LIME LIGHT: THE LIME MANUFACTURING INDUSTRY IN 19th CENTURY OROVILLE, BUTTE COUNTY, CALIFORNIA

by

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ABSTRACT

William Gwynn's entrepreneurial character was the impetus behind the 1850s inception of the lime industry in Oroville, Butte County, along the West Branch of the Feather River. Gwynn recognized the need for collateral industries to gold mining, and the development of a network of small-scale operations, scattered throughout the Sierra foothill gold districts, supplied lime for construction and agriculture in these growing gold mining towns. The purpose of this study is to explore the role these smaller collateral industries – specifically, Oroville's lime-manufacturing industry – played in the long-term processes of community formation during the boom-bust economic times in an emergent capitalist society. In addition, this case study also serves to clarify the inception date of Oroville's lime industry.

Research on the topic of Oroville's lime-manufacturing industry was extensive, covering nearly ten counties within California. Historical documents reviewed include: tax assessments, deeds, and mining and water claims, as well as other official county documents; Mineralogy Reports; Department of Interior Preservation Briefs; newspapers; and maps. In addition, reports from previous archaeological studies were consulted.

This case study identified the actual establishment date of the lime-manufacturing industry in Oroville occurred in June of 1855, by William Gwynn, in partnership with two local businessmen. This information corrects earlier archaeological reports that claimed the industry began sometime between 1885 and 1892, and attributed its establishment to Augustine Parrish. Lime supplied by the West Branch Lime Kilns made its way to buildings in Oroville, Marysville, and elsewhere, as well as on General John Bidwell's rancho in Chico.

The masonry kilns that supplied lime for over 50 years on an intermittent basis, exhibit a basic level of technological sophistication. By investing only a small amount of capital into low-level technology, which required low maintenance costs, Gwynn and his partners could rely on hand labor to operate these satellite kilns to supply the local market with lime, while staying flexible in the ever-changing, mining-driven economy. This business strategy of diversification allowed for greater stability during the economic depressions of the nineteenth century.

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I have many people to thank for sharing their knowledge with me and/or encouraging me during the process of researching and writing my thesis. When I began, I knew nothing on the subject of processing limestone for manufacturing lime, and was only introduced to it after surveying in Butte County for the Oroville Facilities Relicensing project with the ASC. A diligent State Parks employee, John Rudderow, sought out our survey crew while in the Lime Saddle Recreation Area to inform us of some discrepancies he encountered while reading reports from the late 1970s about the lime industry in Oroville that didn't correspond to information he had discovered in his own research. After this encounter, John continued to share information he researched on his own time, which provided new avenues for me to pursue in my own research, or interesting anecdotes to include regarding the history of Oroville's lime industry. His knowledge and insights into the development of Oroville and its surrounding community during the nineteenth century added to my understanding of the lime industry within the context of the expanding gold mining town of Oroville.

Loreley Hodkin of Placer County was extremely helpful by sharing information she had compiled on the 19th-century lime industry in both Placer and El Dorado counties, including that of William Gwynn's activities in the gold mining town of Auburn, after arriving in California during the late 1840s. Loreley took me on fieldtrips to lime kilns and museums in Placer County, and her enthusiasm and access to resources on the topic of Gwynn and the lime industry facilitated my own research.

My gratitude goes to Robert "Bob" Piwarzyk and Mike Luther of the Santa Cruz County and W. David Dawson of Sacramento County who have been unbelievably supportive in my quest for knowledge on the topic of lime and the industry in California during the 19th-century. Bob and Mike have made amazing efforts to bring the history of Santa Cruz County's lime industry and its remnant resources to the foreground, and their hard work has made my own research that much easier. They always made time to answer questions, and were generous in providing new information as they encountered it. David has also made admirable efforts in preserving the history of our State's lime industry by photographing many of the lime kilns that dot the landscape. These beautiful black and white photos – soon to be part of the North Bay Regional Collection at Sonoma State University's Information Center, and currently archived in the California History Room of the California State Library – depict the numerous technological and design variations which characterize these historical structures. David made his collection of photographs and accompanying historical background information available to me, and has been a constant source of support and encouragement since the first day I introduced myself to him via email. His participation and enthusiasm has greatly enriched my own research, and for this I am extremely indebted.

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1. INTRODUCTION

Historical Background

In 1848, General John Bidwell discovered gold on the Feather River at what became the town of Bidwell's Bar. Along with Marshall's discovery months earlier at Sutter's Mill, gold in the northern Sierra Nevada foothills brought a large influx of people to California in search of their fortunes. Sometimes overnight, small towns sprung up out of mining camps. Ophir, its appellation later changed to Oroville, was one of those towns.

Gold became more elusive several years after the Rush, and more capital was required to extract the precious metal. Partnerships became commonplace, and the effort to remove the gold-bearing ore from the countryside was more of a long-term investment than it had been during the earliest Gold Rush days. Oroville and the surrounding communities saw a rise in permanent dwellings and the struggling little village on the bank of the Feather River suddenly mushroomed into the most populated mining town in California (Lenhoff 2001:7). Although much was imported from Sacramento and San Francisco, small-scale industries developed locally to supply the more permanent residents of Oroville. One such industry was lime, a versatile material used in construction as a constituent of plaster and mortar among other uses. It was the availability of lime that enabled the residents of Oroville to construct more permanent masonry structures than the small wooden, fire-prone buildings typical of a mining camp. Limestone was quarried and burned in stone kilns located along the West Branch to manufacture lime, an essential component in building materials. The small-scale lime industry contributed to the development of Oroville as a community in the Sierra foothills gold districts.

Purpose of Study

This thesis relates the history of a small-scale lime industry in Oroville, Butte County, California, during the second half of the nineteenth century as a collateral industry to gold mining. Undertaken in an area known today as Lime Saddle Recreation Area (Lime Saddle) within the larger Lake Oroville State Recreation Area (Figure 1), this study joins together archaeological data in the form of lime kilns and associated limestone quarries, roads, and other ancillary features with historical research to achieve a better understanding the role these smaller industries played in community development in an emergent capitalist society.

Previous researchers believed this industry was established a few miles north of Oroville along the West Branch of the Feather River in the mid-1880s. However, this study will show that lime was first sold 30 years previously, when the town of Oroville was first coming into its own (Furnis and Young 1976; Sampson and McAleer 1977; Hunter and Orlins 2000).

Oroville Facilities Relicensing Project

The ability to examine Oroville's nineteenth century lime industry in this detail was, in part, facilitated by state and federal regulatory compliance of Department of Water Resources (DWR) to renew its operating license of Oroville Dam and Facilities. Established during California's 1950s initiative to develop and expand its water supply, the Feather River was dammed with a 770 ft. earthen dam, flooding parts of the Feather River watershed and creating Lake Oroville (Selverston et al. 2003:3). The reservoir became a source of power generation, water supply, flood control, and recreation.

[Figure 1 - Map]

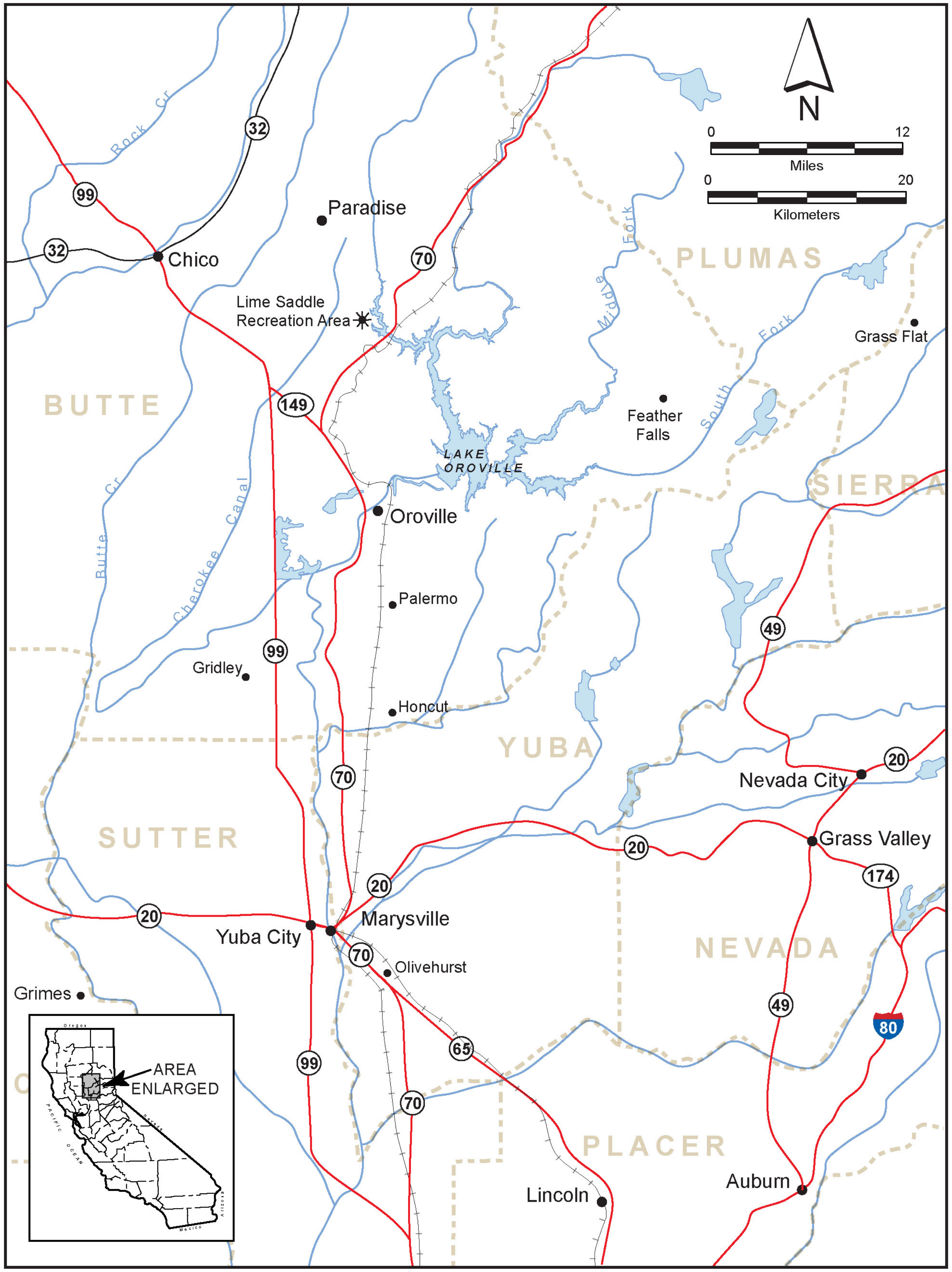

Figure 1: Map of Lake Oroville and Lime Saddle Recreation Area (adapted from Map 1, Selverston et. al. 2003)

The archaeological sites related to the lime industry were part of the cultural resources inventoried and evaluated between 2002 and 2004 by members of the Anthropological Studies Center (ASC), Archaeological Research Center (ARC), and members of the Maidu tribe. This work was expanded on by the author in partial fulfillment of the requirements for the degree of Master of Arts in Cultural Resources Management.

Organization

Chapter 2 discusses the lime industry from a global perspective and the minimal documentation and study of the resources associated with this industry. Despite the minimal documentation, many resources are still extant and can lend an understanding to the industry as a whole and the role lime played in community formation. A lime kiln typology developed from studies in Australia was used by this author to characterize the lime kilns in Oroville.

Chapter 3 explains the long history and uses of lime – an all-purpose material that was important during the early days of the state when sanitation services were not available and, the material we know today, as cement had not yet come into use in the United States.

Chapter 4 introduces the reader to the man who began the lime industry in Oroville: William Gwynn. An enterprising person, Gwynn had the foresight to recognize the opportunities available to a budding capitalist such as himself in the developing state of California. He established a network of lime kilns throughout several counties to supply lime for construction and other purposes. Gwynn diversified his interests and adopted a business strategy that maximized stability in the economically fluctuating, burgeoning American West.

Chapter 5 introduces the reader to Oroville and the lime industry during the nineteenth century. The small-scale operation consisted of several small manufacturing complexes, each comprised of a limestone quarry, lime kiln, work areas, foot paths, and roads leading to main thoroughfares. The property on which these simple kilns were constructed changed hands several times during the latter half of the century and were intermittently fired throughout the years, producing lime for local and regional consumption until circa 1904.

Chapter 6 summarizes this information and the author’s main points, as well as mentions directions for future research.

2. LITERATURE REVIEW AND RESEARCH DESIGN

Introduction

The manufacture of lime from limestone, or some other calcium carbonate-rich material, and its use as a binder in mortar in buildings and structures has a long history. However, research of the lime industries throughout California and beyond, and the role lime played in community formation has a decidedly shorter history. Within California, renewed interest in the old Spanish mission buildings and Mexican ranchos during the 1970s and 1980s brought archaeologists to a closer understanding of the uses of lime during that era. Unfortunately, evidence of this industry was either sporadically encountered or viewed as of lesser importance within the larger scheme of mission archaeology and was not published to any great extent (see Costello 1977 for one of the more thorough discussions on this topic). In fact, a recent posting on HistArch (10 Feb 2004), a public discussion list posted on the internet for topics in, or related to, historical archaeology, requesting further references on mission lime kilns after an archaeological discovery of a kiln in southern California received a paucity of responses, perhaps indicating a lack of enthusiasm for the topic, in general.

Literature Review

Irrespective of its popularity among archaeologists, the role of lime and other small industries in the development of burgeoning areas can shed light on strategies utilized in survival of the economic fluctuations of the time, in addition to elucidating aspects of the lime industry itself. Jenison's (1976:21) research of the New England lime industry during the seventeenth and eighteenth centuries is a perfect example. The limestone deposits now known throughout New England had yet to be discovered, so small, local shell midden deposits provided the raw material to produce small amounts of lime. Lime was therefore scarce and expensive to manufacture, which made large masonry projects only available to the more affluent members of the community. As a result, a vernacular architecture of masonry style construction emerged in areas where local deposits of limestone (or shell) were insufficient for demand or absent altogether, which necessitated the import of lime mortar.

Very few researchers have compiled overviews of local or regional lime manufacturing operations. On the rare occasion when one is compiled, terminology and/or kiln design often vary, which makes comparisons and dating difficult. Rolando (1992) produced a very thorough study of Vermont's lime kilns, documenting 71 sites containing 93 lime kilns. Stylistic and technological design changes in the lime kilns studied, in conjunction with historical data, were used to develop date ranges: farm kilns (ca. 1800-1860s), early commercial kilns (ca. 1850-1900s), later commercial kilns (ca. 1870s-1920s), and modern kilns (1900s-1950s) (Rolando 1992:217). While it is terrific to find a source for lime kiln chronology, Rolando's data are inadequate for comparison with the various-sized industries that arose during the nineteenth century in the West. This is due to the fact that the majority of the lime kilns in Rolando's discussion were constructed during the Industrial Revolution (1790s – 1860s) in the United States, a period in which there was a distinct evolution in kiln technology (Rolando 1992:3). In comparison, the West developed rapidly with an array of different technologies and knowledge imported from around the world, simultaneously. In this swiftly growing place the technologies and kiln designs varied almost irrespective of time, depending on background, skill-level, or finances.

Two researchers in Australia have compiled overviews of the lime manufacturing industries in New South Wales and Victoria (Pearson 1990; Harrington 1996, 2000). These studies make a more suitable comparison with lime industries in California because Australia's frontier characteristics parallel those of the American West. Despite the First Fleet arriving in 1788 and the existence of small, localized lime production, the industry did not flourish until Australia experienced a building boom that followed its own gold rush in the 1850s (Pearson 1990:28; Harrington 2000:21). Harrington's research of the lime manufacturing industry is the first systematic investigation of the archaeology of the industry in the state. Her research has accumulated archaeological and/or historical information on 39 sites containing 34 extant kilns (Harrington 2000:57). While this is a significant contribution to the scholarly data regarding construction detail and typology of lime kilns, Harrington herself recognizes the sites that were identified and studied were those that were the "more intact and impressive of those that have survived" (Harrington 2000:1). Isolated overgrown kilns or kilns from smaller lime manufacturing operations are often those forgotten since the years of their use or have been ignored by researchers because they lack "curb appeal."

A literature review of lime kiln research revealed that a good portion of the time the physical evidence of a past lime manufacturing operation is discovered under the umbrella of cultural resources management, as in the Rudd lime kilns eroding from the Cumberland River in Livingston County, Kentucky (Hockensmith 1996, 1999). Following a flood, a kiln exposed in the riverbank prompted a local Heritage Council member to investigate the area. The mid- to late-nineteenth century lime kiln, along with its associated artifacts, and a nearby limestone quarry were recorded. The abandoned quarry was known to have been in use during the 1930s, but the long-time residents of the area had no knowledge of the presence of the lime kiln. Subsequent storms over the next five years exposed an additional buried kiln in the bank of the Cumberland River (Hockensmith 1996:120; 1999:95). Like many researchers of lime manufacturing industries, Hockensmith was hard-pressed to locate regional references of lime kilns in the archaeological literature, and until these discoveries, no kilns had been excavated in the entire state of Kentucky (Hockensmith 1996:117).

Regions that have enjoyed a large, thriving lime-manufacturing industry subsequently have a more prominent, well-documented history of that industry (Hardesty 1991:33b). These larger operations have left demonstrable evidence of their existence on the landscape, and the public recognizes the role this industry played in the formation of the community. For instance, Maine's lime manufacturing industry has been in existence since 1733 (Grindle 1971:3). Neighboring towns of Rockland and Thomaston along the Penobscot Bay transported lime to areas along the Atlantic coastline, as well as to other areas such as the West Indies (Grindle 1971:3-6). Maritime trade of lime sustained the economy of the area as Maine became the prominent region for lime manufacture in the United States; "at least 100 vessels were used in exporting this [product] to market and importing wood for the Thomaston kilns" (Jackson 1837, as cited in Grindle 1971:6). These two towns provided lime for developing metropolises such as Boston and New York.

In as much the same way, Santa Cruz County lime manufacturers would later provide lime for the developing metropolis of San Francisco. The high-quality limestone deposits found in the county were unrivaled by any other in the state, a fact which did not go unrecognized by the industry's founders, Isaac Elphinstone Davis and Albion P. Jordan in the early 1850s. Along with the region's other abundant resources, such as redwood for fuel, redwood and hazel wood for barrel making, and its proximity to the ever-growing market of San Francisco, the county was destined to become a prosperous lime industry locale, especially with its maritime shipping capabilities, which delivered the product via schooner in half a day's time (Jensen 1976:1,6,8).

Davis and Jordan enjoyed a monopoly of the industry until 1858, when two other lime companies were established (Jensen 1976, as cited in Ziesing 1996:7). However, their success in the business paled in comparison to its development after Henry Cowell bought out Davis' interest in 1863. Cowell's business acumen propelled their lime empire to emerge as one of the top three lime manufacturing companies in Santa Cruz County: Davis and Cowell, Holmes Lime Company (run by Henry T. Holmes, partner and brother-in-law to William Gwynn, founder of Oroville's lime industry) and the IXL Company (Jensen 1976, as cited in Ziesing 1996:7). By 1880, these three companies alone were responsible for the production of half the lime used in California (Irelan 1888:880; Jensen 1976, as cited in Ziesing 1996:7; Eselius 2003:8). Sixty years later, California was still a competitor in the production of limestone for use in the cement industry, ranking among the top three states in the country. Cement surpassed lime as the favored construction material when Portland cement became more available around the turn of the century (Morrison 1942:260).

The prosperous lime industry in Santa Cruz County has enriched the scholarship of research documents from which to better understand the industry in California as a whole. Both avocational and professional researchers have explored the historical and archaeological records to uncover the various participants of the ocean-side community's various lime-manufacturing enterprises.

Much research has been conducted on the lime industry in Santa Cruz County, but aside from the State Mineralogy Reports, Jensen's (1976) is the only overview of the county's lime industry to date (see Eselius 2003; Piwarzyk 1996; and Ziesing 1996). An informal group called "Lime Light" was established in the county in order "to study, understand, and teach the history of the lime industry in the Santa Cruz Mountains" (Piwarzyk 1996). The group's goal is "that by focusing on the technical aspects of individual kiln sites, a complete story of the evolution of this industry will unfold" (Piwarzyk 1996). Piwarzyk (1996) has written a good deal concerning the lime industry of Santa Cruz County. He and his colleagues continue to research the local industry, contributing to their own work, as well as assisting other researchers in discovering more about the county's lime industry.

Piwarzyk (1996), commissioned by the Santa Cruz City Water Department to "compile an historical background and site description of the [Laguna Lime Kilns located] on Ice Cream Grade at Laguna Creek," discovered an interesting feature. One of these two kilns built in 1899 by the Holmes Lime Company has a firebrick floor in the fire chamber, a construction design not seen before 1996 in any other kilns in the county (Piwarzyk 1996). Since the sister kilns are very similar in size (roughly 19 x 16 x 14 ft.), shape, and design, it is likely that the second kiln also has a firebrick floor; however, this has yet to be archaeologically investigated. In addition, the kilns have buttresses supporting the front walls, as well as firebrick lining the interiors (Piwarzyk 1996).

Archaeological investigations of lime kiln sites in the county have provided further understanding of changes in kiln technology over time. This information is useful for comparison with other nineteenth century lime-manufacturing industries in California. Ziesing (1996) investigated the structural details of the three IXL Lime Kilns – located northwest of the town of Felton – specifically for the existence of firebrick floors, like that discovered in the one at Laguna Lime Kilns (Piwarzyk 1996:10). Constructed of limestone blocks joined with a lime-based mortar, the rectangular-shaped kilns at IXL measure approximately 13 x 34 ft., "each with four firing chambers as defined by the presence of arched tunnels leading into the kilns" (Ziesing 1996:9). All three kilns were outfitted with firebrick lining the interiors, as well as narrow, brick-lined channels that were thought to have been later additions to the original construction design, likely undertaken after Henry Cowell acquired the property in 1900 (Ziesing 1996:24).

The county is still uncovering the evidence of the prolific lime industry that bolstered its economy for so many years. The California Department of Parks and Recreation (DPR) in 1997 acquired Gray Whale Ranch, a 2300-acre property adjacent to Wilder Ranch State Park in Santa Cruz County. An inventory of the resources on the property recorded over 20 features related to the lime operations conducted by Samuel Adams beginning circa late 1850s (Wheeler 1998:6-7). Adams constructed three adjoining kilns built of limestone rocks joined with lime-based mortar; buttresses support the front walls and each kiln is equipped with four firing chambers, as defined by the presence of arched tunnels leading into the kilns (Wheeler 1998:27). A unique element of one of Adams' kilns is the load of unfired, limestone still present within the kiln (Wheeler 1998:28).

Adams sold his business to Davis and Cowell in 1869 after an earthquake in San Francisco ruined many masonry structures. The public began to doubt the stability of masonry construction, which consequently caused the lime industry to suffer. Several small lime operations had to close their doors and eventually sold out to the larger businesses. Adams received $10,000 from Davis and Cowell for his business, equipment, and his transport ship, “S.D. Bailey” (Wheeler 1998:7).

In the following years, Cowell started to expand his lime interests into other California counties, including Contra Costa. There he invested in land near Mt. Diablo, which eventually developed into one of the larger lime and cement manufacturing areas (Eselius 2003:14,50). Cowell’s development of his lime empire only continued when Davis died in 1888; Cowell became the sole owner, changing the name of the company to “Henry Cowell Lime & Cement Co.” (Eselius 2003:15). Cowell not only expanded his empire into other counties in California, he developed lime operations within Washington Territory (not yet a state of the Union) on San Juan Island, and in British Columbia, Canada, on Texada Island (Eselius 2003:52). He involved family members into his business, employing his sons Ernest Victor and Samuel Henry (Harry), who managed the lime and cement empire after Henry Cowell’s death in 1903 (Eselius 2003:79). The enduring legacy of Cowell lime and cement was an economic mainstay for the city of Santa Cruz and its surrounding communities, as well as other communities throughout California. However, local deforestation and the new technology of cement were two of the reasons the lime industry in Santa Cruz County began to decline in the 1890s (Jensen 1976, as cited in Ziesing 1996:7); the Cowell empire eventually folded in 1947 (Eselius 2003:16,79).

It is easy to see the impact a large industry such as the Cowell Empire made on its surrounding community. But what can be learned from the smaller scale operations that developed as collateral industries to gold mining, which manufactured lime for their growing, surrounding communities? What strategies, if any, were used to compete or just survive, in the emerging capitalist economy of the region?

Theoretical Background

The theoretical framework assembled for the discussion of small-scale industries in California during the nineteenth century includes New Western History and Historical Archaeology. Prior to the 1990s and the inception of New Western History, history of the American West was viewed from the perspective of the white male and his quest to tame the “Wild West.” The American West is understood to be “the United States west of the 98th meridian, a line passing through the eastern Dakotas down the Great Plains through central Texas” (Malone and Etulain, as cited in Hardesty 1991a:3). Seen as frontier history, Western historian Fredrick Jackson Turner suggested the frontier in the 1890s had been conquered and was drawing to a close: vast land made possible by the containment of the American Indian, had been consumed by a westward-spreading population. New Western historians challenge, among other things, the viewpoint of the American West as a frontier process that ended when the population reached the edge of the nation’s westernmost land holdings, but rather suggest that the frontier and the American West is a place of previously unacknowledged dimensions. In addition, the same characteristics that defined the West within traditional Western history (for example, westward movement and boom-bust economies) continued beyond Turner’s

1893 proclamation that the frontier had closed (Turner, as cited in Limerick 1987:21; Robbins 1994:11,12; Limerick 2000:19).

The idea that "traditional western history is essentially frontier history…featuring a heavily romanticized preoccupation with wilderness, Indians and pioneers, and the adventure of conquering one new land after another" (Malone 1991:98) was one of the perceptions of the American West New Western historians, following the lead of Limerick (1987) and others, sought to change. Exposing the previously unacknowledged dimensions of the American West brought race, ethnicity, gender, and many other layers to the discussion, suddenly giving a voice to the disenfranchised (Limerick 1987:26-27). "The New Western Historians strive to re-tell regional history from the point of view of the oppressed, colonized and conquered; they wish to speak out for the interests of women, minorities, and the environment" (Frisk and Robinson 1997:5).

This broader perspective provides a context for understanding capitalist development in the West. As Robbins (1994:11) states "understanding [capitalism's] complexities is important for the study of western North America; the resettlement of western lands during [the nineteenth century] and the progressive integration of the West into national and international exchange relationships provide the essential framework for broad historical analysis," and more specifically entrepreneurialism (Cronon, Miles, and Gitlin 1992:6; Bryant 1994:196). The United States was among the rapidly developing nations during the nineteenth century, and the discovery of gold in California swiftly catapulted the state's role in the global economy to the forefront (Bryant 1994:198; Robbins 1994:11,86). "[M]ining set the pace and direction of Western development" (Limerick 1987:124) and opened the eyes of the world to the possibilities California offered in the form of mineral extraction, timber, and agriculture; "this was market capitalism at the moment of its most expansive growth" (Robbins 1994:12).

