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COLONIAL INNOVATION SYSTEM, SUB-IMPERIAL INSTITUTIONS AND THE CREOLE ELITE IN NINETEENTH-CENTURY CUBA

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Colonial Innovation System, Sub-Imperial Institutions and the Creole Elite in Nineteenth-Century Cuba

Introduction[*]

The history of technology in Spain's two remaining American colonies in the nineteenth century has been largely neglected by the specialized literature. The paucity of scientific and inventive activity by the Spanish Empire and its technological dependence on the industrialized countries from the second half of the eighteenth century onwards seemed to be the main reason of this lack of interest. Likewise, the ubiquitous presence of sugar might have 'sweetened' and simplified the way in which historians tackled issues relating to the Spanish Caribbean plantation economy.[1] This situation differs from the increasing research on the historical relationship between technology and colonialism that has been published over the last two decades. This recent scholarship has illuminated how the networks of technological exchange globalized to an extent in the nineteenth century such that they included the colonial world.[2]

In contrast to the myriad literature on technology and colonialism in the British and French worlds, the history of technology in the Spanish Caribbean has received relatively little attention, despite its importance. The scant literature on the technological changes within the nineteenth-century Cuban plantation economy has mostly paid attention to the relationship between technical improvements and slave labour.[3] Recent research, however, has revealed the relevance of the efforts by the Creole elite to promote the modernisation of the Cuban sugar industry. Among others, recent works by Alan Dye, Jonathan Curry-Machado, Reinaldo Funes, Stuart McCook, Pedro Pruna and Dale Tomich have shown how modern machinery and organisational innovations were disseminated in nineteenth century Cuba.[4] These new studies have also examined the measures adopted by Cuban institutions so as to promote scientific advancement, such as the 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 stressed the role of British and American technicians and engineers in this modernisation process. As Curry Machado has shown, these foreign technical experts

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acted in Cuba as 'sub-imperial' agents in the process of technical change of the sugar industry.[5] Herein the term 'sub-imperial' refers to the nineteenth century Cuban internal process of economic and technological liberation from the metropolis before the attainment of political independence in 1898.

This paper offers an overview of a vast recently born research project that results from the confluence of three lines of research: Spanish patent history, Cuban commercial history and the modern history of technological globalization. More specifically, this paper studies the nature of the Cuban Innovation System[6] through the analysis of the functioning of the Spanish patent institution at the colony. Section one examines the technological and institutional evolution of Cuba during the nineteenth century. This section will summarize how Spanish colonial institutions in charge of fostering technological innovations acted in the overseas territories in a very different manner to how they did in the metropolis. Cuban institutions such as the Junta de Fomento, Real Consulado or Sociedad Patriótica de Amigos del País were more active in promoting technology transfer than their equivalents in metropolitan Spain. These institutions acted in Cuba as 'sub-imperial' institutions that were administered independently. They were taken over by the Creole Elite of sugar planters to favour their interests: the investment in technology and the increase in exportations. Section two offers an overview of the particular characteristics of the Spanish patent system overseas by focusing on Cuba as the most important Spanish colony of the nineteenth century. The analysis of the practical management of the Spanish patent institution overseas yields an understanding of the increasing nineteenth century extension of patent systems throughout the North Atlantic economies and the colonial world.[7] This process led to a progressive globalization of markets for technology and the mushrooming of international patent agencies which facilitated transfers of technological information to Cuba. Finally, section three offers an interpretation of foreign patenting activities and technology transfer in the Cuban sugar industry in the late nineteenth century. This section stresses the role of *hacendados* (sugar-mill owners) as agents of diffusion of foreign patented technology in Cuba. In the nineteenth century, sugar planters acted as the chief agents of technology transfer, establishing agreements and partnerships with foreign inventors and mechanical manufacturers. Therefore, the Cuban patent system, as a 'sub-imperial' institution, was linked to the world economy through 'sub-imperial' agents. These agents connected the Cuban sugar industry to the international networks of information and knowledge exchange.

In the last decade, economic historians have provided extensive knowledge as to the functioning of the Spanish patent system throughout nineteenth century.[8] These works have shown that Spain was, throughout this period, extremely dependent on European technology in developing its own industry. However, patent dynamics overseas are still largely ignored. Before 1898, metropolitan Spain and Cuba had the same patent legal regime, but their practical management seemed to have been rather different. Similarly to other Cuban institutions in charge of the promotion of economic development, the Spanish patent system became progressively self-governed. These independent institutional practices in nineteenth century Cuba led to the establishment of an autonomous 'Colonial Innovation System' before the political separation of Cuba in 1898. The Cuban innovation system consisted of 'sub-imperial' institutions that helped to insert the Cuban economy in the global networks of technological exchange.[9] These autonomous institutions favoured technology transfers beyond the capacity of Spanish control. In this context, patent networks were a relevant vehicle for the transmission of technological knowledge and information to the colonies.

Sugar, Technology and Institutions

From the end of the eighteenth century and throughout the first half of the nineteenth century, Cuba entered the international world market thanks to its specialization in sugar production and its inclusion in the international network of technological exchange. Cuba filled the void left by the French colony of Saint Domingue[10] after the 1791 slave rebellion. This fact, added to the increasing international demand for sugar as a result of the industrial revolution and the ensuing globalization, forced Cuban sugar planters to reduce costs progressively in the wake of the arrival of new competitors such as sugar beets and new producing countries such as Java, Formosa or the Philippines.

The Spanish, European (especially the British and French) and the United States customs policy also shaped the future of sugar export.[11] Yet, to explain the remarkable transformation that turned Cuba into the world's largest sugar producer, it is necessary to understand the important role played by Cuban institutions in promoting measures, namely technological policies, that allowed the specialization in a sugar monoculture economy. These Spanish colonial institutions acted on the island very differently from how they did in the metropolis. Our hypothesis is that these 'sub-imperial' institutions were more active and immersed in the international networks of technology exchange,

as well as more connected to the recent globalized international market than the metropolis.

Three aspects explain the process through which Cuban creoles achieved this economic and technological independence. First, Spain was not as large a sugar consumer as England. Therefore, the metropolis was not a market for Cuban sugar.[12] Second, Spain was not a great re-exporter of colonial foodstuffs. Third, Spain could not offer the technology required by the sugar industry due to the lack of refineries and scientific and technological expertise. The elite planters had thus to find their own way to access the globalized market and to bring advanced technology to the island.

