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LAIE PLANTATION SUGAR MILL (1868-1900):
ARCHAEOLOGY AND HISTORY

The purpose of this report is to reconstruct a historical overview of the Laie Plantation sugar mill. The sugar mill was investigated through archaeological excavation and historical research with the goal of relocating its ruins.

Sugar was the economic salvation of the Hawaiian Islands during the latter half of the nineteenth century. This commodity played a central role in sustaining early members of the Church of Jesus Christ of Latter-day Saints (Mormons) on the Laie Plantation. These faithful Mormons came to Laie from many Polynesian islands and from the Utah territory. When Mormon proselytizing began in Hawaii in 1850, the president and prophet of the church, Brigham Young, and his followers had settled the Great Salt Lake valley only three years previously. While loved ones remained at home to begin building farms, homes, and cities in the desert West, fathers, sons, and sometimes entire families served as proselyting missionaries in far-off places. Laie was one such place.

The significance of the mill to the history of this Mormon settlement is thus its economic impact. It gave financial support to the LDS church, the community, and to those Polynesian Mormons who came to this "gathering place." Without this source of income they could not have sustained themselves, except at a very rudimentary economic level. In other words, they would have survived by fishing and gardening. But this level of subsistence could not have provided the funds to build mission homes, chapels, or later, the temple. Even so, most of the support funds came from church headquarters in Salt Lake City, Utah territory.

The expansion of this community would have also been determined by how much the Polynesians could extract from the local environment. Once the limit of resources had been exhausted, there could have been no further influx of Polynesian Mormons.

The main points of this presentation are as follows: introductory data on the environment in which sugarcane was grown, particularly the soil; the goals of the archaeological project; the discovery of the sugar mill foundations; the processing of sugarcane in the nineteenth century; a brief history of the mill; and, finally, a summary statement on the preservation of the mill site.

Environment for Growing Sugarcane:

The soils of Hawaii are deep, have abundant iron and aluminum, but lack quartz sand. The upland soils are formed by the erosion of volcanic rock. Lowland soils have formed from coral, which is mostly limestone and sand. Cultivated land amounts to less than one-twelfth of the island; and this land needs to be irrigated to varying degrees, depending on the crop being cultivated. Sugarcane is grown mainly in low-humic latosols. These soils lack quartz, are generally neutral to
slightly acidic, and are mostly kaolinite clay. They are easily compacted by the hooves of grazing animals, such as cattle, horses, sheep and goats. Grazing eventually causes heavy erosion. On Oahu most of the coral sand and alluvial soils are found on the northeast side of the island (Street 1983: 89-95).

The variety of landscapes and rainfall patterns produce an equal variety of vegetation. The native vegetation of the islands has been extensively replaced by endemic species (97 percent). Since the arrival of the first Polynesian sea voyagers, 273 native species (15 percent) have become extinct. However, nearly 4000 exotic species are being cultivated and another 600 species of weeds. Plumeria, hibiscus, coconut and taro were all introduced by colonizers. Natural vegetation is found in the higher elevations, while the replaced vegetation is situated in the lower valleys and coastal areas. Most of the native plants were brought to the islands by migrating birds, while a smaller number of species floated there. The lack of large grazing animals on the islands played an important role in the evolution of vegetation. Many plants, of which about half were introduced accidentally, evolved along with the culture of the settlers (Wister 1983: 99-103).

The ancient Hawaiian voyagers settled the islands in a pristine environment hundreds of years ago, but this condition had changed considerably when Mormon missionaries began proselyting in the Hawaiian Islands, building a sugar mill, and growing sugarcane.

ARCHAEOLOGY

There have been only nine primary excavations on the island of Oahu - all prehistoric sites. The nearest excavation to Laie was in Kahana Valley; all the rest were on the opposite side of the island, or south of Kailua (Tuggle 1979: 168-169). No data on the excavation of historic sites have been published, although Nellar (1984) points out several significant sites just outside the Laie Plantation boundaries. Archaeologically speaking, very little is known about northeastern Oahu. Sterling and Summers (1978: 154-159) recorded several sites near Laie, consisting mostly of locations known to the Hawaiians, such as fishing shrines, fish ponds, sacred places, taro land, as well as Mormon historic sites, such as the temple. They also described sites recorded earlier by McAllister (1933).

