2002

What lies beneath : presenting archaeology through an interpretive museum exhibit

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DOI: <https://doi.org/10.31979/etd.e6a5-m3w3>
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WHAT LIES BENEATH:
PRESENTING ARCHAEOLOGY THROUGH AN INTERPRETIVE MUSEUM
EXHIBIT

A Project Report
Presented to
The Faculty of the Department of
Interdisciplinary Studies
San Jose State University

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

By
Cindy J. Arrington
May 2002

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ABSTRACT

WHAT LIES BENEATH: PRESENTING ARCHAEOLOGY TO THE PUBLIC THROUGH AN INTERPRETIVE EXHIBITION

By Cindy J. Arrington

This report describes an example of presenting basic archaeological methodology and technique to the general public. The project addresses, through the use of a local historical archaeology site, how as archaeologists, we are responsible not only for preserving the past but for making the past accessible to the public, to whom it actually belongs.

The interpretive exhibit presents the transformation of this site's industrial development from grist mill, to ice plant, to electricity generation, to its final metamorphosis into an electric substation. Exhibits include artifacts recovered from their forgotten resting place on the property, which emphasize industrial use, original schematics of the building and its equipment layout from 1911, a Pelton water wheel from the same time period, that generated the electrical power that was the life blood for this industrial site, and a children's archaeological excavation area.

ACKNOWLEDGEMENTS

Archaeological projects are always a team effort, this one particularly demonstrates this. I would like to acknowledge the goodwill and patience of the individuals who have directly or indirectly contributed to this project. A comprehensive list would be far too long and inevitably incomplete.

First, I would like to thank the many students who contributed their time and labor to excavating, analyzing, and documenting research. They all made important contributions, each in his or her own way. Thanks to the 1996 field crew: Marc Missire, Karen Mucci, Heidi Smith, John Bierwagen, Liz Johnson., Andrew Perluss, Julie Liu, Marianne Simoulin, Auda Velazquez-Rivera, Jane Talbot, Josie Salas, Karra Shewalter, Meredith King, and Keith Hamm. Thanks to the 1998 field crew: Diane Chamberlin, Christine Child, Matthew Courtney, Michelle Jennett, Jennifer Monson, Norma Rivera, Elizabeth Snyder, Matt Stocksiek, Teresa Trost, Ilse Werdermann, and Kevin Witten.

Thanks as well go to the individuals who had nothing to gain from their continued assistance and support other than sore backs, long days, and my undying gratitude.

These individuals deserve special mention and include: Glen Wilson, Bill Ford, William Brown, Paul Shen-Brown, Dave Calleri, Brad Brown, Lori Harrington, Glenn Caruso, William A. Wulf, Bob Samay, and John Nickleson.

A special acknowledgement is directed to two gentlemen who have enriched and cultivated my love of archaeology.

[First, Dr. Thomas Layton, to whom I owe my academic knowledge.] It was under his tutelage that I learned to always ask why and then seek out my own answers instead of adhering to conventional thought. Thank you Tom for making sure that my desire never diminished. [Secondly, George Zeimens, who tossed me into the field and said sink or swim.] I owe all practical field knowledge to this man and for teaching me that all archaeology belongs to the public and loses all value if kept only in the scientific/academic arena. A special thanks for showing me how to be a renaissance archaeologist. Under his direction I learned not only to dig, interpret, and analyze a site but how to repair field equipment or barter for new.

A special thank you goes out to my children, Jayson and Shawna, who had to endure years of midterms, late nights, and extended periods away from home. Without their

love and support none of this would have been possible or meant so much.

Finally, there is always one person who stands out just a little more from the rest. [The one person who gives as much as you yourself have devoted, the one that tirelessly accepts e-mail after e-mail, the one the never admonishes you for "I seem to have missed placed that, again", the one that has invested months or years with the only return being thank you, the one that you can always count on to be professional, caring, eloquent and most important a true friend.] Pat Dunning is that person. Thank you Pat for all your guidance, support, and most of all patience.

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INTRODUCTION

The purpose of this project was to share with the public some of the results of the San Jose State University Field School excavations of the Forbes Mill Site. Second was to demonstrate the excitement of archaeology and to present the data collected in a form that would be interesting and free of technical jargon. At the same time, the exhibit demonstrated how archaeology is an integral element of the historical record, which requires special care and handling to preserve it for future interpretation.

This report describes an example of presenting basic archaeological methodology and technique to the general public through the use of a local historical archaeological site, CA-SCL-378H, the Forbes Mill site, located in Los Gatos, California. The project addressed how archaeologists are responsible not only for preserving the past but for making the past accessible to the public, to whom it actually belongs.

The site itself had a long and arduous life history to share. One hopes, when excavating an archaeological site, to recover artifacts that inform us about the people who

occupied or worked at the site and, for an industrial site, how work was organized and executed. Unfortunately, the site had been used in various ways after first the mill and later the ice plant and electric works closed, making interpretation difficult. It is difficult to arrive at some order from the huge miscellany of artifacts that came from this excavation.

The exhibition presents the transformation of the site's industrial development from grist mill, to ice plant, to its final metamorphosis into an electric substation. Exhibits included artifacts recovered from the property, photographs taken during field work, original documentation and schematics from 1911, industrial pieces from the time period loaned by private collectors, a mock archaeological excavation for children, and a display of field tools used to excavate the site.

The following photographs describe what was presented in the exhibit, which was held at the History Museum of Los Gatos in the fall of 2000. The appendixes include the text used in the exhibition in the form of wall hangings.

Kids Archaeological Excavation Area

An exhibition should include at least one exhibit designed for younger patrons. This exhibit tries to give some sense of an archaeological excavation by allowing children to "excavate" hidden plastic toys using trowels.

Early Los Gatos

The entrance to the exhibition displays a short summary of early Los Gatos history (see Appendix A for text). Below the wall hanging are booklets that give in depth descriptions of the history and artifacts displayed throughout the exhibition (see Appendix B for a sample booklet). Just above the booklets is a map, taken from a 1904 Sanborn insurance map, showing the layout of the mill site, with excavated archaeological units displayed on the map (see Appendix C for map).

The Fabric of Los Gatos

The display includes biographies of some of the people in the later development of Forbes Mill and the subsequent use of the site to manufacture ice and generate electricity (see Appendix D for text).

Archaeology

The descriptions on the wall describe the theory and methodology used to excavate an archaeological site (see Appendix E for text). The case on the left exhibits artifacts excavated at the site, diagrams, and photographs. The right side of the exhibit displays some of the tools used to excavate the site, with pictures on the wall depicting the features found.

Artifacts

This case displays artifacts recovered from the site. They include a ceramic marble, a tule elk tooth, a domestic ceramic fragment with a blue transfer design, and numerous metal artifacts indicative of an industrial site. Two intact bottles are displayed with a diagram depicting how the bottles were manufactured.

Field Drawings

The photographs are of the brick features. The picture on the left is of feature #2 and was taken on an east-west axis. The picture on the right is also of feature #2 taken on a north-south axis. The field drawings show excavation profiles.

Field Techniques

This display contains common tools used in the field: shovel, trowel, $\frac{1}{4}$ inch screen, whisk broom and hand pick. Displayed in the $\frac{1}{4}$ inch screen is a rainbow of colored glass fragments excavated at the site. A chart above the screen shows the typical function of various bottle glass colors.

Electricity

The center case for the electricity display. It includes artifacts excavated at the site, a glass pole insulator, knob and tube porcelain insulators and documentation from Pacific Gas and Electric Company's evaluation in 1911 when it was considering purchasing the Los Gatos Ice, Gas and Electric Company. A short summary explaining early electricity in Los Gatos hangs to the left of the case (see Appendix F for text).

Artifacts Pertaining to Electricity

On the left are original knob and tube porcelain insulators, excavated at the site, with diagrams showing how they were used to protect electrical wiring. On the right is an Edison light bulb from the turn of the twentieth century. Also included is a Mazda light bulb circa 1913-1920.

Electricity Case

In the center is an original photograph of the first power pole erected in Los Gatos. Also included are: a 1911 drawing of the power poles at the Los Gatos plant, a payment receipt for electricity purchased from the Los Gatos Ice, Gas and Electric Company and a glass insulator used on power poles, excavated from the site.

Paper Artifacts

Enclosed in the case are the original hand-written documents dating to 1911 and 1912 when the Pacific Gas & Electric did an inventory survey at the Los Gatos Ice, Gas and Electric Company. Documents include original photographs, hand drawings of all equipment on the premise at the time of the survey and a monthly accounting of employees' salaries.

Pelton Water Wheel

The Pelton water wheel was crucial in supplying power for the ice plant. Originally three wheels powered the plant; two were five feet in diameter and one was three feet in diameter. The wheel displayed dates from the late 1800s and has a diameter of 27 inches (see Appendix G for text on hydro power).

Pelton Wheel Alignment

This diagram depicts how a Pelton wheel operates. The water nozzle, shown on the right, directs a stream of water towards the buckets on the wheel. The force created from the turning wheel is stored and converted to electricity in the generator. The area beneath the wheel, where the excess water is funneled, is known as a tail race.

Ice Manufacturing

Although the ice display case holds no artifacts from the site itself, all items displayed are from the industry at the turn of the 20th century (see Appendix H for text of abstract).

Ice Display Case

Items displayed on the left side of the case include: ice picks, an ice placard, a Jack Frost publication from the Frick Ice Manufacturing Company, a maintenance handbook on upkeep and repair of ice manufacturing equipment, and a photograph of Forbes Mill showing the ice plant at the rear of the building.

Ice Display Case

On the right side of the case the items displayed include: ice tongs, ice coupon books and two ice bags. The larger bag was used for industrial customers, such as restaurants, the smaller bag was for home delivery.

Diagram Showing Ammonia Compression Ice
Manufacturing

Taken from Audels' Refrigeration and Air Conditioning
Guide, this diagram shows the principal parts and
components used for ammonia compression ice manufacturing.

Appendix A: EARLY LOS GATOS

Text Shown in Photograph on Page 2

In the Mexican period, the area known today as Los Gatos was part of a rancho called *Rinconada de Los Gatos* that had been granted to Jose Hernandez and Sebastian Peralta by the Mexican government in 1840. In 1853 James Alexander Forbes, the British vice-consul to Monterey, began to build his mill on Los Gatos Creek to fill a need for affordable flour and provide a service for grain farmers in the area. When construction began on Forbes Mill, there was but one small adobe building in the area. When Forbes' mill drove him into bankruptcy in 1856, the only new buildings in the area were a few shanties for the workmen.

When Forbes built his initially unsuccessful mill, the region was sparsely populated, mainly by lumber workers in the mountains, especially around Lexington, a lumber boom town that began to bust by the early 1880s. The first wooden residence, to become the home of Dr. William McMurtry, proprietor of the general store, was built in 1862. The heavy wagon traffic from the mountains brought business interests to Los Gatos. The town began to grow in

the 1860s, especially after the mill was refurbished in 1866 into a successful operation.

But it was after the railroad came that the town really began to grow. The South Pacific Coast Railroad trains began to carry passengers and freight in and out of Los Gatos in 1878. Residents sent their children to distant schools as commuters on the railroad. Another sure sign of prosperity was the opening of the Los Gatos Bank in 1883. Nine years after the railroad came, the needs of a growing population led to the incorporation of the town and creation of a local government. Los Gatos had a population of 1500 in 1887.

It was fruit that really made Los Gatos grow. Not only did the railroad provide local fruit growers with access to more distant markets, but visitors seeing the oranges and lemons growing near the mill property soon realized that the climate and soils there were ideal for horticulture. The mainstay of the Los Gatos economy at that time continued to be the fruit industry of the surrounding ranches and its related canning and shipping industries.

The fruit boom lasted long enough to ensue the survival of the town. In addition, the railroad made

commuting from Los Gatos to San Francisco a pleasurable experience. Los Gatos had grown large enough that it would survive the decline of this boom industry after the Second World War, rather than becoming a ghost town like Lexington and others that had grown up around a single booming industry.

Appendix B: A LOOK INTO THE PAST

Booklet Depicted in the Photograph on Page 2

A LOOK INTO THE PAST

Acknowledgments

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Los Gatos: 1852-1913

The area known today as Los Gatos was once part of a rancho called *Rinconada de los Gatos* granted to Jose Hernandez and Sebastian Peralta by the Mexican government in 1840.¹ There are a number of tales regarding where that name came from, mostly centered around the wild cats of the area and dating to the Spanish or Mexican periods. In 1852, James Alexander Forbes, the British Vice-Consul in Monterey, contracted with Jose Hernandez to buy 2000 acres of land, and the following year began building a mill on Los Gatos Creek. His intent was to fill a need for affordable flour in the region and to provide a service for grain farmers in the Santa Clara Valley.²

At the time construction began on the Forbes Mill there was just one small adobe building in the area of the town.³ Forbes, being a man of aristocratic bearing, wanted to name the little town that began to grow around his mill Forbes or Forbestown. However, Forbes Mill drove him to bankruptcy, and although his mill remained the center of the town, he was no longer a force in the town after his property was sold at auction in 1857. In that year the only buildings in Los Gatos aside from the mill itself were a few shanties for the workmen.⁴ It is unknown whether Forbes ever paid any of the money he promised to Hernandez, or repaid the money he had borrowed to build the mill itself. Although the town did not officially get the name of Los Gatos until it was incorporated in 1887, the post office established in 1864 used the name Los Gatos,⁵ and an 1876 map lists the town by the same name.⁶

While Forbes was overextending himself in the milling business, the real financial future of the town was just beginning on the surrounding ranches. When California became part of the United States at the end of the Mexican-American War, many of the Mexican ranchers were able to keep their land, but many of them had only subsisted off their lands and could not pay property taxes to Santa Clara County. They began to divide their ranches into smaller plots and sell them, primarily to Americans and others who had recently settled in California, most of them gold-mining hopefuls who had either made money or retained enough to buy land after the gold fields had been panned out.⁷ Many of these new settlers attempted to homestead on these small plots.

Among them was a French orchardist named Louis Pellier, who bought land near San Jose in 1850, and by 1856 was producing French Prunes. These would become a highly lucrative commodity, described as the working-mans' fruit, and in the Santa Clara Valley soil would rival the best products of his native France.⁸ Arboriculture was to become the biggest business in the Santa Clara Valley by the 1880s, turning the region into one of the largest fruit-producers in the world. In spite of the suitability of the climate and soils, the fruit industry needed time for the infrastructure to develop, in this case canneries and railroad lines, before it could really boom. The railroad came first in 1878 and the first cannery not until 1882, though much fruit was dried before then, and some was shipped to canneries elsewhere.