The Gold Rush was an entrepreneur's dream. Fueled by autonomous individuals in the beginning, mining the elusive metal grew complex after a few short years and required capital investment to move forward into hard rock mining, which stimulated the growth of small business partnerships. The introduction of global capitalism – "the movement of capital from points of accumulation [in this case, eastern United States and western Europe] to points of investment [the West]" (Robbins 1994:3,86) – led to large-scale corporate ventures based on wage-labor and the volatile market-induced disruptions that went hand-in-hand with participation in the world economy. Scholarly research of the expansion and transformation of the American West has, until recently, slighted the influence decentralized smaller enterprises, producing for local and regional consumption, had on the economic development of the region, and instead, focused more on the impacts made by these large-scale corporate ventures (Smith 1987, as cited in Robbins 1994:101; Mann 1982; Trachtenberg 1982; Bryant 1994; Robbins 1994). "Mining made the transition from individual treasure hunt to corporate enterprise. Although lone prospectors loom large in the story of western mining, Duane Smith (1987:30) reminds us that they had little influence other than to furnish the materials for legend" (Robbins 1994:101). However, by studying these small-scale operations, much can be learned from the culture, economy, and technologies of the day, and how those modes changed over time.

Historical Archaeology provides the framework to identify and interpret this diversification in the material culture from this tumultuous period. Gold mining directed

California's economy, an unstable system where a highly mobile settlement pattern based on booms and declines were routine due to the uncertainty of mining (Limerick 1987:28-29). The most effective means of survival during these times of economic instability was economic diversification (Hardesty 1991a,b; Hayes and Purser 1990:7,39; Praetzellis, Praetzellis, and Purser 1990; Purser 1999; Purser 2004). Purser (2004; Hayes and Purser 1990; Hardesty 1991a,b) coined the term "boom-surfer" to describe a set of strategies people of this place and time employed to survive the harsh boom-bust economic swings. Boom-surfers, usually "middle-level capitalists, skilled workers, and extended families," formed small partnerships, and invested intensive labor and little capital in diverse business endeavors that utilized low-level technology and strategic squatting, reuse, and tenancy, which allowed for survival in one place from one rush to the next (Purser 1995:232). Success of these strategies was not measured in profit, per se, so much as in stability, or ability to stabilize location, household, or extended group subsistence through economically unstable times (Purser 1995:232; Hardesty 1991a,b).

The research of Oroville's lime-manufacturing industry is a case study in applying Purser's boom-surfer model, using Hardesty's (Hardesty and Little 2000:23) concept of feature systems to more comprehensively understand the role smaller industries played within California's economy and their effects on long-term processes of community formation, development, and survival in the Sierra foothill gold districts during this period. Hardesty argues that archaeological remains of extractive industries are difficult to understand as isolated sites, as their features are often widely distributed geographically without clearly defined boundaries, "making it almost impossible to apply the concept of site in a meaningful way" (Hardesty and Little 2000:158). The feature systems approach assists in interpreting large, complex archaeological remains by grouping them into "geographical clusters of archaeological features that [are] linked to the same human activity," such as the manufacture of lime (Hardesty and Little 2000:23). By applying these two approaches to the lime-manufacturing industry in Oroville, and recognizing "superficially haphazard assemblages of machinery, tools, structures, and other material culture," which characterize "functional flexibility, localized maintenance, and portability, rather than cutting-edge technological sophistication" represent the archaeology of boom-surfer enterprises (Purser 1995:232), a more cohesive understanding of this small-scale industry is achieved. In turn, cultural resource managers can use this case study as a model to approach the archaeology of similar small-scale operations, thereby adding to the overall understanding of how these enterprises participated in shaping the American West.

Along with exploring the boom-surfer strategy of diversification, this case study intends to clarify previous twentieth century researchers' mistaken claims regarding who was the person responsible for the inception of Oroville's lime industry. This new information, uncovered by Mr. John Rudderow, sets the start date of the industry back 30 years and attributes its inception to a man named William Gwynn – a quintessential boom-surfer. (Figure 2) Gwynn should not be mistaken with the California senator with the same name.

Research Questions Addressed

The following questions will be addressed while reconstructing the events that brought about and maintained the lime industry in nineteenth century Oroville, Butte County, California (Hayes and Purser 1990; Praetzellis and Praetzellis 1993):

Figure 2. Portrait of William Gwynn (Reeves 1988:20)

- What were the circumstances leading up to the inception of the lime industry in Oroville? What was the actual start-up date? Who were the parties involved?

- What drew them to this location? What was the extent of their operation: how many limestone quarries and lime kilns?

- To what extent did the individuals involved participate in or depend on local mining district markets, as well as the broader market system beyond Oroville area? How did the enterprise obtain access to these market systems?

- What technologies did those involved in the lime industry in Oroville use for the production and transportation of their product? Is there evidence of a transition or innovation in specific technologies or procedures, during the period of site use?

- How do the general production activities evidenced at the lime industry sites compare with that documented for contemporary sites of the same function in the community of Oroville and elsewhere?

- How did the enterprise organize its investment of capital and labor, and how did these investment patterns change over the period of site use? How diversified were the economic activities? How flexible were individual entrepreneurs in the face of seasonal and more long-term economic fluctuations?

Methods

An extensive review of historical documents was conducted to address the research questions listed above. These documents included written records available from federal, state, and county sources, as well as other primary and secondary sources, located in a variety of repositories. A complete list of research facilities can be found in Appendix D, but the majority of research was conducted at the following locations: California State Library; Northeast Information Center of the California Historical Resources Information System (NEIC) at California State University, Chico; Special Collections of the Meriam Library, California State University, Chico; and the Butte County library, Oroville, California, as well as the county offices of eight counties throughout the Central Valley and Sierra Nevada Foothills.

Federal documents consulted included Census and Voter Registration records, General Land Office maps, USGS Topographic and Geological Survey maps, and Department of Interior Preservation Briefs. State documents included annual Mineralogy Reports and reports from previous archaeological studies (see below). County records included annual tax assessment records; deeds; mining, bank and water claims; articles of agreement; and any other records that pertained to land ownership, business partnerships, contracts, or the sale/purchase of merchandise, relevant to the research.

Important sources of information regarding the social and economic aspirations of the growing community of Oroville and the surrounding region was provided by newspaper articles and advertisements from the *Butte Record*, *Daily Butte Record*, *Marysville Daily Appeal*, *Mountain Democrat*, *North Californian*, *Oroville Daily Register*, *Placer Herald*, *Weekly Butte Record*, *Weekly Mercury*, and *Chico Semi-Weekly Record*. All of these documents were used to piece together the lives of those involved with the lime-manufacturing industry in Oroville, as well as establish locations of other kilns in northern California.

Finally, an exhaustive search for historic-period photographs was conducted to provide a basic understanding of kiln design. Those specific to the research include photographs that represent mining the raw material; loading/unloading of the kiln; slaking of the quicklime; packaging/transporting of the product; or the final use of the lime, such as in construction of a dam or building, using mortar. Many of these photographs were not specific to Oroville's industry, but documented industries present during this time period, throughout northern California. William David Dawson of Carmichael, California, who photo-documented many lime kilns in northern California during the early 1990s, graciously shared many of his photographs. His efforts in this endeavor greatly added to the understanding of the varying degrees of sophistication of lime kiln technology used throughout the state. Although his photographs were not included within this document, they can be viewed at the California State Library in

Sacramento, California, and will soon be added to the regional collection at Sonoma State University's Schulz Information Center in Rohnert Park, California.

In addition, written documents from previous archaeological studies within the Lime Saddle area of the Lake Oroville State Recreation Area were consulted. These included site records from the previously recorded sites (CA-BUT-158/H; CA-BUT-392/H; CA-BUT-620/H; and CA-BUT-621H) related to the lime industry, as well as the updated records for these sites, which were conducted during the 2002 field season of the Oroville Facilities Relicensing Project.

Archaeological Methods

During the 2002-2003 field season over 13,000 acres within the Area of Potential Effect of the Oroville Facilities Relicensing Project were inventoried via pedestrian survey conducted by members of the Anthropological Studies Center (ASC), Sonoma State University, Archaeological Research Center (ARC), California State University, Sacramento, and archaeological interns from three local Maidu tribal communities: Mooretown, Berry Creek, and Enterprise. Included in this survey was the area known as Lime Saddle. Previously recorded sites were relocated and updated, and their locations recorded using Global Positioning System (GPS).

3. WHAT IS LIME?

Introduction

Lime is a versatile material that can be produced in a simple and economical manner from a variety of raw materials, mainly limestone (Wingate 1985:1). It was primarily used as a construction material, as a component in plaster and mortar. However, lime served many other functions, in various different industries during the nineteenth century in California. The Spanish missions of Alta California used lime not only for construction, but also in tanning cow hides and in the preparation of food such as in grinding maize, growing grapes and making wine, and pickling olives (Webb 1952; Amerine et al. 1972; Frierman 1982). Later, it was used for sanitation purposes, curbing the offensive odors that wafted from privies or slaughterhouses (Rolando 1992:213). During the last quarter of the nineteenth century, technologies to separate non-ferrous metals from ore were developed in the mining industry; lime was used in the cyanide leaching process to recover gold and silver from ore-bearing rock (Logan 1947:187; Mineral Information Institute 2003). Although the sugar refining industry began in California during the late 1850s, it did not flourish until the late 1880s; lime was used to process the sugar beets into sugar (Bowen 1973:45). The steel industry in California dates to the gold rush days, but limestone and lime as a flux to remove impurities such as phosphorous and sulfur during the manufacture of steel were not consumed in great quantity here until 1880, when the steel mill at Clipper Gap, in Placer County was erected (Clark 1954:460; Bowen 1973:45; Mineral Information Institute 2003). Lime was also used as a temper in the glass industry; the most common type of glass being the combination of the following ingredients: silica (sand), soda, and lime (Ewen 2003:61).

Finally, as California increased its agricultural production during the nineteenth century, lime became increasingly important to the industry as a soil additive. It was used to neutralize acidic soil, to breakdown soil that suffered from high clay content, and it also was used as an insecticide for plants (Logan 1947:180-182).

How Lime Was Made

Lime is the result of calcining (heating/burning) a calcium carbonate mineral such as limestone, usually in a kiln. This process dissociates (drives off) the carbon dioxide gas from the material leaving calcium oxide, often referred to as quicklime. The degree of heat required to complete calcination is dependent on several variables: the nature of the raw calcium carbonate material, quality of the fuel, draft of the kiln, and direction and force of the wind (Rolando 1992:208). However, the minimum temperature required for dissociation to occur is around 1650 degrees Fahrenheit (900 degrees Celsius) (Searle 1935:272; McKee 1973:62; Wingate 1985:9; Mineral Information Institute 2003). Quicklime, a volatile substance and must be handled with care, retains its general shape during the calcination process, although its molecular weight is reduced to about half (Wingate 1985:5-6,9; Mineral Information Institute 2003). A chemical reaction occurs when quicklime is hydrated or slaked, and when the lime is pure and reactive it could increase in volume by over three times during the process, releasing a tremendous amount of heat (Wingate 1985:5,114).

Calcium oxide (CaO) + water (H_2O) => calcium hydroxide ($Ca(OH)_2$) + heat

The affinity of quicklime to water is so great that attention to detail is essential during storage and transportation while it is in this unstable state. Quicklime will combine with the moisture in the air, especially in conditions of high humidity, a process known as "air slaking" (Wingate 1985:115). In addition, the carbon dioxide in the air has a tendency to combine with the calcium hydroxide, reforming the calcium carbonate. To avoid such problems, quicklime is best stored or transported as a dry hydrate, formed when the quicklime is combined with just enough water to change its physical form from lump to dry powder (Wingate 1985:5,115).

Historical Background

The practice of burning limestone to manufacture lime is an ancient one, used in Mesopotamia, Egypt, Rome, and China, millennia ago. The earliest documented use of lime was for plaster, discovered in Mesopotamia around 9000 BC (Delta Construction L.L.C. 2003). In the area of Jordan in 7500 BC, lime plaster was used on a large scale for covering walls, floors, and hearths (Delta Construction L.L.C. 2003). Egyptians began using lime plaster as a base coat for paint and decoration on the walls of their pyramids beginning in 4000 BC (Minerva Stone Conservation 2003). The Greeks modified and improved upon the Egyptian recipe for lime plaster. In 360 BC, the philosopher and historian Theofrast documented the technique for the fabrication and application of plaster in his writings (Delta Construction L.L.C. 2003).

It is not well understood when lime was first used in mortar. The first mortars were made from mud or clay. However, these materials did not hold up well in the presence of humidity and water. The Romans were the first to document the technique for the fabrication of lime-based mortars, which were used extensively during the Roman Empire (27 BC - A.D. 395) (Costello 1977:22; Minerva Stone Conservation 2003). In circa 25 BC, the Roman architect Vitruvius wrote De Architecture Libri Decem (Ten

Books on Architecture), which provided descriptions of the technology and basic guidelines for lime mortars, including the correct proportions of lime to sand:

> After slaking it [the lime], mix your mortar, if using pitsand, in the proportions of three parts of sand to one part of lime; if using river or sea-sand, mix two parts of sand with one of lime. These will be the right proportions for the composition of the mixture. Further, in using river or sea-sand, the addition of a third part composed of burnt brick, pounded up and sifted, will make your mortar of a better composition to use. (Vitruvius 1914:45)

Vitruvius' mention of the addition of burned brick to the mixture is a reference to hydraulic mortar. The Romans discovered the principles of hydraulic lime mortar, which by the addition of highly reactive forms of silica and alumina such as volcanic earths or brick dust, solidify rapidly, even under water (Delta Construction L.L.C. 2003; Minerva Stone Conservation 2003). These mortars were intended to be used in applications where the presence of water would not allow the non-hydraulic mortar to set up properly, such as in the construction and use of a cistern or aqueduct (Minerva Stone Conservation 2003). <u>De Architecture Libri Decem</u> was translated into several languages disseminating the Roman technique from lime-based mortar throughout Europe and the Mediterranean world.

Lime made of shell, used in plaster and mortar, was recorded for the Hsia dynasty in China (2205-1766 BC) (see Hommel 1969, as cited in Costello 1977:23; Wingate 1985:5). The Great Wall, certainly one of China's most impressive architectural accomplishments, was erected as many separate structures as an instrument of foreign policy, defining borders and boundaries between the "civilized" and the "barbaric" (Waldron 1990:154). These walls, constructed over millennia, were mainly built of rammed earth until the Ming dynasty (1368 - 1644) when more concerted efforts were made at strengthening defenses and more permanent border walls and garrisons were constructed of brick and stone using lime-based mortar (Waldron 1990:140-141). These extraordinary architectural achievements have stood since ancient times and demonstrate the contribution of lime to the development of global society as a whole.

The first European colonists to arrive in America brought with them the knowledge of processing limestone into lime for use in construction. Although depending on the locality, these early settlers often faced shortages of available limestone. In 1607, Jamestown became the first English settlement in America, in what was to become the state of Virginia. The settlers were able to produce lime from oyster shells dredged from the nearby estuary (Boynton 1966:270-271). The early colonists of the New England area were not as fortunate. Nonetheless, the lack of obvious calcium carbonate resources was not a deterrent for the colonists who settled at Plymouth Bay in 1620, in what was to become the state of Massachusetts. The English separatists were mostly farmers who had a prescribed construction method that did not include masonry, and upon arrival, chose to adhere to the wattle and daub technique for constructing their homes (Deetz and Deetz 2000). Whitewash, likely manufactured from the local supply of shells, was used to treat the interior walls of their buildings.

Significant limestone deposits were eventually discovered in Providence, Rhode Island, and in Newbury, Massachusetts, during the latter half of the seventeenth century. Supply from these sources could not meet the demand of the growing community, thereby allowing only its more affluent members to afford the high-priced fire-retardant masonry construction for their homes (Jenison 1976:21). This was the case until 1733 when the “father of lime burners,” William MacIntyre, made Thomaston, Maine, one of the largest suppliers of lime to New England (Grindle 1971:4; Taft et al. 2002:205; for a detailed account of Maine's lime industry see Grindle 1971).

Lime was an important material in the Spanish colonization of California. It was utilized in construction, as well as in processing the primary export of Alta California, cattle hides (Webb 1952:83, 106-107, 191-193; Costello 1977:22). The Spanish were familiar with limestone processing and its products from the Romans, who brought the technique to Europe from Asia (Costello 1977:22; Wingate 1985:1). Costello (1977:22) states that "limestone was undoubtedly the major source of lime for the Spanish in California," although it was occasionally obtained from the large shell middens located along the coast near Native American settlements (Boynton 1966:270-271, Duhaut-Cilly 1929:160, Egenhoff 1952:156, as cited in Costello 1977:23). There is evidence of limestone and shells being burned in both open pits and adobe or stone kilns at the Spanish institutions in Alta California (as cited in Webb 1952:107; Frierman 1982:105).

The Spanish buildings and structures of Alta California utilized lime in several different ways. Lime mortar was commonly used to set the stone for the foundation of a building, then adobe (mud) bricks were set in mud mortar to construct the walls (Webb 1952:107). Depending on their exposure to the weather, different treatments were applied to the adobe walls. Exterior walls were protected with a coat of lime plaster, which consisted of lime, sand, and water. With time, it was learned that the addition of cactus juice made the plaster more adhesive, as well as water repellent (Webb 1952:107). Prior to the application of plaster, the walls were either scored or small pebbles or fragments of tile were pressed into the moist mortar to insure the plaster would adhere to the surface (Webb 1952:107). Interior walls not exposed to the destructive effects of weather were finished with a mud mortar then whitewashed (Webb 1952:108). The whitewash consisted of a mixture of lime, milk, and salt, which produced a soft, smooth lasting surface, which also happened to be an appropriate canvas for decoration, as with frescoes (Webb 1952:108). Fresco is the art of painting on fresh wall plaster with pigments mixed in water, in which the design is then absorbed into the plaster as it dries and becomes a permanent part of the wall (The American Heritage Dictionary 1985:534). In addition, whitewash also served as an insecticide; treated rawhide bags repelled insects (Webb 1952:200).

Although the Spanish occasionally burned limestone and shell in open pits, the quantity of lime needed to construct these mission buildings was made in lime kilns made of adobe bricks or field stones (Webb 1952:106; Frierman 1982:105). Untreated, the adobe bricks would have cracked under the intense heat required in the manufacturing process. It is likely that the initial load of limestone was fired too hot, thereby causing the lime to become “dead burned” and fused to the inner walls, giving the kiln refractory properties (Wingate 1985:10). Vitrified adobe brick was found near the lime kiln at Rancho del Escorpion, *estancia* of Mission San Fernando (Webb 1952:107).

Green (as cited in Webb 1952:106-107) notes that the lime kilns at Mission San Diego were similar in size and shape to those found in other California missions. Kilns were often carved out of a hillside in order to lend structural support, provide heat retention, and to permit easy loading of the limestone charge (Wingate 1985:74). The lime kilns at Mission San Diego were bottle-shaped, with the top and bottom tapered, and measured 7 to 15 feet deep and 5 to 8 feet in diameter (as cited in Webb 1952:107). At Mission San Gabriel, Reid (as cited in Webb 1952:83) notes construction of an aqueduct prompted construction of “lime kilns in batteries of two, one being fired, while the other was cooling and being emptied.”

The Spanish had a difficult time adjusting to the environment of Alta California. The arid climate coupled with unpredictable rains created problems with access to a constant and abundant water supply (Webb 1952:61-65). These problems often resulted in the relocation of missions to gain better access to local water sources (Webb 1952:64). In addition, earthen ditches constructed for irrigation of mission crops often failed to provide sufficient water during the dry season, and flooded fields during the rainy season (Webb 1952:61-62). To resolve these problems, masonry dams, flumes, and aqueducts set with lime mortar were constructed (Webb 1952:68). The kiln located on mission grounds provided lime mortar used in construction of structures erected within proximity to the mission. However, it appears the Spanish recognized the logistics of transporting highly reactive lime over large distances and rough terrain, and often constructed satellite kilns along the routes of linear structures or near construction sites of dams (Webb 1952:83). The limestone charge quarried from the hillsides or shells taken from the coast was brought to the kiln to be burned into lime. Green (as cited in Webb 1952:106) located the ruins of eight of these satellite kilns along the route of an aqueduct for Mission San Diego.

The main export of the Spanish missionaries was cattle hides (Webb 1952:188; Costello 1977:22). Cattle imported by the Spanish explorers during the sixteenth century were ancestors of those driven from Mexico in 1769 to provide stock for the future missions of Alta California (Frierman 1982:102-103; Thompson 1942, as cited in Frierman 1982:103). This initial herd of 200 head of cattle reached numbers close to half a million head of cattle by the end of the mission period in 1833 (Frierman 1982:103). Each mission had a tannery, which included vats constructed of stone where hides were soaked (Webb 1952:191-193). Lime was an essential material for this process as it made removal of hair from the hide practically effortless (Jenison 1976:22). The lime was burned at the mission kiln, probably slaked directly in the vats, and then the hides were added and soaked for three to four days (Webb 1952:192). After the hair was removed, the hides were washed thoroughly to remove any remaining lime. The hides became more pliable after soaking in a vat containing oak bark and water (Webb 1952:191). Tanned hides shipped to America or Europe were manufactured into shoes and saddles, then exported back to Alta California (Duhaut-Cilly 1929:143; Webb 1952:190). Deetz (1963:142) offers a contrasting argument based on his work at Mission La Purisima, stating “tanned hides were for domestic use; hides for export were simply scraped and dried” before shipment. In either case, process of turning tallow into soap also needed lime.

Yet another use of lime was in food preparation. Specifically, dried maize (corn) boiled with hydrated lime and allowed to cool, eased the process of removing the skins from the kernel (Webb 1952:40-41). Maize-based dishes were a staple for the mission population (Webb 1952:40-41). In addition to maize, lime was used in growing and processing grapes for wine. A calcareous soil (that is, rich in calcium) is needed for growing grapes and making wine; this is possibly due to it either being a well-draining soil or just that the calcium in the soil creates a natural plastering effect (Amerine et al. 1972:122). The archaic practice of “plastering,” where a powdered form of the material was sprinkled on the grapes before or after crushing, used gypsum (calcium sulfate) (Rice and Van Beck 1993:72). Gypsum has similar characteristics to limestone (calcium carbonate) and makes it a reasonable replacement in this particular process (Rice and Van Beck 1993:72). Although not the same as gypsum, lime has similar qualities that Plastering served several functions: 1) decreased the time needed for fermentation; 2) brightened the color of the juice; 3) improved the acid level of a low-acid grape; and 4) increased the preservation qualities of the final product (Felter and Lloyd 1898; Amerine et al. 1972:33). Known from Roman times, plastering is associated with sherry-making in southern Spain (Amerine et al. 1972:411-412). French explorer Auguste Bernard Duhaut-Cilly visited many California missions, enjoying both a business and social relationship with the padres. After his tour of the gardens at Mission San Luis Rey, he entered in his travel log that he found them to produce “the best olives and the best wine in all California” (Duhaut-Cilly 1929:228). In addition to producing wine, the Spanish missionaries were also responsible for introducing the olive to Alta California. Groves of olives planted at the missions were a source of food and oil. Like grapevines, olive trees are most productive when planted in a calcareous soil; and when harvested, olives were pickled in limewater.

The dismantled mission system led to the Mexican rancho and cattle production as the *Californio* lifestyle. There were no manufactured goods within California, except makeshift items of rawhide (Rice, Bullough, and Orsi 1996:144,151; Rawls and Bean 1998:61; Rawls and Orsi 1999:185). Products of slaughter supplied the home with meat, tallow for candles and soap, and rawhide (Cleland 1941, Tays 1941, both as cited in Frierman 1982:105). These same items were also the chief commercial products for the export market (Ogden 1927, as cited in Frierman 1982:105).

The annual *matanza*, or large slaughter of cattle, usually occurred during the summer months when the cattle were fat (David 1889:36, Belden 1878:14-15, both as cited in Frierman 1982:21). Limited documentation exists of the details of hide processing on the ranchos and the use of lime. Some documentation mentions only the basic processing technique of staking the hides in the sun to dry, and melting the fat in kettles for tallow and soap (Rawls and Bean 1998:61). While there is archaeological evidence that lime was burned at some ranchos, the presumption has been in the past that the lime was used for food processing and construction, as at Ontiveros Adobe in southern California (Frierman 1982:156).

Lime continued to be an important commodity throughout the nineteenth century (Browne 1868:244-246). The true demand for lime in California did not occur until the rapid population explosion brought about by the Gold Rush. This event resulted in the quick settlement of a territory two previous nations were so eager, but ill-equipped, to carry out. Lime was an integral component in the development of California: it was a key ingredient in construction materials, sewage treatment, and agriculture, all necessary in this rapidly expanding area of the American West.

Historical Transition to Portland Cement

Natural cement was a type of hydraulic cement, patented in 1820 in the state of New York by engineers directing construction of the Erie Canal (McKee 1973:68). Natural cement was “cement rock” and limestone calcined together in kilns, similar to lime kilns, and ground into a fine powder (McKee 1973:68). This product was used mainly in areas where masonry required great strength and was subjected to moisture. Sometimes used as an additive to lime mortar, natural cement however, had drawbacks: it shrank in volume with the addition of water, the color was “sometimes unpleasant in appearance,” and masons did not like the “feel” of cement mortar as well as they did lime (McKee 1973:68).

Patented in England in 1824 by Joseph Aspdin, Portland cement was a stronger setting and more dependable product than natural cement (McKee 1973:69). Improved upon by mid-century to provide a uniform quality, Portland cement changed the use of lime in the construction industry. Manufactured from limestone and clay calcined together in a kiln and ground into a fine powder, Portland cement was imported to the United States for some time, although never outselling the local lime cements. In 1860, a similar type of cement was developed from a plant in Benicia, Solano County, California (Browne, 1868:245; Bowen 1951:231; McKee 1973:69).

Portland cement was eventually manufactured in the United States beginning in 1871, and by 1880, it was the preferred ingredient to making mortar: its strength, low absorbency, and hardness were well matched to the bricks made during the time period (McKee 1973:69). The advent of Portland cement reduced the need for the manufacture of lime-based products in the construction industry, with the exception of plaster where the primary ingredient was lime. Although concrete as a building material eclipsed masonry at the turn of the century, lime grew increasingly important in other industries such as in chemical, agriculture, and steel industries.

Raw Materials

The fact that calcium is the fifth most abundant element in the Earth’s crust gives you an idea how easy (in theory) it should be to locate the raw materials necessary to make lime. However, calcium does not always occur with the physical characteristics and chemical purity, and in a location, suitable for procurement for the purpose of lime production (Wingate 1985:15). Calcite, a common rock-forming mineral, is the chief constituent of limestone and most marble (Bowen 1973:10). Limestone is a sedimentary rock classified by geologists Boynton and Gutschick into three groups, according to its origin: “1) autochthonous (or accretionary) limestone which grew by chemical processes that extracted calcium and magnesium carbonates from sea water – for example, chalk, stalactites and stalagmites; 2) allochthonous (or detrital) limestone, where the constituent consists of fragments of coral reef, shells and other fossil debris, which have been transported and redeposited by water currents…[and subsequently] harden[ed] by compaction, cementation or crystallization; 3) metasomatic limestone, where the original character of the rock has been modified by secondary impurities” such as iron, phosphate, silica, etc. (1968, as cited in Wingate 1985:17).

Argillaceous limestone is an example of metasomatic limestone. The impurity present in this type of limestone is a notable proportion of clay that gives lime and mortar made from this limestone, characteristics which enable it to set underwater. The hydraulic properties of gray lime, as it is called, are valuable when building dams or other structures in moist environments, such as the sea wall built in the San Francisco Bay during the latter half of the nineteenth century (Browne 1868:245).

