

DOWNLOAD PDF A CENTURY OF SUGAR REFINING IN THE UNITED STATES

Chapter 1 : How sugar is made - manufacture, used, processing, parts, components, composition, steps, p

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A handbook on Hawaiian soils, by W. A refined fight against the sugar refineries. A statistical survey of the sugar industry and trade of the United States; statistics of stocks, receipts, meltings, distribution and exports of sugar in the years and , by Joshua Bernhardt. Brown printing and binding co. Steam economy in the sugar factory; translated from the German ed. Allahabad, Leader Press [] La Agricultura y la industria Azucarera en Morelos. Extraído do relatório dos trabalhos da 3. Memorias de las Conferencias Anuales, La Habana, , La Prueba, Alcohol for industrial purposes; synopsis of rules and regulations prescribed by the U. A story of the growth of E. Revista Pernambucana de Desenvolvimento, Recife, 2 2: The Art of Making Sugar: Under the Heads of: The Natural History of the Sugar-cane. The Culture of the Sugar Cane. The Method of Making Muscovado. The Method of Preparing clayed Sugars. The Refining of Sugars. Le Programme sucrier ivoirien: Royal Commission on the Sugar Industry. Report of the Royal commission on the sugar industry; together with minutes of evidence and appendices Mullett, acting government printer for the state of Victoria [] Service, c The Australian sugar industry, Australian Gov. O Reconcavo Baiano, A. Del ingenio azucarero patriarcal a la central azucarera corporativa: The Barbados sugar industry: Wien, Universum Verlagsges, [c] The British West Indies sugar industry in the late 19th century, Oxford: Technology and the Plantations: Die Elektrizität in der Zuckerindustrie. With a concluding chapter. Saber Edit ; v. La industria azucarera boliviana [La Paz,] Van Nostrand Reinhold Co. New World, The Sugar Industry: Our Life or Death? A handbook of sugar analysis: The use of refined corn sugar in the manufacture of bottled carbonated beverages [by] J. Buffalo Foundry and Machine Company. Nicholas Procter A treatise on sugar machinery: London, The Manufacture of Sugar, and the machinery employed for colonial and home purposes. Read before the Society of Arts Designed and published by K. O livro da canna de assucar, ou, Manual pratico da cultura da canna e do fabrico dos seus produtos, 2. Statistics Canada, Cane sugar refining corporations. Statistics Canada, The cane-sugar industry of Java. Imprint Buitenzorg [] Carrington; foreword by Colin Palmer Boyle] Prepared under the supervision of W. Steuart, chief statistician for manufactures Tate and Lyle , Chur, Switzerland: Changes in technology and labor requirements in crop production. La perspectiva de la industria azucarera en Puerto Rico. Fu-Min Institute of Agricultural Geography, 17 Norton Parker , Beet sugar industry in California. Chipman, chairman Committee on Industrial Resources of the State. Distributors for the U. Valenciennes, Bureaux du Jour. For Private Circulation, Manchester, s. Correspondence relating to the position of the sugar industry in certain West Indian Colonies, British Guiana, and Mauritius. Os pequenos e grandes engenhos: With the research assistance of Gary Weaver, assistant in economics. Technological Innovation without a Strong Market, A. Together with a description of the machinery. Paris, Librairie de Mme. Une plantation de Saint-Domingue: Elsevier; New York, N. A reference book for planters, factory managers, chemists, engineers, and others employed in the manufacture of cane sugar. Condiciones de la industria azucarera en Cuba. El Iris,[reeditado em Revista Mexicana del Caribe, 6: Antonio Miguel Donoso Madrid: Die Schmierung der Maschinen in Zuckerfabriken. Hamburg, Deutsche Vacuum Oel Aktiengesellschaft [] A canna e o assucar nas Antilhas, Rio de Janeiro: Noticia de los ingenios o fincas azucareras que existen actualmente. Sugar beet from field to factory, etc.

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Chapter 2 : Domino Sugar Refinery - Wikipedia

Century of sugar refining in the United States, [New York: De Vinne Press,] (OCoLC) Online version: Century of sugar refining in the United States, [New York: De Vinne Press,] (OCoLC) Document Type: Book: All Authors / Contributors: American Sugar Refining Company. OCLC Number: Notes: Cover title.

There are no known copyright restrictions in the United States on the use of the text. Manufacture upon a large scale and the continuous operation of its refineries have enabled the Company to sell its product upon a basis of profit smaller than that ordinarily obtained in manufacturing enterprises. By reason of the volume of its business this profit, however, has been sufficient to have paid a fair and regular return upon the investment of the stockholders. Believing that the payment of this dividend is an event of interest, we are noting it by this brief account of the development of the cane-sugar refining industry in the United States during the last one hundred years, prepared by Joseph E. While for many centuries lump or loaf sugar has been in use as a food, it is only within the last century that granulated sugar has become an article of universal consumption. The improvements in operation in the last one hundred years and the advance in the art and science of refining have been such that to-day the consumer can buy his sugar at a price which is less than the cost in of turning the raw product into refined. In Colonial days sugar was sold in the loaf, lump or piece, and the purchaser had to break it up for use in the household. Notwithstanding that granulated sugar is a modern article of diet, the making of white Page Five sugar in moulds was practised long before the settlement of the American colonies. And not many years after the arrival of the Dutch on Manhattan Island a sugar refinery was built on Liberty Street which for over a century and a half was one of the leading manufacturing establishments of the city. That there was some sale of sugar and sugar-candy in the early part of the eighteenth century is clear from an advertisement which appeared in the "New York Gazette" on August 17, Many prominent American families interested themselves in the sugar business, among them the Livingstons, Bayards, Cuylers, Roosevelts, and Van Cortlandts. All these, by turning brown sugar into clean, white loaves of table sugar, added to their fortunes and helped to establish the refining industry in the United States. In the early part of the nineteenth century the Havemeyers founded a refinery at Vandam Street, in a little building 25 x 40 feet in size, with only four or five employees. Page Seven In this small refinery was laid the beginning of a sugar business which, handed down from generation to generation, expanded until at the time of the organization of this GDmpany it owned the largest sugar refinery in the world. Another firm that became prominent in the refining business in the first half of the nineteenth century was that of R. While the details of the industry were not reported with the same exactitude that they are to-day, it is certain that in the total amount of sugar refined in New York City in a year did not exceed nine million pounds. While this seems to be a large quantity of sugar, the largest refinery of The American Sugar Refining Company can refine approximately that amount in forty-eight hours. The art of refining consists in converting raw sugar into refined grades with a minimum loss of sucrose content. To-day a loss of six to seven pounds a hundred made in refining raw sugar of average test is all that is expected. One hundred years ago all the refineries on the island of Manhattan were back from the water-front, and it was not until , when Frederick C. Havemeyer purchased a tract of land in Brooklyn and moved his business from Vandam Street, that the necessity of refining on the water-front became apparent. This location for a refinery sounded the death-knell of inland refining. Following the example of the Havemeyers, many others invested in water-front refineries in Brooklyn and shortly established there the greatest center of sugar refining in the world. The largest of all these plants is that founded in by Frederick C. It later became apparent that a location with sufficient wharfage and railroad traffic connections was essential. In the early part of the last century, and before it was found that a seaboard water-front was necessary for the refining of sugar economically, a small refinery was in operation as far west as Cincinnati, Ohio. Of this the Secretary of the Treasury the Hon. Still, much refined sugar is used to qualify whiskey, which, unhappily, continues to be extensively used in the west by certain classes of persons. The present

