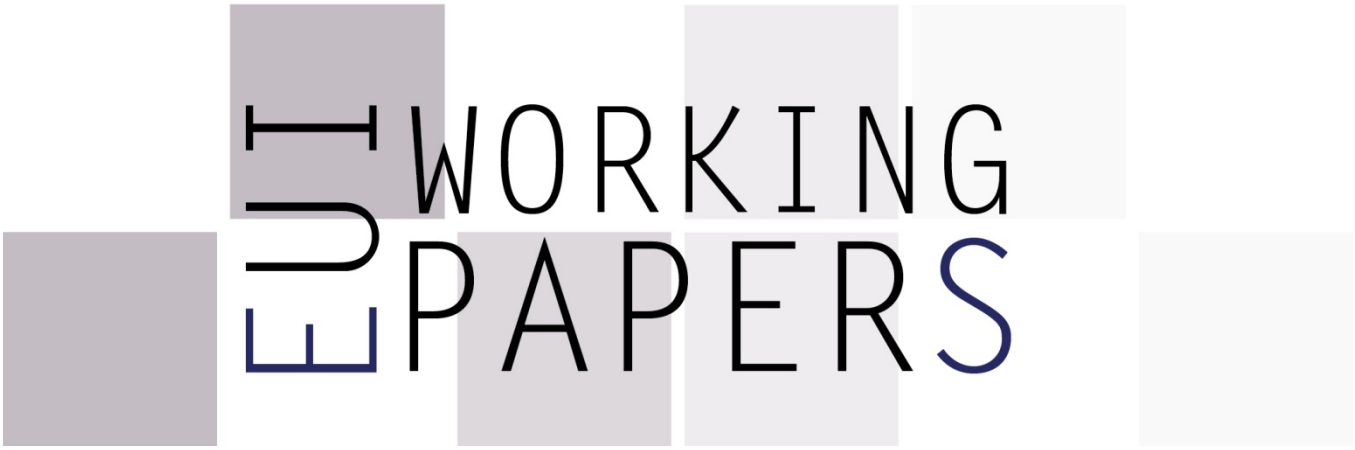

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Abstract
During the nineteenth century the Cuban sugar plantation became a highly dynamic space, open to foreign intervention at many levels. The increasing commercial prospects in the Cuban economy from the mid-nineteenth century led American, French and British manufacturers of refining equipment to actively commercialize their innovations in Cuba. Many of these foreign manufacturers of machinery had branches and agents in Havana. This article seeks to highlight the technological links between these firms manufacturing machinery and the Cuban plantation economy. Through the study of patent data and trade figures, it shows that the pattern of technology transfer to Cuba, which emerged during the nineteenth century, transgressed political boundaries. In addition, this article also considers the circulation of technical expertise between Cuba and advanced industrial nations, particularly the United States and the United Kingdom, as well as the role of transnational networks of experts. The article ends with an examination of the transnational operations in Cuba of the French firm Derosne & Cail, one of the most innovative engineering firms of the mid-nineteenth century as well as one of the first European companies to supply advanced technology to the Caribbean sugar industry.

Keywords
Plantation Economy; Technology Transfer; Patents; Trade Figures; Transnational Expertise.

David Pretel
Max Weber Fellow, 2012-2013
Pompeu Fabra University, Barcelona

Nadia Fernández de Pinedo
Universidad Autónoma Madrid

Introduction

This article analyses the technological transformation of the plantation economy of the Spanish Caribbean during the nineteenth century, from a transnational perspective. It seeks to highlight the technological links between foreign firms manufacturing machinery and the Caribbean colonial economies by focusing on Cuba, the region's largest economy and the most important Spanish colony in the nineteenth century. Through the study of patent data and trade figures, it shows that the pattern of technology transfer to Cuba, which emerged during the nineteenth century, transgressed political boundaries. This article also tries to illustrate the role of indigenous and foreign 'agents' in the diffusion of technology in Cuba during this period. More precisely, we try to uncover the rent-seeking and cooperative behaviors of the Cuban Creole elites in fostering technology transfer and investment by foreign firms, as well as the strategies used by European and American firms to commercialize technology in Cuba. In addition we consider the circulation of technical expertise between Cuba and advanced industrial nations, particularly the United States and the United Kingdom, as well as the role of transnational networks of experts.

The first part of the article places the nineteenth-century Cuban plantation economy within the context of the technological globalization that stimulated the circulation of technology and expertise in the Atlantic world economy. The second part examines the activities of foreign firms and experts in nineteenth-century Cuba, in areas such as the commercialization of technology and patenting. Here we resort to the study of patent data and trade figures, as well as to the study of case studies of technology transfer to Cuba, which involved the participation of a variety of intermediaries and legal and technical experts. The article ends with an examination of the transnational operations in Cuba of the French firm Derosne & Cail, one of the most innovative engineering firms of the mid-nineteenth century as well as one of the first European companies to supply advanced technology to the Caribbean sugar industry. We examine its strategies of commercialization of steam technologies for the sugar industry (such as the use of foreign agents, legal and technical experts, and offices); its management of intellectual property rights vis-à-vis sugar technology; and the relationship of this firm to Cuban sugar planters.