The value of lime is dependent on its calcium carbonate content compared with the percentage of impurities. Impurities affect the ultimate use of the lime product. The purest mineral form of calcium carbonate is calcite, which has less than 5% magnesium carbonate, a common impurity found in limestone (Wingate 1985:16-17). A limestone is considered to be high in calcium if it contains more than 95% calcium carbonate

(Wingate 1985:17). Industrial consumers such as the sugar refiners and paper manufacturers need lime that has high calcium carbonate content (Ratekin 1954:7-8; Scoville 1967:288; Wingate 1985:18). This type of lime should also be used in the manufacture of building products such as bricks; for tasks such as bricklaying, masonry, and plastering gray limes are more suitable due to their hydraulic or semi-hydraulic properties (Wingate 1985:18).

Technology

The simplistic nature of burning a calcium carbonate charge such as limestone to manufacture lime is evident in the fact that the process can be achieved without a kiln. The level of technology is minimal, but fuel efficiency generally increases as the level of technology increases. The advantages and disadvantages of particular kiln technology will be discussed as they relate to the manufacture of lime.

A simple exposed pile of alternating layers of fuel and calcium charge can be burned to produce lime (Pearson 1981). More than a unit of wood is needed to produce a unit of lime, and due to the inability to control the fire, a substantial amount of under-burned lime will result along the edges of the pile. If the pile is sealed with a layer of clay, with air holes at the bottom and a vent hole in the top, the heat is somewhat conserved, thereby regulating the speed at which the wood burns. This results in a more thorough burn, although under-burned pieces of charge still result (Wingate 1985:74; Rolando 1992:207).

The next technological upgrade in lime manufacture is a simple “pot” kiln. Early structures were inverted cone- or barrel-shaped, although square and rectangular pot kilns soon developed. The limestone charge was either separate from the fuel, called “separate feed," or arranged in alternating layers in the kiln, called "mixed feed." A "fire chamber" would be created by the construction of an arch or dome of limestone charge just inside the draw hole or opening. These early kilns were either constructed of, or lined with, a suitable refractory material such as sandstone (Rolando 1992:207). Later, both common- and fire-brick became more commonplace as lining and floors in fire chambers (Rolando 1992:208; Ziesing 1996:24; Piwarzyk 1996). For an in-depth discussion on the manufacture of bricks and brickyards in the Northwest, see Gurcke (1987).

According to Rolando (1992:211), older kilns often had large lintels of stone over the small draw opening. These openings were later enlarged and the lintels were often replaced by an arch, similar to those in small blast furnaces. As designs evolved, and the size of the limestone deposit proved economically suitable to warrant, the kilns grew in size and the number of arches or fire chambers increased. Kilns were sometimes constructed into a hillside to provide support for the structure, as well as insulation during firing. The intense heat sustained over several days of calcining limestone would stress the structure, and it was sometimes necessary to bolster the kiln with buttresses, retaining walls, or iron tension bands (Piwarzyk 1996). Designs incorporated support features to accommodate continuous burning kilns. These kilns were continually loaded from the top with alternating layers of limestone charge and fuel, into the brick-lined masonry, or iron, shaft furnace chamber. Also called perpetual burning kilns, these kilns were often patented, such as the Perkin's monitor kiln (Hutchings' California Magazine [HCM] 1860:220; Wheeler 1998:7). Later evolutions accommodated other fuels such as oil and liquid gases (Wingate 1985:62; Wheeler 1998:7). After the 1900s, the continuous burning kilns eventually evolved into rotary kilns, which consisted of a horizontal metal shaft that rotated while hot gases calcined the limestone charge inside (Wingate 1985:92-96; Rolando 1992:207). These kiln types were developed much later than the time period under study, and will not be discussed further.

Fuels

There are a variety of fuels available for use in making lime: seasoned wood, charcoal, coal and coke, as well as liquid and gaseous fuels. The type of fuel usually reflects the design of the kiln. In many ways, seasoned wood provides the best characteristics for manufacturing quality lime: it produces "long, even flames of mild, moist heat, and requires only natural draft," and provides twice as much heat as freshly cut wood, giving it a uniform calcination (Wingate 1985:43,44). Steam is generated during burning, which helps to lower the temperature needed for dissociation. The lower temperature makes it more difficult for the lime to over-burn; lime burned at these lower temperatures has been proven most suitable for its various applications (Wingate 1985:43; Rolando 1992:211). The fuel consumption, or amount of wood consumed per unit weight of lime, varies considerably according to the kind of wood and type of kiln used; the ratio of limestone to wood ranges anywhere from 3:1 to 6:1 for batch kilns (Wingate 1985:44-45).

Charcoal is manufactured by burning wood under conditions of restricted supply of oxygen. It is very fuel efficient, double the efficiency of seasoned fire wood, and has a bulk density 40 percent lower than wood, which is important for storage as well as for transportation (Wingate 1985:49). However, charcoal is nearly 100 percent pure carbon and burns hotter than wood, which makes it difficult to regulate the heat in a batch kiln (Rolando 1992:147). Charcoal was used as a fuel in iron works in the eastern United

States until around the mid-1800s, when coke became more predominant; in the West, charcoal was used as a fuel by railroad companies, as well as in the silver mines of Nevada (Zeier 1987:80-83; Rolando 1992:147-154).

Coal, the most abundant of the fossil fuels, has been used in lime burning for over 700 years; coal, like coke, was more suitable for continuous burning kiln designs, due to their fuel efficiency (Wingate 1985:49; Rolando 1992:207). Coke was considered the better of the two because fresh coal often caked, which impeded the calcination and contributed impurities to the lime. The process of manufacturing coke removed those properties providing an even distribution of temperature within the kiln, thereby giving greater fuel efficiency and a better quality lime (Wingate 1985: 49-53,56; Rolando 1992:207).

Operation of an Intermittent Kiln

As discussed earlier in this chapter, lime can be burned in an intermittent (batch) kiln or in a continuous burning kiln. A basic pot kiln is the simplest type of intermittent kiln. The disadvantage of this type is that it uses 20 percent more fuel than a continuous burning kiln to produce the same amount of lime (McKee 1973:63; Wingate 1985:45). This is due to the additional fuel needed to heat the entire kiln at the initial firing, as well as the heat lost during cool down, a process exercised in every batch of lime manufactured. Although continuous kilns were known to have been used during the period in which the Oroville lime kilns were believed to be constructed, the kilns located within the case study area are intermittent pot kilns. Therefore, this discussion will focus on the process of lime manufacture relating to this operating type.

A lime operation has to have a layout that promotes efficiency. Paths from the quarry to the top of the kiln, and from the bottom of the kiln to a work area, are necessary for wheelbarrow or cart access. Storage areas for quarried material, as well as a sufficient fuel supply, should be established at appropriate places where these items will be the most needed and easily loaded into the kiln. Good access roads to the lime works are crucial; the cost to produce lime increases if access roads are insufficient for freight wagons, or become impassable due to weather in wet seasons.

The design of a pot kiln is simple: the body, of varying shapes and sizes, was usually built into a hillside, with some type of opening at the bottom for a draw opening and door. The fire door led to a hearth where a wood fire was maintained throughout the manufacturing process. Bricks were sometimes used to line the bottom of the hearth, which made for easy removal of the ash prior to withdrawing the quicklime (Rolando 1992:201; Ziesing 1996:24). Instead of a hearth, a grate was sometimes used over an ash pit at the bottom of the kiln, so as to prevent the contamination of ash in the quicklime and increase air circulation to the fire (Wingate 1985:76; Rolando 1992:211).

This type of kiln utilized draft, which oxygenates the fire, and sends hot gases through voids present in the carefully loaded limestone charge. The limestone, quarried using hand tools such as picks, hammers, drills, and wedges, was a very hard and time-consuming task. Later, or depending on the size of the operation, explosives were used to dislodge larger pieces of limestone from the quarry (Figures 3,4). The quarried material was then size-sorted and carted to the top of the kiln (McKee 1973:16-17; Wingate 1985:124). Large cobbles of limestone charge were used to form an arch or dome above the fire place. The arch created a chamber for the fuel that would burn the limestone and supplied structural support for the remaining limestone charge that was loaded from the top of the kiln (Wingate 1985: 74-75; Ziesing 1996:10). It was also necessary to load the kiln from bottom to top with cobbles of diminishing size so that the larger limestone pieces would be exposed to the maximum amount of heat for a longer duration, thereby decreasing the likelihood of having over- or under-burned lime (Wingate 1985:74; Harrington 2000:8). Waste materials, such as limestone too small for the kiln, or over- and under-burned lime, were used for other purposes, such as soil treatment in agriculture (Wingate 1985:127).

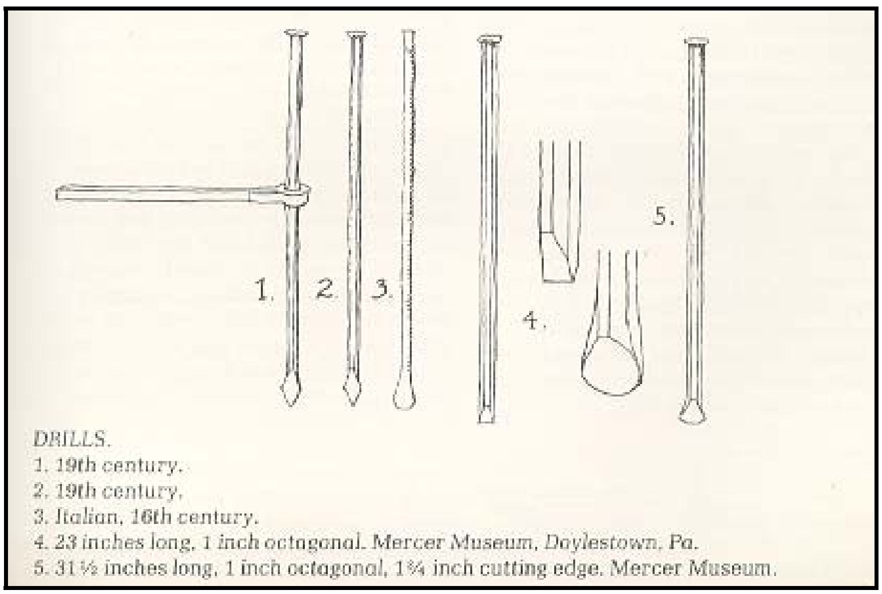

Figure 3. Nineteenth century tools used in quarrying stone. McKee 1973:17.

The fuel in the fire chamber was lit and maintained (by adjusting the draft and adding more fuel) for approximately two days until the limestone reached the proper temperature needed to convert it to lime, between 1650 and 2280 degrees Fahrenheit (between 900 and 1250 degrees Celsius) (Searle 1935:272; McKee 1973:62; Wingate 1985:9-10; Mineral Information Institute 2003). To maintain the heat needed for the duration of the burn, readily accessible fuel was necessary to feed the kiln, day and night.

It is likely that nearby oak trees were used as fuel in the Oroville lime kilns. Manufacturing lime consumed a considerable amount of fuel: about 60 cubic feet of oak was needed to manufacture one ton of lime, depending on the kiln design and technology used (Davey 1961, as cited in McKee 1973:63). The quantity of lime manufactured in one batch was determined by the capacity of the kiln.

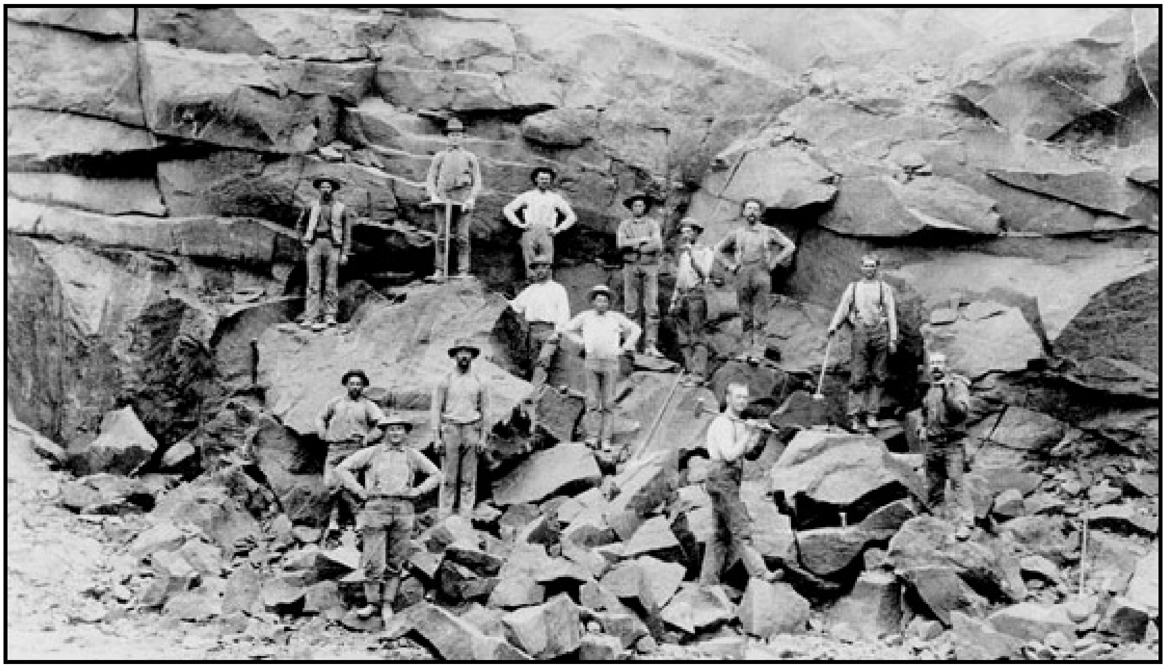

Figure 4. Quarrying stone. Courtesy of Santa Cruz Public Library.

The rate of burning was controlled by adjusting the flow of air into the opening at the bottom. At temperatures greater than 932 degrees Fahrenheit (500 degrees Celsius) materials radiate visible light (Wingate 1985:113). As the kiln heated up, the temperature was determined by the color emanating from the top of the kiln. The temperature range necessary to convert limestone to lime gives off colors ranging from cherry red to a bright orange (Wingate 1985:113). The vibrant colors emitting from the top of the kiln were often observed by Oroville youngsters, who viewed their annual visit to the kiln as an adventure (*Oroville Daily Register* [*ORD*] 1903b). In addition to incandescent light ("limelight"), shrinkage (lime has less mass than its original raw material), and feel (although somewhat smaller, lime maintains its shape during the chemical process, but its density is less and can be determined with a long iron bar thrust into the lime), are indicators the lime has reached the proper temperature.

After the charge reached the appropriate temperature, the fire was left to cool and, after two days, the quicklime was unloaded. The entire process of loading, burning, and cooling, in addition to unloading the quicklime, could take one man as little as one week to complete (Wingate 1985:97). However, if you add in the quarrying of the limestone and the gathering of the fuel, as well as the slaking and packaging of the quicklime, the process could take as long as one month, especially for one man with no assistance (Wingate 1985:97).

When quicklime is slaked, the resultant product is greater than the original volume (McKee 1973:63). Dry hydrate is formed when sufficient water is sprinkled onto quicklime and it cracks open the lumps, leaving a dry powder (McKee 1973: 63; Wingate 1985:115). This is the lightest form of hydrated lime and the most suitable for storage and transport. If quicklime is not hydrated, it will immediately start to convert back into calcium carbonate by absorbing water vapor from the air. In humid conditions, this can become very dangerous due to the rapidity with which this happens, as well as the heat formed by the conversion. It is for these reasons lime was not manufactured during the wet winter months.

Other lime products are formed when additional water is combined with the dry hydrate. Quicklime was occasionally slaked on construction sites to make lime putty, one of the finest building materials. It can be stored indefinitely under moist conditions, and the longer it is stored, the better it becomes. An example of this is Cook's (1973) reference of Spaniards burying "boxes of lime and…brick brought from San Blas…at" Nootka, near Vancouver Island in 1789, with the idea of returning the following Spring to build an oven for a bakery (as cited in Gurcke 1987:40).

Although the addition of water to quicklime renders the material more stable, it increases its bulk and weight. Therefore, depending on proximity, it was more economically feasible to transport the material as quicklime or dry hydrate, tightly sealed in wooden barrels, than as putty (McKee 1973:63; Wingate 1985:116). The season often dictated when lime was manufactured, both for the touchiness of the product with relation to the humidity, as well as the nature of the dirt roads during the wet winter months: heavy rains often flooded bridge and ferry crossings, and turned dirt roads into quagmires for laden freight wagons. Shipment was accomplished by pack mule or wagon making winter travels on sodden dirt roads practically impassable; one such thoroughfare was described as a "bottomless sea[s] of mud" (*Weekly Butte Record* [*WBR*] 1856; Forester 1967:30-32; Davis 1990:15; Ziesing 1996:10).

4. WILLIAM GWYNN – ENTREPRENEUR, i.e. BOOM-SURFER

Introduction

William Gwynn was an important businessman in California during the second half of the nineteenth century. Although only featured in one biographical sketch in any of the published histories from the many counties he resided and conducted business in, Gwynn was nevertheless a prominent man. He was a man of indomitable energy, with an enterprising spirit. As discussed in Chapter 2, periods of economic instability were commonplace during this time period, especially in the American West. The mining industry, by nature, fluctuated between booms and declines. Survival during these economic declines depended on strategies of economic diversification. William Gwynn was a quintessential "boom-surfer:" one who through diversification was able to ride out economic downturns (Hayes and Purser 1990:39).

William Gwynn was born in Hereford, Baltimore County, Maryland on 14 April 1822, to John R. and Martha (Merryman) Gwynn. His mother died of complications from childbirth nine days later at the age of 20 (Reynolds 2003). William's father married Martha's sister, Ann, in August 1822 and proceeded to have fourteen children: Mary, John, Martha, Ellen, Ann Eliza, Robert, Jane, Laura Virginia, Elizabeth, Emily, Benjamin Franklin, Charles, Kate, and Walter (Reynolds 2003).

William Gwynn was educated in the city of Baltimore and was, for a time, the Secretary of the Commercial Library of that city (*Placer Hearld* [*PH*] 1895). Although this library is no longer in existence, it was more than likely a repository for a comprehensive collection of sources pertaining to industry, business, and commerce for the city of Baltimore and, perhaps, the state of Maryland. However, William Gwynn set his mind on California and departed from Baltimore on a voyage to the territory on 16 December 1848 (*PH* 1895), possibly drawn to the region by the discovery of gold by James Marshall at Sutter's Mill on the South Fork of the American River. He left Baltimore just eleven days after the President of the United States, James K. Polk of Tennessee, announced the discovery in his annual message to Congress (Rawls and Bean 1998:95). Gwynn reached the docks in San Francisco on 18 May 1849 (*PH* 1895). In addition to Marshall's discovery on the American River, General John Bidwell discovered gold on the Feather River in March 1848, a location Gwynn would be drawn to within the first decade of his residence in California.

The discoveries of gold brought droves of men to California's Sierra Nevada foothills in search of their fortunes, and Gwynn was one of them. From San Francisco, he traveled to Sacramento City and became a merchant, supplying miners on their way to the gold fields (*PH* 1895). By July 1849, Gwynn had moved closer to the mines when he became a resident of Wood's Dry Diggings and began selling mining equipment and food items from his tent (*PH* 1852a; Thompson and West 1882:365). As was the case of many Gold Rush businessmen, Gwynn often made more money supplying miners than the miners themselves made from their claims (Davis 1990:16).

<u>Auburn, Placer County</u>

The first harsh winter rains of the season destroyed Gwynn's tent and, along with it, his business (*PH* 1852a). However, as the poem <u>Oh! Don't You Remember!</u> written by friend Hiram H. Hawkins mentions, Gwynn's ordeal provided the impetus to expand his business:

> Oh! Don't you remember '49, Billy Gwynn, '49, when the floods came down, And smashed in the top of your calico shop, And did you exceedingly brown! Oh! the calico shop has *vamosed* [sic], Billy Gwynn, And the remains are no more to be seen, For a statlier [sic] building calls you its Lord, And proud may she be who is queen…(*Placer Herald* 1852a)

Gwynn's financially successful first winter and the loss of his calico tent facilitated a more substantial building from which to conduct his business. "Gwynn's Place" soon found itself housed in a two-story cabin, renamed "Eureka Store," which ran advertisements in the local paper announcing the various items in stock just hauled in from the San Francisco and Sacramento waterfronts (*PH* 1852c; *PH* 1853a; Lardner and Brock 1924:238-239; Wilson 1993). The Eureka provided a place for the locals to gather and discuss the events of the day in the barroom and restaurant located on the lower floor (Lardner and Brock 1924:238-239). Gwynn was Auburn's first postmaster, so the Eureka Store was also the place to collect mail (*PH* 1852b; *Sacramento Union* [*SU*] 1895b; Davis 1990:32; Wilson 1993). The United States established mail service in California in 1849, but it was not until March 1851 that Auburn had regularly scheduled mail delivery (Davis 1990:32).

Gwynn was, without a doubt, an important person in the development of the community known as Wood's Dry Diggings. He made many efforts to improve and advance his new hometown both socially and economically, within the local community and statewide (Davis 1990). Law and order were maintained in the community and in 1850, the upper story of Gwynn's log cabin became the location of the first trial conducted in the town (Lardner and Brock 1924:238-239). In addition, during the early days of the community's development, a public meeting was held at Gwynn's to decide upon a more proper moniker for the blossoming mining camp. Gwynn participated in renaming the town "Auburn," within the already-established Sutter County (Davis 1990:6-7). In addition, when the Legislature of the State created the counties of Nevada, Placer, Trinity, and Klamath in 1851, Gwynn was appointed one of the committeemen charged with holding a special election to elect officers for the new county of Placer whose county seat was to remain at Auburn (*SU* 1895b).

William Gwynn's achievements during the early years of Auburn helped to establish the town as a place unto itself, more independent from its affiliation with the mines. He built the National Hotel and was the proprietor from 1849-1850 – at the time, the hotel was the only frame building of that kind in Auburn (*SU* 1895b; *PH* 1895; Davis 1951:17; Wilson 1993). The summer of 1850 saw the teamster Gwynn pioneer the first stagecoach line in Auburn and in the county at large (Davis 1951:122; Davis 1990:35). He was also the leading spirit behind the launch of the local newspaper, later to be named the *Placer Herald* (*PH* 1895; *SU* 1895b; Davis 1951:58).

Gwynn had a knack for diversifying his business interests, perhaps easily accomplished in a town that needed to be built from the ground up. Besides the above-mentioned enterprises, Gwynn added to his income with real estate (Placer County [PC] 1851:13). In a land deed between Gwynn and J.B. Lobdell, Gwynn agreed to lease the parcel of land adjacent to his store for the term of one year at a rate of ten dollars per month (PC 1851:13). Conditions of the agreement had Lobdell build several sheds, a stable, and a fence, all "made of good boards" on the property (PC 1851:13). After a six-month renewal on the lease, which came with a rent increase of an additional fifteen dollars per month, Lobdell was to vacate the property leaving all improvements and appurtenances made during the life of the lease for the sole ownership of Gwynn (PC

1851:13). Lobdell apparently made good on this contract because in November 1852 Lobdell’s American Livery Stable, located across from the National Hotel on Main Street, was advertising its services in the *Placer Herald* (1852e).

Gwynn recognized the potential for opportunity offered by this sprouting town and developing state, and thought it a good idea to have his remaining family in Baltimore join him. In 1851, William succeeded in persuading his father to come to California (*SS Constitution* 1851; Reynolds 2003). John R. Gwynn sold his inn located in Maryland for $500 and, accompanied by seven of his remaining children: Mary, Ellen, Jane, Laura Virginia, Elizabeth, Benjamin Franklin, and Charles Gwynn, relocated to Auburn (Ainsworth 1997:6). John’s (second) wife Ann, as well as six other children died in the years prior to leaving for California. William’s half-sister Emily remained behind in Baltimore and later died on 31 October 1858 (Reynolds 2003).

John R. Gwynn shared William’s ambition to cultivate a more civilized society in the growing mining town of Auburn and made efforts to foster a more refined, “Eastern” existence by actively campaigning for the elimination of the very popular Mexican past-time of bull and bear fights (Davis 1951:78; Davis 1990:22). Equally like-minded in business ventures, the two shared in several business enterprises, the first of which was John’s participation in operating the Eureka Store. After a few years, John bought out his son’s interest in the store when William moved from Auburn to Marysville (*PH* 1853b). John later hired William’s future brother-in-law and business partner, Henry T. Holmes, to run the store while John expanded the business to nearby Millertown (*PH* 1853c; Lardner and Brock 1924:113).

Auburn's growing numbers of residents, many transplants from eastern states, were feeling the isolation of being so far removed from the rest of the county; it required six weeks for the news of California's admission into the Union to reach San Francisco and even longer for it to reach the mines near Auburn (McGowan 1961:167). Business merchants also felt the need for a better communication system when ordering supplies for miners. The first step towards improvement in this matter was the formation of telegraph companies that contracted to establish lines between various communities within California (McGowan 1961:167). The Alta California Telegraph Company was established in the early 1850s and among the stockholders were William Gwynn, his father, and Henry T. Holmes (Figure 5), who had married William's sister, Laura Virginia in 1852 (*PH* 1852d; Sioli 1883:128; Reynolds 2003). The contract was to build a line from Auburn to Grass Valley and Nevada City (Lardner and Brock 1924:113). William Gwynn and Holmes completed this line and made a considerable profit. Gwynn then agreed to build the extension to Sacramento (*PH* 1852d). Another company built the line from San Francisco to Sacramento just after the successful completion of the Sacramento Valley lines, and all of these companies were subsequently transferred to, and merged with, the Western Union Telegraph Company (Lardner and Brock 1924:113).

However, these ventures did not always turn a profit. After Gwynn moved to Marysville he became one of the incorporators of the Oro Telegraph Company (*BR* 1857e-i). In 1857, this company constructed a line connecting Oroville in Butte County with Marysville in Yuba County. The "venture never proved to be a financial success," and the line was later abandoned when the Western Union Telegraph Company ran their own line from Marysville (Wells and Chambers 1882:237). This appears to have been

Gwynn's second business failure at utility installation; in January 1856, he is mentioned as having failed in business in Auburn with relation to the telegraph line extension to Nevada City (*Butte Record* [*BR*] 1856d, 1857b,c).

