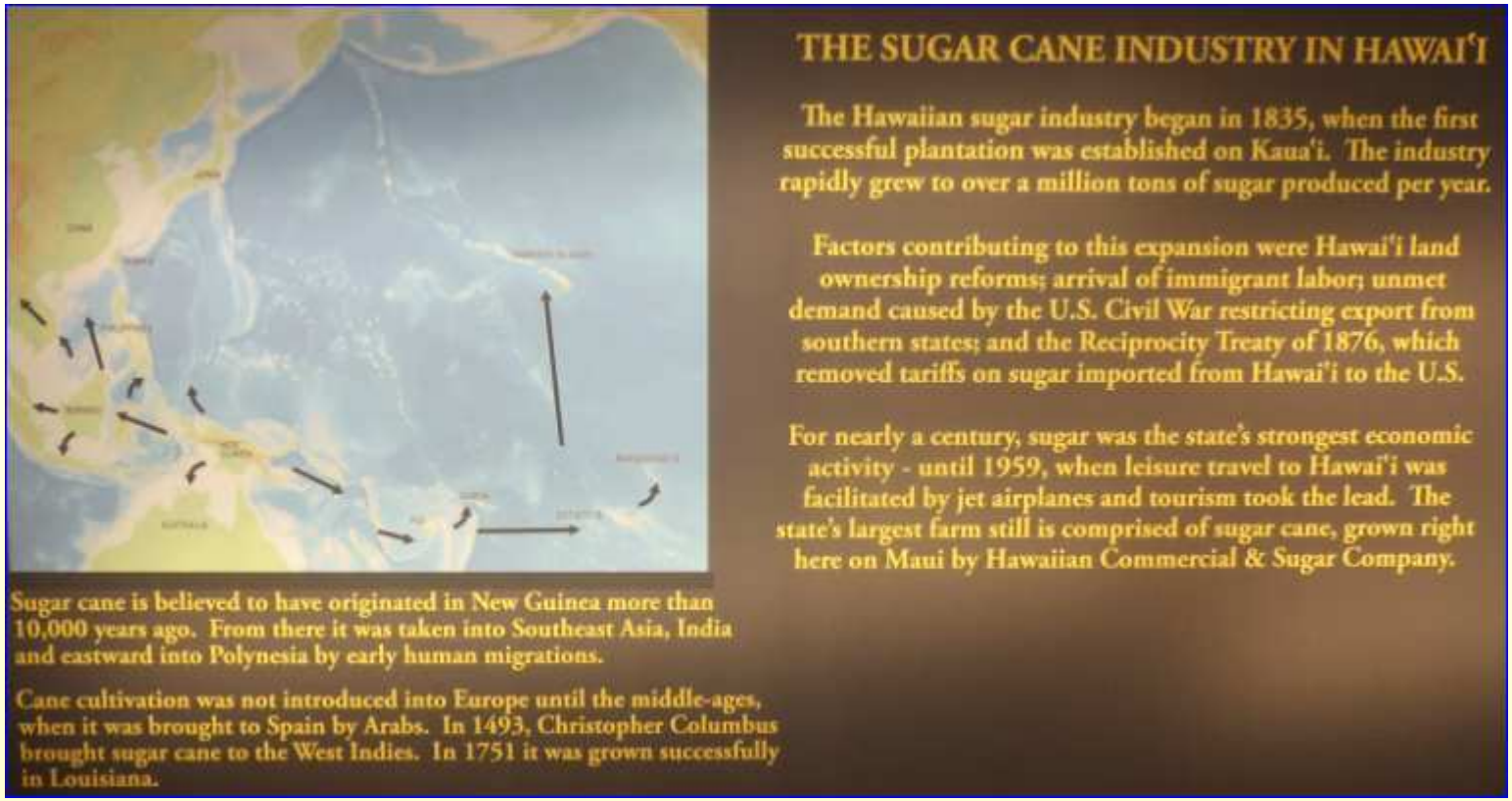
Report: Excursion on Sugar Production in Maui, Hawaii, June 03 – 06, 2014

Source: Kern, M., 6/2014

Sugar Cane Museum, Maui, Hawaii, 6/2014
Origin and Migration of Sugar Cane to Hawaii



Source: Kern, M., 6/2014

Sugar Cane Museum, Maui, Hawaii, 6/2014
Sun, Wind and Water

Water for the Fields

Tremendous physical and engineering difficulties were involved in bringing water from rainy East Maui to the dry central plain. Because of rugged terrain, open ditches could be used in only a third of the ditch system. Approximately 50 miles of the East Maui Irrigation Company's 74 miles of ditches had to be tunneled through rock.