The Technological Transformation of the Cuban Plantation in the Nineteenth Century

In contrast to the extensive literature on technology and colonialism in the nineteenth century in the British and French worlds, the study of the networks and circuits of technological exchange in the Spanish Caribbean has received relatively little attention, despite the subject's importance. The scant literature on the technological changes within the nineteenth-century Cuban plantation economy has focused mostly on the relationship between technical improvements and slave labor. Research in the last two decades, however, has revealed the role of the Creole elite in promoting the modernization of the Cuban sugar industry. Among others, recent works by Daniel Rood, Fe Iglesias, Jonathan Curry-Machado, Reinaldo Funes and Dale Tomich have shown how modern machinery and organizational innovation was disseminated in nineteenth-century Cuba. This scholarship has shown how, during the nineteenth century, European and American circuits of technological exchange grew to such an extent world-wide that they included the Spanish Caribbean. [1]

These new studies have also examined the policies that Cuban institutions adopted to promote scientific advancement, such as the establishment of commissions to study foreign technological progress, the creation of research laboratories, the setting up of advanced botanical gardens and the proliferation of scientific and technical societies. Furthermore, some of these works have also stressed the role of British and American machinists and engineers in this modernization process. As Curry Machado has shown, these foreign technical experts and Creole technocrats acted as 'sub-imperial' agents in the technological transformation of Cuba's sugar industry.[2] Herein the term 'sub-imperial'

[1] See Daniel Rood (2010), Tomich (1991; 2004), Tomich and Reinaldo Funes (2009), Reinaldo Funes (2008), Curry-Machado (2011), Fe Iglesias (1998).

[2] Curry-Machado (2009).

refers to the island's economic and technological liberation from metropolitan Spain and its increasing ties with rival empires that occurred in Cuba several decades before the attainment of political independence in 1898.

The European and American industrial nations and the slave plantations of the Spanish Caribbean were not opposing economic systems but deeply entwined: the technological and organizational 'revolution' in the plantations of Cuba and Puerto Rico coincided with the industrialization of the Atlantic Economy. In the first half of the nineteenth century, Cuba emerged as an advanced agro-industrial region where sugar planters, sugar masters and prominent businessmen were aware of the latest innovations and participated in transnational networks of commercial and knowledge exchange. In this context, Cuban planters managed to transform their small-scale slave plantations into large agro-industrial complexes. Given that sugar was a singular tropical commodity, Cuban planters industrially processed the cane at the plantation site. Moreover, from the late eighteenth century, sugar was a commodity increasingly in demand by the middle classes of the advanced industrial economies of the Atlantic world. This expansion of sugar consumption in the industrial world, along with the technological advancement of sugar technology, led to the intensified integration of the Caribbean islands into the Atlantic world economy and the consolidation of transnational circuits for the exchange of technological knowledge.

During the period 1815 to 1868, the Cuban plantation economy underwent its first remarkable transformation. The Cuban cane-sugar industry became, from the mid-nineteenth century onward, a modern tropical enterprise. For instance, by 1870 Cuban sugar mills produced thirty percent of the total world market of this commodity.[3] This process of modernization and industrialization of sugar production cannot be explained solely by factors such as the expansion of the island's sugar frontier, its fertile soil or ideal climate. Nor can these changes be explained by the use of coercive labor before the abolition of slavery in Cuba in 1886. The technical changes and organizational innovations introduced in Cuba in the nineteenth century played a critical role in the transformation of its plantation economy. As Dale Tomich asserts, it is "not an exaggeration to suggest that technical innovation was the condition for the expansion of sugar and slavery in Cuba".[4]

The country's sugar industry and auxiliary sectors, such as the railroad and steamship, experienced an active process of innovation during this period.[5] Plantations at the western part of the island became advanced sites of technological and industrial experimentation in the tropics. These innovations were introduced in the Spanish Caribbean despite a lack of strong incentives for introducing labor-saving innovations. Mechanical and chemical innovations, and the early introduction of the railway, radically transformed the production level, productivity and scale of Cuba's sugar industry. Meanwhile, the dramatic expansion of its sugar industry also transformed the patterns of supply of credit, machinery and labor to the island.[6] The intensified integration of the Spanish Caribbean in the Atlantic world economy can be explained by, on the one hand, the expansion of sugar consumption in the industrial world and, on the other, the slave revolution in Haiti that opened up opportunities for other countries to take over its position in the sugar market.[7]

The architects of the first great technological transformation of the Cuban sugar industry were the Creole 'sugarocracy' and the transnational experts, such as the migrant engineers and chemists. During this period, sugar planters acted as the chief promoters of technology transfer, establishing agreements and partnerships with foreign inventors and mechanical manufacturers. The Cuban plantation system was also linked to the world economy through various transnational experts, ranging from machinists to commercial agents. These experts connected the Cuban sugar industry to the Atlantic-wide circuits and networks of information and knowledge exchange.[8]

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[3] Dye (1998: 27) and Tomich (2004: 129).

[4] Tomich (2004: 130).

[5] Zanetti and García (1998).

[6] Moreno (1868), Iglesias (1998), and Tomich (2004).

[7] Tomich (2004: 123–33), Mintz (1985: 60–73, 127–50).

[8] Barcia (2007), Machado (2012), Knight (1977), Fdez-Pinedo, Pretel and Sáiz (2010).

During the mid-nineteenth century, the Cuban Creole elite relied on formal political institutions such as the Royal Consulate, the Junta de Fomento, and especially the Economic Society, as forums of discussion and diffusion for all kinds of projects related to economic and industrial activity on the island. These autonomous institutions favored technology transfers to Cuba that were beyond metropolitan control. Although still constrained by political and legal ties with a declining metropolis, these overseas institutions, which devoted themselves to fostering the modernization of colonial industries, began to be controlled by Creole elites. The social support provided by this institutional infrastructure and the administrative networks set up by the Cuban Creole elite was crucial in encouraging technology transfer to the island and in developing its sugar industry. This allowed sugar-mill owners to participate actively in the global circuits of technological exchange that smoothed away the obstacles of the Spanish metropolitan economy to provide Cuba with the required technology.

In the nineteenth century, Cuba's technological requirements and position in the Atlantic world economy were different to those of metropolitan Spain. The Spanish colonies, as advanced sites of sugar production, required policies that differed from those of continental Spain. This situation was not inevitable but the result of a conscious decision by the Creole elite, given that metropolitan Spain was unable to provide the necessary technological innovations. Like other colonial or post-colonial sugar producers, such as the British West Indies, Brazil, Hawaii and Java, Cuba had to look abroad for its technology. However, there is a significant – albeit hardly surprising – contrast. While in these other colonies, or formerly colonized nations, the metropolis supplied an important part of the technology, as well as the capital and experts necessary for its introduction, it seems that in the case of the Spanish Caribbean colonies the role of the metropolis was fundamentally irrelevant.