Like most prehistoric people, the ancient Hawaiians formed artistic petroglyphs in the rocks. Their designs took many shapes: anthropomorphic, zoomorphic and abstract designs. One such petroglyph, a human figure pecked on a boulder with a pointed stone tool, was found on the beach at Kahuku (Cox and Stasack 1970: 96-97).

Archaeologists dealing with the prehistory of Hawaii have been concerned with the problems of how the people who settled the islands came to be "Hawaiian." This research involves exploring the ways in which early settlers and their descendants met the possibilities and limitations of an island environment over a period of 1500 years. Their studies also involve seeking to understand the consequences of isolation from the rest of Polynesia. Therefore, the theme of studies in Hawaiian prehistory has been to determine how the natives used an isolated
and bounded environment, and how they evolved the culture encountered by Europeans in 1778.

Historical archaeology, through the examination of material remains and historical documentation, studies how cultures change after European contact and how foreign cultural elements become included into the indigenous way of life. Through analysis of these data and extrapolation of information from the distant past, changes to native culture can be hypothesized.

A primary objective of any research project involving historic sites is to establish and verify the basic cultural history of the site or community of sites. A site's date of occupation, function, and ethnic affiliation may be determined from documentary sources, interviews, and archeological data, including artifacts and the relationships between the distribution of material objects and cultural features.

Laie is a rich cultural area affording many options of archaeological research, such as the relationship between ethnic groups employed on the plantations. In Laie these groups included Mormon missionaries from the Territory of Utah, Hawaiians and other Polynesians converted to Mormon beliefs, Chinese, Japanese, Portuguese, and Filipinos. Each group had its own camp and own way of living. Archaeological study of these camps could provide pertinent information concerning residents' day-to-day activities, life style, cultural diversity, and relationships both within the plantation and with external commercial and population centers.

The scientific goal of this archeological project was to (1) discover the location of the Laie Plantation sugar mill, (2) determine architectural detail—including construction techniques, materials employed, hardware, sugar-processing machinery, etc., (3) establish artifact types, such as ceramics, glass, hardware, and all other miscellaneous objects recovered, (4) consider the mode of operation of the mill based on archaeology and documentation, and (5) reveal the economic impact of the mill on the community.

About half of the Laie Plantation sugar mill was unearthed during the summer of 1984, but many things still need to be done. First, the architectural details of the mill need to be studied: construction techniques, materials, hardware, and the sugar-processing machinery. Second, the artifacts need to be analyzed, dated, and placed within appropriate time and regional categories. These artifacts include ceramics, glass, hardware, and other objects. Third, the mode of operation of the mill needs to be determined.

At the beginning of the field investigation of the sugar mill site, what was known about the mill was what had been discovered in historical documents. Two documents provided enough accuracy to suggest the location of the mill ruins: (1) an 1884 nautical map, and (2) photographs taken of the mill from two different directions. From this evidence a location was established where the mill may have been situated.

Initial excavation unearthed the location of the track house that stood to the west of the mill. A long trench extending east of the track house soon revealed the substantial foundations of the mill. Although the mill was not totally excavated and few artifacts were found, part of the floor, walls and a large well were
discovered.

This report will not detail the archaeological features found at the mill site but simply indicate that the site was found and partially excavated. As indicated at the beginning of this report, the purpose herein is to outline briefly the history of the events that pertain to the Laie Plantation sugar mill.

HISTORICAL BACKGROUND

The first missionaries of the Mormon Church to the Sandwich Islands were called from Nauvoo, Illinois, in May of 1843. They were Noah Rogers (president), Addison Pratt, Knowlton F. Hanks, and Benjamin Grouard. Pratt had spent some months in Hawaii in 1822, but this time he and the rest of the group went to the Society Islands (Spurrier 1981: 41).

