HACIENDA LA ESPERANZA SUGAR MILL STEAM ENGINE 1861

A NATIONAL HISTORIC MECHANICAL ENGINEERING LANDMARK

Manatí, Puerto Rico
February 10, 1979

The Conservation Trust of Puerto Rico
The American Society of Mechanical Engineers

HACIENDA LA ESPERANZA'S
STEAM ENGINE AND SUGAR MILL

The decorated steam engine is the only West Point Foundry beam engine known to survive. It is also the only known 6-column beam engine by any American manufacturer. Additionally, it is one of only eight beam engines of American manufacture known to exist anywhere. It is properly classified as a 6-column, drop valve, side crank, beam engine with a 16-inch bore and a 40-inch stroke. When running on 60 PSI of steam, the engine turned at about 20 RPM and developed approximately 25 HP. The cast-iron beam, pivoted at its center, serves as a rocking lever connecting the piston rod and crank. The piston produces reciprocating motion, while at the other end of the engine the crank converts this to the rotary motion needed to drive the machinery.

Eccentrics controlled the steam engine's valves. The rod that transmitted motion from the eccentrics on the crankshaft to the valve shaft are missing from the La Esperanza engine.

To deliver maximum power, the La Esperanza engine had to run at approximately 20 RPM, but to extract cane juice efficiently the mill would have had to turn much more slowly. Double-reduction gears accomplished this change in speed. The gear ratio between the engine's crankshaft and the intermediate gear shaft is 4.2:1. The ratio between that shaft and the bull-gear shaft of the cane mill is 2.4:1. Consequently, if the engine ran at 20 RPM, the mill rollers turned at just under 2 RPM.

A drive pulley powered a conveyor which delivered the cane to the mill. This conveyor (not extant), was needed to assure a flow of cane equal to the mill's capacity, which was twice that of a typical mill in Puerto Rico during that period.

A sugar mill worked efficiently only if the clearances between the rolls were carefully set. If the rolls were too close, they wasted power. If too far apart, they failed to extract all the cane juice.

The clearances in this mill were set by bolts, the ends of which bore against the brass bearings of the feed and the discharge rolls. The feed and the top roll were separated by 1/2 to 1-1/2 inches, depending on the type of cane, and the discharge and top rolls were set even closer together. To resist the forces created when the mill was running, the shaft of the top roll was held by the master bolts, which also secured the mill to its foundations. The mill's cast-iron frame was reinforced by truss rods.

The parallel-motion mechanism is a combination of pivoted links. It transmits the power of the piston rod to the beam, correlating the different

motions of the two. As the beam rocks, its end describes an arc of a circle. The piston rod, however, must move in a straight line to keep the piston in line with the cylinder. The parallel-motion linkage maintains the linearity of the piston rod through the geometry of the parallelogram. This ingenious linkage, devised by James Watt, was the invention of which he was most proud.

Technical information taken from survey of Hacienda La Esperanza by the Historic American Engineering Record (HAER) during the summer of 1976.

HACIENDA LA ESPERANZA

Hacienda La Esperanza is a 2,265-acre estate located in the fertile valley of the Río Grande de Manatí, about 35 miles west of San Juan Bautista, Puerto Rico's capital city.

It is bounded to the north by the Atlantic Ocean; to the west by the river; and to the east and south by haystack hills that are part of the Karst Region of Puerto Rico running eastward from Carolina to Aguadilla on the northwesternmost tip of the Island.

Hacienda La Esperanza was started by Fernando Fernández, a career military man possibly from Castille, who arrived in Puerto Rico during the late 18th Century. It was formed through a land aggregation process which began in the 1830s. By the 1850s, José Ramón Fernández y Martínez, eldest son of Fernando, had inherited the land, and by the early 1870s he owned more than 2,000 acres. Ten years later, Hacienda La Esperanza comprised 85% of the low valley lands east of the Río Grande de Manatí.

By the 1860s, Fernández was considered one of the wealthiest men of Puerto Rico, and he either bought or was granted the title of Marqués de la Esperanza. By that time he was also considered one of the most powerful men of the entire Spanish Caribbean.

The soils of Hacienda La Esperanza, rich in alluvial deposits and possibly the best on the north coast for agricultural production, allowed the Marqués to flourish and to participate in the boom of the 1860-1880 period, when sugar was king, providing economic, political, social, and cultural cohesion to the Spanish colony of Puerto Rico.

By 1862, Hacienda La Esperanza's sugar mill was producing annually 135,000 pounds of "moscabado" (dark sugar) and 500 hogsheds of molasses. The hacienda was assessed at 300,000 Spanish pesos, or roughly 300,000 U.S. gold dollars by mid-19th century rate of exchange. This assessment included cultivated and idle lands, tools, cattle, fuel, the sugar factory building and slave quarters. It did not include machinery or slaves.

Slavery and steam technology played a major role in the Hacienda's sugar production. By the time of the Emancipation in 1873, some 175 slaves, both male and female, were working on the various phases of sugar cultivation and production. Most of them served as field workers, others were such skilled workers as masons, carpenters, blacksmiths, coopers, sailors, sugar makers, stokers, and mechanics.

There is conclusive evidence that steam technology reached the Hacienda around 1841 with the introduction of a steam engine. The only property identified in official records of 1847 as an hacienda proper was that of José Ramón Fernández y Martínez' father, since only mechanized or partly mechanized productive units were so denominated. This leads one to conclude that La Esperanza could have been the first one in the area to be partially mechanized. Industrial archeological investigations on the site strongly suggest that the Marqués made extensive alterations to the old factory, apparently to accommodate a new 1861 West Point Foundry engine and mill, possibly a new boiler, and a second "Jamaican train."

There is little documentation with respect to the machinery and the factory layout. The scant evidence available--a judicial record of 1886--indicates that "the factory has a steam engine with its two-flue boiler, elaboration (Jamaican) train, a conveyor belt, four evaporators and other tools." There is doubt as to what the term "evaporator" means in the context of this document, but if it refers to vacuum pans, then there can be no doubt that La Esperanza was possibly the most advanced sugar factory in Puerto Rico in the 1870s.

The Marqués de La Esperanza

José Ramón Fernández y Martínez, Marqués de La Esperanza, was born in San Juan possibly in 1808. He was the eldest of two sons, the other being Manuel Fernández y Martínez, whose descendants include Don Edmundo B. Fernández, owner of a rum plant and producer of the Ron Barrilito brand. Fernández still lives in the old manor house and has his office in the old mill of what remains of Hacienda Santa Ana, in Bayamón.

In his early twenties he was sent to study in England and later to the United States. No doubt during those years he came to know some of the people who later would help him, and became familiar with the modern way of doing business. Some of those people supplied him with the capital needed to establish and expand his enterprises in Puerto Rico.

As a matter of fact, he was to associate himself with Philadelphian George C. Lattimer, U.S. Consul in San Juan, and a sugar broker. Together, they formed the Lattimer & Fernández Co., one of the most powerful companies on the Island, dealing not only in sugar, molasses and rum, but in food, textiles, and other commodities, with the center of operations in San Juan.

Politically, he was clearly identified with the conservative forces that tried forcefully to prevent any changes in the relationship of Puerto Rico with the metropolitan government of Spain.