The high number of patent applications in both the Madrid and Havana patent offices, protecting inventions in Cuba, indicates that this colony was the most innovative Spanish territory between 1820 and 1898, generating an even higher number of patent applications than any 'province' of metropolitan Spain. At least around 4,000 patents were directly registered in Havana between 1826 and 1880, representing nearly 40 percent of all the patents granted in the entire "second" Spanish empire during that period.[9] It is difficult at this point to determine the exact number of applications, given that the records are spread out between different collections of the Archivo Nacional de Cuba (ANC) and the Archivo de la Oficina Cubana de la Propiedad Industrial (AOCPI). Based only on a provisional study of the patent documentation at the ANC, it seems that technology transfer to Cuba through patenting was more prevalent from the late 1830s to 1868, the beginning of the Ten Years' War.

During the mid-nineteenth century it became routine for sugar machinists, planters and machinery manufacturers to register their economically valuable inventions and technical improvements at Havana's patent office. According to patent documentation obtained at the ANC, the main patenting sectors were sugar improvements, combustibles, electricity, steam technology, transport and railways.[10] A more systematic quantitative analysis – now in progress – will provide more nuanced information and support the argument of this section. If we take into account only the records of the ANC, it is clear that the great majority of patent applications occurred during the 1840s and 1850s, coinciding with the first great technological transformation of the Cuban plantation economy.[11]

The study of patent documentation provides us with material for two conclusions. First, it was during the 1840s and 1850s that a higher number of sugar technologies, ranging from industrial chemical processes to capital-intensive vacuum pans, were channeled through the proprietary system. Second, in cases in which it was necessary to protect creoles' interests, Cuban political and economic elites managed to deny foreign inventors' and firms' requests for patents on sugar technology. The

[9] ANC (Patent documentation at the following collections: Gobierno General; Gobierno Superior Civil; Real Consulado y Junta de Fomento) and AOCPI.

[10] ANC (Patent documentation at the following collections: Gobierno General; Gobierno Superior Civil; Real Consulado de Industria, Comercio y Junta de Fomento; Intendecia General de Hacienda).

[11] Sáiz, Pretel and Fernández (2010).

elites also managed to limit the granting of patents of introduction to Cuban residents in an effort to avoid monopolies and foster the exchange of technological knowledge among planters.

Although patent documentation serves as a good proxy for the dynamic of technological change in Cuba, it seems that in the mid-nineteenth century, the most salient transfer mechanisms to the island continued to be the migration of experts, the circulation of technical literature and the direct trade of foreign machinery. However, as patent records show, the transfer of patented technology to the Cuban sugar industry and auxiliary sectors is as old as the institution itself. From the 1820s onwards, some of the most economically valuable technologies transferred from advanced economies to Cuba were channeled through the Spanish patent system. These transfers were carried out through either the metropolitan office located in peninsular Spain or, more frequently, the Cuban patent register. Interestingly, the technical information contained in the patents granted at the Cuban patent 'sub-institution' was regularly published in *La Gaceta de La Habana.*

The last third of the nineteenth century saw the second great technological transformation of the Cuban sugar industry: the transition to the central factory system of production.[12] The Cuban sugar industry became one of the earliest examples of industrial agriculture in the tropics; by the turn of the twentieth century it had become a modern agro-industrial enterprise, highly intensive in both machinery and capital, providing career opportunities for well-qualified industrial experts. Cuba's large agro-industrial complexes became one of the principal destinations for US and European materials, equipment and durable goods. Cuban mills initiated a merging and modernization process during a period of crisis for the sector that was rooted in the increasing competition from beet sugar producers and the extension of sugar cane plantations to new regions.[13] The total number of sugar estates was significantly reduced and the Cuban mills became the largest in the world. The change in the size of the business was closely associated with the introduction of technical and organizational innovations related to the so-called second industrial revolution, such us the continuous process innovations.[14] The change in the scale of production, from 1900, also had consequences on the location of the industry, namely the expansion of the sugar industry to the eastern part of the island. Although from the 1880s incentives to patent modern technology related to sugar cane exploitation increased, there is no clear evidence of this tendency on patent applications according to the documentation at ANC and AOCPI. However, the documentation at AHOEPM in Madrid shows an increasing activity of extension of corporate and 'elite' patent[15] rights, from the metropolis to the colony, during the two last decades of the century.[16]

The preliminary study of Spanish patent documentation from 1820 to 1898, and the Cuban Trade Figures from 1826 to 1863, reveal that the introduction of new technologies of sugar production in Cuba was characterized by well-defined patterns (see Fig. 1 and Fig. 2). Technology was neither imported from the Spanish metropolis nor produced in Cuba. On the contrary, inter-imperial and inter-colonial technological exchange was far more important. In developing its sugar industry, Cuba became dependent on technology from American, British and French engineering firms.[17] Although Cuba maintained its political ties with the declining Spanish metropolis, it established technological links with foreign manufacturers of machinery from the most industrially advanced Atlantic empires. In essence, for the technological development of the Cuba plantation, the economic links assumed greater importance than political control. For instance, according to the trade figures for the year 1850,

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[12] Tomich, (2004: 125–6), Funes (2008: Chapter 5).

[13] Dye (1998).

[14] Dye (1998: 10–14).

[15] 'Elite patents' refers to the small groups of the most valuable patents. The elite status is measured according to the duration for which patentees maintain a monopoly and the number of assignments and licenses made. Foreign patents lodged at a higher cost in Cuba might also be considered 'elite' patenting activity. For in-depth insights into the idea of "elite" patents and the value of patent rights, see Inkster (2003).