Numerous gulches had to be spanned by trestles or inverted siphons. Most treacherous among them was the deep Maliko Gulch.

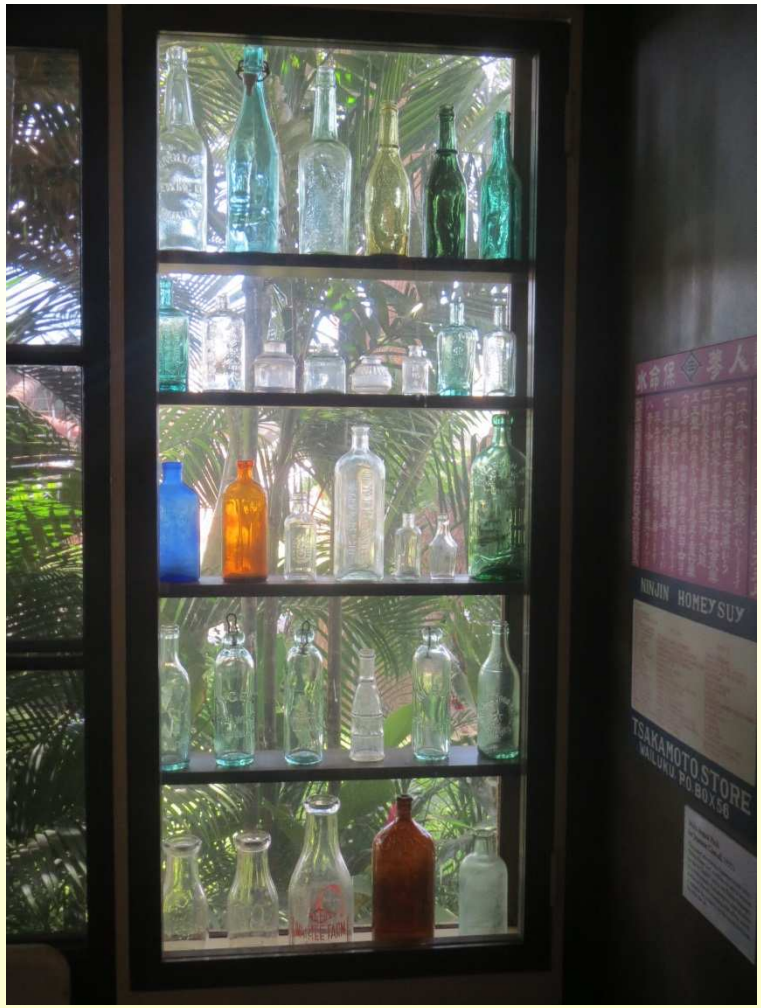
Digging tunnels from opposite sides of a slope, and maintaining water flow in the gravity-operated system called for precise engineering.

Source: Kern, M., 6/2014

Sugar Cane Museum, Maui, Hawaii, 6/2014

Source: Kern, M., 6/2014

Sugar Cane Museum, Maui, Hawaii, 6/2014



Source: Kern, M., 6/2014

Sugar Cane, Maui, Hawaii, 6/2014

- Sugar cane is a giant grass producing stalkes that range from 8 to 30 feet long.
- Stalks are too tall to stand upright so they fell into each other and form tangled masses.
- In Hawaii, sugar cane takes twlo years to mature. From one acre of cane, 12 tons of raw sugar may be produced. This amounts to 22,465 pounds of refined sugar.

Source: Kern, M., 6/2014

Sugar Cane Train, Lahaina, Maui, Hawaii, 6/2014

Source: Kern, M., 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014: Vision

Our Vision

To fulfill our commitment to keep Central Maui in agriculture by being a premier producer of agricultural-based products through the use of modern technology, innovative thinking and skilled employees, and pursuing farming that is sustainable— economically, socially and environmentally.