How did planters succeed in biasing commercial Spanish rules? Cuba was an agricultural colony with a clear specialization in sugar monoculture, with a few other subsidiary goods, such as coffee and tobacco. As it dedicated the greatest part of its land, human labour and capital resources to sugar production, the island was highly dependent on foreign trade, both to sell what it produced and to meet its food needs such as wine, flour, jerked or dried beef, and so on. Lacking a qualified craft industry, it also had to import manufactures. The Cuban economy grew by increasingly binding itself to the exterior. The island elite managed to take advantage of the situation through the enactment of a tariff system and the use of neutrals.[13] The authorities of Havana faced this set of circunstances with successive licenses for trading with neutrals –and with the repeals of these- and decided to act independently,[14] thereby ignoring the orders coming from Spain and allowing the entrance of United States businessmen whenever they believed it to be appropriate.[15] This was one of the means of legalizing contraband. The assault of Havana from England (1762) is considered to be a turning point. Spanish policies turned back to liberalization beginning in 1765 in order to attempt to expedite business relations between the metropolis and the colonies.[16] However, the incapacity of the Spanish military forces to control smuggling and to maintain sea trade in times of war opened maritime trade to foreign nations. The royal decree passed on the 18 February 1818 allowed Cuban free trade with foreign nations,[17] given the constant complaints and difficulties in maintaining regular trade.

The second problem related to commerce was customs tariffs. In general, custom duties were high and brought many fiscal revenues to Spain. This was the only way for the metropolis to receive any fiscal revenue from sugar planters, given that the Cuban fiscal system was based on indirect taxes. Planters were not only exempted from several indirect taxes,[18] but also from the unique direct tax –the diezmos-[19], a privilege

that other primary industries such as cattle breeding did not enjoy. In addition, they obtained the exemption of customs duties in the importation of utensils for the agriculture and reductions in tariffs related to machinery. Planters also maintained a *de facto* prohibition of the transfer of debt of their ingenio at least until 1843.[20] Even if the Spanish custom tariff policy regarding Cuba was quite complex,[21] it was obvious that there was complicity between the elite and the colonial authorities, which was also reflected in the modification of the assessments. For instance, Ramón de La Sagra,[22] a Spanish naturalist and politician, explained how a committee formed by planters, merchants and members of the colonial administration met yearly in Havana to look through custom duties.[23] Indeed, the Royal Decrees of the 4 February 1822 and the 25 March 1825 became the most effective tools to change assessments and to act beyond the Spanish rules.

However, not only did planters manage to have sway over Spanish trade rules, but they also promoted the transfer of technology. The main Spanish colonial institutions throughout the end of the eighteenth century and the first half of the nineteenth century, such as the town council, the Real Hacienda or the Real Consulado –which was renamed Junta de Fomento in 1832-, worked together to promote agriculture and import every type of modern apparatus and innovation that would benefit the sugar industry. The Count of Ricla and a group that Le Riverend[24] called the 'first reformists', which included Captain General Luis de las Casas and the planter and politician Francisco Arango y Parreño, supported the development of Cuban agriculture and above all the sugar culture.[25] These institutions, especially the Junta de Fomento[26] and the Economic Societies,[27] clearly prioritized the planter's interests over the metropolis' concerns, acting as autonomous institutions within the Spanish administration. The Economic Society of Havana in turn created diverse entities that encouraged the transfer of technology. Examples of these are its Public Library[28] (1793), The Botanical Garden (1817) –it promoted a Botany School (1824) and established the first Chair and Chemistry Laboratory (1819)-[29], the Junta Central de la Vacuna and the School of Mechanics (1845). The Society also published its own conscientious reports[30] and several journals such as the Papel Periódico de La Habana and the Revista Bimestre Cubana (1831), where the planters spread their opinions and circulated technological advances. Observing the names of the sugar planters belonging to these institutions, we discover that most of them were present in more than one: Pedroso, Diago, O'Farrill, Peñalver, Herrera, Betancourt, De Escovedo or VillaUrrutia.

Some institutions were created thanks to networks of active planters such as the Real Consulado de Agricultura y Comercio, which was established on the request of Francisco de Arango y Parreño.

Through all of these 'sub-imperial' institutions, Cuba managed to access the new advanced technology available in the rest of the West Indies, the United Kingdom, France, Belgium and the United States before metropolitan Spain did. Therefore, several expeditions were financed by the Junta de Fomento to see *in situ* all the techniques put into practice in Europe and in the rest of the colonies in the Caribbean,[31] so that they could be applied in Cuba. The source of patented technology was found in foreign countries and not in the metropolis. Some of the most advanced technologies were registered and introduced in Cuba before introducing them in metropolitan Spain. Indeed, the most widely used to illustrate this is the railway.[32] It was devised by the Economic Society, the town council and Real Consulado of Havana in 1830.[33] As early as 1837, the first railway line in Cuba, which travelled between Havana and Bejucal, was opened.[34] It was also the first one in Latin America and it was introduced on the island a decade earlier than in metropolitan Spain. Something similar occurred with another communication system, the telephone, tested first in Havana in October 1877 rather than in metropolitan Spain.[35] Less known is the partnership between the inventor Thomas Edison and the Basque businessmen José Francisco Navarro in order to set up the firm 'Edison Spanish Colonial Light Company' in New York in 1881, later renamed 'The Havana Electric Light Company'.[36] This company was set up in Havana with the declared purpose to "own, manufacture, sell, operate and licence" technology patented in Cuba.[37]

The Metropolitan and Colonial Patent Systems in Nineteenth-Century Spain

Another significant example of how Spanish institutions functioned rather differently overseas than in metropolitan Spain was the patent system. During the 'Ancien-Regime' the Spanish Monarchy as well as other European powers made use profusely of Royal privileges of invention, introduction and manufacturing monopolies to promote innovations. The first of this kind of concessions was granted in Madrid in 1478 and, together with government posts or monetary awards for new technologies, remained the only system to encourage invention and innovation activity in an increasingly competitive mercantilist atmosphere up until the beginning of the nineteenth century.[38]

Those privileges were also bestowed on Spaniards or foreigners for the protection of new technologies in the Castilian dominions throughout the Modern Era. Thus, many of them, especially those associated with mining, were granted for the American territories through the Consejo de Indias between the sixteenth and eighteenth centuries.[39] Yet, contrary to that of England and France, Spain never passed a general law regarding their concession, which was arbitrary until the early nineteenth century.