At the time Forbes built his initially unsuccessful mill, the region was sparsely populated, mainly by lumber workers in the mountains especially

around Lexington, a lumber boomtown that lost out to Los Gatos by the early 1880s.¹⁰ In 1850, Mountain Charley McKeirnan began to build a toll road to the summit of the Santa Cruz Mountains to take advantage of the logging traffic. This road, which passed by the mill, was opened on July 5, 1858, by the Santa Cruz Gas Joint Stock Co. and brought increased traffic through the area that was to become Los Gatos.¹¹

With the increased lumber traffic came more business. A stable and a small hotel catering to teamsters and stage coach drivers were established in 1860 and 1861. The first wooden residence, to become the home of Dr. William McMurtry, proprietor of the general store, was built in 1862. It was the heavy wagon traffic, mostly related to the lumber industry, that brought business interests to Los Gatos at this time.¹² The town began to grow in the 1860s, especially after the mill was refurbished in 1866 into a successful operation. Dr. McMurtry, although he had operated the general store since 1863, made the town his home in 1870, by which time most of the accommodations of a small Western town were present.¹³

But, it was only after the railroad came in 1878, that the town began to experience a major leap in growth.¹⁴ Construction began in 1876 by the South Pacific Coast Railroad, and trains began to carry passengers and freight in and out of Los Gatos in 1878. The flour made at Forbes Mill by this time had gained a reputation for quality in San Francisco and beyond, and the ability to transport it more quickly and cheaply by rail was a boon to the town.

Coming into Los Gatos were vacationers from all over looking to enjoy the mountains in enough numbers for the railroad to designate special picnic trains on the run to Los Gatos.¹⁵ Doubtless this gave the hotel business in Los Gatos a second wind; the railroad was able to bring far more people far more cheaply than the old stage coaches could.

But it was fruit that really made Los Gatos grow. Not only did the railroad provide local fruit growers with access to more distant markets, but visitors seeing the oranges and lemons growing near the mill soon realized that the climate and soils in Los Gatos were ideal for arboriculture; there was a tremendous surge in land speculation as people moved in to plant orchards. Land that early settlers had purchased for as little as \$15 per acre sold as high as \$300 per acre, and people who bought at that price often made up for it with their first harvest, now that fruit could be shipped by rail to larger urban markets much more cheaply than shipping by wagon.¹⁶ The railroad was to be a significant force in the history of the town until the line from there to Santa Cruz, always plagued by land slides, was finally closed in 1940, although the advent of the automobile did much to detract from the importance of railroads generally.¹⁷

Los Gatos enjoyed steady growth from the coming of the railroad, which brought the first newspaper to Los Gatos in 1881.¹⁸ Los Gatos residents sent their children to distant schools as commuters on the railroad.¹⁹ Another sure sign of prosperity was the opening of the Los Gatos Bank in 1883. Nine years after the railroad came the needs of a growing population necessitated the incorporation of the town and the creation of a local government. Los Gatos had a population of 1500 when it was incorporated, although this figure may not

include many of the Chinese and other minority peoples of the town, especially those who lived in poor, impermanent housing. When the first interurban railroad opened in 1904, it brought Los Gatos ever more into the domain of San Jose. Los Gatos got another boost in population after the earthquake of 1906, attracting people who preferred to be in a place with fewer large buildings that could collapse on them.²⁰

The growing population and the creation of a town council created a market for public utilities, one of the primary concerns of the new government of Los Gatos. The first actions of the new town council included street improvement projects, a fire department to handle the many conflagrations that had plagued the town, a marshal and a night watchman, the creation of sewers, the acquisition of water for the town (including public drinking troughs for horses²¹ and eventually lighting the streets at night, first with gas and later electricity. A high school was built in 1894, and a library in 1898.²²

During these years there were a number of companies that competed for both city and private contracts to provide services. Initially, numerous small artesian wells provided water, competing with the San Jose Water Company and later the Los Gatos Water Company. The San Jose Water Company started to provide San Jose with water in 1868, at first from artesian wells, but within two years they had to tap Los Gatos Creek for more water, putting them into conflict with Roger's Mill for water rights.²³ Although they were able to buy out the smaller wells, the San Jose Water Company eventually found themselves in competition with three other companies.

The Los Gatos Manufacturing Company competed with the Glen Una Ranch to generate electricity for the town, the latter buying the former out in 1901, and there were similar ventures with gas and telephone services. However, the days of small companies competing with each other to serve the city and its people began to disappear through a process of industrial consolidation.²⁴ When Pacific Gas and Electric bought out Los Gatos Ice, Gas and Electric Co. in 1912, it acquired its current monopoly on electric and gas utilities in Los Gatos, a town then of just over 2000 people.²⁵ The basis of the Los Gatos economy at that time continued to be the fruit industry of the surrounding ranches and in the related infrastructure of canning and shipping. But, by the beginning of the First World War, Los Gatos had diversified to the point that it would be able to survive the decline of the fruit industry after the Second World War, and did not become a ghost town like Lexington and others that had grown up around a single booming industry.

Industry and Economy of the Times: Local and Global Change

The industrial history of Forbes Mill is excellent testimony to the vast changes in the economy of both the region and the world that began after the American Civil War. The mill, itself the heart of the new town of Los Gatos, began as so many business ventures up to the mid-nineteenth century, as an investment on the part of a man from an old-money family with government connections. The \$24,000 Forbes' investment in creating the mill was a fortune

in the 1850s that few could acquire, much less risk. Also the nature of the business was typical of the old economy, both in its product and its relatively local scale. The almost monumental character of its architecture, making the mill much photographed and remembered, fit the character of an aristocratic venture. Even the overshot wheels used to drive the mill were an old technology, eventually to be replaced by turbines. Overshot wheels are big and impressive, lending an appearance of grandeur to a mill building that would impress the onlooker much more than a turbine hidden on the inside. Over time, and in other peoples' hands, that would begin to change, those changes reflecting specific changes in the local economy and the more general shift in the U.S. and the world toward high technology and big business. Along with this historical trend, the Forbes Mill site shows the typical boom-and-bust pattern of the West in two of its three industries.

In the years that Forbes operated his mill at Los Gatos, the Santa Clara Valley was a region of ranchos and wheat farms. The mill filled a need for both the local farmers and the nearby burgeoning metropolis of San Francisco, grown hungry with Gold Rush migrants. Indeed many of the Santa Clara farmers of the time had been 49ers, who came out of the gold fields to buy land from the ranchos and settle down to farm.²⁶ Forbes Mill was not a success for Forbes, and soon there were many competing mills in the valley. After changing hands several times it was given the capital improvements needed to make it an efficient operation. In 1866, under the direction of William H. Rogers, flour from the Los Gatos mill was exported all over the US and had grown a reputation for quality; the mill began to grind flour from outside the valley, brought in by the railroad, by 1885.

But the profitability of the mill was probably in decline. Wheat farmers in the Santa Clara Valley faced numerous problems, including soil depletion and increased competition from Midwestern farms, and the nature of agriculture in the area was changing.²⁷ Fields of wheat gave way to orchards, and mills gave way to fruit canneries. Two investors in the mill, W.S. McMurtry and W. H. Rogers, in fact, were among the early fruit growers in the area, planting orange and lemon trees after they had purchased interests in the mill, pioneering in the very trend that would bring down the mill. A book on the Santa Clara Valley of 1888 even credits the orange grove at Forbes Mill with sparking the fruit boom.²⁸ A fire in 1884 damaged the mill, which by then was already losing its profitability. That the mill was grinding wheat brought in by railroad may be more an indication of diminishing returns, as fewer local farmers brought wheat to the mill, rather than a testimony to the power of Los Gatos industry as touted in the local newspaper. In these years of transition for the mill, from 1884 to 1887, the population of Los Gatos began to swell, nearly tripling from 600 to 1500.²⁹ In 1887 the mill stopped grinding flour altogether and the Los Gatos Manufacturing Company merged with the Central Milling Company, removing the milling equipment. This would be a pattern visited on the mill industry again in the next century.

An ice manufacturing plant was built beside the mill in 1885, utilizing the turbines that had run the mill, and coming into operation the following year.

The ice plant was built by William DeWitt Tisdale and Abram King, officers of the First National Bank of San Jose,³⁰ and organized as the Los Gatos Ice Works. It is interesting to note that W.D. Tisdale was listed as an officer of the Central Milling Company, which consolidated with the Los Gatos Manufacturing Company two years later.³¹ Just as Forbes' venture was not initially successful, the ice works production was unsatisfactory in the first year, apparently due to the concentration of impurities in the core of the ice blocks, a common problem with early manufactured ice.³² Tisdale and King had to invest in new equipment the following year, after which the ice works was so successful that by 1889 the Los Gatos Manufacturing Company was the highest taxpayer in town.³³ In 1901, Tisdale and his partners added an electric generator,³⁴ at first to supply lights for the ice works, then to light city streets and to sell electricity to private consumers. After these improvements the venture became so successful that by 1900 they were shipping over 4 million pounds of ice a year by rail to San Francisco.³⁵ For many years the ice works was hailed as an indication of the modern conveniences available in the young town of Los Gatos in numerous columns of the local papers, in spite of the fact that most of the ice was shipped for use elsewhere.³⁶ But, like the flour mill before it, the ice works were to decline in profitability and eventually close, the equipment left idle after 1904. It is not known why this previously profitable ice industry was not pursued by Farwell. Under Farwell's control the plant continued to produce power until the company was bought out by Pacific Gas and Electric in 1912.³⁷

In the ice works attached to Forbes Mill we see the economic trends of the times, both global and local. The local trend in agriculture put the mill itself out of business, while the water power used was directed for new uses. Tisdale and King, already wealthy from banking, invested in the mill not by attempting to resurrect it, but by bringing in state-of-the-art technology and converting it to other industries that had proven themselves profitable elsewhere. The first ice manufacturing plant west of the Mississippi was built in 1874 in San Francisco,³⁸ and ice was becoming a commercial success, especially with the growth of the fruit industry. Tisdale and King also bought into the San Jose Water Company, which had often fought with the mill in court over water rights, thus eliminating a hindrance to their water-powered business ventures, and entering a potentially lucrative utilities market. Tisdale served as president of the water company for two years.³⁹ In short, they followed trends, investing as bankers often will in a sure thing. It could be surmised that the ice works was related more directly to the new fruit horticulture, but most of the products of the orchards were canned or dried, and much of the ice was sold elsewhere rather than being used to cool fresh fruit at the source.

The introduction of electricity a few years later also seems to have been a case of following a trend. Nearby San Jose had become world-famous for its experiment with electric street lighting only a few years earlier, and although the San Jose Electric Light Tower was a failure, it had made it clear that electricity was destined to replace gas for lighting the night.⁴⁰ It is interesting to note that the two main competitors for the electricity market of Los Gatos both started generating electricity to provide lighting for their other businesses; in the case of

Glen Una, to allow workers to see fruit drying trays at night.⁴¹ And although the reason for the failure of the ice works itself is enigmatic, it is perhaps related to growing competition in San Jose.⁴² The fate of the electrical generator illustrates another trend of the times - industrial consolidation. By the beginning of the First World War, small competing utility firms had mostly disappeared from the scene in the U.S., to be replaced by a relative handful of utility giants.

This trend had begun soon after the American Civil War in a number of industries, and for decades America wrestled with the trust question. Giant monopolies not only inspired board games, they brought out some of the darkest moments in American history. The brutal climb to power of the Standard Oil Trust is perhaps the most infamous and publicized of these struggles⁴³ but industrial combination was growing more the rule through these decades. The era of big business had begun, and most of these big businessmen well deserved their reputation for being robber barons. Trusts and other forms of industrial combination ruined the lives of millions of Americans by driving up the costs of living and lowering working wages. This tendency of monopolies and trusts to inflate prices and cheat their employees caused great unrest in America for decades, and in part made the political career of Theodore Roosevelt, who had gained a reputation as a trust-buster.⁴⁴

It is not known if any of the proprietors of the ice house and power plant at Forbes Mill were guilty of the excesses of the times. There do not appear to have been any injunctions against the business in its various names between 1886 and 1912, nor does there appear to be any history of strikes or boycotts against them. There are a few items that suggest the possibility of a dark side to the business that were uncovered in researching this site. One of the most blatant is the fact that Abram King was a San Jose city councilman when it was decided to build the profitable Mount Hamilton Road to the Lick Observatory,⁴⁵ then was on the board of supervisors that built the road, along with William H. Rogers.⁴⁶ It is not proven that King profited financially from this, but the appearance of corruption is significant. Maybe more trivial, there is an article in the Los Gatos Weekly News which complains of the very high price charged by Tisdale to residential customers for electricity, up to twenty cents per kilowatt hour,⁴⁸ which was far above the eight cents P. G. & E. charged in 1913.⁴⁹ On the subject of prices, another comes from a magazine on refrigeration of 1901 which lists the prices of ice around the U.S.⁵⁰ For California it lists Sacramento, where it names three ice companies that had combined and raised the price from \$6 to \$8 per ton (a 33% price hike), and states that there was much dissatisfaction on the part of businessmen there. This does not in any way show that The Los Gatos Ice and Power Company engaged in what today we would call price-gouging, it only demonstrates that industrial consolidation was affecting the ice industry and raising prices in California at the time. Other suggestions regarding the character of the men who ran the plant could be indicative. For instance, J. Y. McMillin had been part of the Santa Clara Turnpike Company which had been formed in the 1850s to build a road through Los Gatos as a response to teamsters and lumbermen's complaints of the high toll on the one private road through the area.⁵¹ After driving Zachariah Jones, the owner of the private road,

out of business, McMillin's company charged equally high tolls.⁵² Another hint at the character of these people can be seen in how they related to the community during times of calamity. During the fire burned much of the business district of Los Gatos in 1891, the local paper records that Mr. Thomas Cox brought out a hose to prevent damage to the ice and electric plant, but no mention is made of this hose being used to assist anyone else.⁵³ On the other hand, after the 1906 earthquake J. D. Farwell, manager of the plant after it had been bought out by George Hume of the Glen Una Ranch, put up 25 girls whose San Francisco orphanage had been destroyed.⁵⁴ These items are indirect and only hint that some of the proprietors of the ice house and electric works, but perhaps not all, may have engaged in the nefarious practices of so many businesses of the day.