In 1850, the Marqués, along with Augusto de Cottes and Cornelio Kortwright, also very wealthy men, made a proposal to the government to build a railroad from San Juan to Arecibo. The proposal coincided with the spectacular development of railroads both in Europe and the United States. But it was not until the 1890s, after the Marqués' death in 1883, that this project materialized.

The Marqués married Clementina Dorado y Serrano. They had four daughters: María Teresa; Bárbara; Clemencia; and the youngest one who died in her early youth. María Teresa married Edward Savage, of New York. Bárbara married Guillermo F. Lattimer, son and only heir of George Lattimer. Clemencia married Francisco Rubio, a Spanish citizen.

It is interesting to note that a few after the Marqués' death, a conflict arose between his daughters and sons-in-law with respect to the succession of the title; Clemencia alleging that she was the only one legally entitled to it because neither of her two sisters, having married foreigners, could inherit the title.

There are documents which indicate that in 1879 the Marqués consolidated two considerable debts totalling 200,000 pesos or 45,000 pounds. These may have been incurred during the late 1860s or early 1870s to mechanize Hacienda La Esperanza, and representing money borrowed from the Colonial Company Ltd., of London, a major sugar financing source in the Carribbean. He was unable to pay his debts, and at the time of his death his estate was badly indebted. In 1885, Colonial sued for collection. The case dragged on until 1891. That year, Hacienda La Esperanza changed hands, having been bought in a very unclear transaction in London by Wenceslao Borda--a Colonial Company agent in Puerto Rico-- for the amazing sum of 40,000 pesos (equivalent to 8,000 pounds); the same hacienda that had been assessed at 300,000 pesos!

After 1891, Borda continued the sugar planting operation but apparently the West Point Foundry engine and sugar mill were never used again. The cane harvested there was sent to the nearby Central Monserrate for processing.

Wenceslao Borda and his family were absentee owners who leased the land to various persons. Among those who cultivated the land during the first half of the 20th Century were the Calaf family and Don Juan Dávila Díaz, sugar producer and legislator.

In 1975, the totality of Hacienda La Esperanza, 2,265 acres of land according to a survey made for the Marqués de La Esperanza in 1872, was acquired by the Conservation Trust of Puerto Rico.

As previously mentioned, the Marqués was a powerful political figure. He wielded so much power that he was able to divide the territory comprising the municipality of Manatí in two, making Barceloneta, a nearby small settlement, a separate town. His motives were obviously economic; if he were to use the port facilities at Manatí with a customs house, he would then have to declare all movement of goods and slaves with the resulting payment of taxes. He cleverly set up his own port facilities at Palmas Altas, at the mouth of Manatí River, thus obtaining free movement for his merchandise. This may be the reason why researchers have not been able to locate any evidence on the introduction into Puerto Rico of the West Point Foundry steam engine and mill: there are no documents because the Marqués did not have to declare to customs in his own port.

Ecological and Cultural Assets

Hacienda La Esperanza is one of the most precious assets of the Trust. There are within its boundaries valued ecological resources, such as karst formations and forests with unusual flora and fauna, wetlands which are the habitat of endemic and migratory birds, cemented dunes and mangrove systems abounding in marine life, alluvial plains rich in humus for intensive agricultural activities, and one of the very few coastal forests left on the north coast of the island.

There also are such important cultural assets as a prehistoric site of great significance that radioactive carbon analysis dates as far back as 510 A.D., the c. 1861 West Point Foundry steam engine and sugar mill, a lime kiln for producing the lime that was the main substance used for precipitating vegetable albumens and impurities from the sugar juices, and a system of canals for irrigation which was in use as early as 1840.

Based on historical research carried out by Dr. Benjamín Nistal Moret, Assistant Professor, Department of Puerto Rican Studies, School of Social Sciences, Brooklyn College of the City University of New York, and Consultant to the Conservation Trust of Puerto Rico.

THE WEST POINT FOUNDRY ASSOCIATION

The West Point Foundry Association was established at Cold Spring, New York, by Gouverneur Kemble who, with others, were incorporated under that name. The first works was erected in 1817, and was designed for the casting and boring of cannon for the United States Navy and Army with the assurance of support and encouragement from the government.

Until 1851 the Association was operated as a private establishment by one of the proprietors who leased the shares of others. At that time, R. P. Parrott, who had become connected with the works in 1836, leased the

shares of Kemble and the other proprietors and became the sole lessee, assisted in the management by Gouverneur Paulding. Parrott was a graduate of the U. S. Military Academy at West Point, and a captain in the Ordnance Department of the United States.

A problem arose when the cannon were not ordered in such quantities or with such regularity as to give steady employment. Other work necessarily was sought, and the West Point Foundry turned gradually to the manufacture of general castings, steam engines and boilers, and other heavy equipment, with a forging department capable of making the heaviest pieces.

Among the products of the Foundry were the engines of the U.S. Naval steamers "Missouri" and "Merrimac," the Cornish pumping engine for the Jersey City Waterworks at Belleville, and the pumping engine of the dry dock at the Brooklyn Navy Yard. Sugar-mill machinery, steam engines, hydraulic presses, and blowing engines, all of the largest size, were turned out in quantity. A wide range of more routine products also was produced such as cast-iron water pipe, wrought-iron shafting, and a line of general castings and forgings. Much of this machinery and other equipment was exported and was highly reputed in comparison with that of other countries. The establishment that originally was a cannon foundry of moderate size costing about $90,000, grew to one of immense capacity, employing at times as many as 1,000 men.

The location of the West Point Foundry at Cold Spring was determined by two considerations: one, the U.S. Government’s desire at the time that a gun foundry not be too near the coast; and the other, the availability of water power from a stream entering the Hudson River at Cold Spring.

The name West Point Foundry arises from the fact that at the time Cold Spring was only a small landing place of three houses and West Point was the only well known place in the vicinity, although on the opposite side of the Hudson.

The West Point Foundry came to prominence in connection with the manufacture of rifled cannon. Numerous experiments with its manufacture had been made in Europe, and in 1858 and 1859 many tests were made in the United States, chiefly with guns ordered by the Ordnance Department according to plans and specifications brought forward by different inventors. The cannon were, as usual, of cast iron, bored somewhat smaller than normal, and rifled. A projectile frequently used at the time was that of Dr. J. B. Read, of Alabama, in which a cup or flange of wrought iron was cast in the projectile. It was expected that the force of the explosion would cause the rim of the cup to take the grooves. Other forms of projectile were later devised, based on an improvement by Parrott of swaging out the cup partially to the form of the grooves, thus facilitating the "taking" of them at firing.

In 1860, Parrott introduced the first of the guns now known as "Parrott Guns." One peculiarity of the Parrott Gun was a band or reinforcement of wrought iron at the breach end, made by coiling a bar of iron upon a mandril, and then welding this coil into a cylinder which was afterward bored, turned, and shrunk upon the gun.

The Parrott gun was refined again and again, becoming the main armament used both by the Army and the Navy during the American Civil War. It was of two types: that suitable for operation in mobile conflict; and a heavier gun for stage purposes. They contributed largely to the victories of the Union forces at Fort Macon and Fort Pulaski. At the bombardment of Fort Sumter from Morris Island, as well as in the shelling of Charleston, Parrott Guns were used almost exclusively.

Among the many accomplishments of the West Point Foundry Association, was building the first locomotive manufactured in America for actual service on a railroad: the "Best Friend of Charleston." This locomotive was contracted for by E. L. Miller, of Charleston.