[16] Patent documentation at ANC, AHOEPM and AHN (Ultramar). For partial studies of patent activity in Cuba, see Fernández (2008: 113–9) and Marqués Dolz (2006: 98, 224).

[17] See ANC, AOCPI and Balanza General de Comercio de la Isla de Cuba, 1826-1863 (BN and ANC). On the extreme dependence of Cuba on foreign railroad technology in the nineteenth century, see Zanetti and García (1998).

all the machinery, equipment and tools that Cuba imported that year came from Britain and the United States, and were shipped by commercial firms from these two countries. The following passage from an 1851 edition of the patent journal *Scientific American* describes the situation nicely: [18]

> Very few persons are aware of the large amount of machinery that is usually shipped from the United States, particularly from Boston, to Cuba. On account of the large crops which have been produced there in the last few years, and the large demand for molasses and sugar, machinery has been, and is now, in constant demand, for the manufacture of it.

In the mid-nineteenth century, Spain could neither provide the necessary technology to Cuban plantations nor serve as a sufficient market for Cuban sugar. Moreover, Cuba did not have a sufficient industrial base to supply the technology necessary to the expansion of its plantation economy.[19] The early introduction of railroads in Cuba in 1837 had the effect of stimulating foreign manufacturers of machinery from Europe and America to commercialize their technologies in the island, thereby deepening the exporting tendency of Cuba.[20] Rather than facing competition from indigenous manufacturers, foreign multinationals obtained collaboration from political and economic Cuban elites. Foreign multinationals were offered advantageous commercial and material conditions, which promoted the import of foreign technologies, such as institutional changes and infrastructures that helped the imported technology to reach Cuban plantations.

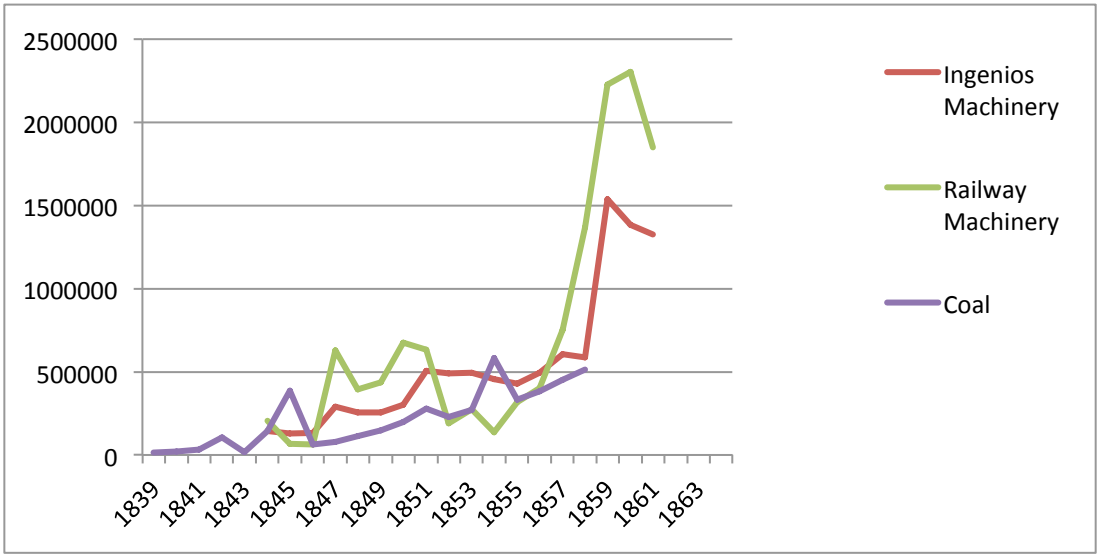

Fig. 1 Machinery Imports, Cuba 1839-1863 (pesos reales)

[18] "Machinery for Cuba", *Scientific American*, Vol. 8, no. 9 (12 November 1852,): 69. A similar reference could be found in 1851 in the same publication, *Scientific American* (Volume 7, issue 8): 59. "Cuba is almost wholly supplied with machinery from the United States. There is in nearly every plantation in Cuba a sugar mill driven by steam engines, built usually in New York or Boston".

[19] Marqués Dolz (2006) ; Zanneti and García (1998).

[20] Zanneti and García (1998).