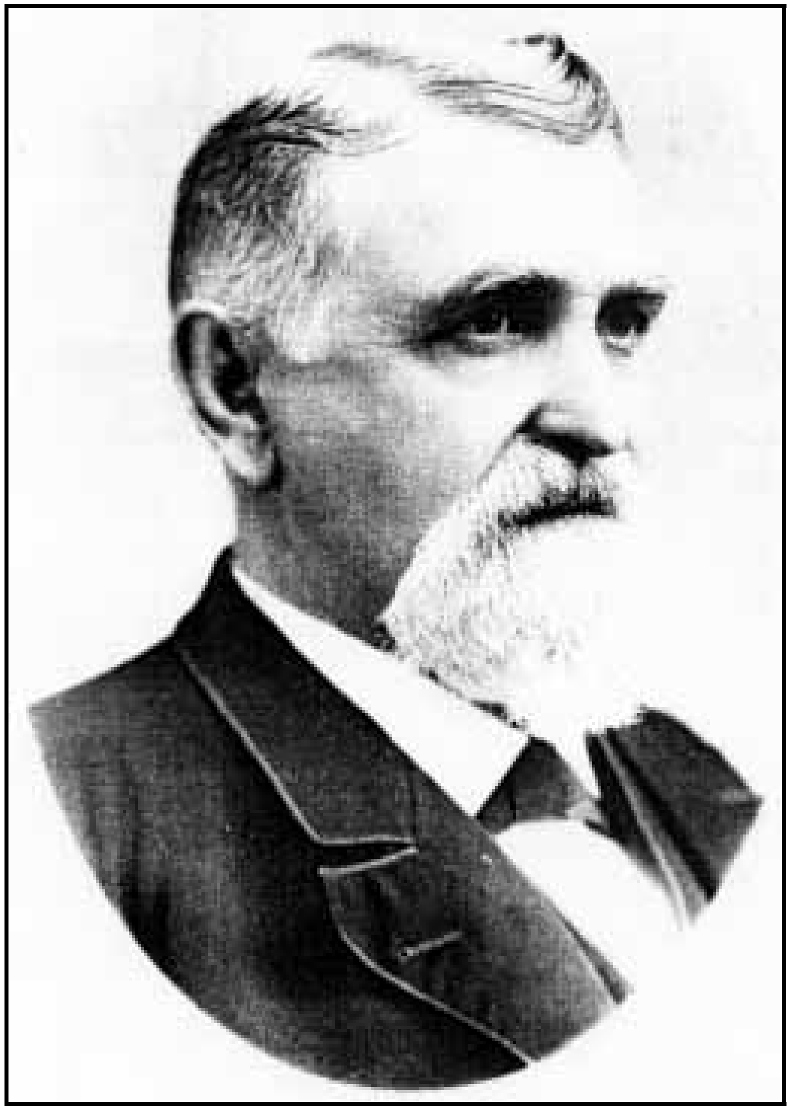

Figure 5. Portrait of Henry T. Holmes (San Francisco Journal of Commerce Publishing Company 1891:204)

Lime: The Beginning

William Gwynn was a man with good business acumen who had a talent for recognizing the needs of the developing community surrounding him and was usually one of the first on the scene to supply the market. The early 1850s saw the birth of a state and the continuing rapid growth of individual towns. Gwynn recognized the need for building materials in these burgeoning areas and in March 1853 announced the completion of his Bear River Saw Mill, which was conveniently located "on the direct road from Auburn to Grass Valley" in the county of Nevada, north of Placer County (*PH* 1853a). In the same year, Gwynn's father discovered a ledge of limestone about one mile north of Auburn (*PH* 1853a; Lardner Brock 1924:114). In no time at all the two men were manufacturing lime. The advertisement in the *Placer Herald* (1853a) read:

> Lime! Lime! Lime! Lime! The undersigned takes this method of informing the citizens of Auburn and vicinity that Lime can be purchased at the Lime Kilns 1 to 2 mile from Auburn….[N]ecessary for building purposes. Persons at a distance can depend on getting Lime at any moment….It will be sold much less than it has been in the country. For information apply to JOHN R. GWYNN, Auburn.

Many small deposits of high calcium limestone such as this ledge were also found near Clipper Gap and Applegate in Placer County, and burned in intermittent kilns in the early 1850s by Henry T. Holmes (Lardner and Brock 1924:114). One month after completion of Gwynn's sawmill, William sold his interests in the mill, along with the Eureka Store to his father and moved to Marysville (*PH* 1853a; *SU* 1895b). Once in Marysville, Gwynn established himself in the lime business by constructing a depot in the downtown area, which was supplied by his kilns on the Bear River tributary of Wolf Creek in Nevada County, along the West Branch of the Feather River in Butte County, and in Auburn in Placer County (Marysville City Directory [MCD] 1855:xxi; Yuba County [YC] 1856; *SU* 1895b). With his network of kilns, Gwynn was able to sell an array of building supplies; he advertised himself as a “dealer in lime, water-cement, plaster, fire brick, laths and lath nails” (*Marysville Daily Appeal* 1860).

Research was conducted in Nevada County to learn more about the kiln on Wolf Creek. However, due to several fires during the nineteenth century, many of the records of this era have been destroyed. It is likely documents exist which would enrich our understanding of the location and type of lime kiln Gwynn constructed on Wolf Creek, but these documents have not been identified to date.

By June 1855, William Gwynn was advertising the sale of lime in the *Butte Record* (1855b) in Oroville, California, the first advertisement in that area. Gwynn was producing the material at the “West Branch Lime Kilns” in an area north of town called Cherokee Flat (Sturgeon 1961:8). Orders were taken by Gwynn at the kilns or at the Moore, Perry, and Company store in Cherokee Flat (*BR* 1855b). Business partners with these men, Gwynn sold his lime at the store for several years, retaining this relationship even after A.G. Perry moved back to Ohio and it became the Moore, McDaniels and Company store in late 1855 (*North Californian* [*NC*] 1856a; *BR* 1857j,k). Oroville’s lime industry and William Gwynn’s association with this industry are discussed in more detail in Chapter 5.

It appears Gwynn moved to Marysville to establish a center of operation for his small-scale lime manufacturing business. Marysville was the head of navigation of the Feather River and was a suitable location to establish a business center for sale of building supplies to local and state markets. The road network surrounding Marysville was sufficient to connect it with Oroville and Cherokee Flat, Grass Valley and the area near Wolf Creek, and Auburn – areas where Gwynn had kilns. At one point Gwynn advertised the sale of Auburn lime along with lime burned in Oroville (*NC* 1857c). The transportation network necessary to support Marysville as the central hub of Gwynn's business was in place. Fortuitously, the Central Pacific Railroad line, which was built in the 1860s and crossed the county of Placer from east to west, was laid within close proximity to the limestone deposits near Auburn, as well as near Clipper Gap and Applegate, where Henry T. Holmes had constructed kilns and with whom Gwynn would form a partnership (Miller Lux Collection 1908:10-3; Logan 1947:262). The closeness of these deposits to inexpensive rail transportation enabled the lime manufactured at these small-scale operations to be exported out of the county to markets where it was in demand, mainly the burgeoning cities of San Francisco and Sacramento, and parts in between. By 1861, Gwynn had a warehouse in Sacramento, possibly shared with his Holmes, and lime could be inexpensively transported to the San Francisco market by both ship and rail (California Farmer 1861b:137).

Alabaster Cave, El Dorado County

While still living in Marysville, William Gwynn married Cornelia M. Stow, a native of Grand Blanc, Michigan, in Oroville in May 1860 (Latter-Day Saints [LDS] 2003; Reynolds 2003). They started a family, eventually having seven children: Holmes, William (who would go on to become the District Attorney in Napa, California), Solon Stow, Mary Louise, Martha Luthera, John Robert, and Walter Howard, but not all would survive into adulthood (Reynolds 2003). Gwynn continued to run his lime businesses from Marysville, maintaining agents in Marysville and Oroville (and perhaps elsewhere) to sell lime on his behalf, so that he could tend to his newly-acquired lime works in the Alabaster District of El Dorado County (*Sacramento Bee* [*SB*] 1860a,b).

Gwynn expanded his lime ventures to El Dorado County in December 1859 when he purchased land near Rattlesnake Bar, owned by M.W. Manning (El Dorado County [EDC] 1859:375). Gwynn appeared in the 1860 census at Rattlesnake Bar in Placer County, as the river forms the boundary between the two counties at this point (U.S. Census, Placer County 1860:70). His occupation was listed as “miner” and this was the first time “Ireland” was listed as his place of birth, contradicting other census documents that list it as Maryland. In fact, William was not born in Ireland, although he was of Irish ancestry; his paternal grandfather, Robert, was born in Ireland then moved his family to Maryland (Reynolds 2003). The census also listed Gwynn had relatives for neighbors: two of his brothers, John and Benjamin Franklin Gwynn (U.S. Census, Placer County 1860:70). It is likely that members of William’s family lived nearby throughout his life and were even participants in his business enterprises. William’s brother Benjamin was affiliated with the *Placer Herald*, a newspaper William helped to establish in 1852 (Davis 1951:58). Benjamin appeared in another area where William had burned lime when in the late 1860s “B.F. Gwynn” became the publisher of the *Daily Union* newspaper in Grass Valley, Nevada County (Langley 1867:144).

Gwynn paid $500 for Manning’s land in El Dorado County, but it would eventually make him thousands of dollars in profits, due to the size and quality of the limestone located on the property (EDC 1859:375; HCM 1860:220; Logan 1947:223). Some of the largest high-calcium limestone deposits in northern California are located within El Dorado County, and the county remained one of the top suppliers of the stone well beyond the end of the nineteenth century (Logan 1947:222). The lens of limestone on Gwynn's property had a high calcium carbonate content ($CaCO_3$ of 97.53 %) and was white in color (Logan 1947:223). The value of lime for most of its uses depends mainly on its lack of impurities, or rather on its content of "available lime" – that is, calcium oxide or calcium hydroxide (Wingate 1985:17). Today, limestone with high calcium carbonate content (well over 90% and preferably as much as 98%) is sought as raw material for lime used in all three main market sectors: industrial or chemical, construction, and for agricultural purposes (Wingate 1985:18).

Gwynn employed a number of men to quarry limestone and begin construction of a perpetual burning lime kiln for his company "Alabaster Lime Quarry and Kiln" (HCM 1860:220). In April 1860, Gwynn was still in the process of building the kiln on his property when a cave was discovered (*SU* 1860a; *SB* 1860b; HMC 1860:223). Gwynn's employees, John Harris and George S. Halterman, discovered Alabaster Cave after a large block of limestone removed from the quarry revealed the cavern (*SB* 1860a,b; HCM 1860:220; Belli 1999:A11). After briefly inspecting the find, the men returned with Gwynn to investigate the cave further – a natural wonder, unmatched by anything they had seen before. It consisted of several chambers with varying sizes and displays of stalagmites and stalactites in a range of colors. The formations were glorious in their display, meriting names such as "Pulpit," "Cathedral Hall," and "Crystal Chapel" (HCM 1860:219,225; Belli 1999:A1,A15). Gwynn wrote of the marvels he saw within the cave in a letter to his brother-in-law of Sacramento, which was printed in the local newspaper:

> Dear Harry: Wonders will never cease. On yesterday, we in quarrying rock, made an opening to the most beautiful cave you ever beheld. On our first entrance, we descended about fifteen feet, gradually, to the center of the room, which is one hundred by thirty feet. At the north end there is a most magnificent pulpit, in the Episcopal church style, that man ever has seen. It seems that it is, and should be called,

> the "Holy of Holies." It is completed with the stalactites of all colors, varying from white to pink-red, all overhanging the beholder. Immediately under the pulpit, there is a beautiful lake of water, extending to an unknown distance. We thought this all, but, to our admiration, on arriving at the center of the first room, we saw an entrance to an inner chamber, still more splendid, two hundred by one hundred feet, with the most beautiful alabaster overhanging in every possible shape of drapery. Here stands magnitude, giving the instant impression of a power above man; grandeur, that defies decay; antiquity, that tells of age unnumbered; beauty, that the touch of time makes more beautiful; use, exhaustless for the service of men; strength, imperishable as the globe, the monument of eternity – truest earthly emblem of that everlasting and unchangeable, irresistible majesty by whom and for whom all things were made. Wm. Gwynn (*SB* 1860a)

The cave soon became a tourist attraction; people journeyed from as far as San Francisco just to see and experience the grandeur of this amazing site (*SB* 1860b). It was estimated that over 400 people visited the cave within the first six days of its discovery; unfortunately, these visitors were unable to restrain themselves from touching the formations, damaging some areas of the cave (HMC 1860:221; Logan 1947:223; Belli 2000:8). Gwynn was disturbed by the harm inflicted on this extraordinary specimen and closed the cave to the public. However, the original discoverers of the cave protested so Gwynn agreed to a business proposition: he would lease the cave to the two men for a term of two years, providing certain considerations were met. The lease stipulated the men were to bring the cave to "complete order at their own expense" (*SB* 1860b) by installing oil-burning lamps and making walkways with railings so as to protect the delicate specimens from the inquisitive visitors and to "pay Mr. Gwynn twenty-five percent of the gross receipts" (*Alta California* [*AC*] 1860; *SB* 1860b). Each person was charged a $1 admission fee when the cave was reopened after several weeks of improvements (*AC* 1860; *SB* 1860b; HMC 1860:221; Belli 2000:8). The lease also stipulated that no liquor was to be "sold in or about the cave, and that whenever practicable, there would be preaching in the [Pulpit], on the Sabbath" (*SB* 1860b). Indeed, over the years sermons, marriages, and cotillions were conducted within the cave (Belli 2000:1). Gwynn must have made quite a profit because by September 1860 an average of forty visitors per day were touring this underground wonder, and the number was thought to have exceeded 3,000 total visitors by the end of September (HMC 1860:224-225; Belli 2000:8). In addition, the Alabaster Hotel only a short walk from the entrance to the cave was erected that same year to accommodate overnight guests (Belli 2000:8). The hotel was a "first class" establishment opened by Gershom F. Holmes, Harry's brother (*SU* 1860b).

Aside from the profits from Alabaster Cave, and possibly a percentage of the earnings from the Alabaster Hotel, Gwynn profited from the Alabaster Lime Quarry and Kiln. The combination of a great demand for lime in the ever-developing city of San Francisco, coupled with the abundant supply of limestone in the Alabaster deposit, made Gwynn's company one of the largest suppliers of lime in San Francisco by December 1860 (HMC 1860:223).

The perpetual kiln, a Perkins' patent monitor kiln, operated night and day and produced anywhere from forty to seventy-five barrels of lime per day, according to various reports (*SU* 1860a; HMC 1860:223; California Farmer 1861b:137). "The kiln was made of granite and was twenty feet square at the base and tapered to ten feet square at the top" with a height of thirty-six feet (California Farmer 1861a:140). The kiln consumed three and a half cords of wood per day, at a cost of $1.75 per cord. The limestone was supplied to the kiln from the top via an elevated platform and was drawn out from the bottom through metal doors every six hours. A constant supply of wood for the kiln was the responsibility of one man, while two men excavated the limestone, and two more men attended the burning kiln. The lime was hauled south to Folsom or Sacramento in wagons as return freight, then transported via steamer or railroad to San Francisco (HMC 1860:223).

Business was thriving for Gwynn and in 1862 he constructed a second lime kiln also of granite near the Alabaster Lime Quarry and Kiln at Wild Goose Flat, near Rattlesnake Bridge (Dawson 1995:2). However, this kiln was the older, intermittent burning style. The reason for this decision not to build another perpetual or continuous burning kiln can only be speculated about, as no documentation has been located to explain otherwise. It can be assumed that since business was “booming” it was not for lack of funds that the decision was made to build a less expensive kiln, rather than another costly ($10,000) continuous burning kiln (California Farmer 1861b:137). Perhaps it was due to the technology of the continuous kiln, and the skill required to properly burn lime in this type of kiln; over-burning the lime can occur if it is not properly tended (Wingate 1985:81). Continuous shaft kilns work on the concept of zones in which the charge is pre-heated, calcined, and cooled (Wingate 1985:81-82). If the process is not monitored during the calcining stage, the material can become fused within the shaft and remain in this zone too long, thereby over-burning the lime (Wingate 1985:82). Over-burned lime is less reactive; that is, it hydrates slowly and, therefore, affects the quality of the product (Wingate 1985:145). For whatever reason, Gwynn opted for the older kiln design and christened it with an engraved stone above the center arch: “Wm Gwynn 1862” (Dawson 1995:2). The lime was bagged in rawhide sacks and shipped to Newcastle on the Central Pacific Railroad (Sioli 1883:96).

From the beginning, Gwynn's businesses were well supported by sufficient infrastructure. El Dorado County was well supplied with water by the American River and its numerous branches and tributaries (Sioli 1883:104). Gwynn made an agreement with the Pilot and Rock Creek Canal Company and the El Dorado Ditch Company to share water rights in exchange for land use (EDC 1860:26). The Pilot Creek and Rock Creek canal was constructed during the mid-1850s at a cost of $180,000, and carried water twenty-six miles east of Georgetown to various areas, including Gwynn's property near Wild Goose Flat (EDC 1860:26; Sioli 1883:104). The road system was relatively extensive in this vicinity, with good haul roads leading away from the Alabaster Lime Quarry and Kiln to places like Auburn and Newcastle, which were commercial depots where merchandise was then transported by rail to markets throughout the state.

However, Gwynn's business in El Dorado County suffered a setback in 1862 when heavy rains washed out the Whiskey Bar Bridge (Sioli 1883:124). The wire suspension bridge was built in 1855 at a cost of $50,000 and crossed the American River downstream of Rattlesnake Bar (Sioli 1883:126). A prominent road leading from Sacramento to Georgetown crossed the bridge (Lardner and Brock 1924:175) and it was an important connection between the Alabaster District in El Dorado County with the markets that purchased Gwynn's lime in Placer County on the opposite bank of the river. An unsubstantiated piece of information was related to Mr. W. David Dawson of Carmichael, California, while photographing lime kilns throughout northern California in the early 1990s. While photographing Gwynn's 1862 kiln, he spoke with the overseer of the property who related the manager of the kiln at Wild Goose Flat found it more economical to pay Chinese workers fifteen cents per rawhide sack to carry the lime across the American River, than to rebuild the washed out bridge (Personal Communication of David Dawson, 1991). This would have been an extremely dangerous situation for the worker, as lime evolves a tremendous amount of heat when hydrated and has been the culprit of many a sunken ship due to an improperly stowed cargo of lime that was exposed to moisture and burst into flame (Wingate 1985:114; Harrington 1996:20-22). Whether or not this account was true, Gwynn needed a bridge across the river to transport his product to market more efficiently.

In 1863, the Legislature of the State of California passed an act that allowed Gwynn to construct a suspension bridge over the North Fork of the American River at Rattlesnake Bar (EDC 1882:576-577). The Rattlesnake Bar Bridge was built using remnant cables from the washed out Whiskey Bar Bridge, which he had hauled by ox teams to Rattlesnake Bar (Lardner and Brock 1924:176). Gwynn solicited the approval of the government for the construction of this bridge to maintain his prosperous lime business, but it also created a money-making enterprise in and of itself because he retained all rights and privileges connected with the bridge, including the right to "have, collect, receive, and retain all tolls allowed by law" (EDC 1882:577).

<u>Real Estate</u>

In 1865, William Gwynn moved his family to Sacramento where he entered into another partnership with Holmes, who had an enormously successful lime business of his own; between 1860 and 1874, he supplied all lime for construction of the State Capitol Building (Miller Lux Collection 1908:10-3). The two men agreed to name the business "H.T. Holmes and Company," with Holmes heading up a new office in San Francisco and Gwynn taking the office in Sacramento, while attaining "an interest in all the business carried on under this firm name" (Miller Lux Collection 1908:7,8). H.T. Holmes and Company was successful for eleven years until January 1877 when Gwynn had, unbeknownst to Holmes, lost company funds in a swampland reclamation venture in Sacramento and Yolo counties.

Gwynn recognized the importance of useable land within the growing state and the Sacramento Valley was an area rich in fertile soil suitable for agricultural pursuits. Agriculture had flourished since the early days in both Sacramento and the adjacent Yolo counties. However, the only real setback in the use of this land was its propensity for seasonal flooding. During the early spring especially, runoff from the Sierra Nevada Mountains would overflow the banks of the Sacramento River, creating swamplands. In the early days of statehood, individuals or small private groups developed their own small-scale flood control and land reclamation projects. By 1861, the State Board of Reclamation Commissioners was established to form reclamation districts to protect the Yolo basin and lower Sacramento County from flooding. By the time Gwynn had moved to Sacramento, some levees and canals had been constructed, but the majority of land was still unprotected (Mc Gowan 1961:169). By 1866, the Board had been dissolved and control of swamp and overflow lands had transferred to the individual counties (Thompson 1958).

Agricultural development expanded as inducement for land sales and settlement in the state increased. Gwynn had bought swamp and overflow land in the areas of Grand Island (Sacramento County) and Lisbon Island (Yolo County). Lisbon District number 307 was one of the earliest reclamation districts formed in Yolo County. It was organized in 1876, then due to improper descriptions of the land, then reorganized in 1877 (De Pue and Company 1879:57). Located on the west side of the Sacramento River, between Babel Slough and Merritt Island south of the city of Sacramento, the district encompassed approximately 6,000 acres of swamp and overflow land, of which Gwynn (and Holmes) owned approximately 2,000 acres (De Pue and Company 1879:99; Miller Lux Collection 1908:9-2).

Gwynn was contracted by the county to construct levees for the reclamation of land in the Lisbon District, and even became “interested in a patent dredger” to expedite the process (De Pue and Company 1879:99; *SU* 1895a,b). After two years of improvements, which totaled 14 miles of levees, the district encompassed 5,644 acres of reclaimed land suitable for agriculture (De Pue and Company 1879:57,99; Coil and McHugh 1940:148-149). However, heavy rains during the last years of the decade caused havoc with the clay levees and were breeched on numerous occasions causing tremendous financial loss to Gwynn and his associates (*SU* 1895a,b). Gwynn had invested tens of thousands of his and company funds in this business venture in an effort to complete the levee system (De Pue and Company 1879:57,99; *SU* 1895a,b). When Holmes returned from Europe and discovered they were in a financial quagmire he made efforts to extricate Gwynn and the company from their indebtedness, mortgaging all of their “property, except the homestead [where] Gwynn lived” (Miller Lux Collection 1908:9). The company resumed business, but was left with only its name.

In 1881, Gwynn and Holmes amicably dissolved their partnership and along with it, the H.T. Holmes and Company business (Miller Lux Collection 1908:9-2). Holmes formed a new lime business under the name H.T. Holmes Lime Company, joining men from his lime works in Santa Cruz and El Dorado counties H.T. Holmes Lime Company

(HTHLC). To pay off his debts, Gwynn sold the remainder of his assets that included the Alabaster Cave and lime works, land in Marysville, and approximately 450 acres of ex-Mission San Jose lands in Alameda County, as well as all rights and privileges to the Rattlesnake Bridge to William Jones, stock holder and treasurer of Holmes' new company (EDC 1882:573-577). Jones, in turn, sold the property that included the patent monitor lime kiln, to the H.T. Holmes Lime Company in May 1883 for the sum of $5000 (EDC 1883:393).

Rebuilding

William Gwynn was a man with a strong will and undying spirit, who when confronted with adversity, tackled it head-on. Although faced with financial ruin after investing his fortune in numerous failed attempts to reclaim swampland, undaunted, Gwynn made efforts to start anew. During the early 1880s, Gwynn liquidated the remainder of his assets, selling off land and other interests he owned in California and journeyed to Mexico to invest his remaining funds in a silver mine (EDC 1882:573-577; *SU* 1895a,b). He had an interest in "El mina de Vaca" – the Vacas silver mine near the town of Muleros (known today as Vicente Guerrero) in the state of Durango, Mexico, and left California nearly destitute, but determined to rebuild his finances (H.T. Holmes Scrapbook [HTHSB]; Wilson 1993).

Durango is located approximately 100 miles northeast of the port city of Mazatlan, on the eastern side of the Sierra Madre Occidental mountain range. When Gwynn arrived at the mine he found the ore to be of good quality, but the mine itself needed considerable improvements in order to make a profit: the equipment was outdated and the roads were insufficient; supplies had to be delivered to Mazatlan and packed by mule over the mountains to the mine (*PH* 1895). He invested what little money he had left in the mine, and through years of perseverance and assistance from his son John, was able to outfit the mine with the most advanced machinery available (*PH* 1895). Although the price of silver was low during the end of the nineteenth century, the mine was successful and Gwynn was able to regain some of his lost fortune. Unfortunately, he had little time to enjoy his turn-around due to sinister events which ended his life in February 1895, at the age of 72 (*PH* 1895). Family legend suggests that Gwynn was murdered, poisoned by the doctor at the mine (Reynolds 2003). Although a tantalizing end to a charismatic and entrepreneurial individual, the author has been unable to verify this information to date. Newspaper obituaries in California state William Gwynn died of pneumonia (HTHSB; *SU* 1895a,b).

Summary

William Gwynn exhibited many characteristics defined by Purser (2004) as representative of boom-surfer strategies, employed by some as a means to stabilize the harsh boom-bust economic swings of the nineteenth century. These strategies were usually carried out by “middle-level capitalists, skilled workers, and extended families,” who formed small partnerships, and invested intensive labor and little capital in diverse business endeavors that utilized low-level technology and strategic squatting, reuse and tenancy (Purser 1995:232). Gwynn jumped feet first into the capitalist society upon arriving in California, establishing a trading post that earned him more money than many made from their mining claims (Davis 1990:16). With his profits, he was able to diversify his future business ventures in construction supplies, communication, transportation, and real estate. Gwynn was not exclusive to kin-based partnerships when it came to forming business alliances; however, his family ties were central to his entrepreneurial endeavors throughout his residence in California. He often collaborated with his father; his brother-in-law Henry T. Holmes, was a long-time partner in various ventures, including establishing a network of satellite lime-manufacturing operations throughout California's gold districts. Gwynn was involved in the development of communication lines in several counties with the construction of telegraph lines; he participated in the inception of the Placer Herald newspaper, as well as serving as postmaster in Auburn. Gwynn started the first stagecoach line to Auburn, was a teamster, and built, owned, and operated the Rattlesnake Bridge over the American River, between Placer and El Dorado counties. Gwynn also owned property in several counties and participated in swampland reclamation in Sacramento and Yolo counties.

Expenses for these business undertakings were minimized by Gwynn's "sweat equity"; his hands-on approach carried him through from the beginning, although he enlisted assistance from others when his network of lime kilns grew into a multi-county enterprise. Another strategy boom-surfer Gwynn put into operation was the use of low-level technology, such as with the lime kilns in Oroville. In general, the avoidance of sophisticated technology reduced initial start-up costs and allowed for easier maintenance; for example, replacement parts manufactured locally decreased the likelihood of affecting production, rather than stopping operation while waiting for an imported part. Gwynn opted for cutting-edge technology when he built the continuous burning kiln in El Dorado County at the Alabaster Lime Quarry and Kiln in 1860, at a cost of $10,000. Two years later, he returned to the intermittent burning kiln technology, which used a less sophisticated level of technology at a fraction of the cost. For comparison, the intermittent burning kilns in Oroville at the West Branch Lime Kilns were consistently valued at $2,000 until 1862 when it dropped to $1000 (California Tax Assessment Rolls [CATAR] 1856:43; 1858:103-104;1860:199; 1862:276).

Lastly, Gwynn and his partners in Oroville, in what was likely a cost-cutting measure, employed strategic squatting. The West Branch Lime Kilns were located on land not owned by Gwynn or his partners, which eventually became a disadvantage to them because Chatham Baltimore appropriated the land by the same technique – squatting – but went a step further by following through with an application to the General Land Office for ownership (see Chapter 5; United States Bureau of Land Management [USBLM] 2004). Gwynn employed this boom-surfer strategy again after a major fire in downtown Oroville, when he attempted to get a jump on reconstruction efforts by setting up a warehouse for storing lime (*BR* 1857l).

