (October):3-4; (November):7; (December):6. Los Angeles, CA.

Chaput, Donald
1985 The Temescal Tin Fiasco. *Southern California Quarterly* 67(1):1-24.

Chesterman, Charles W.
1957 Pyrites. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 449-454. Division of Mines, San Francisco, CA.

Childress, J. G., and E. Ritter
1967 *Archaeological Survey of the Proposed Auburn and Sugar Pine Reservoirs in El Dorado and Placer Counties.* Report for the National Park Service, Western Region, Sacramento from the Department of Anthropology, University of California, Davis.

Chinard, Gilbert
1943 When the French Came to California: An Introductory Essay. *California Historical Society Quarterly* 22(4):289–314.

1968 The Chinese in the Mines. *Chipsa* 8:252.

Clamage, Sandy.
1983 California's Mother Lode. *Journal of the West* 22:88-92.

1998 California's Gold Rush. *International California Mining Journal* 67(8):5.

Clark, William B.
1957 Gold. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 215-228. Division of Mines, San Francisco, CA.

1970 Gold Districts of California. *Bulletin 193.* California Division of Mines and Geology, Sacramento, CA.

1985 Gold Districts of California, An Update. *California Geology* 38:3-4.

Clark, Walter Van Tilburg, ed.
1973 *The Journals of Alfred Doten, 1849-1903*. University of Nevada Press, Reno.

Clay, Karen B., and Wright, Gavin
2003 Order Without Law? Property Rights During the California Gold Rush. Stanford Law and Economics Olin Working Paper No. 265; Stanford University Economics Working Paper No. 03-008. <http://www.econ.stanford.edu/faculty/workp/swp03008.pdf>. Accessed January 2005.

Clayton Historical Society
2002 Almost as Good as Gold. <http://claytonhs.com/chsCoal.html>. Accessed 2007.

Comstock, David A.
1984 Proper Women at the Mines-Life at Nevada City in the 1850s. *The Pacific Historian* 28(Fall):65–73.

Cook, Tony Stanley
1986 Historical Mythmaking: Richard Henry Dana and American Immigration to California, 1840-1850. *Southern California Quarterly* 68:97-118.

Coray, Michael S.
1985 Negro and Mulatto in the Pacific West, 1850–1860: Changing Patterns of Black Population Growth. *The Pacific Historian* 29(Winter):18–27.

Cornford, D.

1999 ‘We all live more like brutes than humans’: Labor and Capital in the Gold Rush. In *A Golden State: Mining and Economic Development in Gold Rush California*, James J. Rawls and Richard J. Orsi, editors, pp. 78–104. University of California Press, Berkeley.

Costa, Eric J.

1994 *Old Vines: A History of Winegrowing in Amador County*. Cenotto Publications, Jackson, CA.

Costello, Julia G.

1981 Historical Archaeology: Identifying Italians in the Mother Lode. *Archaeology* 34(2):18–26.

1983 *Melones: A Story of a Stanislaus River Town.* U.S. Bureau of Reclamation, Department of the Interior, Washington, DC.

1986 *Melones: A Story of a Stanislaus River Town*, reprinted from 1986. Calaveras Heritage Council, San Andreas, CA.

1998 Bread Fresh from the Oven: Memories of Italian Breadbaking in the California Mother Lode. *Historical Archaeology* 32(1):66–73.

Costello, Julia G. (editor)

1999 *Historical Archaeology at the Headquarters Facility Project Site, The Metropolitan Water District of Southern California, Volume 2: Interpretive Report*. Prepared for the Metropolitan Water District of Southern California, Environmental Planning Branch, Los Angeles.

Costello, Julia G, Kevin Hallaran, and Keith Warren

2004 *The Luck of Third Street: Historical Archaeology Data Recovery Report for the Caltrans District 8 San Bernardino Headquarters Demolition Project.* Prepared for The California Department of Transportation District 8, San Bernardino.

Costello, Julia G., Jane Russell, and Susan Stratton

1998 *CA-CAL-1564/H, Locus 4: Selkirk Ranch Homestead with Chinese Hearth and Forge, Excavation Report*. Prepared by Foothill Resources, Mokelumne Hill, CA for Green Creek Golf and Country Club, Angels Camp, CA.

Cowie, Sarah, Laura S. Bergstresser, Nancy E. Pearson, and Susan J. Wells

2005 *Guidelines for Archeological Recording and Evaluation of Abandoned Mining Properties*. Publications in Anthropology 89. Western Archeological and Conservation Center, National Park Service, Tucson, AZ.

Cresap, Bernarr
1952 Early California As Described by Edward O. C. Ord. *Pacific Historical Review* 21:329-340.

Cronon, William, Howard R. Lamar, Katherine G. Morrissey, and Jay Gitlin
1986 Women and the West: Rethinking the Western History Survey Course. *The Western Historical Quarterly* 17(3):269-290.

Cutter, Donald C., Gene M. Gressley, Gilbert C. Fite, W. David Baird, and Glenda Riley
1999 The Gold Rush: Presidential Reflections. *Western Historical Quarterly* 30(4):429-448.

Daggett, Hallie M.
1957 Early Day Mining Camps of the Salmon River. *Siskiyou Pioneer* 2:10:2-9.

Dasmann, Raymond F.
1998 Environmental Changes before and after the Gold Rush. *California History* 77(4):105–122.

Davis, Charlotte, and Bernice Meamber
1980 Henry Levi Davis - Early Builder in Montague. *Siskiyou Pioneer* 5(3):33-35.

Davis, D. L., and E. C. Peterson
1949 Anaconda's Operation at Darwin Mines, Inyo County, California. *American Institute of Mining, Metals, Engineering and Transportation* 181:137-147.

Davis, Fenelon F.
1950 Mines and Mineral Resources of Alameda County, California. *Journal of Mines and Geology* 46(2):279-346.

1957 Manganese. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 325-340. Division of Mines, San Francisco, CA.

Davis, Hazel
1972 Scott Bar. *Siskiyou Pioneer* 4 (5):74-75. Yreka, CA.

Davis, John F.
1902 *Historical Sketch of the Mining Law in California*, 2nd edition. Commercial Printing House, Los Angeles, CA.

Davis-King, Shelly
1990 An Introduction to Historic Mining Ditches (Water Conveyance Systems). In *Death Valley to Deadwood; Kennecott to Cripple Creek: Proceedings of the 1989 Historic Mining Conference, Death Valley National Monument*, Leo R. Barker and Ann E. Huston, editors, pp. 122–128. National Park Service, San Francisco, CA.

de Graaf, Lawrence B.
1980 Race, Sex, and Region: Black Women in the American West, 1850-1920. *The Pacific Historical Review* 49(2):285-313.

Deetz, James
1977 *In Small Things Forgotten: An Archaeology of Early American Life*. Anchor Press, Doubleday, New York, NY.

1988 Introduction: Archaeological Evidence of Sixteenth- and Seventeenth-Century Encounters. In *Historical Archaeology in Global Perspective*, Lisa Falk, editor, pp. 1-9. Smithsonian Institution Press, Washington, DC.

Degroot, Henry
1872 The Mother Lode. *Overland Monthly* 9(5):401-412.

1874 Diving for Gold '49. *Overland Monthly* 13(3):273-280.

Delepine, Alphonse Antoine
1988a A Soul Lost in the Wilderness: Tales of a French Argonaut, Part I. *The Californians* 6:16–25.

1988b Among an Eminently Warlike People: Tales of a French Argonaut, Part II. *The Californian*, 6:48–57.

DeLeen, J. L.
1950 Geology and Mineral Deposits of the Calico Mining District. Unpublished Master's Thesis, Geology, University of California, Berkeley.

De Long, Charles E.
1929 'California's Bantam Cock'—The Journals of Charles E. De Long, 1854-1863. Carl I. Wheat, editor. *Quarterly of the California Historical Society* 8(4):357–363.

Del Rio, Juan
1897 '48 and '98. *Land of Sunshine* 7:181-190, Charles F. Lummis, editor.

Denny, Karl V.
1957 Callahan Mines. *Siskiyou Pioneer* 2(10):41-44. Yreka, CA.

Derezynski, Daniel T.
1979 Polish Settlers. *The Pacific Historian* 23:29–36. Stockton, CA.

Devine, Preston
1953 Gold, Emblematic of Beauty and Strength of State of California. *Grizzly Bear* 90:2. Los Angeles, CA.

Dillon, Richard H.
1955 Kanaka Colonies in California. *Pacific Historical Review* 24(1):17–23.

Dilsaver, Larry M.
1982 *From Boom to Bust: Post Gold Rush Patterns of Adjustment in a California Mining Region (Volumes I and II).* Doctoral Dissertation, Department of Geography and Anthropology, Louisiana State University and Agricultural and Mechanical College, Baton Rouge, LA.

1985 After the Gold Rush. *Geographical Review* 75(1):1–18.

Doble, John
1999 *Journal and Letters from the Mines*, expanded and revised from 1962 edition, Charles L. Camp, editor. Volcano Press, Volcano, CA.

Doolittle, J. E.
1905 Gold Dredging in California. *California Mining Bureau Report* 30. Sacramento, CA.

Douglass, William A.
1998 The Mining Camp as Community. In *Social Approaches to an Industrial Past: The Archaeology and Anthropology of Mining*, A. Bernard Knapp, Vincent C. Pigott, and Eugenia W. Herbert, editors, pp. 97–108. Routledge, New York, NY.

DuFault, David V.
1959 The Chinese of the Mining Camps of California:1848-1870. *Historical Society of Southern California Quarterly* 41:155–170.

Dunbar, Robert
1983 *Forging New Rights in Western Waters.* University of Nebraska Press, Lincoln. <http://www.queenmary.com/index.php?page=queenmarystats>. Accessed 30 October 2006.

Durrell, Cordell
1953 Geologic Investigations of the Strontium Deposits of Southern California. *California Division of Mines Special Report* 32:48. San Francisco, CA.

Dye, Homer
1928 Gold - The Key to the West. *Overland Monthly and the Out West Magazine* 86:176,190.

Dyer, Richard L.
1981 Columbia State Historic Park. *The Pacific Historian* 25(4):46–53.

Eddy, J. M.
1909 Rush of '49. *Out West* 31:987-909.

Edwards, Malcolm
1971 Substantial, Fire-Proof Edifices…Made so by the Marvelous Invention of Iron Door and Window Shutters. *California Historical Society Quarterly* 50(4):431–437.

Egenhoff, Elisabeth L.
1949 The Elephant as They Saw It: A Collection of Contemporary Pictures and Statements of Gold Mining in California. *California Journal of Mines and Geology, Centennial Supplement* 45:1-128.

Eggleston, Benjamin T.
1944 A Gold Rush Document. (Letter dated January 24, 1849). *California Historical Society Quarterly* 23(3):226.

Ellenbecker, John G.
1939 Cache of the Forty-Niners: The Buried Gold Near Seneca, Kansas. *Pony Express Courier*, H. S. Hamlin, editor, 6:12.

Elliott, Daniel R.
1995 *Foodways and Economic Systems on the Late California Gold Rush Frontier*. Master's thesis, Department of Anthropology, California State University, Chico.

Evans, Taliesin
1870 Gold and Gold Mining. *Overland Monthly* 4(6):496-502.

Everhart, D. L.
1946 Quicksilver Deposits a the Sulphur Bank Mine, Lake County, California. *California Division of Mines Report* 42: 125-153. San Francisco, CA.

Ewart, Shirley
1981 Cornish Miners in Grass Valley: The Letters of John Coad, 1858–1860. *The Pacific Historian* 25(4):38–45.

Farkas, Lani Ah Tye
1998 *Bury My Bones In America: The Saga of a Chinese Family in California 1852–1996, From San Francisco to the Sierra Gold Mines.* Carl Mautz Publishing, Nevada City, CA.

Farnham, Eliza
1856 *California In-doors and Out; Or, How We Farm, Mine, and Live Generally in the Golden State*. Farnham, New York, NY.

Farrington, Oliver Cummings
1903 *Gems and Gem Minerals*. A. M. Mumford, Chicago.

Fay, Albert H.
1920 A Glossary of the Mining and Mineral Industry. *Bulletin 95.* U.S. Department of the Interior, Bureau of Mines, Washington, DC.

Felton, David L., Bonnie S. Porter, and Phillip W. Hines
1979 *Survey of Cultural Resources at Malakoff Diggins State Historic Park.* California Department of Parks and Recreation, Sacramento, CA.

Fenenga, Franklin
1947 Artifacts from Excavation of Sutter's Sawmill. *California Historical Society Quarterly* 26(2):160–162.

Fernandez, Trish
2001 *Mexican Miners in the California Gold Rush: A Historical and Archaeological Study*. Master's thesis, Department of Anthropology, California State University, Sacramento.

Fetzer, Leland
2002 *A Good Camp: Gold Mines of Julian and the Cuyamacas*. Sunbelt Publications, San Diego, CA.

Fischer, Christiane
1996 Women in California in the Early 1850s. In *Women in the Life of Southern California, An Anthology Compiled from Southern California Quarterly* edited by Doyce B. Nunis, Jr., pp. 41-71. Historical Society of Southern California, Los Angeles.

1977 *Let Them Speak for Themselves: Women in the American West, 1849-1900.* Archon Books, Hamden, CT.

Fitting, James E, Julia Costello, and Harvy Crew (with contributions by others)
1979 *Cultural Resources Mitigation Program, New Melones Lake Project. Phase I Draft Report.* Sacramento District, U.S. Army Corps of Engineers, Sacramento, and the U.S. Bureau of Reclamation, Sacramento.

Flanders, Mary Powell
1983 From Wales to Manzanita Hill: Eleven Boats, A Wagon and A Mule. *The Californians* 1:35–40.

Forestell, Nancy
1999 The Miner's Wife: Working-Class Femininity in a Masculine Context, 1920-1950. In *Gendered Pasts: Historical Essays in Femininity and Masculinity in Canada*, Kathryn McPherson, Cecilia Morgan, and Nancy Forestell, editors, pp. 139-157. Don Mills, Ontario.

1994 All that Glitters is not Gold: The Gendered Dimensions of Work, Family, and Community Life in the Northern Ontario Goldmining Town of Timmins, 1909-1950. DAI 55(3):700-A.

Fracchia, Charles A.
1969 The Founding of the San Francisco Mining Exchange. *California Historical Society Quarterly* 48(4):3-18.

Francaviglia, Richard V.
1991 *Hard Places*: *Reading the Landscape of America's Historic Mining Districts.* University of Iowa Press, IA.

Francis, Jessie Davis.
1935 The Golden Magnet. *Pony Express Courier* 1:18, 20. Placerville, CA.

Friggens, Paul
1978 The Curious 'Cousin Jacks': Cornish Miners in the American West. *American West* 15(6):4–7,62–63.

Fuller, Willard P., and Julia G. Costello
1990a Madam Felix-Hodson District Gold Mines and Mills; HAER No. CA-76-A. Historic American Engineering Record, National Park Service, Washington, DC.

1990b Royal Consolidated Gold Mines and Mills, HAER No. CA-81. Historic American Engineering Record, National Park Service, Washington, DC.

1990c Mountain King Gold Mine and Mill, HAER NO. CA-77. Historic American Engineering Record, National Park Service, Washington, DC.

Fuller, Willard P., Judith Marvin, and Julia G. Costello
1996 *Madam Felix's Gold: The Story of the Madam Felix Mining District, Calaveras County, California*. Calaveras County Historical Society, San Andreas, CA, and Foothill Resources, Ltd., Mokelumne Hill, CA.

Fuller, Willard, Judith Cunningham, and Julia Costello
1990 Carson Hill and Its Gold Quartz Mills. *Las Calaveras* 29:25-35.

Gamboa, Erasmo
1990 The Mexican Mule Pack System of Transportation in the Pacific Northwest and British Columbia. *Journal of the West* 29(1):16–27.

Gard, Frances.
1961 Early Days at Rich Bar. *Butte County Historical Society Diggin's* 5:18-20

Garrett, Donald E.
1998 *Borates: Handbook of Deposits, Processing, Properties, and Use*. Academic Press, St. Louis, MO.

Gay, T. E. Jr., and L. A. Wright
1954 Geology of the Talc City Area, Inyo County. *California Division of Mines Bulletin* 170: Map Sheet 12. San Francisco, CA.

Gay, Theressa
1935 The Date of Discovery of Gold in California. *Grizzly Bear* 56:1. Los Angeles, CA.

Gernes, Phyllis, editor
1982 *Daily Journal 1852-1860 of Stephen Wing*. Physllis Gernes, Garden Valley, CA

Gibson, Erica, Jack McIlroy, and Elaine-Maryse Solari
1995 How-to Manual for the Cypress Freeway Project. Anthropological Studies Center, Sonoma State University, Rohnert Park, CA.

Giesen, Carol A. B.
1995 *Coal Miner's Wives: Portraits of Endurance*. University Press of Kentucky, Lesington, KY.

Giffen, Guy J.
1948 California Gold. *Quarterly of the Historical Society of Southern California* 30:23.

Gillis, Michael J.
1995 The Changing World of the Sacramento Valley During the 19th Century. *Wagon Wheels* 45:7-17.

Goodman, David
2001 Gold Rush! California's Untold Stories. *Journal of American History* 88:1221-1222.

Gordon, Robert B., and Patrick M. Malone
1994 *The Texture of Industry: An Archaeological View of the Industrialization of North America*. Oxford University Press, New York, NY.

Gorman, George C.
1928 Pioneer Days in California. *Society of California Pioneers Quarterly* 5:116-137.

Goss, Helen Rocca.
1961 The Golden Rock Water Ditch. *Historical Society of Southern California Quarterly* 63: 69-84.

Gould, Barney.
1949 In the Days of Forty Nine. *Pony Express* 15:3, 11.

Gray, Clifton H., Jr.
1957 Tin. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 641-646. Division of Mines, San Francisco, CA.

Greenwood, Roberta S.
1982 Data Recovery form Historical Sites: Final Report of the New Melones Archaeological Project, Volume V. Report prepared for the National Park Service, Washington, DC., from Infotec Research, Sonora, CA. Reprinted 1987 by Coyote Press, Salinas, CA.

1993 Old Approaches and New Directions: Implications for Future Research. In: *Hidden Heritage, Historical Archaeology of the Overseas Chinese*, Priscilla Wegars, editor, pp. 375–403. Baywood Publishing, Amityville, NY.

Greenwood, Roberta S., and Lawrence H. Shoup
1983 Review and Synthesis of Research as Historical Sites: Final Report of the New Melones Archaeological Project, Volume 7. Report prepared for the National Park Service, Washington, DC., from Infotec Research, Sonora, CA, and Greenwood and Associates, Pacific Palisades, CA. Reprinted 1987 by Coyote Press, Salinas, CA.

Grider, J. B.
1957 Gold Mining From Scott Bar to Happy Camp. *Siskiyou Pioneer* 2(10):27-35.

Griswold, Robert C.
1980 Apart But Not Adrift: Wives, Divorce, and Independence in California, 1850–1890. *Pacific Historical Review* 49(2):265–283.

*Grizzly Bear*
1930 Gold Discovery Site Marker. *Grizzly Bear* 46(March):10. Los Angeles, CA. (Native Sons of the Golden West Newsletter).

1944 Onions and Gold. *Grizzly Bear* 72:10. Los Angeles, CA. (Native Sons of the Golden West Newsletter).

Gudde, Erwin G.
1959 Vizetelly Hoax. *Pacific Historical Review* 28:233-236.

1975 *California Gold Camps.* University of California Press, Berkeley, CA.