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method of refining involves between twenty and thirty steps, or processes, depending on the grade or form of the refined product. In the course of a century the invention of the centrifugal machine, the vacuum pan, the boneblack filter and the polariscope has revolutionized the methods of refining sugar. The fundamentals, however, remain as in Colonial days. It was then necessary to melt, clarify, filter, and crystallize by boiling the raw product. To-day the same steps must be followed, but the methods employed in putting through the various processes have all been radically changed. A hundred years ago no centrifugal Pdge Eleven or granulating machine was in operation, and sugar was run into moulds and baked in ovens heated to the proper temperature. The invention of the centrifugal machine and modern granulator has made granulated sugar possible. In the former, centrifugal force throws the molasses free and leaves the white granulated sugar. The combination granulator and drier, as the name implies, dries the sugar and screens it. Since a Frenchman, one Soleil, invented the polariscope. This instrument, by means of polarized light, makes possible an exact determination of the sucrose contained in any grade of raw sugar. By its use the buyer of raw sugar is able to determine, to a fraction of a degree, the value of his purchase. The use of the boneblack filter has done away with the old clarifying agents, ox-blood, clay, and albumen. Boneblack, an article universally used now, quickly and thoroughly cleans raw sugar. For high-grade sugars, such as the Domino brands, are to the hundredth degree free from foreign matter. Purchased in a neat, strong carton or a stout cotton bag, weighed, packed, and sealed by ingenious automatic machinery, they reach the consumer free from dirt, germs, or infection of any kind. In the tariff upon raw sugar imported into the United States was three cents a pound, upon loaf or refined sugar twelve cents, and its price to the consumer was about twenty cents per pound. The tariff on most of the raw sugar now imported is but a cent a pound, and the protection of to the refiner of nine cents a pound has vanished entirely. To-day about one-half of the sugar consumed in the United States pays no duty. Because of abnormal world conditions sugar at the moment is selling on a higher basis than has existed for many years, but Page Thirteen the price now prevailing in the United States is less per pound than that obtaining in any other nation in the world. Sugar is now an indispensable food product for all classes, and no other palatable article of food is furnished the public containing the same amount of energy per pound for a price equal to that paid for sugar. The amount received in customs duties by the Government for that year is now taken in at the port of New York in the space of a week. Formerly sailing vessels of small tonnage brought the raw sugar in hogsheads and it was then transferred by carts to the refineries away from the waterfront. Now ships of 10, tons burden land at the docks of the Company and their cargoes, with a minimum of rehandling, are dumped into the melting pan. Several vessels may dock at the same moment at many of the refineries of the Company. The Chalmette Refinery has a wharf which is feet in length and 80 feet in width and contains extensive warehouses. Railroads bring their cars to the doors of the refineries and take the sugar for direct shipment to any part of the United States. Severely competitive conditions prevail in the refining business and the Page Fifteen rivalry among the many competing refiners is intense. Not only does it require a large organization, but vast capital, resources, and plants to draw the necessary raw products from all quarters of the world sufficient to make a year-round campaign. Employment of capital in large amounts, construction of extensive plants, and manufacture upon a large scale have enabled the refiner to reduce his cost of operation, improve the grade of the product, and sell the same at a reduced price. One of the most important items in the distribution of sugar has been the cost of the barrel. The American Sugar Refining Company and its constituent company. The Franklin Sugar Refining Company, in shipping their products to the four quarters of the globe require every year millions of barrels. This one item has necessitated the acquisition through another constituent company of standing timber on lands covering an area of square miles, or more than one-half the size of Rhode Island. To insure a constant source of supply on a low basis of cost, this constituent company has five large barrel factories and seven stave and heading mills, the latter with six and one-half miles of stave sheds. To bring the logs to the mills it has had to construct and operate miles of railroad. Built in the first instance for this purpose, some of these roads have developed into interstate commerce carriers with standard freight and passenger equipment. One road already forty-four miles long,

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and to which extensions are constantly being made, has become the main artery between thriving industrial centers created by it in a region formerly a swamp. The barrel factories have an annual output of over 7,000,000 barrels, requiring in their manufacture 80,000,000 board feet of timber which is produced in the stave and heading mills of the Company. Prudence has required reforestation on a large scale, and since about one-half million of white Pine, Spruce and fir trees have been planted by the Company in the open forests of the Adirondacks. Fine table sugars like Domino Cane Sugars are the result of two distinct processes. The first is the manufacture of the raw sugar—a brown, moist sugar, containing impurities—and the second is the refining of this sugar into higher grades of varying degrees of color and crystals. More than six hundred and fifty ships annually dock at the different refineries of the Company and discharge their cargoes totaling nearly 1,000,000 tons. The yearly output of the Company in sugar and syrup mounts up to nearly 80,000 car-loads. And this is only a little over one-third of the sugar consumed in the United States. A train reaching from Boston to Denver would be required to move all the sugar so consumed. The moving of the refined product is but a portion of the freight business incident to the operations of the sugar refineries in the United States. The refining and cooperage plants of The American Sugar Refining Company alone require the use of approximately 55,000 freight cars each year for their manufacturing purposes. This total of 55,000 cars, necessary to conduct the yearly business of the Company, forcibly indicates the important relation which the sugar industry bears to the railroad systems of the country. All the sugar refineries a century ago were of small capacity and manufactured but three or four grades of sugar. In one hundred years the advances in the methods of manufacture and the consolidation of plants have enabled the consumer, at a small cost, to exercise a wide choice in the grade and character of his sugar. Plants have been constructed for the manufacture solely of certain grades. At Jersey City this Company has erected a modern five-story steel-and-glass building for the production of the variety widely known as "Crystal Domino Tablets. At prices for the refined product which are less than the sum which was expended by the refiner one hundred years ago to turn the raw sugar into refined, this Company offers for sale over one hundred varieties of grades and packings. Or if he favors the old brown sugar of his boyhood days, there are fifteen grades of that from which he may select.

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Chapter 3 : Sugar - Wikipedia

Excerpt from A Century of Sugar Refining in the United States, Manufacture upon a large scale and the continuous operation of its refineries have enabled the Company to sell its product upon a basis of profit smaller than that ordinarily obtained in manufacturing enterprises.

White sugar A pack of sugar made from sugar beet Refined sugar is made from raw sugar that has undergone a refining process to remove the molasses. While raw sugar can be consumed, the refining process removes unwanted tastes and results in refined sugar or white sugar. The first stage is known as affination and involves immersing the sugar crystals in a concentrated syrup that softens and removes the sticky brown coating without dissolving them. The crystals are then separated from the liquor and dissolved in water. The resulting syrup is treated either by a carbonatation or by a phosphatation process. Both involve the precipitation of a fine solid in the syrup and when this is filtered out, many of the impurities are removed at the same time. Removal of color is achieved by using either a granular activated carbon or an ion-exchange resin. The sugar syrup is concentrated by boiling and then cooled and seeded with sugar crystals, causing the sugar to crystallize out. The liquor is spun off in a centrifuge and the white crystals are dried in hot air and ready to be packaged or used. Brown sugars are granulated sugars, either containing residual molasses, or with the grains deliberately coated with molasses to produce a light- or dark-colored sugar. They are used in baked goods, confectionery, and toffees. They are also used as a preservative to prevent micro-organisms from growing and perishable food from spoiling, as in candied fruits, jams, and marmalades. They are used in the food processing of a wide range of products including beverages, hard candy , ice cream , and jams. Maltodextrin is an easily digestible synthetic polysaccharide consisting of short chains of glucose molecules and is made by the partial hydrolysis of starch. They are used as powdered sugar also known as icing sugar or confectionary sugar , for dusting foods and in baking and confectionery. Polyols are sugar alcohols and are used in chewing gums where a sweet flavor is required that lasts for a prolonged time in the mouth. They are used for decorative table sugars, for blending in dry mixes and in baking and confectionery. They are used to sweeten drinks. This shape is still in use in Germany for preparation of Feuerzangenbowle as well as Iran and Morocco. Syrups and treacles are dissolved invert sugars heated to develop the characteristic flavors. Treacles have added molasses. They are used in a range of baked goods and confectionery including toffees and licorice. If the must formed by pressing the fruit has a low sugar content, additional sugar may be added to raise the alcohol content of the wine in a process called chaptalization. In the production of sweet wines, fermentation may be halted before it has run its full course, leaving behind some residual sugar that gives the wine its sweet taste. After cereals and vegetable oils, sugar derived from sugarcane and beet provided more kilocalories per capita per day on average than other food groups.