Source: http://hcsugar.com. 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014: History

The Beginning

- Well over a century old, HC&S has grown from a small Maui sugarcane plantation founded by two childhood friends into one of the worlds most advanced and productive sugar businesses.
- Augmenting their original investment in 12 acres below Makawao, Maui, with the acquisition of an additional 559 acres, Samuel Thomas Alexander and Henry Perrine Baldwin planted their first sugarcane crop in 1870 on their newly established Alexander and Baldwin plantation. Over the next three decades, they acquired a number of neighboring plantations that, together with their original plantation, formed Maui Agricultural Company.
- During that time, the partners invested in the development of essential water resources for their 3,000 acres and neighboring plantations. The Hamakua Ditch was an elaborate system of tunnels, ditches, siphons, flumes and reservoirs built over 17 miles of mountainous terrain – an engineering feat that would help shape water reclamation and irrigation procedures used by major projects on the U.S. mainland.
- In 1948, Maui Agricultural Company and HC&S merged, keeping the HC&S name and becoming the largest sugar producer in the United States. In 1962, HC&S merged with, and became a division of Alexander & Baldwin,Inc.

- Over time, generation after generation of Maui residents have brought their skills, ingenuity, commitment and community-mindedness to HC&S, and in turn, HC&S became an integral part, if not a driving force, of the social and economic fabric of Maui Nui.
- We are proud of our company's heritage and the important role it has played in shaping Maui's past and growing its future.

Source: http://hcsugar.com. 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014: Future

- For well over a century, sugarcane has been HC&S' crop of choice. It is best suited for the challenging agronomic conditions in Central Maui, and superior for large-scale production and sale. It's a business we know well, and do well. Striving always to optimize our sugar operations, we continue to reinvent the business of growing sugarcane through improvements and investments, modernization and upgrades to our facilities and processes. We remain committed to ensuring a future in agriculture for HC&S, envisioning productive fields of green still carpeting Maui's central valley for decades to come.

- Sugarcane is also currently the USDA's crop of choice as it looks to increase bioenergy production in the United States. Identifying HC&S as the ideal working laboratory for research in this area, the federal government has invested in biofuel research at HC&S. Our agricultural operations have long been energy self-sufficient through the generation of hydroelectricity and the co-generation of bagasse, a by-product of sugar production. As we move forward to actively evaluate a variety of new energy models, we envision ushering in the next generation of agriculture on Maui, while playing an important role in reducing our state's dependence on oil and other fossil fuels.

Source: http://hcsugar.com. 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014:
Growing Maui's Economy

HC&S has been a vibrant and significant force in Maui's economy since its inception. Today, HC&S is one of Maui's largest employers, with 800 employees and an annual payroll of over $35 million.
HC&S also:

- **provides an economic benefit of over $250 million each year, including payroll, benefits and vendor purchases to Maui's economy.**
- **is one of Maui's largest buyers, purchasing more than $50 million in goods and services from local businesses each year.**
- **pays $50 million in annual wages and benefits to our employees and retirees.**
- **contributes $5 million in annual payroll taxes.**
- **has invested $190 million into the business over the past 17 years.**

Source: http://hcsugar.com. 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014: Actual

- The cultivation of sugarcane on **36,000 acres** in Central Maui is our business and our passion.
- State-of-the-art agronomic practices make our fields among the highest yielding in the world. HC&S produces **150,000 to 200,000 tons of raw sugar** and more than 60,000 tons of molasses each year, and we continue to improve our farming practices to maximize sugar production and seek new ways to support our business. The sugar industry faces many challenges, as evident by HC&S being the last sugar plantation in Hawaii. We are dedicated to maintaining sugar as a viable crop, while ensuring that our harvesting and production operations meet or exceed county, state and federal regulations as well as the reasonable expectations of our neighboring communities.
- Together with our core products – raw sugar, specialty sugars and molasses – HC&S also is a significant producer of energy, mostly from renewable sources: hydropower and cane fiber.
- We not only are able to provide for all of our own energy needs, but we also supply about 6% of the power that our local utility provides to the Maui community.

Source: http://hcsugar.com. 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014:
Research and Development

- At HC&S, we continually look for ways to improve – and add value to – our core sugar business through research and development of new sugarcane varieties, new products and co-products, and new markets.
- **The current focus on renewable energy** provides HC&S an opportunity that didn't exist a decade ago.