The final crisis of the 'Ancien Regime' at the end of the eighteenth century and the independence movements in Spanish America brought about the end of the Empire, accompanied by a complex process of liberal revolution that lasted until at least 1833. As occurred with other property rights, there was a rather rapid transition from traditional Royal privileges of invention to modern regulations concerning industrial property.[40] The 1811, 1820 and 1826 patent laws[41] inaugurated a new era of regulation of inventive activity in Spain, which was soon extended to its remaining territories overseas: Cuba, Puerto Rico and the Philippines. Indeed, the origin of the first modern Spanish patent law is to be found in Cuba. The 1820 law –the first one to be completely Spanish, as the 1811 Decree had been passed by the French government of José Bonaparte– was enacted as a consequence of the insistent demands of the Cuban inventor Fernando Arritola, a mechanic from Havana. Arritola's request to patent 'a new and improved still' reached the Spanish parliament, where it was debated. The Cuban high authorities, the General Captain and the Governor of Havana, supported his demands. The new liberal Parliament of 1820 accepted Arritola's request and decreed the new patent law, which was slightly revised in 1826 under Fernando VII's new government.[42]

The Royal Charter of the 30 July 1833[43] officially extended the Decree of the 27 March 1826 on patents of invention and introduction to the three mentioned overseas islands, although after 1820 some modern patents had already been granted in Cuba or the Philippines.[44] Nevertheless, that legal extension was necessary to specify some significant points, especially related to Cuba, where:

> "Art. 2: Attending (its) particular state, non-encouragement is necessary in order to promote the agricultural industry, principally in sugar manufacturing, because both planters and institutions are paying much attention to foreign advances, taking and adopting machines, instruments, artefacts, processes and scientific methods; thus privileges are limited in Cuba to inventors and improvers, and introductions go beyond the discretion of the Gobernador Capitán General and the Intendente, (…) after hearing the Council, the Junta de Comercio o Fomento

and the Sociedad Económica, to establish (…) the industrial or agricultural sectors and districts in which there must not be (that kind of) privilege.

The rest of the Royal Charter of 1833 practically reproduced the 1826 law, thereby setting up the general rules by which inventions and new technologies would be protected in Cuba and the other islands. They would grant patents for Spaniards or Foreigners; for completely unknown mechanisms or processes in the case of inventions; for 5, 10 or 15 years duration (5 for introductions); conditioned to a compulsory working clause within one year after the concession; after paying a quite expensive fee;[45] and with the usual requirements for official publication, assignments record, expiration statement, property right infringements and judicial penalties.[46]

These nineteenth century laws introduced a patent system formed by different 'subsystems'. Each of the different subsystems had, in practice, their own patent and trademarks offices. The 'Real Conservatorio de Artes y Oficios' in Madrid was created to obtain monopolies in metropolitan Spain, while the 'Juntas de Fomento' were in charge of patent protection in Cuba, Puerto Rico and the Philippines. Half of the patent fees collected by the 'Juntas de Fomento' overseas had to be sent to the Conservatorio. This in fact quadrupled the cost of patent protection in all the Spanish territories insofar as it was necessary to obtain four different patent titles. For this reason, the majority of Spanish patents obtained in Madrid for the Peninsula seemed to have never come into effect in Cuba Puerto Rico or the Philippines as it was costly and not usual to extend the property rights to overseas, except in some few sugar technologies.[47] On the other hand, there also had to be hundreds of patent applications and grants in Cuba, directly administered within the island, whose technical information did not reach Madrid. Cuban institutions just sent a list of patents to control the payments from time to time. All of that suggests, up to a certain point, an autonomous conception of the patent management in Cuba that could facilitate capturing the institution by the Creole elite and using it by both local rulers and 'sub-imperial' agents in a rather different manner than in metropolitan Spain. Evidence in the same direction is that the Royal Charter of 1833 was not published in Spain until 1849.[48]

The 1880 Royal Decree on industrial property extended the 1878 patent law to 'overseas provinces'. [49] The administration of patent rights remained autonomous in the colonies in the same way in which it had been established previously. However, from that moment on, the patent fees had to be paid once and the extension to overseas territories (or vice versa) was free, although agent costs continued to make the operation

expensive. The Royal Decree of 14 May 1880 maintained the autonomous administration of the patent system in Cuba due to "the substantial delay that patent administration from the Peninsula would cause… Art. 6: Patents of invention which have to only and exclusively be used in the overseas provinces will still be granted by the respective Gobernadores Generales, in the same way it is currently established, although overseas patents could easily be extended to metropolitan Spain by an uncomplicated free application.[50] In 1897, just before the Cuban war, another Order indefinitely widened the period (four months) to send those applications from overseas to the Peninsula because of continuous post delays among Ministries.[51]

As Table 1 demonstrates, less than 4 percent of patents applied for by domestic residents and presented in the Madrid register between 1820 and 1898 were from Cuba. The percentages vary according to the decade and that of 1830s must be highlighted, when almost 27 percent of domestic patents were registered by Cuban residents, probably in response to the Royal Charter of 1833 being enacted. Nevertheless, after 1840, patents from Cuba seem to practically disappear until the 1880s, when the new law of 1878 was passed and extended to Cuba, allowing overseas applicants the free extension of their rights to the Peninsula, as we have seen above. That meant an immediate rise of overseas applications in Madrid of almost 5 percent up until their independence.

Our interpretation notwithstanding, an in-depth understanding of the patent system is still necessary. Historical patent records in Havana strongly suggest that two distinct patent system were employed in the Spanish empire during the nineteenth century: a metropolitan system in Madrid and another in Cuba in the form of a particular 'Colonial Innovation System'. We have found, for instance, that approximately 4,000 patents were directly registered in Havana between 1830 and 1880, which practically represent 40 percent of all patents granted in the whole Spanish Empire in the same period.[52] That amount of registered patents in Havana during the nineteenth century situates the island at the top of the ranking of all innovative areas of Spain before the independence. Further research will provide a better understanding of patenting activity in both sub-systems. For example, how difficult the previous technical exams to grant a patent were compared with those of Madrid,[53] how other 'sub-imperial' institutions (Junta de Fomento, Sociedad Económica) captured the system beyond the metropolis limits to promote technological changes and sugar industrial expansion, or how British, French and very often Anglo-American

technicians and the Creole elite used the patent protection system. Yet we can already affirm in this overview that, whilst Catalonia was 'the factory of Spain', as the economic historian Jordi Nadal has asserted,[54] Cuba seems to have been its laboratory and technological workshop, and as has commonly occurred with many laboratories, scientists and technicians in Spanish modern history, Cuba also wound up in exile.