According to a letter written in 1859 by David Matthews, foreman of the fitting department of the Foundry:

> "The Best Friend was a four-wheel engine, all four wheels drivers. Two inclined cylinders at an angle, working down on a double crank inside of the frame, with the wheels outside of the frame, each wheel connecting together inside, with outside rods. The wheels were iron hub, wooden spokes and felloes, with iron tire and iron web and pins in the wheels to connect the outside rod to.
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> "The boiler was a vertical one, in form of an old-fashioned porter bottle, the furnace at the bottom surrounded with water, and all filled inside full of what we called teats, running out from the sides and top, with alternate stays to support the crown of the furnace; the smoke and gas passing out through the sides at several points, into an outside jacket; which had the chimney on it. The boiler sat on a frame upon four wheels, with the connecting-rods running by it to come into the crank-shaft. The cylinders were about six inches bore and sixteen inches stroke. Wheels about 4 1/2 feet in diameter. The whole machine weighted about 4 1/2 tons. It was shipped to Charleston, South Carolina, for the Charleston and Hamburg Railroad, in the fall of 1830, and was put upon that road during the winter.
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> "It was the first locomotive built in America, was

> exhibited at our shop under steam for some time, and visited by many. She was shipped to Charleston on board of the ship Niagara, in October 1830." (The History of the First Locomotive in America, William H. Brown, D. Appleton and Co., N. Y., 1874, pages 140-41.).

The West Point Foundry was also responsible for building the second American locomotive, aptly called the "West Point," for the South Carolina Canal & Railroad Co., in 1831. According to Matthews, this Locomotive had the same size engine, frame, wheels, and cranks, as the "Best Friend," but had a horizontal boiler with tubes two and a half inches in diameter and about six feet long. Also in 1831, the foundry built the "Dewitt Clinton," New York State's first steam locomotive. In 1832, West Point Foundry built a locomotive called "The Experiment," which set an unofficial world speed record of 80 M.P.H.

During the Panic of 1873, the West Point Foundry ran into trouble. A change in administration after Parrott's death affected the contracts. Moreover, their source of material, the iron-ore deposits near the plant, could not compete with the rich deposits found in the West. By 1886, the population of Cold Spring started declining, and in 1911 the Foundry was closed, after almost one hundred years of successful operation.

Although very frustrating for historians and researchers, it is interesting to note that being in the armament business, the West Point Foundry had a systematic method for disposing its records. Every four years a huge bonfire was lit in its yard for burning all sensitive material such as plans, specifications, etc. The only available evidence of the firm's work is in manufacturers' catalogs and technical books of the time.

Based on material provided by: Tom Rick, Manitou Machine Works, Cold Spring, N. Y.; Robert M. Vogel, the National Museum of History and Technology, Smithsonian Institution; Robert L. Johnson, Curator and Owner, Whistles In the Woods Museum; Benjamin Nistal-Moret; The Putnam County Historical Society

SUGAR MAKING AT HACIENDA LA ESPERANZA

Type of Plantation

Hacienda La Esperanza was a slave-operated sugar plantation which can be technologically characterized as semi-mechanized; that is, it had a crushing mill powered by a steam engine, but the processes of evaporation, purging, and packing were conducted manually.

This method of sugar manufacture was characterized by a profound imbalance between the mechanized element, located exactly at the beginning of production, and the rest of the process which maintained the elements of 18th Century technology.

The large capacity of the mill required a great number of agricultural workers (cane cutters, lifters and drivers), and at the same time necessitated an expansion of the clarification and evaporation equipment (where technological change had not occurred) thereby increasing the number of trains and boilers, but reducing the quality of the final product.

Production

From the 1840s to the l860s, Antillean sugar plantations produced three types of sugar: clayed, raw and "centrifugal." The production of clayed sugar required the use of thousands of moulds made of clay or metal. It is very unlikely that it was produced at La Esperanza; not a single trace of these moulds has been found in the archeological excavations. Moreover, by 1840, this type of sugar no longer had a big market.

The possibility of La Esperanza producing centrifugal sugar has been eliminated because no evidence has been found in historical documents and there are no traces of centrifugal installations at the site. Another reason is that centrifugal sugar was considered refined sugar, and, therefore, subject to very stiff tariffs under the U.S. Sugar Act of 1861, geared to protect the sugar refining industry which was one of the strongest in the United States.

Production Capacity

There is enough evidence to assume that there have been three successive mills at Hacienda La Esperanza: an animal-powered mill that possibly worked until the late 1830s or early 1840s, with horizontal rolls of iron; a second mill with a small steam engine and a horizontal crusher which may have survived until the late 1850s or early 1860s; and the third, present mill, thoroughly documented by physical remains and records.

Based on estimates of similar mills in the Antilles, the first mill at La Esperanza produced between 100 to 150 tons of raw sugar per harvest.

The second mill, whose size can be estimated on the basis of the remains of the conveyor, averaged perhaps 200 tons per crop.

The third mill may have produced between 500 to 600 tons per harvest. This volume established Hacienda La Esperanza as the largest producer of its time in Puerto Rico, and among the largest semi-mechanized operations in the Antilles, the sugar-to-cane yield should not have exceeded 5% as a crop average, although it is well established that the yield curve shows lows at the start and finish of the harvest, and a peak at the state of maximum maturity of the cane.

Sugar Planting and Cutting

Sugar cane was planted in rows from three to five feet apart. In planting, pieces of cane twelve to fifteen inches long were placed in furrows about one foot deep. The pieces were laid horizontally, each end joining the end of the next. In poor land, two pieces were put side by side. The plant was then covered with soil, and as the shoots sprang up, the ground was cleared of weeds by hoeing. Cane planted in good land usually was ready to harvest one year after planting.

When the cane was ripe and ready for crushing it was cut down with "machetes," fine, sword-like steel blades with wooden grips. The stalks were cut about one foot above the ground, leaving the roots to grow again for the next year. The leaves were taken off and the top part cut off about one foot from the end. These ends and the leaves were used as fodder for cattle. The canes were then cut in pieces of about four feet long and carted to the mill. The period of harvest -- called "zafra" -- usually begins in early January, lasting until late May.

The fields were divided into sections, called "tablones," and spaces were left, at convenient distances, for carts to get in to take the cane to the mill.

In good land, the cane did not require replanting for four or five years. Good lands in Puerto Rico and Cuba would produce four hogsheads of sugar per acre, while poor lands would not produce more than one and a half to three hogsheads. The hogshead contains 1,700 pounds on the average.

Operation and Maintenance of the Mill

As the climate is very damp at La Esperanza, and the mill is near the coast, the resulting humidity and salt-water spray made it necessary during the dead season, from June to late November -- the months when the cane was growing -- to dismantle and thoroughly clean the engine, and to remove, clean and pack all the brightwork (brasses). The parts of the

machinery that could not be taken down and packed were coated for protection. The timbers and brickwork of the foundations were inspected for any settling in consequence of the heavy rains during the dead season and the movements of the machine. Valves, cylinders, etc., were adjusted and oiled.

The steam boiler at La Esperanza was of the type then in common use for mills that made open-kettle sugar, and known as a "lancashire" boiler. It had two flues and was built into brickwork. The fire passed through the two flues returning under the bottom of the boiler and then to the chimney. The furnaces of the steam boiler were fired with wood, bagasse, and, if wood was scarce, coal.

