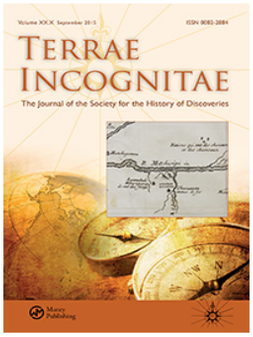

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Exploring Reforms in Cuban Education: The Mechanical Institute in Havana, 1830 – 1860

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In 1845, a unique teaching institution opened its doors in Havana, Cuba, to teach practical mechanics to young boys from the capital of the Spanish colony. This new teaching institution was called *Escuela Mecánica* although its name changed several times in the years that followed. The Mechanical School or Mechanical Institute was operated by the Society of Friends and quickly began to impact production modes in Cuba's most important economic branches, such as the sugar and tobacco industries. This educational institution resulted from two dynamics. The first was the transformation of education in Europe, which led to the creation of more specialized institutions. The second dynamic was the reform initiatives in Cuba, which changed the education and science sector in particular.

KEYWORDS education; reforms; mechanization; industrialization; Cuba; nineteenth century

En 1845 un exceptionnel établissement d'enseignement a ouvert ses portes à la Havane (à Cuba) pour enseigner la mécanique pratique aux jeunes de la capitale de cette colonie espagnole. Ce nouvel établissement d'enseignement s'appelait *La Escuela Mecánica*, bien que ce nom ait changé plusieurs fois pendant les années suivantes. *L'Ecole Mécanique* ou *l'Institut Mécanique* était géré par les Quakers et a vite commencé à avoir un effet sur les modes de production dans les sections économiques les plus importantes de Cuba, les industries du sucre et du tabac. Cet établissement d'enseignement était un des résultats de deux dynamiques: la première était la transformation de l'instruction européenne, ce qui a mené à la création d'établissements plus spécialisés. La deuxième était les initiatives de

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réformes à Cuba, ce qui a changé les secteurs de l'instruction et de la science en particulier.

MOTS-CLÉS l'instruction, les réformes, la mécanisation, l'industrialization, Cuba, le dix-neuvième siècle

En 1845 una institución educativa singular abrió sus puertas en La Habana (Cuba) para enseñar mecánica práctica a los jóvenes de la capital de esta colonia española. A esta nueva institución educativa se le llamó *Escuela Mecánica*, aunque su nombre cambiaría varias veces en los años siguientes. La *Escuela Mecánica* o *Instituto Mecánico* era administrada por la Sociedad de Amigos y pronto empezó a tener cierto impacto sobre los modos de producción de las ramas más importantes de la economía cubana, como las industrias del azúcar y del tabaco. Esta institución educativa fue uno de los frutos de dos dinámicas: la primera, la transformación de la educación en Europa, que condujo a la creación de instituciones más especializadas; la segunda, las iniciativas de reforma en Cuba, que afectaron en particular al sector educativo y científico.

PALABRAS CLAVE educación, reformas, mecanización, industrialización, Cuba, siglo diez y nueve

In 1845, a unique teaching institution opened its doors in Havana (Cuba) to teach practical mechanics to young boys from the capital of the Spanish colony. This new teaching institution was called *Escuela Superior Preparativa de Mecánica* (or *Escuela Mecánica*), although its name changed several times in the years that followed. The Mechanical School or Mechanical Institute was operated by the Society of Friends and quickly began to impact production modes in Cuba's most important economic branches, such as the sugar and tobacco industries.

Through various reforms, particularly initiated by the island's "creoles" in the first half of the nineteenth century, a slavery-based plantation economy had become an economic engine exemplary of the entire Caribbean.[1] While the new sugar economy favored rigid social structures, it also created spaces for the rise of a more capitalistic economy.[2] During the course of the nineteenth century, capitalist and industrialized production tendencies based on wage labor emerged. This new development was

[1] Dale Tomich and Michael Zeuske, "Introduction, the Second Slavery: Mass Slavery, World-Economy, and Comparative Microhistories," *Review* (Fernand Braudel Center) 31, 2 (2008), pp. 91–100; Dale Tomich, *Through the Prism of Slavery. Labor, Capital and World Economy* (Lanham MD, et al.: Rowman & Littlefield, 2004), pp. 75–94.

[2] Immanuel Wallerstein, *Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century* (New York: Academic Press, 1974). Others have argued against this theory but for different reasons: Steve J. Stern, "Feudalism, Capitalism, and the World-System in the Perspective of Latin America and the Caribbean," *American Historical Review* 93, 4 (1988), pp. 829–872; Ernesto Laclau, "Feudalism and Capitalism in Latin America," *New Left Review* 67 (1971), pp. 19–38. Zeuske views slavery as a form of colonial capitalism. See, Michal Zeuske, *Sklavenhändler, Negreros und Atlantikkreolen. Eine Weltgeschichte des Sklavenhandels im atlantischen Raum* (Berlin: De Gruyter Oldenbourg, 2015), p. 240.

spawned from reform ideas held by some individuals in the business elite, Cuban administration, and political-administrative leadership.[3] However, economic reforms were hampered by a lack of knowledge and not enough well-trained workers. The professionally oriented industrial school, the Escuela Mecánica in Havana, was intended to remedy this unfortunate situation.

