Norbert Rillieux and a Revolution in Sugar Processing

New Orleans, Louisiana

April 18, 2002

Chemical Landmark

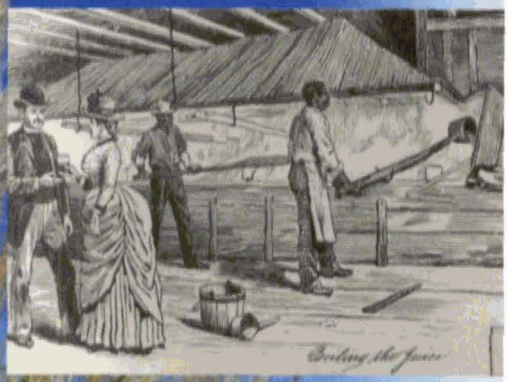
A National Historic

sugar

AMERICAN CHEMICAL SOCIETY

SCIENCE THAT MATTERS

A revolution in sugar processing



Sugar Cane Production

Early Nineteenth Century Sugar Processing

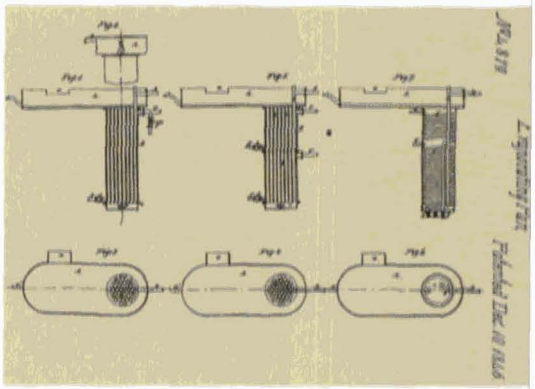
Sugar cane is normally harvested in the fall. After cutting, the cane is milled to produce sugar cane juice. Originally animal power was used to grind the cane; by the 1830s, steam power began to replace animal power. In either case, the cane juice was boiled in four large open kettles arranged in a kettle train, often called the Jamaica train. In this system, teams of slaves ladled boiling sugar juice from one open kettle to another. At each step of the process, the juice became more and more concentrated; in the last kettle, the boiling mass began to produce sugar crystals.

The Jamaica train was primitive because it required the constant attention of teams of slaves performing tedious, backbreaking, and dangerous manual labor; wasteful because much sugar was lost in the process; and inefficient because each kettle required its own source of heat, usually wood. The resulting sugar tended to be of low quality since the heat could not be regulated, and much sugar was lost in the process of transferring juice from kettle to kettle.

The Multiple Effect Evaporator

Norbert Rillieux's great scientific achievement was to recognize the economies that could be realized by the repeated use of the latent heat in steam, in effect to harness the energy of the steam rising from the boiling juice to heat the liquid in the next step in the refining process.

Rillieux utilized the latent heat produced from evaporating sugar cane juice by employing a series of three or four closed evaporating pans in which vapor was piped out of each pan to heat the juice in the next, with the vapors in the end going to a condenser. At the same time, pressure in the system was reduced by pumps, which created partial vacuums and lowered the boiling point of the liquid. A description of the invention's design is given in Rillieux's 1846 patent:

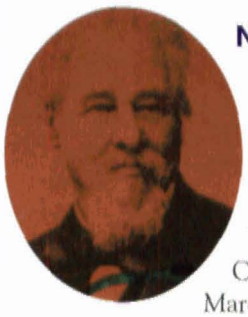


A series of vacuum pans, or partial vacuum pans, have been so combined together as to make use of the vapor of the evaporation of the juice in the first, to heat the juice in the second and the vapor from this to heat the juice in the third, which latter is in connection with a condenser, the degree of pressure in each successive one being less… The number of sirup-pans may be increased or decreased at pleasure so long as the last of the series is in conjunction with the condenser.

Better, Cheaper Sugar- and More

Rillieux's invention allowed for the production of better quality sugar with less manpower and at reduced cost. One of the major economies was the conservation of fuel, because wood was needed to heat only the first chamber. Each successive chamber used the latent heat released by steam from the preceding chamber.

Sugar manufacturers around the world in Cuba, Mexico, France, and Egypt, as well as the United States, adopted Rillieux's evaporator. Moreover, the device was not limited to sugar production but came to be recognized as the best method for lowering the temperature of all industrial evaporation and for saving large quantities of fuel. Multiple effect evaporation under vacuum is still used in sugar production as well as in the manufacture of condensed milk, soap, glue, and many other products.



Norbert Rillieux

The birth record on file in New Orleans City Hall is spare: "Norbert Rillieux, quadroon libre, natural son of Vincent Rillieux and Constance Vivant. Born March 17, 1806. Baptized in St. Louis Cathedral by Père Antoine."

