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Introduction

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"The Santa Cruz lime is unquestionably equal to the best in the world. None that has ever been imported here can compare with it."—*San Francisco Times,* 1868

They are quiet now. Ferns, mosses, and lichens cling to their stone walls. Shrubs and vines cascade over their buttresses. Trees sprout from their floors. Nature is slowly laying claim to Santa Cruz County's historic lime kilns.

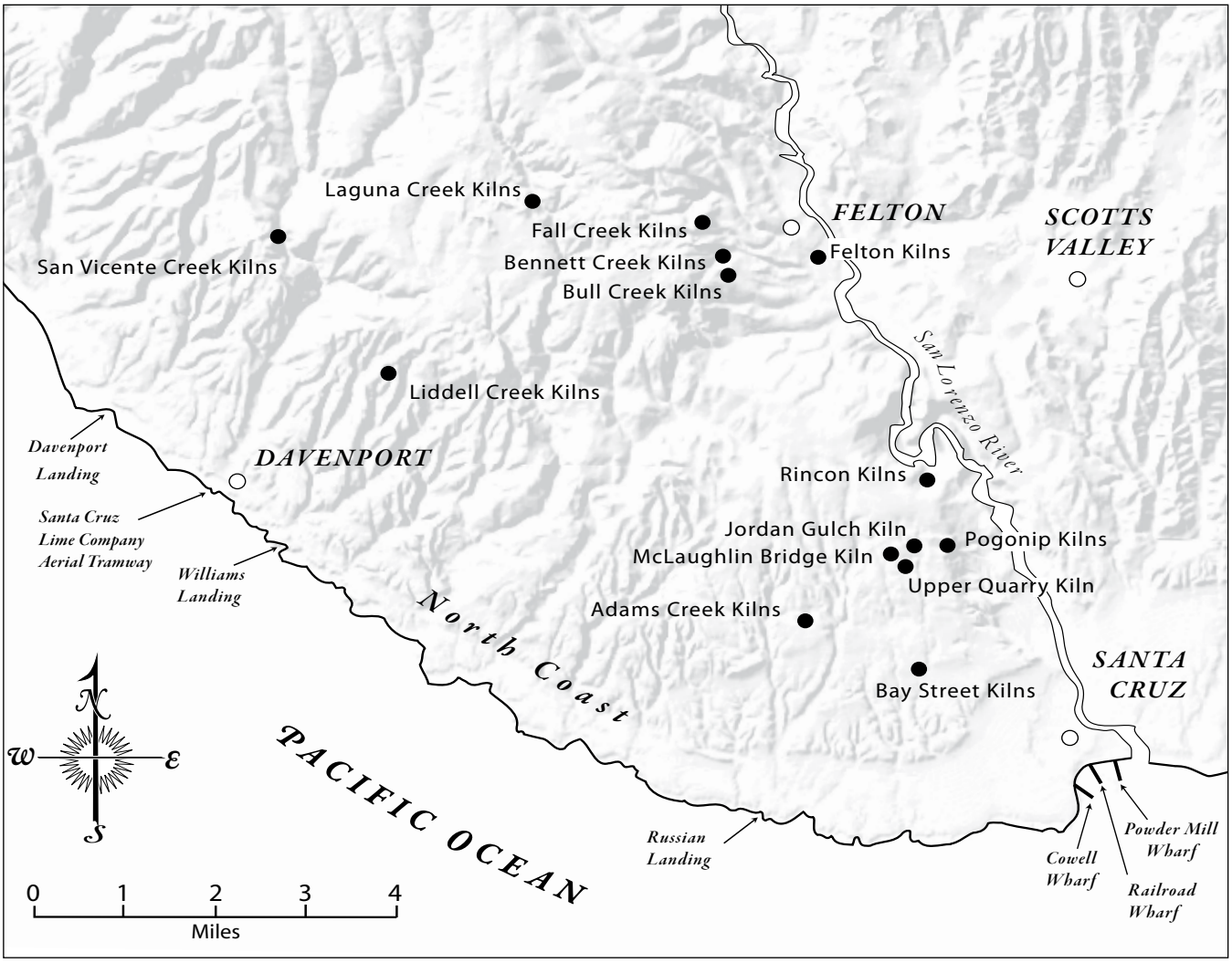
If the lime makers of the late 1800s could somehow return and see where they once toiled—stacking rock, stoking fires, packing barrels—they would be amazed at the changes. Save for a few quarries and kilns tucked away in the region's forests and canyons, nearly every trace of the lime industry has disappeared. Yet, its effects reverberate to this very day. Lime had a major influence on the geographic, economic, and social development of Santa Cruz County. Both the University of California campus and Henry Cowell Redwoods State Park owe their origins to lime. Over fifty regional place names have connections to lime-related activities and people. Even today, a surprising number of area residents have ancestors with links to lime.