The history of this school institution, which is comparable to those in many European countries, reveals an emerging overlap between industry and education.[4] Previous research into the convergence of production, technology, and knowledge in Cuba has been limited to the sugarcane agriculture and sugar production sector.[5] This article focuses on the relationship between education and training, taking into account the historical evolution of various industrial sectors of the Caribbean island. The Mechanical School of Havana serves as an example of the intersection of several societal sectors as it shows the work of a relatively enlightened elite in Cuba in the global context. On the other side of the Atlantic, education systems were in the process of reformation relating to new production methods and of changing industrial requirements. The movement to reform Cuban schools was inspired primarily by developments in Europe; therefore, a brief recapitulation of the histories of similar institutions in England, France, and Prussia is necessary to understand the Cuban situation.

The foundation of the Mechanical School was part of a revisioning of the Cuban education system as a whole in which the Economic Society of Havana played an important role.[6] The reforms also brought about the foundation of new public primary schools and a variety of similarly specialized institutions, as well as reforms to the university. This article aims to place the foundation and early history of the *Escuela Mecánica* in Havana within this context of educational, societal, and economic renewals between the 1830s and the 1860s.

[3] Gabriel B. Paquette, *Enlightened Reform in Southern Europe and its Atlantic Colonies, c. 1750–1830* (Farnham: Ashgate, 2009), pp. 12, 319.

[4] On the very convincing idea of an "imperial nation" that includes the topic of education, see Josep M. Fradera, *The Imperial Nation. Citizens and Subjects in the British, French, Spanish, and American Empires* (Princeton, NJ: Princeton University Press, 2018), p. 202, and pp. 233–242.

[5] Leída Fernández Prieto, "Introducción. Ciencia, Agricultura y saberes locales en América Latina y el Caribe: Nuevas perspectivas," *Asclepio* 67, 1 (2015), pp. 1–4; Leída Fernández Prieto, "Making Tropical Agriculture: Science, Knowledge and Practice in Cuba, 1881–1906," *Studies in the History of Biology* 6, 1 (2014), pp. 7–25; Angelo Baracca, The Cuban *Exception*: The Development of an Advanced Scientific System in an Underdeveloped Country, in *The History of Physics in Cuba*, eds. Jürgen Renn, Angelo Baracca and Helge Wendt (Boston: Springer, 2014), pp. 9–50; Dale Tomich, "Commodity Frontiers, Spatial Economy, and Technological Innovation in the Caribbean Sugar Industry, 1783–1878," in *The Caribbean and the Atlantic World Economy*: Circuits of Trade Money and Knowledge, 1650–1914, eds. Adrian B. Leonard and David Pretel (London: Palgrave Macmillan UK, 2015), pp. 184–216.

[6] In other settings, economic or patriotic societies also engaged in educational reforms. See, Koen Stapelbroek and Jani Marjanen (eds.), *The Rise of Economic Societies in the Eighteenth Century. Patriotic Reform in Europe and North America* (Basingstoke: Palgrave Macmillan UK, 2012); Gabriel Paquette, "State-Civil Society Cooperation and Conflict in the Spanish Empire: The Intellectual and Political Activities of the Ultramarine Consulados and Economic Societies, c. 1780–1810," *Journal of Latin American Studies* 39 (2007), pp. 263–298, especially. p. 269; Fidel J. Tavarez, "Colonial Economic Improvement: How Spain Created New *Consulados* to Preserve and Develop Its American Empire, 1778–1795," *Hispanic American Historical* Review 98, 4 (2018), pp. 605–634. https://doi.org/10.1215/00182168-7160336.

Practical training between the late eighteenth and early nineteenth centuries aimed to train experts in specialized tasks. Unlike in universities, the focus was not on the generation of new knowledge; teaching and learning were strictly praxis-oriented. Nevertheless, an institutional framework to complement apprenticeships was considered useful. State officials and entrepreneurs expanded upon the basis of this theoretical-practical education approach, and employed it in new institutions.[7] Incoming students needed to have good technical knowledge as well as good manual and practical skills. In the early days, new enrollees were not young, as might be expected, but rather experienced workers with different production backgrounds, such as specialists, foremen, and engineers.

At the same time, innovative institutions emerged across Europe. They offered training in technical occupations or continuing education. In eighteenth-century England, a movement emerged that promoted education in the technical-practical sphere within the framework of the Philosophical Societies.[8] A variety of schools were set up to replace the previously popular evening classes and evening lectures of these Philosophical and Literary Societies. It was a philanthropic undertaking, endowed with a pinch of self-interest, that was carried on by industrialists, merchants, and mine operators who founded night schools and hired teachers. These kinds of specialized teaching institutions were created in Manchester and Newcastle upon Tyne, for example. In a later stage of development, so-called Mechanics' Institutes emerged, which offered a more systematic education. Such institutions attracted younger learners and focused on knowledge that would be useful to work in local factories. The first of these highly specialized and praxis-oriented institutes was the School of Arts that was founded in Edinburgh in 1821. The following two years saw the creation of similar institutions in Glasgow and London under the name Mechanics' Institute.[9] The graduates were probably not engineers but highly trained skilled workers. The British mechanical institute model was copied in the colonies, for instance, in Australia.[10] These British precursors were particularly important for the Cuban founding of a mechanical school, as will be explained later.