Crossing Empires: Foreign Patenting Activities in the Cuban Sugar Industry

During the nineteenth century the Cuban plantation economy underwent a remarkable transformation. The Cuban cane-sugar industry became, from mid-nineteenth century onward, a modern tropical enterprise. For instance, by 1870 Cuba produced thirty percent of the total world market of this commodity.[55] In a context of increasing competition in the world sugar market, Cuban planters managed to transform their former small-scale slave plantations into large agro-industrial complexes. As Moreno Fraginals has asserted, there was a 'jump from manufacture to big industry', a sort of 'sugar industrial revolution'.[56] Both production levels and productivity multiplied exponentially. This process of modernization and industrialization of sugar production cannot solely be explained by the expansion of the sugar frontier, a fertile soil and an ideal climate. Nor can it be explained by the use of coercive labour before the abolition of slavery in Cuba in 1886. The technical changes and organizational innovations introduced in the mid-nineteenth century also had a critical role in this significant change. During those years, Cuban sugar mills became the most technically advanced in the world.[57] Cuba emerged as an advanced 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. The introduction of modern refining techniques and estate railways in Cuba followed well-defined patterns. Technology was not introduced via the Spanish metropolis. On the contrary, the inter-imperial and inter-colonial technological exchanges were far more important. In developing its sugar industry, Cuba thus became extremely dependent on technology from rival Atlantic Empires.

The relative importance of technology transfer mechanisms varied considerably throughout the nineteenth century, from relatively informal ones, such as the direct migration of skilled engineers at the middle of the century, to the implementation of more formal technical institutions such as patents rights in the last decades of the century. Similarly, the nature of technical improvements evolved during this period

from the diffusion of steam-powered artisanal grinding mills to the assembly of large-scale and capital-intensive steel machinery. The shifting nature of technological relationships in the late nineteenth-century globalized economy and the wave of science-based innovations associated with the second industrial revolution had also an important impact on how sugar machinery was transferred to Cuba. Technology transfer through patenting turned out to be more noticeable in the 1880s. In late nineteenth century Cuba, foreign patent activity became routine for economically valuable inventions in a context of increasing corporate capitalism. Before that date, expert migration and the circulation of technical literature appeared as prominent transfer mechanisms. 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, or 'elite' inventions, using Ian Inkster's terminology,[58] transferred from advanced economies to Cuba were channelled through the Spanish patent system. These transfers were carried out through either the metropolitan office located in peninsular Spain or, mostly, the Cuban patent register. As we have seen above, the latter office was based in Havana and functioned, in practice, independently from the metropolis. Interestingly, the diffusion of technical information contained in the patents granted at the Cuban patent 'sub-institution' was regularly published in La Gaceta de La Habana.

An example of an early attempt to usher patented technology into Cuban plantations is the introduction of Derosne's Vacuum pan. This refining system was first set up in 1841 on La Mella, a sugar estate owned by Wanceslao de Villaurrutia. It was the inventor himself, the prominent French chemist Charles Derosne, who provided all the machinery and supervised the assembly of the new system in Villaurrutia.[59] According to the United States Patent Office, the Derosne installation bought by Villaurrutia cost $32,000.[60] The crop of May 1843 was the first one made entirely with the new apparatus. According to a report by Villaurrutia on the performance of Derosne's new 'sugar machinery' on the 1843 crop, the new system of vacuum pan evaporation significantly saved labour and reduced charcoal consumption.[61] However, the initial investment was considerably higher than was required for technically inferior vacuum boilers. The new system reduced dependence on slave labour but needed skilled labour to operate it. In their 1844 treaty describing the new method, which was translated to Spanish by the renowned Cuban Chemist José Luis Casaseca, Derosne and 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 labour.[62] It was Derosne himself who trained Villaurrutia's technicians to use the new innovation.

Derosne and his business partner Jean François Cail, a French boilermaker, had already secured the patent right of his invention in France and Britain, thereby amassing a small fortune in sales of the new invention. In 1836, the two men established the firm 'Derosne et Cail', which by the middle of the century would become one of the world's foremost sugar machinery manufacturers.[63] After the successful introduction of the new vacuum pan in Cuba, Derosne and Cail tried to secure the property rights of their apparatus also in the Cuban patent 'sub-system'. In June 1842, they applied for a fifteen-year 'royal privilege of invention' to Havana's Junta de Fomento. Their agent in Cuba was Joaquín de Arrieta a sugar planter who acted as intermediary in the application process to obtain this patent. In introducing Derosne's apparatus in 1843 in his *ingenio* 'Flor de Cuba', Arrieta acted not just as an agent but also as a business partner. The patent application was officially rejected by the Havana's Junta de Fomento y Agricultura. The reasons put forward to reject patent rights on this invention were two-fold. First, it was argued that, according to Spanish law, the new technology had been already introduced on the island. Second, Cuban institutions such as the Junta de Fomento and Real Sociedad Económica, had already invested significant capital in order to introduce Derosne's invention in Cuba's sugar mills. [64]

Although Derosne's patent application was rejected, this episode yields an understanding of the patenting activity and transnational operations of foreign sugar machinery manufacturers in the Spanish Caribbean plantation economy during the mid-nineteenth century. Cuban sugar planters and engineering firms based in New York, Paris, Liverpool and Glasgow began to be closely interconnected during those years. Steam engineering and manufacturing companies like the British Fawcett Preston, the North American Novelty Iron Works and the French Derosne et Cail were some of the most important suppliers of the sugar machinery in Cuba.[65] Although the political ties were maintained with the declining Spanish metropolis, the technological links were drawn with the most industrially advanced Atlantic empires. In a period of accelerated globalisation, the most industrialised nations began to dominate the trade of modern industrial technologies in the Caribbean. Cuban planters, through their 'sub-imperial' institutions, were inserted into an international network of technology circulation in which patent activity became, along with technical journalism and expert migration, a

major vehicle of knowledge dissemination. As the international patenting of valuable inventions progressively became routine in colonial settings, western manufacturers of refining equipment begun to actively protect and commercialize their innovations in Cuba.