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Chapter 4 : Refined Sugar History

[Honolulu, Hawaii] Association of Hawaiian sugar technologists, c A century of sugar refining in the United States, [New York, The De Vinne press,] 3. A refined fight against the sugar refineries.

Coaching Program Refined Sugar History Until the second middle of the 18th century, sugar was a luxury and its profits made people to call it as "the White Gold. The America Continents discovery established the sugar industry, because the climate in the Caribbean was very suitable for growing sugar cane. In , the first sugar refinery was set in Germany. The impact of refined sugar on human health had started in 17th century become very noticeable among mass population starting years ago. During the 18th century, sugar became vastly popular. During that time, high demand of sugar production came about largely due to a great shift in diet habits of Europeans populous. They began eating tea, coffee, chocolates, jams, candies, processed food, and other sweets in much greater amounts. In , the average person consumed about 4 pounds of sugar per year. In , the average person consumed about 18 pounds of sugar per year. In , individual consumption had risen to 90 pounds of sugar per year. In , there were fewer than 3 diabetes per , people in US. Today, there are 8, diabetes per , people in US. In many industrialized countries, sugar has become one of the most heavily subsidized agricultural products along with corn and soy to feed live stocks for meat production. Below is the time table of history of refined sugar. Exacerbation of many infectious diseases, such as bubonic plague and tuberculosis, is closely related to refined sugar consumption. Refined sugar is not only main cause of diabetes, but also promotes cancer growth, tooth decay, and depression. People think cotton was the main cause for slave trade, but the raise of sugar consumption and demand was one of the major causes for increased slave trade, along with tobacco. Click here to read about why refined sugar is bad for our health. This page also explains that if sugar is eaten right out of sugar cane instead of going through refinery process, it is not as bad as white and brown sugar most people are eating. British pass Navigation Act of to prevent transport of sugar, tobacco, or any other American Colonies products to any ports outside England, Ireland, and land owned by Britain. It was noticed that people who lived without sugar escaped harm. In , refined sugar is the most important export of France. This puts a heavy tax on sugar and molasses coming from everywhere, except the British sugar islands in the Caribbean. Sugar was also essential for rum production " a significant percentage of people were already addicted to alcohol. Tobacco, begins to gain more significance in world use in addictive substances. It induces a British sugar boycott through Europe. The British East India companies, which was already involved with opium drug trafficking, uses the slavery issue in their PR advertising campaign to improve their company images. Their ad said, "East India sugar not made by slaves. Over 8 million pounds of sugar are produced in one year. Nowadays, most of wine contain refined white sugar, which is why it is so sweet. American stores give away a half pound of sugar for free with purchase of five dollars or more. This situation lasted until sugar plantations were taken over by the United States. Sugar consumption would double again by This can postulate assumption that Freud was eternally high and sexually frustrated, which was projected to his own sexually dependent theory taken up later by psychiatry, due to his fixation on this matter. This bear used sugar in its production process. The sugar used in this beer was contaminated with arsenic during sugar refining process from carbonic acid gas production from coal. For more details on this chemical process, click here. Incidence of tuberculosis TB in Japan rises dramatically. Robert Boesler, New Jersey dentist, notes that "modern manufacturing of sugar has brought about entirely new diseases. Sugar has caused a vast degeneration of the people. The drink contains coal tar derivatives, flavorings, and massive amounts of sugars. This opens a whole new medical market because of the growing sugar addiction in the US public. Seale Harris of the University of Alabama discovers that sugar can cause hyperinsulinism and recommends people cut sugar consumption. The medical establishment comes down on Harris. His work is suppressed. This was not any conscious part of AMA, but the pharmaceuticals to control low blood sugar are developed and put into production. The basic contribution of refined sugar to the problem remains suppressed. Weston

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Price, a research dentist, publishes "Nutrition and Physical Degeneration: A Comparison of Primitive and Modern Diets and Their Effects," which proved that refined foods and sugar causes physical degeneration and disease and opposed to natural unrefined whole foods. John Tintera rediscovers the vital importance of the endocrine system, and connects sugar use to production of hyperadrenocortic episodes in humans intolerant to sugar, where adrenal hormones are suppressed, producing inability to think clearly, allergies, inability to handle alcohol, depression, apprehension, craving for sweets, and low blood pressure. If you find information in this website helpful, your contribution will be appreciated, as it will increase the time to do research for putting more of useful information.

Chapter 5 : Sugar Factories of the World

About this Book Catalog Record Details. A century of sugar refining in the United States, American Sugar Refining Company. View full catalog record. Rights: Public Domain, Google-digitized.

Saccharum officinarum - sugar cane The people of New Guinea were probably the first to domesticate sugarcane, sometime around 8, BC. India , where the process of refining cane juice into granulated crystals was developed, was often visited by imperial convoys such as those from China to learn about cultivation and sugar refining. Henry the Navigator introduced cane to Madeira in , while the Spanish, having eventually subdued the Canary Islands , introduced sugar cane to them. Indians discovered how to crystallize sugar during the Gupta dynasty , around AD. It is mentioned in Purananuru In Purananuru and Ainkurunuru, sugarcane juice extraction with use of huge machineries was compared with the sound made by elephants and the smoke produced during the process of making of sugar spread over a heap of unwinnowed paddy was like clouds over mountains. Indian sailors, consumers of clarified butter and sugar, carried sugar by various trade routes. Early refining methods involved grinding or pounding the cane in order to extract the juice, and then boiling down the juice or drying it in the sun to yield sugary solids that looked like gravel. The Sanskrit word for "sugar" sharkara also means "gravel" or "sand". In the year , sugar rose by degrees to an enormous price in Great Britain. The East India Company was then called upon to lend their assistance to help in the lowering of the price of sugar. Paterson, of the Bengal establishment, reported that refined sugar could be produced in India [16] with many superior advantages, and a lot more cheaply than in the West Indies. Cane sugar in the medieval era in the Muslim World and Europe[edit] The westward diffusion of sugarcane in pre-Islamic times shown in red , in the medieval Muslim world green , and in the 15th century by the Portuguese on the Madeira archipelago, and by the Spanish on the Canary Islands archipelago islands west of Africa, circled by violet lines [17] There are records of knowledge of sugar among the ancient Greeks and Romans, but only as an imported medicine, and not as a food. For example, the Greek physician Dioscorides in the 1st century AD wrote: Yemen [18]] similar in consistency to salt and brittle enough to be broken between the teeth like salt. It is good dissolved in water for the intestines and stomach, and [can be] taken as a drink to help [relieve] a painful bladder and kidneys. It is a kind of honey found in cane, white as gum, and it crunches between the teeth. It comes in lumps the size of a hazelnut. Sugar is used only for medical purposes. Medieval Arabs in some cases set up large plantations equipped with on-site sugar mills or refineries. The cane sugar plant, which is native to a tropical climate, requires both a lot of water and a lot of heat to thrive. The cultivation of the plant spread throughout the medieval Arab world using artificial irrigation. Sugar cane was first grown extensively in medieval Southern Europe during the period of Arab rule in Sicily beginning around the 9th century. The volume of imports increased in the later medieval centuries as indicated by the increasing references to sugar consumption in late medieval Western writings. But cane sugar remained an expensive import. Its price per pound in 14th and 15th century England was about equally as high as imported spices from tropical Asia such as mace nutmeg , ginger, cloves, and pepper, which had to be transported across the Indian Ocean in that era. Early in the 12th century, Venice acquired some villages near Tyre and set up estates to produce sugar for export to Europe, where it supplemented honey as the only other available sweetener. The crucial problem with sugar production was that it was highly labour-intensive in both growing and processing. Because of the huge weight and bulk of the raw cane it was very costly to transport, especially by land, and therefore each estate had to have its own factory. There the cane had to be crushed to extract the juices, which were boiled to concentrate them, in a series of backbreaking and intensive operations lasting many hours. However, once it had been processed and concentrated, the sugar had a very high value for its bulk and could be traded over long distances by ship at a considerable profit. The [European sugar] industry only began on a major scale after the loss of the Levant to a resurgent Islam and the shift of production to Cyprus under a mixture of Crusader aristocrats and Venetian merchants. The local population on Cyprus spent most of their