[7] Wolfgang König, "Zwischen Verwaltungsstaat und Industriegesellschaft. Die Gründung höherer technischer Bildungsstätten in Deutschland in den ersten Jahrzehnten des 19. Jahrhunderts," *Berichte zur Wissenschaftsgeschichte* 21 (1998), pp. 115–122, especially. p. 119; Patrick Wallis, "Between Apprenticeship and Skill: Acquiring Knowledge Outside the Academy in Early Modern England," *Science in Context* 32, 2 (2019), pp. 155–170 doi:10.1017/S0269889719000164.

[8] L.L. Ardern, "The Manchester Literary and Philosophical Society," *Journal of Chemical Education* 39, 5 (1962), pp. 264–265; Ian Inkster, "The Public Lecture as an Instrument of Science Education for Adults. The Case of Great Britain, c. 1750–1850," *Paedagogica Historica* 20, 1 (1980), pp. 80–107; Ruth Watts, "Some Radical Educational Networks of the Late Eighteenth Century and Their Influence," *History of Education* 27, 1 (1998), pp. 1–14.

[9] Thomas Kelly, "The Origin of Mechanics' Institutes," *British Journal of Educational Studies* 1, 1 (1952), pp. 17–27.

[10] John Hirst, *Sense and Nonsense in Australian History* (Melbourne: Black Inc. Agenda, 2006), pp. 138–139.

The British government likewise started to reorient or to found practical-oriented schools, which seemed to copy those new civil and often private institutes, at least to a certain degree. Mainly, newly reformed cadet and military schools began to train skilled soldiers and officials, who could be appointed to take on specialized tasks. The list of those reshaped military institutions is long. The Royal Naval Academy (originally founded in 1729) in Portsmouth was transformed into the Royal Naval College in 1808. In the same year, the Royal Military Academy in Woolwich Warren (founded in 1720) was extended and 300 cadets were admitted. In 1802, a new Royal Military College designed to receive around 400 students was inaugurated in Great Marlow. Only ten years later, it moved to Sandhurst. The East India Company opened two schools: Haileybury in Hertford in 1806 and Addiscombe in Croydon in 1809.[11] The teaching plans in all of the newly founded or reformed military schools included mathematics, design, physics, and mechanics in the curriculum for future military officials.

French developments in the education and training system also played a role in the emergence of the Escuela Mecánica in Havana. Schools such as the *École Polytechnique* (founded in 1774), the *Ponts et Chaussées* (1775), and the *École des Mines* (1783) along with other institutions aimed to train engineers in quite specialized areas, including infrastructure projects, civil engineering, mining, and mechanical engineering.[12] Such engineers were expected to maintain or develop the machines installed in existing factories.[13] Specialized engineers were also trained in other institutions, for example, the Mining School in Saint Etienne (founded in 1816), which exchanged people and teaching content with the Parisian *École des Mines*.[14] Beginning in 1820, nationwide application-based teaching was offered outside the aforementioned schools in different institutions[15] and even in universities.[16] While British schools tended to attract educated and experienced senior workers, the French equivalent was an extension of the state secondary school system. Additionally, the French schools were exclusively state-owned; in other words, they were not private foundations. These special schools trained a "caste"

[11] Trevor Hearl, "Military Education and the School Curriculum 1800–1870," *History of Education* 5, 3 (1976), pp. 251–264.

[12] Ivor Grattan-Guinness, "The 'Ecole Polytechnique,' 1794–1850: Differences over Educational Purpose and Teaching Practice," *The American Mathematical Monthly* 112, 3 (2005), pp. 233–250; Jean-Yves Dupont, "Première partie – La genèse d'un enseignement: 1794–1806," *Bulletin de la Sabix* (online) 25 (2000) (consulted 27 June 2019, URL: http://sabix.revues.org/255).

[13] Frederick B. Artz, *The Development of Technical Education in France 1500–1850* (Cambridge, MA: Society for the History of Technology, 1966).

[14] Louis Aguillon, *Notice historique sur l'Ecole des Mines de Paris* (Paris: Dunod, 1889).

[15] Renaud d'Enfert, "Circulations mathématiques et offre locale d'enseignement: le cas de Troyes sous la Restauration et la monarchie de Juillet

[16] Kostantinos Chatzis, "Fabriquer et recevoir un cours magistral: Les cours de mécanique appliquée de Jean-Victor Poncelet à l'École de l'Artillerie et du Génie et à la Sorbonne, 1825–1848," *Histoire de l'education* 120 (2008), pp. 113–38.

of engineers, instructed in various fields, for leadership positions in state institutions and the emerging private industrial economy.[17]

In the German-speaking territories, especially in Prussia, education developments roughly combined British and French approaches. Over the course of the eighteenth century, a trend emerged that found mining, civil engineering, and military engineering schools under state direction.[18] Other schools were acquired and further developed after the territorial expansion of Prussia. In addition, military training was reformed and systematized, so that subjects for engineering programs were taught at the Potsdam Engineering Academy (from 1788 to 1806), the Potsdam Cadet Institute (from 1822), and the Berlin Cadet Institute (1719–1776).[19] The Prussian state pursued two objectives concurrently: first, training an engineering elite in polytechnic (high) schools, and second, providing basic education for trained workers in vocational schools and at evening lectures. These institutions blossomed in an era of liberal politics and continued in the reformist restoration after 1848 as separate institutions.[20]