Guinn, J. M.
1893 Early Gold Discoveries in Southern California: Where, When, and By Whom Was Gold First Discovered in California? *Publications of the Historical of Southern California* 3:10-16.

1895 Date of the First Discovery of Gold in California. *Publications of the Historical Society of Southern California* 3:59.

1896 Gold Placers of Los Angeles. *Land of Sunshine* 5: 60-63, Charles F. Lummis, editor.

1897 Some Famous Gold Rushes. *Publications of the Historical Society of Southern California* 4:124-130.

1903a In the Days of '49. *Annual Publication of the Historical Society of Southern California* 6:71-77.

1903b The Myth of Gold Lake. *Annual Publication of the Historical Society of Southern California* 6:82-86.

Hadley, J. B.
1942 Manganese Deposits of the Paymaster Mining District, Imperial County, California. *U.S. Geological Survey Bulletin* 931-S:459-473.

Haine, J. J. F.
1959 A Belgian in the Gold Rush: California Indians. Translated with an introduction by Jan Albert Goris. *California Historical Society Quarterly* 38 (2):141–155.

Hale, Duane
1979 California's First Mining Frontier and Its Influence on the Settlement of That Area. *Journal of the West* 18(1):14–21.

Hall, Sharon M.
1908 In the Land of the 'Forty-Niners. *Out West* 29:397-417.

1909a In the Land of the 'Forty-Niners. *Out West* 30:2-41.

1909b In the Land of the 'Forty-Niners. *Out West* 30:111-129.

Hamlin, H. S.
1948 History of Gold Discoveries. *Pony Express* 14(8):3-13. Placerville, CA

1955 Where Is the Mother Lode? *Pony Express* 22(3):7-10,12. Sonora, CA.

1957 Breyfogle's Lost Map to Gold Mine. *Pony Express* 23(10):1, 3-8. Sonora, CA.

Hamlin, H. S. (editor)
1937a A Dance in the Mines. *Pony Express Courier* 4(5):1. Placerville, CA

1937b On To the Gold Fields. *Pony Express Courier* 4(2):1. Placerville, CA.

1938 The Miner's Ten Commandments. *Pony Express Courier* 4(9):15. Placerville, CA.

1939 Bigler Records the Discovery of Gold. *Pony Express Courier* 5(11):1. Placerville, CA

1942 Composite Picture of Different Methods of Early Day Mining. *Pony Express Courier* 8(10):4. Placerville, CA

1949 Map of Gold Regions. *Pony Express* 15(9):3, 5, 8-9, 12. Placerville, CA.

1952 'The Niantic Hotel' on Sansome St. Beach in Days of '49. *The Pony Express* 18(9):6. Placerville, CA.

1956 More Gold Per Mile on the Middle Fork Than Any Other River in California. *Pony Express* 23(2):8. Sonora, CA.

1963 Mining Camps on the Middle Fork American River. *Pony Express* 30(2):8. Sonora, CA.

1968 The Chinese in California. *The Pony Express* 34(12):3-6. Sonora, CA.

Hanks, H. G.
1884 Silver in California. *California Mining Bureau Report* 14:361-368. Sacramento, CA.

Hardesty, Donald L.
1986 Industrial Archaeology on the American Mining Frontier: Suggestions for a Research Agenda. *New World Archaeology* 6(4):47–56.

1987 The Archaeological Significance of Mining Districts. In *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*, Jeff Buechler, editor, pp. 77–90. South Dakota State Historical Preservation Center, Vermillion.

1988 *The Archaeology of Mines and Mining: The View from the Silver State*. Special Publication Series, Number 6. Society for Historical Archaeology, Pleasant Hill, CA.

1990 Evaluating Site Significance in Historical Mining Districts. *Historical Archaeology* 24(2):42–51.

1992 The Miner's Domestic Household: Perspectives from the American West. In *Toward a Social History of Mining in the 19th and 20th Centuries,* edited by K. Tenfelde, Verlag C. H. Beck, pp 180-196.Beck, Munich.

1994 Class, Gender Strategies, and Material Culture in the Mining West. In *Those of Little Note: Gender, Race, and Class in Historical Archaeology*, edited by E. Scott, pp. 129-145. University of Arizona Press, Tucson.

1998a Gender and Archaeology on the Comstock. In *Women on the Comstock Lode*, edited by R. Raymond and R. James, pp. 283-302. University of Nevada Press, Reno.

1998b Power and the Mining Community in the American West. In *Social Approaches to an Industrial Past: The Archaeology and Anthropology of Mining*, A. Bernard Knapp, Vincent C. Pigott, and Eugenia W. Herbert, editors, pp. 81–96. Routledge, New York, NY.

2003 Issues in Preservation of Mining Landscapes. Paper presented at the 36th Annual Society for Historical Archaeology Conference on Historical and Underwater Archaeology, Providence, RI.

Hardesty, Donald, and Barbara Little
2000 *Assessing Site Significance: A Guide for Archaeologists and Historians*. Alta Mira Press, Walnut Creek, CA.

Hardeman, Nicholas P.
1981 Overland in Cargo Ships: The Inland Seaport of Stockton, California. *Journal of the West* 20(3):75–85.

Hargis, Donald E.
1955 Women's Rights: California 1849. *Historical Society of Southern California* 37(Dec):320–334.

Harris, Dennis E.
1984 The California Census of 1852: A Note of Caution and Encouragement. *The Pacific Historian* 28:58–64.

Hector, Susan M., William R. Manley, James D. Newland, and Stephen R. Van Wormer
1991 *The Archaeology of Oregon: Mining Activities in American Girl Canyon.* Report prepared for the American Girl Mining Joint Venture, Winterhaven, CA, from Regional Environmental Consultants (RECON), San Diego, CA.

Heizer, Robert F.
1947 Archaeological Investigation of Sutter Sawmill Site in 1947. *California Historical Society Quarterly* 26:134-159.

Hendry, Mike, Mary Luecke, and Jim Rock
1988 John Daggett and Salmon River Mining. *Siskiyou Pioneer* 7:156-167.

Henry, Oscar J.
1970 Early Days of Mining on the South Fork of Scott River. *Siskiyou Pioneer* 4(3):47-52, 77.

Hess, F. L.
1908 Manganese Deposits of California. *U.S. Geological Survey Bulletin* 355. Washington, DC.

Higgs, Robert
1979 The Wealth of Japanese Tenant Farmers in California, 1909. *Agricultural History* 53(2):488–495.

Hines, Elizabeth, and Michael S. Smith
2002 Gold Is Where You Find It: Placer Mining in North Carolina, 1799–1849. *Earth Science History* 21(2):119–149.

Hirata, Lucie Cheng
1979 Free, Indentured, Enslaved: Chinese Prostitution in Nineteenth-Century America. *Signs* 5(1):3-29.

Historic American Engineering Record (HAER)
2007 HAER documents for historic resources in the Copperopolis vicinity, Calaveras County, CA. <http://memory.loc.gov/ammem/collections/habs_haer/> (accessed 26 March 2007). Library of Congress, Washington, DC.

Hittell, John S.
1869a *The Resources of California Comprising Agriculture, Mining, Geography, Climate, &c., and the Past and Future Development of the State*, 5th edition. A. Roman and Company, San Francisco, CA.

1869b The Mining Excitements of California. *Overland Monthly* 2(5):413-417.

Hoeper, George
1995 The Fischer Family Calaveras Pioneers. *Las Calaveras* 42(2):15–19.

Hofer, E.
1926 Days of '49. *Overland Monthly and the Out West Magazine* 85:10-11.

Holliday, J. S.
1957 The Influence of the Family on the California Gold Rush. In *Proceedings of the 3rd Annual Meeting of the Conference of California Historical Societies, Held in San Diego*, 20-22 June 1957. Richard Coke Wood, editor, pp.157-169, University of the Pacific, Stockton, CA.

1981 *The World Rushed In: The California Gold Rush Experience*. Simon and Schuster, New York, NY.

1982 In the Diggings. *California History* 61:168-188.

1998 Reverberations of the California Gold Rush. *California History* 77(1):4–15.

1999 *Rush For Riches: Gold Fever and the Making of California.* University of California Press, Berkeley, CA.

Hovis, Logan, and Jeremy Mouat.
1996 Miners, Engineers, and the Transformation of Work in the Western Mining Industry, 1880-1930. *Technology and Culture* 37(3):429-456

Hunt, Rockwell D.
1911 California and Manifest Destiny. *Grizzly Bear* 8:2-3. Los Angeles, CA.

Huntley-Smith, Jen
2002 Water in Print: Nature and Artifice. *Agricultural History* 76(2):354–363.

Hurtado, Albert L.
1999a *Intimate Frontiers*: *Sex, Gender, and Culture in Old California*. University of New Mexico Press, Albuquerque, NM.

1999b Sex, Gender, Culture, and a Great Event: The California Gold Rush. *The Pacific Historical Review* 68(1):1-19.

1999c Interpreting California: The Art of History. *California History* 78(2):108-113.

2001 Settler Women and Frontier Women: The Unsettling Past of Western Women's History. *Frontiers: A Journal of Women Studies* 22(3):1-5.

Hutchings, James Mason
1965 Packing, in the Mountains of California. Roger R. Olmstead, editor. *American West* 2(3):92–95.

Hutchings, James Mason
2001 Mountain Scenery in California: From Hutchings' California Magazine, 1856. *Dogtown Territorial Quarterly* (45):51, 53–56, 58–60.

*Hutchings' Illustrated California Magazine*
1857-1860 Mining Gold in California. *Hutchings' Illustrated California Magazine* 2(September 1860); (November 1857); 5(September 1860).

Ingalls, Walter Renton
1897 Borax and Boracic Acid. In *The Mineral Industry: Its Statistics, Technology and Trade, in the United States and Other Countries to the End of 1896*, Volume V, Richard P. Rothwell, editor, pp. 57-62. The Scientific Publishing Company, New York, NY.

Inkersley, Arthur
1895 The Churches of Forty-Nine. *Overland Monthly, 2nd Series* 25:533–542.

Irelan, William, Jr.,
1888 *Eighth Annual Report of the [California] State Mineralogist*. California State Mining Bureau.

Isenberg, Andrew C.
2001 The California Gold Rush, the West, and the Nation. *Reviews in American History* 29(1):62-71

2005 *Mining California: An Ecological History*. Hill and Wang, New York, NY.

Jackson, W. Turrentine
1972 Wells Fargo's Pony Expresses. *Journal of the West* 11(3):405–436.

Jackson, W. Turrentine, and Stephen D. Mikesell
1979a *The Stanislaus River Drainage Basin and the New Melones Dam: Historical Evolution of Water Use Priorities*. Department of History, University of California, Davis.

1979b Mexican Melones. *Las Calaveras* [Quarterly Bulletin of the Calaveras County Historical Society] 28(1):1–15.

Jacobs, Gordon.
1957 Mines of the Henley-Hornbrook Area. *Siskiyou Pioneer* 2(10):48-51.

James, Ronald M., and C. Elizabeth Raymond (editors)
1997 *Comstock Women: The Making of a Mining Community*. University of Nevada Press, Reno, NV.

Jameson, Elizabeth
1984 Women as Workers, Women as Civilizers: True Womanhood in the American West. *Frontiers: A Journal of Women Studies* 7(3):1-8.

1988 Toward a Multicultural History of Women in the Western United States. *Signs* 13(4):761-791.

1996 Frontiers. *Frontiers: A Journal of Women Studies* 17(3):6-11.

Janicot, Michael
1990 The Weissbein Brothers of Grass Valley and San Francisco: Banking, Mining and Real Estate. *Western States Jewish History* 22(3):223–225.

Jeffrey, Julie Roy
1979 *Frontier Women*. Hill and Wang, New York, NY.

Jenkins, Olaf P.

1943 Manganese in California. *California Division of Mines Bulletin* 125:387. San Francisco, CA.

1948 Geologic Guidebook Along Highway 49—Sierran Gold Belt. *California Division of Mines Bulletin* 141. San Francisco, CA.

1949 Geologic Guidebook Along Highway 49 – Sierran Gold Belt: The Mother Lode. Country, Bulletin 141. California Division of Mines, San Francisco, CA.

1950 *Mineral Commodities of California: Geologic Occurrences, Economic Development, and Utilization of the State's Mineral Resources*. Bulletin No. 156. Division of Mines and Geology, Sacramento, CA.

1951 Minerals Useful to California Agriculture. *California Division of Mines Bulletin* 155:95. San Francisco, CA.

Jensen, Joan M.

1988 Passage from India: Asian Indian Immigrants in North America. Yale University, New Haven, CT.

Jensen, Joan M., and Darlis A. Miller

1980 The Gentle Tamers Revisited: New Approaches to the History of Women in the American West. *The Pacific Historical Review* 49(2):173-213.

Jenson, Paul M.

1980 *Diggin' Harrison Diggin's: Archaeological Excavations at an Historic Mining Camp in the Northern Sierra Nevadas*. Report prepared for the U.S. Forest Service, Plumas National Forest, Quincy, CA.

Johnson, George.

1945 Marshall and the Monument. *Pony Express* 11:3-4.

Johnson, J. J., and D. J. Theodoratus

1984a *Cottonwood Creek Project, Shasta and Tehama Counties, California: Dutch Gulch Lake Intensive Cultural Resources Survey*. Report for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA from Foundation of California State University (presently Archaeological Research Center), Sacramento, CA.

1984b *Cottonwood Creek Project, Shasta and Tehama Counties, California: Tehama Lake Intensive Cultural Resources Survey*. Report for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA from Foundation of California State University (presently Archaeological Research Center), Sacramento, CA.

Johnson, Kenneth M.

1978 Two Mines: Two Books. *Journal of the West* 17:27-38.

Johnson, Susan Lee
2000 *Roaring Camp: The Social World of the California Gold Rush.* W. W. Norton, New York, NY.

Johnston, Andrew
2004 Quicksilver Landscapes: The Mercury Mining Boom, Chinese Labor, and the California Constitution of 1879. *Journal of the West* 43(1):21–29.

Jones, William A.
1986 Yreka's Chinese and The Great Flood of '90. *The Californians* (Sept/Oct):31–35.

Jones, Olive and Catherine Sullivan
1989 *The Parks Canada Glass Glossary for the Description of Containers, Tableware, Flat Glass, and Closures.* National Historic Parks and Sites, Canadian Parks Service, Hull, Quebec.

Joslin, G. A.
1945 Gold. *California Division of Mines Bulletin* 130:122-151. San Francisco, CA.

JRP Historical Consulting Services (JRP) and California Department of Transportation (Caltrans)
2000 *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures*. JRP Historical Consulting Services, Davis, CA, and California Department of Transportation, Environmental Program/Cultural Studies Office, Sacramento.

Julian, R. W.
1997 A Gold Rush Legacy. *Coins* 44(4):34.

Jung, M. A.
1999 Capitalism Comes to the Diggings: From Gold Rush Adventure to Corporate Enterprise. In *A Golden State: Mining and Economic Development in Gold Rush California*, James J. Rawls and Richard J. Orsi, editors, pp. 52–77. University of California Press, Berkeley.

Kahn, Edgar M.
1969 Pioneer Jewish San Francisco Stock Brokers. *Western States Jewish History* 1(2).

Kallenberger, W. W.
1954 The French in Nevada County's Early History. *Nevada County Historical Society Quarterly* 8:1–3.

Kasper, Sydney H.
1982 You Can Still Strike It Rich in the Gold Country. *Early American Life* 13(1):72-73, 88-90.

Kelley, Margaret A.
1935 The Sutter-Marshall Mill, and What Became of It. *Pony Express Courier* 1:3, 6.

Kelley, Robert L.
1954 The Hydraulic Gold Mining Industry in California. *Pacific Historical Review* 23:343-356.

1956 The Mining Debris Controversy in the Sacramento Valley. *Pacific Historical Review* 25:331-346

1959 *Gold vs. Grain: The Hydraulic Mining Controversy in California's Sacramento Valley*. Arthur H. Clark Co, Glendale, CA.

Kelly, Roger E., and Marsha C.C. Kelly
1983 Arrastras: Unique Western Historic Milling Sites. *Historical* Archaeology 17(1):85-95.

Kenn, Charles.
1965 A Visit to California Gold Fields. *Hawaiian Historical Society Annual Report* 7-16.

Kennedy Mine and Milling Company
Var. Kennedy Mine and Milling Company Records. On file Amador County Archives, Jackson, CA.

Kenny, William R.
1967 Mexican-American Conflict on the Mining Frontier, 1848–1852. *Journal of the West* 6(4):382–592.

1973 Nativism in the Southern Mining Region of California. *Journal of the West* 12(1):126–138.

Kerr, Thomas
1928a An Irishman in the Gold Rush: The Journal of Thomas Kerr. Edited by Charles L. Camp. *Quarterly of the California Historical Society*, 7(3):203227.

1928b An Irishman in the Gold Rush: The Journal of Thomas Kerr (continued). Edited by Charles L. Camp. *Quarterly of the California Historical Society,* 7(4):395–404.

1929a An Irishman in the Gold Rush: The Journal of Thomas Kerr (continued). Edited by Charles L. Camp. *Quarterly of the California Historical Society,* 8(1):17–25.

1929b An Irishman in the Gold Rush: The Journal of Thomas Kerr (continued). Edited by Charles L. Camp. *Quarterly of the California Historical Society,* 8(2):167–182.

Kett, William F.
1947 Fifty Years of Operation by the Mountain Copper Company, Ltd. In Shasta County, California. *California Journal of Mines and Geology* 43:105-162.

Kiester, E.
1999 Turning Water to Gold. *Smithsonian* 30:18.

Kinkel, A. R.
1951 Geology of the Massive Sulfide Deposits at Iron Mountain, Shasta County, California. *California Division of Mines Special Report* 14:19. San Francisco, CA.

Knapp, A. Bernard, Vincent C. Pigott, and Eugenia W. Herbert
1998 *Social Approaches to an Industrial Past: the Archaeology and Anthropology of Mining.* Routledge, London, England.

Knopf, A.
1918a A Geologic Reconnaissance of the Inyo Range and the Eastern Slope of the Sierra Nevada, California. *U.S. Geological Survey Professional Paper* 110:106-118.

1918b Strontianite Deposit Near Barstow, California. U.S. *Geological Survey Bulletin* 660:257-270.

1929 The Mother Lode System of California. U.S. Geological Survey *Professional Paper 157*.

Knowland, Joseph R.
1947 California Gold Discovery: Centennial Papers on the Time, Site, and Artifacts. *California Historical Society Quarterly* 26:107-108.

Kowalewski, Michael (editor)
1997 *The Gold Rush: A Literary Exploration.* Heyday Books, Berkeley, CA.

2002 Romancing the Gold Rush: The Literature of the California Frontier. *California History* 79(2):204-225.

Kraft, Jarith A.
1998 Gold Miners Living on the Fringes: A Historical Ethnographic Study, Butte County, California. Master's thesis, Anthropology Department, California State University, Chico.

Krauskopf, K. B.
1953 Tungsten Deposits of Madera, Fresno, and Tulare Counties, California. *California Division of Mines Special Report* 35:83. San Francisco, CA.

Kundert, Charles J.
1957 Barite. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 71-74. Division of Mines, San Francisco, CA.

LaLande, Jeffrey M.
1983 Hydraulic Mining Techniques of the Chinese in Southwestern Oregon: A case of Technological Acculturation. Paper presented at the 16th Annual Meeting of the Society for Historical Archaeology, Denver.