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time growing their own food and few would work on the sugar estates. The owners therefore brought in slaves from the Black Sea area and a few from Africa to do most of the work. The level of demand and production was low and therefore so was the trade in slaves – no more than about a thousand people a year. It was not much larger when sugar production began in Sicily. In the Atlantic ocean [the Canaries, Madeira, and the Cape Verde Islands], once the initial exploitation of the timber and raw materials was over, it rapidly became clear that sugar production would be the most profitable way of getting money from the new territories. The problem was the heavy labour involved because the Europeans refused to work except as supervisors. The solution was to bring in slaves from Africa. It started in Madeira in 1482, using advisers from Sicily and largely Genoese capital for the mills. The accessibility of Madeira attracted Genoese and Flemish traders keen to bypass Venetian monopolies. By 1500, there were cane sugar mills in Santa Catarina Island and there were another 2, on the north coast of Brazil, Demarara, and Surinam. The first sugar harvest happened in Hispaniola in 1499; and many sugar mills had been constructed in Cuba and Jamaica by the 1500s. Specialist trades in mold-making and iron casting developed in Europe due to the expansion of sugar production. Sugar mill construction sparked development of the technological skills needed for a nascent industrial revolution in the early 17th century. Contemporaries often compared the worth of sugar with valuable commodities including musk, pearls, and spices. Sugar prices declined slowly as its production became multi-sourced, especially through British colonial policy. Formerly an indulgence of only the rich, the consumption of sugar also became increasingly common among the poor as well. Sugar production increased in mainland North American colonies, in Cuba, and in Brazil. The labour force at first included European indentured servants and local Native American slaves. However, European diseases such as smallpox and African ones such as malaria and yellow fever soon reduced the numbers of local Native Americans. African slaves became the dominant source of plantation workers because they were more resistant to malaria and yellow fever, and because the supply of slaves was abundant on the African coast. Britain, for example, consumed five times as much sugar in 1700 as in 1500. The heightened demand and production of sugar came about to a large extent due to a great change in the eating habits of many Europeans. For example, they began consuming jams, candy, tea, coffee, cocoa, processed foods, and other sweet victuals in much greater amount. Reacting to this increasing craze, the islands took advantage of the situation and set about producing still more sugar. In fact, they produced up to ninety percent of the sugar that the western Europeans consumed. Some islands proved more successful than others when it came to producing the product. Planters later began developing ways to boost production even more. For example, they began using more farming methods when growing their crops. They also developed more advanced mills and began using better types of sugarcane. In the eighteenth century "the French colonies were the most successful, especially Saint-Domingue, where better irrigation, water-power and machinery, together with concentration on newer types of sugar, increased profits. A 19th-century lithograph by Theodore Bray showing a sugarcane plantation. On right is "white officer", the European overseer. Slave workers toil during the harvest. To the left is a flat-bottomed vessel for cane transportation. As Europeans established sugar plantations on the larger Caribbean islands, prices fell, especially in Britain. By the 18th century all levels of society had become common consumers of the former luxury product. At first most sugar in Britain went into tea, but later confectionery and chocolates became extremely popular. Many Britons especially children also ate jams. Sugarcane quickly exhausts the soil in which it grows, and planters pressed larger islands with fresher soil into production in the nineteenth century as demand for sugar in Europe continued to increase: Instead, nearly three-quarters of its land formed a rolling plain – ideal for planting crops. Cuba also prospered above other islands because Cubans used better methods when harvesting the sugar crops: All these technologies increased productivity. Cuba also retained slavery longer than the most of the rest of the Caribbean islands. A sugar mill complex in Puerto Rico, painted by Francisco Oller in Brooklyn Museum Long established in Brazil, sugar production spread to other parts of South America, as well as to newer European colonies in Africa and in the Pacific, where it became especially important in Fiji. Mauritius, Natal and Queensland in Australia started growing sugar. The older and newer sugar production areas now tended to

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use indentured labour rather than slaves, with workers "shipped across the world In the second half of the nineteenth century over , indentured labourers went from India to the British West Indies, others went to Natal, Mauritius and Fiji where they became a majority of the population. In Queensland workers from the Pacific islands were moved in. On Hawaii , they came from China and Japan. The Dutch transferred large numbers of people from Java to Surinam. In Colombia , the planting of sugar started very early on, and entrepreneurs imported many African slaves to cultivate the fields. The industrialization of the Colombian industry started in with the establishment of Manuelita , the first steam-powered sugar mill in South America, by Latvian Jewish immigrant James Martin Eder. More information in the History section at Sugar beet In the German chemist Andreas Marggraf identified sucrose in beet root. While never profitable, this plant operated from until it suffered destruction during the Napoleonic Wars ca. Napoleon , cut off from Caribbean imports by a British blockade , and at any rate not wanting to fund British merchants, banned imports of sugar in In the developed countries, the sugar industry relies on machinery with a low requirement for manpower. A large beet refinery producing around 1, tonnes of sugar a day needs a permanent workforce of about for hour production. Mechanization[edit] Beginning in the late 18th century, the production of sugar became increasingly mechanized. The steam engine first powered a sugar mill in Jamaica in , and soon after, steam replaced direct firing as the source of process heat. In the British chemist Edward Charles Howard invented a method of refining sugar that involved boiling the cane juice not in an open kettle, but in a closed vessel heated by steam and held under partial vacuum. At reduced pressure, water boils at a lower temperature, and this development both saved fuel and reduced the amount of sugar lost through caramelization. Further gains in fuel-efficiency came from the multiple-effect evaporator , designed by the United States engineer Norbert Rillieux perhaps as early as the s, although the first working model dates from This system consisted of a series of vacuum pans, each held at a lower pressure than the previous one. The vapors from each pan served to heat the next, with minimal heat wasted. Modern industries use multiple-effect evaporators for evaporating water. The process of separating sugar from molasses also received mechanical attention:

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Chapter 6 : Full text of "A century of sugar refining in the United States, "

A century of sugar refining in the United States, A century of sugar refining in the United States, by American sugar refining company.