With nearly a century of development since it closed, the trends we see in the history of the ice house at Forbes Mill have become major forces in our economy today. Advancing the trends of the time, big business rules the day, in spite of Roosevelt and many other trust busters, especially in areas that require large capital investment and utilize the latest technologies. The computer industries of Silicon Valley illustrate this well in a local context. Just as the railroad provided the transportation infrastructure for the ice and fruit industries, the Internet provides the transportation infrastructure for the new information industry. In both cases the infrastructure and the industries grew together, each intertwined with and facilitating the other.

People Associated with the Ice and Electricity Works.

Below are brief biographic portraits of some of the people associated with the ice and electricity works at Forbes Mill. Most of these people were prominent businessmen in Los Gatos and San Jose, and several were also involved in politics and other aspects of community life. They were often involved in numerous business ventures in addition to their work at the ice and electric works. Many of them were closely connected to each other in their other business dealings. Some of the people discussed were only tangentially related with the ice and electricity works or only for a limited time, while others were key players in the business through most of its years. Some names known to be associated with the businesses have proven impervious to research. Naturally the people who were most active in civic affairs are those about whom the most historical information is available.

James D. Farwell (1872 - 1943)

J. D. Farwell was born in San Francisco in 1872 and moved to the Los Gatos area at age 19 when he was hired to manage the Hume Ranch at Glen Una, which he did for 25 years.⁵⁵ Shortly afterward he married Irma Lyndon, a daughter of pioneer John W. Lyndon. Two years after he began to manage the Hume Ranch, at that time one the largest prune orchards in the world, he installed a dynamo to run electric lights so the prune dryers could set the trays out at night. As a founder of the Glen Una Electric Company, he sold the extra

electricity produced to businesses and residents of Los Gatos in direct competition with the Los Gatos Ice and Power Company, which Hume bought out in 1901. Farwell managed the combined company until it was bought by P.G. & E. in 1912. Farwell was involved in many other ventures in addition to the electric utilities and the Hume Ranch, some of which were very long-term positions. He was director and later manager of the Bank of Los Gatos from 1883, which later became a branch of the Bank of Italy and was finally absorbed by Bank of America. He was the local manager of Bank of America until he retired in 1937. He also founded the Los Gatos Telephone Company in 1911, and was its president when he died in 1943.

Abram King (1825 - 1903)

Abram King was born in Cayuga County, New York, September 6, 1825.⁵⁶ He went to San Francisco in 1850, then moved to a ranch in the following year to engage in agriculture. The San Jose City Directories of the 1870s and 1880s list him as an orchardist, which may have been the business that brought him to prominence. His name also appears in the 1890 Great Register as an orchardist. An article in the San Jose Mercury of 1868 claims that he had the longest grape vine in the valley. He was one of the founders of the First National Bank of San Jose in 1871. Banking and agriculture do not seem to have been his only interests, as he spent the years from 1874 to 1878 as the District 2 representative on the San Jose Board of Supervisors. In 1884, with W. D. Tisdale, he founded the Los Gatos Ice Works. In 1891 he and Tisdale again founded a bank, this time the Security State and Savings Bank, serving as its vice-president until 1895, then as president after Tisdale retired. King passed away in 1903 at his home on Julian Street in San Jose.

John Young McMillin (1826 - 1901)

John McMillin was born in Indiana in 1826 and came to California in 1850.⁵⁷ He built the first sawmill in the Santa Cruz Mountains in Lexington, where he lived with his wife Parneta née Howell, until the town began to dry up in the 1880s, when they relocated to Los Gatos. McMillin was an officer of the Santa Cruz Gap Joint Stock Company in 1856 which built the second road from San Jose through Los Gatos to serve the lumber interests around Lexington, bypassing the first road built by Zachariah Jones.⁵⁸ McMillin was also an officer of the First National Bank of San Jose, which he helped to form in 1871 with Abram King and William Tisdale. His other notable activities include being a San Jose City Councilman and a prominent member of the Odd Fellows Society. In 1869 he purchased a half interest in Forbes Mill from William Rogers along with Dr. McMurtry and it was incorporated as the Los Gatos Manufacturing Company.⁵⁹ Although the Los Gatos Ice Works was originally incorporated under King and Tisdale in 1885, Mr. McMillin remained on the board when the two companies combined in 1887. John McMillin died at his home in San Jose in October of 1901.

Dr. William Sharp McMurtry (1818-1908)

William McMurtry was born in Kentucky August 14, 1818, though his family relocated to Indiana in 1825.⁶⁰ It was there that he began medical training at Miami University in Cincinnati in 1839, completing his medical education at the Louisville Medical Institute in 1844. He started to practice medicine in that year, but when the Mexican-American War began in 1846 he joined the Texas Rangers until the war ended in 1848. Afterwards he took up medicine again in Baton Rouge, Louisiana. McMurtry married Olive McMillin, sister of John Young McMillin, before moving to California.⁶¹ He came to California in May of the next year to mine gold, mainly in Grass Valley. Later in 1858 he went into lumbering in the Santa Cruz Mountains and opened the first saw mill in the area on Los Gatos Creek above Lexington with J. Y. McMillin. Dr. McMurtry was among the first settlers of Los Gatos, having bought the first wooden home built in the area in 1870. He and McMillin opened two of the town's first businesses: the general store and the first lumber yard in 1863, which suggests that at first he saw Los Gatos only as a business venture, but later as it grew he began to see it as a home. He also opened up a medical practice in Los Gatos in 1868, two years before moving into town. McMurtry continued to be involved in many business ventures in San Jose, however, and was elected to the state senate to represent Santa Clara County in 1863. The next year he was sent as a representative to the Republican convention in Baltimore. His son, George S. McMurtry, was also active in politics, though at the local level, having participated in the incorporation of the town in 1887 and sat on the town council. George was also manager of the LG Manufacturing Co. after Rogers left. Dr. McMurtry died December 8, 1908.

William H. Rogers (1830 - 1890)

William H. Rogers had many years of experience milling when he bought Forbes Mill in 1866. Born in Wayne County, New York, January 11, 1830, he moved to Michigan as a child and worked in the Detroit City Flour Mill before coming to California in 1853.⁶² He married Louisa Greeley in 1850, and they had four children. After two years mining for gold in Placerville, Rogers helped build and manage a mill in the area, then sold his share in 1860, to become the Postmaster of Placerville, then the Sheriff of El Dorado County in 1863. Because of his experience managing a mill and his willingness to invest in upgrading the technology of the mill, it was he who first made it a success. This was mainly done by investing the effort and money to raise the head sufficiently to provide enough power to drive the grinding stones. He also replaced the old overshot wheels with more efficient and modern turbines. Tripling the head at first to sixty feet, these improvements were promising, but by 1870 Rogers found it necessary to raise the head even further, this time to two-hundred feet. He seems to have needed more capital to do this than he had, as he invited other local businessmen to invest in the improvements. Presumably the milling business must have declined sufficiently, more likely he wanted to expand the mill's capability for him to seek partners, for in August of 1869 he sold a half share in the mill to a Mr. C.G. Harrison, who later that year sold his

share to McMurtry and McMillin, who then incorporated the mill as the Los Gatos Manufacturing Company. Most likely it was these two who had the idea of manufacturing ice, though they continued running the mill for another six years. An 1881 newspaper article lists Rogers as the manager, with McMurtry as president. Very little is known about Rogers, except that he left Los Gatos in 1882 for reasons unknown. Rogers himself does not seem to have been interested in the ice venture. The ice works was begun two years after he left, however, it would not have been possible without his initial improvements to the mill. Rogers died in San Francisco in 1890 of a brain hemorrhage.⁶³

Judge Francis E. Spencer

Judge Spencer was born in Ticonderoga, New York, on September 25, 1834.⁶⁴ In 1846, at the age of twelve, he moved to Illinois, where he stayed until moving to California by wagon in 1852. He settled in San Jose where he at first raised sheep. For a brief period he studied medicine, then gave that up to study law in the office of Archer & Voorhies, where he worked until he opened his own office in 1858. From 1862 to 1865 he was District Attorney, and from 1863 to 1879 City Attorney. He was elected to the State Assembly in 1871, and became a Superior Judge in 1879. It was during the year of his election as a judge for San Jose Superior Court in 1879, that he invested in the Los Gatos Manufacturing Company. An article in the Los Gatos Weekly News of 1881 lists Spencer as Secretary.⁶⁵ It is unknown if he was still part of the company when the mill began to produce ice.

William DeWitt Tisdale (1845-1898)

W.D. Tisdale was born in Utica, NY on Oct. 12, 1845.⁶⁶ His family moved to Nevada County, California in 1854, when he was nine, by way of Panama. The family planned to make their living in mining. He attended Santa Clara College for three years beginning in 1860, then returned to Nevada County to continue quartz mining. This was apparently somewhat successful for him, as he and his father owned interests in two successful mines (the Banner Mine and the Mohawk). With his mining earnings he was able to move to San Jose in 1871 where he helped establish the First National Bank.⁶⁷ The bank was running by 1874 and he held the position of cashier, a position of responsibility and importance more akin to management in those days, and became its president in 1880. He held that post until 1894, when he retired due to failing health. He also participated in the governing of the Security State Savings Bank from 1891 until his retirement. Tisdale was involved in a number of business ventures during his years with the bank, including his creation of the Los Gatos Ice Works, the Los Gatos Ice and Power Company (which provided Los Gatos its first street lights in 1892) and acquisition of the Los Gatos Water Works. He also was president of the San Jose Water Works from 1894 to 1896. It was Tisdale, with his banking partner Abram King, who created the ice works at Forbes Mill. He died at his home in Los Gatos March 7, 1898.

A number of other names can be found relating to the ice works and electricity generating station at Forbes Mill, though little has been learned of any of these. Thomas William Cox, for instance, was the manager of the mill under

Rogers, and after the mill closed stayed on as an employee of the ice works at least until 1904. He is listed as a laborer at the Los Gatos Ice Works in the San Jose City Directory for 1904/05, but not in any of the following years.⁶⁸ His name appears in the 1890 Great Register for Santa Clara County, which lists him as a miller, 42 years of age at that time, a native of Ireland naturalized in New York in 1862.⁶⁹ This would have him born in 1848.

Claudius Cabot Hayward invested in the mill along with McMillin, McMurtry and a W. H. Rector in 1869 and was among the trustees of the Los Gatos Manufacturing Company. He appears in the 1890 Great Register for Santa Clara County, listed as a merchant, age 41 and a native of Ohio.⁷⁰ His obituary in the San Francisco Herald declares that he was a native of Irvington, Indiana, born in 1850.⁷¹ It claims that he managed the mill from the time it opened until it closed six years later, which is clearly wrong, since his investment in the mill began in 1870 and the mill did not close down until 1887. It is difficult to determine if he had any connection with the ice house, or if he was gone by the time it was built. Hayward died in September 1904 in San Francisco. W. H. Rector does not appear in the Register, so he may have left Santa Clara County by that time. Cornelius Gooding Harrison is another name associated with both the Forbes Mill and the First National Bank of San Jose, of which he was vice-president in 1881.⁷² He bought a share of the mill from Rogers in 1869, but was bought out by McMurtry and McMillin later that same year.⁷³ He does not seem to be connected to the ice works in any direct way, but given the scarcity of information located this conclusion could be modified in future. Harrison died in Pasadena in September 1904.⁷⁴

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How a Hydro-Powerhouse Operates

Hydroelectric power generation is based on two interlocking systems: the water system that provides the motive force, and the generation and transmission of electricity that has been created by that force. The first is far easier to comprehend than the second, but both must be explained in order to understand the functioning of a hydroelectric powerhouse. The following section provides a generalized scheme of the water system that runs into, and the electrical system that runs out of, typical high-head powerhouses.

Typical High-Head Water System

In the mountainous western part of the country, where elevation is easier to find than water, hydroelectric plants usually have high heads, or operate under higher pressure, and use impulse wheels.¹

A high-head hydroelectric plant requires a tall column of water situated above the powerhouse in order to provide the pressure needed to spin impulse wheels. The purpose of the water system in any high-head plant is to provide this sort of pressure. Water has to be taken far upstream from the powerhouse and transported by a conduit that will move the water toward the powerhouse. The grade of the conduit has to be just enough to move the water efficiently, and will be far less than the grade of the river bed. As the water nears the powerhouse, the canyon floor drops in elevation, leaving the conduit higher and higher up the canyon wall. By the time it reaches the powerhouse, the conduit water is hundreds of feet above the bed of the canyon. At this point, it enters a steeply angled metal pipeline for the final drop into the powerhouse. This is the basic principle of the water system used in a high-head plant.

The water system begins with a diversion dam that funnels water into the conduit. Where the water enters the system is referred to as the intake. Once in the system, water is transported along a conduit, a narrow channel that may consist of any combination of wooden or metal flumes, pipelines, tunnels, and inverted siphons.

One of the most important components of the conduit is the sandbox, a small reservoir in which the water is slowed sufficiently for sand to settle out. To prevent the damage which such particulate material could cause to the impulse water wheel or to the conduit itself, the sandbox is situated as close to the intake as possible. Many are equipped with gates and baffles so that one section can be closed off and cleaned out while water is rerouted through another section. Another feature usually associated with the sandbox is the rock drop, which serves the same function, to catch small rocks that may have entered the intake. Auxiliary features along the conduit, usually found near the intake, are leaf rakes and fish screens. Most of these are revolving devices designed to keep floating debris and large fish out of the conduit.

After the water has traveled the length of the conduit, it enters another small reservoir called the forebay, situated between the conduit and the steeply graded pipeline that leads to the powerhouse. Additional leaf rakes and fish screens may be found here, as well as a series of gates needed to control the water flow. It is at the forebay that attendants in the powerhouse can micro-manage the flow of water into the pressure pipes.² If the flow of water into the powerhouse is shut off at the forebay, then the water that continues to flow through the conduit must be rerouted. Spillway pipes are provided for such instances, as are other spillways at various intervals along the conduit.

The pressure pipe, the plunging pipeline that descends to the powerhouse from the forebay, is also referred to as the penstock. This is a thick pipe of riveted steel segments capable of withstanding enormous pressure. In a high-head system, the penstock holds the water before it is released to the impulse wheels within the powerhouse itself. Generally speaking, the head is the elevation from the powerhouse to the forebay.³ Static head is the height of the water equilibrium within the penstock. In theory, this equilibrium should be at or just below the forebay, providing a solid column of water within the penstock that will exert powerful force when released in the powerhouse below.