1985 Sojourners in Search of Gold: Hydraulic Mining Techniques of the Chinese on the Oregon Frontier. *Industrial Archaeology* 2(1):29–52.

Lamar, R. S.
1952 California Talc in the Paint Industry. *California Journal of Mines and Geology* 48:189-199.

Lamson, Bereniece
1978 The Frenchmen's Dream. *The Pacific Historian* 22(Fall):254–261.

Lane, Eric
1940 Soap in California History. *California History Nugget* 7(March):179–186.

Lapp, Rudolph M.
1966 Negro Rights Activities in Gold Rush California. *California Historical Society Quarterly* 45(1):3–20.

Lawrence, Susan
1998 Gender and Community Structure on Australian Colonial Goldfields. In *Social Approaches to an Industrial Past: The Archaeology and Anthropology of Mining*, A. Bernard Knapp, Vincent C. Pigott, and Eugenia W. Herbert, editors, pp. 39-58. Routledge, New York, NY.

Leeper, David Rohrer
1894 The Argonauts of 'Forty-Nine, Some Recollections of the Plains and the Diggings, J.B. Stoll & Company, South Bend, IN. Available online http://memory.loc.gov/ammem/cbhtml/ Accessed May 2008.

Lenhoff, James.
1998 Sesquicentennial Recalls Nugget That Changed History. *Butte County Historical Society Diggin's* 42(1):3.

Lennon, J. W.
1955 Investigation of California Talc Use in Wall Tile. *American Ceramic Society Journal* 38 (11):418-422.

Lets Go See It.com
2002-2007 Old Harmony Borax Works. http://www.letsgoseeit.com/index/county/inyo/death_valley/loc04/harmony.htm. Accessed January 2008.

Levinson, Robert E.
1971 The History of the Jews of Grass Valley, Nevada City and Vicinity. *Nevada County Historical Society* 25(July):1–8.

Levy, Jo Ann
1988 We Were Forty-Niners Too! Women in the California Gold Rush. *Overland Journal* 6(3):29–34.

1992 *They Saw The Elephant: Women in the California Gold Rush*. University of Oklahoma Press, Norman, OK.

Limbaugh, Ronald H.
1971 Secret Ravine: The Rise & Fall of a Gold Mine. *Pacific Historian* 15:53-70.

1993 The Chinese of Knight's Ferry, 1850-1920: A Preliminary Study. *California History* 72 (2):106-128.

1998 Making Old Tools Work Better: Pragmatic Adaptation and Innovation in the Gold-Rush. *California History* 77(4):24-51.

1999 Making Old Tools Work Better: Pragmatic Adaptation and Innovation in Gold-Rush Technology. In *A Golden State: Mining and Economic Development in Gold Rush California*, James J. Rawls and Richard J. Orsi, editors, pp. 24–51. University of California Press, Berkeley.

Limbaugh, Ronald H., and Willard P. Fuller
2004 *Calaveras Gold: The Impact of Mining on a Mother Lode County*. University of Nevada Press, Reno, NV.

Limerick, Patricia Nelson
1998 The Gold Rush and the Shaping of the American West. *California History* 77(1):30–41.

Lindenmeyer, Kriste (editor)
2000 *The Human Tradition, Ordinary Women, Extraordinary Lives: Women in American History*. Rowman & Littlefield, Maryland.

Lindstrőm, Susan
1988 A Comparative Evaluation of the Natomas Ground Sluice Diggings, Folsom, California, Sacramento County. Report prepared for Environmental Impact Professionals, Sacramento, CA

1989 A Cultural Resource Evaluation of Lands Within Aerojet General Corporation, Sacramento Plant, Sacramento County. Report prepared for Aerojet General Corporation, Sacramento, CA.

Lindstrőm, Susan, with a contribution by John Wells
1990 A Historic Sites Archaeological Survey of the Main Hydraulic Pit Basin, Malakoff Diggins State Historic Park, North Bloomfield, Nevada County, California. University of California, Department of Anthropology. Prepared for California Department of Parks and Recreation, Sacramento.

Lindström, Susan, John Wells, and Norman Wilson
2000 Chasing your Tailings: A Review of Placer Mining Technology. *Proceedings of the Society for California Archaeology*(13):59-83.

Lingenfelter, Richard E.
1974 *The Hardrock Miners*: *A History of the Mining Labor Movement in the American West, 1863-1893.* University of California Press, Berkeley, CA.

Liss, Jennifer
2001 Your town: Behold the View. *California History* 80(4):176–187.

Little, Barbara
1992 *Text Aided Archaeology*. CRC Press, Boca Raton, FL.

Little, Barbara, and Erika Martin Seibert, with Jan Townsend, John Sprinkle, and John Knoerl, Jr.
2000 *Guidelines for Evaluating and Registering Archaeological Properties.* National Register Bulletin 36. U.S. Department of the Interior, National Park Service, Washington, DC.

Littlefield, Douglas R.
1983 Water Rights During the California Gold Rush: Conflicts Over Economic Points of View. *Western Historical Society Quarterly* 14(4):415–434.

Logan, C. A.
1981 History of Mining and Milling Methods in California. *California Geology* 34(9):193-196.

Lopez, Carlos U.
1988 The Chilenos in the California Gold Rush. *The Californians* 6:28–33.

Lorenz, Anthony J.
1957 Scurvy in the Gold Rush. *Journal of the History of Medicine and Allied Sciences* 12(4):473–510.

Lott, Charles F.
1900 As It Was in '49. *Overland Monthly*, second series 36 (213) (September 1900):225-230.

1968 As It Was in '49. Reprint. Butte County Historical Society Diggin's 12(Fall):3-13.

Lowell, Waverly B.
1989 Where Have All the Flowers Gone? Early Environmental Litigation. *Prologue* 21(3):247–255.

Lummis, Charles F.
1900 The Days of 'Forty-Niners. 13:271-276.

Lummis, Charles F. (editor)
1900 California in 1849: Some Typical Incidents and Pictures. *Land of Sunshine* 13:167-173.

Lydon, Philip A.
1957 Sulfur and Sulfuric Acid. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 613-622. Division of Mines, San Francisco, CA.

Lyman, Chester Smith
1934 Conditions in California in 1848. *California Historical Society Quarterly* 13:176-179.

Lynch, Edward J.
1946 Let's Begin to Plan. *Grizzly Bear* 76:7. Los Angeles, CA.

Lynton, E. D.
1938 Sulphur Deposits of Inyo County, California. *California Division of Mines Report* 34:563-590. San Francisco, CA.

MacKevett, E. M.
1953 Geology of the Santa Rosa Lead Mine, Inyo County, California. *Division of Mines Special Report* 34:9. San Francisco, CA.

Maniery, Mary L., and Jody L. Brown
1994 *National Register Evaluation of CA-SAC-344/H: A Multicomponent Site Near Folsom, Sacramento County, California.* Draft Report. Report prepared for Elliott Homes, Folsom, CA, from PAR Environmental Services, Sacramento, CA.

Mann, Ralph
1972 The Decade after the Gold Rush: Social Structure in Grass Valley and Nevada City, California, 1850-1860. *The Pacific Historical Review* 41(4):484-504.

1982 *After the Gold Rush: Society in Grass Valley and Nevada City, California, 1849-1870.* Stanford University Press, Stanford, CA.

Marleau, Michael H.
1969 Mining in the Sky. *The Pacific Historian* 13(1):54–57. Stockton, CA.

Martin, Patrick
1987 The Historical Archaeologist’s Perspective. In *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*, Jeff Buechler, editor, pp. 91–106. South Dakota State Historical Preservation Center, Vermillion.

Marvin, A. S.
1899 California in '49. *Overland Monthly*, second series 34:329-333.

Marvin, Judith
2005 Field notes from survey of sites along the Calaveras River. Foothill Resources, Murphys, CA.

Maurer, R. B., and R. E. Wallace
1953 Gold, Silver, Copper, Lead and Zinc Production in California in 1952: *U.S. Bureau of Mines Annual Area Report C-7*:6.

May, Phillip Ross
1970 *The Origins of Hydraulic Mining in California.* Holmes Book Company, Los Angeles, CA.

McAdams, C. Michael
1977 The Croatians of California and Nevada. *The Pacific Historian* 21(4):333–350.

McCone, Michael (editor)
2002 California’s Vanishing Landscape: Nineteenth-Century Images from the Collection of the California Historical Society. *California History* 61(2):178–191.

McDowell, A. G.
2002 From Commons to Claims: Property Rights in the California Gold Rush. *Yale Journal of Law & the Humanities* 14(1):1–72.

McGie, J. F.
1956 *History of Butte County*. Two volumes. Butte County Board of Education, Oroville, CA.

McGinty, Brian
1978 The Green & the Gold. *American West* 15:18-21, 65-69.

McGrath, Roger D.
2003 A Violent Birth: Disorder, Crime, and Law Enforcement, 1849–1890. *California History* 81(3/4):27–73.

McIlroy, Jack and Mary Praetzellis
1997 Vanished Community—19th Century San Francisco Neighborhoods: From Fourth Street to Mission Creek and Beyond, Archaeological Research Design and Treatment Plan for the SF-80 Bayshore Viaduct Seismic Retrofit Projects. Sonoma State University, Anthropological Studies Center, Rohnert Park, CA. Prepared for California Department of Transportation, Oakland, CA.

McIntosh Robert
2000 *Boys in the Pits: Child Labour in Coal Mines*. McGill-Queen's University Press, Montreal.

McKanna, Jr., Clare V.
2004 Enclaves of Violence in Nineteenth-Century California. *Pacific Historical Review* 73(3):391–423.

McNeil, Samuel
1849 McNeil's travels in 1849, to, through, and from the gold regions in California. Online at California As I Saw It: First-Person Narratives of California's Early Years, 1849-1900 http://memory.loc.gov/ammem/cbhtml. Accessed June 2008.

McNeill, Jim.
1983 The Saga of the Salmon River Lifting Rock. *Siskiyou Pioneer* 5(6):1-6. Yreka, CA.

Meals, Hank
1994 Cultural Resource Inventory and Site Evaluations for the South Yuba Trail, Nevada County, California, Nevada City Ranger District, Tahoe National Forest. Report prepared for the U.S. Forest Service, Tahoe National Forest, Nevada City, CA.

Medin, Anmarie
2002 Chapter 7: Cooking Features. In *Excavation of the Woolen Mills Chinatown (CA-SCL-807H), San Jose. Vol. 1*, Rebecca allen and r. Scott Baxter, editors, pp. 105-120. Report prepared for the California Department of Transportation, District 4, Oakland, from Past Forward, Richmond, CA.

Mercier, Laurie
2001 Reworking Race, Class, and Gender into Pacific Northwest History. *Frontiers* 22(3):61-74.

Merithew, Caroline Waldron
2006 "We Were Not Ladies" Gender, Class, and Women's Auxiliary's Battle for Mining Unionism. *Journal of Women's History* 18(2):63-94.

Metcalfe, George, M. J. Lowry, and J. A. Bauer
1921 A Memorial For A Blue-Collar, Bavarian-Born, San Francisco Forty-Niner. *Western States Jewish Historical Quarterly* 14(1):42–44.

Meyer, Michael D., Erica Gibson, and Julia Costello
2005 City of Angels, City of Sin: Archaeology of the Los Angeles Red Light District ca. 1900. *Historical Archaeology* 39(1):107-125.

Miller, George
2000 Classification and Economic Scaling of 19th Century Ceramics. In *Approaches to Material Culture Research for Historical Archaeologists*, compiled by David R. Brauner, pp. 3-58. The Society for Historical Archaeology, Rockville, MD.

Miller, David B.
1987 Preservation of the Cultural Resources Related to the History of Mining in the Black Hills—The Historian's View. In *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*, edited by Jeff Buechler, pp. 25-44. South Dakota State Historical Preservation Center, Vermillion.

Miller Jr., Charles Wallace
1998 *The Automobile Gold Rushes and Depression Era Mining.* University of Idaho Press, Moscow.

Mitchell, Martin D.
1994 Land and Water Policies in the Sacramento-San Joaquin Delta. *Geographical Review* 84(4):411–423.

Mix, Steven Russell
1999 History of Laundry Farm Canyon. Oakland, CA. <http://pages.prodigy.net/stevenmix/laundry.htm>. Accessed 2007.

Moore, Marat
1996 Women in the Mines: Stories of Life and Work. Twayne Publishers, New York, NY.

Moratto, Michael J.
1984 *California Archaeology*. Academic Press, Orlando, FL.

Moratto, Michael J., Judith D. Tordoff, and Laurence H. Shoup
1988 Culture Change in the Central Sierra Nevada, 8000 B.C.–A.D. 1950. Final Report of the New Melones Archeological Project, Volume 9. Report submitted to National Park Service, Washington, DC.

Morefield, Richard Henry
1956 Mexicans in the California Mines, 1848–1853. *California Historical Society Quarterly* 35(1):37–46.

Morehouse, Bert
1945 Pegleg - Famous Ghost Mine. *Pony Express* 11(12):9- 10. Placerville, CA.

Morgan, Dale L.
1959 The Ferries of the Forty-Niners. *Annals of Wyoming* 31:5–31.

Mount Diablo Interpretive Association
2007 *Geology of Mt. Diablo, Mount Diablo Mining History*. Mount Diablo Interpretive Association, Walnut Creek, CA.

Moynihan, Ruth Barnes, Susan Armitage, and Christine Fischer Dichamp
1998 *So Much to be Done: Women Settlers on the Mining and Ranching Frontier*. University of Nebraska Press, Lincoln, NE.

Muir, John
1992 *The Eight Wilderness Discovery Books*. The Mountaineers Books, Seattle, WA.

Mumma, Phil
1998 The National Gold Rush Symposium of the Oakland Museum of California. *California History* 77(1):2.

Murphy, Mary
1997 *Mining Cultures: Men, Women, and Leisure in Butte, 1912-41*. University of Illinois, Butte, MT.

Nadeau, Remi
1992 *Ghost Towns & Mining Camps of California: A History and Guide,* 4th Edition. Crest Publishing, Santa Barbara, CA.

Naftzger, Roy E.
1950 Early California Gold. *Historical Society of Southern California Quarterly* 32:309-315.

National Archives and Record Administration (NARA)
1916 *Keating-Owen Child Labor Act of 1916.* U.S. National Archives & Records Administration, Washington DC. <http://www.ourdocuments.gov/doc.php?doc=59>.Retrieved 2007.

National Park Service (NPS)
1934 *Death Valley National Monument, California.* United States Government Printing Office, Washington. <www.usgennet.org/usa/ca/state1/dvalley>. Accessed February 2008.

1983 *Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines [as amended and annotated]*. National Park Service, Washington DC. <http://www.cr.nps.gov/local-law/Arch_Standards/htm>

1991 *How to Apply the National Register Criteria for Evaluation.* National Register Bulletin 15. National Park Service, Washington, DC.

1996 *History in the National Park Service: Themes and Concepts*. National Park Service, Washington, DC. <http://www.cr.nps.gov/history/hisnps/NPSThinking/revthem.htm>.

1998 *Draft Environmental Impact Statement and General Plan for Death Valley National Park.* National Park Service, Washington, DC. <http://www.nps.gov/archive/moja/devaplan/affcult.htm>. Last accessed February 2008.

2004 A History of Chinese Americans in California: The 1860s. National Park Service, Washington, DC. http://www.nps.gov/history/history/online_books/5views/5views3c.htm. Accessed June 2008.

Neasham, Aubrey
1947 Sutter's Sawmill. *California Historical Society Quarterly* 26:109-133.

Nestor, Sandy
2007 *Silver and Gold Mining Camps of the Old West: A State by State American Encyclopedia.* McFarland and Company, Jefferson, NC.

Newland, Mike, Margaret J. Markwyn, and Robert G. Douglass
2006 *Spring Valley Gulch Placer Mining Complex (CA-BUT-1872/H):Site Technical Report, Forks of the Feather River Historic District Evaluation, Oroville Facilities Relicensing FERC Project No. 2100*. Draft Report. Report prepared for the Department of Water Resources, Sacramento, CA, from Anthropological Studies Center, Sonoma State University, Rohnert Park, CA.

Noble, Bruce J., Jr., and Robert Spude
1997 *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties*, revised from 1992 edition. National Register Bulletin 42. National Park Service, Washington, DC.

Noble, Johnny
1947 Sutter Mill Timbers Found. *Grizzly Bear* 78:7, 18. Los Angeles, CA.

Norman, L. A.
1951 Mines and Mineral Resources in Inyo County. *California Journal of Mines and Geology* 47: 17-223.

Norman, L.A. and R.M. Stewart
1951 Mines and Mineral Resources of Inyo County, California. *Journal of Mines and Geology*, vol. 4:17-223.

Norris, Randall, and Jean-Philippe Cypress
1996 *Women of Coal*. University Press of Kentucky, Lexington, KY.

Norris, R. M., and R. W. Webb
1976 *Geology of California*. John Wiley and Sons, New York, NY.

Novkov, Julia
2000 Historicizing the Figure of the Child in Legal Discourse: The Battle over the Regulation of Child Labor. *The American Journal of Legal History* 44(4):369-404.

O'Brian, J. C.
1957 Zinc. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 699-706. Division of Mines, San Francisco, CA.

Odall, R. P.
1972 Life In The Diggin's. *Chispa* 12:410–412

1973 Life In The Diggin's. *Chispa* 12:421–425.

Office of Historic Preservation
1988 Five Views: An Ethnic Historic Site Survey for California. California Department of Parks and Recreation, Office of Historic Preservation, Sacramento, CA.

2001 *Instructions for Nominating Historical Resources to the California Register of Historical Resources.* Office of Historic Preservation, Sacramento, CA.

Ogden, Annegret
1985a 'Go West, Young Woman!' Part I. *The Californians* 3:6–7.

1985b 'Go West, Young Woman!' Part II. *The Californians* 3:6, 51.

1986 The Frontier Housewife: Stereotype vs. Reality. *The Californians* 4:8–13.

1993 From All Parts of the World to Form a New Society in California: The Voice of Professor Julius Froebel, Journalist, Political Scientist, and Mineralogist. *The Californians* 10:6–7, 42–46

1898 Old Gold Days: The Discovery of Gold. *Land of Sunshine* 8:79- 81, Charles F. Lummis, editor.

O'Neill, Stewart James
1974 *History of the California Mining Industry 1866-1883.* Master's Thesis, Department of History, California State University Sacramento, CA.

Osborne, Lewis, pub.
1968 *The Discovery of Gold in California.* Palo Alto, California.

Otterstrom, Samuel M.
2003 The Influences of Transportation and Geography on the Settlement and Development of Lake County, California. *Journal of the West* 42(2):34–44.

*Pacific Historian*
1983 Mining and Water. *Pacific Historian* 27:36-41. Stockton, CA.

Page, L. R., and T. P Thayer
1945 Temescal Tin District, Riverside County. U.S. Geological Survey unpublished report. On File at California Division of Mines Library.

Palais, Hyman
1946 Some Aspects of the Black Hills Gold Rush Compared with the California Gold Rush. *Pacific Historical Review* 15:59-67.

Palazzo, Robert
1996 *Darwin, California*. Western Places, Lake Grove, OR.

Palmer, Lex
1991 Metal mining on California's National Forests: a Portrait of Societal Demands, Technology, and Multiple Use from Prehistoric Times to World War II. Unpublished draft supplied by author; 195 p.

Palmquist, Peter
1986 Silver Plates Among the Goldfields: The Photographers of Siskiyou County, 1850–1906. *California History* 65(2):114–125.