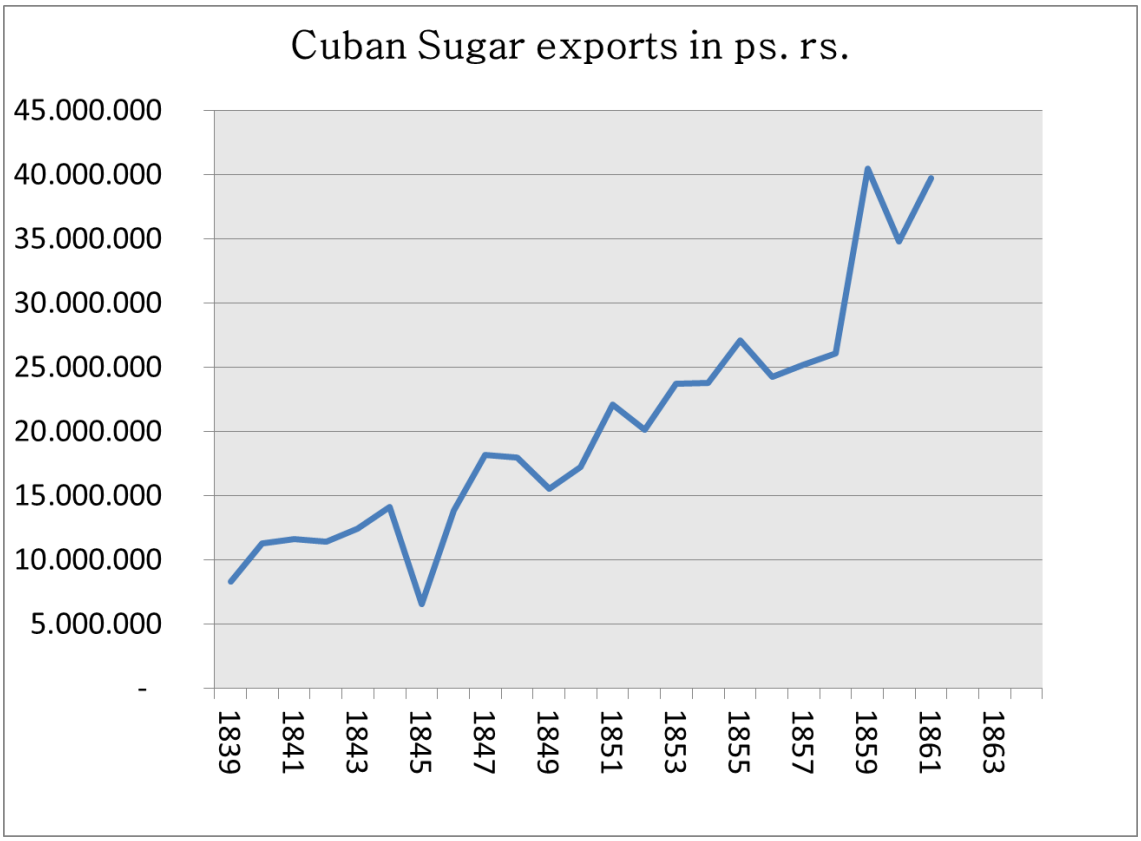

Fig. 2 Source: Balanzas de la Isla de Cuba, 1839-1863

Engineering Firms and Transnational Expertise

In the mid-nineteenth century, one of the largest markets of machinery makers and engineering firms in Europe and the United States was in the Cuban sugar plantations. Foreign sugar-machinery manufacturers based in New York, Paris, Liverpool and Glasgow, and the sugar elites of the Spanish Caribbean, became closely interconnected during the mid-nineteenth century, developing a commercial relationship that favored the transfer of technical innovations to the region. By the late 1830s, American and British companies had begun to introduce the overwhelming majority of machinery used on sugar plantations in the Spanish Caribbean. Moreover, the development and growth of mechanical engineering, in cities like Glasgow, was stimulated by the expansion of the sugar plantations in the Caribbean, which demanded a large quantity of tools and machinery.

Steam engineering and manufacturing companies, such as the British company Fawcett Preston, the North American Novelty Iron Works and West Point Foundry, and the French Derosne et Cail, were some of the most important suppliers of sugar machinery to Cuba. Only French firms managed to compete with British and American companies manufacturing machinery.[21] Other firms, such as the Glasgow-based Duncan Stewart & Co. and Babcock Wilcox, along with the French firms Compagnie de Fives Lilles, Société Anonyme des Anciens Établissements Cail and Frères Brissoneau et Compagnie, would take over during the last decades of the nineteenth century.[22] According to the literature, Cuban plantations also became, during these years, sites of incremental innovation, industrial experimentation and trials for foreign firms.[23]

For instance, large Scottish machinery makers, based in Glasgow, such as W. & W. McOnie and Mirless Watson & Co. had Cuba as their primary market, where they signed hundreds of export

[21] Matei (1985: 20–30), Machado (2009: 39), and Tomich and Funes (2009: 103).

[22] Ayala (1995), Machado (2011), and Iglesias (1998).

[23] Rood (2011) and Barcia (2007).

contracts in the mid-nineteenth century. These two firms not only sold machinery, tools and equipment (steam engines, sugar mills, hammers, juice pumps, cane carriers, etc) to the Cuban sugar plantations but they also provided planters with instructions to set up and work the machinery, sketch plans showing the whole arrangement of the buildings and the position of the machinery, repair services and machinery testing.[24] Scottish machinery makers and Cuban plantations relied on a highly mobile group of "transnational experts" that acted as intermediaries in the commercialization and transfer of technology to Cuba. The careers of some of these experts in machinery and sugar production had transatlantic dimensions. A good example is the activity, from the late 1850s, of the Scottish machinists Edward Beanes and William H. Ross, agents and technical experts for Mirless Watson & Co. and the Liverpool based firm Fawcett Preston. The two of them had spent many years working on Cuban sugar plantations and returned to Liverpool where they acted as intermediaries for British engineering firms, trading technology in Cuba, first as business partners and from 1862 separately. Beanes was also a prolific inventor, owning several patents for technical improvements in the manufacture of sugar.[25]

An excellent example of the transnational operations of a large engineering firm in Cuba in the late nineteenth century is the activity of Babcock & Wilcox. From its foundation in 1881 this company had a global strategy of commercialization of technology and management of property rights through foreign agents. According to Kristine Bruland, between 1881 and 1891 the Glasgow branch of this firm sold and installed technology in 44 countries. Its third most important market, after France and Russia, was Cuba, where this firm signed 88 export contracts over those ten years. The importance of Cuba for this firm is clear: it set up an office in Havana in 1882, directed by Alberto Verastegui, a Spaniard who had migrated to New York where he became director of exports for Babcock & Wilcox and then traveled to Cuba to work as an agent of this firm.[26] Less well-known is the partnership between the inventor Thomas Edison and the Basque businessmen José Francisco Navarro who set up the firm 'Edison Spanish Colonial Light Company' in New York in 1881, later renamed 'The Havana Electric Light Company'. This company was set up in Havana with the declared purpose to "own, manufacture, sell, operate and licence" technology patented in Cuba.[27]