The beginning of proselyting in Hawaii occurred in the year 1850, when ten men were called from the gold fields of California. After working for the funds to get to the islands, they arrived in Honolulu late in 1850. These elders split up in twos and went to the islands of Hawaii, Maui, Molokai, Oahu, and Kauai. Half of the group in this far-off land lasted three months, at which time they left Hawaii; even Hiram Clark, the mission president, departed. The remaining elders, Henry W. Bigler, George Q. Cannon, William Farrer, James Hawkins, and James Keeler, intensified their efforts where they had been most successful, on Maui and Oahu (Kuykendall 1938: 344-345; Spurrier 1981: 41).

In Laie, Elder Farrer was busy baptizing Hawaiians, so much so that in a year's time he had baptized over one hundred individuals. In 1853 Brigham Young designated Hawaii as the gathering place for Polynesian saints, and Lanai was chosen as the primary gathering place. After the missionaries left the islands to support the church against the movement of Union troops during the Mormon War in 1857-1858, and after the Walter Gibson episode which ended in 1864 Kuykendall 1953: 101-102), Laie was selected as the new gathering place (Chase 1981: 92).

Late in December of 1864, Elders George Nebecker and Francis Hammond arrived on the island of Oahu with the intent to buy land suitable for growing crops such as cotton, sugarcane, rice, and other grains. They had come to build a plantation where native Hawaiians could assemble and be taught "the principles of the Gospel and in right living."

A tract of land consisting of 6,000 acres, know as the Laie Plantation, was purchased early in 1865 from Thomas T. Dougherty, former American consul to the Hawaiian Islands who lived in Honolulu at the time (Spurrier 1981: 45). One thousand acres were arable; the remaining land was used for woodland and pasture for 500 head of cattle, 500 sheep, 200 goats, and 25 horses, which were all included in the purchase price of $14,000. A large frame house on the property was know as the "Mansion" (Cummings 1965: 5). Thirty eight saints, including husbands, wives, and children settled on the plantation.

By 1866 125 Hawaiian members were living on the plantation and helping with the planting and picking of a substantial cotton crop. The land was considered to have a good potential for growing sugarcane, but they needed financial support to construct a mill for processing the cane.
The following year, a crop of cane was planted, houses were being built, a new meetinghouse was furnished, and over three miles of stone fence was built to enclose pasture and farming land.

In the Spring of 1868, a mule-powered mill was purchased to process the cane, and the saints began to build adequate structures to house the machinery. It was estimated that the mill could produce 3,000 pounds of sugar per day. By December the mill was completed at a cost of nearly $9,000. The two large centrifuges, or dryers, were run by steam, each drying fifty pounds of sugar in five minutes. Twenty-five men worked in the mill, while women stripped the cane. Also employed to run the mill were 24 mules, which worked in two alternate 12-hour shifts. Supervising the work was Jonathan H. Nepala, who had earlier helped George Q. Cannon translate the Book of Mormon into the Hawaiian language (Chase 1980:3).

A harvest of five acres of cane produced 16 tons of sugar and 1600 gallons of molasses. Four pounds of sugar produced one gallon of syrup. The sugar brought a price of 7 1/2 cents per pounds. Two grades of sugar were produced: one straw-colored grade was of good quality, while a lesser grade was darker and tasted like molasses. The molasses was sold in San Francisco to make rum. The saints were confident of their product and thought they could supply Utah Territory with the best sugar available at a cheaper price than any other supplier (Deseret News 1869:545).

In less that two years, the little colony had grown to seven families from Utah, a Scotsman, and 300 Polynesians. They cut timber from the gulches, grew fruit, and harvested honey from wild bees.

The value of the plantation was estimated at $50,000 (Nebeker 1870:281).

By 1871 a store, dairy and several frame houses had been built. There was also a school that nearly 100 boys and girls attended regularly. With sixty men of the Hawaiian community working in the cane fields, they still expected to ship eight schooner loads of melons, gourds, corn, as well as growing hay for feeding livestock (Nebeker 1872:458).

In 1873 a new steam boiler was installed in the mill, but by the following year the entire structure needed repairs. The mill was so run-down that the nearly 200 acres of cane could not be processed as fast as the crop matured.