The mill for crushing the cane to extract the juice was the element of the machinery subject to the greatest stress and thus the one most liable to break down, so that maintenance was imperative. The mill had three rollers, set in a strong frame of cast iron, resting upon large timbers set upon solid foundations.

The conductor or cane carrier was an arrangement to convey the cane from the yard up into the mill. It consisted of two endless chains at each side, and boards or slats fastened to the chains. These chains passed over and around a drum in the yard, and another at the mouth of the mill, where the cane fell in as the conductor revolved.

There was another conductor at the other end of the mill that conveyed the bagasse up to a point high enough for a cart to get under and to receive it as it came out of the mill.

The mill's engineer, Pedro Defontain, of French origin, was in charge of keeping the engine running steadily, not too fast, not too slow; maintaining the steam nearly always at the same pressure; seeing to it that the cane was laid on the carrier regularly; watching over the rollers; and ensuring that the juices flowed steadily to the collection pans.

The Manfacture of Sugar

The various stages of manufacturing sugar out of the cane may be described as follows: (1) the extraction of the juice from the cane; (2) the separation from the juice of all the matter except sugar and water (known as defecation and clarification); (3) the removal of the water from the sugar (known as reduction or granulation); and, (4) the cleansing of the sugar crystals by washing or draining (known as purging or curing).

At La Esperanza, the sugar cane was crushed in a "trapiche," consisting of three cast-iron rollers placed horizontally in a cast-iron frame. (The middle roller is called the king roller, the others are called the side

roller and the macasse roller.) The sugar cane was fed by means of a slate gutter to the rollers. The juice ran into a gutter under the rollers and from there drained into big square pans or collectors. These collectors were kept clean at all times to prevent the start of fermentation that would sour the juice.

After the juice had been extracted, it was necessary to remove everything that contaminated it. This was done by adding lime, a strong alkali, which when combined with the albumens in the juice, coagulated. The process took place while the juice was in the defecating pans -- large kettles at the extreme end of the "Jamaican train" (the term used for the line-up of equipment used in the entire process). The juice was heated at this stage, and as the temperature rose, more lime was added. A thick, greenish-yellow scum formed at the surface. Boiling was carefully avoided, since it would break up the floating scum and diffuse it throughout the juice.

The juice was then allowed to settle until it formed three layers: at the top, the coagulated scum; at the bottom, particulate matter; and in between, a clear and transparent liquid.

The scum was removed with perforated strainer-like ladles attached to long wooden handles. From there, the clear juice flowed to the clarifiers, a set of big cast-iron kettles generally known as "taches," arranged in a row. At La Esperanza, there was a double set in tandem.

Heat was applied at each end of the "train," with the largest kettle farthest from it. The largest kettle was called the "propre" and able to hold all the juice produced at one crushing.

From there, the juice, reduced in volume, passed to the next kettle, smaller than the first, called "flame" or "flambeau," where the heat was intensified. Straining the scum was still done at that stage.

From there, the juice, further reduced, passed first to the kettle known as "syrup" or "sirop," and then to the smallest one called "taiche," or "batterie."

In this last kettle, the syrup was further reduced, almost to the granulating point, or sufficiently concentrated to separate into grains of sugar upon cooling. At that point, a test was done by touch. A dab of syrup was taken upon the thumb, bringing the forefinger in contact with it, and rolling both fingers to see the length to which a thread of syrup could be drawn before it broke. The person who performed this test was called the "puntista."

From the "tache" or "batterie," the crystallized sugar went to the coolers -- shallow open vessels, each one capable of containing around one

hogshead of sugar. They were made of wood so that cooling would be gradual. In about twenty-four hours, the sugar grained -- that is, it formed into a soft mass of crystals imbedded in "melasses."

From the coolers the sugar was taken in small carts to the curing or purging house, where it was packed in potting-casks called "bocoyes." The "melasses," still attached to the crystals, was let to drain into a container or reservoir under the casks, leaving the crystals almost dry. Within two or three weeks, and sometimes longer, the sugar was fit for shipment. Sugar produced by this method is known as "raw sugar."

Information based on historic and archeological research conducted at La Esperanza by: Dr. Manual Moreno Fraginals, Historian and Economist; Ovidio Dávila y Dávila, Chief Archeologist, Office of Archeology, Institute of Puerto Rican Culture; flow charts prepared by José García Gómez, School of Architecture, Columbia University, with the advice of Dr. Benjamín Nistal Moret, Brooklyn College, School of Social Sciences. Other sources: The History of Sugar, Noel Deere, Chapman & Hall, London, 1950; Cyclopaedia of Useful Arts, Vols. II & III, Virtue & Co., London, 1866; Appleton's Dictionary of Machines, Mechanics, Engine Works and Engineering, Vol. II, New York, 1869.

SUGAR CANE

Sugar cane generally is believed to have originated in northern India, the earliest mention of it being in some of the legends concerning Buddha in about the 4th Century B.C. Until the development of field culture, its use for several centuries was restricted to chewing the cane and drinking the juice.

From India the planting of cane probably spread first to China. Neither sugar nor sugar cane is referred to in the Bible, the Talmud, or the Koran, although all three mention honey many times.

The earliest possible evidence of sugar in solid form seems to date from about 500 A.D. in Persia. The original Persian name for white sugar was "kandi-sefid" from which the word "candy" comes. The East Indian word for sugar, "shekar" or "shakar" is probably the origin of the English word, sugar. In its earliest days sugar was a rare delicacy and also was highly valued for medicinal purposes.

Commercial manufacture and refining developed in Egypt during the 9th and 10th centuries. The exportation of sugar was an important part of that country's commerce. The culture of sugar cane spread from the Arabs through northern Africa and southern Europe at the same time the Chinese were carrying this skill to Java and the Philippines. The Crusaders brought sugar back to France in the 11th and 12th centuries, after which time its commercial development and use became widespread in Europe. By the 16th century sugar refineries had been built in Germany, France, and England.

Columbus introduced sugar cane into Santo Domingo on his second voyage in 1494, and from there it was carried to Cuba, Puerto Rico, and parts of the West Indies and Central and South America. The industry did not attain immediate importance in North America. By 1600, however, the production of raw sugar from cane grown in tropical America had become the greatest industry in the world.

Sugar cane is a large grass belonging to the genus Saccharum. The endless varieties that occur throughout the tropical and semi-tropical regions of the world were the results of soil conditions, climate, and methods of cultivation. In general terms, there are three recognized classes: (1) white, yellow and green canes; (2) striped or ribbon canes; and (3) solid colors not included in the first class. Dark-colored canes are usually grown in the sub-tropics, while the lighter-colored canes have been favored in the tropics.

The creole or indigenous cane, also known as Spanish cane, was practically the only known commercial variety in the Antilles up to the

18th Century. This was the variety used by Linnaeus for the classification of Saccharum officinarum L. Other well known varieties are: the Otaiti cane, which was the basis of the great sugar development of the first half of the 19th Century; crystalline sugar, prevalent from the 19th Century to the first decades of the 20th Century and the basis of the Cuban sugar industry; and POJ-2686, which was the first great variety obtained through hybridization and the variety propagated throughout the world because of its resistance to the "mosaic disease".

Año I. Puerto-Rico, 16 de Mayo de 1886. Núm. 20.

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LIT. BOLETIN, P. R.