When the transfer of capital-intensive central sugar technology to Cuba began to be introduced from the 1880s, there was a multiplication in patent experts and other intermediaries transferring inventions to Cuba. The extension of patent rights granted in metropolitan Spain to the colonial territories was a lucrative activity. Foreign machine and engine manufacturers required agents who were experts in the particularities of Spanish patent regulations and administrative procedures in the colonies. During the last decades of the century, the extension of patents and trademarks issued in metropolitan Spain to *Ultramar* (colonial Spain) was an important activity of the leading Spanish patent agencies. The three agencies that monopolized this activity in Cuba – Elzaburu-Vizcarrondo, Centro Auxiliar de la Industria and Clarke, Modet & Co. – also happened to be the most active agencies in international patenting in metropolitan Spain.[28] Machinery manufacturing companies, like the Glasgow-based Duncan Stewart & Co. and the French firms Compagnie de Fives Lilles, Société Anonyme des Anciens Établissements Cail and Frères Brissoneau et Compagnie, made extensive use of these agencies to secure their colonial patents. Moreover, many of the foreign machinery firms

[24] Glasgow University Archives. Ref. UGD/118

[25] Mirless Watson & Co. Order Books. Ref. UGD/ 118/ 2/4. See also: The Scientific American: Vol.1007, issue 8, Aug. 23. 1862; The Scientific American, Vol. 1012, issue 13, march 25, 1865; The London Gazette, January 13, 1863.

[26] Bruland (1998, 2004).

[27] Document of Incorporation of Edison's Spanish Colonial Company (5/09/1881), The Thomas Alva Edison Papers, Rutgers, ref. XX19.

[28] See for instance the hundreds of files of patent rights extended to the colonies in AHN, Ultramar, (Ministerio de Ultramar Remite Patentes de Invención), nos. 127, 155, 156, 131 for the years 1888, 1889 and 1891-1893 and AHN, Ultramar, (Convalidación de Patentes Dadas en la Peninsula) nos. 178, 180, 182, 184, for the years 1893-1896.

active in the Spanish patent system, such as Babcock & Wilcox and Société des Constructions Mécaniques Saint Quentin, had branches in Havana during the last decades of the century.[29]

Spanish and Cuban lawyers, businessmen and planters guided and assisted foreign corporations in registering, publicizing and commercializing their inventions in Cuba. Experts' assistance in preparing patent applications, including mechanical drawings, had already become essential by around 1850. One patent practitioner, who worked intensively for foreign sugar machinery manufacturers, including Duncan Stewart and Fives Lille, was the Puerto Rican Julio Vizcarrondo, the first professional agent to work intensively in Spain for foreign firms and inventors such as Thomas Alva Edison and the German steelmakers Krupp. A renowned lawyer based in Madrid from 1863, Vizcarrondo was a prominent liberal politician and journalist as well as a leader of the Spanish slavery abolitionist movement. Vizcarrondo was educated in San Juan, Paris, the US and Madrid where he obtained his law degree from the Universidad Central. Because of his political stand against slavery in Spain's Caribbean plantations, Vizcarrondo was exiled in 1850 to New York City, where he met and married Harriet Brewster, daughter of the American abolitionist Henry Brewster Stanton. Vizcarrondo's international education and four years of exile in New York would give him the ideal personal and professional background to build, late in his life, a sizeable international industrial property agency in Madrid: the Anglo-Spanish General Agency and Commission House, set up in 1865.[30] In 1854 he had returned to Puerto Rico, where, in addition to his political activities, he worked as an attorney and helped to promote industrial activity on the island with the mercantile publication *El Mercurio*, which he founded in 1857, and subsequently edited. Before moving to Madrid in 1863, Vizcarrondo worked mainly as a representative of American and British firms in Puerto Rico and Cuba. [31]

The patenting activity of the firm Duncan Stewart and Co. provides a good example of Vizcarrondo's role as a transnational expert in 'colonial patents' and intermediary in technology transfer to Cuba. This machinery manufacturing company, based in Glasgow, used the services of Vizcarrondo's agency in several of its patent applications in the Spanish patent system. For instance, in April 1887, Vizcarrondo presented an application – in the Madrid Register – for a patent of introduction for 'an improvement in sugar mills.'[32] Vizcarrondo supported Duncan Stewart in the patent application process, translated the technical memorandum and arranged the necessary mechanical drawing services. A year later this agent would also assist Duncan Stewart in officially certifying that the new invention had been put into practice in Cuba, following the legal requirements of the 1878 Spanish patent law extended to Cuba in 1880.[33] The new mill was set up on the Soledad sugar estate, a large modern 'sugar central' owned by the Boston firm E. Atkins and Company and one of the first major direct investments by an American firm on the island.[34]

Derosne & Cail in Cuba

In order to conduct a closer investigation of the operations of multinational engineering firms and the role of transnational expertise in Cuba in the nineteenth century, we use the following case study: the international activities and strategies (such as patenting and commercialization of technology) of the French machinery manufacturer Derosne & Cail between 1812 and 1898. During the nineteenth century this firm pursued a global strategy through the use of agents and the management of patent rights in different countries. Derosne & Cail was established in 1812 by the prominent French chemist Charles Derosne, and became Derosne & Cail in 1836 when the boilermaker Jean François Cail

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[29] ANC, Gobierno General, 1885, Leg. 455, no. 22246; *Revista de Agricultura*, año XII, no. 4 (24 January 1892:48) and *Revista de Agricultura*, año XII, no. 11 (13 March 1892:13).

[30] Register of Patent Operations and Business Diaries, Elzaburu Agency Private Records, Madrid, and the original powers of attorney kept in the patent documentation of the AHOEPM for the period 1826-1903.

[31] Historical Dossier, Elzaburu Industrial Property Agency (Madrid, 2009).

[32] AHOEPM, priv. no. 6,915.

[33] Julio Vicarrondo's Business Diaries, Elzaburu Private Records, Register of Patent Operations for the Year 1887.