5. OROVILLE LIME KILNS

Introduction

Hardesty (1988:9-11, as cited in Hardesty and Little 2000:23) uses the concept of a feature system to assist in understanding large, scattered sites with indistinct boundaries by grouping archaeological features from the same human activity or technology into geographical clusters. This perspective is necessary for examining the lime-manufacturing sites in Oroville as a case study of Purser's (1995;1999) boom-surfer model for observing small-scale enterprises and their effects on community formation and development. "Superficially haphazard assemblages of machinery, tools, structures, and other material culture," which characterize "functional flexibility, localized maintenance, and portability, rather than cutting-edge technological sophistication" represent the archaeology of boom-surfer enterprises (Purser 1995:232). The representative material culture of Oroville's nineteenth century lime-manufacturing industry is indicative of the boom-surfer modus operandi: technologically rudimentary lime kilns constructed and operated with locally acquired materials.

CASE STUDY AREA

Location

Encompassed within the Lake Oroville State Recreation Area, the Lime Saddle Recreation Area (Lime Saddle) is located along the West Branch of the North Fork of the Feather River. It is located 5.5 miles southeast of the town of Paradise, 2.0 miles southwest of the community of Pentz, and roughly 15.0 miles north of Oroville, within

Sections 7, 8, 17, and 18, Township 21 North, Range 4 East, as depicted on the Cherokee USGS 7.5-minute quadrangle (Figure 6; 1994).

Geology

The geology of the area is varied; however, Lime Saddle is comprised primarily of the Upper Paleozoic Calaveras formation (Creely 1965:Plate 1). This area is surrounded by the Upper Pliocene Tuscan formation to the west, the Hodapp Member to the north, the Pentz Sandstone Member to the south, with intrusive basalt porphyry to the southeast (Creely 1965:5,Plate 1).

The Calaveras formation includes "minor limestone" (Creely 1965:5). Two distinct units within this formation were identified by Creely (1965:12) in this locality: the (older) Hodapp Member, which is composed of low-grade metamorphosed volcanic rocks of basic composition; and the (younger) Pentz Sandstone Member, which is composed of "sandstone and conglomerate, with some interbedded fragmental volcanic rocks." Several of the belts of the Hodapp Member extend southeastward from beneath tertiary strata near the area of Nelson Bar and Lime Saddle (Creely 1965:13).

The Hodapp Member is principally derived from flows, tuff, and tuff-breccia; the tuff-breccia includes limestone fragments up to eight inches across (Creely 1965:13). There are two belts of the Pentz Sandstone Member that are exposed from Parish Camp and Glover Ridge, southwestward to the lower part of Sawmill Ravine and Mesilla Valley, which also appear intermittently from beneath tertiary sediments (Creely 1965:14). The Pentz Sandstone Member consists of "interbedded sandstone and slate, with subordinate amounts of conglomerate, and small, widely separated masses of chert and limestone" (Creely 1965:14). "Sheared argillaceous sandstone is the dominant

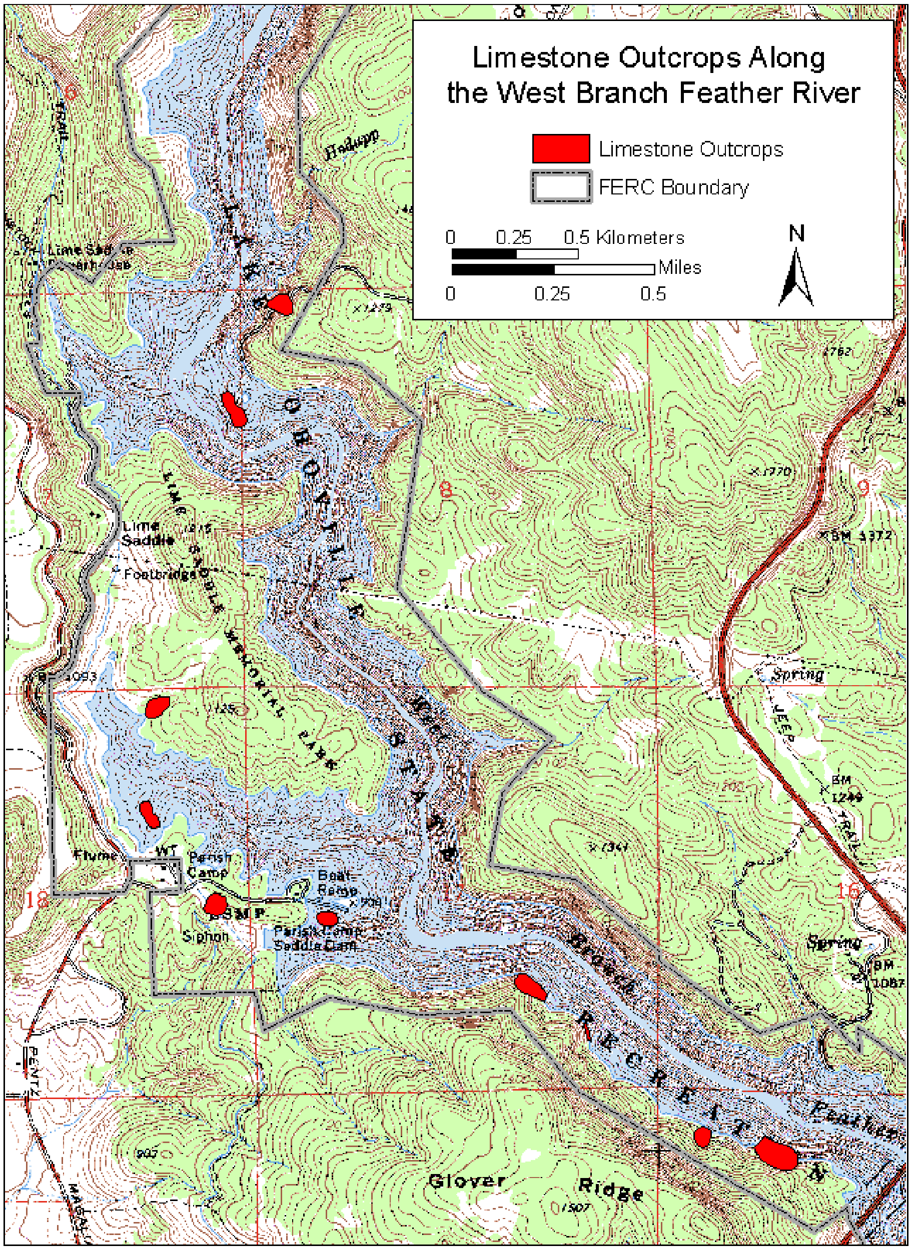

Figure 6. Limestone outcrops in Lime Saddle

lithologic type, which tends to be dark gray or black on fresh exposure, but soon weathers to shades of light gray or pale buff" (Creely 1965:14). The sandstone is "massive to thin-bedded, and tends to be fine- to medium-grained, but where massive, it is usually coarse-grained and frequently grades into strongly sheared, fine-pebble conglomerate" (Creely 1965:14). Black crystalline limestone is common as clasts within these conglomerates (Creely 1965:15).

Several large lenticular masses of limestone lie interbedded with the slates within the Calaveras formation. They occur east and south of Parish Camp, one lies east of Nelson Bar, and small bodies occur north of Nelson Bar and southeast of Lime Saddle, respectively (Creely 1965:18). The weathered surface of the limestone is light gray, but a fresh fracture reveals a core that is dark gray to black. The rock is dense, but some recrystallization to coarse-grained calcite has occurred locally (Creely 1965:18). Aside from several small indeterminate gastropod specimens collected from a limestone outcrop east of Nelson Bar and a specimen of coral collected from a large outcrop "lying east and slightly south of Parish Camp," Creely (1965:18) states that most of the limestone in the area lacks obvious organic structures. However, the author located fossils in the limestone outcrops at both the Parish Camp Lime Kiln and the Parish Camp Saddle Dam Lime Kiln.

The Tuscan formation consists exclusively of volcanic rocks and their sedimentary derivatives: tuff-breccia, lapilli tuff, volcanic conglomerate, and sandstone (Creely 1965:66,67). This formation is well exposed and is located predominantly west of the West Branch, whereas outcrops to the east of the West Branch are restricted to the tops of ridges (Creely 1965:67). In particular, the Tuscan sandstone varies from a light gray or buff to dark orange-brown or dark gray, but commonly appears bluish-gray on fresh exposure (Creely 1965:70). The grain size of the sandstone is highly variable, even within a single outcrop, with gradations from very fine- to very coarse-grain (Creely 1965:70). The sandstone from this formation tends to be friable, especially the coarse-grained type (Creely 1965:70). This sandstone is the source for the large, dressed blocks present at all known lime kilns in Oroville.

HISTORICAL OVERVIEW

The area that later became Butte County was first ventured into by American settlers in pursuit of missing animals belonging to Captain John A. Sutter. John Bidwell, Peter Lassen, and several others retrieved the missing animals in what became the area surrounding Red Bluff. The men were so impressed with the territory covered in their pursuit, several later applied to the Mexican government for land grants in the area (Wells and Chambers 1882:129). The first land granted in this region was to Lassen in 1844; in 1845, John Bidwell settled on his land grant, Rancho del Arroyo Chico.

Bidwell would play a role in initiating this region into the frenzy of California’s gold rush with his discovery of gold along the Feather River, several months after the initial discovery at Sutter’s Fort in 1848. The first mining settlement of the area, Bidwell’s Bar (a.k.a. Bidwell Bar), was a mere “rag city” as described by Dame Shirley in 1851, who passed through the settlement on her way to the mining area of Rich Bar on the East Branch of the Feather River (Rice, Bullough, and Orsi 1996:171,173). The early mining settlements in the area were very similar. For most gold seekers, the intention was to remain in California no longer than to claim their fair share of gold then return whence they came. Therefore, the early camps consisted of very sparse living shelters of canvas tents, hence the name “rag city.” As the years went on, canvas dwellings became relics of a past age (*North Californian* [*NC*] 1855a). As riches became more difficult to come by and the level of investment grew, living out the harsh winter months in more permanent settlements became the more chosen path. Log cabins and wood framed shacks were constructed like the one Dame Shirley and her husband enjoyed when they moved to Indian Bar in 1851: “The fireplace is built of stones and mud, the chimney finished off with alternate layers of rough sticks and this same rude mortar” (Rice, Bullough, and Orsi 1996:176). Mud mortar was used when the location of limestone deposits was not known, or the expense of using lime mortar was too great (Jenison 1976:21; Donnelly 1971:91).

The mining settlement of Bidwell Bar came into its own in 1853 when it became the county seat of Butte (Lenhoff 2001:15). The town was platted, a wealth of businesses sprang up, and there was talk of incorporating this rich mining camp-turned-metropolis into a city, which boasted of a population in excess of 2,000, taking into account the smaller camps in its vicinity (Wells and Chambers 1882:255). However, in August 1854, the town fell to ruin under the fierce flames that claimed so many mining camps during the early years of the gold rush (Wells and Chambers 1882:256). Bidwell Bar recovered within several months with several buildings rebuilt using a more “fire proof” construction of brick and stone, bound together with lime-based mortar. These masonry buildings became more the norm after destructive fires in many mining camps resulted in damages that often reached over the $100,000 mark. Lime for this purpose was imported from San Francisco until 1855, when the product was commercially available locally (*Butte Record* [*BR*] 1855b).

However, the face of mining had changed and the long-overdue water conveyance systems that the townspeople had been clamoring for, needed to work the rich, dry diggings of the area, had finally come to pass (*NC* 1855d; Hitchcock 1998:60). Local capitalists formed small partnerships and invested $350,000 to build dams, reservoirs, and ditches throughout the area, which brought new life into areas that had long since been neglected (Figure 7,8; *NC* 1855d). For example, Marysville merchants Thomas B. Walker and James C. Wilson made a water claim in 1854, and “surveyed and completed their ditch from Little Butte Creek to Sinclair Flat, near Pence’s ranch…and let it remain until the spring of 1856” (Wells and Chambers 1882:258-259). Then a cry for water from Thompson’s Flat miners rousted Walker and Wilson to extend their ditch around Table Mountain to Thompson’s Flat (*NC* 1856d). The entire 36-mile long ditch was completed in 1858 (Wells and Chambers 1882:258-259).

Ophir was a small mining area approximately seven miles southwest of Bidwell Bar, which benefited greatly from the completion of another water conveyance system in 1855, the South Fork Ditch. The ditch brought the much-needed water to sluice the rich, dry diggings around Ophir, making it the mining center of Butte County (Lenhoff 2001:7). Rechristened Oroville, the town was laid out in 1855 by forty-niner, Captain Ralph Bird, and a year later Oroville spirited the county seat away from Bidwell Bar (Lenhoff 2001:7,114). The aspiring and spunky little town on the banks of the Feather River flourished into the most populated mining town in California with a population of 4,500 (Lenhoff 2001:7,21). The *Butte Record*, having moved from Bidwell Bar, joined Oroville’s original town newspaper the *North Californian*, in apprising the town’s

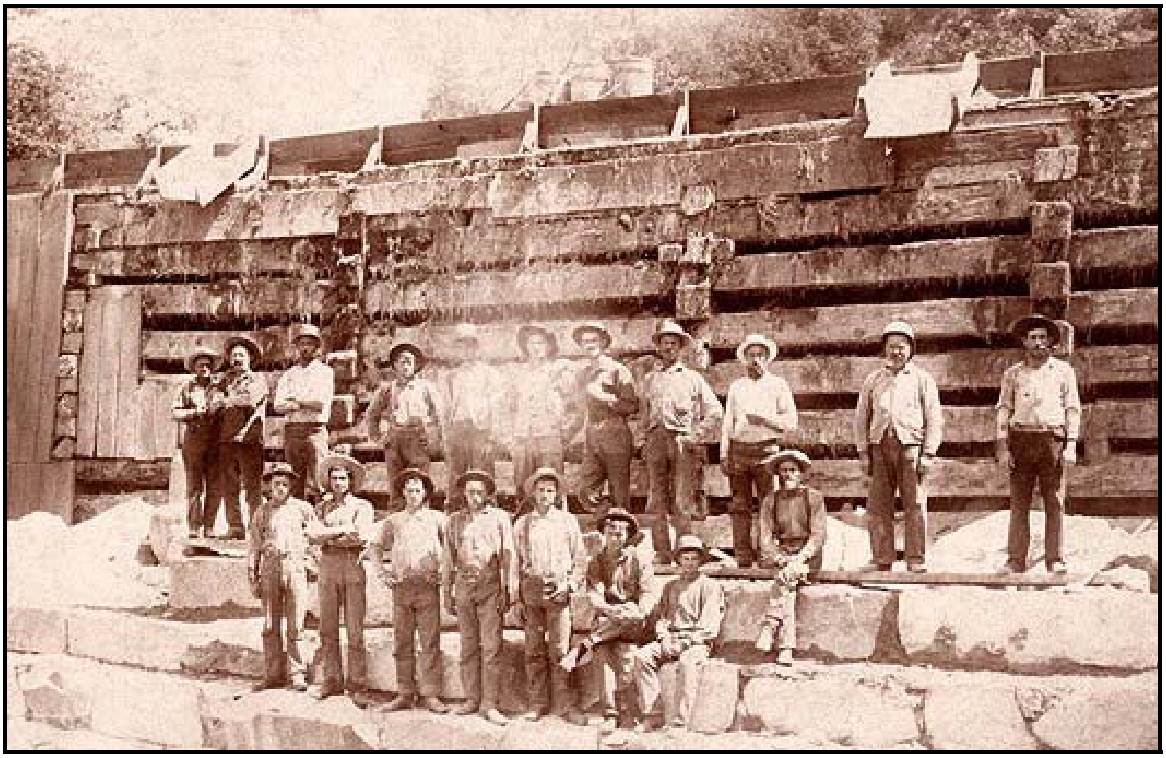

Figure 7. Dam of mortared stone, 1902. Enterprise, Calif. Courtesy of CSU Chico Special Collections Sc21345.

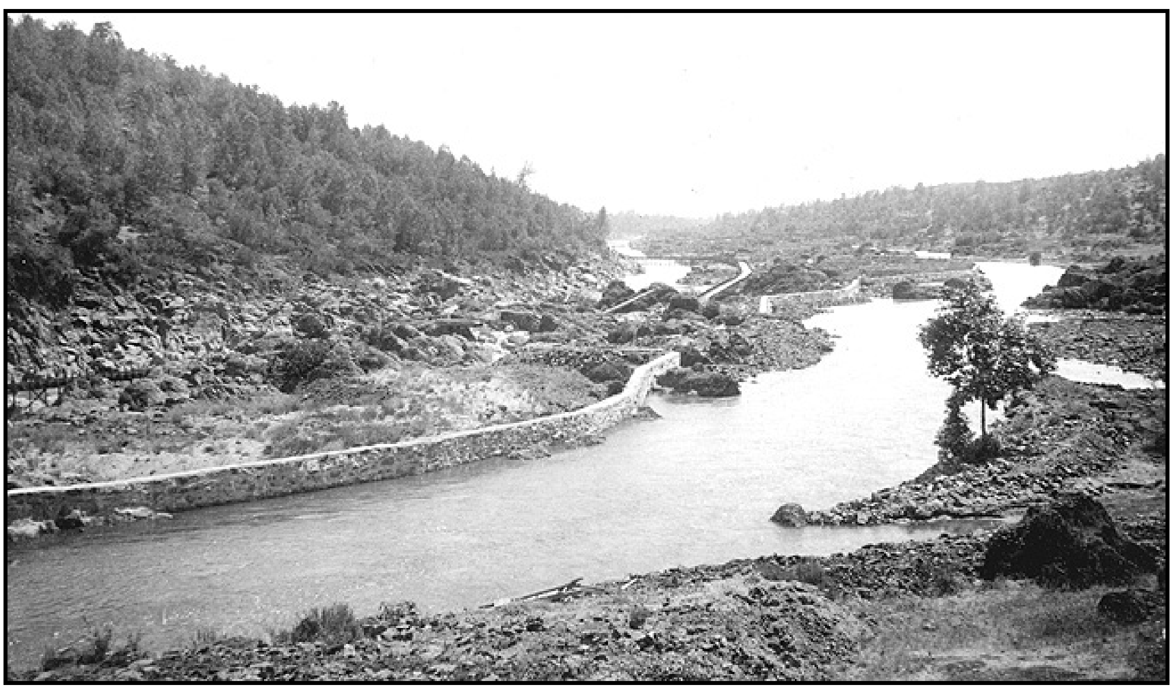

Figure 8. Masonry wall along Feather River near Golden Gate River Mine, 1890. Near Oroville, Calif. Courtesy of CSU Chico Special Collections Sc15426.

residents of both local events and news from the Union (Lenhoff 2001:115). In its glory days, with hourly stages and scores of hotels and saloons, Oroville was a commercial center supporting the surrounding towns of Cherokee Flat (a.k.a. Cherokee), Oregon City, Forbestown, Bangor, Bidwell Bar, and Honcut (Lenhoff 2001:23,27).

DEVELOPMENT OF THE LIME INDUSTRY

William Gwynn

The first documentary evidence that lime was being burned in the Oroville vicinity was the following announcement in the local newspaper:

> West Branch Lime Kilns – We beg leave to inform the citizens of Butte county, that we are prepared to furnish FIRST QUALITY LIME, at our Lime Kilns, on the West Branch, at low rates. All orders sent to our store, (Cherokee Flat) or Wm. Gwynn, at the Lime Kilns, will be promptly attended to. Lime constantly on hand. MOORE, PERRY & Co. (*Butte Record* 1855b)

William Gwynn formed a partnership with Moore, Perry and Company, no doubt, specifically for the purpose of manufacturing lime. No historic documentation, aside from newspaper advertisements and tax assessment rolls, has been located to elucidate this partnership further. However, by the time they first announced the sale of their product several kilns had been constructed at the limestone deposits along Dogtown Road – present day Pentz-Magalia Highway. By December of that same year Perry was no longer a partner, replaced by another prominent businessman of Cherokee, Thomas McDaniels (a.k.a. McDanel, McDaniel), making it Moore, McDaniels and Company (*NC* 1855c). The new partners opened a new store in Cherokee, retaining their partnership with Gwynn.

It is likely that Gwynn himself had the knowledge to manufacture lime. An advertisement mentions Gwynn available "at the Lime Kilns," but when he was otherwise engaged during 1856-1857 establishing Oroville's first telegraph line with Marysville, the advertisements stated that "parties must furnish their own labor:"

> To Contractors: Bids will be received for the burning and manufacturing of lime per two hundred pounds at the West Branch Lime Kilns, up to the first day of April and for the term of nine months. The parties must furnish their own labor in manufacturing lime. Security will be given and required. MOORE, McDANIELS & Co. N.B. – Proposals must be addressed to William Gwynn, Telegraph Office, Oroville. (*Butte Record* 1857j)

As Oroville became increasingly important within the region, there was discussion of making it, instead of Marysville, the head of navigation of the Feather River (*BR* 1855d,e; *BR* 1857a). The concern was the river was not deep enough, but in 1857, the paddle wheel *Gazelle* steamed up the Feather River, followed by the *Sam Soule* (Lenhoff 2001:97). Transporting goods and people by boat was a more economical and reliable venture than transporting them by freight wagon. However, the river proved too dangerous to navigate during low water months, and Oroville could not wrestle the prized head of navigation away from Marysville. It was not until 1864 that Oroville was connected to Marysville by rail when A.J. Binney completed the California Northern, the fourth railroad constructed in California (Lenhoff 2001:98).

As Gwynn's lime business expanded, it became increasingly necessary to employ others to act as agents for his business of selling lime. The "extensive lime kilns" situated on the West Branch (*NC* 1857d), as well as the other lime kilns he owned/partnered in other counties, required his attention, and Gwynn was frequently splitting his time between Oroville, his larger lime works at Alabaster Cave in El Dorado County, and his lime depot and growing family in Marysville. In April 1857, Gwynn appointed an agent in Oroville for the sale of lime from both the West Branch Lime Kilns and his operation in Auburn, in Placer County:

> Lime! Lime! Lime! FOR SALE! The subscribers would respectfully inform the public that they are now manufacturing LIME, at their kilns on the West Branch, and will keep a constant supply on hand. Thankful for past favors. MOORE, McDANIELS & Co. N.B. – Wm Gwynn is the business partner. All orders will be promptly attended by him. I have this day appointed Joel A. Burlingame as Agent for the sale of Auburn and West Branch Lime at Oroville. Office with Morse and Burlingame, United States Building. WM GWYNN (*North Californian* 1857b)

Although Gwynn's business ventures kept him occupied, he was never too busy to recognize another business opportunity. In 1857, Oroville suffered yet another fire and the Metropolitan Theatre was destroyed, along with eight other buildings along the downtown plaza and Huntoon Street. Gwynn took advantage of the tragedy by erecting a temporary lime warehouse on the recently available downtown property, in hopes of being a direct supplier to the reconstruction efforts (*BR* 1857l). His business venture was not met with enthusiasm, though, as several of the locals found Gwynn's "squatting" on public land offensive and tore down the structure (*BR* 1857l).

Gwynn hired a man by the name of Chatham Baltimore to manufacture the lime at his West Branch Lime Kilns. Baltimore first appeared in Oregon Township of the Butte County tax assessment records in 1860 (California Tax Assessment Rolls [CATAR] 1860:25). He claimed 320 acres that was bounded to the north by Moore and McDaniels land. However, Baltimore must have fallen into financial troubles and lost his land because he is not listed in the 1861 tax assessment records, and then in 1862 he claimed half of the Lewis Knox Ranch on 160 acres in Oregon Township (CATAR 1862:30,203). It is during this time, 1861-1862, that Baltimore began working for Gwynn and it is through letters written by both Gwynn and Baltimore to (then Major) John Bidwell in Chico, that we know some of the dynamics of this relationship.

Gwynn employed Baltimore to manufacture lime at the West Branch Kilns in Oregon Township, Butte County, and paid cash for each load of lime he burned (Bidwell: Box 1, Folder 6, Page 188). However, it seems that Baltimore used his position as lime burner, and the frequent absences of his employer, to pay off his personal debts to Major Bidwell with the manufacture of lime: “Mr. Bidwell.…I will sell what lime you want and take it all in trade. I want to pay that [debt] with interest….I have had all the bad luck that a man could have for the last five months” (Bidwell: Box 1, Folder 5, Page 134). In another letter, Baltimore goes beyond just filling orders, and notifies Bidwell that he can take Bidwell’s payment for the lime: “[Y]ou can settle with me for [the lime], as I don’t know what Gwynn charges you for it” (Bidwell: Box 1, Folder 6, Page 183). At one point, Baltimore even pointed out to Bidwell in a letter that he has no partner in the lime business (Bidwell: Box 1, Folder 5, Page 146), and Gwynn responds in a letter to Bidwell:

> All lime taken by your order or request from the lime kilns will be charged to you and I do request you not to settle with any other person than myself. Mr. Baltimore is simply making or manufacturing lime for me on contract and subject to my orders. He says that he is indebted to you about $90 and desires me to give you credit for that amount whenever we settle for lime….I shall be happy to supply you with all the lime you may order, and have requested Mr. Baltimore to fill your orders….Wm Gwynn (Bidwell: Box 8, Folder 3, Page 3056)

Gwynn eventually agreed to pay Baltimore’s debt: “I understand that Mr. Baltimore was indebted to you the sum of ninety dollars this amount I will settle with you but no more. Mr. Baltimore is simply burning for me by the contract and he is not authorized to collect for me” (Bidwell: Box 1, Folder 6, Page 188). By mid-August 1862, Gwynn informed Bidwell of the ‘change of guard’ at the kilns, “Mr. Baltimore is not doing business for me at the kilns. Mr. George Haskell is my burner [now]” (Bidwell: Box 8, Folder 3, Page 3058).

Baltimore does not appear in the 1863 tax assessment records for Butte County, but in 1864, he is back in Oregon Township with 40 acres of land near the Reservoir House known as the Reservoir Lime Kilns, bounded on the west by Dogtown Road (CATAR 1864:15; 1865:26). Information relating to this property and the exact location of the "kilns" has not been discovered, but it is presumed to have been part of the original 240 acres used by Moore, McDaniels and Co. for the West Branch Lime Kilns as the Walker and Wilson Ditch passed through this land (Butler 1962:4). Baltimore may have been squatting on property that was not in use by Gwynn or Haskell at the time.

In 1865, a mortgage was drawn up between Chatham Baltimore and William Gwynn "intended…to secure the payment of the sum of $687.50 according to law the terms and conditions set forth in the certain promissory note, drawn by [Baltimore] payable to [Gwynn]…[due] twelve months after date…with interest at the rate of 2% per month…" (Butte County [BC] 1865:461-463). This mortgage was for title to "land situate [sic] in Township of Oregon, Butte County…commencing at the Walker and Wilson Ditch where it empties its waters into the reservoir…together with the undivided two thirds of all the tenements…particularly in and of a certain lime quarry and kiln situated thereon, excepting a certain barn thereon of which only the undivided one half is included in this sale and conveyance" (BC 1865:461-463). The mortgage goes on to say that if default on this conveyance occurs, [Gwynn] is "empowered to sell the premises…and out of the money shall then be due on the said promissory note" (BC 1865:461-463), including all costs and charges.

Four years later, Baltimore enters into the same agreement with Henry A. Moore (partner in Moore, McDaniels and Co.) for the sum of $455 for the same parcel of land

(BC 1869:127-128). In April of 1870, Baltimore applied to the General Land Office (GLO) for a cash-sale entry for 160 acres in Section 18, Township 21 North/Range 4 East, which included the lime kilns contained within the area known today as Lime Saddle (United States Bureau of Land Management [USBLM] 2004). In December of that same year, Gwynn filed a foreclosure notice in the District Court of the 2nd Judicial District in Butte County on the property described in Baltimore's mortgage, and included Henry A. Moore as a co-defendant (BC 1872:84). The outcome of the proceedings has not been uncovered, but this is around the time that Gwynn fades from Oroville's lime manufacturing scene, having moved to Sacramento during the mid-1860s. Baltimore ended up selling his GLO claim of 160 acres to Augustine Parrish for the sum of $400 (BC 1870:134-135).