EL MARQUÉS DE LA ESPERANZA.

POCAS palabras vamos á consagrar al por desgracia difunto Marqués de la Esperanza, cuyo retrato honra hoy la primera plana de este periódico.

Pocas, sí, pero expresivas y sinceras, como brotadas de corazones que sienten arraigado cariño hácia este querido pedazo del territorio nacional y á todos sus hijos, los hijos de la fiel y gallarda Borinquen.

En este suelo vió la luz primera el ilustre Prócer, el acrisolado patriota, el ciudadano benemérito, el acaudalado Marqués de la Esperanza, el conspicuo caballero, el consecuente político, el esclarecido puertorriqueño que ha pagado ya el supremo tributo á la inexorable ley de la instabilidad del hombre sobre la tierra, y cuya memoria ha de sernos por siempre amable y grata.

Incurriríamos, además, en una perfecta redundancia, si emprendiéramos aquí la tarea de escribir una biografía del inolvidable Marqués de la Esperanza.

Hombre él de nuestra época, y á quien todos conocimos, sus hechos en la memoria de todos están grabados, y de tan honrosa existencia, consagrada, como la del Marqués de la Esperanza, al servicio de su Patria y al de su provincia natal, se publicó ya, hace algunos años, extensa biografía.

El Excelentísimo Sr. Don José Ramón Fernández nació á principios de este siglo trascendental y laborioso. Además de poseer el título nobiliario de Marqués, era Gran Cruz y había sido Presidente de la Diputación Provincial de Puerto-Rico, Teniente Coronel y Coronel de Voluntarios, Jefe, más que jefe, fundador, puede decirse, del gran Partido Español Incondicional, Diputado á Cortes en memorable legislatura, fundador también y gran sostenedor de la Sociedad Anónima de Crédito Mercantil, que tantos beneficios ha reportado y reporta á esta provincia, Presidente del Casino Español y del Centro Hispano Ultramarino.

De otros cargos importantísimos y de realce estuvo investido el Marqués de la Esperanza.

Su fortuna, como ya hemos indicado, era cuantiosísima; sus cajas viéronse en infinidad de ocasiones abiertas para toda obra de generosidad, patriotismo y desprendimiento.

Hemos dicho así mismo que en política fué consecuente. Añadamos ahora que fué más que consecuente, consecuentísimo hasta la abnegación y el sacrificio, porque mil veces supo sacrificar su peculio y su tranquilidad, sus afecciones y su sosiego, á las nobles exigencias y elevados compromisos de su honrada política y de sus honrados ideales, á la majestuosa marcha y triunfos de su partido, á las sublimes inspiraciones del patriotismo más absoluto, del amor más soberano á la madre patria y á sus glorias, á ésta su tierra nativa y á su prosperidad y bienandanza.

En el ocaso de su vida, el septuagenario Marqués de la Esperanza experimentó terrible desgracia que sometió á durísima prueba su fortaleza y su temple de alma.

El Marqués de la Esperanza quedó ciego, envuelto en densas tinieblas, tinieblas á las cuales no tardaron en seguir las más densas aún de la eternidad.

Ni siquiera el consuelo de ver á la compañera de su vida, ni á sus hijos, en las postrimerías de su existencia, le fué dado al anciano Marqués.

Pero tan tremendo infortunio no fué bastante á aniquilar su tesón, sus energías como político, su acción como hombre público, útil á la Patria común y á su país natal.

El Marqués de la Esperanza, Diputado Provincial en los últimos tiempos de su vida, ciego, achacoso, triste, cuando los altísimos intereses del país y del partido incondicional lo demandaban, no vacilaba un momento y se hacía llevar al Palacio de aquella corporación; allí, en prolongadísimas sesiones, se mantenía en su puesto, siempre sereno, siempre inmutable en sus profundas convicciones.

El Marqués de la Esperanza no desmereció nunca, ni aun poco antes de morir, de aquel Marqués de otros dias, de aquel viril ciudadano que en los trances más calamitosos de las luchas políticas en Puerto-Rico, se hizo respetar y admirar siempre por sus alientos y por sus prestigios.

Llegó al fin la hora aciaga de su muerte.

Y el Marqués de la Esperanza rindió el postrer suspiro con la edificación de un buen creyente el 13 de Febrero de 1883.

Y su cuerpo cayó en la tumba, acompañado de tiernas despedidas y de piadosas oraciones.

De él no quedarán ya sino cenizas en el panteón, mas su recuerdo sobrevive y sobrevivirá perdurablemente.

Y sobre la losa de su sepulcro escribirán las posteridades:

LEALTAD, HIDALGUÍA, PATRIOTISMO.

***

EXCMO. SR. MARQUÉS DE LA ESPERANZA.

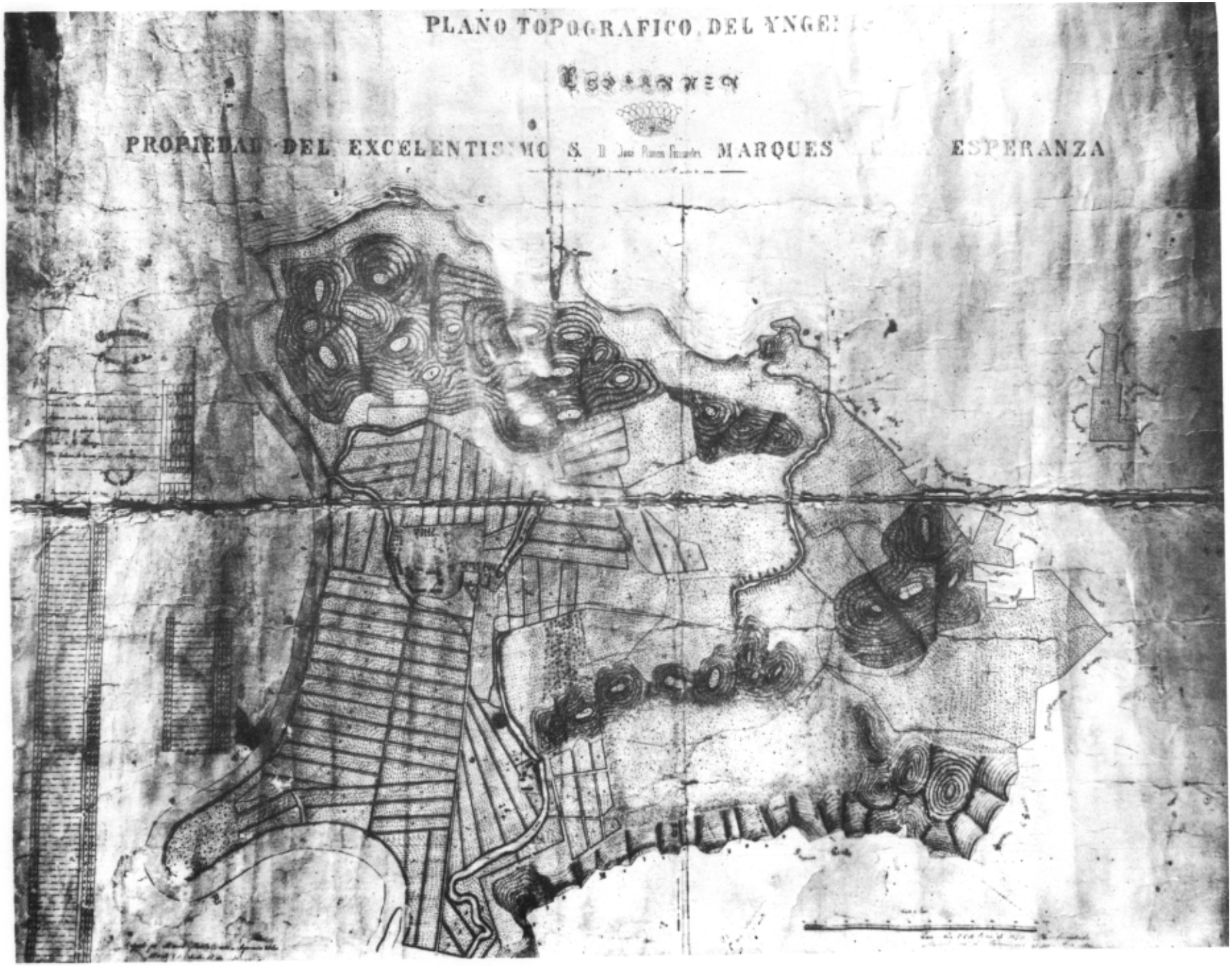
LA FIESTA DEL CARNERO.