Lime is generally made by heating limerock (rock made of calcium carbonate, such as limestone or marble) to over 1,640ºF. This drives carbon dioxide from the rock, leaving behind lime. Pure lime is white, caustic, lighter in weight than the original rock, and reacts violently with water. It has many uses, but its principal historical use was for making mortar and plaster. When mixed with water and sand, it will adhere to stone and brick.

The process of making lime has been known for thousands of years. It may have been discovered accidentally when stones around a campfire got cooked enough to turn into lime. In Turkey, archaeologists have discovered lime mortar dating back seven thousand years.[1] The ancient Romans and Mayans perfected the use of lime mortar on a truly grand scale, making stone buildings, roads, and monuments. They also used lime plaster as a finish on walls and floors. In North America, however, lime was not used for construction north of Mexico until European settlement.[2]

In Santa Cruz, the builders of the mission were the first to use lime in construction. Small amounts of lime were manufactured throughout the first half of the 1800s; some was even exported. But it was not until the Gold Rush that large quantities of lime were produced in Santa Cruz County.

While some of the gold seekers returned East following their exploits, others stayed, and California was never the same. Small settlements grew into towns; towns grew into cities. Demand for construction materials, such as lumber, bricks, lime, and other supplies, increased rapidly. Importing goods from the East Coast was expensive, and the materials took months to arrive. Huge profits were to be made by those entrepreneurs who could locally manufacture the products and corner a major share of the market.



Map showing locations of lime kilns and coastal landings in Santa Cruz County.

The path followed by Santa Cruz's lime industry is a familiar one, similar to the American automobile industry during the twentieth century and the home computer industry of the 1980s and 1990s, albeit on a smaller scale. In the 1850s a number of lime businesses sprouted up to meet the sudden demand. The smaller outfits could not compete with the larger ones, and by the early 1860s only a few remained. Later, as the market grew and technology changed, some newer companies managed to get a foothold in the market.

Santa Cruz County lime production increased during the late 1800s as the demand for lime rose and improvements in transportation opened up new markets. In 1884 Santa Cruz County produced a third of the state's supply and three quarters of the lime for the San Francisco market.[3]

Although production peaked in 1904, the twentieth century brought the beginning of the end of the Santa Cruz County lime industry. This was because of the widespread adoption of Portland cement as a building material. Like lime, Portland cement is made by firing limestone or marble in a kiln. It differs, however, in that the rock is pulverized first and several other ingredients, such as silica, iron, and alumina, are mixed with it before firing. Mortar made of cement is stronger and harder than lime mortar. Furthermore, cement can be mixed with water, sand, and gravel to make concrete—the most commonly used building material in the modern world. The effect of this superior product was not instantaneous, but by the 1920s Santa Cruz area lime production was on the decline. Santa Cruz County's last lime manufacturing plant closed in 1946.

In 1900 the vast majority of lime used in the United States was for construction. Today, roughly 90 percent

Adams Creek
Description: three pot kilns—west, middle, and east.
Status: west and middle kilns standing, east kiln partly collapsed.
Other names: Samuel Adams's kilns, Cowell's upper kilns, Gray Whale Ranch kilns, Wilder Ranch kilns.

Bay Street
Description: three pot kilns—west, middle, and east; one stone continuous kiln.
Status: all still standing.
Other names: Davis and Jordan kilns, Davis and Cowell kilns, Cowell's lower kilns, UCSC gate kilns.

Bennett Creek
Description: two pot kilns and one continuous (Monitor) kiln in 1876.
Status: one pot kiln still standing.
Other names: Bennett's lime kilns, Holmes kilns. Probably the same as the site referred to as the Holmes upper kilns, which had additional pot kilns in the 1880s and early 1900s.