It was during the two last decades of the century that an increasing number of complex sugar technologies ranging from industrial chemical processes to capital-intensive mechanized mills were channelled through the proprietary system. From the mid-nineteenth century, American and British companies had begun to introduce the overwhelming majority of machinery used at central sugar factories in the Spanish Caribbean. Only French firms managed to compete with Anglo-Saxon machinery manufacturing companies. Firms such as 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 an extensive use of the Spanish patent system. Once their patents had been secured, those firms could go ahead in their manufacturing and exporting activities or eventually commercialize the patent rights in Cuba. This pattern would seem to confirm Ian Inkster's statement that from the mid-nineteenth century 'securing patent rights was very often a prelude of technology transfer by active change agents'.[66]

The 1880s and 1890s were a period of great technological turnover in the Cuban sugar industry. In the face of a crisis stemming from increasing competition from beet sugar producers and the extension of sugar cane plantations to new regions, Cuban mills initiated a merging and modernization process. The total number of sugar estates was significantly reduced and Cuban mills became the largest in the world. The change in the business size was closely associated with the introduction of technical and organisational innovations related to the second industrial revolution.[67] In this context, the incentives for patenting modern technology related to sugar cane exploitation increased. Machinery producers and engineering firms in Europe and the United States had one of their largest markets in Cuban sugar plantations. The control and management of patented technology in colonial settings became hence fundamental. In this context, active transfer agents, from patent professionals to businessmen, not only carried technological information from rival empires to Spain, but they also assisted inventors in the commercialization of patented technology in the colony.

As the number of patent applications for Sugar technology rocketed, patent agents and other intermediaries transferring inventions to Cuba multiplied. Foreign

machine and engine manufacturers required agents who were experts in the particularities of Spanish regulations and administrative procedures in the colonies. Agents guided and assisted foreign patentees in registering, publicizing and commercializing their inventions in Cuba. Agent's assistance in mechanical drawing had already become essential around 1870. The extension of patent rights to colonial territories was a lucrative activity. For example, Moss and Company, the largest nineteenth century patent agency in the United States, began publication of the journal La América Científica e Industrial in New York in 1890. This technical journal advertised services to extend patent rights to Spanish-speaking countries. The Cuban economy and the improvement in sugar technology were highlighted contents in this journal.

An agent who worked intensively for foreign manufacturers, including Duncan Stewart and Fives Lille, was the renowned lawyer Julio Vizcarrondo.[68] A Puerto Rican based in Madrid, Vizcarrondo was an important politician, senator and one of the leaders of the slavery abolitionist movement. He began practising as an agent in 1875 and founded the intellectual property agency Elzaburu, still one of the largest agencies in international patenting and trademarks application in Spain.[69] The patent activity of the Sugar machinery manufacturer Duncan Stewart and Co. is a good example of Vizcarrondo's role as an intermediary in 'colonial patents'. This machinery manufacturing company, based in Glasgow, used the service of Vizcarrondo's agency in several of its patent applications in the Spanish overseas territories. For instance, in April 1887, Vizcarrondo presented in the Madrid Register the application for a patent of introduction for 'an improvement in sugar mills'.[70] 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 to officially certify that the new invention was put into practice in Cuba, following the legal requirements of the 1878 Spanish patent law extended to Cuba in 1880. The new mill was set up in the 'Soledad' sugar estate, a large modern central property owned by the Boston firm E. Atkins and Company and one of the first major direct investments of American firms on the island.[71]

Conclusion

In the course of the nineteenth century the institutions that made up the Innovation System in the Spanish colonies experienced a progressive independence.

Although still constrained by political and legal ties with declining metropolitan Spain, these overseas institutions which devoted themselves to fostering the modernisation of colonial industries began to be controlled by Creole elites. The preliminary findings of an ongoing research on the circulation of technology in nineteenth century Cuba has revealed that it was actually colonial elites who controlled these institutions in their objective to promote the transfer of technological innovations to the island. Cuban institutions such as the Junta de Fomento and the Sociedad Económica were dominated and administered by sugar mill owners, who managed to place the Cuban plantation economy within the global networks of technological exchange. This situation was not inevitable but a conscious decision on the part of 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 or Java, Cuba had to look abroad for its technology. However, there is a significant –albeit hardly surprising– contrast. Whilst 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, in the case of the Spanish Caribbean colonies the role of the metropolis was highly irrelevant. Inter-imperial connections smooth away the obstacles of the 'Spanish Innovation System' to develop indigenous technical capabilities through the setting up of a 'Colonial Innovation System' and autonomously administered 'sub-imperial' institutions.

This picture appears clearer when we look at the patenting activity in the Cuban 'sub-system' and at the model of institutional organization of the patent administration itself. Although our knowledge of the functioning of the Spanish patent system overseas during the nineteenth century is still incomplete, this paper has offered a tentative explanation of patent activity and management in colonial Spain. From the study of nineteenth-century industrial property law concerning the colonies and the original historical patent records in Havana and Madrid, we suggest that Cubans self-administered the patent institution at the island. Furthermore, the high number of patent applications, both in Madrid and Havana patent offices, which protected inventions in Cuba indicates that this colony was, at least between 1830 and 1880, the most innovative Spanish 'province'. In 1880 the extension of the 1878 patent law to the overseas territories introduced significant practical changes. Patenting activity in Cuba, however, seemed to have remained relatively higher than in other Spanish 'provinces' until 1898. The increasing commercial prospects in the Cuban and Puerto Rican

plantation economies during the last two decades of the century led foreign manufacturing firms from advanced economies to systematically protect their inventions in the Spanish system, either through metropolitan patent offices or directly at the Cuban patent 'sub-institution'. Foreign and corporate patent activity in Cuba reveals that the view of empires as bound entities cannot be sustained. Technology transfer and patent dynamics in nineteenth century Spanish colonies can only be explained as the result of a larger interacting system whereby rival empires acted as 'shadow' metropolis.

Table 1: Patents recorded at the OEPM in Madrid applied for by Spanish residents (1820-1898).

	Cuba	Puerto Rico	Philippines	Total Spanish Residents	Cuban residents %
1820-1829	2	1	2	89	**2.2**
1830-1839	40	3	0	148	**27.0**
1840-1849	15	18	1	451	**3.3**
1850-1859	5	22	0	902	**0.6**
1860-1869	2	1	0	1,021	**0.2**
1870-1879	7	1	0	1,022	**0.7**
1880-1889	174	7	3	3,645	**4.8**
1890-1898	254	8	9	5,420	**4.7**
TOTAL	**499**	**61**	**15**	**12,698**	**3.9**

Source: Archivo Histórico Nacional y Gaceta de Madrid for privileges from 1820 to 1826. Between 1826 and 1898: Original documents of patents at the Oficina Española de Patentes y Marcas (OEPM).