TERMINADO el *Ramadán* en Rabat, se me acercaron, uno por uno, todos los criados del Consulado, diciéndome, como si hubiesen aprendido la lección de memoria:

—Señor, dáme el salario del mes para comprar el carnero.

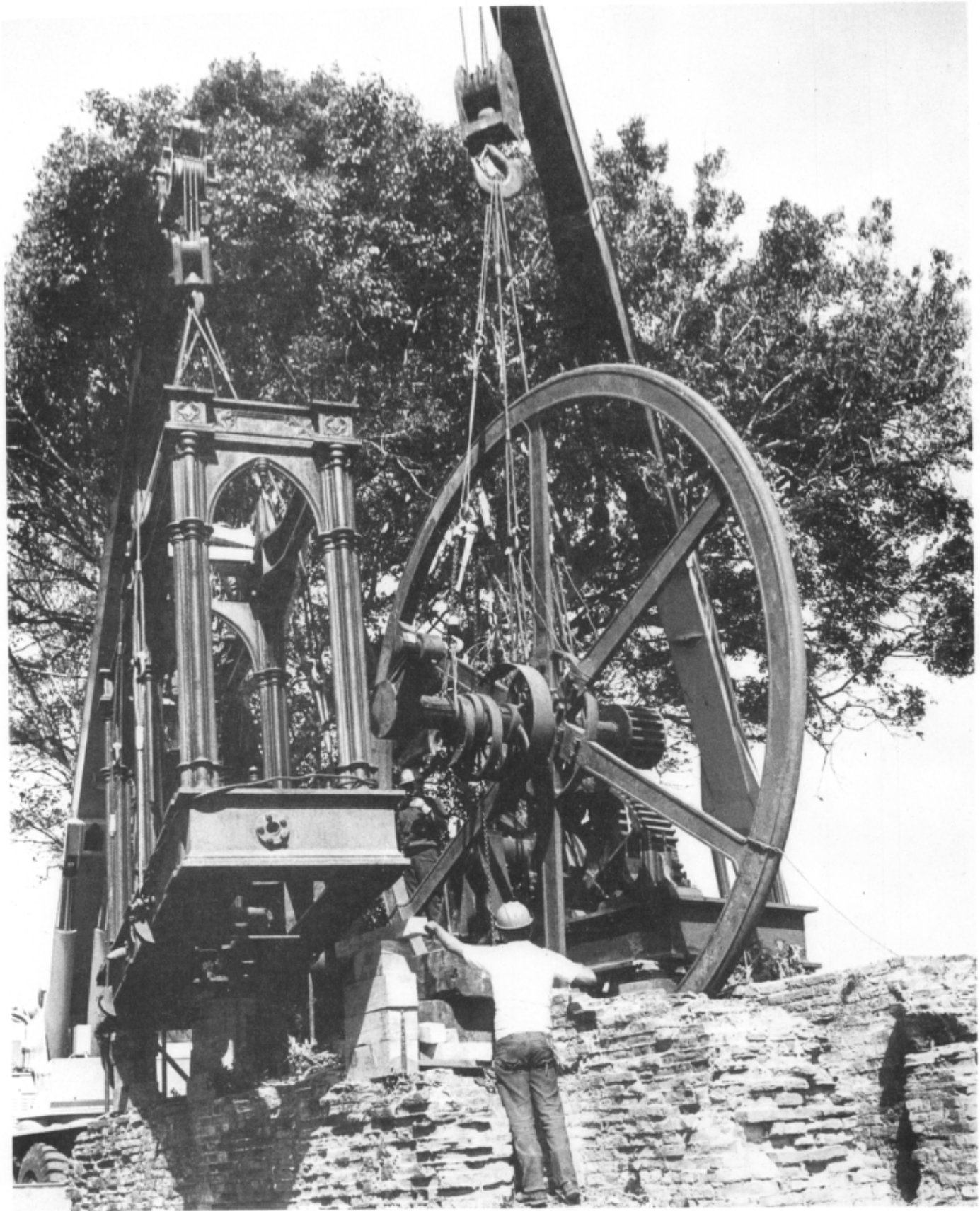
—¿Y para qué quereis el carnero? pregunté, ya cansado de oir la misma petición por parte de todos.

Front-page article on the Marqués de La Esperanza, Puerto Rico Ilustrado, May 16, 1886.