BIBLIOGRAPHY Sugar has been an important commodity historically due to a variety of factors, including the human appetite for sweet foods and drinks, the complementarity that sugar brings to the other flavors in food, its preservation and fermentation properties, and the calories it provides. Sugar or more precisely sucrose was first prepared in India. Trade in sugar was further expanded in the Mediterranean region by the Arab conquest of the sixth century CE. Improvements in the crystallization process expanded the sugar trade especially in the form of molasses in the twelfth century. However, the limited supply of sugar in the international market caused refined sugar to be relatively costly until the production of sugar by European colonies in the Americas grew after This expansion, coupled with improvements in refining technologies that reduced unwanted tastes in the sweetener, caused sugar to replace other sweeteners such as honey, becoming the dominant sweetener over time. While demand for sugar remained relatively unaffected by the introduction of non-nutritive sweeteners, in the early twenty-first century the dominance has been challenged, particularly in the United States , by high fructose corn syrup HFCS. The competition between sugar and HFCS raises several policy questions. Specifically colonization of the Americas as well as other parts of the globe in the eighteenth and nineteenth centuries was at least partially driven by economic considerations of the countries involved. Restrictions were placed on the countries with which colonies could trade. Raw goods produced in the colonies were required to be sold in the mother country and significant import restrictions existed to encourage the purchase of manufactured goods to each respective European power. This enabled the European powers economic benefits from the colonization of the New World. Another byproduct of the rise of sugar in European colonies in general and in the Americas in particular was the linkages between sugar and slavery. As described by B. The movement toward monoculture and increased farm size has proven not to be unique to sugar; however, certain characteristics of sugar production may make the crop more susceptible to the establishment of plantations. The relationship between sugar and slavery may be more systematic. The exact reason for this linkage is unclear. One explanation for this linkage could be the presence of scale economies. In Mark Schmitz found evidence of significant economies of scale in Antebellum sugar production in Louisiana , which used slavery. The elimination of slavery in the colonial powers and the United States in the nineteenth century changed the institutions in the labor relationship. Slaves were replaced with contract labor, but the use of contract labor in the sugar plantations implied a radical change in the source of that labor. Before one-half to two-thirds of the contract labor destined for the British Caribbean and other North American colonies came from Europe. However, the contract labor for the sugar plantations was predominantly non-white. This shift also implied significant changes in the terms of the labor contract. In addition, the reduction of the availability of contract labor from countries such as India undoubtedly accelerated the introduction of labor-saving technology to the industry. The entanglement of European powers in the trade of sugar also contributed to the first significant alternative sweetener. The British blockade of European ports during the Napoleonic wars led to the development of a viable sugar beet industry in France. In the twenty-first century sucrose from sugarcane and sugar beets share the global market for refined sugar. The expansion of sugar beet production in the second half of the nineteenth century followed a host of factorsâ€”including the abolition of slavery in Britain and France and the expansion of grain imports from Russiaâ€”that reduced the profitability of grain crops in Europe. The decline in the price of sugar had two divergent impacts on the economy. First, lower sugar prices reduced the cost of a primary input for a variety of industries i. Second, lower sugar prices impoverished producers in the colonies. The same policy scenario applies to the present-day United States. Sugar tariffs pit the interest of sugar producers against the interests of confectionary manufacturers. The ultimate dispensation of this debate depends on the relative political power

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of each sector through rentseeking behavior. One response to the declining sugar prices both in the nineteenth and in the twenty-first centuries is the establishment of import tariffs or quotas to increase the domestic price and, thereby, protect domestic sugar producers. The CAP established a system of tariffs to protect domestic producers from foreign competition. At the beginning of the twenty-first century, most countries that support their internal sugar price use a form of the tariff rate quota TRQ which is allowed under the Uruguay Round Agreement on Agriculture. The TRQ is a system of two tariffs. The first tariff allows the sale of a fixed quantity or minimum access of a commodity at a lower or first tier tariff. Any quantity of that commodity imported above this fixed quantity is charged a higher typically prohibitive tariff. Given that the second tariff level is prohibitive, the country can increase the price received by domestic producers by reducing the fixed quantity imported under the first tier tariff. This is the policy instrument used by both the United States and the EU to increase the price of sugar for their respective producers. Specifically, former colonies can be allocated portions of the minimum access quantity, in essence giving ACP countries access to a higher internal price of sugar at a low tariff rate. The United States allocates its first-stage quota in a similar way to a group of forty countries. Apart from its grounding in historical trade patterns, the international sugar market is also affected by a myriad of regional and global trade agreements. Regional trade agreements involve a small number of countries in the same geographic region. In this context, the agreements forming the EU are a regional trade agreement. The effect of each of these trade agreements on sugar markets is dependent on the role sugar plays in each group of economies. An example of the ambiguous role regional trade agreements play in the sugar market can be found in NAFTA. As discussed, the sugar price in the United States is protected by a system of tariffs. From this perspective both freer trade with both Canada and Mexico raise critical issues. First, while Canada does not pose a direct threat to the U. However, NAFTA still allows for the importation of sugar containing products from Canada, increasing the competition for confections in the United States and reducing the demand for sugar. A different set of problems was raised by the potential effects of Mexican sugar production on the U. Specifically, since Mexico imports sugar and other sweeteners, the domestic producers wanted to be protected from pass-through sugar i. Hence, Mexico was granted duty-free access to the U. If Mexico obtained the status of a net sugar-surplus producer, the quota would be expanded to 25, metric tons in years 1 to 6 and , metric tons in years 7 to . Some controversies have arisen in the implementation of these provisions. Specifically, the original provisions were restricted to becoming a net sugar-surplus producer, ignoring the potential impact of alternative sweeteners such as HFCS. The primary question is then whether significant changes to these accepted instruments will occur in the Doha round of WTO negotiations started in

At its inception, increases in market-access were primary to the Doha round discussion on agricultural trade. One idea is to increase market access by expanding the minimum access portions of the TRQs. Adding a layer of complication, the government supports the domestic price of sugar by providing a nonrecourse loan for raw sugar at 18 cents per pound and refined sugar produced from sugar beets at . If the market price falls below 18 cents per pound, producers or more accurately sugar mills store their raw sugar and receive a loan from the government of 18 cents for every pound of raw sugar placed in storage. If the market price for sugar rises over 18 cents per pound plus any interest accrued, they take the sugar out of storage, sell it at the prevailing market price, and repay the loan. However, if the market price for sugar does not exceed 18 cents per pound plus accrued interest during the marketing year, producers simply forfeit sugar in storage to the government in fulfillment of the loan. While the nonrecourse loan program for sugar is typical for agricultural commodities in the United States, it is encumbered by the Dole Amendment, which requires the sugar program to be operated at no cost to the government. Certain characteristics of sugar production have implications for vertical integration in the market channel for sugar. Sugar is produced from two different primary crops: While the end product is . The production of sugarcane typically occurs in tropical or subtropical climate zones. The stalks containing the sucrose are removed from the field for milling that produces a raw form of sugar that is relatively stable. The raw sugar is then later refined into table sugar, removing impurities that may affect the flavor. Technical considerations require that these mills be located close to production. When the stalks are

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harvested in the field the sucrose content of the sugarcane starts to deteriorate. Further, the sucrose content of standing sugarcane deteriorates after a freeze. In the case of sugarcane, the potential deterioration of quality gives rise to the possibility of monopolistic rents. The possible economic losses of economic rents more than offset the economic costs of diversification into processing facilities. Viewing the transaction from the other side, the diversification into sugarcane production insures a steady supply of sugarcane into the future, reducing the risk of investment. Production of sucrose from sugar beets does not face the same climatic constraints as sugarcane. Further, the sucrose content of sugar beets is more stable than sugarcane, extending the period for the extraction of sucrose from sugar beets. Thus sugar beet producers have less impetus for vertical integration than producers and processors of sugarcane. Finally, any discussion of the sweetener markets, particularly in the United States, is not complete without reference to HFCS. HFCS is a liquid sweetener derived from corn that can be used in production of soft drinks and other industrial uses. It is typically conceded that sugar tariffs in the United States provided the incentives for the commercial development of HFCS production. However, while HFCS is a perfect substitute for sugar in many applications, it lacks the baking quality to replace sugar completely. The interaction between sugar and HFCS prices is then dependent on the saturation of specific sweetener markets. For example, HFCS is easily used in the production of soft drinks and, because it is typically priced lower than sugar, dominates the sweetener market for this market. Thus the relationship between HFCS and sugar prices depends on the substitutability of the use at the margin. The Nature of the Firm. *Journal of Economic History* 43 3: American Economic Review 67 3: Transitions in the Mexican Sugar Industry. Sugar Policy and Prospects for the U. Andrew Schmitz, Thomas H. *Economic History Review* 53 2: Cointegration with Substitute Goods. The Plantation Economy as an Economic System.

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The original refinery was built in , and by it processed more than half of the sugar used in the United States. The Havemeyer family established their first sugar refinery on Vandam Street in Manhattan at the turn of the nineteenth century.