Bull Creek
Description: one pot kiln and one continuous (Monitor) kiln
Status: pot kiln still standing, continuous kiln has cooling chamber only.
Other names: Bull's lime kilns, Bull & Holmes kilns, Holmes kilns.

Fall Creek
Description: three pot kilns—north, middle, and south.
Status: still standing.
Other names: I.X.L. Lime Co. kilns (later operated by Cowell).

Felton
Description: five (?) pot kilns and two continuous kilns.
Status: pot kilns altered and partly covered, continuous kilns removed and/or covered.
Other names: Holmes kilns, Holmes lower kilns, Holmes lower plant.

Jordan Gulch
Description: one pot kiln.
Status: front wall collapsed.
Other names: unknown kiln, Elfland kiln.

Laguna Creek
Description: two pot kilns.
Status: still standing.
Other names: Grove Adams kilns (used incorrectly since not built by Adams), Holmes new kilns, Laguna lime kilns, Bonny Doon kilns, Russell's new lime kilns.

Liddell Creek
Description: four pot kilns.
Status: only one remaining, collapsed.
Other names: Williams brothers' kilns, Andrew Glassell kiln, B. F. Lee & Co. kilns, Boomer and Payne kilns, Payne's kilns, Cowell's old lime kilns, Jacob's kiln.

McLaughlin Bridge
Description: one pot kiln.
Status: standing, but damaged in 1989 earthquake.
Other names: unknown kiln, possibly Hensley's or Tarpy's kiln.

Pogonip
Description: three pot kilns—north kiln, south kiln, and collapsed kiln.
Status: north and south kilns standing, other kiln has a collapsed front wall.
Other names: unknown kilns, Reed and Lewis kilns, Rincon [Ranch] kilns?, Lewis and Goss kilns?, Ocean View kilns?

Rincon
Description: three pot kilns and four continuous kilns.
Status: pot kilns buried and not visible, continuous kilns removed.
Other names: Henry Cowell Lime and Cement Co. kilns.

San Vicente Creek
Description: three pot kilns and two continuous kilns
Status: no longer standing.
Other names: Santa Cruz Lime Company kilns.

Upper Quarry
Description: one pot kiln.
Status: front wall and one side wall still standing.
Other names: unknown kiln, McDonald Big Kiln?, Tarpy kiln? (also used by Henry Cowell).

List of lime kiln locations in Santa Cruz County. Because some sites have been known by several different names, it was necessary to standardize the names for this book.

is put to chemical and industrial use. Lime is an ingredient in glass, plastics, paper, paints, caulks, resins, pharmaceuticals, and a multitude of other products. It is also put to such diverse tasks as refining sugar, treating water, reducing air pollution, and making steel. People have more daily encounters with lime and limerock than ever before. For example, it has been estimated that more than 300 pounds of limerock are used in manufacturing an average American car.[4]

Surprisingly, little research was done on the history of the Santa Cruz County lime industry until 1976, when Kenneth Jensen chose it as the topic for his master's thesis at San Jose State University.[5] His pioneering work laid the foundation and was an inspiration for the present study.

The purpose of this volume is to explore in detail the lime industry from multiple perspectives. How was lime made? What companies were involved? Who were the workers who made the lime? How did it get to market? What was the impact of geology and geography? And where can people go to see some of the old kilns and quarries? These are just a few of the questions we have explored and tried to answer. We have strived for historical accuracy and to leave no (lime)stone unturned, but history does not give up its secrets easily. Some things we will never know.

The authors also hope that this volume will encourage preservation of the surviving lime kilns and associated structures. Sadly, wind, rain, tree roots, earthquakes, and human neglect have been slowly destroying what little tangible evidence remains of our lime-making heritage. Photographs and words printed on a page can tell about

Uses of Lime

Today, the uses of lime are so numerous that to list and describe them all would easily fill a book. Lime is one of the most useful compounds on Earth.

In the late nineteenth century most of the lime manufactured in the United States was used to make mortar for construction of masonry buildings and plaster for finishing walls and ceilings. To make mortar and plaster, the lime was mixed with water and sand to form a paste. Lime was also the main ingredient in whitewash—a milky solution of lime and water for coating wood, stone, and plaster walls. The vast majority of the lime made in Santa Cruz County was likewise used for construction, but some of it saw other uses, both locally and in distant markets.