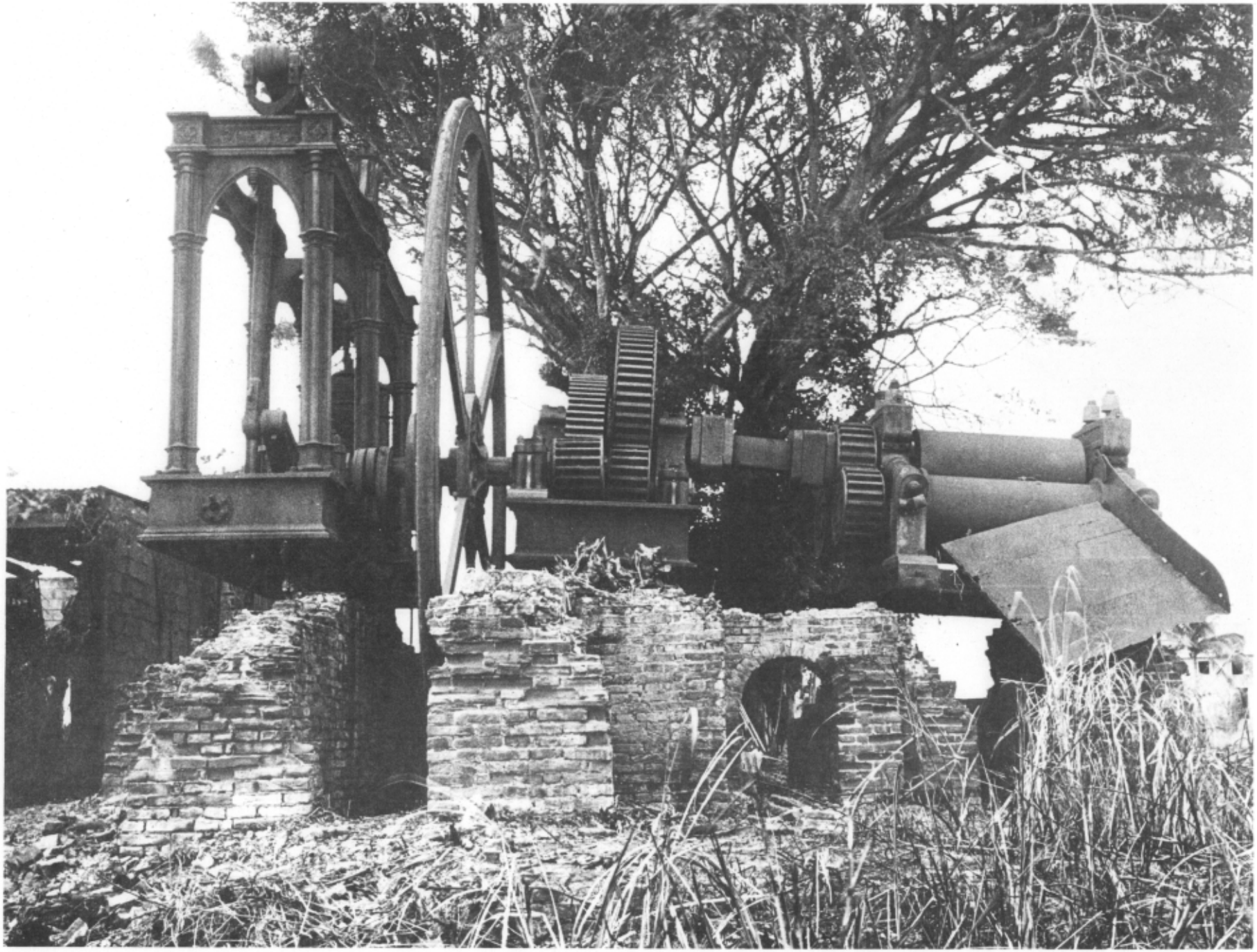


Survey and topography of Hacienda La Esperanza property of His Excellency, S.D. José Ramón Fernández, Marqués de La Esperanza made by Surveyor José Antonic Calderon, and signed by him on January 22, 1872.

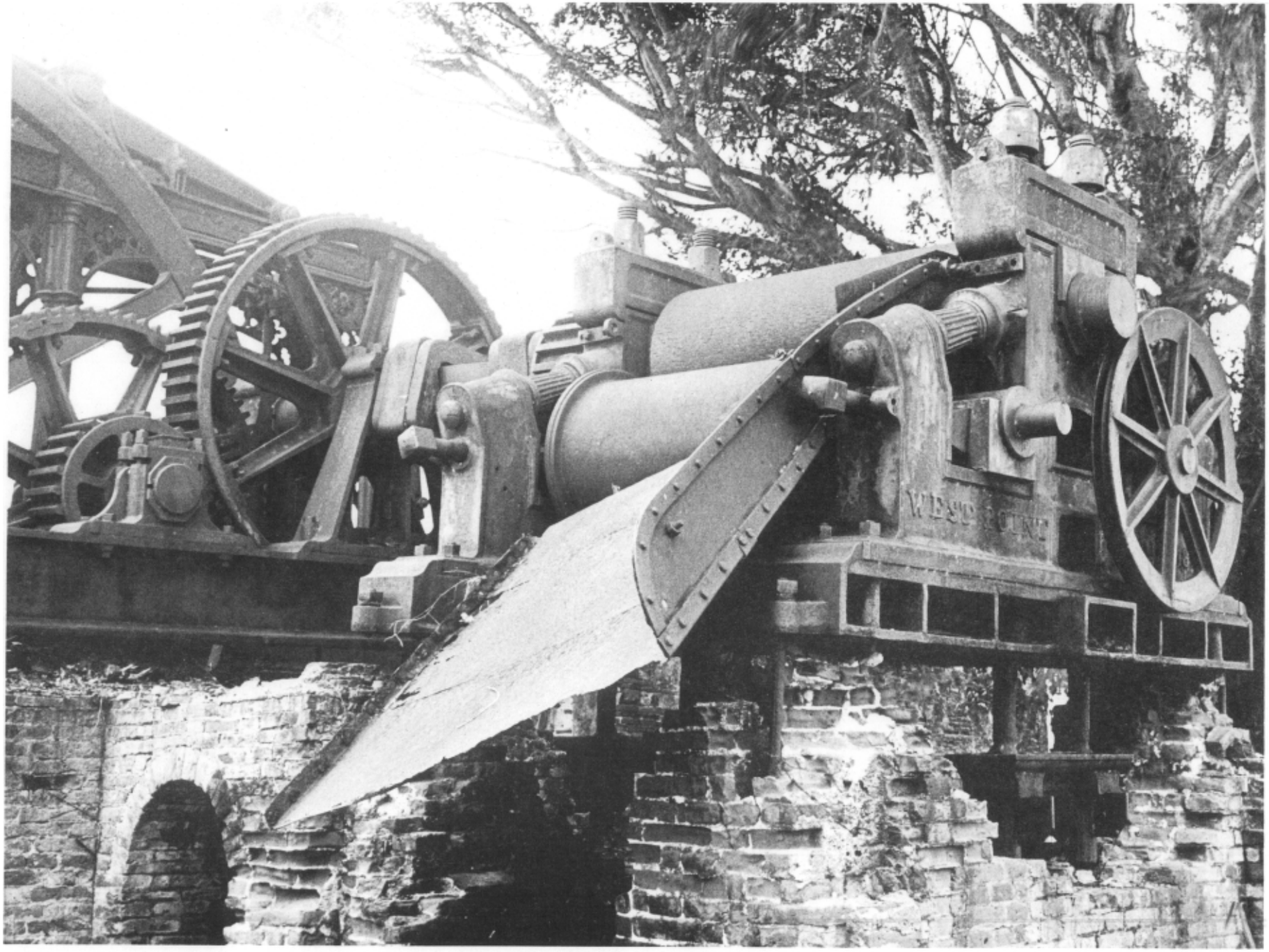
(Document in the collection of the Conservation Trust of Puerto Rico.)