Any reproduction by any means whether printed, electronic, or other media, regardless of whether for sale, commercial use, or gratis, without the written permission of the author is prohibited. Before sugar made from sugar cane was discovered, the only sweetening product was honey that was produced by bees. In an B. Chinese writing, it was noted that sugar originally come from India. It was not until B. From most indications, the Egyptians were the first to use modern methods to convert cane juice into sugar. Lime calcium oxide and albumen egg white removed the impurities from the pressed cane juice. The resulting liquid was then boiled, evaporating most of the water, and as the liquid was agitated, crystals of sugar formed. Lastly the residual molasses was washed from the crystals using water. This method was very similar to that used later in Europe. Darius the Great brought sugar to Persia, on his return from expeditions to India around B. The 2 Saracens introduced sugar into Egypt, Sicily and Spain. Pliny the Elder wrote of a sweet reed and described sugar as being white, which crackled like salt, was sweet like honey, with the largest pieces being the size of a filbert hazelnut , and only was used as a medicine. It is thought that the Arabs first brought sugar from India into Arabia around A. There are numerous references to sugar and sugar cane in the Arabian Nights and in , an Arabian author wrote about the cultivation of sugar cane and the process used to create sugar crystals. Another premise, on the spread of sugar in the western word, was that soldiers returning from the Crusades in A. D introduced sugar to their homelands. It is believed that Marco Polo introduced sugar to the Venetians in the twelfth century; he wrote of the abundance of sugar in China and of the described the Egyptian method of sugar refining. The astute Venetians merchants recognized the advantages of this sweet substance, and established European control of the sugar market from the early s to the late s. In the beginning they imported Egyptian sugar, but later they imported the cane and built their own refineries. The Venetians were the first to form sugar loaves or cones and, for more than five hundred years, the process and shape of refined sugar remained almost unchanged. Sugar-candy was also introduced by the Venetians sometime between and The first cookbook to include recipes including sugar was published in Venice in Since sugar was readily available in Italy, those that could afford it consumed it in great quantities. It was used in all foods and the use of sugar decorations was extensive. In some cases, entire table services and the food were made from spun sugar. In France, as sugar became more available and in , it was recorded that Charles V used a mixture of cinnamon and sugar to spice his foods. It is unclear if France obtained its sugar from Venice or if they imported it directly from the Greek islands. The break on the Venetian sugar monopoly began in , when Vasco de Gama introduced Indian sugar to Portugal, and Lisbon then began refining its own sugar. In , the Portuguese planted sugar cane in Madeira and the Canary Islands and from there it traveled to the coast of Africa and in Brazil. Columbus introduced sugar cane to the West Indies in , on his second voyage to the 3 Americas, and by , sugar was being produced in Haiti and the Dominican Republic. In England, before, sugar was extremely rare in because it was had to be imported from Portugal, Venice and Genoa, which made it so expensive that only the wealthy could afford sugar. Despite the expense, the royal households had a sweet tooth, and there were records of regular purchases of sugar being made by the household of Henry II, and in Henry III ordered pounds of sugar. In , the household of Edward I purchased more than 6, pounds of sugar and there was a shipping record listing the sale of 1,, pounds of refined sugar and 10, pounds of sugar-candy to English sources. Refined sugar was also mentioned in a provision list during the reign of Henry VII. After coffee and tea were introduced in England, the demand for sugar continued to increase and in the English began to manufacture sugar in St. Claims were made that sugar cured hemorrhoids, ulcers of the stomach, headaches, and relieved childbirth pain. A writer from the mids mentioned that sugar could clean the blood,

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strengthen the body and mind, was good for the eyes and common cold, healed wounds, and when mixed with wine and cinnamon invigorated the elderly, but also warned that it could cause the teeth to decay. The growing of sugar cane required an abundance of cheap labor, i. The Spanish started by using the native population to produce cane but soon exhausted the available labor pool. They began to import slaves from Africa and by they were bringing slaves into Hispaniola. The Portugese started importing slaves into Brazil in to work on the five sugar plantations, and by , there were sugar plantations in Brazil which required slaves. In two hundred years, millions of slaves had been imported from Africa into the New World just to work on sugar plantations. This slave economy in the West Indies influenced the economy of the English colonies and later that of the United States. The New England colonies supplied food to the Indies, particularly salted cod, which were used to feed the slaves on the plantations. The ships returning to New England brought sugar and molasses from the Indies. Since it was more profitable to ship the sugar, rather than molasses, to Europe, the cheaper molasses was left in New England for the colonists but the supply of molasses was greater than the consumption. Soon there was a surplus of molasses in New England and the surplus was eliminated by distilling it into rum. Thus, the New England rum industry was born. As New England became a ship building and shipping center, slaves were 4 purchased in Africa, sold to the plantations in the Indies to work on the sugar plantations. Other colonies began shipping their exports to the West Indies in order to purchase raw sugar for processing. After , sugar culture migrated from western Europe to the West Indies and later to America. Sugar cane was grown, on a small scale, in the warmer climates of Louisiana, Mississippi, Georgia, and Alabama and in , the first sugar mill was built by the Mississippi River. By , sugar as a crop, was introduced to New Orleans by Jesuit priests, but they met with little success. John Randolph, of Louisiana, established one of first successful sugar plantations in The sugar content of American sugar cane was lower than that of West Indian cane; it was never grown in the quantities that could completely eliminate the need for imported sugar. Refineries found it more profitable to purchase raw sugar and molasses from the Indies and refine the sugar in the States rather than to depend solely on domestic sugar crops. In , the United States imported ,, pounds of raw sugar and 30,, gallons of molasses Dept. The Civil War almost stopped sugar production and in Louisiana, the production dropped from , tons of sugar in to less than tons in The American sugar industry never quite recovered after the Civil War, especially after competition from Cuba and Hawaii increased. Though sugar was not grown in America until the early nineteenth century, raw sugar was imported and refined in factories situated in the northeastern colonies or states. Rhinelanders was the first sugar refinery in the English colonies was built in in New York City. The tax rolls of Boston indicate that Ezechiel Cheever operated a sugar refinery in Charlestown from to According to the United States Census, there were thirty-three refineries in the United States, and by , there was a total of thirty-nine sugar refineries; eighteen of which were in New York and only two were located in southern states. The highest number was recorded in , with forty-two refineries but 5 by , the number had dwindled to thirty-seven. One of the oldest refineries was established in by two brothers, William and Frederick Havemeyer who had just emigrated from England to the United States. They opened a sugar refinery on Manhattan Island, New York. The above statistics are for refined sugar, both cane and beet when applicable , rather than for economic consumption total amount of sugar produced divided by population. Most of us are familiar with shortages in the South, but few think of the northern shortages. The blockaded southern ports and the inability to import or export goods, caused shortages. Some were artificially created when 6 speculators purchased a majority of a particular item and others were due to the blockaded ports. In the North shortages were created by the ships being used for war purposes and not the importing of foreign goods and railroads being used for military purposes. In the case of sugar, the raw sugar was not exported from the South. Before the war, sugar sold for about the same price in both the North and South. Brown sugar cost about nine cents per pound and white sugar sold for an average price of nineteen cents per pound Molasses sold for about seventy-five cents per gallon. Molasses was cheaper in the North before the war at about thirty-three cents per gallon. As the war progressed, prices rose; more so in the South than in the North. In Maine, by , the price of both brown sugar and molasses had doubled. White sugar also disappeared