Augustine Parrish

Parrish came to the Mineral Slide area (north of Lime Saddle, south of the town of Paradise) circa 1853, where he made one of his first placer mining claims (Sampson and McAleer 1977). An avid miner, Parrish partnered with many men, including his brother Harrison, in a number of claims throughout this region of Butte County. Placer mining was an activity that Parrish continued throughout his residence in Lime Saddle, increasing his land holdings to include several of his mining claims (Butte County Tax Assessment Plat [BC TAP] 1887-1891; BC 1891a,b). As stated above, Tennessee-born Parrish purchased 160 acres of land in the Oregon Township from Chatham Baltimore in 1870.

Parrish periodically manufactured lime on his land, burning as early as 1875:

> Lime Burning: A. Parrish is doing a good business in lime burning this Spring. He is now burning the fourth kiln. His lime has improved in quality of late, better lime-rock having been struck in his quarry. (*Weekly Mercury* [*WM*] 1875c)

The phrase “fourth kiln” could be interpreted two ways: 1) Parrish is burning lime in the fourth of a number of kilns, or 2) Parrish is burning lime for the fourth time this season; that is, because the kilns in Lime Saddle are all single batch kilns, he would have to burn several batches to keep up with the demand of the market. Since all other references of Parrish burning lime refer to a single (not plural) kiln, the phrase “fourth kiln” is interpreted to mean that Parrish is burning his fourth batch of lime this season. Between 1875 and 1904, Parrish sold lime manufactured on this property, likely taking on boarders who managed the lime operation while Parrish focused on his primary business: farming (*Weekly Mercury* [*WM*] 1875a-c; U.S. Census, Butte Co., 1880:20).

A successful farmer, particularly of citrus, Parrish exhibited his oranges in the Sacramento Citrus Fair in January 1886 (*BR* 1886). The citrus grown in the vicinity of Oroville drew attention at the Fair for its ability to grow at a higher elevation, as well as ripen six weeks earlier than most citrus due to a local thermal belt (Lenhoff 2001:107). The following year the first statewide Citrus Fair was held on the courthouse lawn in downtown Oroville (Lenhoff 2001:54). Parrish continued his agricultural pursuits until he retired in 1904, at one time amassing 520 acres of land for pasturage, horticultural, and agricultural endeavors (BC TAP 1887-1891; BC 1900:53-58).

It seems that Parrish was a bit of a boom-surfer as well, and branched out into small-scale business ventures that he could manage from the central location of his homestead. His multiple business endeavors often seemed to go hand-in-hand with each other, such as agriculture and the manufacture of lime. As agriculture became more popular as a business, helpful remedies, some of which often contained lime as an ingredient, were advertised in local newspapers to insure against pestilence and disease that afflicted local crops:

> Lime, Sulphur and Salt Wash. The following formula and directions if properly carried out, will produce an effective solution…[for the] curl leaf and mildew [which] are becoming quite prevalent in parts of the State in unusually wet seasons. The above wash is recommended by the Horticultural Commissioner of Butte County, and should be applied while the trees are dormant. (*Chico Semi-Weekly Record* [*CSWR*] 1894)

Parrish also registered himself as a lumberman in the Great Register of Butte County (recorded in September 1884), a venture perhaps launched after noticing the numerous trees growing on his expansive acreage going unused, except for the occasional use as fuel for his kilns (BC 1886:40). This is the only indication that he participated in this occupation; although a map produced by the Butte Irrigation Water Supply and Land Development Project, has an illegible word that appears to be “mill” located in the vicinity of, what is here referred to as, Parrish Camp Saddle Dam Lime Kiln (CA-BUT-621H) (Hall 1891). However, the word could also be “kill,” which was used in earlier days to describe a lime kiln; burning the limestone was said to “kill” the stone (Jenison 1976:22). In any case, no other evidence of lumbering by Parrish has been uncovered during research for this study, and it may have only been a short-term pursuit.

In addition to farming, lime manufacture, lumbering, and mining, Parrish was briefly affiliated with the business of cement manufacture. Parrish and his wife, Martha Elizabeth, entered into a covenant with F.C. Williams on 13 July 1900 that secured Parrish’s land for Williams and his assigns to use in the manufacture of cement:

> [F]or and in consideration of the payment of three thousand five hundred dollars…at any time within eighteen months from the date hereof [13 July 1900] …agrees to sell and convey…[480 acres]… for the purpose of quarrying, digging, and mining and taking out limestone, clay and other materials thereon except gold…and using the same in the manufacture and compounding of cement…and without any expense to him for so using one kiln formerly used for burning lime now on said premises known as the Baltimore kiln. (Butte County [BC] 1900:53-58)

The quality of cement was tested and found to be of equal strength to Portland cement, which had become the preferred product in the construction industry (Chico Semi-Weekly Record [*CSWR*] 1900a, 1900b). By 1904, Parrish and his wife had retired to Chico, although he was still advertising lime for sale in the Chico newspaper (*CSWR* 1902). Parrish died in the county infirmary in Oroville in September 1917 (Chico Enterprise [*CE*] 1917).

<u>Charles Curtis</u>

A mile north of Lime Saddle Recreation Area is Nelson’s Bar (a.k.a. Nelson Bar). This was a prolific mining area, and in 1855 Charles S. Curtis settled here after working the mines in nearby Helltown, where he lived since 1850 (Forester 1967:29; U.S. Census, Butte Co. 1860). His son Henry joined Curtis, a native a Maine, in 1856, and then his wife Amanda and another son Frank moved to Nelson Bar a few years later (Forester 1967:29). Their eldest son, Joseph, was a resident of Amador County until the mid-1870s, when he too joined the family at Nelson Bar (Forester 1967:31). Charles Curtis built the first road to the area from the original Pentz Road, and later built and operated a ferry across the West Branch of Feather River, transporting miners across the river at Nelson Bar (*BR* 1857d; Forester 1967:29-30). He later built and operated a toll bridge across the river at the same place (Forester 1967:30).

Curtis’ professions were many: miner, ferry and toll bridge operator, and farmer, and in the early 1860s, he began to burn limestone from an outcrop on the east bank of the West Branch (Forester 1967:30). Curtis, however, ran into difficulties early on as the location of the limestone quarry and kiln were on the opposite side of the river from the road to town. Heavy rainstorms of 1862-1863 reeked havoc on Nelson Bar, and the rising waters swept away both the ferry and bridge (Forester 1967:30). His continual efforts to restore these structures proved to be just in time for the next big storm, and it was not until 1875, that he was able to restore his lime manufacturing business (*WM* 1875a). Curtis, along with his son Joseph ("Joe"), burned in their one kiln the "finest lime to be obtained in the State," and had erected a lime warehouse "on the old West Branch Ferry Road" (*WM* 1875a). The old West Branch Ferry Road was later called Nelson Bar Road, which used to cross the river at this location. In 1883, Joe Curtis (and others) constructed a public highway from Pentz Road to Nelson Bar, with a covered bridge across the river, which utilized cement abutments. This bridge was later washed out in 1903 when the Concow Dam breeched. The 40-year-old lime warehouse was torn down in 1912; the lumber from which was reused to construct a large poultry house on Henry's ranch in Pentz (*Oroville Daily Register* [*ODR*] 1912).

The Curtis lime business remained a small-scale operation, never expanding beyond the one kiln, repairing it themselves, and never assigning an agent in a local trading post to sell their product, unlike Gwynn and his partners (*WM* 1875b). Lime was for sale at the Curtis kiln, and orders could be made there. Henry Curtis went on to be a tanner for a short time period, but soon reverted back to farming and grew, among other vegetables, olives (U.S. Census, Butte Co. 1880; *BR* 1903).

<u>ARCHAEOLOGICAL SITES RELATING TO LIME INDUSTRY</u>

<u>Previous Studies</u>

Frequent recreational development of the Lime Saddle over the last 30 years prompted extensive archaeological survey and site investigations. Department of Parks and Recreation (DPR) proposed development of a day-use area in 1976, which identified two lime industry sites previously recorded: CA-BUT-158 and CA-BUT-392 (Furnis and Young 1976). CA-BUT-158 was originally recorded by Parmer (1962) and described only as a prehistoric campsite situated near an overhang “at the base of a limestone cliff” (Furnis and Young 1976). It was not until Ritter and Smith (1965) returned to the site a few years later and noted an “old limestone mining area with walls, dirt road above site.”

Ritter and Smith (1965) originally recorded CA-BUT-392 as a “small house pit village site with 10 bedrock mortars” in two limestone boulders with associated midden. The record states that the midden on the site had been partially destroyed or badly disturbed by bulldozing, as had three house pits; no artifacts were noted. The site was revisited by Furnis and Riddell (1976) and noted to be on two adjacent knolls, with additional bedrock mortars discovered in the limestone outcrop. The previously unidentified historic-period component consisting of a limestone quarry and lime kiln were finally identified during Furnis and Young’s (1976) site update. Research on the limestone/lime industry in the area resulted in a construction date for the kiln between circa 1885 and 1892 (Furnis and Young 1976). This information was based on geology reports published by the state mineralogist who noted in 1884 limestone deposits that had not been worked in the area near the town of Pentz, along the West Branch of the Feather River; then in 1892 it was noted a “couple of small kilns are burning limestone” (Hanks 1884:108; Hanks 1886:113; Irelan 1893:156,157). In addition, information from a former resident of Pentz, Nessie Blum, regarding the existence of two kilns in the area during the 1880s or 1890s, gave the impression that CA-BUT-392 was one of those kilns (McGie 1956:304, as cited in Sampson and McAleer 1977; Furnis and Young 1976). The second kiln was presumed to be on the property of Joseph C. Curtis, who owned property to the northwest of the Lime Saddle, during late nineteenth and early twentieth centuries (Furnis and Young 1976; BC TAP 1887-1891). Further documentary research and test excavation of CA-BUT-392 were recommended to determine the complexity and depth of the site (Furnis and Young 1976).

In 1977, DPR conducted archaeological investigations of CA-BUT-392, including additional survey of the surrounding area, which identified two new sites related to the lime industry: CA-BUT-620 and CA-BUT-621 (Sampson and McAleer 1977). Detailed recording of the archaeological features of CA-BUT-392 documented an historic-period artifact scatter located on the knoll north of the lime kiln; 100 percent of these surface artifacts were collected (Sampson and McAleer 1977:4). The variety of artifacts collected substantiated a local informants' recollection of a "small, one-room miner's shack (in poor condition) still standing" circa 1915-1925 (Table 1a,b (see also Appendix B); Sampson and McAleer 1977:6). However, backhoe trenches and auger units placed throughout the site, except where the historic-period artifact scatter was located, were less productive: "all subsurface sampling…provided negative results" (Sampson and McAleer 1977:6). The site was thought to have been seriously disturbed by bulldozing activity in preparation for the inundation of Lake Oroville, as well as possible "extensive artifact collecting" by recreational users (Sampson and McAleer 1977:7).

In addition to the collection of surface artifacts and subsurface testing, the lime kiln at CA-BUT-392 was mapped in detail. Built into the natural slope of a small hillside below a limestone outcrop, the kiln rests on a shale bedrock foundation. The kiln and its outer wall were constructed of volcanic sandstone blocks from the local Tuscan formation (identified in 1977 by geologist Kenneth Cole), the majority of which were chiseled into rectangular or subrectangular shapes, with chisel marks still evident on most blocks (Sampson and McAleer 1977:2,4). The blocks were mortared using the local shale bedrock as an ingredient, with small pieces of shale evident in the mortar. Vitrified and blackened surfaces were evident on the inner surfaces of the sandstone blocks of the kiln. The kiln itself is roughly cylindrical in shape, measuring 14 ft. 1 in. tall, with an elliptical "diameter" of 6 ft. 3 in. x 5 ft. 10 in. Its outer wall, nearly 160 degrees around the front of the kiln, was separated from the kiln by a distance of 4 ft. This gap was filled with soil as a means of insulation and support during firing. The outer wall, which bows out slightly, had partially collapsed, leaving 45 blocks in ruins in front of the kiln. During the investigation, these blocks were removed from this area. The lintel above the doorway measured 54 x 19 x 15-1/2 inches thick (Figure 9a,b, 10; Sampson 1977b).

TABLE 1a.

SUMMARY OF ARTIFACTS BY GROUP
1977 Surface Collections – CA-BUT-392/H

Description	Count	MNI	% of MNI
Activities	1	1	0.4
Domestic	240	87	30.7
Indefinite Use	62	32	11.3
Industrial	1	1	0.4
Personal	47	16	5.7
Structural	261	146	51.6
TOTAL	612	283	100.1

TABLE 1b.

SUMMARY OF ARTIFACTS BY CATEGORY
1977 Surface Collections – CA-BUT-392/H

Description	MNI	Percent
Clothing	1	0.4
Clothing Maintenance	1	0.4
Electric	1	0.4
Food Prep/Consumption	55	19.4
Food/Food Storage	27	9.5
Furnishings	4	1.4
Grooming/Health	8	2.8
Hardware	145	51.2
Indefinite	1	0.4
Misc. Closures	2	0.7
Misc. Containers	9	3.2
Misc. Containers and Closures	1	0.4
Misc. Fasteners	2	0.7
Misc. Metal Items	18	6.6
Social Drugs - Alcohol	3	1.1
Social Drugs - Tobacco	3	1.1
Tools	1	0.4
Toys	1	0.4
TOTAL	283	100.2

Proposed development in Lime Saddle prompted archaeologists from the Department of Water Resources to conduct a survey of the area in 1999 (Hunter and Orlins 2000). No new lime industry sites were recorded, however, two previously recorded sites, CA-BUT-158 and CA-BUT-621, could not be relocated and were determined to be casualties of the construction of the Oroville reservoir (Hunter and Orlins 2000:5).

Discussion

In their site record, Ritter and Smith (1965) note the limestone outcrop of CA-BUT-158 had been quarried and “walls” had been observed. Unfortunately, the walls were not measured or discussed further, as to how they related to the rest of the site. William Gwynn, referred to as the "Lime King of California," was reported in 1861 to have 28 kilns in several different counties, six of which were purported to be in Butte

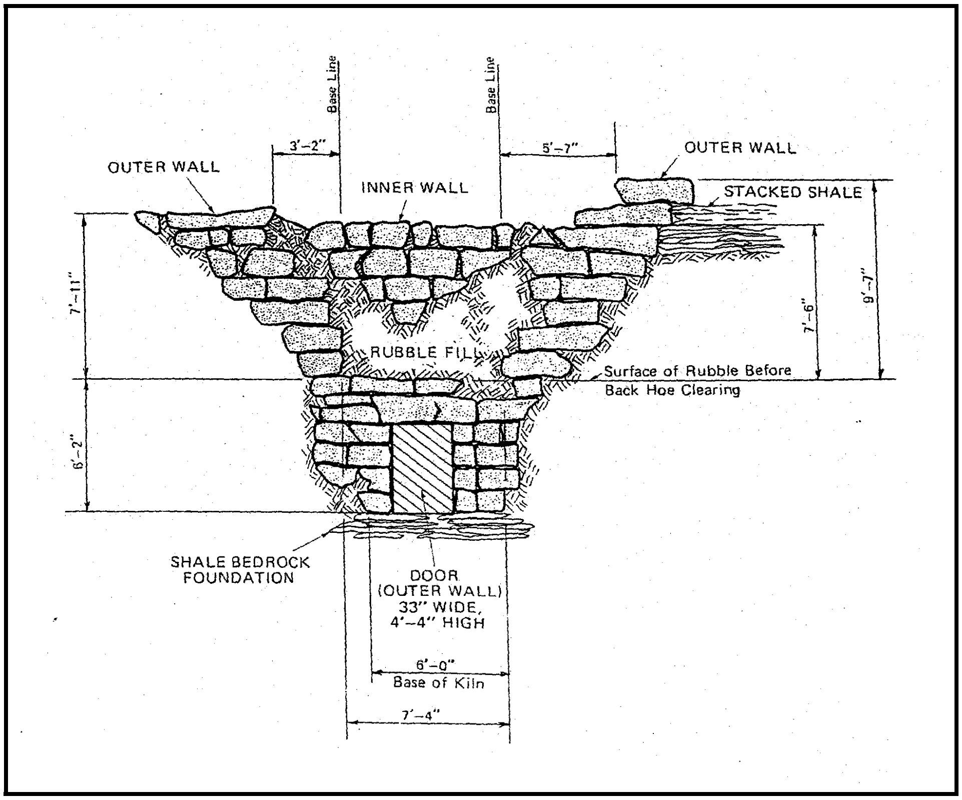

Figure 9a. CA-BUT-392/H - Drawing (front view) of lime kiln. (Sampson and McAleer 1977)

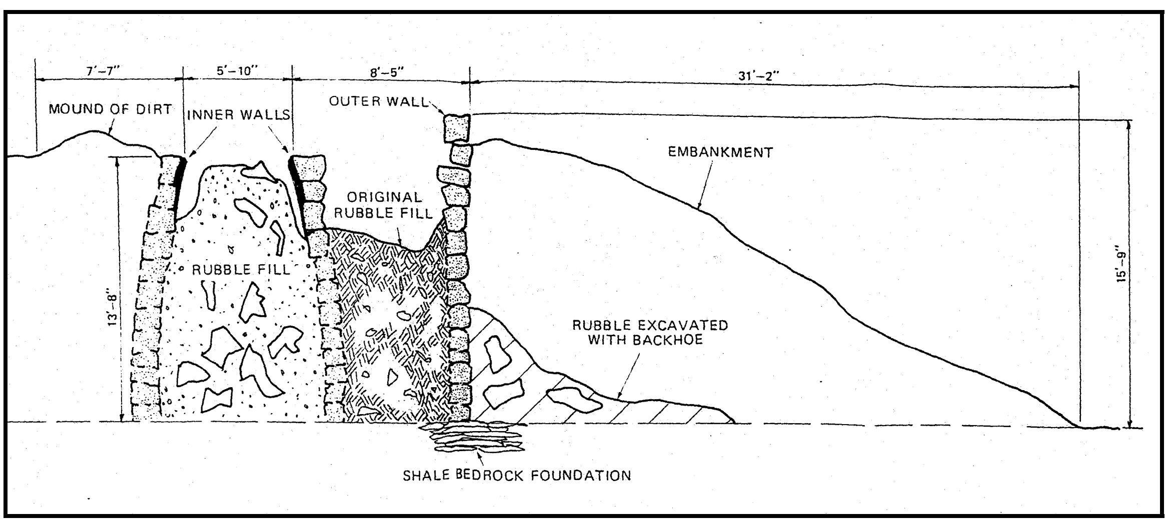

Figure 9b. CA-BUT-392/H - Drawing (section view) of lime kiln. (Sampson and McAleer 1977)

Figure 10. CA-BUT-392/H - Lime kiln. (1977 DPR, Accession #095_P007330)

County (California Farmer 1861b). Since CA-BUT-158 is less than one half mile easy traveling distance from one of the three lime kilns sites associated with Gwynn and the limestone is good quality, it is possible it is the location for one of Gwynn's other lime kilns in the case study area of Oroville.

The Furnis and Young (1976) study was the first to propose that Parrish was responsible for starting the lime industry in Oroville. This information was based on reports compiled by the state of California, with respect to extractable minerals (Hanks 1884:108; Hanks 1886:113; Irelan 1893:156,157). The presence of quality limestone in the vicinity of Oroville and the apparent construction of a couple of lime kilns after several years of reports, was reason to suggest that the land owner (Parrish) at the time of the appearance of these kilns was responsible for the inception of the industry. As we have seen from research documented in previous chapters, these mineralogy reports only represented the partial truth. Consulting additional sources such as the General Land

Office (GLO) map from 1867, which shows an “old lime kiln” in the area of CA-BUT-392/H, would have pushed back the dates for the inception of the industry almost 20 years, several years before Parrish had arrived in the Lime Saddle area (Figure 11; GLO 1867).

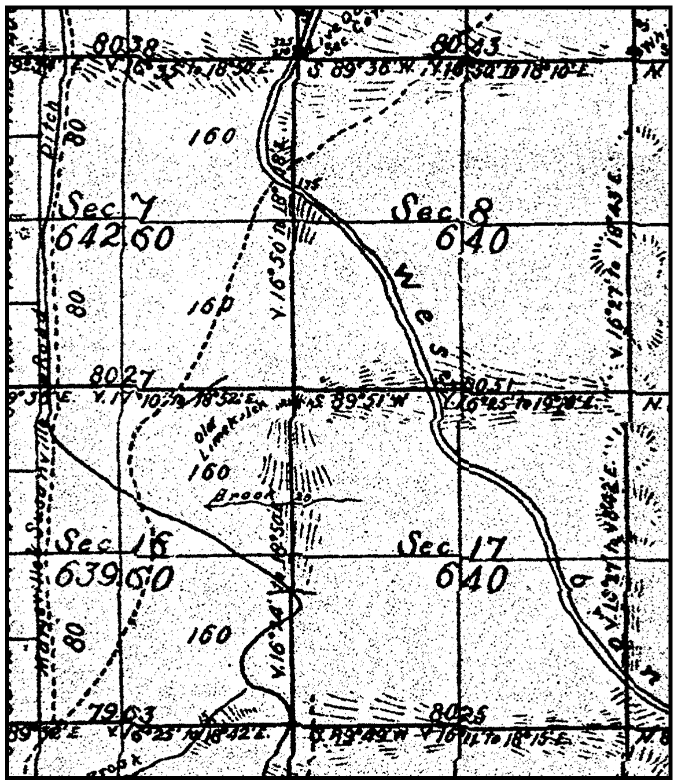

Figure 11. 1867 GLO Township 21N, Range 4E, Section 18: "Old Lime Kiln"

The 1977 archaeological investigations at CA-BUT-392/H raise a couple of important points. First, the kiln was shown to have been constructed of locally quarried sandstone. Building the structure from local materials would have reduced the cost of construction. In addition, sandstone is a naturally refractive stone, which makes an excellent material for use in kiln construction. These refractory properties provide longevity and low maintenance, if the kiln is constructed well, which appears to be the case, with its dressed stone blocks built into a hillside for additional support. The refractory properties would have reduced the stresses sustained by the structure during the extreme temperature changes that occur during the intermittent burning of the kiln. Investing relatively little capital into low-level technology, where maintenance is minimal, is the tool kit of a boom-surfer.

Second, oral testimony suggests there was once a building on the site near the kiln. The investigations at the site identified historic-period artifacts on the knoll north of the kiln. Surface artifacts were collected (see Tables 1a and 1b, as well as Appendix B), however, by that time the site had already endured the affects of ten years of annual inundation by Lake Oroville, not to mention the unknown affects sustained from bulldozing the site prior to inundation. Despite the disturbances, the knoll north of the kiln was the only area on the site that appears to have had data potential, yet it was the only location on the site where subsurface testing was not conducted.

Hunter and Orlins (2000) continue the misconception started by Furnis and Young (1976) that Augustine Parrish was responsible for the lime industry in the Lime Saddle area north of Oroville. As stated above, Parrish was merely a participant in an industry that had developed nearly 20 years prior to his arrival to the area. Hunter and Orlins determined, incorrectly, that CA-BUT-621H had been a casualty of the construction of the Oroville reservoir; “site CA-BUT-621H is now covered by the Lime Saddle Marina or associated parking area” (Hunter and Orlins 2000:5). However, the site was relocated during the relicensing survey of 2002, located in a densely vegetated area, above lake level, south of the Lime Saddle Marina access road (Goetter et al. 2002b). CA-BUT-158 was also relocated during the 2002 survey (Glover 2002).

2002 RESEARCH

The area of Lime Saddle was surveyed during the fall of 2002. No new sites directly related to the lime industry were recorded; however, several alignments of historic-period roads were recorded. Previously recorded sites were relocated and updated, and their locations recorded using Global Positioning System (GPS).

Findings

Lime Saddle Recreation Area contains several different exposed limestone outcrops, most of which have been quarried in years past (Logan 1947). There are a total of four sites directly related to the limestone industry that have been recorded (including those previously recorded) in the area of Lime Saddle: two are multi-component sites, having both prehistoric and historic-period components (CA-BUT-392/H and CA-BUT-620/H), one site has only a historic-period component (CA-BUT-621H), and one site is a prehistoric milling site on a limestone outcrop that is suspected of being a limestone quarry site, which may have also featured a lime kiln (CA-BUT-158). Previous research in this area of Lime Saddle dated these lime kilns to as early as the mid-1880s, but archival research demonstrated that William Gwynn had been burning lime in this location since the mid-1850s, and that Parrish received ownership of the kilns when he purchased the land in the 1870s (*BR* 1855b; BC 1874:598; BC 1891:415-416; Sampson and McAleer 1977; Hunter and Orlins:4). In addition to those kilns employed by both Gwynn, and later Parrish, the location and remains of the Curtis family kiln at Nelson Bar north of Lime Saddle, were sought out for inclusion in this research study.

CA-BUT-392/H – Parish Camp Lime Kiln

This multi-component site is situated within the exposed and sparsely vegetated, fluctuation zone of Lake Oroville at an approximate elevation of 840 feet above mean sea level (amsl). It is located on two northeast-facing knolls, between two unnamed drainages, north-northeast of the entrance to the Lime Saddle Marina from Pentz-Magalia Highway. This site covers an area measuring 460 ft. (140m) north/south x 230 ft. (70m) east/west.

The historic-period component is representative of a small-scale limestone-processing complex, minus obvious work areas and roads leading away from the complex connecting to major thoroughfares, although these thoroughfares are nearby. The absence of these features may be due to the preparations made to this location prior to flooding the Oroville reservoir, as well as from the annual inundation of Lake Oroville. The site is comprised of a limestone quarry and a small, cylindrical shaft kiln, both of which appear to be in fairly the same condition as they were during the 1977 investigation of the site (Sampson and McAleer 1977; Pearson 1990:29). However, a few of the sandstone blocks in the outer wall have toppled; the inner wall of the elliptical-shaped kiln remains intact.

This is the best example of a lime kiln within the case study area of Oroville. Technologically speaking, the kiln has a basic level of sophistication. It is built into a hillside next to the limestone quarry and has an outer wall constructed of sandstone blocks for support and insulation. The 1977 examination did not investigate the floor of the kiln, so it is not known what type of features it may have, such as an ash box or a brick or sandstone base, which may change its level of technological sophistication.

Several historic-period artifacts including fragments of ceramics, glass, miscellaneous metal, and cut nails, the majority of which date to between the late 1890s to 1930s, were identified within an area on the north knoll within the site. The paucity of artifacts identified during the 2002 field season was no doubt due to the collection of all the surface artifacts during the 1977 investigation, and those that were recovered during the recent survey were most likely exposed by erosion during the cyclical retreat of the waters of Lake Oroville. The concentration of artifacts in this area compared to elsewhere on the site, bolsters the argument that there is depth to this deposit, and therefore has data potential. Unfortunately, the site is accessible from a public road and a moderately traveled path that bisects the site, making artifacts available to souvenir seekers. Evidence of use of this area is in the form of recent campfire rings and modern refuse, both on the site and within the kiln itself.