[34] Dye (1998: 58–60).

became Derosne's business partner. By the middle of the century, this firm would become one of the world's foremost sugar machinery manufacturers and the second largest firm in France after Schneider. Interestingly, Derosne & Cail not only had factories in France (Paris, Douai, Denain and Valenciennes), but also pursued a global strategy of production and commercialization of technology, as well as of international management of property rights through foreign agents and offices. During the mid-nineteenth century, this firm became a multinational corporation that created an extensive network of factories, representatives, agents and branches throughout Europe, Russia, Latin America and the Caribbean. Derosne & Cail based its development on an astute global strategy of diversification and internationalization, effectively harnessing an extensive international network of factories, agents and intermediaries, and thereby successfully establishing itself as one of the pioneering European companies to supply steam technologies to the Caribbean plantation economies.[35]

From 1815 this firm also extended its network to the sugar-producing islands in Antilles, Africa and Southeast-Asia, and was soon present on the islands of Cuba, Puerto Rico, Guadeloupe, Martinique, Mauritius, Java and Bourbon.[36] Derosne & Cail was especially active in Cuba during the mid-nineteenth century. Contact between Derosne & Cail and Cuban sugar planters started in the late 1830s, with the attempt to introduce Derosne's vacuum pan into Cuban plantations. The sugar planters Joaquín de Arrieta, Wenceslao de Villaurrutia and Pedro Lefranc Arrieta acted as Derosne's business partners. The first refining system sold and installed by this firm in Cuba was a vacuum pan set up in 1841 on the sugar estate *La Mella* owned by the wealthy planter Wanceslao de Urrutia. The May 1843 crop was the first processed entirely with the new apparatus. According to a report by Villaurrutia on the performance of Derosne's new 'sugar machinery' with the 1843 crop, the new system of vacuum pan evaporation significantly saved labor and reduced charcoal consumption.[37] However, the initial investment was considerably higher than had been required for the technically inferior vacuum boilers.

In their 1844 treaty describing the new method – translated into Spanish by the renowned Cuban Chemist José Luis Casaseca – Derosne & Cail recognized that the new apparatus needed a skilled sugar master to operate it; yet, they also underlined that the new mechanical system simplified the tasks of unskilled-slave labor.[38] According to the United States Patent Office, the Derosne installation bought by Villaurrutia cost $32,000.[39] Derosne himself trained Villaurrutia's machinists to use this innovation and supervised installation on other Cuban plantations, such as *La Gran Azucarera (San Martino* and *Santa Susana*) and the plantations of the Zulueta family (*Habana*, *Vizcaya* and *Alava*).

As Carlos Rebello's statistics for the year 1859 confirm, the use of Derosne apparatus proliferated throughout the island during the 1840s and 1850s.[40] According to Rebello, by 1860, only 77 of the 1300 Cuban sugar mills were using vacuum pans, although these 77 included the majority of the largest Cuban sugar mills. Of the 77 plantations using this steam technology, at least 33 were using the Derosne technology and 20 were using the Rillieux system, commercialized in Cuba by the agency Merrick & Towne. However, according to several complementary sources (including mechanics journals, contemporary treatises and documentation on specific sugar plantations obtained in Cuba's National Archive), it seems that the number of sugar mills employing some sort of Derosne technology was higher than indicated in Rebello's statistics.

The introduction of Derosne's Vacuum technology was a massive investment for Cuban planters, who did not have easy access to credit because of the weak Cuban banking institutions of the

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[35] Chadeau (1988: 28-29), Smith (2006: 210), Thomas (2004), and Gaillard (1960).

[36] E. Chadeau (1998 : 25, 28 and 29)

[37] J. A. Leon, *The Sugar Question. On The Sugar Cultivation in The West Indies* (London, 1848), 19-25.

[38] Ch. Derosne and J. L. Cail, *De la Elaboración del Azúcar y de los Nuevos Aparatos Destinados a Mejorarla* (La Habana, 1844), 15-22.

[39] "Annual Report of the Commissioner of Patents for the Year 1848", *United States Patent Office* (Washington, 1849): 328.

[40] Carlos Rebello, *Estados Relativos a la Producción Azucarera de la Isla de Cuba* (La Habana: Intendencia del Ejercito y de Hacienda, 1860).

time and the inability of the Spanish metropolis to provide capital to introduce modern technology and skills to the island.[41] Because planters needed loans to buy technology, Derosne and Cail provided some credit to planters who could not borrow money from Cuban banks or foreign institutions such as Moses Taylor, Baring Brothers, and Brown & Brown.[42] The installation of Derosne technology and other similar vacuum pans left Cuban planters exposed to large debts in the second half of the century, drawing many of them into bankruptcy.[43]

After the successful introduction of the new vacuum pan in Cuba, Derosne & Cail also tried to secure the property rights of their apparatus in the Cuban patent 'sub-system'. Derosne and his business partner Jean François Cail had already secured the patent rights of this invention in France and Britain, thereby amassing a small fortune in sales of the new invention. In June 1842, they applied to Havana's *Junta de Fomento* for a fifteen-year 'royal privilege of invention'. Their agent in Cuba was Joaquín de Arrieta, a sugar planter, who acted as an intermediary in the application process to obtain this patent. Arrieta acted not only as an agent but also as a business partner, insofar as he introduced Derosne's apparatus in 1843 into his sugar mill *Flor de Cuba*. Soon after setting up the Derosne machinery, the *Junta de Fomento* organized a commission of sugar planters whose task was to visit Arrieta's 'sugar state' in order to examine Derosne's new technology.[44]

The patent application was officially rejected by Havana's *Junta de Fomento y Agricultura*. The reasons put forward for this rejection were two-fold. First, it was argued that, according to Spanish law, the new technology had already been introduced into the island. Second, Cuban institutions controlled by the planters, such as the *Junta de Fomento* and *Real Sociedad Económica*, had already invested significant capital in introducing Derosne's invention to Cuba's sugar mills.[45] Indeed, in 1843 the *Junta de Fomento* commissioned the chemist Jose Luis Casaseca to travel to Brussels to visit the Derosne & Cail factory and examine the firm's improvements in sugar technology.[46] A year later, in 1844, Casaseca translated Derosne's treatise with the economic support of the *Junta de Fomento*, distributing 500 copies among Cuban sugar planters and five copies to the island's public libraries.[47]