Notes and References

[1] For relevant works related with sugar technology in Cuba see: J. H. Galloway (1989), M. Moreno Fraginals (1964), A. Dye (1998), N. Derr (1986), S. W. Mintz (1985), D. Denslow (1988), M. Fernández (1988), H. B. Hagelberg (1974), G. R. Knight (1985), A. Méndez (1964), C. Scott (1984) , D. Turu (1981), F. Charadán (1982), A. Sánchez-Tarniella (2002) or C. Schnackenbourg (1984).

[2] Much has been written on the relationship between technology and colonialism. Among them are particularly valuable: Michael Adas, Machines as Measure of Men: Science, Technology, and Ideologies of Western Dominance, (New York, Cornell University Press, 1990); Daniel R. Headrick, The Tentacles of Progress. Technology Transfer in the Age of Imperialism, 1850-1940, (New York, Oxford University Press, 1998); Ian Inskter, Science and Technology in History: An Approach to Industrial Development, (New Brunswick, N. J., Rutgers University Press, 1991); or Jeniffer Tann, "Steam and Sugar: The Diffusion of the Station and Steam Engine to the Caribbean Sugar Industry 1770-1840", History of Technology 19 (1997): 63-84.

[3] Manuel Moreno Fraginals, El Ingenio, complejo socioeconómico cubano (La Habana, Comisión Nacional de la Unesco, 1964); Manuel Moreno Fraginals, Between Slavery and Free Labor (Baltimore, Johns Hopkins University Press, 1982); Stanley L. Engerman, The Political Economy of Slavery: Studies in the Economy and the Society of the Slave South, (New York, Pantheon,1965); David Eltis and Stanley L. Engerman, "The importance of slavery and the slave trade to industrializing Britain", Journal of Economic History 60 (Cambrideg University Press, 2000): 123-144; R. Fogel and S. L. Engerman, Time on the Cross: The Economics of American Negro Slavery (New York, Norton, 1995); Sidney W. Mintz, Sweetness and Power: The Place of Sugar in Modern History (New York, Penguin, 1985).

[4] Alan Dye, Cuban Sugar in the Age of Mass Production. Technology and the Economic of the Sugar Central, 1899-1929, (California, Stanford University Press, 1998); Stuart George McCook, States of Nature, Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940, (Austin, University of Texas Press,2002); Jonathan Curry-Machado, "Rich Flames and Hired Tears: Sugar, Sub-imperial Agents and the Cuban Phoenix of Empire", Journal of Global History 4 (2009): 33-56; Reinaldo Funes, From Rainforest to Cane Field in Cuba. An Environmental History since 1492, (Chapel Hill, University of North Carolina Press, 2008); Reinaldo Funes and Dale Tomich, "Naturaleza, tecnología y esclavitud en Cuba. Frontera azucarera y revolución industrial, 1815-1870" in Trabajo Libre y Coactivo en Sociedades de Plantación, coord. J. A. Piqueras (Madrid, Siglo XXI, 2009), 75-117; Pedro M. Pruna, "Nacional Science in a Colonial Context. The Royal Academy of Sciences of Havana, 1861-1898", Isis 85, 3 (1994): 412-426.

[5] See Jonathan Curry-Machado, "Privilege Scapegoats: The Manipulation of Migrant Engineering Workers in Mid-nineteenth Century Cuba", Caribbean Studies 35-1 (2007): 207-245 and especially "Rich Flames…" 34-35.

[6] Herein a "national innovation system" is understood as the analysis of technological change into the institutional, educational, entrepreneurial, political and socio-cultural environment in which it occurs following: Christopher Freeman, Technology and Economic Performance: Lessons from Japan (London, Frances Printer Publishers, 1987). See also Bengt-Ake Lundvall, "Innovation as an Interactive Process: From User-Producer Interaction to the National System of Innovation" in Technical Change and Economic Theory, eds. G. Dosi, C. Freeman, R. R. Nelson and G. Silverger (London, Pinter Publishers, 1988), 349-369.

[7] On the internationalization of patent systems see Edith T. Penrose, The Economics of the International Patent System (Baltimore, Johns Hopkins Press, 1951). See also Eda Kranakis, "Patents and Power. European Patent-System Integration in the Context of Globalization", Technology and Culture 48 (2007): 689-728.

[8] See J. Patricio Sáiz, Invención, patentes e innovación en la España contemporánea (Madrid, OEPM, 1999). Also J. Patricio Sáiz "The Spanish Patent System (1759-1907)", History of Technology 24 (2002): 45-79; and José María Ortiz-Villajos, Tecnología y desarrollo económico en la historia contemporánea. Estudio de las patentes registradas en España entre 1882 y 1935 (Madrid, OEPM, 1999).

[9] We follow here the main hypothesis of Jonathan Curry-Machado in "Rich Flames…", 54-56.

[10] The world's richest sugar island up to 1791.

[11] Pierre Chalmin, Tate & Lyle, géant du sucre (Paris, Ed. Economica, 1983): 13. See also J. H. Galloway, The Sugar Cane Industry: An Historical Geography from Its Origins to 1914 (Cambridge, Cambridge University Press, 1989): 95-96.

[12] With regard to sugar consumption see Alexander von Humbolt, Essai politique sur l'île de Cuba, (Paris, Gide, 1826): 2: 56-62; J. Canga Argëlles, Diccionario de Hacienda, con aplicación a España (Madrid, Imprenta de Don Marcelino Calero y Portocarrero, 1834): 1: Word Azúcar; A. Fernández García, El abastecimiento de Madrid en el reinado de Isabel II, (Madrid, CSIC, 1971): 114-115; Manuel Martín y Antonio Malpica, El azúcar en el encuentro entre dos mundos (Madrid, Asociación General de Fabricantes de Azúcar de España, 1992): 145.

[13] The authorities of the island, in many occasions, decided to act by their own account and allowed the landing of foreign neutrals ships for supplies. The interest of the colonial administration and mainly those of the Cuban landowners coincided with those of the neutral Anglo-American ship-owners. J. H. Coastworth, "American Trade with European Colonies", William and Mary Quarterly 24, 2, (1967): 252.

[14] In 1783 the port of Havana allowed the arrival of ships from the US. Legislation accepting this trade existed since the Royal Order of the 21 January 1790 until 1804.