In some cases, the penstock enters the powerhouse directly; in others, the penstock connects with a perpendicular pipeline that used to be called a receiver and is now known as a header. A receiver or header is commonly used when water from the penstock has to be divided to supply a number of generators within the powerhouse. Both receivers and penstocks are commonly equipped with shut-off valves to control the flow of water in the powerhouse.

Inside the powerhouse, the final pipes that leave the penstock or receiver are constricted to a point where a nozzle and needle can be used to direct a small stream of incredible force against the buckets of an impulse wheel. This is the most common application of force in a typical high-head powerhouse. It is also possible to run the whole flow of water through a reaction turbine. The main difference between the impulse wheel and a reaction turbine is that water strikes only a small portion of the impulse wheel at any one time, while the whole body of the water stream passes through a turbine. The impulse wheel is typically used in high-head plants because it responds better to fluctuations in the water load; a reaction turbine has greater efficiency only when the water load is at maximum capacity.⁴

When water strikes an impulse wheel or passes through a turbine, the hydraulic system of the powerhouse intersects with the electrical system, creating its energy. Beyond this point, water exits the powerhouse through a tail race.

Basic Electrical System

Any device that converts mechanical energy (in this case water power) to electricity is called a generator. A device that changes electricity back to mechanical power is a motor.⁵ The generator, also known as a dynamo, is the

focus of the powerhouse, and a number of devices converge on the generator to ensure its proper operation. Foremost among these mechanisms are the water wheel, the water wheel governor, and the exciter.

The water wheel powers the generator. When they are directly connected, they are located on the same shaft and rotate at the same speed. One of the devices that regulates the generator is the governor of the water wheel, which controls the speed of the wheel and, by extension, the generator itself. The governor prevents the water wheel from spinning too fast, which can damage the metal parts of an impulse wheel. The impulse wheels are ideally suited for high-head powerhouses because the wheels tend to have a low specific speed: the high speed of the water and the low speed of the wheel tend to create a workable moderate speed for the generator.⁶

Another device that helps regulate the generator, and in fact creates the electrical current, is the exciter. The exciter creates the electromagnetic force that has to interact with the wire coil. Although exciters can be water driven, with their own water wheels, they also require a series of DC batteries for regular use or for emergencies.

This basic outline of a typical water and electrical system of a hydroelectric powerhouse is as applicable today as it was at the turn of the century. That is one very important reason why these powerhouses are still in operation. This is not to suggest, however, that these powerhouses were in any way typical or routine at the time they were built, for such was not the case. The years between 1895 and 1915 witnessed rapid change and dramatic evolution in hydroelectric technology. Beginning with the inauguration of the hydroelectric plant at Niagara Falls in 1895, the following 20 years were a period of remarkable innovation in hydroelectric design, water wheel configuration, and plant setting.

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History of Ice Manufacturing in the United States

As demand for ice increased in the 19th century ice companies were organized to cut and transport ice to major market areas. Experiments to manufacture artificial ice also began in the first half of the 19th century, but significant production of manufactured ice began in the mid 1800s. Little was recorded regarding the use and harvesting of ice in the United States prior to 1800. Initially ice was harvested on a small scale, primarily by farmers for their own use, especially for the storage of meat and dairy products.

The early ice harvesters used simple equipment: axes and crosscut hand-saws. Ice harvesting was time consuming and inefficient. Each year, usually during January or February, rural communities in the northern states set out to fill their icehouses. Farmers with horse teams and flat sleighs congregated at a designated lake or pond. A large hole was cut in the ice to accommodate a wooden chute. Some of the men cut ice; using one-handed crosscut saws with heavy sharp teeth, they cut ice blocks weighing up to 300 pounds.¹ The blocks were then pulled up the chute with picks (or with rigging towed by a horse) onto the sleighs. After loading, a teamster would haul a sleigh to one of the farms, where other neighbors unloaded the sleigh while the teamster took an empty one back to the lake for reloading. The cycle was repeated many times during the day.

The storage facility was prepared for ice storage by placing a thick layer of sawdust or salt hay on the floor of the icehouse before any ice was brought in.² Ice blocks were then pushed up a plank into the house. Layer by layer the icehouse was filled. Each layer got a sprinkling of sawdust. This aided in separating blocks when taken out during the summer. In addition, about a foot of sawdust or salt hay was tamped between the ice and walls of the icehouse for insulation. After the house was filled, a layer of sawdust or hay was also put on top of the stack. The sled unloading gang would then move on to the next farm to repeat the process.

Ice harvesting was hard work for both people and horses. It was truly a cooperative community activity. Icehouses in a community would be filled in a couple of weeks, assuming the weather cooperated.

As towns grew into cities during the nineteenth century, the demand for ice grew rapidly. This demand created a unique and specialized industry. And with it, large ice companies were organized to cut, store, and transport the product long distances. Harvesting became large scale and very efficient.

During the 1800s, consumption of ice for preserving fresh foods, brewing, making ice cream, etc. steadily increased.³ Mechanical refrigeration was successfully launched mid-century. Its importance grew as an alternative to natural ice. In 1890, the winter weather in the northern states was unseasonably warm, resulting in a great shortage of natural ice, except in Maine and Wisconsin. This phenomenon added impetus to the rapid development and utilization

of mechanical refrigeration in the United States. The rapidly growing population, and resulting increased product demands, plus the greater costs of transportation from the harvesting areas to points of consumption, made it harder for natural ice to compete with artificial ice. The increasing demand for ice, especially in the Southern states encouraged development of ice manufacturing processes.

In 1834, Jacob Perkins (1766-1894), of Newburyport, Massachusetts, but then residing in England, obtained a British patent for making artificial ice.⁴ He is considered the father of practical, mechanical refrigeration. He built the first machine capable of producing ice in quantity, using the vaporization of a volatile liquid followed by the condensation of the vapor, in a continuous and closed cycle. This principle is the basis of virtually all refrigeration equipment today.

Perkins' invention was important because he incorporated, for the first time, the four basic elements of the vapor-compression cycle, essential to all refrigeration machinery of this type: a compressor, condenser, expansion valve, and evaporator. In the compressor, vapor was cooled and then liquefied by passing through the condenser coils, which were immersed in cold water. The liquid then passed through the expansion valve where, its pressure relieved, it returned to a gaseous state. The heat for the evaporation was drawn from the water within the evaporator, lowering its temperature and turning it into ice. The vapor, under low pressure, was taken into the suction side of the pump for recompression, completing the cycle.

Professor C. Twining, of New Haven, Connecticut, procured a British patent in 1850 and a United States patent in 1853 for another ice-making machine.⁵ By 1855, he had a machine in operation in Cleveland, Ohio that produced 1,600 pounds of ice in a twenty-four hour run.

In 1851, Dr. John Gorrie, a physician from Apalachicola Florida, invented an air-cooling device used to lower the temperature in hospital rooms of malaria patients. For the system to work, he needed a constant supply of ice.⁶ In that era, mid 1800s, Southern states were totally dependent on natural ice from the Northern states. The supply was not dependable, and when supply was short, due to a scant crop, the price became prohibitive.

As a result, he designed and built a machine to make ice. It used air as the gas, and through compression and then expansion, the air was cooled and ice produced. Dr. Gorrie was issued a patent for his artificial ice machine in England on August 22, 1850. The United States patent (no. 8080) was issued on May 6, 1851.⁷

In 1848, Ferdinand Carre of France devised an original process, using ammonia vapor. In 1865, he patented an ice machine, and in 1867, at the French International Exposition, it produced six tons of ice daily. During the years 1873-1875, C.P.G. Linde, of Germany, and David Boyle, of the United States, introduced the first commercially successful ammonia compression machines.⁸ Between 1875 and 1900 many new forms of ice making apparatus were introduced and improvements made.

New Orleans played an important role in the development of ice manufacturing. Once natural ice was introduced to the city in the 1820s, the demand grew rapidly. Initially only the very wealthy could afford it. Schooners from the Northeast, particularly Maine and Massachusetts, made regular deliveries.

In 1864, a small experimental ice-making plant, with a capacity of 600 pounds every three hours, opened in a cotton warehouse at Tchoupitoulas and Orange Streets.⁹ 1868 was an important year. The Louisiana Ice Manufacturing Company built the first artificial ice-manufacturing plant operating on a regular basis on Delachaise Street and the Mississippi River. The product first sold for \$1.75 per hundred pounds, a significant reduction from what the ice dealers were charging for natural ice.

Interest in ice making equipment gained momentum throughout the country during the latter half of the 1800s. Uncertainty of supply, large fluctuations in price, and weak sanitation standards made natural ice vulnerable to the new artificial product. Installation of ice making and refrigeration equipment progressed rapidly in many population centers of the United States. Ice making equipment also became increasingly important for the long distance shipment of perishables such as fruits, meat and dairy products.

In 1920, the Census Bureau estimated 4,800 plants produced 40,000,000, tons of ice, of which 25,000,000 were sold to the public.¹⁰ Approximately 160,000 people were employed in the production and distribution of ice. Total investment in the ice manufacturing business equaled \$450,000,000.00. In the same era, 15,000,000 tons of natural ice was harvested. The total industry ranked ninth in America's commercial enterprises.¹¹

The last gasp for the natural ice industry was World War I. Household refrigerators had been developed but distribution was interrupted by the war. The War promoted greater use of natural resources and conservation of critical commodities, including ammonia. When the war ended so did any reason for perpetuating the natural ice business.

The production of plant ice gained such inroads on the natural ice harvest that by 1925 little remained of that industry. Giant icehouses stood vacant, symbols of an industry that in a matter of decades experienced rapid growth and importance to the American economy and unprecedented obsolescence.

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Ice in California

A brief look at the beginning of the ice industry in Northern California helps set the scene for its arrival in the Santa Clara Valley. Prior to the mechanical manufacture of ice in California, ice was imported from Alaska or harvested from frozen mountain lakes, where it was packed in sawdust and hay, and moved by ship, wagon, or rail car to market areas.

From an historical standpoint, the ice industry in California began during the Gold Rush. In July 1850, a cargo of ice arrived by ship at San Francisco from New England, having made the journey around Cape Horn. The original cargo weighed 500 tons, but it had shrunk to 200 tons by the time it arrived at San Francisco.¹ This was not a very satisfactory source of ice. So in 1851, a group of San Francisco businessmen contracted with the Russian American Company of Sitka, Alaska, for ice from two Alaskan fresh-water lakes. The first shipment arrived successfully, and Alaska remained the major source of ice until 1869. In that year, the Central Pacific Railroad was completed over the Sierras, and the rails enabled ice to be harvested at Prosser and Boca creeks, Truckee and Iceland, then shipped to San Francisco in box cars.

The annual harvest from the Sierras was about 150,000 tons, which was shipped throughout California to cities and towns served by rail lines.² One of the companies handling the Sierra ice was the Peoples Ice Company, founded in 1875, which was one of the predecessors of the Union Ice Company.

Ice was first manufactured in Northern California in 1882, when the Union Ice Company, in San Francisco, built the first ice manufacturing plant west of the Mississippi.³ Northern California was now being served by both natural and manufactured ice. The early machinery was steam driven, but as electric power became more plentiful, electrically driven machinery was used. With the increased availability of electric power, the extension of railroad lines between cities, and a year-round demand for ice, new ice companies began appearing all over the state.

From its inception, the ice industry filled a dual purpose: service to industry and service to households. In the late 1800s young agricultural communities such as Santa Clara, Los Altos and Los Gatos evolved from settlements along the railways into towns. The mild and even climate of the Santa Clara Valley made it the heart of the fruit and vegetable growing industries of the state. The long growing season and the rich soil were factors contributing to the tremendous productivity and early need of the growers for the preserving and storing accommodations of ice.

Although the artificial manufacture of ice was invented in the 1850s, the technology was not perfected until the 1870s when the first ammonia compression machines were introduced. The commercial application of this new technology to manufacture ice did not gain wide acceptance until the turn of the century. In 1879 there were only five ice plants in the United States producing manufactured ice. By 1909 that number had increased to 77 ice plants.

The Los Gatos Plant

The ice works was incorporated on the first of January 1886, as the Los Gatos Ice Company, and began production that year under the direction of Tisdale and King. The first year of operation was not very successful, however, due to a fault in the process.⁴ The equipment originally used froze water in buckets from the outside in, which had the unfortunate side-effect of concentrating impurities in the core of the ice blocks. This resulted in a product that had an unhealthy appearance and therefore reduced value. The following year the tanks were upgraded to a newer system that froze the water from the top down, which did not concentrate the impurities in the water so visibly.

Tisdale is listed as a member of the board of directors of the Central Milling Company⁵, which opens up the possibility that he may have intended the ice works to replace the flour mill from the inception. The original mill building was then used to store ice, although another storage building was built on the property in April 1894.⁶ In August 1887 the Los Gatos Manufacturing Company took control of the Los Gatos Water Company, which had used the water from the tail race of the mill. This move put an end to disputes over water rights with that company, but the larger San Jose Water Works continued to fight with them over water rights to Los Gatos Creek.

After the new tanks were installed, the ice works became a thriving business. Most of its product was shipped by rail to San Jose and San Francisco.⁷ A 1901 newspaper article says that they shipped 4,343,900 tons of ice in 1900.⁸ It is probable that some of this product was used specifically to cool fresh fruits in grocery markets and during shipping, making the ice works an outgrowth of the fruit industry, but likely much of the product went to domestic icebox subscribers in large cities.

For a number of years, from its inception in 1885, the ice works was discussed in local newspapers and directories as a significant industry in Los Gatos and a sign of that town's modernization and available comforts (see, for instance, "Ramblings About Town" *Los Gatos Weekly News*, April 27, 1894). In short, it was a source of community pride in its day. It was also a major source of tax revenues for the Los Gatos after the town incorporated in 1887. In 1888 they were the second largest taxpayer in the town, followed by the South Pacific Coast Railroad.⁹

The equipment used to make ice was changed at least once, after the first year of operation. The original equipment of the ice works is described in an 1886 article as consisting of a 25' x 35' freezing tank on a foundation, containing 450 buckets, each 1' x 1' x 3', a four-ton pump and a condenser placed under the water discharged by the water wheels,¹⁰ except that in the original process water was frozen from the outside in, while the newer equipment froze the water from the top down.¹¹ The original process had the drawback of concentrating impurities in the core of the ice blocks, a common problem even into the middle of the twentieth century,¹² while the newer process distributed impurities more evenly, making a more aesthetically pleasing product by rendering the impurities more

difficult to see. There is some disagreement in the literature concerning the number and capacity of the tanks that were used in the ice house. Most sources of the time list three tanks, and put the capacity of the plant at 25 or 30 tons per day.¹³ However, George Bruntz, in his History of Los Gatos, records eight tanks with a capacity of ten tons each.¹⁴ H. S. Foote, writing in 1888, recorded ten tanks with a capacity of ten tons total.¹⁵ The assessment made by P. G. & E. in 1912 states that there were ten tanks, each of these divided into two, and lists them in summary as twenty tanks, having a capacity of 750 pounds each.¹⁶ Given that this assessment was done for purposes of purchasing the electrical materials and the ice works was of no interest to the company, there is little reason for the auditor misrepresent what was there. It is probable that the difference in the number and capacity of the tanks was a mistake on the part of Bruntz. Another possibility is that the plant actually had twenty tanks, but could only operate a few at a time in an assembly-line fashion to produce the 25 to 30 tons of ice per day.