from the tables of most people. Sorghum appeared in both regions to make up for the loss of sugar and molasses. Before the war, it was grown both in the North and the South, but during the war its cultivation increased in the Northwest. Maple sugar and beet sugar was also used to some extent, but did not completely compensate for the loss of refined sugar. Evidence of sugar refining exists from the fourth century but the Venetians were probably the most well known European refiners. The methods used in the United States up until the mid-nineteenth century were very similar to those used by the Venetians since the thirteenth century. There were many steps between the cane fields and the barrel of sugar or blue wrapped loaves on store shelves. The initial refining was done near the cane fields because freshly pressed cane juice fermented in less than twenty-four hours. Cane juice was pressed from the stalks by running them through a series of fluted wood or cast iron rollers; the juice was then cooked in large flat-bottomed copper pans, called clarifiers. The acidity of the cane juice was reduced by adding quicklime [calcium oxide] and as the impurities rose to the surface they were removed by skimming the surface of the liquid. The cleared liquid was siphoned into copper evaporating pans, where additional lime-water was added to further reduce the acidity. As the liquid boiled the scum was removed a second time. The remaining liquid, called treche, was boiled again in smaller copper pans until it was reduced sufficiently to support the granulation of sugar. The thickened liquid was placed in cooling pans and was stirred with wooden paddles, and as it cooled, the sugar crystalized into small, irregular crystals or grains which were suspended in the molasses. The molasses slowly drained through the 7 spongy stalks, leaving the sugar crystals in the bottom of the hogshead. After about three weeks, the sugar that remained in the barrels, was packed into large hogsheads or tierces, each weighing between twelve hundred and two thousand pounds which were shipped from the sugar-houses to the refineries or stores where it was refined further or sold in stores as Muscovado or raw sugar. The molasses that remained could be processed into inferior sugars, rum or sold as sugar-house molasses. Basic steps of refining process using the vacuum pan but the other steps were the same in with other refining processes. Once the dark Muscovado sugar reached the refinery, it was clarified into a lighter colored sugar. The liquid was then heated to boiling, which caused the protein in the egg white or blood to coagulate and float to the 8 top, and the encapsulated impurities in the sugar were removed by a skimmer. The skimmed liquid was simmered for a time and the heat gradually increased until a sufficient amount of water had evaporated, thus producing a syrup.

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Chapter 8 : American Sugar Refining Company - Wikipedia

American Sugar Refining Company continued to dominate the sugar industry in the United States through most of the 20th Century. Its brands included the dominant Domino Sugar, Franklin Sugar, Sunny Cane Sugar, and its West Coast beet sugar operation under the Spreckels brand.

Sugar Background Before the birth of Jesus of Nazareth, sugarcane from which sugar is made was harvested on the shores of the Bay of Bengal; it spread to the surrounding territories of Malaysia, Indonesia, Indochina, and southern China. The Arabic people introduced "sugar" at that point a sticky paste, semi-crystallized and believed to have medicinal value to the Western world by bringing both the reed and knowledge for its cultivation to Sicily and then Spain in the eighth and ninth centuries. Later, Venice's importing finished sugar from Alexandria succeeded in establishing a monopoly over this new spice by the fifteenth century; at that point, it started buying raw sugar, and even sugarcane, and treating it in its own refineries. In 1498, Portuguese navigator Vasco da Gama returned from India bringing the sweet flavoring to Portugal. Lisbon started to import and refine raw sugar, and, in the sixteenth century, it became the European sugar capital. It was not long before the sweetener was available in France, where its primary function continued to be medicinal, and during the reign of Louis XIV, sugar could be bought by the ounce at the apothecary. By the 18th century, sugar though still expensive was widely available to both upper and middle classes. **Raw Materials** Sugar is a broad term applied to a large number of carbohydrates present in many plants and characterized by a more or less sweet taste. The primary sugar, glucose, is a product of photosynthesis and occurs in all green plants. In most plants, the sugars occur as a mixture that cannot readily be separated into the components. In the sap of some plants, the sugar mixtures are condensed into syrup. Juices of sugarcane *Saccharum officinarum* and sugar beet *Beta vulgaris* are rich in pure sucrose, although beet sugar is generally much less sweet than cane sugar. These two sugar crops are the main sources of commercial sucrose. The sugarcane is a thick, tall, perennial grass that flourishes in tropical or subtropical regions. Sugar synthesized in the leaves is used as a source of energy for growth or is sent to the stalks for storage. It is the sweet sap in the stalks that is the source of sugar as we know it. The reed accumulates sugar to about 15 percent of its weight. Sugarcane yields about 20,000 tons of sugar per year. The sugar beet is a beetroot variety with the highest sugar content, for which it is specifically cultivated. While typically white both inside and out, some beet varieties have black or yellow skins. About 30,000 tons of sugar are manufactured from sugar beet. Other sugar crops include sweet sorghum, sugar maple, honey, and corn sugar. The types of sugar used today are white sugar fully refined sugar, composed of clear, colorless or crystal fragments; or brown sugar, which is less fully refined and contains a greater amount of treacle residue, from which it obtains its color. **The Manufacturing** **Planting and harvesting** 1 Sugarcane requires an average temperature of 75 degrees Fahrenheit The harvested cane stalks and beets are loaded mechanically into trucks or railroad cars and taken to mills for processing into raw sugar. Once there, they are cleaned, washed, milled to extract juice, filtered, and purified. The result is a clear, sugar-filled juice. Celsius and uniform rainfall of about 80 inches centimeters per year. Therefore, it is grown in tropical or subtropical areas. Sugarcane takes about seven months to mature in a tropical area and about 12 months in a subtropical area. At this time, fields of sugarcane are tested for sucrose, and the most mature fields are harvested first. In Florida, Hawaii, and Texas, standing cane is fired to burn off the dry leaves. In Louisiana, the six- to ten-foot 1. The harvested cane stalks are loaded mechanically into trucks or railroad cars and taken to mills for processing into raw sugar. **Preparation and processing** 3 After the cane arrives at the mill yards, it is mechanically unloaded, and excessive soil and rocks are removed. The cane is cleaned by flooding the carrier with warm water in the case of sparse rock and trash clutter or by spreading the cane on agitating conveyors that pass through strong jets of water and combing drums to remove larger amounts of rocks, trash, and leaves, etc. At this point, the cane is clean and ready to be milled. When the beets are delivered at the refinery, they are first washed and then cut into strips. Next, they are put into diffusion cells with After being purified, the clear juice undergoes vacuum

evaporation to remove most of the water. In this process, four vacuum-boiling cells are arranged in series so that each succeeding cell has a higher vacuum. The vapors from one body can thus boil the juice in the next one, a method called multiple-effect evaporation. Next, the syrupy solution is vacuum-crystallized to form sugar crystals. The remaining liquid is removed using centrifuging and drying, and the sugar is packaged.

Juice extraction 4 Two or three heavily grooved crusher rollers break the cane and extract a large part of the juice, or swing-hammer type shredders 1, RPM shred the cane without extracting the juice. Revolving knives cutting the stalks into chips are supplementary to the crushers. In most countries, the shredder precedes the crusher. A combination of two, or even all three, methods may be used. The pressing process involves crushing the stalks between the heavy and grooved metal rollers to separate the fiber bagasse from the juice that contains the sugar. The extracted juice, called vesou, contains 95 percent or more of the sucrose present. The mass is then diffused, a process that involves finely cutting or shredding the stalks. Next, the sugar is separated from the cut stalks by dissolving it in hot water or hot juice.

Purification of juice 6 The juice from the mills, a dark green color, is acid and turbid. The clarification or defecation process is designed to remove both soluble and insoluble impurities such as sand, soil, and ground rock that have not been removed by preliminary screening. The process employs lime and heat as the clarifying agents. Milk of lime about one pound per ton of cane neutralizes the natural acidity of the juice, forming insoluble lime salts. Heating the lime juice to boiling coagulates the albumin and some of the fats, waxes, and gums, and the precipitate formed entraps suspended solids as well as the minute particles. The sugar beet solution, on the other hand, is purified by precipitating calcium carbonate, calcium sulfite, or both in it repeatedly. Impurities become entangled in the growing crystals of precipitate and are removed by continuous filtration. The non-sugar impurities are removed by continuous filtration. The final clarified juice contains about 85 percent water and has the same composition as the raw extracted juice except for the removed impurities. Generally, four vacuum-boiling cells or bodies are arranged in series so that each succeeding body has a higher vacuum and therefore boils at a lower temperature. The vapors from one body can thus boil the juice in the next one—the steam introduced into the first cell does what is called multiple-effect evaporation. The vapor from the last cell goes to a condenser. The syrup leaves the last body continuously with about 65 percent solids and 35 percent water. The sugar beet sucrose solution, at this point, is also nearly colorless, and it likewise undergoes multiple-effect vacuum evaporation. The syrup is seeded, cooled, and put in a centrifuge machine. The finished beet crystals are washed with water and dried.