[15] The Royal Order of the 12 October 1780 granted the permission to trade with foreign countries to lay in supplies the Havana. Archivo Nacional de Cuba (AHN), Intendencia General de Hacienda, leg. 377, exp. 26. See also Nadia Fernández de Pinedo "Commercial Relations between USA and Cuba in Times of Peace and War, 1803-1807", Illes E Imperis 4, (2001): 5-23.

[16] The neutral country was in the great majority of these cases the so-called Anglo-Americans. National Archives of the United States, T. 20 "Despaches from USA Consuls in Havana, 1783-1807".

[17] Felix Erenchun, Anales de la isla de Cuba (La Habana, Imp. de la Antilla, 1856): 1: 266; and Manuel Moreno Fraginals, Cuba/España España/Cuba: una historia común (Barcelona, Grijalbo Mondadori, 1995): 154 y 162.

[18] Ramón de la Sagra, Historia económico-política, estadística de la isla de Cuba (Habana, Imprenta de las viudas de Arazoza y Soler, 1831): 88.

[19] "Reclamación hecha por los representantes de la isla de Cuba contra la ley de aranceles sobre las restricciones que ésta impone al comercio de dicha Isla" (Madrid, Imprenta de Don José de Collado, 1821). The consulate of Havana requested the 8 April 1796 the exemption of the diezmo, which was effectively passed by the Real Cédula of the 22 April 1804.

[20] Vicente Vázquez Queipo, Informe fiscal sobre fomento de la población blanca en la isla de Cuba (Madrid, Imp. de J. Martín Alegría, 1845): 70.

[21] Nadia Fernández de Pinedo, Comercio exterior y fiscalidad: Cuba (1794-1860) (Bilbao, UPV Servicio Editorial, 2002): Chapter 2.

[22]Ramón de la Sagra lived in Havana between 1821 and 1835. During his sojourn, he has been in charge of the Botanic Garden and was titular of the Chair of Botanic in the School of Agriculture since 1824. From 1827 to 1831 he founded in Havana Anales de Ciencia, Agricultura, Comercio y Artes. He was the author of Historia física, política y natural de la isla de Cuba (14 Vols.). He returned to Spain in 1835 and became deputy in 1837 and 1854. Jordi Maluquer de Motes, El socialismo en España, (Barcelona, Crítica, 1977): 201-235.

[23]Ramón de La Sagra "Breve idea de la administración del comercio y de las rentas y gastos de la isla de Cuba", Hacienda Pública Española, 69, ([1835] 1981): 426. See also J. de la Pezuela, Diccionario geográfico, estadístico, histórico de la Isla de Cuba (Madrid, Imprenta del Establecimiento de Mellado, 1863): 2: 51.

[24] Julio Le Riverend, Breve historia de Cuba, (La Habana, Ed. Ciencias Sociales, 1978): 37.

[25]About Creole Enlightened Reformism look up José A. Piqueras, Sociedad Civil y poder en Cuba, (Madrid, Siglo XXI, 2005): 65-72.

[26] Named firstly Consulado de Agricultura y Comercio in 1795.

[27] The first Economic Society was la Sociedad Económica de Santiago de Cuba in 1787 without much relevance, and in 1791 sugar planters with Francisco Arango y Parreño at the front created the Sociedad Económica de Amigos del País.

[28] The first public library in Havana.

[29] Jacobo de la Pezuela, Diccionario geográfico, estadístico, histórico de la Isla de Cuba, (Madrid, Imprenta del Establecimiento de Mellado, 1863): 3: 437.

[30]Memorias de la Sociedad Económica de Amigos del País. See Izaskun Álvarez Cuartero, Memorias de la Ilustracion: las Sociedades Económicas de Amigos del País en Cuba, 1783-1832 (Bilbao, Publicaciones de la Delegación en Corte, 2000). The Economic Society translated several technical books as those of De Corbeaux, Dutrône La Couture or Derosne.

[31] The first expedition took place in 1795, headed by Francisco Arango y Parreño and the Count of Casa-Montalvo, who travelled over Portugal, England and British colonies (Jamaica, Barbados) during eleven months. In 1828, another expedition was carried out led by Ramón Arozarena and Pedro Baudhuy to

Jamaica. In 1834 Alejandro Oliván travelled to England, Jamaica and France. In 1848 J. la Torre went to the United States. ANC, Real Consulado, Junta de Fomento, leg. 94, n. 3,966 and n. 3,962.

[32] Gert J. Oostendie, "La burguesía cubana y sus caminos de hierro, 1830-1868", Boletín de Estudios Latinoamericanos y del Caribe 37 (1984): 114.

[33] Heinrich E. Friedlander, Historia Económica de Cuba (La Habana, Ed. Jesús Montero, 1944), 237 and Affaires Etrangères, Paris, Correspondance Consulaire, La Havane, vol. 11, fs. 405-423.

[34] "The stockholder consortium, called 'the few', was controlled by Alfonso-Aldama, Poey, Cespedes and Drake families" in Gert J. Oostendie, "La burguesía cubana...", 103-104.

[35] Angel Bahamonde, G. Martínez and L. E. Otero Las comunicaciones en la construcción del Estado contemporáneo en España. 1700-1936 (Madrid, Ministerio de Obras Públicas, Transportes y Medio Ambiente, 1993).

[36] Conchita Burman and Eric Beerman, Un vasco en America, José Francisco Navarro Arzac, (Madrid, RSBAP Delegación en Corte, 1998): 158 and 162.

[37] The Thomas Edison Papers. 5/09/1881 Document of Incorporation of Edison Spanish Colonial Company, ref. XX19; William J. Hausman, Peter Hertner and Mira Wilkins, Global Electrification: Multinational Enterprise and International Finance (New York, Cambridge University Press, 2008): 77-78.

[38] The first privilege of invention, granted by Isabel 'the Catholic' to her physician Pedro Azlor for a new mill in 1478, in Nicolás García Tapia, "Los orígenes de las patentes de invención" in Historia de la tecnología en España, coord. F. Ayala Carcedo (Barcelona, Valatenea, 2001), II, 89-96, 91. On privileges of invention and introduction of new technologies during the sixteenth and the seventeenth centuries see also Nicolas García Tapia, Patentes de invención españolas en el Siglo de Oro (Madrid, OEPM, 1990).

[39] See Nicolás García Tapia, "Los orígenes…" 90.