The 1886 newspaper article describes the equipment of the ice works as consisting of 6' x 3' x 1' molds (buckets) set on edge and immersed in brine, with their ends set in a water tank. The freezing coils were set in the brine above the molds and a slow pump agitated the water, which both quickened the crystalization process and helped carry away the impurities. When the water had frozen the brine was pumped out and the ends of the molds opened to allow the blocks to be removed. The ice molds described above are very different in size from those that were found on the property in 1912 when P. G. & E. purchased the plant, which shows that the equipment was changed at least one more time before the ice works went out of use. These might have been put in when Tisdale added a second compressor in 1887. Originally there was only one, but Tisdale put in a second compressor at the same time the flour mill went out of operation.¹⁷ Before the new compressor was added the plant could only produce ten tons of ice per day, but the new compressor allowed them to produce 25 to 30 tons per day.¹⁸ The compressors and the dynamo were probably originally run by the old turbines that Rogers had installed to run the mill in 1869. Although most sources state that this was a Pelton "hurdy-gurdy" or "splitter" wheel, the Pelton Water Wheel was not invented until 1878, and patented in 1880.¹⁹ Clearly the original turbines set by Rogers could not have been of this type. The earliest mention of the Pelton Wheel by name at the Los Gatos plant comes from a newspaper article of 1891,²⁰ though it gives no indication of how long the Pelton Wheel had been in place. But an 1881 article describes the wheel used to run the mill as having two nozzles,²¹ which is the identifying feature of the Pelton Water Wheel.

When P. G. & E. took an interest in buying the Los Gatos Ice, Gas and Electric Company in 1912, auditors were sent to evaluate the property. Below is listed the equipment they found, excluding buildings, the fire tower and other items that were not in the area of the ice house.

- 1 Pelton Water Wheel outfit, 150 hp, 230 rpm
- 1 Bullock Manufacturing Co. (Cincinnati, Ohio) 100 Kilowatt generator, 25.2 amp, 2300 volt, 900 rpm.
- 1 50-light Western Electric 950 rpm arc generator.
- 1 Armington and Sims Engine Co. (Providence, RI) 9" cylinder 45 hp rated steam engine.
- 1 Westinghouse Automatic Compound Engine, No. 57, 150 hp.
- 2 Clot and Meese (San Francisco, CA) 12" x 20" duplex ammonia compressors, with a 7' flywheel.
- 10 sets of ice tanks, 28' x 9' x 6', divided into two sections, each section divided into ten, making 20 buckets, 12" x 30" x 7", six of these lined with zinc.
- 2 Parke & Lacey Co. (San Francisco, CA) horizontal tubular boilers, 70 hp each.
- 3 General Electric 100 Kilowatt transformer and regulator switchboards.
- 1 Alarm system switchboard.

There are also two concrete foundations listed, 8'0" x 9'0" x 0'18" though it is not made clear whether these piers supported the generator or the Pelton Wheel, or both. The arc generator is listed as being fastened to the wooden floor. The boilers were in a concrete setting, 19'0" x 14'9" x 1'6". A number of miscellaneous pipes and pulleys are also listed. The audit records that the Pelton Wheel was housed in a wooden box rather than a metal casing provided by the manufacturer, which could mean that it was built for them before the Pelton Water Wheel Company was incorporated in 1888, as Pelton built and sold many such "splitter" wheels after inventing it in 1878.²² A newspaper article of 20 November 1901 states that a new water wheel is to be put in,²³ so either a new the Pelton Wheel was installed or, more likely, this change never happened.

It is difficult to determine exactly when the ice works went out of service. The 1904 Sanborn Insurance Map lists the equipment in it as no longer used. However, the Los Gatos Ice Company is still listed in the 1904/05 San Jose City Directory. Note that for many years the Ice Company was listed separately from Los Gatos Manufacturing Company and later the Los Gatos Ice and Power Co. 1904 is also the year in which Thomas W. Cox is last listed in the Directory as an employee of the ice works.²⁴ Afterwards, he is only listed by name and residence. These suggest that the company stopped producing ice some time in 1904, before the Sanborn map was made, although the name Los Gatos Ice, Gas and Electric continued to be listed in the Directory until the 1912/13 edition. It is likely that Hume and Farwell simply did not bother to change the corporation's name, even though they were no longer interested in manufacturing ice after a certain point.

When the company was bought out by P. G. & E. in 1912, an assessor mentioned that the ice works was being leased to the Union Ice Company, and had been for several years.²⁵ However, the equipment was in such a state of disrepair that it was not being used at that time. Since the Union Ice Company was paying \$150 per month for rental of the ice works, it is unlikely that it had

been disused for very long when its condition was reported in 1912. That the equipment was listed as unused on the 1904 Sanborn map may only represent an interlude in its use during that year.

Why the Los Gatos Ice, Gas and Electric Company stopped making ice after 1904 is not known. An examination of San Jose City Directories for the years the ice works was in operation shows a growth in the number of competitors until 1903-04, when the Union Ice Company is first listed, then shrinkage thereafter. It may be that they were simply out-competed, perhaps by the much larger Union Ice Company itself.

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The Development of Electricity

Electricity had been known and studied long before it was put to practical use or organized into a system of distribution for paying customers. The various properties of electricity had been examined since the late 1700s, almost 100 years before the commercial applications evolved from the theoretical concepts and basic principles of electricity. As early as the mid-1700s, Benjamin Franklin explored the nature of electricity with kites that attracted lightning.

His ideas greatly aided the work of Alessandro Volta.¹ In 1800, Volta created the voltaic pile, a series of metals and chemicals that produced an electrical charge. The voltaic pile was in effect the first battery, and it produced continuous current electricity that traveled along a line from a positive pole to a negative pole. This early form of electricity would later be known as direct current (DC). As early as 1808, Sir Humphry Davy of London's Royal Institution used 2000 voltaic cells to create the first man-made electric arc that spanned the distance between two carbon electrodes.² Although it was not known at the time, this would be the prototype of the first popular method of electric lighting, the arc lamp.

By the 1820s the search was on for the connection between magnetism and electricity. Danish scientist Hans Christian Oersted explored the properties of electromagnetic effect, but it was Michael Faraday who discovered the practical connection between magnetic fields and electrical currents.³ By the early 1830s, Faraday discovered that he could create electric impulses by plunging a magnet into a coil of wire; electrical current was generated by keeping the wires and magnets in constant flux. This was the first generation of electricity by magnetism, and with this discovery, he had created the first dynamo or electric generator. Faraday also discovered the principle of electrical induction, the manner by which electric current set up in one coil could be transferred to another if the coils were adjacent.⁴

With Faraday's discoveries, the basis of modern electrical science had been established. Volta had found a way to produce a constant current source; Oersted had discovered the connection between magnetism and electric current; and Faraday generated electric current from the power of magnetism.⁵ The ramifications of these discoveries were soon probed and improved throughout Western Europe and in the United States.

The first practical application of electricity came with the development of the telegraph in the 1840s. By the time of the American Civil War, the major cities of the eastern United States were connected by a network of metal wires on wooden poles over which messages could be relayed by means of a weak electric current. In 1866, the first successful transatlantic telegraph cable was laid from Ireland to Newfoundland.⁶ In the 1870s, the communication network tightened with the invention of the telephone. All electrical systems for telegraph or telephone operated with direct current (DC), where electrical current

passed in one direction along a wire or circuit from the positive pole of a battery to the negative pole. Alternating current (AC) was known, but its use was very limited.

By this time, the basic measurements of electric current began to receive the names that are used today. The units of measurement were named for the early inventors and electrical physicists; watts, volts, ohms, and amperes. The term "ohms" was first proposed in 1861 and was universally accepted 20 years later at a congress of electrical scientists in Paris. "Volts" was used in the modern sense by the 1870s. "Amperes" was adopted at the same 1881 Paris Electrical Congress that first designated ohms. The term "watts" was adopted in 1882 by the British electrical community and its use spread quickly throughout Europe and America.

An "ohm," named for German physicist Georg Ohm, measured the resistance of a conductor during the transmission of an electrical current. "Volts," named for Volta, measured the pressure or "voltage" of the current. "Amperes," named for the Frenchman Andre Ampere, measured the current itself. Volts and amps were discovered to be inversely proportional in any electric current, as first formulated in Ohm's Law. Finally, "watt," named for Scotsman James Watt, was adopted as a unit of electrical power. It is the rate of work represented by a current of one ampere under the pressure of one volt, or 1/746th horsepower. Such definitions meant little to most laymen. For this reason, these properties of electricity were often compared to the different characteristics of flowing water. Amperes measure the quantity of electrical flow, like gallons per minute measures the flow of water. Volts measure the force of the electrical current. It would be comparable to water pressure in a pipeline; the greater the pressure, the greater the force pushing it through the pipe. Ohms would be the friction or resistance created by the pipe itself, resistance that would have to be overcome by the pressure or volts. Watts measure the usable force that can be obtained from an electrical current, like the horsepower rating of a steam engine or water wheel. While terms like watts, volts, and amps were well established within the scientific community, more traditional terminology persisted well into the twentieth century; watts, for example, did not completely supplant "horsepower" until the 1920s.

For most of America in the early 1870s, electricity hardly existed. Practical mechanical force was provided by steam engines located in factories. Aside from railroad locomotives, which were steam engines put on wheels, transportation was still based on the horse. Artificial lighting was limited to kerosene lamps and gas lights. There were some 500 horse-railway companies in American cities, with a combined total of 120,000 horses and 25,000 cabs. The newest innovation in lighting was gas, which provided street illumination in the larger cities and interior lighting service in many homes.

In the early 1870s, electrical dynamos were curiosities powered by reciprocating steam engines. Such engines were almost universal by the mid-1800s and were no more than 30 to 35 percent efficient; some operated as low as 5 percent.

Efficiency levels were not then a major concern, if only because steam engines had a relatively small day-to-day impact on the lives of most Americans; their use was essentially limited to railroad engines and large factories. There was no way to transport this mechanical energy except directly with gears and shafts, as was common in Europe, or a system of hide and canvas belts, more common in the United States. To overcome this deficiency, steam engines grew to enormous size, but there was still no way to export the energy they created beyond the confines of a single building.

All of this would begin to change in the mid-1870s with the development of new dynamos and the spread of arc lights. These initial steps in the commercial exploitation of electricity were based on discoveries that were already decades old, but they quickly lead to new applications that were truly revolutionary. The years between 1875 and 1900 were a time of innovation in electrical generation, a period that witnessed the evolution from arc lights powered by direct current, to incandescent lamps and induction motors powered by alternating current.

Electricity in Los Gatos

As was true in most American cities of the late nineteenth century, their initial interest in electricity was an interest in lighting city streets at night. Due to its small size, Los Gatos was still dark when nearby San Jose streets were being lit by gaslights. It was not until the town incorporated in 1887 that electricity became a possibility for Los Gatos, because electric generators (referred to as dynamos in those days) were prohibitively expensive. However, the town had other priorities during its first few years. The first streetlights were gaslights, installed in 1888 by the Los Gatos Gas Company. In 1890, the Los Gatos Manufacturing Company installed a generator to light its ice factory and suggested the town purchase electricity from them for lighting the streets, which happened the following year. For a number of years both gas and electricity were used for lighting, gas mainly for streets and electricity for interior lighting for private customers, primarily downtown businesses.

Initially, The Los Gatos Manufacturing Company had a monopoly on electricity, and there were complaints of price-gouging. However, it was not long before competition arrived. J. D. Farwell, manager of a tremendously successful prune orchard at Glen Una owned by the G. W. Hume Company, installed a generator in 1893 so that prune drying trays could be set at night. The generator was powered by water, as was the generator of the Los Gatos Manufacturing Company, behind the old Forbes Mill. In 1896 the Glen Una Electric Company won the contract for the lighting of Los Gatos streets and expanded service throughout the town.

In 1901 the G. W. Hume Co. purchased the Los Gatos Ice and Power Co. and in 1903 purchased the Los Gatos Gas Co., creating a monopoly on power in Los Gatos. They moved their headquarters to the Los Gatos plant in town, rather than continuing to generate electricity for the town from the prune ranch,

but retained the Los Gatos Ice and Power Co. name.. In 1907 the Los Gatos Ice and Power Co. was reincorporated as the Los Gatos Ice, Gas and Electric Co. But as population grew and the demand for electricity grew with it and more uses were found for electricity, the surviving company found it could not keep up. In 1911 the Pacific Gas and Electric Co., already a utility giant, began examining the plant at Forbes Mill and bought it out the following year. From then on, electricity for Los Gatos was provided by P. G. & E., transmitted from their Mountain View station, for which the plant at Forbes Mill became a substation.

Timeline of Electrical History

1796 - Alessandro Volta invents the voltaic pile, the first battery.

1801 - Humphrey Davy creates the first arc lamp.

1819 - Hans Oersted discovers the connection between magnetism and electricity.

1821 - Michael Faraday discovers that electric current around a magnet will produce rotation, the breakthrough that allowed the first electric motor to be created.

1831 - Faraday invents the first electric generator.

1830s - First commercial application of electricity for medicine: numerous generators built based on Faraday's dynamo.

1833 - Hermann Jacobi builds an electric motor large enough to power a steamship.

1834 - Samuel Morse invents the telegraph.

1842 - John Woolrich builds first commercial generator.

1844 - First long-distance telegraph line built, between Washington D.C. and Baltimore.

1851 - By this year there are fifty telegraph companies spread across the US. A primary impetus was that the telegraph revolutionized newspaper service and railroad dispatching, and was used to transmit orders during the Civil War.