Crystallization 9 Crystallization is the next step in the manufacture of sugar. Crystallization takes place in a single-stage vacuum pan. The syrup is evaporated until saturated with sugar. As soon as the saturation point has been exceeded, small grains of sugar are added to the pan, or "strike. Seed grain is formed by adding 56 ounces [1, grams] of white sugar into the bowl of a slurry machine and mixing with 3. The machine runs at RPM for 15 hours. Additional syrup is added to the strike and evaporated so that the original crystals that were formed are allowed to grow in size. The growth of the crystals continues until the pan is full. When sucrose concentration reaches the desired level, the dense mixture of syrup and sugar crystals, called massecuite, is discharged into large containers known as crystallizers. Crystallization continues in the crystallizers as the massecuite is slowly stirred and cooled.

Centrifuging 11 The high-speed centrifugal action used to separate the massecuite into raw sugar crystals and molasses is done in revolving machines called centrifugals. A centrifugal machine has a cylindrical basket suspended on a spindle, with perforated sides lined with wire cloth, inside which are metal sheets containing to perforations per square inch. The basket revolves at speeds from 1, to 1, RPM. The raw sugar is retained in the centrifuge basket because the perforated lining retains the sugar crystals. The mother liquor, or molasses, passes through the lining due to the centrifugal force exerted. The final molasses blackstrap molasses containing sucrose, reducing sugars, organic nonsugars, ash, and water, is sent to large storage tanks. Once the sugar is centrifuged, it is "cut down" and sent to a granulator for drying. In some countries, sugarcane is processed in small factories without the use of centrifuges, and a dark-brown product noncentrifugal sugar is produced. Centrifugal sugar is produced in more than 60 countries

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while noncentrifugal sugar in about twenty countries. Drying and packaging 12 Damp sugar crystals are dried by being tumbled through heated air in a granulator. The dry sugar crystals are then sorted by size through vibrating screens and placed into storage bins. Sugar is then sent to be packed in the familiar packaging we see in grocery stores, in bulk packaging, or in liquid form for industrial use. Byproducts The bagasse produced after extracting the juice from sugar cane is used as fuel to generate steam in factories. Increasingly large amounts of bagasse are being made into paper, insulating board, and hardboard, as well as furfural, a chemical intermediate for the synthesis of furan and tetrahydrofuran. The beet tops and extracted slices as well the molasses are used as feed for cattle. It has been shown that more feed for cattle and other such animals can be produced per acre-year from beets than from any other crop widely grown in the United States. The beet strips are also treated chemically to facilitate the extraction of commercial pectin. The end product derived from sugar refining is blackstrap molasses. It is used in cattle feed as well as in the production of industrial alcohol, yeast, organic chemicals, and rum. Quality Control Mill sanitation is an important factor in quality control measures. Bacteriologists have shown that a small amount of sour bagasse can infect the whole stream of warm juice flowing over it. Modern mills have self-cleaning troughs with a slope designed in such a way that bagasse does not hold up but flows out with the juice stream.

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Chapter 9 : Domino Park | History

In the United States and Japan, high-fructose corn syrup has replaced sugar in some uses, particularly in soft drinks and processed foods. The process by which high-fructose corn syrup is produced was first developed by Richard O. Marshall and Earl R. Kooi in

Sugar was produced in Stephen F. In the s sugar production and acreage devoted to growing sugar increased. Cane production on a commercial scale was not attempted until the s, when wet weather and crop pests damaged much of the coastal cotton crop. Production climbed throughout the decade, due largely to improved farming methods and processes of refining, and reached the antebellum peak of 11, 1,pound hogsheads in Brazoria County produced almost 75 percent of the total. The other significant sugar producing counties during this period were Fort Bend, Matagorda, and Wharton, but in no part of the sugar district was cane grown on a majority of the farms. After reaching its peak in the early s, cold weather and severe drought caused a decline in the industry in Texas. Sugar production in the antebellum era required a substantial capital outlay. In addition to land and slaves, most planters had a steam roller mill for grinding the cane and a sugarhouse for boiling it in the open-kettle method. Although raw sugar produced on antebellum plantations was of a poor grade, it was usually sold without further processing in southern markets. A smaller amount of sugar was sold in the northeast, where it was refined before marketing. In the s it was estimated that each full hand could cultivate slightly more than three acres of land in cane. Under plantation milling conditions, with juice extractors that were only 55 to 65 percent efficient, an acre of cane yielded approximately one ton of sugar in its first year and somewhat less in the following year as stubble cane or ratoons. If the cane was not then replanted, the yields in succeeding years would be too small to yield a profit. The rich river bottoms usually required a rotation of two years of cane and one or two years of corn and peas to restore soil fertility. Insects and crop diseases caused less damage than weather conditions. Late frosts injured growing cane and reduced stands, early frosts destroyed ripened cane before it could all be harvested, and storms and floods were a constant threat. The abolition of slavery necessitated a new labor system after the Civil War. Unlike Louisiana, where most of the sugar plantations were worked by wage labor, Texas relied on the convict lease system. The cost per worker actually exceeded the prevailing wage scale, but the labor force, as under slavery, was constant and guaranteed. In a Texas Sugar Growers Association was formed for the purpose of expanding sugar production in the state, but it failed to get federal funding for a sugar experiment station. Major innovations in cane culture and sugar processing came from the Caribbean and Louisiana. In the last quarter of the nineteenth century, larger roller mills for crushing cane and extracting juice, combined with improvements in the crystallization process, greatly increased yields and improved the grade of the product. The new machinery separated cane farming from sugar manufacturing. Growers adopted such labor-saving devices as the row cultivator and mechanical cane loader. The first decade of the twentieth century saw expansion within the Brazos and Colorado sugar region and the beginning of cane production in the lower Rio Grande valley. Expansion continued until , when a combination of factors hurt the domestic sugar industry. Mosaic disease that spread through the entire United States cane crop caused declining yields. Prices plummeted from an average of 14 cents a pound in to 5 cents late in and 3. Commercial cane production was largely abandoned in Texas for about fifty years following . During the s most Texas sugar was used for the production of syrup. Sorghum syrup was produced in East Texas counties with small mills using homegrown sorghum crops. Sugarcane syrup was also produced in some Gulf Coast and East Texas counties. In , gallons of sorghum syrup were produced. In the late s, however, sorghum syrup production declined. Only 30, gallons were produced in the state in . Sugar beets were also grown in the s in Texas, mainly in Deaf Smith and other Panhandle counties. The production of sugar beets was estimated at , bushels. The first sugar mill for processing beets in Texas was opened at Hereford in Deaf Smith County in . In that year approximately , tons were processed, and by sugar beet production in Texas yielded , tons. In the state produced a total of , tons of

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refined beet sugar. Limited amounts of cane were grown through the s and s, but cane production in Texas greatly increased in the latter half of the century. In Texas produced , tons of cane sugar. The leading cane growing counties were Hidalgo, Cameron, and Willacy. Throughout the late twentieth century, Imperial Sugar Company in Sugar Land was the only company refining cane sugar in Texas. Carnegie Institution, ; rpt. Hogan, *The Texas Republic: A Social and Economic History* Norman: University of Oklahoma Press, ; rpt. Mintz, *Sweetness and Power*: Joseph Carlyle Sitterson, *Sugar Country*: University of Kentucky Press,