Paquette, Mary G.
1978 The French in the Mother Lode. *Chispa* 18:601–604.

Partridge, J. F.
1954 Tungsten Resources of California. *California Division of Mines Special Report* 37:225-326. San Francisco, CA.

Patera, Alan H.
1999a The California Gold Rush of 1849, as Reported in the Alta California. *Western Express* 49(1):3.

1999b The California Gold Rush of 1849, as Reported in the Alta California and the Sacramento Times. *Western Express* 49(3):5.

1999c The California Gold Rush of 1849. *Western Express* 49(4):5.

2000a The California Gold Rush. *Western Express* 50:1(2000):5; 50:2(2000):4

2000b The California Gold Rush: A Sesquicentennial Tribute. *Western Express* 50(3):3.

2000c California Gold Rush Letters. *Western Express* 50(3):7.

Paul, Rodman W.
1947 *California Gold: The Beginning of Mining in the Far West.* University of Nebraska Press, Lincoln, NE.

1963 *Mining Frontiers of the Far West*. Holt, Rinehart and Winston, New York, NY.

1964 Mining Frontiers as a Measure of Western Historical Writing. *Pacific Historical Review* 33:25-34.

1982 After the Gold Rush: San Francisco and Portland**.** *The Pacific Historical Review* 51(1):1-21.

Pearson, David W.
1996 *This Was Mining in the West*. Schiffer Publishing, Atglen, PA.

Peele, Robert
1941 *Mining Engineers' Handbook*, 3rd edition. John Wiley & Sons, New York, NY.

Perry, Frank A., Robert W. Piwarzyk, Michael D. Luther, Alverda Orlando, Allan Molho, and Sierra L. Perry
2007 *Lime Kiln Legacies*. The Museum of Art and History at the McPherson Center, Santa Cruz, CA

Perry, J. B., and G. M. Kirwan
1942 The Bald Eagle Magnesite Mine, California. *American Institute of Minerals, Metals, Engineering and Transportation* Volume 148:35-50.

Peters, Charles
2001 The Good Luck Era: The Placer Mining Days in California in the 1850s. *Western States Jewish History* 33(3):220–226.

Peterson, H. C.
1938 The Terrors and Tragedies of the Winter of Forty-Nine. *Pony Express Courier* 4(8):13-14. Placerville, CA.

Peterson, Richard H.
1974 The Failure to Reclaim: California State Swampland Policy and the Sacramento Valley, 1850–1866. *Southern California Quarterly* 56(1):45–60.

1976 The Foreign Miners' Tax of 1850 and Mexicans in California: Exploitation or Expulsion? *The Pacific Historian* 20(3):265–272.

1980 Anti-Mexican Nativism in California, 1848–1853: A Study of Cultural Conflict. *Southern California Quarterly* 62(4):309–327.

1985 The Mexican Gold Rush: 'Illegal Aliens' of the 1850s. *The Californians* 3:19-23.

1994 Thomas Starr King's California. *True West* 41:42. Cave Creek, AZ.

1997 Gold! The Rush for California's Riches. *Wild West* 10(4):50.

Petrik, Paula
1985 The Gentle Tamers in Transition: Women in the Trans-Mississippi West. *Feminist Studies* 11(3):677-694.

1872 Pioneer Days of California. *Overland Monthly* 8:457-462.

Pisani, Donald J.
1991 The Origins of Western Water Law: Case Studies from Two California Mining Districts. *California History* 60(3):242–258.

1996 *Water, Land, and Law in the West: the Limits of Public Policy, 1850–1920*. University Press of Kansas, Lawrence.

Piwarzyk, Robert W.
1996 Lime Production in Santa Cruz County, Historical Background. Santa Cruz Public Library, Santa Cruz, CA. <http://www.santacruzpl.org/history/work/limepro.shtml>. last accessed February 2008.

Praetzellis, Adrian, Mark D. Selverston, Mike Newland, Mark Walker, Jo Markwyn, and Robert G. Douglass
2006 *McCabe Creek Placer Mining Complex (CA-BUT-362/H):Evaluation and Site Technical Report, Oroville Facilities Relicensing FERC Project No. 2100*. Report prepared for the Department of Water Resources, Sacramento, CA from Anthropological Studies Center, Sonoma State University, Rohnert Park, CA.

Prudhomme, Charles J.
1922 Gold Discovery in California: Who Was the First Real Discoverer of Gold in This State? *Annual Publications of the Historical Society of Southern California*, 12:18-25.

Quinn, Larry D.
1967 "Chink Chink Chinaman": The Beginning of Nativism in Montana. *Pacific Northwest Quarterly* 58(2):82–89.

Ransome, A. L. and J. L. Kellogg
1939 Quicksilver Resources of California. *California Journal of Mines and Geology* 35, no. 4:359, 361.

Rawls, James J.
1976 Gold Diggers: Indian Miners in the California Gold Rush. *California Historical Society Quarterly* 5(1):28–45.

1998 A Golden State: An Introduction. *California History* 77(4):1-23.

Rawls, James J., and Richard J. Orsi (editors)
1999 *A Golden State: Mining and Economic Development in Gold Rush California*. University of California Press, Berkeley, CA.

Raymer, Robert G.
1945 California's Early Mineral Industry. *Pacific Historical Review* 14:204-210.

Reid, Anna Morrison
1902 The Gold Dredging Era. *Overland Monthly* 39:987-992.

Reidt, Theo
1980 The Discovery of Gold Bearing Quartz. *Nevada County Historical Society Bulletin* 34:28-30.

Reinhardt, R.
1998 All That Glittered (The California Gold Rush). *American Heritage* 49:42-54.

Reno, Ronald L.
1990 The Status of Archaeological Studies at Nevada Mining Camps. In *Death Valley to Deadwood; Kennecott to Cripple Creek: Proceedings of the 1989 Historic Mining Conference, Death Valley National Monument*, Leo R. Barker and Ann E. Huston, editors, pp. 51–64. National Park Service, San Francisco, CA.

Reyer, Eduard
1935 Placer-Mining in California. *Pacific Historical Review* 4:386-392. Stockton, CA.

Rhodes, Patricia Hertert
1988 The Italians of Tuolumne County. *Chispa* 28:941–945.

Rice, William B.
1942 Documents: Early Freighting on the Salt Lake-San Bernardino Trail. *Pacific Historical Review* 11(1):73–80. Stockton, CA.

Richards, Leonard L.
2007 The California Gold Rush and the Coming of the Civil War. Vintage Books, New York, NY.

Ridge, Martin
1999 Disorder, Crime and Punishment in the California Gold Rush. *Montana* 49(3):12–27.

Riley, Glenda
1999 Feminizing the History of the Gold Rush. *The Western Historical Quarterly* 30(4):445-448.

Ritchie, Neville
1981 Archaeological Interpretations of Alluvial Gold Tailing Sites, Central Otago, New Zealand. *New Zealand Journal of Archaeology* 3:51–70.

Robbins, W. G.
1986 The ‘Plundered Province’ Thesis and the Recent Historiography of the American West. *Pacific Historical Review* 55(4):577–598.

Rock, James T.
1984 Cans in the Countryside. *Historical Archaeology* 18(2):97–111.

1987 Rocky-Bar Mining Company: Circular. *Pacific Historian* 22:253. Stockton, CA.

Roff, Sandra Schoiock
1973 The California Gold Mines from Brooklyn: As Viewed by the Local Press. *Journal of Long Island History* 9(2):6-22.

Rohe, Randall E.
1982 After the Gold Rush: Chinese Mining in the Far West, 1850–1890. *Montana* 32(4):2–19.

1984 Gold Dredging in the American West: Origin and Diffusion. *Pacific Historian* 28. Stockton, CA.

1985 ‘Feeding the Mines,’ The Development of Supply Centers for the Goldfields. *Annals of Wyoming*, 57(1):40–59.

1986 Origins and Diffusion of Traditional Placer Mining in the West. *Material Culture* 18(3):127–166.

1994 The Chinese and Hydraulic Mining in the Far West. *Mining History Association Annual* (1994):73–91.

1996 Chinese Mining and Settlement at the Lava Beds, CA. *Mining History Journal* 3:51–60.

Rohrbough, Malcolm J.
1997 *Days of Gold: The California Gold Rush and the American Nation.* University of California Press, Berkeley, CA.

1998 The California Gold Rush as a National Experience. *California History* 77(1):16-29.

2000 No Boy's Play: Migration and Settlement in Early Gold Rush California. *California History* 79(2):25–43.

Romanowitz, Charles M.
1970 California's Gold Dredges. *Mineral Information Service: a Publication of the California Division of Mines and Geology* 23(8):160–165. Sacramento, CA.

Rosborough, Alex J.
1957 California's Gold Find. *Siskiyou Pioneer* 2(10):62-69. Yreka, CA.

Rosen, Ruth
1986 Go West Young Woman? Prostitution on the Frontier. *Reviews in American History* 14(1):91-96.

Roske, Ralph J.
1963 The World Impact of the California Gold Rush, 1849-1957. *Arizona and the Wes*t 5:187-232.

Rossi, Louie
1958 Lost Mines of the West. *Pony Express Courier* 24: 6. Placerville, CA.

Rotchev, A.
1970 New Eldorado in California. *Pacific Historian* 14:33-40. Stockton, CA.

Russell, Malcolm
1978 Four $20.00 Gold Pieces. *Siskiyou Pioneer* 5(1):31. Yreka, CA.

Ruiz, Vicki L.
2001 Shaping Public Space/Enunciating Genter: A Multiracial Historiography of Women's West 1995-2000. *Frontiers: A Journal of Women's Studies* 22(3):22-25.

Sabato, George
1998 Sesquicentennial: Gold Rush to Golden Statehood. *Social Studies Review* 37:98-100.

St. Clair, David J.
1994 New Almaden and California Quicksilver in the Pacific Rim Economy. *California History* 73(4):279–295.

1999 The Gold Rush and the Beginnings of California Industry. In *A Golden State: Mining and Economic Development in Gold Rush California*, James J. Rawls and Richard J. Orsi, editors, pp. 185-208. University of California Press, Berkeley, CA..

Sampson, R. J., and W. Burling Tucker
1931 Feldspar, Silica, Andalusite and Cyanite Deposits of California. *California Division of Mines Report* 21: 325-382. San Francisco, CA.

1942 Mineral Resources of Imperial County. *California Division of Mines Report* 38: 105-145. San Francisco, CA.

Sauder, Robert A.
1990 The Agricultural Colonization of a Great Basin Frontier: Economic Organization and Environmental Alteration in Owens Valley, California, 1860–1925. *Agricultural History* 64(4):78–101.

Savage, Sherman H.
1945 The Negro on the Mining Frontier. *The Journal of Negro History* 30 (1):30-46.

Sayre, James A.
1964 A Bonanza in Borax: The Story of John Wemple Searles and Searles Lake. *Journal of the West* 3(3):277–290.

1998 Scenes from the California Gold Rush. *California Geology* 51(4):14.

Schlissel, Lillian
1978 Mothers and Daughters on the Western Frontier. *Frontiers: A Journal of Women Studies* 3(2):29-33.

Schmitt, Dave N., and Charles D. Zeier
1993 Not by Bones Alone: Exploring Household Composition and Socioeconomic Status in an Isolated Historic Mining Community. *Historical Archaeology* 27(4):20–38.

Schneider, Jimmy
1992 *Quicksilver: The Complete History of Santa Clara County's New Almaden Mine.* Zella Schneider, San Jose, CA.

Schulz, Peter and Sherri Gust
1983 Faunal Remains and Social Status in 19$^{th}$ Century Sacramento. *Historical Archaeology* 17(1):44-54.

Schuyler, R. L.
1988 Archaeological Remains, Documents, and Anthropology: A Call for the New Culture History. *Historical Archaeology* 22(10):36–42.

Scott, Shaunna L
1995 *Two Sites to Everything: The Cultural Construction of Class Consciousness in Harlan County, Kentucky*. State University of New York Press, Albany, NY.

Segerstrom. R. J.
1941 Tin in California. *California Division of Mines Report* 37:531-557. San Francisco, CA.

Self, Jean
1967 Jarnagin's Gold. *The Quarterly of the Tuolumne County Historical Society* 7:221-223.

Shasta County Historical Society
1985 Chinese Chronicles of Shasta County. *Covered Wagon* 1985:53-68.

Shinn, Charles Howard
1885 *Mining Camps: A Study in American Frontier Government*. Scribner, New York, NY. Reprinted 1948, Knopf, New York.

1897 Northern California Gold Fields: Glimpses of Shasta, Trinity, and Siskiyou. *Overland Monthly* 30:506-513.

Shirley, Dame [Louisa Amelia Knapp Smith Clappe)]
1933 *California in 1851[–1852]; the Letters of Dame Shirley.* Carl I. Wheat, introduction and notes. The Grabhorn Press, San Francisco, CA.

1970 *The Shirley Letters: being letters written in 1851-1852 from the California Mines*, with an introduction by Richard Oglesby. Peregrine Smith Books, Salt Lake City, UT.

Shoup, L. H.
1983a Theoretical Models for Project Area History. In Review and Synthesis of Research as Historical Sites: Final Report of the New Melones Archaeological Project, Volume 7, Roberta S. Greenwood and Lawrence H. Shoup, editors. Report prepared for the National Park Service, Washington, DC., from Infotec Research, Sonora, CA, and Greenwood and Associates, Pacific Palisades, CA. Reprinted 1987 by Coyote Press, Salinas, CA.

1983b *An Interpretation and Assessment of the Significance of the Historic Cultural Properties of Redwood National Park*. Report prepared for the U.S. Department of the Interior, National Park Service, Redwood National Park, Arcata, CA, from Archaeological Consultants.

1999 Significant California Events During 1849. *Butte County Historical Society Diggin's* 43(3):57.

Silva, Michael
1986 *Placer Gold Recovery Methods*. Special Publication No. 87. California Department of Conservation, Division of Mines and Geology, Sacramento, CA.

Simmons, Alexy
1989 *Red Light Ladies: Settlement Patterns and Material Culture on the Mining Frontier.* Anthropology Northwest No. 4. Department of Anthropology, Oregon State University, Corvallis,OR.

Simmons, James C.
1981 Lure of the Mother Lode. *Americas* 33:(1):33-39.

Sioli, Paolo
1883 *Historical souvenir of El Dorado County, California: with Illustrations and Biographical Sketches of its Prominent Men & Pioneers.* Paolo Sioli, Oakland, CA.

*Siskiyou Pioneer*
1951 Northern California, Scott and Klamath Rivers By a Practical Miner. *Siskiyou Pioneer* 1(5):26-35.

1978 Mines of Scott Bar. *Siskiyou Pioneer* 5(1):92-94. Yreka, CA.

Sisson, David A.
1993 Archaeological Evidence of Chinese Use along the Lower Salmon River, Idaho in *Hidden Heritage, Historical Archaeology of the Overseas Chinese,* Pricsilla Wegars, editor, pp.33–60, Baywood Publishing, Amityville, NY.

Skaar, Sven
1958 Alpha and Omega. *Nevada County Historical Society* 12:1-3.

Skelensky, Al
2002 Jobs Kennedy Mine. The Kennedy Mine Foundation, Jackson, CA.

Skyhawk, W. F.
1950 French Pioneers of the West: A Graphic Account of Lives of Frenchmen in Early California, Nevada, and Arizona; their endeavors in the fields of arts, science, business, and profession, and the important part they played in the building of the West. *Pony Express* 12(6):6–8, 13.Placerville, CA.

Slyter, Robert I.
1980 The Alpha Diggings. Nevada *County Historical Society Bulletin* 34:23-27.

Smith, Duane
1993 *Mining America: the Industry and the Environment, 1800–1980.* University Press of Kansas, Lawrence, KS.

1998 Mother Lode for the West: California Mining Men and Methods. *California History* 77(4):149-173.

Smith, Gail McBridge
1968 The Western Mining Camps as Described by Women Who Lived in Them. Master’s Thesis, History Department, Texas A & M, TX.

Smith, H. M.
1903 Placer Mining. *Overland Monthly* 41:410-412.

Smith, Jessica L. K.
2006 A Land of Plenty: Depression-Era Mining and Landscape Capital in the Mojave Desert, California. Doctoral Dissertation, Anthropology Department, University of Nevada, Reno, NV.

Smith, Mary H.
1983 Chinese Placer Mining and Site Formation Processes. Paper presented at the 17th Annual Meeting of the Society for California Archaeology, San Diego, CA.

Smith, Paul B.
1980 Highway Planning in California's Mother Lode: The Changing Townscape of Auburn and Nevada City. *California History* 59(3):204–221.

Smith, R. M.
1981 Source of Mother Lode Gold. *California Geology* 34(5):99-103.

Snyder, Jacob A.
1931 Frontier Days. *Society of California Pioneers Quarterly* 8:220-223.

*Society of California Pioneers Quarterly*
1932a Note 2: Sam Brannan, Reporter of the Discovery of Gold. *Society of California Pioneers Quarterly* 9:23-24.

1932b Note 4: Winter in the Trinity Mines - 1849. *Society of California Pioneers Quarterly* 9:24.

Solomons, Theodore S.
1938 Making Money in Early California. *California History Nugget* 6:80–85.

Sonoma State University, California
2007a Town Sites: Historic Context and Archaeological Research Design (Draft). Prepared for the California Department of Transportation, Sacramento. Available online http://www.sonoma.edu/asc/publications/index.html.

2007b Work Camps: Historic Context and Archaeological Research Design (Draft). Prepared for the California Department of Transportation, Sacramento. Available online http://www.sonoma.edu/asc/publications/index.html.

South, Stanley
1977 *Method and Theory in Historical Archaeology*. Academic Press, New York, NY.

Southern, May H.
1967 The Legend of the Lost Cabin Mine. *Covered Wagon* 1967:1-2.

Spence, Clark C.
1961 British Investment and the American Mining Frontier, 1861–1914. *New Mexico Historical Review* 36(2):121–137.

1980 The Golden Age of Dredging: The Development of an Industry and Its Environmental Impact. *Western Historical Quarterly* 11(4):401-414.

1999 Review of *The Automobile Gold Rushes and Depression Era Mining* by Charles Wallace Miller Jr., University of Idaho Press, Moscow, 1998. *The Journal of American History* 86(2):823.

Splitter, Henry Winifred
1957 Quicksilver at New Almaden. *Pacific Historical Review* 26(1):33–50.

Spude, Catherine Holder
2005 Brothels and Saloons: An Archaeology of Gender in the American West. *Historical Archaeology* 39(1):89–106.

Spude, Robert L.
1987 Mining Technology and Historic Preservation with Special Reference to the Black Hills. In *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*, Jeff Buechler, editor, pp. 45–58. South Dakota State Historical Preservation Center, Vermillion.

1990a Introduction in *Death Valley to Deadwood; Kennecott to Cripple Creek: Proceedings of the 1989 Historic Mining Conference, Death Valley National monument*, Leo R. Barker and Ann E. Huston, editors, pp. 3–7. National Park Service, San Francisco, CA.

1990b Mining Technology and the National Register in *Death Valley to Deadwood; Kennecott to Cripple Creek: Proceedings of the 1989 Historic Mining Conference, Death Valley National monument*, Leo R. Barker and Ann E. Huston, editors, pp. 31–38. National Park Service, San Francisco, CA.

Stanley, Reva Holdaway
1935 Sutter's Mormon Workmen at Natoma and Coloma in 1848: Was Shadrach Holdaway One of These? *California Historical Society Quarterly* 14(3):268–282.