1853 - First telegraph line connecting San Jose to San Francisco.

1860 - Pacific Telegraph Act funds first transcontinental telegraph line, completed in the following year.

1866 - The Western Union Telegraph Company becomes one of America's first monopolies.

1872 - The Society of Telegraph Engineers, the first electrical engineers' society, is formed.

1876 - Alexander Graham Bell and Elisha Gray submit patent applications for a telephone on the same day.

1876 - First practical arc lamp run by an AC generator created by Paul Jablochkov.

1877 - Bell Telephone Company created.

1878 - Arc lamps used to light a department store in Philadelphia, powered by a dynamo developed by Charles Brush, whose dynamos became the most commonly used electric generators in the US until the end of the century.

1878 - First successful incandescent lamp invented by Joseph Swan.

1879 - Thomas Edison creates the carbon filament light bulb and opens first commercial power station.

1885 - By this year arc lights were used for outdoor lighting all over the US.

1886 - The first AC central power plant is built in Buffalo, NY.

1887 - Heinrich Hertz demonstrates the existence of electric waves.

1897 - The Glen Una Electric Company wins the contract for lighting the streets of Los Gatos, underbidding the Los Gatos Ice and Power Company.

1901 - The Glen Una Electric Company buys Los Gatos Ice and Power Co. and later the Los Gatos Gas Co.

1907 - the Los Gatos Gas Company and Los Gatos Ice and Power Company dissolve and are re-incorporated as the Los Gatos Ice, Gas and Electric Company.

1909 - 1912 - Pacific Gas and Electric evaluates the Los Gatos Ice, Gas and Electric Company and takes control of it in the following year, closing the ice works and turning the electricity generation plant into a substation.

1914 - By this time there were 9.5 million telephones in the US.

End Notes

- 1 Bern Dibner, Discovery of Electromagnetism (New York: Blaisdell, 1962) 17.
- 2 John Hammond, Men and Volts: The Story of General Electric (New York: Lippincott, 1941) 303-304.
- 3 Leslie Williams, Michael Faraday (New York: Simon and Schuster, 1971) .
- 4 Bern Dibner, Discovery of Electromagnetism (New York: Blaisdell, 1962) 64.
- 5 Bern Dibner, Discovery of Electromagnetism (New York: Blaisdell, 1962) 57.
- 6 C. Jarvis, The Distribution and Utilization of Electricity (Oxford: Clarendon, 1958) 226.

Archaeology and Site History

One hopes, when excavating an archaeological site, to recover artifacts that inform us about the people who occupied or worked at the site and, for an industrial site, how work was organized and executed. Unfortunately, the site has been used in various ways after first the mill and later the ice plant and electric works closed, making interpretation difficult.

Forbes Mill was built in 1853 and 1854, finally opening in December 1855. Initially unsuccessful, it began to operate at a profit after W. H. Rogers purchased the property in 1867 and increased the available water power by increasing the head and substituting turbines for the overshot wheels. Power was increased again in 1870 and the enterprise was incorporated as the Los Gatos Manufacturing Company. They continued to grind flour at the mill until 1887, when it was consolidated with the Central Milling Co., and the milling equipment at this site was sold. The subsequent use of the mill building, aside from its use to store ice, is undocumented.

Beginning in 1885, a building was built behind the mill to manufacture ice, using surplus water power from the mill. In 1891, dynamos were added to generate electricity, initially for internal use, but subsequently sold to others. Electric generation continued until at least 1912, when the company was sold to PG&E. It is less clear when ice manufacture ceased, but most likely after 1903.

PG&E used the storage annex, built in 1880, as a transformer substation. The mill building itself was torn down to the first story in 1915, with the remainder removed to the foundation in 1929. Stone was deposited in the wheel pit and other areas earlier used to generate power and manufacture ice. Other contemporary debris was invariably mixed with the building material at that time. PG&E continued to use the site as a substation and gas storage facility until 1955, when construction of what is now Highway 17 reduced the size of their lot and they moved to their current location.

After PG&E relocated, the property remained vacant, and the area behind the extant annex was used as a dump. Short term uses of the annex beginning in the 1970s probably ended dumping, and the site was cleaned up in the early 1980s as the annex building was restored for use as the Forbes Mill Regional History Museum. Subsequent uses of the park behind the museum include the homeless.

Because of the history of the area, the archaeological excavations in the area including the wheel pit, the power facility and part of the ice plant (the portion of the site covered in this report) can be expected to yield some artifacts tossed into the water during the time of primary site use, artifacts relating to the buildings which were torn down and contemporary artifacts, artifacts from off-site use dumped here, and, near the surface, artifacts left during the last 20 years. Given the lack of site stratigraphy, differentiating between the various components ranges from difficult to impossible.

Recovered Materials

A total of 7,705 individual items were recovered from the Forbes' Mill site, catalogued under 1369 entries. All materials found, including those that were possibly or clearly modern, were recorded. For discussion, artifacts were divided into five categories, based on material. The largest category, 66.8 percent of the artifacts (5,149 objects and fragments) were made of glass. Unfortunately, only 3.2 percent of the assemblage was ceramic materials, 245 pieces, the category of artifact usually most useful to archaeologists. Metal objects, 2034 pieces or 26.4 percent of the collection. The smallest category are the faunal remains, 25 pieces, or 0.2 percent of the assemblage. These include both domesticated and non-domesticated species, some of which may have been used by occupants of the site. The final category is comprised of miscellaneous artifacts, 258 pieces, or 3.3 percent of the assemblage. These include artifacts made from multiple materials, and most are modern refuse.

Glass

Glass containers can be more reliable dating devices because they proceed rapidly through the cycle of manufacture, distribution, use, and discard. They also can aid in reconstructing the eating and drinking habits, as well as the socioeconomic status, of a site's occupants. Although glass artifacts have much potential, because of the mixed nature of the deposits at this site, the glass, like the ceramic, artifacts, provide only a general temporal range.

There were 477 separate catalog entries (with each entry ranging from 1 to 119 pieces) of various glass objects and fragments recovered, totaling 5,149 individual pieces. Few items of glass possessing short-lived, temporally diagnostic characteristics were recovered. For instance, while brown and amber glass together represent 26.7 percent of the assemblage, they only indicate an 1870 terminus pro quem. Similarly, purple and aqua glass, common in historic sites with a nineteenth century component, comprise 2.9 percent of the glass assemblage and only provide a 1917 terminus ante quem.

Thus all that can be said about the dating of the collection is that it includes material that was manufactured between these dates. The absence of pontil marks, commonly found on specimens dating to before 1858, is not evidence of absence, especially given the highly fragmentary nature of most of the finds. A majority of the materials most likely postdate the 1853 to 1912 period this project is focused on. Because of the mixed nature of the deposits and the paucity of temporally diagnostic artifacts, few conclusions can be drawn from the assemblage about previous uses of the area, past economic behavior, etc.

Of the 5,149 glass objects and fragments recovered, only 1,101, or 21 percent, could be reliably identified by function. The largest class is window glass, comprising 13.6 percent of the glass artifacts, and almost half the identifiable glass. However, large quantities of glass in colors traditionally used primarily for beverage containers, amber, brown and clear, though not clearly identifiable as such, suggest that that category may be larger than the identified

possible window glass category. Attempting to draw conclusions based on counts can also be unreliable because of site formation processes. The small number of glass insulators and fragments found (n=23) may under represent electricity usage at the site. Collectors "pot hunting" the site for the secondary use¹ of insulators as antiques, a common practice in the western United States today, may have dramatically reduced the number of insulator fragments and whole insulators left at the site to be discovered by excavation. Whole glass bottles and perhaps large bottle fragments may have been collected for "recycling" as well, leaving mostly small pieces to be recovered archaeologically.

Eighty-eight catalog entries (with each entry ranging from 1 to 37 pieces) recorded eight intact bottles and fragments of the many additional bottles recovered, for a total of 343 pieces. Of the eight intact bottles, three date to the late twentieth century: two were beer bottles: Heineken and Coors; the third was a Gallo wine bottle. Five of the intact bottles were located in the brick wall area, while the remaining three were located in the 2-3S units at various depths. Of the 88 catalog entries, the predominant glass color was clear, with 37 entries (40.0 percent). The second most predominant color was brown/amber with 33 entries (37.5 percent). The brick wall area again contained the highest concentration of glass: 20 percent of the glass assemblage. The remaining pieces are scattered though out the other units at varying depths. Two of the pieces had inscriptions that identified them as historic materials. One of these was an aqua fragment with the partial inscription "RNY - 1894". The other was a whole brown bottle embossed vertically "PALMER DRUG CO." This most likely came from the Palmer Drug Co., based in Santa Cruz, California. The base would have been imprinted with "WT CO/U.S.A.," but that mark has not survived. The bottle was manufactured by the Whitall-Tatum Glass Co. between 1857 and 1935.¹ It is described as amber; 4 7/8" x 1 7/8" x 1 1/4", with a "bead" neck finish. The base would have been "Blake (variant 1)." Given the long temporal range during which these bottles were made, its presence is not a sensitive chronological indicator.

Table 1: Glass artifacts by color.

Color	Count	Percent
Clear	2658	51.6
Brown	1015	19.7
Green	782	15.1
Amber	363	7.0
Aqua/Purple	150	2.9
Other	178	3.5

Table 2: Glass artifacts by inferred function.

<u>Function</u>	<u>Count</u>	<u>Percent of glass assemblage</u>
Shards	4048	78.6 (to small to infer function)
Window	698	13.6
Bottle	373	7.2
Insulator	23	0.4
Light Bulb	3	0.1
Jar	1	0.1
Mirror	1	0.1
Mug	1	0.1
Thermometer	1	0.1

Ceramics

Ceramics comprise that class of artifact perhaps most cherished by archaeologists. Not only do ceramics possess attributes of form, decoration, and material which are aesthetically pleasing to both the archaeologist and his audience, these same attributes can be arranged into temporally diagnostic sequences which allow the archaeologist to date a site and to reconstruct certain aspects of past behavior.² However, no temporally diagnostic western ceramics which were recovered.

A total of 96 ceramic entries were made in the catalogue for a total of 245 pieces. This assemblage ranges from fragmented serving ware and plates and bowls, to insulators and sewer pipe. The largest concentration was located in the brick wall section of the excavation. The remaining 71 entries were scattered throughout the units and appear at all levels, ranging from 0-10 cm to 152-270 cm. The predominant color is white (40 entries (41.7 percent) or 223 pieces 91 percent). There are ten ceramic insulators, all found in the brick wall area. As I argued in the opening paragraph of this section, there can be little analysis performed on the ceramic assemblage due to the heavily disturbed matrix that runs though out the excavation area. Even the locations of sewer pipes and electrical fittings such as the insulators and the two ceramic connectors that would have held electrical wire suspended from rafters in the 1920s cannot be used to draw firm conclusions about the locations or extent of such utilities, given that the deposits may be secondary as well as temporally mixed.

Table 3: Ceramic artifacts by color.

<u>Color</u>	<u>Count</u>	<u>Percent</u>
White	223	91
Off-white	11	4.5
Blue	9	3.7
Blue/white	5	2.0

Brown	4	1.6
Off-white/brown	4	1.6
Black	3	1.2
Bone white	3	1.2
Green	2	0.8
Grey	2	0.8
Red	2	0.8
Oatmeal	1	0.4
White/green	1	0.4
White/yellow	1	0.4
Yellow	1	0.4

Table 4: Ceramic artifacts by inferred function.

<u>Function</u>	<u>Count</u>	<u>Percent</u>
Fragmented	139	56.7
Plate	55	22.4
Insulator	22	9.0
Sewer Pipe	18	7.3
Pot	6	2.4
Connector	2	0.8
Button	1	0.4
Fitting	1	0.4
Tile	1	0.4

Table 5: Ceramic artifacts by material.

<u>Material</u>	<u>Count</u>	<u>Percent</u>
Ceramic	214	87.3
Porcelain	23	9.4
Clay	8	3.3

Metal Artifact

Metal objects comprise a large class of the materials discovered in this excavation; unfortunately, a large majority are non-diagnostic or clearly modern refuse, much of which could not be identified by type of metal. The only materials that could definitely be identified as historic were 76 entries of square nails, for a total of 842 individual nails, 34.92 percent of the total collection of metal objects. Square nails were used throughout the nineteenth century, so they are not very sensitive markers, although by 1890 square and wire nails were equally used, so a predominance of square nails suggests a date before 1890. However, this data may prove to be useful for the study of formation processes,

considering the large proportion of ferrous metal objects that can be shown to have survived at least one century. It may be significant that these nails are largely clustered. Of the square nails, 467 (55.5 percent) were found in three large concentrations, two of these in the same unit, the other in an adjacent unit. 184 square nails were found in the 50-85 cm level of unit 2-3S 25W, while 193 were found in the 30-50 cm level and 90 in the 70-90 cm level of unit 2-3S 26W, or 467 similar items in a volume of 1.5 cubic meters. This clustering may represent a disposal context, a cache, or possibly gravitational sorting. Other objects found in the same units and levels are suggestive. Unit 2-3S 25W included only a few other pieces, most of which are non-diagnostic and probably modern, though one piece of aqua glass is consistent with a historical date. Thus it cannot be concluded that this unit/level is undisturbed. The deeper level of 2-3S 25W is also shared with nondescript materials, though the presence of a rodent humerus suggests disturbance by burrowing activity, while the more shallow level contains clearly modern trash, such as rubber hose and carpet fiber. Thus neither of the three possibilities suggested can be ruled out, including the possibility of gravitational sorting in a disturbed deposit, though it may be that the deeper deposits were less disturbed than the more shallow deposits. Other materials aside from the square nails are either clearly modern or non-diagnostic.