The introduction of Derosne's Vacuum pan in Cuba gives us an understanding of how, during the mid-nineteenth century, sugar planters exchanged and shared technological information, instead of competing among themselves, through the institutions they controlled, such as the *Junta de Fomento*. This successful strategy of cooperative efforts among planters promoted innovation and satisfied the demand for technology and expertise in Cuba. In the last decades of the nineteenth century, Creole planters would also become organized in associations that shared technological knowledge. One such organization was *El Círculo de Hacendados*, a corporation set up in the late 1870s whose purpose was to diffuse the most advanced foreign sugar technologies in their sugar plantations as well as to exchange knowledge and information.[48] The activities of *La Junta de Fomento* and *El Círculo de Hacendados* are good examples of how the Cuban Creole elite used its political power to secure rent-seeking economic enterprises related to the sugar industry during the nineteenth century.

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[41] Roldán de Montaud (2004), Calavera (1996), and Collazo (1989).

[42] Thomas (2004).

[43] Moreno (1983:73, Iglesias (1983; 1999) and Zogbaum (2002).

[44] ANC, Real Consulado y Junta de Fomento, Leg. 95, no. 4,006, 1843.

[45] ANC, Gobierno Superior Civil, Leg. 1,476, no. 58,365, June 1842.

[46] ANC, Real Consulado y Junta de Fomento, Legajo 95, no. 3996, 1842. See also José Luis Casaseca, *De la Necesidad de Mejorar la Elaboración del Azúcar en la Isla de Cuba y de las Mejoras de que es Susceptible esta Fabricación* (Habana: Imprenta del Gobierno y Capitanía General, 1843).

[47] *Informe presentado a la Real Junta de Fomento, de Agricultura y Comercio de la Isla de Cuba, por el Sr. D. Wenceslao de Villa Urrutia sobre Los Resultados de la Zafra que este año ha hecho su ingenio en un tren Derosne* (Habana: Oficina del Faro Industrial, 1843).

[48] See *Reglamento del Círculo de Hacendados de la Isla de Cuba* (La Habana: Establecimiento Tipográfico O'Reilly nº 9, 1889): Capítulo 1, Artículo 1, p.4. See also Leida Fernández Prieto (2008).

Although Derosne's patent application was rejected, this episode shows how the control and management of patented technology in colonial plantation economies like Cuba's became a common activity for foreign firms in the mid-nineteenth century. It seems that American, British and French firms patenting in Cuba followed a general strategy in the extension of property rights to countries on the periphery of industrial development. As Inkster has pointed out, multinational corporations "used patent rights to establish their markets abroad".[49] Their primary strategy was to block imitation. Once their patents had been secured, those firms could proceed with their manufacturing and exporting activities or eventually commercialize the patent rights in the Caribbean.[50] Securing industrial property rights as quickly as possible was likely the best way for these foreign firms to avoid imitation in countries like Spain (and its colonies), where 'introductory patents' were granted to importers of overseas inventions, and not just to the 'first' and 'true' inventor.

Conclusion

During the nineteenth century the Cuban sugar plantation became a highly dynamic space, open to foreign intervention at many levels. In a period of accelerated capitalist globalization, foreign engineering firms from the most industrialized nations began to dominate the trade in modern industrial technologies in sugar in Cuba. The increasing commercial prospects in the Cuban economy from the mid-nineteenth century led western manufacturers of refining equipment to actively protect and commercialize their innovations in Cuba. Many of these foreign manufacturers of machinery had branches and agents in Havana.

Creole planters were inserted into an international network involving the circulation of technology, in which expert migration became, along with patenting and technical journalism, a major vehicle for the dissemination of knowledge. The Cuban Creole elite was the main promoter of the modernization of the Cuban sugar industry in the mid-nineteenth century, through industrial and commercial policy, the diffusion of foreign technology and the attraction of foreign experts. In this context, active transfer agents, from technical experts to businessmen, not only carried technological information to Cuba, but also assisted machinery manufacturers in the commercialization of their technology on this island. During these years, not only did Cuba receive experts from abroad, but Cuban professionals and machinists themselves traveled to America and Europe to learn about new techniques and industrial methods. The transfer of foreign technology and the circulation of transnational expertise in Cuba reveal that the view of nineteenth-century empires as bound entities cannot be sustained. The transfer of technology, and expert migration, in the Atlantic world economy can only be explained as the result of a larger interacting global economy in which rival empires (and their firms and professionals) acted as a kind of 'shadow' metropolis.

The Derosne & Cail case study provides an example of the transnational operations of foreign sugar machinery manufacturers and the circulation of transnational expertise in the plantation economy of the Spanish Caribbean during the mid- and late nineteenth century. The Derosne case study highlights the global strategy of one of the firms that, from the mid-nineteenth century, began to introduce what would become the majority of the machinery to be used on sugar plantations in Cuba. Moreover, this firm routinely patented valuable inventions in Cuba. However, it is difficult to know to what extent patent rights were important for foreign firms such as Derosne & Cail and Babcock & Wilcox. It is striking that, despite the persistent corporate patenting activity that occurred in Cuba and metropolitan Spain protecting inventions in the island during this period, sugar machinery manufacturers usually did not manufacture, or commercially exploit, in Cuba the industrial property rights they had obtained. It seems that the patenting activity was rather linked to the use of the Cuban "sub-patent" system for commercial purposes, specifically as a means of advertising new technologies on the island.

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[49] Inkster (1991: 113). Fox and Guanini (1999) have also identified "protective patenting" strategies among large German chemical firms in the late-nineteenth century.

[50] Curry-Machado, *Cuban Sugar Industry: Transnational Networks and Engineering Migrants in Mid Ninetheenth Century Cuba*, 32, 42 and 43.

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