Starr, Kevin
1998 The Gold Rush and the American Dream. *California History* 71(1):56-67.

Steeples, Douglas
2000 Mules, Mines, and Millions: Frank Smith and Calico Borax. *Montana* 50(1):28–43.

Stegner, Wallace.
1993 California's Empire Mine: Memories of the Gold Rush and a Renowned Fortune Extracted from the Hills of Grass Valley. *Architectural Digest* 50:168-175.

Stevens, Elmer E.
1964 The Cornish Miner. From the Nevada County Historical Society Quarterly. *California Historian* 10(5):132–135.

Stewart, James D.
1935a California Gold Production. *Pony Express Courier*, H. S. Hamlin, editor, 1:22. Placerville, CA.

1935b The Gold Discovery and Its Influence in California. *Pony Express Courier,* H. S. Hamlin, editor, 1:15. Placerville, CA.

Stewart, Richard M.
1957a Lead. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 281-292. Division of Mines, San Francisco, CA.

1957b Silver. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 529-538. Division of Mines, San Francisco, CA.

1957c Tungsten. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 655-668. Division of Mines, San Francisco, CA.

Stovall, Denis H.
1903 Golden Pockets. *Overland Monthly* 41:414-416.

Sullivan, Sister Jeanne
1973 A French Family in French Gulch: The Charles Joseph Family. *Covered Wagon* 1973:40–50.

Sundahl, E., and E. W. Ritter
1997 *West Redding Archaeology Project: Chinese and Native American Occupations at CA-SHA-1544/H and CA-SHA-1969/H*. Report prepared for the Bureau of Land Management, Redding, CA.

Supernowicz, Dana, Julia Huddleson, and Kimberly Wooten, with contributions by Darrell Cardiff, Anmarie Medin, and Richard Levy
2006 Archaeological Survey and Historic Resource Evaluation Report for the Proposed Rehabilitation and Shoulder Widening Project State Highway 49 in Jackson, Amador County, California. Report prepared for the California Department of Transportation, Stockton, CA.

Swope, Karen K.
1999 Historical Properties Recordation Program, Death Valley National Park: Chloride Cliff/Chloride city Mining Site (CA-INY-5461H). Archaeological Research Unit, UC Riverside. MS prepared for National Park Service, Death Valley National Park. On file at Eastern Information Center, CHRIS.

Swope, K. K., and M. C. Hall
2000 *Historical and Prehistoric Archaeological Investigations of the Hart Townsite (CA-SBR-3060/H), Eastern San Bernardino County, California.* Report prepared for Lilburn Corporation, San Bernardino, CA from Archaeological Research Unit, University of California, Riverside,CA.

Tamony, Peter.
1968 To See the Elephant. *Pacific Historian* 12:23-29.

Taniguchi, Nancy J
2000 Weaving a Different World: Women and the California Gold Rush. In *Rooted in Barbarous Soil: People, Culture, and Community in Gold Rush California*, Kevin Starr and Richard J. Orsi, editors, pp. 141-168. University of California Press, Berkeley, CA.

Taylor, Bayard.
1850 *El Dorado*: *Adventures in the Path of Empire*. George P. Putnam New York, NY.

1862 *Travels: At Home and Abroad*. G. P. Putnam and Sons, New York. NY.

Teague, George A.
1980 *Reward Mine and Associated Sites.* Western Archaeological Center, Publications in Anthropology No. 11. U.S. Department of the Interior, National Park Service, Tucson, AZ.

Thompson, Kenneth
1960 Historic Flooding in the Sacramento Valley. *Pacific Historical Review* 29(4):349–360.

Thompson, Kenneth, and Richard A. Eigneheer
1979 The Agricultural Promise of the Sacramento Valley: Some Early Views. *Journal of the West* 18(4):33–41.

Thompson, Monroe
1873 The Gravel Ranges of the Gold Belt. *Overland Monthly* 11 (5):393-403.

Thrush, P. W.
1968 *A Dictionary of Mining, Mineral and Related Terms*. United State Department of the Interior, Bureau of Mines

Thurman, Dr. A. Odell
1976a The Negro in California Before 1890, Part I. *The Pacific Historian* 20:67–72.

1976b The Negro in California Before 1890, Part II and Conclusion. *The Pacific Historian* 20:197–188.

Tibbetts, Deborah
1997 *Gold Mining in Northern California 1848–1890: Development of a Taxonomic Framework and Harrison Diggings Revisited*. Master's thesis, Anthropology Department, California State University, Chico.

Tinloy, Patrick
1971 Nevada County's Chinese in Two Parts: Part I, Prior to 1900. *Nevada County Historical Society Quarterly* 25:1–8.

Toleman, Vera.
1966a Happy Camp. *Siskiyou Pioneer* 3(9):9-35. Yreka, CA.

1966b The Klamath River. *Siskiyou Pioneer* 3(9):1-3. Yreka, CA.

1966c Somes Bar. *Siskiyou Pioneer* 3(9):3-5. Yreka, CA.

Tong, Benson
1994 *Unsubmissive Women: Chinese Prostitutes in Nineteenth-Century San Francisco*. University of Oklahoma Press, Norman, OK.

Tordoff, Judith D.
2004 *The Evolution of California's Placer Mining Landscape - A View from Prairie City*. Report prepared for the California Department of Transportation, District 3, Marysville, CA.

2005 *Phase II Investigations at Logtown, CA-ELD-685H, El Dorado County, California*. Report prepared for the California Department of Transportation, District 3, Sacramento, CA.

Tordoff, Judith D., and Mary L. Maniery
1986 *Analysis, Evaluation, Effect Determination and Mitigation Plan for Two Chinese Mining Sites in Butte County, California*. Public Anthropological Research, Sacramento, CA.

1989 *Data Recovery at Two Mining Sites in Butte County, California*. Report prepared for the Lassen National Forest, Susanville, CA, from PAR & Associates, Sacramento, CA.

Tordoff, Judith D., and D. M. Seldner
1987 *Dutch Gulch Lake Excavation at Thirteen Historic Sites in the Cottonwood Creek Mining District*. Report prepared for the U.S. Army Corps of Engineers, Sacramento, CA.

Torma, C.
1987 Introduction to Proceedings Publication. In *Proceedings of the Workshop on Historic Mining Resources: Defining the Research Questions for Evaluation and Preservation*, edited by Jeff Buechler, pp. 1–4. South Dakota State Historical Preservation Center, Vermillion.

Tracey, Patricia Cleland
1979 A Trail Bearing to the Left. *Covered Wagon* 6-11.

2000 Cherokee Gold in Georgia and California. *Journal of the West* 39(1):49–54.

True, D. L.
1976 *Archaeological Evaluation of Cultural Resource in American River Canyon Auburn-Folsom Project.* Report for Bureau of Reclamation, Sacramento, CA.

Tsai, Shih-Shan Henry
1988 The Chinese and 'Gold Mountain.' *The Californians* 6:34–35.

Tucker, W. Burling
1921 San Bernardino County. *California Division of Mines Report* 17. San Francisco, CA.

1927 Mineral Resources of Santa Catalina Island. *California Mining Bureau Report* 23:32-39. Sacramento, CA.

Tucker, W. Burling and R. J. Sampson
1938 Mineral Resources of Inyo County, California. *California Division of Mines Report* 34:368-500. San Francisco, CA.

1942 Mineral Resources of Imperial County, California. *California Division of Mines Report* 38:105-145. San Francisco, CA.

Turner, Justin G.
1965 All Is Not Gold That Glitters. *Pacific Historian* 9(February):9-11, 44.

1967 All Is Not Gold That Glitters. *American Book Collector* 17(5):19-22.

Tuttle, Carolyn
2001 Book Review: Boys in the Pits: Child Labour in Coal Mines. Economic History Services, Miami University, Oxford, Ohio. <http://eh.net/bookreviews/library/0424>.Accessed 8 August 2007.

Twitty, Eric
2005 *Riches to Rust: A Guide to Mining in the Old West*, 2nd edition. Western Reflections Publishing Company, Montrose, CO.

Umbeck, J. R.
1981 *A Theory of Property Rights with Application to the California Gold Rush*. Iowa State University Press, Ames, IA.

United Mine Workers of America
2007 A Brief History of the UMWA. United Mine Workers of America, Fairfax, VA. <http://www.umwa.org/history/>. Accessed January 2008.

United States Department of the Interior, Bureau of Mines (USBM)
1941 *Minerals Yearbook Review of 1940*. U.S. Department of the Interior, Bureau of Mines, Washington, DC.

1967 *Minerals Yearbook, Volume III: Area Reports: Domestic.* U.S. Department of the Interior, Bureau of Mines, Washington, DC.

Uren, Edward C.
1959 Gold and Its Production. *Nevada County Historical Society* 13:1-3.

Van Bueren, Thad
1998 *Dragstones and Stockraising: Results of Archaeological Test Excavations at CA-AMA-363/H and –364/H in Amador County, California.* Prepared for the California Department of Transportation, District 10, Stockton, CA.

2004 The ‘Poor Man’s Mill’: A Rich Vernacular Legacy. *Industrial Archeology* 30(2):5–23.

Ver Planck, William E.
1957a Boron. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 87-94. Division of Mines, San Francisco, CA.

1957b Magnesium and Magnesium Compounds. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 313-324. Division of Mines, San Francisco, CA.

1957c Strontium Minerals. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 607-612. Division of Mines, San Francisco, CA.

Vischer, Eduard
1932 A Trip to the Mining Regions in the Spring of 1859: 'Californischer Staats-Kalender' in the Leap Year A.D. 1860. *Quarterly of the California Historical Society* 11:224-246.

Vredenburgh, Larry M.
2005 An Overview of Mining in the California Desert. In *Old Ores, Mining History in the Eastern Mojave Desert*, Robert E. Reynolds, editor, pp. 22-27. California State University, Desert Studies Consortium and LSA Associates, Inc. <http://vredenburgh.org/mining_history/pages/mining_overview2005.htm>. Accessed February 2008.

Walker, Mark, Margaret J. Markwyn, and Robert G. Douglass
2006 *Edel Consolidated Placer Mine (CA-BUT-1886/H):Site Technical Report.Forks of the Feather River Historic District Evaluation, Oroville Facilities Relicensing FERC Project No. 2100*. Draft report. Prepared for the Department of Water Resources, Sacramento, CA, from Anthropological Studies Center, Sonoma State University, Rohnert Park, CA.

Watkins, T. H.
1971 Golden Dreams and Silver Realities: The Mechanics of Civilization on the Mining Frontier. *American West* 8:34-43.

Watson, Douglas S.
1932a Millions for a Cent - Gold Mines of California - New Details, Douglas S. Watson, translator, from a French broadside. *Quarterly of the Historical Society of California* 11:40-41.

1932b Spurious Californiana: 'Four Months Among the Gold- Finders' : Henry Vizetelly's Confession to an Astounding Literary Hoax. *Quarterly of the Historical Society of California* 11: 65-66.

Weber, Francis J.
1974 California's Gold Discovery: The Record Set Straight. *Pacific Historian* 18:16-19.

Wegars, Priscilla
1991 Who’s Been Workin’ on the Railroad? An Examination of the Construction, Distribution, and Ethnic Origins of Domed Rock Ovens of Railroad-related Sites. *Historical Archaeology* 25(1):37–65.

Wegars, Priscilla (editor)
1993 *Hidden Heritage*, *Historical Archaeology of the Overseas Chinese*. Baywood Publishing, Amityville, NY.

Weinstein, Robert A.
1969 The Search for California Gold - A Photographic View. *California Historical Society Quarterly* 38:16-interleaves.

1970 Gold Was for the Young. *California Historical Society Quarterly* 49(4):352, interleaves.

Weissberg, Al
1985 Pioneer Jewish Families of Shasta County. *Covered Wagon* 1985:34–36.

Weissberg, Muriel
1986 Pioneer Jewish Merchants of the Gold Rush Period In and Around Shasta. *Covered Wagon* 1986:67–79.

Wells, Harry L.
1950 History of Siskiyou County, California: Chapter V: Discovery of Gold. *Siskiyou Historical Society Yearbook* 1:39-46.

Wells, John H.
1966 *Report on Placer Mining in the United States in Relation to the National Surface Mine Study*. Report prepared for the U.S. Department of the Interior, Bureau of Land Management, Portland Service Center, Portland, OR.

1969 *Placer Examination – Principles and Practice*. Technical Bulletin 4 – Field Edition, Bureau of Land Management, Washington D.C.

West, Elliott
1983 Heathens and Angels: Childhood in the Rocky Mountain Mining Towns. *The Western Historical Quarterly*, 14(2):145- 164.

1987 Beyond Baby Doe: Child Rearing on the Mining Frontier. In *The Women's West*, Susan Armitage and Elizabeth Jameson, editors, pp. 179-192. University of Oklahoma, Norman, OK.

Wheeldon, George
http://www.georgewheeldon.org

White, Richard.
1998 The Gold Rush: Consequences and Contingencies. *California History* 77(1):42-55.

Whiteside, C. E.
1944 First Gold Discoveries in California. *Pony Express Courier*, H. S. Hamlin, editor, 11:9-10.

Wierzbicki, Felix Paul
1995a California As It Is and As It May Be (1849), Part I: The Country and Its Resources. *The Californians* 12(2):34-47;

1995b California As It Is and As It May Be (1849), Part II: The Gold Region. *The Californians* 12:(3):41-46.

1995c California As It Is and As It May Be (1849), Part III: Advice to the Miner. *The Californians* 12(4):30-37.

Wiese, J. H., and L. R. Page
1946 Tin Deposits of the Gorman District, Kern County, California. *California Journal of Mines and Geology* 42(1):31-52. Sacramento, CA.

Wiggins, Donegan R. Bennett
1947 Discovered Gold at Coloma. *Pony Express* 13:3-5.

Wilder, Mona
1971 Early Trails of Shasta County. *Covered Wagon* 1971:55–59.

Williams, Carol
1986 My First Indian: Interaction between Women and Indians on the Trail, 1845-1865. *Overland Journal* 4:13-18.

Williams, Henry F.
1948 Some Barges Are Built. *Publication of the Society of California Pioneers* (1948):35–36.

Williams, Jacqueline
1996 India Rubber Kept Them Dry. *Overland Journal* 14:4–8.

Willmarth, Kate Green
2001a *Like A Leaf Upon The Current Cast: An Intimate History of Shady Flat, Neighboring Gold Rush Landmarks & Pioneer Families Along the North Fork of the Yuba River Between Downieville & Sierra City, California.* Sierra County Historical Society, Lincoln, CA.

2001b *Like A Leaf Upon The Current Cast: Supplement to the Second Edition: Chapter 9; Additions & Corrections.* Sierra County Historical Society, Lincoln, CA.

Winter, Mark
1993-2007 Chemistry: WebElements Periodic Table: Professional Edition: Copper: Key Information. University of Sheffield. http://www.webelements.com/webelements/elements/text/Cu/key.html. Accessed 2008.

Wilson, Eugene B.
1907 *Hydraulic and Placer Mining*, 2nd edition. John Wiley and Sons, New York, NY.

Winston, W. B.
1949 Barium. *California Journal of Mines and Geology* 45(1): 85-97

Winthrop, K. R., D. J. Gray, and R. H. Winthrop
1987 *Oak Knoll Historic Data Recovery Project Site #05-05-51-49 and #05-05-51-50, Klamath National Forest.* Report prepared for USDA Forest Service, Klamath National Forest, Yreka, CA. Prepared by Winthrop Associates Cultural Research, Ashland, OR.

Witschi, Nicolas.
1999 John of the Mines: Muir's Picturesque Rewrite of the Gold Rush. *Western American Literature* 34:316-343.

Wolf, E. R.
1982 *Europe and the People without History*. University of California Press, Berkeley, CA.

Wollenberg, Charles
1971 Ethnic Experiences in California History: An Impressionistic Survey. *California Historical Society Quarterly* 50(3):221–223.

1956 World's Largest Nugget. *Pony Express* 23:8.

Woods, Daniel Bates
1851 Sixteen Months at the Gold Diggings. New York, Harper & Brothers. Online at California As I Saw It: First-Person Narratives of California's Early Years, 1849-1900. http://memory.loc.gov/ammem/cbhtml/cbhome.html. Accessed June 2008.

Woyski, Margaret S.
1981 Women and Mining in the Old West. *Journal of the West* 20(2):38-47.

Wright, Lauren A.
1950 California Talcs. *American Institute of Mining, Metals, Engineering, and Transportation* 187:122-128.

1957a Talc and Soapstone. In *Mineral Commodities of California*, Lauren A. Wright, editor, pp. 623-634. Division of Mines, San Francisco, CA.

Wright, Lauren A. (editor)
1957b *Mineral Commodities of California*. Division of Mines (California), San Francisco, CA.

Wyllys, Rufus Kay
1929 The French in Sonora, 1850–1854. Doctoral dissertation, History Department, University of California, Berkeley, CA.

1932 The French of California and Sonora. *Pacific Historical Review* 1(3):337–359.

Wyman, Mark.
1979 *Hardrock Epic: Western Miners and the Industrial Revolution.* University of California Press, Berkeley, CA.

1974 Industrial Revolution in the West: Hard-Rock Miners and the New Technology. *The Western Historical Quarterly* 5(1):39-57.

Yescas, Dolores Nicoline, Richard Yescas, and Roberta M. McDow
1972 Chinese Camp. *The Pacific Historian* 16(2):47–64.

Young Jr., Otis E.
1965 The Spanish Tradition in Gold and Silver Mining. *Arizona* 7(4):299–314.

1969 The ’49 Gold Rush: A Portfolio. *American History Illustrated* 4(5):13–17.

1970 *Western Mining: An Informal Account of Precious-Metals Prospecting, Placering, Lode Mining, and Milling on the American Frontier from Spanish Times to 1893.* University of Oklahoma Press, Norman, OK.

1980 The Southern Gold Rush: Contributions to California and the West. *Southern California Quarterly* 62(2):127–141.

Zanjani, Sally
1997 *A Mine of Her Own: Women Prospectors in the American West 1850-1950*. University of Nebraska Press, Lincoln, NB.

Zerbe Jr., Richard O., and C. Leigh Anderson
2001 Culture and Fairness in the Development of Institutions in the California Gold Fields. *The Journal of Economic History* 6(1):114–143.

Zhu, Liping
1999 No Need to Rush: The Chinese, Placer Mining, and the Western Environment. *Montana* 493:42–57.

Ziesing, Grace H.
1997 *Archaeological Investigations of the Vasco Adobe Site, CA-CCO-470H, for the Los Vaqueros Project, Alameda and Contra Costa Counties, California.* Los Vaqueros Project Final Report No. 4. Report for CCWD, Concord, CA from Anthropological Studies Center, Sonoma State University, Rohnert Park, CA.

# Appendix A:
# Major Mines by Focus Commodity

This appendix contains mines listed as important producers in *Mineral Commodities of California* and *Gold Districts of California.* Mines were included for the 19 commodities which were defined as focus commodities for this study (see chapter one). Locational data (latitude, longitude) is from Mineral Resource Data System entries and is often based on approximations from older maps at varying scales. Experience suggests that locations are only accurate within a few hundred meters.