Vincent Rillieux was an inventor himself who designed a steam-operated press for baling cotton. He appears to have had a long relationship with Constance Vivant, "a free woman of color," and one of their sons, Norbert, became what is now called a chemical engineer. The use of the father's surname and the baptism in New Orleans' cathedral indicate the paternity was publicly acknowledged.

As a boy the precocious Norbert showed an interest in engineering, and his father sent him to France for his education. By the age of 24, Rillieux was an instructor in applied mechanics at the École Centrale in Paris. Around 1830, Rillieux published a series of papers on steam engines and steam power.

While in France, Rillieux began working on the multiple effect evaporator. He returned to New Orleans in the early 1830s, years that coincided with a sugar boom. Rillieux tinkered with his invention over the next decade, and in 1843 he was hired to install an evaporator on Judah Benjamin's Bellechasse Plantation. Benjamin, a Jewish lawyer who later served as secretary of war in the Confederacy, became Rillieux's staunchest supporter in Louisiana sugar circles. Benjamin wrote in 1846 that sugar produced with the Rillieux apparatus was superb, the equal of "the best double-refined sugar of our northern refineries."

The success of his evaporator apparently made Rillieux, according to a contemporary, "the most sought after engineer in Louisiana," and he acquired a large fortune. But while his invention no doubt enriched sugar planters, Rillieux was still, under the law, "a person of color" who might visit sugar plantations to install his evaporator but who could not sleep in the plantation house. (Nor, for that matter, could a man of Rillieux's accomplishments be expected to stay in slave quarters. Some planters, it appears, provided Rillieux with a special house with slave servants while he visited as "a consultant.") As the Civil War approached, the status of free blacks deteriorated with the imposition of new restrictions on their ability to move about the streets of New Orleans and other draconian laws.

It was about this time that Rillieux moved back to France. Race relations may have played a part in his decision, and so may have the declining profitability of the sugar industry in Louisiana. In any event, in Paris, Rillieux developed a passion for Egypt. In 1880, a visiting Louisiana sugar planter found Rillieux deciphering hieroglyphics at the Bibliothèque Nationale.

Rillieux died in 1894 and was buried in the famed Paris cemetery of Père Lachaise. His wife, Emily Cuckow, lived comfortably for another eighteen years.

"I have always held that Rillieux's invention is the greatest in the history of American chemical engineering and I know of no other invention that has brought so great a saving to all branches of chemical engineering."

Charles A. Browne (1870-1947), Sugar Chemist, U.S. Department of Agriculture

Cotton Merchants in New Orleans, 1873

The Degas Connection

The great French impressionist painter, Edgar Degas, visited New Orleans in 1872, a time when the city, still recovering from the ravages of the Civil War, was in the throes of Reconstruction and under Federal control. Degas' productivity as a painter had stalled, but something about the war-torn and divided city gave him new inspiration and elicited some of his finest paintings.

The primary reason for Degas' trip was to spend a few months with the American branch of his family. The painter's great grandfather, Vincent Rillieux, had built a large house on Royal Street. His daughter Maria was Degas' maternal grandmother.

A well-kept secret of the Rillieux clan was the liaison of one of Vincent's sons, also named Vincent, with Constance Vivant. Two of their sons - first cousins of Degas' mother - were Edmond, who became superintendent of the New Orleans water works, and Norbert, the chemist and engineer.

National Historic Chemical Landmark

The American Chemical Society designated the invention of the Multiple Effect Evaporator under Vacuum by Norbert Rillieux a National Historic Chemical Landmark on April 18, 2002. The plaque commemorating the event reads:

Norbert Rillieux (1806-1894) revolutionized sugar processing with the invention of the Multiple Effect Evaporator under Vacuum. Rillieux's great scientific achievement was his recognition that at reduced pressure the repeated use of latent heat would result in the production of better quality sugar at lower cost. One of the great early innovations in chemical engineering, Rillieux's invention is widely recognized as the best method for lowering the temperature of all industrial evaporation and for saving large quantities of fuel.

About the National Historic Chemical Landmarks Program

The American Chemical Society, the world's largest scientific society with more than 163,000 members, has designated landmarks in the history of chemistry for more than a decade. The process begins at the local level. Members identify milestones in their cities or regions, document their importance, and nominate them for landmark designation. An international committee of chemists, chemical engineers, museum curators, and historians evaluates each nomination. For more information, please call the Office of Communications at 202-872-6274 or 800-227-5558, e-mail us at nhclp@acs.org, or visit our web site: chemistry.org/landmarks.

A nonprofit organization, the American Chemical Society publishes scientific journals and databases, convenes major research conferences, and provides educational, science policy, and career programs in chemistry. Its main offices are in Washington, DC, and Columbus, Ohio.

Acknowledgments:
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