In 1875 the mill had deteriorated so much that it had to be shut down to make extensive machinery repairs. The iron pans were replaced with new copper ones, the boiling train had to be rebuilt and engines repaired, the smoke stack removed and rebuilt, and the grinding mill generally cleaned and repaired. The production of sugar had gone down considerably because of the shutdown, but also because of worm and rat infestation in the cane.

Twelve to thirteen yoke of oxen were used to plow the fields with forty to fifty laborers helping. Portuguese field hands operated one of the two big plows, while the other was run by missionaries.

It did not take long for the mill machinery to wear out. By the end of 1880 the plantation had received authorization from church leaders to buy machinery and build a new sugar mill. To further supply the needs of the local population and for sale elsewhere, an orchard was planted in Kolu Gulch consisting of 200 mango
trees, 110 orange and lime trees, 2,000 coffee trees. In 1880 the Mormons in Laie were reportedly "obtaining a comfortable living by their own industry." The Hawaiian converts were encouraged to live the principles of the Mormon Church, and they worked willingly and industriously on the plantation (Bowser 1880: 487-488).

In 1881 the new mill was completed at a cost of $24,000. It was described by Harvey L. Cluff as follows:

The engine house is a frame building, 16 x 25; the crushers or rollers being located under a shed roof by the side of the same, both engine-house and mill being 12 feet above the floor of mill or boiler-house. The mill is driven by a steam engine of 20 horsepower, and is capacitiated to grind four tons of sugar per day. The boiler-house is located on the site of the former mill and is a frame building, 60 x 58, built in the form of the letter L, 18 feet to the square. On the south side of the building, commencing at the makai, or east end, is situated the train of open pans, running a distance of 38 feet, and at the end of this train is located a steam boiler six feet in diameter and 16 feet in length, with 84 four (1) inch tubes, the fire from the furnace at the east end passing under the train also passes through the tubes of the boiler, thus utilizing the heat which would otherwise pass off through the smoke stack and become lost in the atmosphere; at the same time a sufficient fire will be kept up in the boiler furnace to make up the deficiency in steam. Opposite to the train in the east end is located two cast-iron clarifiers of 500 gallons capacity each. The vacuum pan is in the center of the building at an elevation of 15 feet, resting upon a framework which is floored, and a bannister railing around the same.

The centrifugal and engine to drive the same are near the vacuum pan; the coolers and sugar bin are in the end of the north L. There are four steam pumps located in various positions contiguous to the work they have to perform, one for the boiler, one for the vacuum pan, one for pumping water into the reservoir, which is located about 70 feet from the mill in the hillside, and one for pumping molasses into the blow-up. We expected in the commencement that the old mill building would answer by raising the walls about 12 feet higher, but when we came to thoroughly test them, we found they would not do to build upon; hence we built anew from the group up. (Jensen 1935)

The first artesian well on the windward side of the island was excavated by Chinese, who leased 50 acres of land from the Laie Plantation. This moist land was well suited for the cultivation of rice.

A deficiency of water for the vacuum pans in the mill was corrected by building a flume two miles long to obtain water. Two additional artesian wells were dug, one to provide enough water to run the mill, the other for general needs on the plantation.

During 1883 a substantial new meetinghouse was built and dedicated. The king of Hawaii, Kalakaua, attended the dedication on October 6, 1883. This same year, after working on the meetinghouse, Isaac Fox worked the centrifugals of the mill (Chase 1983: 9).

Also during 1883, another artesian well was drilled in which a 7 1/8 inch pipe was placed. It had a flow of 18 inches of water
per minute. The old flume had deteriorated so rapidly that it was taken down in 1884. Many improvements were made to the mill, including a track house, 30 x 65 feet, with a shingled roof, costing almost a thousand dollars. The track house was used to stack cane stalks in preparation for processing in the rollers on the same side of the mill.

Several changes were made to the mill in 1886: a new sugar boiler, drier, and bookkeeper. The residents were busy putting up stone fences until the cane-processing season, which was announced by the mill steam whistle at about the first of December. In this particular year, the mill began grinding the sugar cane crop on December 6.

Changes to the mill during the following year improved profits enough to pay all the mill employees. Mill modifications included a "blow-up pan" that saved cane sediments for further processing to remove residual sugar crystals.