CA-BUT-620/H – Lime Saddle Campground Lime Kiln

This multi-component site is situated above the fluctuation zone, located at the base of a south-facing slope, adjacent to an unnamed, southwest flowing intermittent stream at an elevation of 960 ft. amsl.

The historic-period component is representative of a small-scale limestone processing complex, comprised of a limestone quarry, (the remains of a) kiln, prospect pits, road, retaining wall, and berm. The prehistoric component consists of a single bedrock mortar in a limestone outcrop. The site appeared unchanged since it was last updated (Michel 1999). No cultural materials were noted for either component during the 2002 field visit.

The lime kiln was reported by Sampson (1977a,c) to have been collapsed to the ground and filled with rubble, with not much of the original kiln remaining (Michel 1999). Photographs taken during Sampson's recording show partially stacked stone in a roughly circular shape, situated around a depression located at the edge of a hillslope (California State Parks, Department of Parks and Recreation [CADPR] 1977). Michel (1999) recorded the inner diameter of the depression as 11 ft. 6 in., whereas Goetter et al. (2002a) recorded the measurements of the elliptical depression as 10 ft. 6 in. (north-south) x 13 ft. 2 in. (east-west). It is difficult to determine the type of kiln this was given what little remains above surface. There is a possibility, however, that more can be learned of the kiln construction through subsurface investigation.

The berm is a particularly interesting feature, as no other lime industry site encountered in the case study area exhibited the same type of characteristics. The soil on the berm is a greenish-gray color, like that of cement. Although it is not certain this material actually is cement, it is because of this similarity that this site is likely the lime kiln associated with Chatham Baltimore, and mentioned as "Baltimore's kiln" in the covenant between A. Parrish and his wife, Martha Elizabeth, and F.C. Williams:

> …[F]or and in consideration of the payment of three thousand five hundred dollars…at any time within eighteen months from the date hereof [13 July 1900]…agrees to sell and convey unto the party of the second part or his assigns [that is, F.C. Williams]…[480 acres of land within] Township 21 North, Range 4 East [what is today Lime Saddle]….The said parties of the first part [that is, A. and M.E. Parrish] further agree and covenant that the said party of the second part or his assigns...have the right and privilege to enter upon the said premises and every part thereof for the purpose of quarrying, digging, and mining and taking out limestone, clay and other materials thereon except gold…and using the same in the manufacture and compounding of cement… [A]lso the privilege of taking said limestone, clay or other materials from said premises for the said purposes of manufacturing and compounding the same into cement, but not to make or manufacture or sell lime….
>
> And…further agrees that the party of the second part or his assigns may have the free use and without any expense to him for so using one kiln formerly used for burning lime now on said premises known as the Baltimore kiln and being the one near the

> Yankee Hill Road [that is, Nelson Bar Road] for the purpose of making cement and for burning the materials to be compounded therein. (BC 1900:53-58)

CA-BUT-621H – Parish Camp Saddle Dam Lime Kiln

This historic-period site is representative of a small-scale limestone-processing complex. The site is situated on a south-facing slope of a ridgeline, 658 ft. (200m) northwest of the Parish Camp Saddle Dam, and covers an area measuring 330 ft. north/south x 330 ft. east/west. It is comprised of a limestone quarry, the remains of a kiln, prospect pit, concentrated piles of quarried limestone, an adit, a road, and paths. The cultural materials noted at the site include glass, ferrous cans and strapping, zinc plated bucket, an enameled pan, and a wagon wheel hub (Goetter et al. 2002b). Evidence of modern use is in the form of refuse, utility lines, and access roads crossing the southern edge of the site.

The lime kiln was reported by Sampson and Hines (1977) to have measured 10 ft. 6 in. across at the top, with large sandstone construction blocks capping the top of the kiln around the back and sides of the circular structure. The kiln was built into the hillside with the front of the kiln constructed of shale bedrock (Sampson and Hines 1977). This was likely a small cylindrical shaft kiln, similar to that of CA-BUT-392/H, the difference being it was not built entirely of sandstone blocks, but rather local shale was utilized to construct the body of the kiln. Sampson and Hines (1977) speculated the numerous sandstone blocks strewn in a rubble heap in front of the kiln might have fallen out of an outer wall. However, there is no information as to the number of blocks located at the base of the kiln and no photographs to substantiate this hypothesis, so it remains speculation.

Sometime between 1977 and 2002 (Figures 12,13) the kiln was destroyed; by 2002 what remained of the kiln was a cavity that measured 25 ft. north/south x 14 ft.

Figure 12. CA-BUT-621H - remains of lime kiln in 1977, note the capstones. (DPR Accession #095_P007358)

Figure 13. CA-BUT-621H - absence of lime kiln in 2004 (ASC Accession #27-03-D29-26)

east/west x 22 ft. deep (Goetter et al. 2002b). Sandstone blocks were no longer in situ, but strewn about the ground, along with roasted pieces of limestone and vitrified pieces of sandstone. The cavity was squared off, presumably by the bucket of a bulldozer.

The adit is a curious feature, which has an opening that measures 5 ft. 6 in. high and 5 ft. wide; was its purpose to investigate the extent of the limestone outcrop, or was it related to the mining of other minerals, such as gold? Parrish was an avid miner, who teamed with several different partners to mine placer claims in the area of what became Lime Saddle (BC 1891b,c). Parrish's claims often mention "tunnels" up to 50 ft. in length (BC 1891a). Historic documents researched for this study did not mention this feature in association with Parrish, or anyone else for that matter, but given his history as a miner, it is a safe assumption that Parrish was responsible for the adit.

CA-BUT-158 – Lime Saddle Marina Outcrop

This site is a small prehistoric bedrock milling complex on a limestone outcrop located south of the Lime Saddle Marina boat launch. It was recorded in 1962 (Parmer) and again in 1965 (Ritter and Smith) when it was noted the limestone outcrop had been quarried and "walls" had been observed. This outcrop was surveyed in 2002 and no evidence was found of these walls. In addition, due to annual inundation by Lake Oroville, the limestone was considerably water-worn, and it was extremely difficult to distinguish any quarry scars. The marks that were observed were determined to be recent modifications to the outcrop used to mount mooring cables for the marina.

However, archival research uncovered field notes taken during the 1977 investigation of Lime Saddle that mentioned local resident Marion "Buzz" Bennum stating that this was the likely location of a lime kiln. A photocopied topographic map that indicated the same (Sampson 1977b) accompanied the notes. No information in the notes led to how this conclusion came about, and unfortunately, there appears to be no evidence remaining on the ground to confirm this supposition.

Curtis Family Kiln – Nelson Bar

An article in *Tales of Paradise Ridge* brought to the attention of the author by John Rudderow, noted a lime kiln located in the area near Nelson Bar Road, built and operated in the 1860s, by the Curtis family (Forester's 1967:30). This lime kiln was extant prior to Lake Oroville reservoir being flooded, when Forester's article was written. During the 2002 field season, the limestone outcrop became evident when the water level of Lake Oroville dropped below approximately 800 ft. amsl. Several attempts were made to locate the remains of this kiln as the lake level receded to approximately 690 ft. amsl.

The area of Nelson Bar was surveyed during the Oroville Relicensing Project, but no resources directly related to the lime industry were found. The author, accompanied several times by Mr. Rudderow, conducted additional survey, which produced negative results. Unfortunately, this resource was not identified and recorded prior to the flooding of the Oroville reservoir, and it appears that Forester's article (and accompanying photograph) is all that remains of the lime kiln. Attempts at obtaining a copy of the original photograph have been unsuccessful to date. The limestone outcrop is located at the bend in the West Branch, but is seasonally inundated by Lake Oroville.

Summary

The research of Oroville's lime-manufacturing industry is a case study in applying Purser's (1995) boom-surfer model, using Hardesty's (Hardesty and Little 2000:23) concept of feature systems. Together, a more comprehensive understanding of the role smaller industries played within California's economy and their effects on long-term processes of community formation, development, and survival in the Sierra foothill gold districts during the nineteenth century is developed. "Superficially haphazard assemblages of machinery, tools, structures, and other material culture" represent the archaeology of boom-surfer enterprises (Purser 1995:232). These assemblages characterize "functional flexibility, localized maintenance, and portability, rather than cutting-edge technological sophistication" (Purser 1995:232). Oroville's industry is archaeologically represented by lime-manufacturing complexes, which include lime kilns, quarries, piles of quarried stone, work areas, foot paths, and dirt roads. The kilns are relatively inexpensive, constructed of locally acquired materials, and technologically unsophisticated.

Limestone occurs near the West Branch of the Feather River north of Oroville in relatively small outcrops with minimal overburden. The presence of these exposed outcrops of good quality limestone near main thoroughfares made them easily accessible and exploitable for manufacturing lime at a reasonable cost. In addition, locally acquired materials were used in constructing the kilns. Sandstone from the nearby Tuscan formation was used for blocks in all the kilns; local shale was used in constructing the bodies of the kilns at CA-BUT-620/H and CA-BUT-621H, as well as at CA-BUT-392/H where it was used as mortar between the sandstone blocks that comprise the entire kiln and its outer wall.

The kilns are of a basic level of technological sophistication: built small and nestled against the hillside for support and insulation. Each kiln has one draw hole, with no timber, brick, or iron work added for support or enhancement of design. If these kilns were intended for larger production, augmentations to the basic design might include: a larger body, with multiple draw holes, in perhaps a battery of kilns; additions for support would include buttresses, timbers, or iron work that brace the masonry structure during heat expansion experienced while operational.

Limestone is heavier and bulkier to transport than lime, and therefore, it is more expensive to construct a kiln away from the quarry (Wingate 1985:25). The Oroville kilns are located adjacent to the scattered limestone quarries in the Lime Saddle area. These complexes are connected to main thoroughfares with dirt roads, another necessary component to an efficient lime works (Wingate 1985:124). Larger enterprises such as in Santa Cruz County, enlisted the help of pack mules, wagons, chutes, and rail to transport quarried stone and fuel to kilns, and lime packaged in barrels to schooner (Figure 14; Jensen 1976:4-8; Eselius 2003:12,25). Again, larger enterprises such as in Santa Cruz County were self-supporting, with their own cooperage for barrel manufacture and their own schooners delivering the product to market (Figure 15; Jensen 1976:4,6,8,13). It is not known how lime made in Oroville was transported other than by wagon directly to customers or market centers (Bidwell Box 8, Folder 3, Page 3056); there are remnants of barrels in the archaeological record, however, no on-site cooperage provided them.

The archaeology of a larger industry would illustrate a more complex representation of the basic elements seen in a small-scale enterprise. The kilns would be larger, greater in number, and exhibit design elements and features intended for longevity and durability during extended use. These characteristics may not be part of the initial construction of the kiln, but a later modification. Additionally, cutting-edge technology or evidence of changes in technology would be present in the archaeological record.

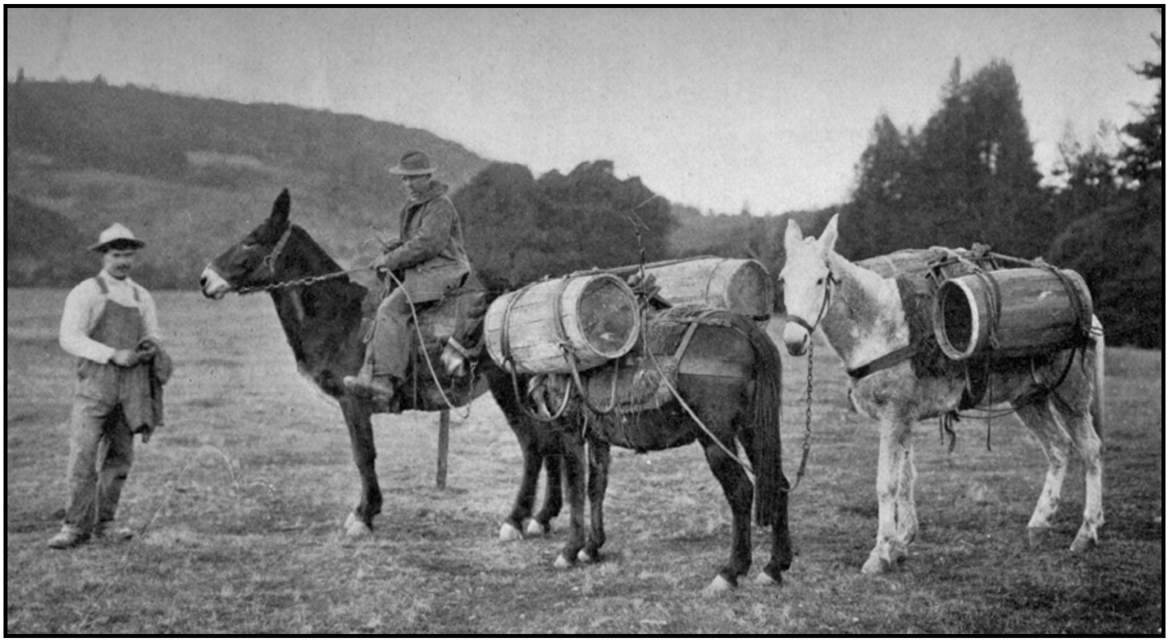

Figure 14. Pack mules hauling barrels of lime. Originally published in *Overland Monthly,* July 1912. Courtesy of Santa Cruz Public Library.

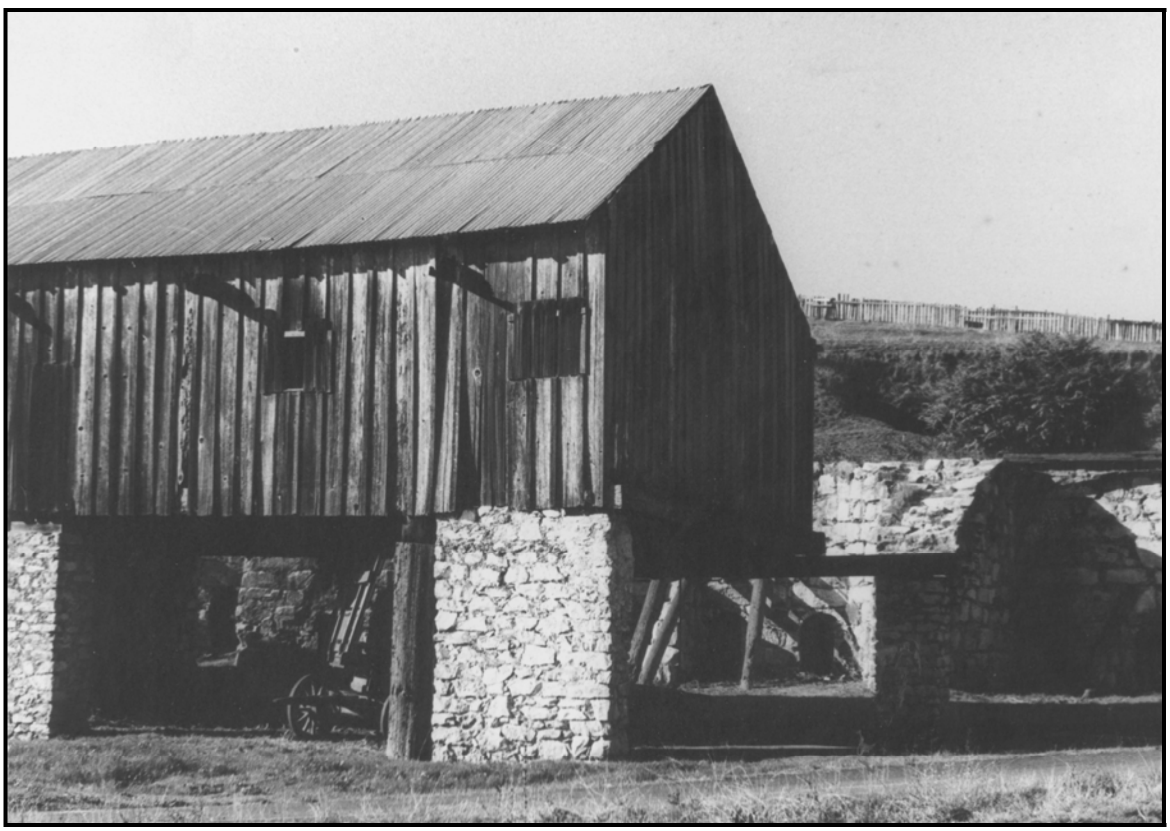

Figure 15. Cooperage on Cowell Ranch, with lime kilns in background. Courtesy of Santa Cruz Public Library.

6. CONCLUSION

The Gold Rush of 1849 thrust California into the world economy, dynamically influencing the general approach to business, which quickly evolved from autonomous individuals to large-scale, wage labor operations in an effort to maximize the plentiful natural resources California could offer to the global market. However, the tendency for those researching the topic has been to simplify this transformation; a perspective that has essentially marginalized the importance of smaller industrial operations and their influence in community development and the expansion of local and regional economies. In an effort to provide a broader understanding of the economic transformation of the American West, the details of the influences of small-scale enterprises, such as William Gwynn's lime-manufacturing operation, are lost in the tale of global capitalism and its interconnectedness to the rapidly developing events that transpired during the relatively short time period between the beginning of the Gold Rush and the end of the nineteenth century. A goal of this current study was to examine the influence these smaller industries, specifically Oroville's lime-manufacturing industry, had on long-term processes of community formation, development, and survival in the Sierra foothill gold districts during this economically tumultuous time.

Purser's (1995:232; 2004) boom-surfer model provided a framework in which to explore the nineteenth century small-scale lime-manufacturing operations in Oroville, Butte County, California. The model illustrates a strategy to survive the harsh boom-bust economic swings employed by people of the American West during this time period (Purser 2004). This strategy was usually carried out by "middle-level capitalists, skilled workers, and extended families," who formed small partnerships, and invested intensive labor and little capital in diverse business endeavors that utilized low-level technology and strategic squatting, reuse and tenancy, which allowed for survival in one place from one rush to the next (Purser 1995:232). The archaeology of these types of enterprises is represented by "superficially haphazard assemblages of machinery, tools, structures, and other material culture," which characterize "functional flexibility, localized maintenance, and portability, rather than cutting-edge technological sophistication" (Purser 1995:232). Success of these strategies was not measured in profit, per se, so much as in the ability to "stabilize location, household, or extended group subsistence through economically unstable times" (Purser 2004). By minimizing the amount of capital expended on initial start-up and maintenance, these smaller-scale industries could be more flexible in the unstable market driven by gold mining, and could avoid failure of the business when the absence of gold moved prospective markets to the next strike.

Quintessential boom-surfer, William Gwynn, began the industry in 1855, although earlier researchers credited Augustine Parrish with starting the lime operations in Oroville after the mid-1880s (Furnis and Young 1976:IV.C; Sampson and McAleer 1977; Hunter and Orlins 2000:4). Gwynn, who had already established himself in the industry in Nevada and Placer counties, as well as being the proprietor of a lime depot in Marysville, partnered with local businessmen to establish a small-scale industry in Oroville, likely drawn to the area by the prospect of Oroville replacing Marysville as the head of navigation for the Feather River.

Several factors aside from Oroville's pending status as an economic depot likely contributed to Gwynn's decision to branch north into Butte County. First, the limestone deposits along the West Branch of the Feather River were of good quality and had minimal overburden, which reduced the costs of quarrying the stone (Wingate 1981:124). Second, these outcrops were surrounded by oak woodland, an appropriate and plentiful fuel source for firing a kiln. The availability and convenience of nearby wood added to the efficiency of the operation, and would further reduce the costs by not having to haul wood into the area from elsewhere. Lastly, the limestone outcrops were located on public land, and based on the established land laws of the State and Federal governments at the time, squatting was the acceptable means of acquiring and settling land. Based on research to date, it appears Gwynn and his associates never got around to filing a claim with the General Land Office for ownership of the property, a fact that would later cause them to lose their holdings.

There are four sites directly related to the lime-manufacturing industry in Oroville, located along the West Branch of the Feather River, in the area today known as Lime Saddle. Three of these sites have (or had) all the elements of a small-scale, lime-manufacturing complex, which for the purposes of this study, includes a quarry and associated lime kiln, work areas, foot paths, and transportation routes that lead to major thoroughfares into the surrounding commercial areas. In addition to these sites, there are a couple of outcrops of limestone along the West Branch that may have had similar sites, but no longer exhibit these features due to lake inundation, dense vegetation, or destruction. The sites with remaining intact features give a perspective on the technological aspects of the site’s function. Gwynn operated the West Branch Lime Kilns during a dynamic time period when investments in hard rock mining, the mainstay of California’s economy at that time, intensified, along with the collateral industries of mining. Demand for supplies and equipment necessary for this extractive industry far outreached the imports from overseas (Bryant 1994:200). As a result, collateral industries developed in California, including building materials. Compared to other lime kilns in northern California that were constructed during this time period, the kilns in Oroville appear to be of low-level technological sophistication. They are relatively short in stature, intermittent burners, with single draw holes. No technological enhancements appear to have been made to the kilns during the years they were in use; likewise, there is no historical documentation to that effect. Archival materials do indicate there was a single man needed to burn a kiln, and that the kilns were used in tandem, one being loaded, while the other(s) burned (Bidwell Box 8, Folder 3, Page 3056; *Weekly Mercury* 1875c). If these kilns were intended for larger production, augmentations to the basic design might include: a larger body, with multiple draw holes, in perhaps a battery of kilns; additions for support would include buttresses, timbers, or iron work that brace the masonry structure from heat expansion experienced while operational. There is no archaeological or archival evidence that Gwynn used no rail system within the lime works for transporting quarried stone to kiln. Larger enterprises tended to be self-supporting and enlisted the help of pack mules, wagons, chutes, and rail to transport quarried stone and fuel to kilns and the final product to market (Jensen 1976:4-8; Eselius 2003:12,25). Gwynn relied on draft animals to haul the product via wagon to its destination, until 1864 when the California Northern Railroad connected the cities of Oroville with Marysville, which remained the head of navigation for the Feather River (Lenhoff 2001:98)

The Oroville lime-manufacturing sites represent an adaptation to the economic surges of a mining-driven market system (Hayes and Purser 1990; Bryant 1994). Within an unpredictable economy, a diversified Gwynn – who partnered with various businessmen throughout the mining region, in enterprises related to communication, transportation, real estate, and building materials – operated a small-scale lime-manufacturing network based on boom-surfer strategies. These strategies not only allowed him to supply the growing communities of Oroville, Chico, and Marysville, but also allowed him to profit from these ventures to the point of eventually becoming a major player in the nineteenth century lime-manufacturing industry in California.

The lime industry in California suffered a decline after a major earthquake struck San Francisco in 1869 (Wheeler 1998:7). Destruction of many brick buildings and structures resulted in a "popular distrust in the stability of masonry construction" (Wheeler 1998:7). Gwynn was already out of the Oroville lime business by that time, but was able to ride out the depression in the industry due to his diversification.

Future Research

To begin, what type of lime-manufacturing resources does California have? There are many lime kilns still in existence in California in varying degrees of technological sophistication. To understand the lime-manufacturing industry during the nineteenth century better, there needs to be a typology of kiln designs. This typology will allow comparative studies to determine regional and temporal design preferences within the state, with the caveat that not all designs will be temporally indicative. It will be difficult to date lime kilns based on archaeological data alone due to the propensity for boom-surfers to utilize older technology, as well as the tendency to reuse materials. As seen with this case study, historic documents coupled with archaeological data provided a more accurate inception date for the lime industry in Oroville than the material culture offered. With a typology in place, hypotheses such as Rolando's (1992:211) assertion that later kilns in Vermont often had large draw holes framed by an arch, which replaced smaller openings topped with a stone lintel can be tested in California. Or Wingate's (1985:73,77) assertion that separate and mixed feed kilns can be distinguished by whether or not a grate is present at the base of the kiln to separate out the ash from the fire.

Second, how far did William Gwynn's lime-manufacturing network extend? Both well established in the lime-manufacturing industry before joining forces in the mid-1860s, William Gwynn and brother-in-law Henry T. Holmes had their individual networks of satellite lime-manufacturing complexes scattered throughout the Sierra Nevada foothill gold districts. However, it is possible this research has not uncovered the entirety of their reach. For instance, after his failed swampland reclamation venture, Gwynn sold off his assets, which included land in San Jose. It is unknown what this land was used for, or when Gwynn had spent time in Alameda County. Did his lime enterprise extend to Alameda County? In addition, Holmes is known to have manufactured lime in Kern County in southern California. What was the extent of the operation? Was Gwynn involved in the operation? Where else did these men burn lime in California, and what role did they play in community formation?

Finally, what more can be learned from the resources in Oroville? The archaeological investigations at the Parish Camp Lime Kiln (CA-BUT-392/H) in 1977 produced sparse material culture: all subsurface tests were negative, but the one location where surface artifacts were concentrated was not investigated. This artifact deposit may still yield data, despite the effects of annual inundation by Lake Oroville since the late-

1960s. Data potential at this location, for example, could include insights into extraction and production techniques, site occupation, worker lifestyle, and local commerce.

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APPENDIX A: GLOSSARY*

* All definitions have been adapted from Wingate (1985) or Bates and Jackson (1984)

Air-slaked lime: The degenerate product formed naturally when quicklime is stored in moist air. It is a powdery mixture of oxides, hydroxides and carbonates.

Argillaceous: Rocks or substances composed of clay minerals, or having a notable proportion of clay in their composition.

Calcareous: Containing chalk or other forms of calcium carbonate or containing limes.

Calcination: In this context, the conversion of carbonate to lime, but the word has a much wider meaning including the conversion of metals into their oxides by strong heating.

Calcite: The mineral form of calcium carbonate.

Calcium (Ca): A soft white metallic element which tarnishes rapidly in air.

Calcium carbonate ($CaCO_3$): A solid which occurs naturally as chalk, marble, calcite and the many different forms of limestone. It is also the main constituent in corals and sea shells and a constituent of bones.

Carbonate: Any salt of carbonic acid. Used in this book to describe calcium carbonate and dolomite used as the feed for a lime kiln. This includes chalks, limestone and any other form of calcium carbonate such as coral or sea shells.

Carbon dioxide (CO_2): Carbonic acid gas. It is a colorless gas with a faint tingling smell and taste. It occurs naturally in the atmosphere. It is generated in lime kilns partly by the combustion of carbon-based fuels but mainly by the decomposition of calcium and magnesium carbonates.

Carboniferous: Literally means “bearing carbon” but the geological description “carboniferous” means that the sedimentary formation as a whole bears carbon, perhaps coal. The individual samples of carboniferous limestone usually contain no carbon.

Cement: Generally means a bonding material and in building means a quick setting binder used between sand particles in a mortar or concrete.

Charge: Used here to describe the carbonate (and also fuel if in a mixed feed kiln) which is fed into a lime kiln.

Concrete: A structural material formed by mixing carefully proportioned sand, stones, water and a binder. The binder is usually Portland cement but may be hydraulic lime or lime and a pozzolan.

Continuous burning kiln: A kiln designed to burn limestone without requiring a cool-down period in order to remove the quicklime. Alternating fuel and charge loaded from above, quicklime can be removed from draw holes below, without losing heat, making it more fuel-efficient.

Coral: A natural form of calcium carbonate formed in warm seas by secretion from marine polyps.

Dead-burned lime: Calcium oxide formed at excessively high kiln temperatures. It has a dense physical structure which does not allow it to hydrate reality under normal conditions.