The implementation of such a specialized curriculum was important not only at the beginning of an industrialization process.[21] The entire European education sector, Carlo Cipolla wrote, had to move in step with industrial development, even though it created significant additional costs to the government.[22] Experts in the early phase of industrialization processes emphasize how interdependent both sectors were, and how developments in one caused developments in the other.[23] This intermeshing of the education and production sectors is emphasized in other national contexts. The Mechanical School in Havana, as an initial attempt to adapt a successful European model to a Cuban context, can thus be understood as a major investment on the part of the Economic Society of Havana in an effort to

[17] The national and international spread of the French educational system is studied by: Margaret C. Jacob, *The First Knowledge Economy: Human Capital and the European Economy*, 1750–1850 (Cambridge, Cambridge University Press, 2014); Jonson Miller, "Pathways and Purposes of the 'French Tradition' of Engineering in Antebellum America: The Case of the Virginia Military Institute," *Engineering Studies* 5, 2 (2013), pp. 117–136.

[18] Wolfgang König, "Technische Hochschule und Industrie – Ein Überblick zur Geschichte des Technologietransfers," in Hermann J. Schuster ed. *Handbuch des Wissenschaftstransfers* (Berlin, Heidelberg: Springer, 1990), pp. 29–41.

[19] For the example of the Berlin Cadet Institute, see Adolf F.J. v. Crousaz, *Geschichte des Königlich Preußischen Kadetten-Corps: Nach seiner Entstehung* (Berlin: Schindler, 1857), pp. 20, 24, 80, 245, 339. Compare for specialized education at the Bavarian Cadet Institute in Munich: Anton J.J. Frh. v. Schönhueb, *Geschichte des königlich bayerischen Kadetten-Corps. Aus Original-Quellen verfasst zur 100 jährigen Jubel-Feier* (München: Deschler, 1856); Horst Erlich, *Die Kadettenanstalten. Strukturen und Ausgestaltung militärischer Pädagogik im Kurfürstentum Bayern im späten 18. Jahrhundert* (München: Utz, 2007).

[20] Wolfgang König, "Spezialisierung und Bildungsanspruch. Zur Geschichte der Technischen Hochschulen im 19. und 20. Jahrhundert," *Berichte zur Wissenschaftsgeschichte* 11 (1988), pp. 219–25; José-María Aguilera Manzano, "Las corrientes liberales habaneras a través de las publicaciones periódicas de la primera mitad del siglo xix," *Cuban Studies* 38 (2007), pp. 125–53.

[21] Joel Mokyr, "Thinking about Technology and Institutions," *Malcalester International* 13: Article 8 (2003). Werner Plumpe, "Die Neue Institutionenökonomik und die moderne Wirtschaft. Zur wirtschaftshistorischen Reichweite institutionenökonomischer Argumente am Beispiel des Handlungsmodells der Rationalität," in Clemens Wischermann and Karl-Peter Ellerbrock eds. *Die Wirtschaftsgeschichte vor der Herausforderung durch die New Institutional Economics* (Dortmund: Gesellschaft für Westfälische Wirtschaftsgeschichte 2004s, pp. 31–57.

[22] Carlo Cipolla, *The Economic History of World Population* (Harmondsworth: Penguin, 1978).

[23] Wallis, *Between Apprenticeship and Skill*.

promote sustainable industrialization and lift the growth rates of the Cuban (agro-) industrial economy.

Contrary to the assumption that Spain is considered a "latecomer" in the history of industrialization,[24] several specialized educational institutions had already been founded by the end of the eighteenth century, mainly by patriotic economic societies, the *Reales Sociedades de los Amigos del País*. These societies were political pressure groups made up of self-organized "enlightened" entrepreneurs. As in many other European states,[25] there were societies in nearly every town on the Spanish peninsula, but also Havana, as will be explained later.

These *sociedades* were also important institutions, as the members—mainly entrepreneurs and merchants—aimed to create a sufficiently trained senior workforce that could be employed to perform specialized tasks in new production processes. Economic societies flourished in the fairly liberal political environment of mid-eighteenth-century Spain, and the enlightened spirit carried over to the society chapters in most major cities in the colonies.[26] It was these societies that began to organize specialized education—even for economically and socially disadvantaged students.

One school founded by such a society was the *Real Seminario de Bergara* in the Basque Country. After a ten-year-long founding process, it opened its doors in 1776 and is probably the oldest foundation of such a specialized institution in Spain.[27] This school is a good example of how liberalism of individuals combined with enlightened politics in an emerging economic environment could lead to the creation of a specialized educational institution. Francisco Xavier María de Munibe e Idiaquez, VIII Conde de Peñaflorida, played a key role in the foundation of the establishment with the assistance of the sixteen other members of the *Real Sociedad Bascongada de los Amigos del País*.[28] It was redesigned in 1848–1850 and has since been called the *Real Seminario Científico e Industrial de Bergara*.[29] Other schools were founded by the Madrid Economic Society and the Valencia Economic Society.[30]

[24] Walther L. Bernecker, *Sozialgeschichte Spaniens. Vom Ancien Régime zur parlamentarischen Monarchie* (Frankfurt am Main: Campus Verlag, 1990).