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| **Barium-Barite** | | | | | | |
| * Barstow Area | | | San Bernardino | Barium-Barite | | Mojave Desert |
| Synthetic Iron Color Company | 40.14810 | -121.10780 | Plumas | Barium-Barite | | Sierra Nevada |
| Camp Neslon Mine | | | Tulare | Barium-Barite | | Sierra Nevada |
| Democrat Mine | 39.24470 | -120.80060 | Nevada | Barium-Barite | | Sierra Nevada |
| Egenhoff | 37.58500 | -119.77750 | Mariposa | Barium-Barite | | Sierra Nevada |
| El Portal Barite Mine | 37.67140 | -119.80190 | Mariposa | Barium-Barite | | Sierra Nevada |
| Fremont Peak Mine | | | San Benito | Barium-Barite | | Coast Ranges |
| Gunter Canyon Barite Mine | 37.46580 | -118.28310 | Inyo | Barium-Barite | | Basin & Range |
| LaBrea Mine | | | Santa Barbara | Barium-Barite | | Coast Ranges |
| The Glidden Co. | 41.13583 | -122.24860 | Shasta | Barium-Barite | | Klamath Mountains |
| *Paso Baryta (Nine Mile Canyon) | | | Tulare | Barium-Barite | | Sierra Nevada |
| Red Hill Mine | | | Orange | Barium-Barite | | Peninsular Range |
| San Dimas Barite Deposit | 34.17250 | -117.77580 | Los Angeles | Barium-Barite | | Peninsular Range |
| Savercool | 40.14170 | -121.10640 | Plumas | Barium-Barite | | Sierra Nevada |
| Spanish Barite Deposit | 39.40420 | -120.78750 | Nevada | Barium-Barite | | Sierra Nevada |
| Sulfide Queen Mine | | | San Bernardino | Barium-Barite | | Mojave Desert |
| **Boron-Borate** | | | | | | |
| Searles Lake | | | San Bernardino | Boron-Borates | | Mojave Desert |
| Owens Lake | | | Mono | Boron-Borates | | Basin & Range |
| Borax Lake | | | Lake | Boron-Borates | | Coast Ranges |
| Death Valley | | | Inyo | Boron-Borates | | Basin & Range |
| Amargosa Valley | | | Inyo | Boron-Borates | | Basin & Range |
| Koehn Lake | | | Kern | Boron-Borates | | Mojave Desert |
| Salt Wells Valley | | | Inyo | Boron-Borates | | Basin & Range |
| Saline Valley | | | Inyo | Boron-Borates | | Basin & Range |
| Furnace Creek, Death Valley | | | Inyo | Boron-Borates | | Basin & Range |
| Shoshone Mines | | | Inyo | Boron-Borates | | Basin & Range |
| Calico Mountains, Daggett | | | San Bernardino | Boron-Borates | | Mojave Desert |
| Lang Mine | 34.48140 | -118.36390 | Los Angeles | Boron-Borates | | Transverse |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| | | | | | | Ranges |
| ne corner | | | Ventura | Boron-Borates | | Coast Ranges |
| **Chromium-Chromite** | | | | | | |
| Copper Creek Chrome Mine | 41.92250 | -124.03630 | Del Norte | Chromium | | Klamath Mountains |
| High Plateau Mine | 41.92806 | -123.94910 | Del Norte | Chromium | | Klamath Mountains |
| French Hill Chrome Mine | 41.80667 | -123.98580 | Del Norte | Chromium | | Klamath Mountains |
| Rattlesnake | | | Del Norte | Chromium | | Klamath Mountains |
| Holliday | | | Del Norte | Chromium | | Klamath Mountains |
| Cyclone Gap | 41.86250 | -123.62170 | Siskiyou | Chromium | | Klamath Mountains |
| Seiad Creek/Emma Bell | 41.91110 | -123.14280 | Siskiyou | Chromium | | Klamath Mountains |
| Fairview | | | Siskiyou | Chromium | | Klamath Mountains |
| Croggins | | | Siskiyou | Chromium | | Klamath Mountains |
| Little Castle Creek Mine | 41.18278 | -122.30160 | Shasta | Chromium | | Klamath Mountains |
| Lambert Mine | 39.79167 | -121.61270 | Butte | Chromium | | Sierra Nevada |
| P.U.P. Zenith Mine | 39.53361 | -121.23220 | Butte | Chromium | | Sierra Nevada |
| Red Ledge Mine | 39.34444 | -120.80050 | Nevada | Chromium | | Sierra Nevada |
| Boiler Pit | 39.11167 | -120.76330 | Placer | Chromium | | Sierra Nevada |
| Bunker Mine | 39.03722 | -120.75860 | Placer | Chromium | | Sierra Nevada |
| Shelley Mine | 38.83389 | -120.87910 | El Dorado | Chromium | | Sierra Nevada |
| Pillikin Pilliken | 38.77521 | -120.51750 | El Dorado | Chromium | | Sierra Nevada |
| Murphy Mine | 38.52722 | -120.94940 | El Dorado | Chromium | | Sierra Nevada |
| Ward And Lyons Mine | 38.27222 | -120.82250 | Calaveras | Chromium | | Sierra Nevada |
| Madrid Mine True Blue | 38.14306 | -120.51190 | Calaveras | Chromium | | Sierra Nevada |
| Mccormick Mine | 37.88194 | -120.51110 | Tuolumne | Chromium | | Sierra Nevada |
| Lacey | 36.94860 | -119.41420 | Fresno | Chromium | | Sierra Nevada |
| Clara H. | 36.94694 | -119.41580 | Fresno | Chromium | | Sierra Nevada |
| Jack Sprat No 6 | 36.89250 | -119.33530 | Fresno | Chromium | | Sierra Nevada |
| Holston Mine | 36.02389 | -118.95270 | Tulare | Chromium | | Sierra Nevada |
| Grau Mine | 40.02670 | -122.67170 | Tehama | Chromium | | Klamath Mountains |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Grey Eagle Mine | 39.73810 | -122.70220 | Glenn | Chromium | | Coast Ranges |
| Lucky Strike | | | Lake | Chromium | | Coast Ranges |
| White Angel | | | Napa | Chromium | | Coast Ranges |
| Newman Mine | 37.55806 | -120.62130 | Alameda | Chromium | | Coast Ranges |
| No. 5 | | | Stanislaus | Chromium | | Coast Ranges |
| Big Ridge & Mistake | 36.31220 | -120.54670 | Fresno | Chromium | | Coast Ranges |
| Norcross Mine | 35.40360 | -120.74310 | San Luis Obispo | Chromium | | Coast Ranges |
| Colorado Mine | 35.36080 | -120.69920 | San Luis Obispo | Chromium | | Coast Ranges |
| Mistake | | | San Luis Obispo | Chromium | | Coast Ranges |
| Trinidad Mine | 35.36310 | -120.68560 | San Luis Obispo | Chromium | | Coast Ranges |
| Pick And Shovel Mine | 35.35780 | -120.66810 | San Luis Obispo | Chromium | | Coast Ranges |
| **Coal** | | | | | | |
| Rogue River Dist. (Southern Extension) | | | Siskiyou | Coal | | Cascade |
| Big Bar District | | | Trinity | Coal | | Klamath Mountains |
| Hayfork Valley District | | | Trinity | Coal | | Klamath Mountains |
| SE Douglas City District | | | Trinity | Coal | | Klamath Mountains |
| Lincoln District | | | Placer | Coal | | Great Valley |
| Ione District | | | Amador | Coal | | Great Valley |
| Mount Diablo District | | | Contra Costa | Coal | | Coast Ranges |
| Corral Hollow District | | | Alameda | Coal | | Coast Ranges |
| Stone Canyon District | | | Monterey | Coal | | Coast Ranges |
| Alberhill District | | | Riverside | Coal | | Peninsular Range |
| **Copper** | | | | | | |
| Copper Hill | 38.50194 | -120.96660 | Amador | Copper | Silver, Gold, Zinc | Sierra Nevada |
| Newton Mine | 38.34167 | -120.88610 | Amador | Copper | | Sierra Nevada |
| Big Bend | 39.69167 | -121.43130 | Butte | Zinc, Copper | Gold, Silver, Lead | Sierra Nevada |
| North Keystone | 37.98722 | -120.64660 | Calaveras | Copper | | Sierra Nevada |
| Napoleon | 37.92750 | -120.72880 | Calaveras | Copper | Gold, Silver, Zinc | Sierra Nevada |
| Penn Mine | 38.23000 | -120.87330 | Calaveras | Copper | | Sierra Nevada |
| Quail Hill | 37.96110 | -120.74890 | Calaveras | Copper | | Sierra Nevada |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Copper King | 36.91080 | -119.44500 | Fresno | Copper | | Sierra Nevada |
| Fresno | 36.89810 | -119.66810 | Fresno | Copper | | Sierra Nevada |
| Pine Creek Mine | 37.36667 | -118.71660 | Inyo | Tungsten, Molybdenum, Copper, Bismuth | | Basin & Range |
| Daulton Copper Mine | 37.10670 | -119.96690 | Madera | Copper | | Sierra Nevada |
| Spenceville | 39.11556 | -121.27050 | Nevada | Copper | Silver, Gold | Sierra Nevada |
| Dairy Farm Trent, Vantrent | 39.03083 | -121.28800 | Placer | Copper, Gold | Silver | Sierra Nevada |
| Valley View | 38.97722 | -121.25690 | Placer | Copper | Silver, Gold, Lead, Zinc | Sierra Nevada |
| Engels | 40.20333 | -120.77360 | Plumas | Copper | Gold, Silver | Sierra Nevada |
| Superior | 40.20333 | -120.77360 | Plumas | Copper | Gold, Silver | Sierra Nevada |
| Walker | 39.96028 | -120.66750 | Plumas | Copper | Silver, Gold | Sierra Nevada |
| Copper World Mine | 35.50530 | -115.60280 | San Bernardino | Copper | | Mojave Desert |
| Bagdad-Chase Mine | 34.62750 | -116.16690 | San Bernardino | Copper, Gold | Silver | Mojave Desert |
| Afterthought | 40.73610 | -122.08220 | Shasta | Copper | | Klamath Mountains |
| Balaklala | 40.72528 | -122.49800 | Shasta | Copper | Silver, Gold, Iron | Klamath Mountains |
| Bully Hill | 40.79917 | -122.20270 | Shasta | Copper | Zinc, Silver, Gold | Klamath Mountains |
| Hornet | | | Shasta | | | Klamath Mountains |
| Iron Mountain Mine | 40.67556 | -122.52660 | Shasta | Copper, Zinc | Gold, PGE - Platinum, Iron, Silver | Klamath Mountains |
| Keystone Mine | 40.72110 | -122.51390 | Shasta | Gold, Copper, Zinc, Silver | | Klamath Mountains |
| Mammoth Mine | 40.76310 | -122.45440 | Shasta | Copper | Gold, Silver, Zinc | Klamath Mountains |
| Rising Star | 40.79190 | -122.21580 | Shasta | Copper | | Klamath Mountains |
| Shasta King Mine | 40.72720 | -122.49690 | Shasta | Copper | Gold, Zinc, Silver | Klamath Mountains |
| Sutro Mine | 40.78310 | -122.45560 | Shasta | Copper | Gold, Zinc, Silver | Klamath Mountains |
| Blue Ledge | 41.95000 | -123.10000 | Siskiyou | Copper, Zinc | Silver, Gold, Lead | Klamath Mountains |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Gray Eagle | 41.86280 | -123.37170 | Siskiyou | Copper, Zinc, Silver, Gold | Cobalt, Lead | Klamath Mountains |
| Island Mountain Consolidated | 40.03333 | -123.48410 | Trinity | Copper | Silver, Gold | Klamath Mountains |
| **Feldspar** | | | | | | |
| W H Childers | 37.13530 | -119.54000 | Fresno | Feldspar | | Sierra Nevada |
| Jens Deposit | 36.58280 | -121.40310 | Monterey | Feldspar | | Coast Ranges |
| Carter Deposit | 36.44170 | -118.89170 | Tulare | Feldspar | | Sierra Nevada |
| Nine Mile Canyon | 35.84080 | -117.93530 | Inyo | Feldspar | | Basin & Range |
| White Butte Deposit | 35.23860 | -117.30330 | San Bernardino | Feldspar | | Mojave Desert |
| Sweetzer (Rosamond) | | | Kern | | | Sierra Nevada |
| Swan | | | San Bernardino | | | Mojave Desert |
| Riverside Portland Cement Company | 33.79080 | -117.10720 | Riverside | Feldspar | | Peninsular Range |
| Blom Mine | 33.64890 | -117.19670 | Riverside | Feldspar | | Peninsular Range |
| American Encaustic Tiling Co. | 33.59390 | -117.20170 | Riverside | Feldspar | | Peninsular Range |
| Mcginty Mtn Deposit Dehesa Cornty | 32.75444 | -116.85910 | San Diego | Feldspar | | Peninsular Range |
| Pacific Mine | 32.66390 | -116.53530 | San Diego | Feldspar | | Peninsular Range |
| Elder | | | San Diego | | | Peninsular Range |

**Gold Dredge Fields**

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Yuba | | | Sierra Nevada |
| | | | Sacramento | | | Sierra Nevada |
| | | | Butte | | | Sierra Nevada |
| | | | Merced | | | Sierra Nevada |