Dissociation: The reversible decomposition of the molecules of a compound. In this context, the separation of carbon dioxide from carbonates to form lime.

Draw kiln: One of the names for a continuously operated shaft kiln. Lime can be drawn from the kiln at the bottom and fresh charge added at the top whilst the kiln is burning.

Dry hydrate lime ($Ca(OH)_2$): Calcium hydroxide, or slaked lime, in its dry powder form.

Exothermic reaction: A chemical reaction which generates heat. For example, the slaking of quicklime.

Flux: A substance added to others to assist fusion.

Fossils: The remains of organisms contained with the Earth's crust.

Fossilliferous: Containing fossils.

Gypsum: Hydrated calcium sulphate which loses 75% of its water of crystalliztion to form plaster of Paris when heated to 248 degrees Fahrenheit (120 degrees Celcius).

High calcium lime/limestone: High calcium lime is that prepared from high calcium limestone. High calcium limestone must contain at least 95% calcium carbonate. This specification thus distinguishes magnesia (MgO) as an impurity.

Hydration: Slaking. The addition of water to quicklime, which forms hydroxides in an exothermic chemical reaction.

Hydrated lime: The dry powder obtained by slaking quicklime with enough water to form the hydroxide. The hydrate may be of a high calcium lime, a magnesium lime, dolomitic lime or of some form of hydraulic lime.

Hydraulic lime: Limes which will set, even under water, and with which hydraulic engineering structures (harbors, canal locks, bridges, etc.) can be built. These limes are formed from impure limestone and the setting properties come from the compounds of silica, alumina and ferric oxide with lime and magnesia.

Kiln: Any structure or chamber in which materials are heated. Temperatures would usually be greater than those in any oven and lower than those in any furnace. Different forms of kiln are used for making lime, pottery, brick and other processes.

Lime: In this context, the term lime includes all oxides and hydroxides of calcium and magnesium. The quicklime and slaked lime forms are thus included but the carbonate forms are not included. In other context lime is: a viscous material (such as bird lime); ground limestone misnamed agricultural lime; and as a verb, the act of spreading a viscous material or applying agriculture.

Lime burning: Converting calcium (and perhaps magnesium) carbonate to quicklime in a kiln.

Lime concrete: A building material cast from aggregate (usually sand and stone) in a matrix of hydraulic lime or lime and pozzolana, but not using Portland cement.

Lime mortar: Sand bound in a matrix of lime or lime and pozzolana (but not Portland cement) and used for laying bricks and blocks in buildings.

Lime plaster: A mixture of water, lime, sand and sometimes hair which is applied to walls and ceilings in a plastic state before drying to give a hard smooth surface for decoration. In good quality work, the plaster is applied in three coats (layers) using progressively finer materials.

Lime powder: Dry hydrated lime.

Lime putty: Slaked lime stored in an excess of water to fatten up the lime, making it more plastic. This process also enables less reactive particles to be hydrated. In Roman times, the putty for plastering had, by law, to be stored for three years.

Limestone: Any rock or stone whose main constituents are calcium carbonate or a combination of calcium and magnesium carbonates.

Limewash: Paint prepared readily from lime with or without various additives. It is suitable for use on walls.

Marble: In this context, marble is a stone with a very high calcium carbonate content, which has undergone metamorphosis under the action of pressure, and possibly heat, giving it a new crystalline structure. It takes a decorative polish. In other contexts, it is any decorative stone which can be polished.

Masonry: Building elements with bricks, blocks or stones. In some contexts the word is used to exclude brickwork.

Mixed feed: The charge for a shaft kiln when the carbonate and fuel both enter at the storage/preheating zone; when the charge and fuel are loaded in alternating layers into the kiln. Also used to describe this method of operation. The alternative is some form of separate firing.

Mortar: A mixture of water, sand and a binder used to joint bricks, blocks and stone in building.

Natural cement: A quick-setting hydraulic cement prepared by calcining naturally occurring cement stones.

Over-burned lime: Quicklime which has been calcined at too high a temperature and which will not slake readily. In extreme cases it shrivels up and has a wizened appearance.

Parker's cement: A natural cement patented in England in 1796 by James Parker.

Portland cement: Artificial cement so named because it was as strong as Portland stone (then a highly-prized building stone). There are various standard specifications available.

Pozzolana, pozzolan, pozzolanic: An Italian volcanic ash from Pozzuoli, used since Roman times to produce hard and waterproof lime concretes and mortars. Pozzolans react with limes to assist their setting properties. Deposits may be expected in any region which has volcanic activity.

Preheating zone: The part of a kiln where the charge is heated to just below its dissociation temperature.

<u>Quicklime:</u> Lime which has not been slaked. A calcined material whose major component is calcium oxide (CaO) or calcium oxide in natural association with magnesium oxide (CaO.MgO) and which is capable of being slaked with water. It is often described by its size grading, for example pebble lime and lump lime.

<u>Refractory:</u> Able to resist decay under extreme conditions in a kiln or furnace. Also, a brick which has refractory properties and would be suitable for lining a kiln.

<u>Roman cement:</u> Natural cement. A description used widely in the nineteenth century.

<u>Scaffolding:</u> In this context, the formation of columns of fused material within a shaft kiln. These also develop into arches and prevent the charge from falling correctly downwards through the kiln.

<u>Sedimentary rocks:</u> Rocks which have been formed by materials deposited in water and which are generally laid down in distinct layers.

<u>Separate feed:</u> The charge for a shaft kiln when the carbonate enters at the storage/preheating zone, and the fuel enters through the draw hole; when the fuel is loaded into the kiln at the base, and the charge is loaded from the top of the kiln. The alternative is mixed feed.

<u>Slaked lime:</u> Lime which has been slaked with water to the hydroxide form. It may be in the form of dry hydrate, putty, slurry, milk of lime or even limewater. It may be pure or hydraulic and calcitic or magnesian. $Ca(OH)_2$, $Ca(OH)_2.MgO$, $Ca(OH)_2.Mg(OH)_2$.

<u>Slaking:</u> The addition of water to quicklime.

<u>Unburned lime:</u> Carbonate which has passed through the kiln without dissociating completely thus leaving a core of carbonate within the quicklime.

<u>Unslaked lime:</u> Quicklime.

<u>Vertical Kiln:</u> A shaft kiln; generally used to distinguish a shaft kiln from a rotary kiln in the U.S.

<u>Whitewash:</u> A thin lime wash, or paint made from whiting (finely ground chalk), size (glue) and water.

APPENDIX B: 1977 SURFACE COLLECTION – PARISH CAMP LIME KILN

TABLE 2. 1977 SURFACE COLLECTIONS – ARTIFACT DESCRIPTIVE LIST

Group and Category	Description	Count	MNI
ACTIVITIES			
Tools			
-	Ferrous Shear	1	1
Subtotal Tools		1	1
DOMESTIC			
Clothing Maintenance			
Sewing	Copper-alloy Thimble	1	1
Subtotal Clothing Maintenance		1	1
Food Prep/Consumption			
Container	Aqua Glass Pickle Bottle	1	1
Drinking Vessel	Colorless Glass Tumbler	4	1
Indefinite	Ferrous Knife	2	1
Indefinite	White Improved Earthenware Body	32	5
Kitchen	Ferrous Handle	1	1
Serving	Amethyst Glass Indefinite	5	2
Serving	Amethyst Glass Lid	1	1
Serving	Colorless Glass Indefinite	2	1
Serving	White Improved Earthenware Dish	4	2
Serving	White Improved Earthenware Hollow	5	1
Serving	White Improved Earthenware Indefinite	1	1
Serving	White Improved Earthenware Platter	8	2
Tableware	Opaque Porcelain Hollow	4	2
Tableware	Opaque Porcelain Plate	1	1
Tableware	Porcelain Bowl	1	1
Tableware	White Improved Earthenware Alphabet Plate	5	2
Tableware	White Improved Earthenware Bowl	2	1
Tableware	White Improved Earthenware Bowl/Cup	7	4
Tableware	White Improved Earthenware Cup Plate	1	1
Tableware	White Improved Earthenware Hollow	10	7
Tableware	White Improved Earthenware Indefinite	3	1
Tableware	White Improved Earthenware Plate	14	10
Tableware	White Improved Earthenware Saucer	8	5
Tableware	White Improved Earthenware Soup Plate	1	1
Subtotal Food Prep/Consumption		123	55
Food/Food Storage			
Closure	Ferrous Lid	2	1
Closure	White Milk Glass Canning Jar Lid Liner	1	1
Closure	Zinc Lid	1	1
Container	Aqua Glass Bottle	14	5

TABLE 2. 1977 SURFACE COLLECTIONS – ARTIFACT DESCRIPTIVE LIST

Group and Category	Description	Count	MNI
Container	Aqua Glass Jar	25	2
Container	Aqua Glass Soda-water Bottle	1	1
Container	Aqua Glass Spice Bottle	6	3
Container	Chinese Brown Glazed Stoneware Indefinite	4	1
Container	Cobalt Glass Soda-water Bottle	1	1
Container	Colorless Glass Jelly Jar	6	1
Container	Ferrous Can	37	7
Container	Ferrous Sardine Can	2	1
Container	Green Glass Pickle Bottle	9	1
Container	Green Glass Soda-pop Bottle	1	1
Subtotal Food/Food Storage		110	27
Furnishings			
-	Colorless Glass Knob	1	1
-	Ferrous and Copper alloy Clock	1	1
Decorative Item	Porcelain Indefinite	1	1
Indefinite	Colorless Glass Indefinite	3	1
Subtotal Furnishings		6	4
INDEFINITE USE			
Indefinite			
-	Wood Indefinite	1	1
Subtotal Indefinite		1	1
Misc. Closures			
-	Ferrous Lid	1	1
Subtotal Misc. Closures		1	1
Misc. Containers			
-	Amber Glass Bottle	7	1
-	Aqua Glass Bottle/Jar	1	1
-	Colorless Glass Bottle	5	2
-	Colorless Glass Indefinite	5	1
-	Ferrous Can	15	4
Subtotal Misc. Containers		33	9
Misc. Containers and Closures			
-	Ferrous Can and Lid	1	1
Subtotal Misc. Containers and Closures		1	1

TABLE 2. 1977 SURFACE COLLECTIONS – ARTIFACT DESCRIPTIVE LIST

Group and Category	Description	Count	MNI
Misc. Fasteners			
-	Copper-alloy Rivet	1	1
-	Ferrous Rivet	1	1
Subtotal Misc. Fasteners		2	2
Misc. Metal Items			
-	Aluminum Scrap	1	1
-	Copper-alloy Indefinite	1	1
-	Copper-alloy Pipe	1	1
-	Ferrous Handle	5	3
-	Ferrous Hinge	2	1
-	Ferrous Indefinite	2	2
-	Ferrous Pipe	1	1
-	Ferrous Scrap	1	1
-	Ferrous Stove part	3	1
-	Ferrous Strap	2	2
-	Ferrous Wire	5	4
Subtotal Misc. Metal Items		24	18
INDUSTRIAL			
Misc. Closures			
-	Ferrous Blasting Cap Lid	1	1
Subtotal Misc. Closures		1	1
PERSONAL			
Clothing			
Fastener	Porcelain Button	1	1
Subtotal Clothing		1	1
Grooming/Health			
Container	Amber Glass Bitters Bottle	8	1
Container	Aqua Glass Bitters Bottle	1	1
Container	Aqua Glass Sarsaparilla Bottle	1	1
Container	Aqua Glass Specific Bottle	1	1
Container	Blue Glass Pharmaceutical Bottle	3	1
Container	Colorless Glass Bottle	1	1
Container	White Improved Earthenware Ointment Pot	1	1
Toiletry	Hard-rubber Comb	1	1
Subtotal Grooming/Health		17	8

TABLE 2. 1977 SURFACE COLLECTIONS – ARTIFACT DESCRIPTIVE LIST

Group and Category	Description	Count	MNI
Social Drugs – Alcohol			
Container	Olive Glass Alcoholic-beverage Bottle	22	3
Subtotal Social Drugs – Alcohol		22	3
Social Drugs – Tobacco			
-	Ball Clay Pipe	1	1
Container	Ferrous Can	5	2
Subtotal Social Drugs – Tobacco		6	3
Toys			
Tricycle	Ferrous Pedal Assembly	1	1
Subtotal Toys		1	1
STRUCTURAL			
Electric			
-	Stoneware Insulator	1	1
Subtotal Electric		1	1
Hardware			
-	Ferrous Plate	1	1
Fastener	Aluminum Nut	1	1
Fastener	Ferrous Bolt	1	1
Fastener	Ferrous Cut Nail	156	104
Fastener	Ferrous Finishing Nail	4	4
Fastener	Ferrous Latch	1	1
Fastener	Ferrous Saw Nut Medallion	1	1
Fastener	Ferrous Spike	1	1
Fastener	Ferrous Wire Nail	29	29
Fastener	Ferrous Wood Screw	2	2
Subtotal Hardware		197	145
Materials			
-	Colorless Glass Window	63	0
Subtotal Materials		63	0
TOTAL		612	283

APPENDIX C: EVALUATION

Purpose and Project Background

The California Department of Water Resources (DWR) operates the Oroville Facilities in eastern Butte County under a license from the Federal Energy Regulatory Commission (FERC) that will expire in 2007. As a Federal undertaking, relicensing of Lake Oroville must comply with State and Federal statutes and regulations including the California Environmental Quality Act (CEQA) and Section 106 of the National Historic Preservation Act. FERC has authorized DWR to initiate the Section 106 Process for this project, under which FERC is required to consider the effects of relicensing on historic properties, and to provide the Advisory Council on Historic Preservation (ACHP) reasonable opportunity to comment on FERC's plans to treat them. The Section 106 Process, codified at 36 Code of Federal Regulations Part 800, specifies how historic properties are to be inventoried, evaluated, and treated. Accordingly, an inventory of nearly 15,500 acres within the FERC relicensing project Area of Potential Effects (APE) was accomplished during 2002 and 2003. Over 550 sites containing tangible remains reflecting the history of the region were identified. An evaluation program addressing the eligibility of the historic-era resources as contributing elements of the proposed Forks of the Feather River Historical District was undertaken following the inventory (Praetzellis et. al. 2005:1).

The approach to this phase of the Oroville Facilities Relicensing Project has been to evaluate the cultural resources within the project's "APE as the setting of an National Register of Historic Places (NRHP) district," so as to view "the interrelationships of individual sites and clusters of site types…in terms of their functional similarities or divergences" (Praetzellis et al. 2003:1-3) as a means to accommodate "regulatory, research and management goals" (Praetzellis et al. 2003:1-3). NRHP districts must possess "a significant concentration, linkage, or continuity of sites…united historically" (National Park Service [NPS] 1991:41). To construct a district, it is necessary to assess the identified sites' ability to contribute to the district's theme(s) and period(s) of significance, as presented in the historic context statements. Properties that are not associated with the theme or those with poor integrity are considered "noncontributing elements" to the district.

A property – in this instance defined as a district, site, building, structure, or object – must meet one or more of the following Criteria for Evaluation in order to be considered to possess significance:

> A) Properties that are associated with events that have made a significant contribution to the board patterns of our history,
> B) Properties that are associated with the lives of persons significant in our past,
> C) Properties that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that present a significant and distinguishable entity whose components may lack individual distinction, or
> D) Properties that have yielded, or may be likely to yield, information important in prehistory or history. (36 CFR 60.4)

In addition, a property must have sufficient integrity to convey its "significance in American history, architecture, archeology, engineering, and culture" (36 CFR 60.4). The National Register recognizes seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association, and a property must possess these aspects in order to be eligible for the NRHP.

Due to the diversity and considerable number of historic-era resources inventoried within the Oroville APE, a two-tiered approach was used to consider each site's eligibility to the NRHP. The lower tier included all historic-era resources in a "broad level of analysis" to determine eligibility as a "contributing element of a district and as an individual property, without incorporating any additional, site-specific investigation" (Praetzellis et al. 2003:1-4). The top tier incorporated a more refined analysis that consisted of site-specific investigations of a representative sample of resource property types identified within the APE; this analysis focused on "supplementing understanding of site associations, structure, integrity, and data potential" (Praetzellis et al. 2003:1-4).

General Analysis – Summary

"The historic-era resources identified during the inventory phase were grouped into property types that correspond to general historic themes relating to the economic and settlement history of the Oroville area. The property types are as follows: Mining properties; Water-systems properties; Agricultural properties; Timber-industry properties; Industrial/commercial properties; Transportation properties; and Settlement properties" (Praetzellis et al. 2003:2-4,2-5). The lime manufacturing resources within the project area fall under Industry and Commerce along the Feather River, with the period of significance occupying the fifty years from 1855 to 1905. These years represent the active period of use for Oroville's intermittent lime kilns, from the inception of the industry by William Gwynn to the end of the industry with the retirement of Augustine Parrish. After the turn of the century, the industry as a whole changed with the preference for Portland cement and the local industry in Oroville dwindled due to the expense to transport the inexpensive material to larger markets.

Hardesty argues archaeological remains of extractive industries are difficult to understand as isolated sites, as their features are often widely distributed geographically without clearly defined boundaries, "making it almost impossible to apply the concept of site in a meaningful way" (Hardesty and Little 2000:158). The feature systems approach assists in interpreting large, complex archaeological remains by grouping them into "geographical clusters of archaeological features that [are] linked to the same human activity," such as the manufacture of lime (Hardesty and Little 2000:23). It is from this perspective Oroville's lime-manufacturing resources are evaluated using the National Register Criteria.

There are four sites directly related to the lime industry in Oroville, in the area today known as Lime Saddle, all within one mile of each other. Three of these sites (CA-BUT-392/H, CA-BUT-620/H, and CA-BUT-621H) have (or had) all the elements of a small-scale, lime-manufacturing complex. For the purposes of this study, a lime-manufacturing complex includes a quarry and associated lime kiln, work areas, foot paths, and transportation routes that lead to major thoroughfares into the surrounding commercial areas. The fourth site has oral testimony associated with it as the location of a historic-era lime kiln.

Taken separately, all four sites appear individually eligible under Criterion B for their association with the lives of persons significant in our past, as these sites appear to be those included in William Gwynn's company: West Branch Lime Kilns, which he started with his partners in 1855. Gwynn, called the "Lime King of California," was reported to have 28 kilns in several different counties by 1861, and was a major player in the lime industry of California for over 25 years (California Farmer 1861b). Gwynn's entrepreneurial character resulted in the operation of lime-manufacturing enterprises in at least six counties, maybe more. The Oroville lime-manufacturing sites represent an adaptation to the economic surges of a mining-driven market system (Hayes and Purser 1990; Bryant 1994). Within an unpredictable economy, a diversified Gwynn – who collaborated with various businessmen throughout the mining region, in enterprises related to communication, transportation, real estate, and building materials – operated a small-scale network of lime-manufacturing operations based on boom-surfer strategies. These strategies not only allowed him to supply the growing communities of Oroville, Chico, and Marysville with lime, but also allowed him to profit from these ventures to the point of eventually becoming a major player in the nineteenth century lime-manufacturing industry in California, which resulted in his moniker.

Likewise, all four sites appear individually eligible under Criterion D for their potential to yield information important in history, as only a modest amount of data is known regarding lime production in California during the nineteenth century, especially that of smaller-scale operations. Intact features and the potential for subsurface artifacts could answer questions on the topic of technology, site structure and function, as well as the lifestyle of those burning the lime.

However, in addition to eligibility, a property must also possess integrity. “Integrity of a property is measured through its ability to convey its significance” (NPS 2002:VIII.1). A property is considered significant if it meets one or more of the National Register criteria and possesses most of the seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association (NPS 2002:VIII.1-2). Individually, two out of the four sites lack integrity due to impacts by the construction, maintenance, and use of the Lake Oroville reservoir or by mechanical earth-moving equipment, utility poles, and looting (see Site-Specific Analysis below). The Lime Saddle Campground Lime Kiln (CA-BUT-620/H) site retains all seven aspects of integrity. The kiln at this lime-manufacturing complex is in a state of ruins, but enough of the structure remains to communicate its function within the complex, thereby conveying the property's significance. The site retains integrity and, is therefore, considered individually eligible to the National Register. The Parish Camp Lime Kiln (CA-BUT-392/H) site, located within the fluctuation zone of Lake Oroville, has been compromised somewhat by construction of the reservoir, placement of fish habitats on an adjacent knoll, and its accessibility to the public, which have impinged on three of the seven aspects of integrity – Setting, Materials, and Feeling. However, the essential physical features of this site, the kiln and limestone quarry, remain, and are in good condition to convey the property's significance as a small-scale, nineteenth century lime-manufacturing complex. The site retains integrity and, is therefore, considered eligible to the National Register.

Site-Specific Analysis – Parish Camp Saddle Dam Lime Kiln – CA-BUT-621H

This site was chosen as the test site for evaluation based on several reasons. First, it has representative features of a small-scale lime-manufacturing complex – quarry, kiln, work areas (likely used for packaging and storage), and nearby roads for distribution. By studying this encapsulated environment, a more complete understanding of the operations involved in such an industry can be obtained. Second, out of the three sites CA-BUT-392/H, CA-BUT-620/H, and CA-BUT-621H, this site is the only one with just an historic-era component. Lastly, this site is above pool (of Lake Oroville reservoir) and could logistically be dealt with at anytime during the field season without concern for changing lake levels.

Field Methods

As part of the Oroville Facilities Relicensing Project's evaluation phase, the ASC conducted a field study of CA-BUT-621H from 8 to 12 March 2004. Per the work plan approved by the Office of Historic Preservation, the field study consisted of (1) clearing vegetation to improve visibility of the kiln area, (2) investigating identified features with a metal detector for subsurface elements as a means of defining activity areas, and (3) mapping the site with GPS equipment. All identified artifacts and features were recorded and mapped; a sample of potential feature locations identified through metal detection were explored down to a depth of 4 inches and similarly documented. An area located within the quarry was also investigated to a depth of 4 inches due to unusual soil characteristics observed on the surface. No additional subsurface work was conducted.

Summary of Findings

The site was originally recorded as a lime kiln and quarry. The site record describes the kiln as 10 feet 6 inches across the top, with sandstone block capstones. The front of the kiln was constructed of shale bedrock, much of which was noted to have fallen in and out of the front of the kiln. In addition, several sandstone blocks were strewn in a rubble heap in front of the kiln. Photos (see figures 12, 13) from the site record show that it was a circular structure, built into the side of a hill, downslope from a flat area. The near-destruction of the kiln post-dates the site's initial recording.

The 2004 evaluation fieldwork revealed a two-tiered limestone quarry, as well as a few smaller boulder limestone outcrops to the west of the quarry; a cavity carved out of a hillside where the kiln once existed, with kiln construction debris within the cavity; several work areas; a road leading from the front of the kiln area; and adit excavated into the lower tier of the limestone quarry; two separate utility lines that run through the southern portion of the site; and an area of disturbance, likely the result of earth-moving mechanical equipment, represented by cobbles of lime and kiln construction debris strewn around the top and bottom of the kiln cavity. Artifacts were sparse, although there was a concentration within the upper tier of the quarry, mostly consisting of ferrous metal, and personal and domestic items, the dates of which range from the late 1890s to the early 1930s, or later (Tables 3a,3b).

As mentioned above, this site appears individually eligible under criteria B and D. However, this site has been greatly impacted by mechanical earth-moving equipment, utility poles, and looting. The kiln itself was destroyed sometime after 1977 when the site was first recorded. The site would have retained its integrity, even with the introduction of utility poles, were it not for the destruction of the kiln itself, seen as an essential physical feature to a lime-manufacturing complex. For these reasons, this site lacks integrity and, is therefore, considered ineligible to the National Register.

Conversely, when these sites are seen from the perspective of a feature system – a landscape of individual lime-manufacturing features geographically clustered within one mile from each other, and knowing Gwynn employed boom-surfer strategies while he operated this network of kilns – their individual integrity becomes less important, so long as they contribute some element to the greater feature system. Therefore, these sites should be considered contributing elements to the larger feature system of nineteenth century small-scale lime-manufacturing resources, eligible under criteria B and D, as well as contributing elements to the proposed Forks of the Feather River Historical District.

TABLE 3a.

SUMMARY OF ARTIFACTS BY GROUP
Parish Camp Saddle Dam Lime Kiln – CA-BUT-621H

Description	Count	MNI	% of MNI
Activities	2	2	11
Domestic	6	4	22
Indefinite Use	11	8	44
Industrial	1	1	6
Personal	3	3	17
TOTAL	23	18	100

TABLE 3b.

SUMMARY OF ARTIFACTS BY CATEGORY
Parish Camp Saddle Dam Lime Kiln – CA-BUT-621H

Description	MNI	Percent
Food	3	16.7
Grooming/Health	1	5.6
Heating/Lighting	1	5.6
Indefinite	1	5.6
Misc. Containers	4	22.2
Misc. Metal Items	5	27.8
Social Drugs - Alcohol	2	11.1
Transportation	1	5.6
TOTAL	18	100.2

APPENDIX D: RESEARCH FACILITIES AND CONTACTS

LIBRARIES

- Butte County Library, Oroville, California
- California State Library, Sacramento, California
- CSU Chico Meriam Library; Special Collections, Chico, California
- CSU Sacramento Library, Sacramento, California
- El Dorado County Library, Placerville, California
- Nevada County Library, Nevada City, California
- Placer County Library, Auburn, California
- SSU Jean and Charles Schulz Information Center – University Library, Rohnert Park, California
- UC Berkeley Bancroft Library, Berkeley, California
- UC Davis Shields Library, Davis, California
- UC Santa Cruz McHenry Library; Special Collections, Santa Cruz, California
- Yuba County Library, Marysville, California

COUNTY OFFICES

- Butte County Recorder's Office, Oroville, California
- El Dorado County Recorder's Office, Placerville, California
- Nevada County Recorder's Office, Nevada City, California
- Placer County Recorder's Office, Auburn, California
- Placer County Archives and Research Center, Auburn, California
- Sacramento County Recorder's Office, Sacramento, California
- Yolo County Recorder's Office, Woodland, California
- Yuba County Recorder's Office, Marysville, California

STATE OFFICES

- Department of Parks and Recreation, Archaeological Collections Unit: 2505 Port Street, West Sacramento, California 95691; Contact: Glenn Farris (916) 375-5921
- North Central Information Center, CSU, Sacramento, 6000 J Street, Foley Hall #213, Sacramento, California 95819 (916) 278-6217
- Northeast Information Center: Department of Anthropology, Langdon 303, CSU, Chico, Chico, California 95929 (530) 898-6256
- Northwest Information Center, Sonoma State University: 1303 Maurice Avenue, Rohnert Park, California 94928 (707) 664-0880

FEDERAL OFFICES

- Bureau of Land Management, California Public Room: 2800 Cottage Way, W-1605, Sacramento, California (916) 978-4400

MUSEUMS

- Cherokee Museum, Butte County, California: Contact: Jim Lenhoff
- El Dorado County Museum
- Placer County Museum

HISTORICAL SOCIETIES
- Butte County Historical Society
- Nevada County Historical Society
- Placer County Historical Society

GENEALOGY WEB PAGES
- www.Ancestry.com
- www.Familysearch.com

OTHER
- W. David Dawson, Sacramento County, California
- Loreley Hodkin, Placer County, California
- Mike Luther, Santa Cruz County, California
- Robert “Bob” Piwarzyk, Santa Cruz County, California
- John Rudderow, Butte County, California