[25] See the volume edited by Stapelbroek and Marjanen eds. (2012) the contributions by Hans Erich Bödeker, Economic Societies in Germany, 1760–1820: Organization, Social Structures and Fields of Activities (pp. 182–211) and Juliane Engelhardt, Patriotic Societies and Royal Imperial Reforms in Denmark, 1761–1814 (pp. 212–231).

[26] Luis Miguel Enciso Recio, *Las sociedades económicas en el Siglo de las Luces* (Madrid: Real Academia de la Historia, 2010).

[27] Robert Jones Shafer, *The Economic Societies in the Spanish World, 1763–1821* (Syracuse: Syracuse University Press, 1958), p. 30.

[28] Inés Pellón González and José Llombart Palet, "La formación científica recibida en el Real Seminario Bascongado por los estudiantes riojanos," in: *Actas del III Simposio Julio Rey Pastor (1996)* (Logroño: Instituto de Estudios Riojanos, 1998), pp. 343–368; Álvaro Sainz, *La formación de las élites ilustradas vascas: el Real Seminario de Vergara (1776–1804)* (Universidad del País Vasco. Barakaldo. Dissertation, 2009).

[29] María Cinta Caballer Vives, Isabel Garaizar Axpe, Isabel and Inés Pellón González, "El Real Seminario Científico e Industrial de Vergara, 1850–1860," *Llull* 20 (1997), pp. 85–116.

[30] Shafer, *The Economic Societies*, pp. 99–100.

Less strongly institutionalized and following the English model of evening lectures, the economic and patriotic societies in Barcelona and Gijón organized courses in production methods. Smaller institutions also sought to combine the working and in-service training.[31] Throughout the nineteenth century, similar foundations were established in Spain. It was in this liberal and enlightened context that the industrial engineering schools in Seville and Madrid were founded in 1850.[32] Examples of state-directed higher education in the field of engineering included military schools in Madrid and Barcelona as well as the mining schools in Almadén and Mexico.[33]

In Cuba, the possibilities of a specialized institution for teaching mechanics were first mentioned by Ramón de la Sagra in an article he published in 1827 in the *Anales de ciencias, agricultura, comercio y artes* (Annals of Science, Agriculture, Trade, and Crafts). At the time, Sagra was the director of the Havana Botanical Garden and of the self-published aforementioned magazine. Sagra was renowned and well informed on the latest developments in science, politics, and education. In the article, he referred to the training schools in Scotland and England, which he associated with the names Andrew Ure and George Birkbeck, respectively.[34] Sagra did not explicitly propose to found such schools in Cuba but rather gave a kind of report about the development, the number of students, and applications to the working world in Britain. According to his information, about 90 schools had been founded in the two British kingdoms in only five years. In London alone, 1,900 students attended these institutions, which mainly trained young people to become specialized and skilled workers.[35] According to Sagra, success in Britain was also the reason why a comparable system had been introduced in France. Sagra used the example of the application of the British model in France to show that it was possible to transfer the system of practical and vocational training schools from

[31] Francisco Carbonell i Bravo, *Discurso que en la abertura de la Escuela Gratuita de Química establecida en la Ciudad de Barcelona por la Real Junta de Comerico del Principado de Cataluña dixo el Dr. Dr. Francisco Carbonell y Bravo* (Barcelona, 1805); Moisés Llordén Miñambres, *Desarrollo económico y urbano de Gijón en los siglos XIX y XX* (Oviedo: Universidad de Oviedo, 1994).

[32] José M. Cano Pavón, "La enseñanza de la ingeniería industrial en España entre 1850 y 1868. La Escuela Industrial de Sevilla," *Llull* 19 (1996), pp. 27–49; J.M. Cano Pavón, "El Real Instituto Industrial de Madrid (1850–1867): Medios humanos y materiales," *Llull* 2 (1998), pp. 33–62; Georgina Blanes Nadal, Carlos Millán Verdú, Rafael Sebastiá Alcaraz, "El Origen de la Escuela de Artes y Oficios de Alcoy, 1886/1888," *Quaderns d'història de l'enginyeria* 5 (2002–2003), pp. 85–97.

[33] See a list of several schools founded in the European territories of Spain: Christopher Schmidt-Nowara, *Empire and Antislavery: Spain, Cuba and Puerto Rico, 1833–1874* (Pittsburgh: University of Pittsburgh Press, 1999), p. 52.

[34] Both are important figures within the history of British vocational schools: J.F. Donnelly, "Getting Technical: The Vicissitudes of Academic Industrial Chemistry in Nineteenth-Century Britain," *History of Education* 26, 2 (1997), pp. 125–143; James Foreman-Peck, "Spontaneous Disorder? A Very Short History of British Vocational Education and Training, 1563–1973," *Policy Futures in Education* 2, 1 (2004), pp. 72–101; Inkster, "The Public Lecture."

[35] On then prevailing Cuban admiration for English economic and industrial measurements, see Paquette, *State-Civil Society Cooperation*, pp. 283–286.

one country to another.[36] Sagra, however, neglected to mention the differences between the Scottish, English, and French systems. He embellished the details and ignored historically different contexts to serve his underlying argument that this kind of school could be implemented in Cuba as well. He hoped that this knowledge from the other side of the Atlantic would bridge the gap between the economic demands in Cuba and the lack of specialized labor.