**Gold Lode Mines**

| | | | | | | |
|---|---|---|---|---|---|---|
| Empire Mines Co. | 39.20556 | -121.04500 | Nevada | Gold | Lead, Zinc, Silver, Copper | Sierra Nevada |
| North Star | 39.19417 | -121.14500 | Nevada | Gold | Copper, Lead, Zinc | Sierra Nevada |
| Pennsylvania | 39.20860 | -121.05530 | Nevada | Gold | | Sierra Nevada |
| Brunswick | 39.21333 | -121.03770 | Nevada | Gold | Silver, Copper, Lead, Zinc | Sierra Nevada |
| Idaho Lode | 39.21722 | -121.03660 | Nevada | Gold | | Sierra Nevada |
| Central Eureka Mine | 38.38310 | -120.79690 | Amador | Gold | | Sierra Nevada |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Kennedy | 38.36722 | -120.77910 | Amador | Gold | Lead | Sierra Nevada |
| Carson Hill Gold Mining Co. | 38.02194 | -120.50160 | Calaveras | Gold | Silver | Sierra Nevada |
| Argonaut | 38.36306 | -120.78520 | Amador | Gold | | Sierra Nevada |
| Original Sixteen To One Mine | 39.46580 | -120.84280 | Sierra | Gold | | Sierra Nevada |
| Keystone | 38.41806 | -120.82190 | Amador | Gold | | Sierra Nevada |
| Standard Mine | 38.21140 | -118.99690 | Mono | Gold | | Basin & Range |
| Utica No 2 | 38.08278 | -120.58440 | Calaveras | Gold | | Sierra Nevada |
| Sierra Buttes | 39.57528 | -120.64300 | Sierra | Gold | Silver | Sierra Nevada |
| Brown Bear | 40.72360 | -122.72920 | Trinity | Gold | | Klamath Mountains |
| Plymouth Consolidated Group | 38.47530 | -120.84330 | Amador | Gold | | Sierra Nevada |
| Yellow Aster Mine | 35.35690 | -117.66190 | Kern | Gold | | Mojave Desert |
| Lava Cap | 39.22780 | -120.97000 | Nevada | Gold | | Sierra Nevada |
| Golden Queen Mine | 34.99190 | -118.18720 | Kern | Gold | | Mojave Desert |
| Plumas-Eureka | 39.75720 | -120.70940 | Plumas | Gold | | Sierra Nevada |
| Eagle-Shawmut Mine | 37.86810 | -120.40000 | Tuolumne | Gold | | Sierra Nevada |
| Gwin Mine | 38.27560 | -120.75970 | Calaveras | Gold | | Sierra Nevada |
| Sheep Ranch | | | Calaveras | | | Sierra Nevada |
| Gladstone | 40.72500 | -122.58500 | Shasta | Gold | | Klamath Mountains |
| Georgia Slide | 38.92560 | -120.84720 | El Dorado | Gold | | Sierra Nevada |
| Dutch-App Group | 37.92583 | -120.42300 | Tuolumne | Gold | | Sierra Nevada |
| Bagdad-Chase Mine | | | | multiple commodities, see Copper | | Mojave Desert |
| Rawhide | 37.96139 | -120.44470 | Tuolumne | Gold | | Sierra Nevada |
| Soulsby Group | 37.98833 | -120.26190 | Tuolumne | Gold | | Sierra Nevada |
| South Eureka | 38.38030 | -120.79500 | Amador | Gold | | Sierra Nevada |
| Bunker Hill Mine | 38.42500 | -120.82360 | Amador | Gold | | Sierra Nevada |
| Cactus Queen Mine | 34.95778 | -118.28660 | Kern | Silver, Gold | | Mojave Desert |
| Fremont-Gover Inc. Loyal Lode | 38.43889 | -120.83080 | Amador | Gold | | Sierra Nevada |
| Jumper & Golden Rule Group | 37.91000 | -120.41330 | Tuolumne | Gold | Silver | Sierra Nevada |
| Princeton | 37.50190 | -119.97000 | Mariposa | Gold | | Sierra Nevada |
| Providence Gold Qtz | 39.25528 | -121.03500 | Nevada | Gold | | Sierra Nevada |
| Royal Mine | 38.00190 | -120.68940 | Calaveras | Gold | | Sierra Nevada |
| Wildman | 38.39390 | -120.80000 | Amador | Gold | | Sierra Nevada |
| Zeile Mine | 38.34500 | -120.76280 | Amador | Gold | | Sierra Nevada |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Confidence | 38.04360 | -120.20780 | Tuolumne | Gold | | Sierra Nevada |
| Brush Creek | 39.50170 | -120.88030 | Sierra | Gold | | Sierra Nevada |
| Midas | 40.38970 | -122.98420 | Shasta | Gold | | Klamath Mountains |
| Pine Tree Josephine Mine | 37.59580 | -120.12250 | Mariposa | Gold | | Sierra Nevada |
| Mount Gaines Mine | 37.53970 | -120.17690 | Mariposa | Gold | | Sierra Nevada |
| Black Oak Group | 37.97028 | -120.27580 | Tuolumne | Gold | | Sierra Nevada |
| Plumbago | 39.45278 | -120.81160 | Sierra | Gold | | Sierra Nevada |
| Original Amador Mine | 38.42310 | -120.82610 | Amador | Gold | | Sierra Nevada |
| Clearinghouse | 37.67330 | -119.86390 | Mariposa | Gold | | Sierra Nevada |
| Angels Mine | 38.07556 | -120.54660 | Calaveras | Gold | | Sierra Nevada |
| Black Bear | 41.25222 | -123.16110 | Siskiyou | Gold | | Klamath Mountains |
| Champion Con Qtz | 39.26222 | -121.03720 | Nevada | Gold | Silver, Zinc, Lead, Copper | Sierra Nevada |
| Siskon Mine | 41.57860 | -123.64170 | Siskiyou | Gold | | Klamath Mountains |
| Hite | 37.64580 | -119.86420 | Mariposa | Gold | | Sierra Nevada |
| **Gold Hydraulic Mines** | | | | | | |
| Alpha Lode | 39.24610 | -121.00110 | Nevada | Gold | | Sierra Nevada |
| Badger Hill And Cherokee | 39.37000 | -121.03170 | Nevada | Gold | | Sierra Nevada |
| Blue Tent | 39.33830 | -120.84190 | Nevada | Gold | | Sierra Nevada |
| Brandy City Mine | 39.54030 | -121.01940 | Sierra | Gold | | Sierra Nevada |
| Buckeye Hill | | | Nevada | | | Sierra Nevada |
| Cherokee Placer | 39.64030 | -121.54670 | Butte | Gold | | Sierra Nevada |
| Craigs Flat Placer Diggings | 39.63778 | -120.91300 | Sierra | Gold | | Sierra Nevada |
| Deadwood | | | Placer | | | Sierra Nevada |
| Depot Hill | 39.48780 | -121.01080 | Sierra | Gold | | Sierra Nevada |
| Dutch Flat | | | Placer | | | Sierra Nevada |
| Elephant Hydraulic | 38.46083 | -120.64110 | Amador | Gold | | Sierra Nevada |
| French Corral Dredge | 38.92560 | -120.98970 | El Dorado | Gold | | Sierra Nevada |
| Gibsonville | 39.74280 | -120.87690 | Sierra | Chromium | | Sierra Nevada |
| Howland Flat | | | Sierra | | | Sierra Nevada |
| Indian Diggings Creek | 38.54060 | -120.58440 | El Dorado | Gold | | Sierra Nevada |
| Indian Hill | 39.50780 | -120.99560 | Sierra | Gold | | Sierra Nevada |
| Iowa Hill | 39.03080 | -120.82940 | Placer | Gold | | Sierra Nevada |
| La Porte | 39.69440 | -120.97670 | Plumas | Gold | | Sierra Nevada |
| Last Chance | | | Placer | | | Sierra Nevada |
| Liberty Hill Con | 39.20389 | -121.05500 | Nevada | Gold | | Sierra Nevada |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Lost Camp Hydraulic Mine | 39.23920 | -120.71330 | Placer | Gold | | Sierra Nevada |
| Lowell Hill | 39.26640 | -120.77830 | Nevada | Gold | | Sierra Nevada |
| Malakoff | | | Nevada | | | Sierra Nevada |
| Mayflower | 39.04080 | -120.81750 | Placer | Gold | | Sierra Nevada |
| Michigan Bluff | 39.04280 | -120.74440 | Placer | Gold | | Sierra Nevada |
| Minnesota Flat | 39.42420 | -120.84060 | Sierra | Gold | | Sierra Nevada |
| Moore's Flat | | | Nevada | | | Sierra Nevada |
| Morristown And Angora Group | 39.65280 | -120.90330 | Sierra | Gold | | Sierra Nevada |
| North Columbia | 39.26667 | -120.80000 | Nevada | Gold | | Sierra Nevada |
| Omega | 39.33860 | -120.76000 | Nevada | Gold | | Sierra Nevada |
| Patagon | | | Placer | | | Sierra Nevada |
| Port Wine | | | Sierra | | | Sierra Nevada |
| Poverty Hill | 39.62944 | -121.00300 | Sierra | Gold | | Sierra Nevada |
| Quaker Hill | 39.23780 | -120.89940 | Nevada | Gold | | Sierra Nevada |
| Red Dog Group | 39.25140 | -120.84420 | Nevada | Gold | | Sierra Nevada |
| Relief Hill | 39.36139 | -120.86080 | Nevada | Gold | PGE - Platinum | Sierra Nevada |
| Remington Hill | | | Nevada | | | Sierra Nevada |
| Saw Pit Mine | 39.79170 | -120.88110 | Plumas | Gold | | Sierra Nevada |
| Scales Placer Mng Co | 39.59806 | -120.99000 | Sierra | Gold | | Sierra Nevada |
| Scotts Flat | 39.41670 | -120.86670 | Nevada | Gold | | Sierra Nevada |
| Smartsville | | | Yuba | | | Sierra Nevada |
| Stewart Gravel Mines | 39.16310 | -120.84720 | Placer | Gold | | Sierra Nevada |
| Texas Hill | 38.72000 | -120.76280 | El Dorado | Gold | | Sierra Nevada |
| Todd Valley | | | Placer | | | Sierra Nevada |
| Whiskey Creek No. 1 | 39.62360 | -120.86500 | Sierra | Gold | | Sierra Nevada |
| Yankee Jim Diggings | 39.03083 | -120.86410 | Placer | Gold | | Sierra Nevada |
| You Bet Group | 32.90861 | -116.51630 | San Diego | Gold | | Sierra Nevada |
| **Gold Drift Mines** | | | | | | |
| Bald Mountain | 39.50917 | -120.83830 | Sierra | Gold | | Sierra Nevada |
| Big Dipper | 39.09060 | -120.84580 | Placer | Gold | | Sierra Nevada |
| Blue Lead Mine | 39.40690 | -121.44470 | Butte | Gold | | Sierra Nevada |
| Calaveras Central Mine | 38.20166 | -120.54470 | Calaveras | Gold | | Sierra Nevada |
| Emma Drift Mine | 39.85220 | -121.62220 | Butte | Gold | | Sierra Nevada |
| Feather Fork Mine | 39.76667 | -120.93660 | Plumas | Gold | | Sierra Nevada |
| Glenn Cons | 39.12810 | -120.51940 | Placer | Gold | | Sierra Nevada |
| Hespidam | | | Plumas | | | Sierra Nevada |
| Hidden Treasure Mine | 39.09690 | -120.71220 | Placer | Gold | | Sierra Nevada |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Hook-and-Ladder | | | El Dorado | | | Sierra Nevada |
| Indian Springs | 39.87500 | -121.63030 | Butte | Gold | | Sierra Nevada |
| Live Yankee | 39.48420 | -120.85610 | Sierra | Gold | | Sierra Nevada |
| Lyon | 38.72640 | -120.76060 | El Dorado | Gold | | Sierra Nevada |
| Magalia | 39.84420 | -121.58860 | Butte | Gold | | Sierra Nevada |
| Morning Star | 39.10360 | -120.83440 | Placer | Gold | | Sierra Nevada |
| Morris Ravine | 39.56610 | -121.54440 | Butte | Gold | | Sierra Nevada |
| Mountain Gate Mine | 39.14360 | -120.71330 | Placer | Gold | | Sierra Nevada |
| Occidental | 39.08830 | -120.82780 | Placer | Gold | | Sierra Nevada |
| Pacific Slab Mine | 39.10330 | -120.64250 | Placer | Gold | | Sierra Nevada |
| Perschbaker | | | Butte | | | Sierra Nevada |
| Royal Drift | 39.90860 | -121.62390 | Butte | Gold | | Sierra Nevada |
| Ruby | 39.51861 | -120.84520 | Sierra | Gold | | Sierra Nevada |
| Startown | | | Placer | | | Sierra Nevada |
| Tiedemann | 38.94220 | -120.74280 | El Dorado | Gold | | Sierra Nevada |
| Vallecito Western Mine Bishop Estate | 38.20166 | -120.54470 | Calaveras | Gold, Silver | | Sierra Nevada |
| **Lead** | | | | | | |
| Big Bend | 39.69167 | -121.43130 | Butte | Zinc, Copper | Gold, Silver, Lead | Sierra Nevada |
| Collier | 38.13940 | -120.38940 | Calaveras | Gold | | Sierra Nevada |
| Penn | 38.23028 | -120.87380 | Calaveras | Zinc, Copper | Lead, Gold, Silver | Sierra Nevada |
| Quail Hill | 37.96111 | -120.74910 | Calaveras | Zinc, Copper | Lead, Gold, Silver | Sierra Nevada |
| Cerro Gordo Mine | 36.53970 | -117.79280 | Inyo | Lead | | Basin & Range |
| Copper Queen | 35.80060 | -117.27750 | Inyo | Lead | | Basin & Range |
| Darwin Mines | 36.27580 | -117.59530 | Inyo | Lead | | Basin & Range |
| Estelle | 36.52170 | -117.81330 | Inyo | Lead | | Basin & Range |
| Shoshone Mines | 35.80920 | -116.10220 | Inyo | Lead | | Basin & Range |
| Zinc Hill | 36.31170 | -117.50190 | Inyo | Zinc | | Basin & Range |
| Black Jack | 33.38528 | -118.40520 | Los Angeles | Lead | Copper, Zinc, Silver | Peninsular Range |
| Blue Moon | 37.54690 | -120.27440 | Mariposa | Zinc | Silver, Lead, Gold, Copper | Sierra Nevada |
| Blue Light Mine | 33.74780 | -117.58080 | Orange | Lead | | Peninsular Range |
| Carbonate King | 35.61720 | -115.49000 | San Bernardino | Lead | | Mojave Desert |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Mohawk Mine | 35.47860 | -115.61690 | San Bernardino | Lead | | Mojave Desert |
| Afterthought | 40.73610 | -122.08220 | Shasta | Copper | | Klamath Mountains |
| Bully Hill | 40.80140 | -122.19580 | Shasta | Copper, Zinc, Silver, Gold | | Klamath Mountains |
| Iron Mountain Mine | 40.67556 | -122.52660 | Shasta | Copper, Zinc | Gold, Platinum, Iron, Silver | Klamath Mountains |
| Mammoth | 40.76306 | -122.45440 | Shasta | Copper, Zinc | Silver, Gold | Klamath Mountains |
| Rising Star | 40.79190 | -122.21580 | Shasta | Copper | | Klamath Mountains |
| Blue Ledge | 41.95000 | -123.10000 | Siskiyou | Copper, Zinc | Silver, Gold, Lead | Klamath Mountains |
| **Limestone** | | | | | | |
| Calaveras Cement Company | | | Calaveras | | | Sierra Nevada |
| Henry Cowell Lime & Cement Co. | | | Contra Costa | | | Coast Ranges |
| Auburn Lime Company | | | El Dorado | | | Sierra Nevada |
| Cowell Cave Valley Deposit | | | El Dorado | | | Sierra Nevada |
| Diamond Springs Lime Company | | | El Dorado | | | Sierra Nevada |
| El Dorado Limestone Compnay | | | El Dorado | | | Sierra Nevada |
| Monolith Portland Cement Company | | | Kern | | | Sierra Nevada |
| Jameson Lime Company | | | Kern | | | Sierra Nevada |
| Union Lime Company | | | Kern | | | Sierra Nevada |
| **Magnesite** | | | | | | |
| Bald Eagle Mine | | | Stanislaus | | | Coast Ranges |
| Cedar Mountain | 37.55944 | -121.62750 | Alameda | Magnesite | | Coast Ranges |
| Fresno | 36.81640 | -119.37190 | Fresno | Magnesite | | Sierra Nevada |
| Gray Eagle | 37.84670 | -120.43190 | Tuolumne | Magnesite | | Sierra Nevada |
| Porterville | 36.10140 | -118.97940 | Tulare | Magnesite | | Sierra Nevada |
| Hemet | | | Riverside | | | Peninsular Range |
| Hixon Ranch | | | Mendocino | | | Coast Ranges |
| Kings Magnesite Co. | 35.90560 | -120.26140 | Kings | Magnesite | | Coast Ranges |
| Red Mountain | 37.41720 | -121.45360 | Stanislaus | Magnesite | | Coast Ranges |
| Sonoma Magnesite | 38.61560 | -123.09140 | Sonoma | Magnesite | | Coast Ranges |
| Sampson Magnesite Mine | 36.40580 | -120.72580 | San Benito | Magnesite | | Coast Ranges |
| Maltby No 2 Mine | 38.51360 | -122.31170 | Napa | Magnesite | | Coast Ranges |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Success | | | Tulare | | | Sierra Nevada |
| Sullivan | 39.24250 | -120.77780 | Placer | Magnesite | | Sierra Nevada |
| Western Mine | 37.41140 | -121.48830 | Santa Clara | Magnesite | | Coast Ranges |
| White Rock Mine | 38.73670 | -122.37140 | Napa | Magnesite | | Coast Ranges |
| Ball | 34.64167 | -117.07690 | San Bernardino | Magnesite | | Mojave Desert |
| New Trail Magnesite Deposit | 35.38310 | -115.47860 | San Bernardino | Magnesite | | Mojave Desert |
| Richter Dolomite Deposit | 34.60110 | -116.96390 | San Bernardino | Dolomite | | Mojave Desert |
| Afton | | | San Bernardino | | | Mojave Desert |
| Bissell Magnesite Deposit | 34.98310 | -118.00940 | Kern | Magnesite | | Mojave Desert |
| Capitan | 34.74720 | -114.82640 | San Bernardino | Magnesite | | Mojave Desert |
| Kramer | | | San Bernardino | Magnesite | | Mojave Desert |
| Needles Magnesite Deposit | 34.77640 | -114.77560 | San Bernardino | Magnesite | | Mojave Desert |
| American Magnesium Mine | 35.71667 | -116.93330 | San Bernardino | Magnesite | | Basin & Range |
| **Manganese** | | | | | | |
| Ladd Mine | 37.60667 | -121.49580 | San Joaquin | Manganese | | Coast Ranges |
| Buckeye Mine | 37.52722 | -121.39440 | Stanislaus | Manganese | | Coast Ranges |
| Pioneer (Tolbard) | | | Imperial | Manganese | | Mojave Desert |
| Black Jack Mine | 37.59139 | -121.60690 | Alameda | Manganese | | Coast Ranges |
| New Deal Mine | 35.64889 | -116.69720 | San Bernardino | Manganese | | Basin & Range |
| Langdon Deposit | 33.84194 | -114.80020 | Riverside | Manganese | | Mojave Desert |
| Foster Mountain Independent, Busch, Lucky Boy | 39.44083 | -123.17720 | Mendocino | Manganese | | Coast Ranges |
| Blue Jay Mine | 40.11194 | -123.24500 | Trinity | Manganese | | Coast Ranges |
| Thomas Mountain | | | Mendocino | Manganese | | Coast Ranges |
| Fort Seward | 40.20083 | -123.71020 | Humboldt | Manganese | | Coast Ranges |
| Hale Creek Mine | 40.36611 | -123.46750 | Trinity | Manganese | | Coast Ranges |
| Liberty Mine | 37.54000 | -121.37160 | Stanislaus | Manganese | | Coast Ranges |
| Welch Mine | 35.27056 | -120.77770 | San Luis Obispo | Manganese | | Coast Ranges |
| Fort Baker | 40.59444 | -123.75660 | Humboldt | Manganese | | Coast Ranges |
| Manganese Canyon | | | Riverside | Manganese | | Mojave Desert |
| Linser | 39.98444 | -123.63610 | Mendocino | Manganese | | Coast Ranges |
| Big Reef | 34.80583 | -116.33830 | San Bernardino | Manganese | | Mojave Desert |
| Lee Yim | 34.76056 | -116.22720 | San Bernardino | Manganese | | Mojave Desert |
| Cummings Mine | 37.58417 | -121.48380 | San Joaquin | Manganese | | Coast Ranges |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Fabian Mine | 37.61111 | -121.50000 | San Joaquin | Manganese | | Coast Ranges |
| Monument King | 34.29306 | -114.29690 | San Bernardino | Manganese | | Mojave Desert |
| **Mercury** | | | | | | |
| New Almaden Mine | 37.17920 | -121.84190 | Santa Clara | Mercury | | Coast Ranges |
| New Idria Mine | 36.39860 | -120.66500 | San Benito | Mercury | | Coast Ranges |
| Oat Hill Mine | 38.67500 | -122.52750 | Napa | Mercury | | Coast Ranges |
| Sulphur Bank | 39.00389 | -122.66470 | Lake | Mercury, Sulfur | | Coast Ranges |
| Knoxville | 38.82530 | -122.33890 | Napa | Mercury | | Coast Ranges |
| Guadalupe Mine | 37.20890 | -121.90170 | Santa Clara | Mercury | | Coast Ranges |
| Great Western | 38.69194 | -122.63080 | Lake | Mercury | Chromium | Coast Ranges |
| Mount Jackson/Great Eastern | 38.54390 | -122.98140 | Sonoma | Mercury | | Coast Ranges |
| Aetna | 38.65750 | -122.50220 | Napa | Mercury | | Coast Ranges |
| Mirabel Mine | 38.70000 | -122.60110 | Lake | Mercury | | Coast Ranges |
| Oceanic Mine | 35.58530 | -120.99970 | San Luis Obispo | Mercury | | Coast Ranges |
| Altoona | 41.13640 | -122.54560 | Trinity | Mercury | | Klamath Mountains |
| Klau Mine | 35.62080 | -120.89940 | San Luis Obispo | Mercury | | Coast Ranges |
| Reed Mine | 38.86500 | -122.37060 | Yolo | Mercury | | Coast Ranges |
| Cloverdale | 38.82330 | -122.86750 | Sonoma | Mercury | | Coast Ranges |
| Abbott Mine | 39.02060 | -122.44390 | Lake | Mercury | | Coast Ranges |
| St. John Mine | 38.15190 | -122.19170 | Solano | Mercury | | Coast Ranges |
| Helen Mine | 38.74110 | -122.70000 | Lake | Mercury | | Coast Ranges |
| Culver Bear | 38.78080 | -122.81780 | Sonoma | Mercury | | Coast Ranges |
| Manhatten Mine | 38.83830 | -122.36330 | Napa | Mercury | | Coast Ranges |
| **Pyrite** | | | | | | |
| Iron Mountain | | | Shasta | Pyrite | | Klamath Mountains |
| Boss Mine | 39.35250 | -121.13330 | Nevada | Gold | | Sierra Nevada |
| Spenceville | | | Nevada | Pyrite | | Sierra Nevada |
| Leona | | | Alameda | Pyrite | | Coast Ranges |
| Alma | | | Alameda | Pyrite | | Coast Ranges |
| **Silver** | | | | | | |
| Blind Springs Hill | 37.77333 | -118.49300 | Mono | Silver | Lead, Copper, Gold | Basin & Range |
| Panamint | 36.10000 | -117.08330 | Inyo | Silver | | Basin & Range |
| Panamint Mines | 36.11580 | -117.09720 | Inyo | Silver | | Basin & |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| | | | | | | Range |
| Silver Falls | 40.52720 | -122.57690 | Shasta | Silver | | Klamath Mountains |
| Silverfalls - Chicago Consol. | 40.52750 | -122.57720 | Shasta | Silver | Copper, Zinc, Gold, Lead | Klamath Mountains |
| Calico | 34.96667 | -116.86660 | San Bernardino | Silver | | Mojave Desert |
| Kelly Mine | 35.35310 | -117.62420 | San Bernardino | Silver | | Mojave Desert |
| Waterman | 34.95778 | -117.02110 | San Bernardino | Silver | | Mojave Desert |
| Waterman Mine | 34.96170 | -117.02920 | San Bernardino | Silver | | Mojave Desert |
| **Strontium** | | | | | | |
| Avawatz Salt and Gypsum Co. | | | San Bernardino | Strontium | | Basin & Range |
| Du Pont | | | San Bernardino | Strontium | | Mojave Desert |
| Roberts And Peeler | 33.04530 | -116.10420 | San Diego | Strontium | | Peninsular Range |
| Dupont, Rowe And Buehler | 34.75810 | -116.27670 | San Bernardino | Strontium | | Mojave Desert |
| Ross | 35.01920 | -116.91030 | San Bernardino | Strontium | | Mojave Desert |
| Solomon | | | San Bernardino | Strontium | | Mojave Desert |
| **Sulfur** | | | | | | |
| Chalk Mountain deposit | | | Lake | Sulfur | | Coast Ranges |
| Coyote Mountain deposit | | | Imperial | Sulfur | | Peninsular Range |
| Elgin Mine | | | Colusa | Sulfur | | Coast Ranges |
| Full Moon Sulfur Deposit | 33.25190 | -115.25580 | Imperial | Sulfur | | Mojave Desert |
| Lost Chance Range | | | Inyo | Sulfur | | Basin & Range |
| Leviathan | 38.71222 | -119.65660 | Alpine | Sulfur, Copper | Silver, Gold | Basin & Range |
| Seward property | | | Lake | | | Coast Ranges |
| Sulphur Bank | 39.00389 | -122.66470 | Lake | Mercury, Sulfur | | Coast Ranges |
| Sunset Oil District | | | Kern | | | Coast Ranges |
| Supan Sulphur Works | | | Shasta | | | Cascade |
| Leona | 37.78310 | -122.17030 | Alameda | Sulfur | | Coast Ranges |
| Iron Mountain Mine | 40.68810 | -122.53030 | Shasta | Copper | Silver, Zinc, Gold | Klamath Mountains |
| **Talc** | | | | | | |
| Alliance Talc Mine | 36.34140 | -117.67140 | Inyo | Talc-Soapstone | | Basin & Range |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Amargosa Mine | 35.78330 | -116.20220 | San Bernardino | Talc-Soapstone | | Basin & Range |
| Booth Mine | 35.76110 | -116.05970 | San Bernardino | Talc-Soapstone | | Basin & Range |
| Eclipse | 35.84280 | -116.38000 | Inyo | Talc-Soapstone | | Basin & Range |
| Florence Talc Mine | 36.58000 | -117.78170 | Inyo | Talc-Soapstone | | Basin & Range |
| Silver Lake Mine | 35.45720 | -116.02000 | San Bernardino | Talc-Soapstone | | Basin & Range |
| Talc City Mine | 36.33330 | -117.66830 | Inyo | Talc-Soapstone | | Basin & Range |
| Western Mine & Dunn Mill | 35.78080 | -116.12470 | San Bernardino | Talc-Soapstone | | Basin & Range |
| White Eagle Talc Mine | 36.83720 | -117.93220 | Inyo | Talc-Soapstone | | Basin & Range |
| White Mountain | 36.58333 | -117.80580 | Inyo | Talc-Soapstone | | Basin & Range |
| **Tungsten** | | | | | | |
| Black Rock Mine | 37.68310 | -118.52690 | Mono | Tungsten | | Basin & Range |
| Strawberry Mine | 37.54970 | -119.29080 | Madera | Tungsten | Molybdenum | Sierra Nevada |
| Adamson Mine | 37.36170 | -118.70330 | Inyo | Tungsten | Copper, Molybdenum | Sierra Nevada |
| Pine Creek Tungsten Mine & Mill | 37.36170 | -118.70330 | Inyo | Tungsten | Molybdenum, Copper | Sierra Nevada |
| Round Valley | 37.35000 | -118.53330 | Inyo | Tungsten | | Sierra Nevada |
| Little Sister | 37.34720 | -118.52970 | Inyo | Tungsten | | Sierra Nevada |
| Garnet Dike | 36.87750 | -119.01190 | Fresno | Tungsten | | Sierra Nevada |
| Consolidated Tungsten Mine | 36.63720 | -119.11310 | Tulare | Tungsten | | Sierra Nevada |
| Tulare County Tungsten | 36.28333 | -118.91660 | Tulare | Tungsten | | Sierra Nevada |
| Tungstore Mine | 35.79360 | -118.66060 | Tulare | Tungsten | | Sierra Nevada |
| Durham | 36.26860 | -117.57110 | Inyo | Tungsten | | Basin & Range |
| Atolia-Rand Placers | 35.30333 | -117.62690 | San Bernardino | Tungsten | | Mojave Desert |
| Starbright Tungsten Mine | 35.12280 | -116.90890 | San Bernardino | Tungsten | | Mojave Desert |
| **Zinc** | | | | | | |
| Big Bend | 39.69167 | -121.43130 | Butte | Zinc, Copper | Gold, Silver, Lead | Sierra Nevada |