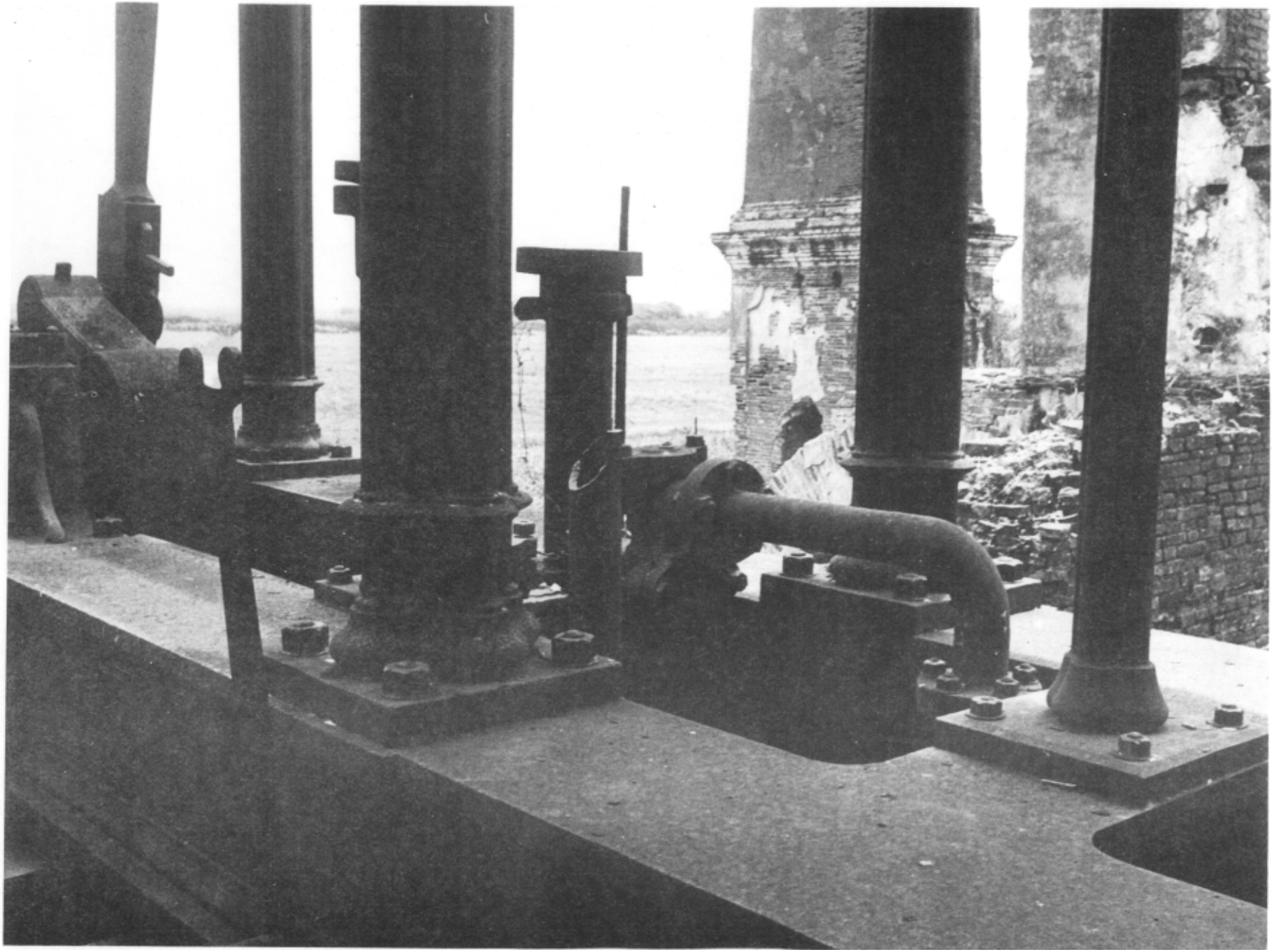
After emergency blocking was placed for temporary support, arrangements were made to disassemble the engine and remove it from its precarious perch on the old crumbling foundations. This work was carried out by Mediavilla's cranes and Conservation Trust workmen under the direction of Robert L. Johnson, Whistles in the Woods Steam Engine Museum, July 6-9, 1976. Here the engine frame is swung out of the way by one crane while another lifts the 20-foot flywheel and swings it clear.



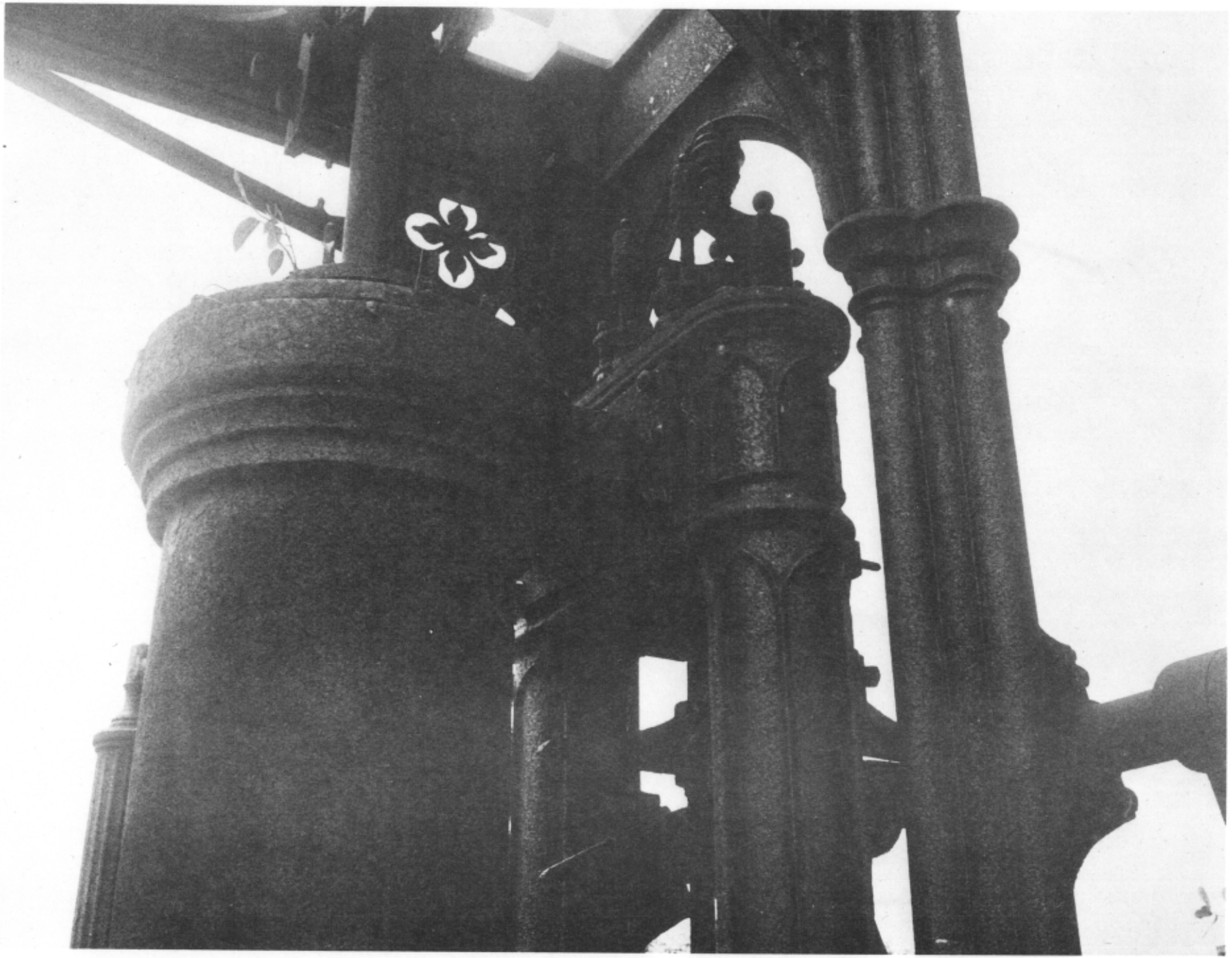
1861 West Point Foundry beam engine, intermediate gear and sugar mill; Hacienda la Esperanza, Manati, Puerto Rico.



The cane mill carries the only identification still visible. View from the outfeed or discharge end.



West Point Foundry beam engine; details of crank, bases of the entablature columns, and one of the twin pumps.



Top of cylinder and valve chest showing the acutating cams or levers. To the extreme left may be seen the governor link beam supporting column.