- In recent years, we have sharpened our focus on developing new forms of renewable energy from biomass feedstock, such as advanced biofuels. A breakthrough in this area would help Hawai'i—and the nation–to reduce dependence on imported foreign oil and other fossil fuels. These exciting initiatives, which include research on crop development and technology assessments as well as an evaluation of the long-term resource requirements for biomass production, have the support of the Federal government, with grants from the Department of Energy and the U.S. Navy's Office of Naval Research. Additionally, two studies are being conducted at HC&S by the University of Hawai'i's College of Tropical Agriculture and Human Resources (CTAHR) and the U.S. Department of Agriculture (USDA), respectively. Currently, a wide variety of bio-fuel crops including **Jatropha, sugarcane, sweet sorghum and banagrass** are being tested throughout numerous locations at HC&S to determine where it will thrive.

- **Finding an alternative to cane-burning** that is environmentally, socially, technically and economically beneficial to Maui continues to be a priority for HC&S.
- Transformation of HC&S from a producer of sugar to a producer of energy requires significant investment and significant risk. Our overriding consideration is the preservation of 800 jobs for the community as we explore these transformation options. Success would benefit our employees and our community.

Source: http://hcsugar.com. 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014:
From Field to Factory

Field Preparation

- The first step in preparing a field for planting is to plow and loosen the soil before the seed cane is planted. Only disease-resistant cane varieties are selected for planting at HC&S. Insects and pests are controlled biologically, using natural predators. The Hawaii sugar industry has been a world leader in this area.

Planting and Irrigation

- Short pieces of cane stalks—called seed billets—are planted by machines that dig the furrows, drop the cane pieces and inject the irrigation tubing, all at one time. Workers adjust billet placement when necessary, to ensure they are evenly spaced.
- During the initial growing stage, the sugarcane is highly dependent on a stable water supply to survive. An efficient system of drip irrigation supplies water and fertilizer directly to the cane roots. HC&S monitors the weather, soil type and moisture, and cane tissue to determine how much water and fertilizer the plants need.

Crop Maintenance

- HC&S is stingy with its water and costly fertilizers, applying only what is needed. No fertilizer is applied in the last 12 months before harvesting. Sand filters throughout the plantation remove sediment from the irrigation water to reduce plugging in the drip tubing.

Source: http://hcsugar.com. 6/2014

Hawaiian Commercial & Sugar Company (HC&S), 2014:
From Field to Factory

Ripening

- Weeds must be kept in check because they compete with cane plants for water and nutrients. HC&S uses herbicides for only the first six months of growth while the cane is still short.

Harvesting

- When the cane is about two years old and ready to harvest, the fields are burned to remove the leaves, leaving just the juice-filled stalks for transport to the mill. Each field is burned only once every two years. We carefully monitor weather conditions prior to each burn, including wind speed and direction, and we utilize forecasts and models to play our pre-harvest burns so as to minimize the inconvenience to our neighbors. We also make our harvesting schedule available to the public a week in advance, and provide real-time updates.
- After burning, harvesting machines push the cane stalks into large windrows, leaving the root system in the ground, to re-grow for one additional crop cycle. The cane stalks are then loaded into huge trucks called tournahaulers, which can carry up to 55 tons per load. Many truckloads are required to haul the harvested cane from each field to the factory. To preserve sugar content, it is important to get the harvested cane to the mill for processing as soon as possible. Since the mill runs 24 hours a day, seven days a week, during the harvest seasons, harvesting is a round-the-clock operation at HC&S.

Source: http://hcsugar.com. 6/2014

Sugar Cane Production in Maui, Hawaii, 6/2014






Source: Kern, M., 6/2014

Sugar Cane Production, Irrigation, Maui, Hawaii, 6/2014






Source: Kern, M., 6/2014

Sugar Cane Production, Irrigation, in Maui, Hawaii, 6/2014






Source: Kern, M., 6/2014

Sugar Cane Preparation of Land in Maui, Hawaii, 6/2014






Source: Kern, M., 6/2014

Sugar Cane Crop Protection, Fungicide Bath of Seed Cuttings in Maui, Hawaii, 6/2014





Source: Kern, M., 6/2014

Sugar Cane New Planting in Maui, Hawaii, 6/2014






Source: Kern, M., 6/2014

Sugar Cane New Planting in Maui, Hawaii, 6/2014





Source: Kern, M., 6/2014

Sugar Mill in Maui, Hawaii, 6/2014

Source: Kern, M., 6/2014

Sugar Mill in Maui, Hawaii, 6/2014






Source: Kern, M., 6/2014

Brown Sugar from Maui, Hawaii, 6/2014

Source: Kern, M., 6/2014

Sugar House, Lahaina, Maui, Hawaii, 6/2014

Source: Kern, M., 6/2014