In this regard, Alexander von Humboldt claimed that the lack of chemists slowed down the development of the Cuban economy in his account of his visit to the island in 1826. Humboldt stated that Cuba lagged behind Europe considerably in the processing of agricultural products and that they could greatly benefit from the use of advanced chemistry in products. Humboldt referred in particular to the bleaching of sugar by vegetal carbon, as was common practice in England, and to the chemical studies of the French chemists Joseph Louis Gay-Lussac and Louis Jacques Thénard (as well as a number of other French and British chemists) on the further processing of sugar, rubber, and wood.[37]

In fact, the initiative by Ramón de la Sagra at the end of the 1820s was part of a broader campaign in Cuba to found specialized training schools. In 1804, the School for Navigation opened its doors in Havana. The *Sociedad Económica* had managed the *Escuela Especial de Dibujo de San Alejandro* since 1817.[38] Like comparable schools founded in Prussia and France as well as by other economic societies across Europe,[39] this drawing school likely taught, among other types of drawing, technical drawing, which was closely related to engineering and construction. Two notable students of this academy were Francisco Larroca and Juan Jorge Peoli who continued their studies in Rome and Paris, respectively.[40] The creation of the *Academia de Pintura y Dibujo de San Alejandro* was founded on the initiative of Alejandro Ramírez and (like the Mechanical School later) was supervised by the *Sociedad Económica*.[41] The founding directors were de la Beumara (in French Beaumé) and Juan Bautista Vermay, two well-known French painters who emigrated from France after Napoleon's defeat. In 1833 (the year Vermay died), the director of the *sociedad*

[36] Ramón de la Sagra, "Noticia sobre las escuelas de Industria establecidas en Inglaterra, y de los libros destinados para ellas," *Anales de ciencias, agricultura, comercio y artes* 1, 3 (1827), pp. 85–86.

[37] Alexander v. Humboldt, *Essai politique sur l'ile de Cuba: avec une carte et un supplément qui renferme des considérations sur la population, la richesse territoriale et le commerce de l'archipel des Antilles et de Colombia*. Vol. 1 (Paris: Gide Fils, 1826), p. 218.

[38] Reforma de la Academia de Dibujo de la Sociedad Económica de La Habana, 1833. Archivo Histórico de la Nación (AHN) in Madrid, Spain. Ultramar, 1, Exp. 4. Sostenimiento de Escuelas de Maquinaria y Artes de La Habana, 1852/1854. AHN. Ultramar, 30, Exp. 32.; see also Paul Niell, "Founding the Academy of San Alejandro and the Politics of Taste in Late Colonial Havana, Cuba," *Colonial Latin American Review* 21, 2 (2012), pp. 293–318.

[39] Shafer, *The Economic Societies*, pp. 86 and 220; Bödeker, "Economic Societies in Germany," p. 199.

[40] Guerra y Sánchez, *Historia de la nación cubana*, Vol. IV, p. 398.

[41] Emilio Roig de Leuchsenring, *La Habana. Apuntes históricos*, Vol. III (La Habana. Oficina del Historiador de la Ciudad de la Habana, 1964), p. 100; Antonio Santamaría García, "Reformas coloniales, economía y especialización productiva en Puerto Rico y Cuba, 1760–1850," *Revista de Indias* 65, 235 (2005), pp. 709–28.

requested the king to bestow the honor of the "royal academy" upon the institution.[42]

Only five years after Sagra's article, the Cuban philosopher and educator and politician Luz y Caballero wrote the *Proyecto para la creación del Instituto Cubano* (Project to create the Cuban Institute).[43] He proposed an educational institution in which mechanics would be taught alongside the liberal arts. This practical school, he argued, would help solve the economic and moral deficits of the Cuban island society. In the program, set up in the former tobacco factory of Havana, white young men over the age of 13 were taught mathematics, drawing, navigation, physics, chemistry, and modern languages. Luz y Caballero's project was probably a reconditioned solution to an idea that the *Sociedad Económica* had already initiated in 1807, when it commissioned its member Juan Miguel Calvo to draw up a plan for regulating the training of craftsmen. This initiative happened at the same time as the first school reform movement was launched by the priest, Félix Varela y Morales, and the Bishop of Havana, Juan José Díaz de Espada (who had secured the services of Beaumé and Vermay for the drawing school). The initial idea for educational reform – that did not focus only on vocational training but also aimed to revise the entire education sector – can be traced back to Arango y Parreño's plan that was adopted by the *Junta de Gobierno* of the municipal government of Havana in 1796.[44]

Varela set out his reform plan in detail in the book, *Instituciones de filosofía ecléctica para uso de la juventud*, published in 1814.[45] Varela was a member of the society that supported not only Cuba's economic development but also other issues, such as education, research, and social reform. Another member of the society was Alejandro Ramírez, who had come to Cuba via Guatemala and Puerto Rico. He became secretary of the society's education section and a full-time executive at the Ministry of Finance in Havana. Parts of his initiatives to establish specialized school were the San Alejandro drawing school and his suggestion of founding chairs of chemistry and physics at the University of Havana.[46]

The newfound emphasis on advanced and university education followed the neglect of primary education, for which the religious orders dominant in the field

[42] Reforma de la Academia de Dibujo de la Sociedad Económica de La Habana, 1833. AHN. Ultramar, 1, Exp. 4.