In 1887 the cattle on the plantation were in poor condition due to excessive work. The sugar produced at the mill had to be transferred by oxen teams to a landing, where it was placed on a small boat, carried through the surf, and loaded on a steamship for transport to Honolulu. One yoke of oxen was accidentally killed while moving sugar. In one week the amount of sugar transported was almost 42 tons. The sugar was shipped to the J.T. Waterhouse Company in Honolulu, the agent of the plantation, to help decrease the plantation's debt.

To improve the landing conditions at the beach, a warehouse of corrugated iron was constructed to store sugarcane before loading. Also, a landing pier was built to stack sacks for loading onto the small boats. This eliminated loading in the surf, where the sacks of sugar often got wet.

The cane that was watered by the two artesian wells produced nearly four tons of sugar per acre, while that cane not under irrigation produced little juice. The production also depended on how numerous the destructive rats became during the growing season.

In 1888 the cane fields were extended, in order to keep the mill running continuously at full capacity for the entire grinding season. Enough land and water were available to raise a thousand tons of cane per year, but the small mill could refine only three hundred tons of sugar. The grinding season was started in August, somewhat earlier than usual, to avoid destruction by rats to the ripe crop.

In 1889, dry weather in Hawaii caused partial failure of the Laie Plantation crop. However, careful manipulation and rationing of water from the artesian wells and occasional rain helped save the Laie crops.

The live-stock on the plantation survived the drought fairly well; however, several other ranchers had to kill their animals for hides.

Eighty to one hundred local employees on the plantation received 50 to 75 cents per day in wages. Much of their wages was spent at the plantation store. The store at this time was situated in a small room in the old mission home. The store's stock was relatively small, causing potential customers to go elsewhere for needed goods.

The processing of the sugarcane crop in the early months of 1890 was hampered by frequent
shutdowns caused by a malfunctioning boiler that had to be replaced. At this same time, engines and pumps had to be overhauled. The shutdown was timely in that heavy rains that year caused considerable flooding. The heavy rain caused extensive erosion on the mountain sides, filled gulches, and inundated the lowlands, flooding cane fields and homes. This destructive precipitation washed away bridges, damaged rice and taro crops, and damaged the mill. Many of the Polynesian employees were kept busy hauling building materials to the location of the new Kahuku Sugar Company mill, then under construction.

All the 1891 sugarcane crop was sold to the Kahuku Sugar Company for use as seed cane. The crop brought in $387.50 per acre. However, the financial prospects for 1892 were not as good. For example the ripe crop was sold to the same company for $125 per acre - a considerable difference. But it was cheaper than building a new mill and processing the cane (Noall 1892a). Although sugar prices were low, it was calculated that the plantation would clear approximately $50 per acre by having the Kahuku mill grind the cane. Some Chinese farmers wanted to lease some of the land for $20 an acre, but using the land for cane was more profitable. (Noall 1892b).

During this year, a new plantation store was completed and occupied. A Kahuku store and other stores were taking customers away from the old plantation store, which made it necessary to build a new one with a larger inventory (Noall 1892c). All goods were purchased from J.T. Waterhouse, which was as cheap as any other place to buy goods, but the advantage of using this company was that it gave the plantation three months to pay for purchases. A new mission home was built this same year. A glass box with several documents was placed in a cavity in the octagon cornerstone of the home.

During April conference, the gathering missionaries completed many tasks on the plantation, such as drying molasses, painting the new store, planting "Australian Iron trees," whitewashing fences and buildings, and moving the windmill. Water drawn by the old windmill had turned brackish and was not suitable for consumption or even for washing clothes. Therefore, by using old boiler pipe from the abandoned sugar mill, they pumped clear water from the Chinese artesian well. Actually, water flowed from the well to a tank at the bottom of the hill, from which the water was pumped (50 feet) by the windmill to another tank (70-80 feet) on top of the hill (Noall 1892d). From there it was used in the wash house located behind the old meetinghouse and other buildings on the settlement.