| Mine Name | Latitude | Longitude | County | Major Commodity | Minor Commod. | Geomorphic Province |
|---|---|---|---|---|---|---|
| Napoleon | 37.92750 | -120.72880 | Calaveras | Copper | Gold, Silver, Zinc | Sierra Nevada |
| Penn Mine | 38.23000 | -120.87330 | Calaveras | Copper | | Sierra Nevada |
| Quail Hill | 37.96110 | -120.74890 | Calaveras | Copper | | Sierra Nevada |
| Cerro Gordo Mine | 36.53970 | -117.79280 | Inyo | Lead | | Basin & Range |
| Darwin Mines | 36.27580 | -117.59530 | Inyo | Lead | | Basin & Range |
| Black Jack | 33.38528 | -118.40520 | Los Angeles | Lead | Copper, Zinc, Silver | Peninsular Range |
| Blue Moon | 37.54690 | -120.27440 | Mariposa | Zinc | Silver, Lead, Gold, Copper | Sierra Nevada |
| Carbonate King | 35.61720 | -115.49000 | San Bernardino | Lead | | Mojave Desert |
| Mohawk Mine | 35.47860 | -115.61690 | San Bernardino | Lead | | Mojave Desert |
| Afterthought | 40.73610 | -122.08220 | Shasta | Copper | | Klamath Mountains |
| Bully Hill | 40.79917 | -122.20270 | Shasta | Copper | Zinc, Silver, Gold | Klamath Mountains |
| Bully Hill | 40.80140 | -122.19580 | Shasta | Copper, Zinc, Silver, Gold | | Klamath Mountains |
| Mammoth Mine | 40.76310 | -122.45440 | Shasta | Copper | Gold, Silver, Zinc | Klamath Mountains |
| Iron Mountain Mine | 40.67556 | -122.52660 | Shasta | Copper, Zinc | Gold, Platinum, Iron, Silver | Klamath Mountains |

# Appendix B:
# Mineral Commodities of California

Entries in this appendix are commodities listed in *Mineral Commodities of California*. A total of 77 commodities are listed in that source. Mineral commodities selected for this study are those that were industrially mined and played an important role in local, state, regional or national economies prior to 1940. A total of 19 commodities met these criteria and are identified as "commercial" in this study. Rationale for exclusion of other commodities is also presented.

| Mineral | Inclusion | Commentary | Localities |
|---|---|---|---|
| abrasives | non-mining methods | | |
| aluminum | non-commercial deposits | No bauxite deposits can be commercially developed in California because the occurrence is in small scattered deposits. | |
| antimony | non-commercial deposits | Antimony was mined in California as early as 1887, but only a few hundred tons of the metal was produced. More than half of the antimony production was during the period 1915-1917 due to high wartime prices. | |
| arsenic | non-commercial deposits | Arsenical ores are usually avoided because arsenic is a nuisance during refining. It is recovered in small amounts at scavenger smelters, a byproduct of the refining of other metals. | |
| asbestos | non-commercial deposits | Deposits of potential commercial asbestos are rare in California. Production has been small and sporadic. | |
| asphalt and bituminous rock | construction commodity, exclude from this volume | | |
| barite | commercial | From 1910 to 1952, California produced approximately 540,000 tons of barite valued at $3,650,000. | Mined at 16 locations. |
| beryllium | non-commercial deposits | The beryl deposits of California are sparsely distributed and have not been exploited as a source of beryllium. There has been limited gemstone production. | |
| bismuth | non-commercial deposits | Bismuth production has been limited to about 20 tons of ore produced at a copper mine in Riverside County in 1904. | |
| black sands | non-commercial deposits | There has been no commercial market for black sands in California. Primary exploitation of black sands has been the extraction of gold and platinum. They occur throughout the state in water-borne sands and gravels. | |
| boron | commercial | California supplied 90% of the world's boron requirements in the mid-20th century. | Deposits of colemanite mined at Death Valley, Daggett, Los Angeles and Ventura Counties. Borates have been commercially produced at the Kramer deposit and Searles Lake. |
| bromine | salts | Bromine and bromine compounds were produced at the rate of 1000 tons per year in the mid-20th century. | Main production was at Newark from salt works bittern and at Trona from Searles Lake salts. |
| cadmium | byproduct of refining | Cadmium has been recovered as a byproduct of refining other ores, especially zinc. | Lead-zinc ores of Inyo and San Bernardino counties and copper-zinc ores of the Sierra Nevada foothills and Shasta county. |

| Mineral | Inclusion | Commentary | Localities |
|---|---|---|---|
| calcite | non-commercial deposits | None of the deposits in California was large enough to support a continuing mining operation. | |
| calcium chloride | salts | Calcium chloride has been mined commercially at a single playa (Bristol Lake) in San Bernardino County. Salts produced from this one mine constituted just under 5% of the US production in the middle of the 20th century. | |
| carbon dioxide | non-mining methods | Two fields, one at Hopland in Mendocino county and one at Salton Sea in Imperial County are credited with producing 3 billion cubic feet of carbon dioxide gas. | |
| cement | construction commodity, exclude from this volume | | |
| chromite | commercial | Between 1869 and 1955, California produced an estimated 534,000 tons of chromite valued at $20,800,000. About two-thirds of this output was mined during the World Wars. | |
| clay | construction commodity, exclude from this volume | | |
| coal | commercial | Between 1855 and 1954, California produced 5,290,000 tons of coal valued at $23,600,000 | Mount Diablo District, Corral Hollow District, Stone Canyon District, Ione District, Alder Hill area, Eel River District, Trinity County |
| cobalt | non-commercial deposits | Minor occurrences of cobalt are widespread but there has been very little commercial development. | Most discoveries of cobalt are associated with the copper belt in the Sierra foothills and the zinc-lead districts of southern California. |
| copper | commercial | Approximately 631,000 tons of copper were obtained from California deposits between 1860 and 1953. | There are 32 primary copper deposits (those which produced more than a million pounds of copper) located in 13 different counties. |
| diatomite (diatomaceous earth) | non-mining methods | | |
| feldspar | commercial | Between the early 1900's and 1955, California produced about 170,000 tons of potash feldspar from pegmatite sources. | There are 50 pegmatite feldspar properties in the state. The largest producer is located near Campo in San Diego County. |
| fluorspar | non-commercial deposits | Only a few hundred tons of fluorspar had been mined by the mid-20th century. | |

| Mineral | Inclusion | Commentary | Localities |
|---|---|---|---|
| gem stones | non-mining methods | Gem mining in California was most active between 1890 and 1912. There are about 50 principal localities. | Gem-bearing pegmatites in the Peninsular Ranges of San Diego and Riverside counties have yielded more than $2,000,000 worth of gemstones (tourmaline, spodumene, beryl, topaz, quartz and garnet). Other formal mining operations in California have yielded benitoite, chrysoprase, idocrase, jade, opal and turquoise. |
| gold | commercial | Between 1848 and 1954 California produced 103,000,000 fine ounces of gold valued at more than 2 1/3 billion dollars. | |
| graphite | non-commercial deposits | From 1865 to 1935 California produced only 1,500 tons of graphite. | The small production came entirely from Tuolumne, Mendocino, Sonoma and Los Angeles counties. |
| gypsum | construction commodity, exclude from this volume | | |
| iodine | salts | Extracted from brines as a byproduct of oil drilling in some fields. | Mainly Los Angeles county. |
| iron industries | non-commercial deposits | Prior to 1942 most iron and steel manufacture used materials imported from outside the state. | Minor operations in Placer and Shasta counties prior to World War I. |
| kyanite and andalusite | non-commercial deposits | The two deposits were mined between the 1920's and the mid-1940's. | Kyanite mined only near Ogilby in Imperial County. Andalusite mined only in the White Mountains of Mono County. |
| lead | commercial | California produced 450 million pounds of lead from 1877 through 1954, but this constituted less than 0.8% of the US production for the same time period. | Most of the lead produced in California is derived from the Cerro Gordo, Darwin and Tecopah districts in Inyo County. |
| limestone, dolomite and lime products | commercial | Played a significant role in the rapid industrial development of the state. | |
| lithium compounds | salts | | Recovered from Searles Lake brine. |
| magnesium compounds, magnesite | commercial | Large scale mining of magnesite prior to 1945. Important in supplying the US during World War I and World War II. | Chemical recovery from brines at Newark (Alameda County), Moss Landing (Monterey County) and South San Francisco (San Mateo County). Magnesite is associated with serpentine and occurs mainly in the Coast Ranges and the Sierra foothills. |
| manganese | commercial | Between 1867 and the middle of the 20th century California produced 230,000 tons. About 90% of the production occurred during the war years (1914-19 and 1941-45). | Deposits in more than 700 localities in 44 counties. |

| Mineral | Inclusion | Commentary | Localities |
|---|---|---|---|
| mercury | commercial | Only a few hundred tons of fluorspar had been mined by the mid-20th century. | 29 of the 30 mines that have been consistent producers of Mercury are located in the Coast Ranges. The largest producers were the New Almaden and New Idria mines. |
| mica | non-commercial deposits | | |
| minor metals | recovered and refined from smelter flue dust and residues | Cesium and rubidium are derived from pegmatite. Gallium, germanium, indium and thallium are recovered from zinc residues. Selenium is recovered from copper residues. Rhenium is derived from molybdenum processing. | No data are available on the distribution and recovery of these metals from California sources. |
| molybdenum | was not produced at commercial levels until 1939 | | Most of the production is from the Pine Creek mine in Inyo county where Tungsten-Molybdenum ores are mined. |
| natural gas | non-mining methods | First gas was produced at Stockton in 1854-58. Most natural gas is associated with oil production in California. | |
| nickel | non-commercial deposits | | Some prospecting in the Julian-Cuyamaca are of San Diego county. |
| nitrogen compounds | non-commercial deposits | There are no known commercial mineral sources in California. Most commercial nitrogen compounds (principally ammonium nitrate) are derived from atmospheric nitrogen. | |
| peat | non-mining methods | | Principally located in the Sacramento-San Joaquin Delta Region. |
| petroleum | non-mining methods | | |
| phosphate | non-commercial deposits | | |
| platinum and allied metals | byproduct of placer gold operations | About 25,000 ounces produced between 1850 and the mid-20th century. | Northwest California (Del Norte, Humboldt, Trinity and Shasta Counties) and the Sierra Nevada foothills from Butte to Merced counties. |
| pumice, pumicite, perlite and volcanic cinders | construction commodity, exclude from this volume | | 12 deposits have been exploited in seven areas: Glass Mountain, Coso, Bishop, Benton, Napa, Mono Craters and Friant. |
| pyrites | commercial | Pyrites includes the minerals pyrite, marcasite and pyrrhotite. | West-Shasta copper-zinc district is the principal production area. There were also two successful mines in Alameda County. |
| pyrophyllite | not mined commercially until 1945 | | Mono, San Bernardino and San Diego counties |

| Mineral | Inclusion | Commentary | Localities |
|---|---|---|---|
| quartz crystal (electronic grade) | only mined during World War II | Used in radio transmitters | Principally at Chili Gulch in Calaveras County. |
| quartzite and quartz | construction commodity, exclude from this volume | Used primarily in the manufacture of silica brick. | Most from San Bernardino and Inyo Counties |
| rare earth elements | These deposits were discovered in 1949-50 | The largest deposit of high-grade rare earth minerals in the western hemisphere is located in California. | Mountain Pass District, San Bernardino County |
| salines | salts | Primary minerals derived from saline are borates, bromine, calcium chloride, gypsum, iodine, potassium salts, salt, sodium carbonate and sodium sulfate. | There are 108 localities distributed throughout the state but Owens Lake (Inyo County) and Searles Lake (san Bernardino County are the largest. |
| salt | salts | Solar evaporation of sea water is the only method used on a commercial scale. | The Leslie Salt Company had 30,000 acres in San Francisco Bay devoted to salt production. There were a few smaller salt operations located in Alameda, Monterey, Orange and San Diego Counties. |
| sand and gravel | construction commodity, exclude from this volume | California produced more than $53 million worth of sand and gravel in 1953 and lead the nation in production. | Throughout the state with major producing districts at Healdsburg, Sacramento, Niles, Livermore, Tracy, San Fernando Valley, San Gabriel Valley, Orange County, San Bernardino and San Diego. |
| shale, expansible | construction commodity, exclude from this volume | Certain varieties of shale have been heated to produce lightweight aggregate | Principal operations were located in Solano, Marin, Santa Barbara and Ventura counties. |
| silver | commercial | Silver was first mined in California in 1825. California produced 105 million ounces of silver between 1880 and 1954. There are no production statistics prior to 1880. | San Bernardino, Inyo and Shasta counties were the main production areas where silver was the principal metal sought. Silver is also an important byproduct of gold mining. |
| sodium sulfate | salts | California produced 80 to 90 percent of the U.S. total in the 1950s. | Searles Lake |
| sodium carbonate | salts | California produced half of the nation's soda ash in the 1950s. | Searles Lake and Owens Lake. |
| specialty sands | non-mining methods | Specialty sands are high quality sands used for sand blasting sand, engine sand, foundry sand or glass manufacture. | Monterey County near Monterey and Pacific Grove |
| stone, crushed and broken | construction commodity, exclude from this volume | California production of crushed stone was $17.7 million in 1952. | There were 155 operations active during the 1950s. |
| stone, dimension | construction commodity, exclude from this volume | Dimension stone is used for building stone, monumental stone, paving stone, curbing and flagging. | There were 32 principal sources in 1956. |

| Mineral | Inclusion | Commentary | Localities |
|---|---|---|---|
| strontium minerals | commercial in World War years | Strontium minerals were mined from 1916-1918 and from 1939-1946 due to high demand and shipping difficulties during the war years. | Cady Mountains (San Bernardino County), Fish Creek Mountains (San Diego County), Aawatz Mountains (San Bernardino County). |
| sulfur & sulfuric acid | commercial | Almost all of the native-sulfur deposits in the state are associated with volcanic rocks. Sulfur mined in California is used principally for production of sulfuric acid. | Sulfur has been mined in Alpine, Colusa, Imperial, Inyo, Kern, Lake and Shasta Counties. The most important deposits are located in Alpine and Inyo counties. |
| talc and soapstone | commercial | A total of 1,830,000 tons of talc had been produced in California by 1956. Most of the California production was used in ceramics and paint. | More than 90% of the talc mined in California was derived from the Southern Death Valley and the Inyo Mountains. |
| thorium | non-commercial deposits | Thorium is a soft radioactive metal. California deposits are small and low-grade. | Most occurrences are located in the Mojave Desert. |
| tin | limited production in CA | Tin in California is derived from the mineral cassiterite. Mining began in Riverside County about 1853. | Production areas are located in southern California with the most important in the Temescal District of Riverside County and the Gorman District of Kern County. |
| titanium | non-commercial deposits | The total production of titanium from California deposits has been quite small. | Titanomagnetite was mined from localities in the San Gabriel Mountains of Los Angeles County. |
| tungsten | commercial | Tungsten mined in California between 1905 and 1954 was valued at $98,000,000. | There are 4 major sources located in Mono, Inyo, Kern and San Bernardino Counties. |
| uranium | commercial production post-dates World War II | By the mid 1950s some 200 to 300 uranium localities had been identified in California but there had been limited production. | Major sources clustered in the desert region of southern California, the southern Sierra Nevada, eastern Plumas County and southern Lassen County. |
| vanadium | non-commercial deposits | Vanadium is used primarily in steel production. | Kern, San Bernardino, Amador and Calaveras counties. |
| wollastonite | non-commercial deposits | This mineral has potential uses in ceramics. | Big Maria and Little Maria Mountains in Riverside County, Panamint Range in Inyo County, Shadow Mountains in San Bernardino County. |
| zinc | commercial | Most zinc is derived from sphalerite. Zinc ores are frequently encountered in association with lead. | Shasta, Calaveras, Inyo and San Bernardino counties and Santa Catalina Island. |
| zirconium and hafnium | non-commercial deposits | Primary uses are in refractories, foundry facings, ceramics and metal alloys. | Only recorded production was from a dragline dredge near Lincoln in Placer County. |