Table 6: Metal artifacts by type

<u>Material</u>	<u>Type</u>	<u>Count</u>
Aluminum	Bottle cap	17
Aluminum	Can	9
Aluminum	Coaster	1
Aluminum	Fragment	1
Aluminum	Fitting	1
Aluminum	Light bulb base	2
Aluminum	Pull tab	3
Aluminum	Strip	1
Copper	Cable connector	1
Copper	Penny	1
Copper	Tube	1
Copper	Wire	8
Iron	Band	1
Iron	Bolt	28
Iron	Bracket	3
Iron	Cable wire	5
Iron	Fastener	1
Iron	Fitting	1
Iron	Flange	1

Iron	Fragment	236
Iron	Gate latch	1
Iron	Hinge	1
Iron	Knob	1
Iron	Nail, square	508
Iron	Nail, wire	726
Iron	Nail fragment	83
Iron	Nut	38
Iron	Pipe	19
Iron	Railroad spike	4
Iron	Rebar	1
Iron	Retaining ring	1
Iron	Rod	11
Iron	Screw	29
Iron	Washer	22
Iron	Wire	107
Iron, cast	Sheet metal	30
Iron	Wrought	1
Lead	Fragment	1
Lead/tin alloy	Solder	3
Steel	Bar	3
Steel	Barometer housing	1
Steel	Battery terminal	2
Steel	Buckle	1
Steel	Can	7
Steel	Cap	4
Steel	File	1
Steel	Lid	1
Steel	Nail	26
Steel	Pipe	2
Steel	Ring	2
Steel	Safety pin	1
Steel	Sheet metal	29
Steel	Spring	1
Steel	Staple	2
Steel	Strap	7
Steel	Strip	2
Steel	Tack	6
Steel	Wire	1
Steel	Woven wire	1
Tin	Can rim	1
Tin	Fragment	3
Tin	Pop top	1

Faunal Remains

The faunal remains from this excavation were few: a total of 21 pieces of bone, one tooth and three shells. Only a few of these could be identified to the species level, these being a humerus and femur of a domestic chicken and a right central incisor from a dwarf tule elk (*Cervus nannodes*). Two less certain finds include one bone from an immature bovid that most likely comes from a cow (*Bos domesticus*), and one metacarpal may be from a domestic cat (*Felis domesticus*). One of the shells is from a snail. Four bones exhibit cut or saw marks, and one bone is burnt, but because they come from mixed deposits they are undatable. Because this was an industrial site, it could be supposed that faunal materials brought in as food for the employees of the mill would most likely have been removed and disposed of elsewhere. The tule elk tooth is interesting in that it demonstrates at least some use of non-domesticated food resources in an urban context, though the assemblage is too small to suggest how significant non-domesticated resources may have been.

Miscellaneous Items

A great many artifacts from this excavation are either modern refuse or undatable remains of a mixed nature, apart from the categories of artifacts that have already been discussed. Few, if any, of these are likely to provide any contribution to history. However, since the needs of the future cannot be ascertained, they are tabulated below for the sake of posterity. Context has not been recorded due to the mixed nature of the deposits.

Table 6: Miscellaneous artifacts.

<u>Material</u> <u>assemblage</u>	<u>Count</u>	<u>Percent of total</u>
Asphalt	1	>0.1
Brick	7	>0.1
Cement (mortar)	4	>0.1
Chalky material	1	>0.1
Fabric	11	0.1
Fiber	41	0.5
Leather	1	>0.1
Multiple	10	0.1
Paper	68	0.8
Plastic	45	0.6
Resin, pine	5	>0.1
Rubber	11	0.1
Stone	10	0.1
Styrofoam	3	>0.1
No data	3	>0.1
Vinyl	1	>0.1
Wood	21	0.3

Conclusion

It is difficult to arrive at some order from the huge miscellany of artifacts that came from this excavation. This is especially so due to the fact that the deposits are secondary and mixed with modern materials, which adds a level of ambiguity especially to dating artifacts that have relatively long temporal ranges. There are materials that relate directly to technology and the architecture of the mill itself, such as glass and ceramic insulators related to the introduction of electricity to the mill, and numerous nails and other fastening devices. However, many of these cannot be firmly dated, making the employment of statistical procedures unreliable.

One fact that comes out of the material remains, however, is that domestic objects were recovered from what was an industrial site. Among the glass insulators for power lines, metal fasteners and sewer pipe to be expected in an industrial site were found fragments of plates, ceramic pots, a button, a jar, a mug, part of a mirror, a safety pin, a metal buckle and hundreds of fragments of bottles. It cannot be determined with certainty that all those bottles were beverage or medicine containers, that the pots were not used to store some substance related to the business of the mill, or that the safety pin was not an improvisation to repair some piece of equipment rather than to repair some worker's clothes.

Sawn and burned bones, however, are most likely the remains of meals eaten by employees of the mill, and other remains of meals such as beverage containers, would be consistent with this finding. The small number of these, however, only really confirms that the site was industrial and not domestic. The small number of faunal remains are likely to provide as real a picture of the materials deposited as other categories of artifacts rather than being artificially lowered due to differential preservation, given the large quantities of square nails found at the site. The absence of high-quality tableware fragments could mean that the owners of the mill did not take meals there, which suggests that the faunal remains reflect the diet of at least some of the employees. To choose between the low-pay and the adequate-pay hypotheses would require further archival research to identify, if possible, the existence of eating establishments in the immediate vicinity or other practices that could explain the very small quantities of faunal remains. Also, residue analysis of medicine bottles could be used to determine if employees of the mill may have suffered from nutrition-related illnesses. However, only one identifiable medicine bottle was recovered. Thus questions of social status are hinted at by the results of this excavation, but not satisfied.

Appendix C: SANBORN MAP

Text Shown in Photograph On Page 2

Appendix D: BIOGRAPHIES

Text Shown in Photograph on Page 3

James D. Farwell (1872 - 1943)

J. D. Farwell was born in San Francisco in 1872 and moved to the Los Gatos area at age 19 when he was hired to manage the Hume Ranch at Glen Una, which he did for 25 years. Shortly after moving to Los Gatos he married Irma Lyndon, a daughter of pioneer John W. Lyndon. Two years later he began to manage the Hume Ranch, at that time one of the largest prune orchards in the world. He installed a dynamo to run electric lights so the prune dryers could set the trays out at night. As a founder of the Glen Una Electric Company, he sold the extra electricity produced to businesses and residents of Los Gatos in direct competition with the Los Gatos Ice and Power Company, which Hume bought out in 1901. Farwell managed the combined company until it was bought by P.G. & E. in 1912. Farwell was involved in many other ventures, some of which were long-term positions. He was director and later manager of the Bank of Los Gatos from 1883, which became the Bank of Italy and was finally absorbed by Bank of America. He was the local

manager of Bank of America until he retired in 1937. He also founded the Los Gatos Telephone Company in 1911, and was its president when he died in 1943.

Abram King (1825 - 1903)

Abram King was born in Cayuga County, New York, on September 6, 1825. He went to San Francisco in 1850, then moved to a ranch in the following year to engage in agriculture. The San Jose City Directories of the 1870s and 1880s list him as an orchardist, which may have been the business that brought him to prominence [an orchardist was the name given to fruit growers at that time]. His name also appears in the 1890 Great Register as an orchardist. An article in the San Jose Mercury of 1868 claims that he had the longest grape vine in the valley. He was one of the founders of the First National Bank of San Jose in 1871. Banking and agriculture do not seem to have been his only interests, as he spent the years from 1874 to 1878 as the District 2 representative on the San Jose Board of Supervisors. In 1884, with W. D. Tisdale, he founded the Los Gatos Ice Works. In 1891 he and Tisdale again founded a bank, this time the Security State and Savings Bank, serving as its vice-president until 1895,

then as president after Tisdale retired. King passed away in 1903 at his home on Julian Street in San Jose.

John Young McMillin (1826 - 1901)

John McMillin was born in Indiana in 1826 and came to California in 1850. He built the first sawmill in the Santa Cruz Mountains in Lexington, where he lived with his wife Parneta née Howell until the town began to dry up in the 1880s, when they relocated to Los Gatos. McMillin was an officer of the Santa Cruz Gap Joint Stock Company in 1856 which built the second road from San Jose through Los Gatos to serve the lumber interests around Lexington, bypassing the first road built by Mountain Charlie McKiernan. McMillin was also an officer of the First National Bank of San Jose, which he helped to form in 1871, along with Abram King and William Tisdale. His other notable activities include being a San Jose City Councilman and a prominent member of the Odd Fellows Society. In 1869 he purchased a half interest in Forbes Mill from William Rogers along with Dr. McMurtry and it was incorporated as the Los Gatos Manufacturing Company. Although the Los Gatos Ice Works was originally incorporated under King and Tisdale in 1885, Mr. McMillin remained on the board when

the two companies combined in 1887. John McMillin died at his home in San Jose in October of 1901.

Dr. William Sharp McMurtry (1818-1908)

William McMurtry was born in Kentucky on August 14, 1818, although his family relocated to Indiana in 1825. It was there that he began medical training at Miami University in Cincinnati in 1839, completing his medical education at the Louisville Medical Institute in 1844. He started to practice medicine in that year, but when the Mexican-American War began in 1846, he joined the Texas Rangers until the war ended in 1848. Afterwards, he took up medicine again in Baton Rouge, Louisiana. McMurtry married Olive McMillin, sister of John Young McMillin, before moving to California. He came to California in May of the next year to mine gold, mainly in Grass Valley. Later, in 1858, he went into lumbering in the Santa Cruz Mountains and opened the first saw mill in the area on Los Gatos Creek above Lexington with J. Y. McMillin. Dr. McMurtry was among the first settlers of Los Gatos, having bought the first wooden home built in the area in 1870. He and McMillin opened two of the town's first businesses: the general store and the first lumber yard in 1863, which

suggests that at first he saw Los Gatos only as a business venture. As it grew, he began to see it as a home. He also opened a medical practice in Los Gatos in 1868, two years before moving into town. McMurtry continued to be involved in many business ventures in San Jose, and was elected to the state senate to represent Santa Clara County in 1863. The following year he was sent as a representative to the Republican convention in Baltimore. His son, George S. McMurtry, was also active in politics, although at the local level, having participated in the incorporation of the town in 1887 and sat on the Town Council. George was also manager of the Los Gatos Manufacturing Co. after Rogers left. Dr. McMurtry died on December 8, 1908.

William H. Rogers (1830 - 1890)

William H. Rogers had many years of experience in milling before he bought Forbes Mill in 1866. Born in Wayne County, New York, on January 11, 1830, he moved to Michigan as a child and worked in the Detroit City Flour Mill before coming to California in 1853. He married Louisa Greeley in 1850, and they had four children. After two years mining for gold in Placerville, Rogers helped

build and manage a mill in the area, then sold his share in 1860, to become the Postmaster of Placerville, then the Sheriff of El Dorado County in 1863. Because of his experience managing a mill and his willingness to invest in upgrading the technology of the mill, it was he who first made Forbes Mill a success. This was mainly done by investing the effort and money to raise the head sufficiently to provide enough power to drive the grinding stones and other mill equipment. He also replaced the old overshot wheels with more efficient modern turbines. Tripling the head at first to sixty feet, these improvements were promising, but by 1870 Rogers found it necessary to raise the head even further, this time to two hundred feet. He seems to have needed more capital, as he invited other local businessmen to invest in the improvements. Presumably the milling business must have declined sufficiently [more likely he wanted to expand the mill's capability] for him to seek partners, for in August of 1869 he sold a half share in the mill to a Mr. C.G. Harrison, who later that year sold his share to McMurtry and McMillin, who then incorporated the mill as the Los Gatos Manufacturing Company. Most likely it was these two who had the idea of manufacturing ice, though they

continued running the mill for another six years. An 1881 newspaper article lists Rogers as the manager, with McMurtry as president. Very little is known about Rogers, except that he left Los Gatos in 1883 for reasons unknown. Rogers does not seem to have been interested in the ice venture. The ice works was begun two years after he left, however, it would not have been possible without his initial improvements to the mill. Rogers died in San Francisco in 1890 of a brain hemorrhage.

Judge Francis E. Spencer

Judge Spencer was born in Ticonderoga, New York, on September 25, 1834. In 1846, at the age of twelve, he moved to Illinois, where he stayed until moving to California by wagon in 1852. He settled in San Jose where he at first raised sheep. For a brief period he studied medicine, then gave that up to study law in the office of Archer & Voorhies, where he worked until he opened his own office in 1858. From 1862 to 1865 he was District Attorney, and from 1863 to 1879 City Attorney. He was elected to the State Assembly in 1871, and became a Superior Judge in 1879. During the year of his election as a judge for the San Jose Superior Court in 1879, he

invested in the Los Gatos Manufacturing Company. An article in the Los Gatos Weekly News of 1881 lists Spencer as Secretary. It is unknown if he was still part of the company when the mill began to produce ice.

William DeWitt Tisdale (1845-1898)

W.D. Tisdale was born in Utica, New York on October 12 of 1845. His family moved to Nevada County, California, in 1854 when he was nine, by way of Panama. The family planned to make their living in mining. He attended Santa Clara College for three years beginning in 1860, then returned to Nevada County to continue quartz mining. This was apparently successful for him, as he and his father owned interests in two successful mines (the Banner Mine and the Mohawk). With his mining earnings he was able to move to San Jose in 1871 where he helped establish the First National Bank. The bank was running by 1874 and he held the position of cashier, a position of responsibility and importance more akin to management in those days, and became its president in 1880. He held that post until 1894, when he retired due to failing health. He also participated in governing the Security State Savings Bank from 1891 until his retirement. Tisdale was involved in a

number of business ventures during his years with the bank, including creation of the Los Gatos Ice Works, the Los Gatos Ice and Power Company (which provided Los Gatos its first street lights in 1892) and acquisition of the Los Gatos Water Works. He also was president of the San Jose Water Works from 1894 to 1896. Tisdale, with his banking partner Abram King, created the ice works at Forbes Mill. He died at his home in Los Gatos March 7, 1898.

Other Prominent People in the History of Los Gatos

A number of other names can be found relating to the ice works and electricity generating station at Forbes Mill, though little has been learned of any of these.

Thomas William Cox, for instance, was the manager of the mill under Rogers, and after the mill closed stayed on as an employee of the ice works at least until 1904. He is listed as a laborer at the Los Gatos Ice Works in the San Jose City Directory for 1904/05, but not in any of the following years. His name appears in the 1890 Great Register for Santa Clara County, which lists him as a miller, 42 years of age at that time, a native of Ireland naturalized in New York in 1862. This would have him born in 1848.

Claudius Cabot Hayward invested in the mill along with McMillin, McMurtry and a W. H. Rector in 1869 and was among the trustees of the Los Gatos Manufacturing Company. He appears in the 1890 Great Register for Santa Clara County, listed as a merchant, age 41 and a native of Ohio. His obituary in the San Francisco Herald declares that he was a native of Irvington, Indiana, born in 1850. It claims that he managed the mill from the time it opened until it closed six years later, which is clearly wrong, since his investment in the mill began in 1870 and the mill did not close until 1887. It is difficult to determine if he had any connection with the ice house, or if he was gone by the time it was built. Hayward died in September 1904 in San Francisco. W. H. Rector does not appear in the 1890 Register, so he may have left Santa Clara County by that time.