At sugar refineries, lime or limerock was added to the raw sugar solution to precipitate out impurities. Today, the adding of lime remains an important step in refining sugar. According to the *Santa Cruz Surf* of November 4, 1897, "Three and four car loads of lime rock per day are being shipped to the sugar factory at Watsonville."

Lime was also utilized in the paper-making process. At the San Lorenzo Paper Mill, located just north of Santa Cruz on the San Lorenzo River, brown wrapping paper was made from straw. "They put in lime also, and steam it for twenty-four hours; then the straw is taken out and put into other vats, where it undergoes further processes of being worked into pulp for the rollers," said an 1869 newspaper account.[1] The lime dissolved away non-cellulose constituents of the straw.

In the late 1800s Santa Cruz County was home to several tanneries, and all of them used lime. "In the manufacture of leather, lime is employed for softening the raw hides and causing them to swell (thus giving them greater bulk and opening the pores ready for the tanning agent), and also to loosen the hairs, which are afterwards removed by a blunt knife in the currying process."[2] Old maps of the Kron Tannery in Santa Cruz show a separate building for lime storage.

In the late 1800s lime was also important in metallurgy (as it is today). It was used as a flux in steel making (removing impurities) and in blast furnaces for smelting iron ore. Limerock was also utilized for the same purpose. "Lime rock in large quantities is being shipped from Davis & Cowell's quarries to Whittier, Fullers & Co's smelting works at Melrose, near Oakland," reported the *Surf*, January 5, 1889.

In agriculture, lime was an ingredient in insecticides (such as lime sulfur) and a soil amendment. Today, most agricultural "lime" is actually powdered limerock.

In 1906 86 percent of the lime sold in the United States was for building purposes, 8 percent for chemical and manufacturing processes, and 6 percent for agricultural purposes. By 1934 only 27 percent of lime was used for building, 63 percent for chemical processes and manufacturing, and 10 percent for agriculture. By 1970, only 8 percent was used for building, 91 percent of lime was used in chemical processing and manufacturing, and 1 percent for agriculture.[3]

Today, the major markets for lime include steel making, reducing air pollution, construction (especially soil stabilization), water treatment, paper making, mining, and other chemical and industrial purposes.[4]

— F. P.

1. "The Paper Mill," *Sentinel*, February 13, 1869, p. 1.
2. Alfred B. Searle, *Limestone & Its Products* (London: Ernest Benn Limited, 1935), p. 624.
3. Curtis H. Ault, Lawrence F. Rooney, and Margaret V. Palmer, *The Lime Industry of Indiana*, Indiana Department of Natural Resources, Geological Survey Bulletin 42-J, 1974, pp. 3-4.
4. M. Michael Miller, "Lime," U. S. Geological Survey, Mineral Commodity Summaries, January 2006 (available at http://www.lime.org) and "Lime," U. S. Geological Survey, Minerals Information (http://minerals.usgs.gov/pubs/commodity/lime/390498.pdf), both viewed March 20, 2005.

history, but they do not let the reader experience history. They cannot replace touching the vitrified surface of a kiln wall, peeking into a long-abandoned cabin and seeing a rusty old bed frame, poking a finger into a quarry drill hole, spying a stack of barrels inside a cooperage, or hiking along an abandoned ox road. During the many years spent researching this volume, the authors reveled in these and countless other adventures. We hope that generations yet to come will be able to enjoy the same.

Notes

1. "Lime–Limestone," Mineral Information Institute (http://www.mii.org/Minerals/photolime.html), viewed May 29, 2005.
2. Jeffrey T. Jones, "Lime Production in Southern Arizona," *Old Pueblo Archaeology*, No. 37, June, 2004, p. 7.
3. *Fourth Annual Report of the State Mineralogist* (Sacramento: California State Mining Bureau, 1884), p. 107.
4. Don Dupras, "Representative Industrial Mineral Mines of the San Francisco Bay Region: Sand and Gravel, Crushed Rock, and Limestone," in David L. Wagner and Stephan A. Graham, eds., *Geologic Field Trips in Northern California*, California Division of Mines and Geology, Special Publication 119, 1999, p. 238.
5. Kenneth Jensen, *The Lime Industry in Santa Cruz County*. Master's thesis, San Jose State University, 1976.