[40] See J. Patricio Sáiz, Propiedad industrial y revolución liberal. Historia del sistema español de patentes (1759-1929) (Madrid, OEPM, 1995).

[41] Royal Decree of the 16 September 1811 (Gaceta de Madrid of the 24 September 1811), Decree of the 2 October 1820 (Archivo Histórico Nacional, Estado, Leg. 164), and Royal Decree of the 27 March 1826 (Decretos del Rey Nuestro Señor D. Fernando VII y Reales Resoluciones y Reglamentos generales expedidos por las Secretarías del Despacho Universal y Consejos de S.M., T. X.).

[42] ANC, Real Consulado, Leg. 204, Exp. 9,007 y 9,008.

[43] See Biblioteca Nacional, Sig. H. A. 17,303.

[44] See the Parliamentary debates of the 3 August 1820 in order to pass the Decree on patents of the same year (Diario de Sesiones de Cortes, Congreso, 1820, August, n. 30, 367). See also the Preamble of the Royal Charter of the 30 July 1833.

[45] The cost of an invention patent for 15 years was superior to the annual wage of a qualified worker (see J. Patricio Sáiz, Invención, patentes…, 133-137).

[46] See J. Patricio Sáiz, "The Spanish Patent System…", Table 1, for a summary.

[47] Only in a very few cases it is possible to find in the Archive of the OEPM an invention with four different patent titles for the Peninsula, Cuba, Puerto Rico and the Philippines. See, for instance, OEPM, Historical Archive, privilegios n. 413, 414, 415 and 416 (G. Williams) or privilegios n. 796, 797, 798 and 799 (F. J. Einar Fabrum) or privilegios n. 993, 994, 995 and 996 (J. Brandeis). Thus, all of them were granted to foreigners for the protection of sugar technologies.

[48] See Circular of the 31 January 1849 (Colección Legislativa de España, T. XLVI).

[49] Law of the 30 July 1878 (Colección Legislativa de España, T. CXIX). It extended invention patetns to 20 years and maintained introductions for five; doubled the obligatory working period to two years; regulated a new payment system through progressive annual quotas, which reduced the monopoly costs; guaranteed priority rights to previous patents abroad and also allowed small additions. See J. Patricio Sáiz, "The Spanish Patent System…", section II, for further details.

[50] Colección Legislativa Española, T. CXXIV. See articles 6 and 8.

[51] The Royal Order of 12 January 1897, Gaceta de Madrid of the 7 February 1897.

[52] ANC and the Archive of the Oficina Cubana de la Propiedad Industrial.

[53] The patent applications were informed by members of the Junta de Fomento, Real Sociedad Patriótica and other institutions, who asked experts to make deep technical reports, as it occurred with several patents of Derosne and Cail between 1841 and 1846 (see ANC, Gobierno Superior Civil, Leg. 1475, Exp. 58, 365 and Junta de Fomento, Leg. 206, Exp. 9,172). In Peninsular Spain there were no previous exams or there were rather simple.

[54] See Jordi Nadal, "Cataluña, la fábrica de España. La formación de la industria moderna en Cataluña" in Moler, tejer y fundir. Estudios de historia industrial ed. J. Nadal (Barcelona, Ariel, 1992): 84-154.

[55] Alan Dye, Cuban Sugar …, 27.

[56] Manuel Moreno, The Sugarmill. The Socieconomic Complex of Sugar in Cuba (New York, Monthly Review Press, 1976), 113, 141 and 142.
[57] For the early introduction of steamed-powered machinery, vacuum pans, centrifugals and modern iron grinding mills in the Cuban sugar industry see Manuel Moreno Fraginals, The Sugarmill…, 81-127 and Nadia Fernández de Pinedo, Comercio Exterior y Fiscalidad: Cuba, 1794-1860 (Bilbao, UPV Servicio Editorial, 2003), 233-161; for the late nineteenth and early twentieth centuries' technological developments see Alan Dye, Cuban Sugar...
[58] For the idea of 'elite' patents and the value of patent rights see Ian Inkster, "Patents as Indicators of Technological Change and Innovation", Transactions of the Newcomen Society 73 (2003): 201-205.
[59] Antonio Bachiller, "Breve ojeada sobre los progresos de la agricultura y su estado actual", Memorias de la Sociedad Económica de la Habana, (Havana, 1856); Manuel Moreno, The Sugarmill…, 111-112.
[60] Annual report of the Commissioner of Patents for the Year 1848 (Washington, United States Patent Office, 1849), 328.
[61] J. A. Leon, The Sugar Question. On The Sugar Cultivation In The West Indies (London, John Ollivier, 1848), 19-25; Reinaldo Funes and Dale Tomich, "Naturaleza, tecnología…", 108-109.
[62] Ch. Derosne and J. L. Cail, De la elaboración del azúcar y de los nuevos aparatos destinados a mejorarla (Havana, 1844), 15-22.
[63] For 'Derosne et Cail' see M. Stephen Smith, The Emergence of Modern Business Enterprise in France, 1800-1930 (Cambridge, MA, Harvard University Press, 2005), 210.
[64] ANC, Gobierno Superior Civil, Leg. 1,476, n. 58,365, June 1842.
[65] Jonathan Curry Machado, "Rich Flames…", 39; A. Ramos Matei, "The Role of Scottish Sugar Machinery Manufacturers in the Puerto Rican Plantation System, 1842-1909", Scottish Industrial History 8, 1 (1985), 20-30; Manuel Moreno, The Sugarmill…, 102, 103, 112 and 113
[66] Ian Inkster, Science and Technology in History…, 161.
[67] Alan Dye, Cuban Sugar…, 10-14.
[68] There have been examined Julio Vicarrondo's Business Diaries from 1875 (Register of patent operations, Elzaburu Agency Private Records, Madrid) and the original powers of attorney kept in the patent documentation of the OEPM for the period 1826-1903.
[69] Julio Vizcarrondo had worked as representative of American and British Businessmen in the Spanish colonies before 1875. His patent business, created in 1875 as 'Anglo-Spanish general agency and commission house' provided all sort of patent services. Julio Vizcarrondo house became a full-time patent agency in the 1880s. In 1884 Vizcarrondo became foreign member of the British Institute of Patent Agents and the French Syndicat des Ingénieurs et Conseils en Matière de Propriété Industrielle.
[70] Julio Vicarrondo Business Diaries, Elzaburu Agency Private Records, Madrid. Register of patent operations for the year 1887.
[71] OEPM, Historical Archive, privilegio n. 6,915.