Cornelius Gooding Harrison is another name associated with both the Forbes Mill and the First National Bank of San Jose, of which he was vice-president in 1881. He bought a share of the mill from Rogers in 1869, but was bought out by McMurtry and McMillin later that same year. He does not seem to be connected to the ice works in any direct way, but given the current scarcity of information,

this conclusion could be modified in future. Harrison died in Pasadena in September 1904.

Appendix E: ARCHAEOLOGICAL METHODOLOGY AND TECHNIQUE

Text Shown in Photograph on Page 4

Archaeology is the study of past peoples and cultures based on the systematic examination of the materials they leave behind. Although most people have heard of an archaeological "dig," few understand what goes on at an excavation. In order for archaeologists to reveal information concerning the past, it is necessary for them to remove the material residues of cultures in a systematic, orderly fashion.

The past century has seen archaeology evolve from romanticized tomb raiding into a modern discipline which draws upon several scientific fields in order to expand our knowledge of human history. Archaeology has become more responsible by being more sensitive to the wishes of the descendants of those being excavated. Today, few digs are undertaken without the consent of the ethnic groups whose ancestors are being studied. Federal legislation passed in 1974 requires that all archaeological resources on federal lands, or projects which use federal funds, must be protected. This is a critical concept in modern

archaeology, because most of the excavations conducted today come under the auspices of salvage work; that is, excavations undertaken to retrieve cultural resources which are threatened to be destroyed by various construction projects.

In urban areas such as here in Los Gatos, modern development frequently intrudes upon older industrial sites, which is the case with the Forbes' Mill project. In situations like these, it is important to document the resources present. By acknowledging the hard work and accomplishments of the early mill workers, we can realize our debt to them, as well as develop a common bond with the people in history. Reaching across time to the people in the past develops a stronger sense of tradition and community for the modern residents of Los Gatos.

STRATIGRAPHY

The term stratigraphy refers to the analysis of the various layers of sediment (the strata) which cover an archaeological site. The main principle to understand is that through the years, artifacts, structures, features, etc. become buried by naturally deposited dirt (such as silt from flooding streams or wind blown sand). Distinct

episodes of deposition can be recognized and usually their depositional origin can be identified. Through time, sediments are laid down like layers in a cake. The important idea to bear in mind is that the oldest layers of sediment are on the bottom of a soil column, and the youngest are on the top. This concept is known as the law of superposition, and it is a crucial one for archaeologists, especially when trying to establish relative ages of materials on a site.

METHODOLOGICAL CONCEPTS

Two of the most critical concepts in archaeological method and theory are *context* and *provenience*. The context of an artifact (or an assemblage of artifacts) refers to how it ultimately came to be in the location where it was found. Generally, an object is either left where the person used it (primary context), or the object is used and then discarded in a privy or some other form of trash receptacle (secondary context), or the object is discarded and then deposited in its final resting place by natural forces (i.e., by flood waters, powerful wind and rain, or eroding down a hill side). It is common to encounter

archaeological deposits whose origins are a combination of human and natural agents.

Cultural refuse in a primary context is the most valuable for archaeologists because it sheds light on how objects (which might seem very foreign to us now) related to one another. Secondary cultural refuse is also important because discarded trash at archaeological sites is often stratified (to be discussed later), and usually contains the full realm of materials in use on the site at any given time. Archaeological features such as middens, privies (outhouses), and other dump sites can reveal changes through time regarding what the site inhabitants ate, their activities, etc. Materials deposited by forces of nature (in other words, in a *derived* context) are not nearly as informative as those which were deposited by human agents. However, they are crucial in understanding the post-occupational processes which created the site.

The provenience of an artifact or cultural feature means its present location on a site. All objects have both a horizontal and a vertical (depth) provenience. Provenience can be either culturally or arbitrarily defined. Cultural provenience includes the floor of a Puebloan kiva, or the inside of an historic privy.

THE GRID

One of the first procedures to be undertaken on any site is the establishment of an arbitrary grid system which allows us to locate materials three dimensionally. The grid aids in mapping and allows researchers to understand spatial and temporal relationships of the resources found, and it consists of stakes or nails that are set at certain intervals to allow the excavators to establish their arbitrary provenience system. Field workers must decide in advance whether their control grid will be measured in the English system or in metrics.

The first order of business is to establish a site datum, which is where the grid originates. Typically this point is a stake set outside the site boundaries on a high point which will allow an unobstructed view of the entire site. The main site datum will serve as the control point from which all measurements are made. It is helpful if the datum is set to the southwest of the site, allowing all measurements to be made north and east of the datum.

To construct a grid system, it is necessary to establish a centerline or meridian (the Y axis), which is a bearing

aligned along true or magnetic north, originating at the site datum and continuing a little north of the site. A baseline (the X axis) is then established, which is an east-west running line which starts at the site datum and continues to just east of the site. It is crucial that the junction of these two lines forms a right angle; if not, the grid squares will not be truly square.

The Z axis or depth/elevation is also critical to establish within the grid system. The elevation of the main site datum is arbitrarily defined as 100 meters, allowing the calculation of the relative elevation of any point on the site. Deriving elevations is done by using a mapping instrument such as a transit, or more commonly today by an electronic transit (an EDM). Elevations within individual grid squares or individual features, etc. can be established by tying a string to a grid stake (or an auxiliary stake or nail for that matter), attaching a carpenter's line level to the string, and measuring distances below the level string. Afterwards the elevation of the stake to which the string is tied can be measured with a mapping instrument and calculated relative to the site datum.

EXCAVATION

Whenever excavation of a site is undertaken, the archaeologists usually have some idea what will be present, and this knowledge certainly influences their procedures. After a site has been cleared of brush and a grid system is in place, grid squares (or sometimes trenches) will be excavated in order to define the stratigraphic sequence at the site, to sample the overburden, etc. Typically the first units excavated will be dug in increments of 10 centimeters. The reason for this is that all materials recovered must be provenienced, and if natural or cultural strata can not be defined, then the next best alternative is to provenience the materials within the arbitrary grid system.

Once a few units have been excavated, the researchers might be able to define distinct stratigraphic layers, and perhaps they will decide to abandon excavation in 10 cm. increments in favor of digging stratigraphically. This means that each sedimentary stratum is removed at once without any arbitrary subdivision. This is a preferred method because soil strata represent distinct episodes of deposition; thus the cultural materials contained within them have a much closer relationship to each other than

they do with cultural materials inside a stratigraphic deposit of a different age. When natural strata are "cross-cut" by arbitrary levels, frequently materials of very different ages are lumped together, which only serves to cloud the interpretation of these materials.

All of the soil removed from controlled excavation is sifted through a wire mesh screen with holes either one quarter or one eighth inch in size. This is done to maximize the number of artifacts recovered, and to ensure that smaller artifact types (such as tiny beads or small animal bones) will not be underrepresented. Archaeology is no longer centered around spectacular monuments and ornate artifacts; instead, the focus of the discipline is to recover all cultural materials, no matter how mundane, in order to reconstruct the lifeways of past cultures.

Appendix F: ELECTRICITY IN LOS GATOS

Text Shown in Photograph on Page 8

As was true in most American cities of the late nineteenth century, their initial interest in electricity was an interest in lighting city streets at night. Due to its small size, Los Gatos was still dark when nearby San Jose streets were being lit by gaslights. It was not until the town incorporated in 1887 that electricity became a possibility for Los Gatos, because electric generators (referred to as dynamos in those days) were prohibitively expensive. However, the town had other priorities during its first few years. The first streetlights were gaslights, installed in 1888 by the Los Gatos Gas Company. In 1890, the Los Gatos Manufacturing Company installed a generator to light its ice factory and suggested the town purchase electricity from them for lighting the streets, which happened the following year. For a number of years both gas and electricity were used for lighting, gas mainly for streets and electricity for interior lighting for private customers, primarily downtown businesses.

Initially, The Los Gatos Manufacturing Company had a monopoly on electricity, and there were complaints of price-gouging. However, it was not long before competition arrived. J. D. Farwell, manager of a tremendously successful prune orchard at Glen Una owned by the G. W. Hume Company, installed a generator in 1893 so that prune drying trays could be set at night. The generator was powered by water, as was the generator of the Los Gatos Manufacturing Company behind the old Forbes Mill. In 1896 the Glen Una Electric Company won the contract for the lighting of Los Gatos streets and expanded service throughout the town.

In 1901 the G. W. Hume Co. purchased the Los Gatos Ice and Power Co. and in 1903 purchased the Los Gatos Gas Co., creating a monopoly on power in Los Gatos. They moved their headquarters to the Los Gatos plant in town, rather than continuing to generate electricity for the town from the prune ranch, but retained the Los Gatos Ice and Power Co. name. In 1907 the Los Gatos Ice and Power Co. was reincorporated as the Los Gatos Ice, Gas and Electric Co. But as population grew and the demand for electricity grew with it and more uses were found for electricity, the surviving company found it could not keep up. In 1911 the

Pacific Gas and Electric Co., already a utility giant, began examining the plant at Forbes Mill and bought it the following year. From then on, electricity for Los Gatos was provided by P. G. & E., transmitted from its Mountain View station, for which the plant at Forbes Mill became a substation.

Appendix G: HYDROPOWER IN LOS GATOS

Text Shown in Photograph on Page 12

Hydropower, the use of the kinetic energy of falling water, seems to have been underemployed in the early history of Los Gatos, even though it was hydropower that gave birth to the town. Los Gatos grew up around the flour mill that James Alexander Forbes built on Los Gatos Creek from 1853 to 1855. Before Forbes Mill was built, there were a few ad hoc mills built in the vicinity, but Forbes provided the first permanent hydropower establishment in Los Gatos. In fact, in the 1850s and 60s Los Gatos, then known simply as Forbes Mill, was just a stop on the road to Lexington, a center during the lumber boom.

Even as Los Gatos grew and Lexington faded into obscurity, largely a result of the railroad coming through Los Gatos, Forbes Mill continued to be the only source of hydropower in town. That power was used originally for the grinding of grain; in 1869 a woollen mill was put in utilizing power from the mill's turbines, although the woollen mill burned down in 1872 and was not rebuilt. By 1887 the economy of the Santa Clara Valley had shifted from grain to fruit agriculture to such an extent that the mill

was no longer viable as a business. Some of the power had been used to run a compressor for an ice factory, and when the mill equipment was removed, a second compressor was added increasing the capacity of the ice works. This ice works was very successful, and in 1890 an electricity generator was put in to light the ice works. There was still plenty of power from the turbines, and in the following year the ice works began selling electricity to the town of Los Gatos and to private customers, mainly downtown businesses.

A book noted in 1896 that only a tenth of the potential power of Los Gatos Creek was tapped by the company which then owned the mill, the rest being available for further industrial development. This situation does not seem to have changed. In time the growth of electric technology made it more practical to convert electricity into kinetic energy rather than harness the kinetic energy of running water directly. Electricity made it unnecessary to locate near running water to get power, since electricity could be transmitted almost anywhere. It is also possible that the water rights owned by the Los Gatos Manufacturing Company and the San Jose Water Company (which provided drinking water, not hydropower) excluded

competition for hydropower in Los Gatos. Electricity generated cheaply by hydropower plants in the high mountains could provide businesses and residents with power regardless of the local water rights. When the mill property was bought by Pacific Gas and Electric Company in 1912, the waterpower was considered to be of negligible value to that company.

Appendix H: ICE IN LOS GATOS

Text Shown in Photograph on Page 14

The history of ice manufacture in Los Gatos is essentially the history of one company: the Los Gatos Ice Company. This company changed hands and names a number of times, but it was always at the same site. It began in 1885 when associates of William McMurtry and John McMillin, proprietors of the Los Gatos Manufacturing Company, decided to invest in an ice manufactory using power from the mill to run the compressor and conveyors. These were William D. Tisdale and Abram King, both prominent San Jose bankers. Construction of the ice house began in 1885. It was incorporated on the first of January, 1886, as the Los Gatos Ice Company and began production that year. The first year of operation was not very successful, however, due to a fault in the process. The original equipment froze water in buckets from the outside in, which concentrated impurities in the core of the ice blocks. The following year the tanks were upgraded to a newer system that froze water from the top down, which did not concentrate the impurities in the water so visibly.

After the new tanks were installed, the ice works became a thriving business. Most of its product was shipped by rail to San Jose and San Francisco. A 1901 newspaper article states that they shipped 4,343,900 tons of ice in 1900. It is probable that some ice was used specifically to cool fresh fruits in grocery markets and during shipping, making the ice works an outgrowth of the fruit industry. Likely much of the product went to domestic icebox subscribers in large cities as well.

For many years the ice works was discussed in local newspapers and directories as a significant industry in Los Gatos and a sign of that town's modernization. It was a source of community pride. It was also a major source of tax revenues for Los Gatos after the town incorporated in 1887. In 1888 it was the second largest taxpayer in the city, followed by the South Pacific Coast Railroad. In 1896 it was re-incorporated as the Los Gatos Ice and Power Company, the Los Gatos Ice Company and the Los Gatos Manufacturing Company both dissolving to combine into the new company.

In 1890 the ice works put in a dynamo to run lights at night, and the following year began to sell electricity. In

1896 a second electric company, the Glen Una Electric Company, began operating in the area, and five years later the Glen Una Electric Company bought the Los Gatos Ice and Power Company, but retained the Los Gatos name.

It is difficult to determine exactly when the company stopped making ice. The 1904 Sanborn Insurance Map shows the equipment no longer in use. However, the Los Gatos Ice Company is still listed in the 1904/05 San Jose City Directory. The company may have stopped producing ice sometime in 1904, before the Sanborn map was made. When the company was bought by P. G. & E in 1912, an assessor mentioned that the ice house was being leased to the Union Ice Company and had been for several years.

The fact that the equipment was listed as unused on the 1904 Sanborn map may only represent an interlude in its use during that year. Why the Los Gatos Ice, Gas and Electric Company stopped making ice after 1904 is not known. An examination of San Jose City Directories for the years the ice works was in operation shows a growth in the number of competitors until 1903-04, when the Union Ice Company is first listed, then shrinkage thereafter. It may be that the company was simply out-competed, perhaps by the much larger Union Ice Company.

Appendix I:

Exhibit Floorplan

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See Appendix B for full text of A Look into The Past

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