[43] José de la Luz y Caballero, "Proyecto para la creación del Instituto Cubano (1833)," in Eduardo Torres-Cuevas ed. *Historia del pensamiento Cubano*, Vol. 1, (La Habana: Editorial de Ciencias Sociales, 2004), pp. 430–55.

[44] Archivo Nacional de Cuba, Intendencia de Hacienda, 1126, cited from Josep M. Fradera, "De la periferia al centro Cuba, Puerto Rico y Filipinas en la crisis del Imperio español," *Anuario de Estudios Americanos* 61, 1 (2004), pp. 161–99; p. 184. https://doi.org/10.3989/aeamer.2004.v61.i1.146.

[45] Manuel F. Gran, "Félix Varela y la ciencia," *Cuadernos de Historia Habanera* 27 (1945), pp. 7–28.

[46] José Altshuler and Angelo Baracca, "The Teaching of Physics in Cuba from Colonial Times," in Baracca, Renn and Wendt eds. *The History of Physics in Cuba*, pp. 57–106; Miguel Ángel Puig-Samper and J. Luís Maldonado, "Ciencia y cultura en la época de Alejandro Ramírez en Guatemala, Cuba y Puerto Rico," in José A. Piqueras ed. *Las Antillas en la era de las luces y de la revolución* (Madrid: Siglo XXI, 2005), pp. 159–183; José María Aguilera-Manzano, "The Role of Higher Education Reform in the Construction of Cuban Identity," *The Latin Americanist* 54, 2 (2010), pp. 95–111.

of education were responsible.[47] Although the Ursulines began their pedagogical work in 1803, by 1826 only around 6,000 children had attended the approximately 140 primary schools on the island. Beginning in 1840, teacher training became a municipal responsibility so that new schools could be founded with the help of private initiatives, especially in the economically stronger municipalities of Havana and Santiago.[48] Nevertheless, in the first half of the nineteenth century, the number of privately operated primary schools remained relatively low. This situation changed with some local initiatives that were closely linked with the name of Captain General Concha. In 1855, Concha reinforced the urban impetus in the education sector by instructing that a separate budget for the school system should be included in the city's financial planning.[49] Moreover, his *Plan de Instrucción Primaria de la Isla de Cuba* (Plan for primary education on the island of Cuba) regulated, among other things, primary education. This plan, adopted in 1863, followed the Ley Moyano, which had been in force since 1857 on the Spanish peninsula.[50] As early as 1867, however, the newly established school administration became one of the victims of the conflict between Havana and Madrid over the island's legislative autonomy. So as not to promote independence, Madrid demanded that schools and universities were to be administered by the Ministerio de Ultramar.[51]

In 1827, there were 95 recognized trades in Havana, 45 of which were exclusive to the white population. Since the *Sociedad Económica* only accepted white members, it came as no surprise that the plans to improve education were also made exclusively for white, but not necessarily wealthy, students.[52] In 1835, the Industry and Commerce section of the *sociedad* owned two workshops to train apprentices, and when Luz y Caballero became the director of the society in 1837, he issued instructions on how these students should be trained. These instructions intended to centralize craftsmen training in Havana under the management of the *sociedad*. The institution required that all apprentices should be enrolled and sign a contract.[53] The institutional and legal framework did not define or regulate the content of the

[47] See Schmidt-Nowara, *Empire and Antislavery*, p. 64.
[48] Rogelio A. de la Torre, *Historia de la Enseñanza en Cuba*. https://sites.google.com/site/escueladehoy/historia-de-la-ensenanza-en-cuba.
[49] Guerra y Sánchez, *Historia de la nación cubana*, Vol. IV (La Habana: Edición Histoira de la Nación Cubana), p. 408.
[50] Guerra y Sánchez, *Historia de la nación cubana*, Vol. IV, pp. 412–414. Carlos Isabel, "El plan de instrucción primaria para Filipinas de 1863 y sus orígenes en la legislación educativa española," *Revista Filipina* 2, 1 (2014), pp. 25–36; As for the differences between the legal situation applicable to the Spanish peninsula and that applicable to overseas territories, see Gabriela Ossenbach Sauter, "Política educativa española para la Isla de Cuba en el siglo XIX (1837–1868)," *Historia de la Educación. Revista* interuniversitaria 2 (1983), pp. 256–263.
[51] Ramiro Guerra y Sánchez, *Historia de la nación cubana*, Vol. IV, p. 56.
[52] Enrique Sosa Rodríguez and Alejandrina Penabad Félix eds., *La educación secundaria, técnica y profesional entre 1800 y 1841. Otras enseñanzas iniciadas en el período* (La Habana: Editorial Pueblo y Educación, 2004), pp. 62–66.
[53] "Instrucciones para el orden y el progreso de la enseñanza pública de artes y oficios," (February 1839), published in Sosa Rodríguez and Penabad Félix eds. *La educación*, 2004, p. 68.