The population of Laie was expanding. In 1893 a pump, to raise water to higher cropland, and a 16-foot-long "Aeronoster" with a 10,000-gallon capacity, were purchased and installed to increase the acreage under irrigation in sugarcane. A reservoir at the mouth of Wailele Gulch was constructed along with ditches and flumes to transport the water.

By 1895 the old sugar mill had stood idle almost six years. The cane was being processed by the Kahuku mill at a much cheaper price to the plantation, and it freed the missionaries to do more proselyting. The old mill had lost nearly thirty percent of saccharin water while extracting and
processing the sugar. This loss reduced the margin of profit so much that it made the business feasible, especially since at this time there was intense competition in the sugar market. The competition was so close that the cheapest labor had to be sought, namely, Japanese and Chinese workers; modern and more-efficient machinery had to be installed; and the sugar had to be mass-produced.

In the contract with the Kahuku Plantation Company for the year 1895, the company refused to incur the cost of the cutting of sugarcane, but the plantation received half of the processed sugar. This situation changed in 1896, when the contract including cutting, transportation and processing the entire sugarcane crop.

At the beginning of 1896, sugarcane was hauled slowly by four ox carts, three mule carts, and two mule wagons. To reduce the hauling time to the mill, a railroad track bed was graded and track was laid. Also, fertilizer was experimentally used on two acres of the Laie Plantation.

In 1899 a new boiler with fixtures, possibly steam pumps, arrived at the Laie wharf, weighing 11 tons 643 pounds. It took one week to position the pump in the pump house. This pump could pump water 110 feet above the elevation of the pump. The pump was kept running night and day to irrigate the crops.

The total weight of sugarcane cut in 1898 was 7,284,000 pounds; it yielded 726,000 pounds of sugar at 7,260 pounds per acre. The Laie Plantation share of the proceeds was 363,000 pounds of sugar.

By the turn of the century many changes had taken place in Laie: the old mission home was gone (though a new one was in its place); the old sugar mill was no longer functioning; the cane crop was being processed at the Kahuku mill; 450 acres were planted in cane; the homes of the Polynesians had been removed from the sugarcane fields; 250 acres of rice was being cultivated by Chinese families; powerful pumps and wells were irrigating much of the higher elevations; a new plantation store was in operation; a new meetinghouse had been built on the hill where the temple now stands; a school was in full session; many stone walls had been removed; and many other minor changes were taking place.

By 1915 the financial situation of the plantation was secure, and it appeared that the colony would prosper. Five hundred acres of land was planted in sugarcane, which was then sold to the Kahuku mill. For many years there were few trees in Laie due to the strong trade winds, but the fast-growing Australian Iron trees which could withstand the strong winds soon made the acre lush with vegetation. In fact, it could be said that the whole face of the land had changed (Smith 1915). (Most of the data and chronology of the sugar mill are derived from Jensen (1935), and are not included as references within the body of the history.)

Site Preservation:

The Mormon Church and its Polynesian members have contributed much to the rich cultural heritage of twentieth century Laie; this is evident in such structures as the Hawaii Temple, Brigham Young University—Hawaii Campus, and the Polynesian Cultural Center. If visitors to Laie who were introduced to the history of the community, especially the early
missionary efforts and the ways missionaries and members sustained themselves could enjoy a much deeper historical experience. An effective overview of Laih history could develop their desire to learn and appreciate more intimately the heritage of Laie. The site of the sugar mill, a very appropriate historical setting, would be an excellent place to present this history.

The sugar mill should be completed excavated and the foundations, as well as other features within the mill, stabilized. A structure built over the site would protect it from the elements. The structure would not only shelter the remnants of the mill, but feature exhibits on the history and economy of nineteenth century Laie and the processing of sugarcane. In this one location are also two ancient Hawaiian sites: one a rock-walled heiau (ceremonial site), the other a domestic site. Close by are the old pump house, the Portuguese camp, and a Hawaiian fish pond. Because all these sites are within one area, the sugar mill would provide an excellent central location to relate the culture-history of Laie. The account of the plantation and its economy is also closely interwoven with the history of Hawaii; a whole era of economic development of the sugar industry in the islands can be seen on a small scale in Laie.
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