apprenticeship. *Sociedad* board members recruited young boys from primary school. In these early years, the *sociedad* offered evening classes of linear drawing in various schools. Only one teacher, Mariano Dumas Chancel (of French descent), taught mechanics in a more institutionalized way at a school at Güines.[54] Therefore, it is important reconsider Luz y Caballero's "Cuban Institute" project as well as the context of public and private teaching in Havana in the 1830s. His idea for the Cuban Institute was still of interest to the government in Havana. The Ministry of Agriculture and Trade, which oversaw this project, was willing to rededicate the existing Nautical School and to create new chairs in physics and mathematics. In 1834, Luz y Caballero proposed that the Nautical School, which had existed since 1804, be turned into the *Instituto de Ciencias físicas y matemáticas*. After various stages of development, this reformed teaching institution ultimately comprised six different teaching areas: mathematics, linear drawing, nautical studies, physics, chemistry, and living languages.[55] It also incorporated the school in San Cristóbal, which specialized in philosophy.[56]

Around the mid-1830s, several reforms in the education sector occurred. In 1837, Juan Claudio Díaz, the director of a primary and secondary school of Havana, wrote to the governor of Cuba, asking to found an institution called the *Colegio Cubano de Conocimientos útiles* (Cuban College of Practical Knowledge) that would include a primary school. Both sections of this institute would follow the "Lancaster system," in which the more advanced students would help and teach the junior ones.[57] This institute opened its doors in Amistad Street in 1838, but the teaching plan apparently did not include professional training.[58] The following year, the Cuban government called for a reform of teacher education on the island. In October 1839, the governor officially proposed the foundation of the *Escuela Normal* in order to properly train future primary school teachers.[59] At the end of the 1830s, another specialized school was founded, namely the School for Commerce and Mercantile Law.[60]

Returning to the history of the Mechanical Institute's establishment, José Bruzon, the head of the industry section of the society, wrote to Governor Joaquín Ezpeleta in 1840. He asked to establish a chair for applied mechanics and a "school where the young men receive a complete industrial education," in order to "provide an inexhaustible source of many and useful careers to them." He imagined "a class, where the pupils acquire the elemental instruction of those sciences that have a tight relationship with mechanics and also a more general knowledge of its laws and

[54] Sosa Rodríguez and Penabad Félix eds., *La educación*, 2004, pp. 71–73.
[55] "Informe presentado a la Real Junta de Fomento de Agricultura y Comercio de esta isla," en sesión de 11 de Diciembre de 1833, Habana: Imprenta del Gobierno y Capitania General 1834, 27. AHN. Ultramar, 126, Exp. 1.
[56] Establecimiento del Instituto Cubano en La Habana. AHN. Ultramar, 126, Exp. 1, fols. 57–157.
[57] Creación del Colegio Cubano de Conocimientos en La Habana, 1837/1838. AHN. Ultramar, 7, Exp. 13.
[58] Francisco González del Valle, *Instituciones de enseñanza privada en La Habana de 1841*. http://www.bpvillena.ohc.cu/2017/05/instituciones-de-ensenanza-privada-en-la-habana-de-1841/.
[59] Establecimiento de Escuela Normal en la Habana. AHN. Ultramar, 18, Exp. 35.
[60] Establecimiento de Escuela de Comercio y Derecho Mercantil. AHN. Ultramar, 9, Exp. 20.

theories."[61] This petition was positively received, but it did not lead to the immediate establishment of a school. This was rather linked with the foundation of the 1844 established agricultural school, which the *sociedad* initially considered impracticable. In the context of the debates about this foundation, there was also a discussion about how pupils could be taught, and how to operate a steam engine on the steamboat *Cristina*. Later in the year, the *sociedad* supported the establishment of the agricultural school if the *hacendados* (landowners) could raise the necessary funds.[62]

That same year the board of the *Sociedad* discussed the possibility of another kind of institute—a mechanical school—where students would learn to operate different kinds of steam engines on boats and on *ingenios* (sugar plantations).[63] This project for a mechanical school gained renewed enthusiasm with the return of Teodoro Vaurigaud, a man with a French background who had studied in Philadelphia. Upon his return to Cuba, he met with the society member Juan A. Ferrety, who again approached Governor Esteva with the plan to found a school for mechanics. The regulations of this new school were finalized in 1846. The teaching plan comprised linear drawing, geometry, plan drawing, blacksmithing and forging, lathing, and theoretical and practical mechanics.[64]

1847

The Industrial and Trade Exhibition of 1847, organized by the *Real Sociedad Económica de Habana* (Royal Economic Society of Havana), demonstrates that the history of the Escuela General Superior Preparativa played a significant role in the country's economic development. The exhibition was organized by the *Sociedad Económica* and the captain general of Cuba, Leopoldo O'Donnell. In March 1847, O'Donnell issued a decree allowing the exhibition to take place, and the Sociedad began to seek exhibitors who were able and willing to present their products and production methods in the society's Havana headquarters. During this period in Cuba, such an exhibition was a political event, just as the *Sociedad Económica* itself was a strongly politicized institution.

The role of the *Sociedad* in reforming the education system, founding the mechanics school, and in supporting the Cuban economy, was central. The Cuban economic or patriotic society was founded in 1793 in the Cuban capital. In an essay about this society, Lilian Vizcaíno González quotes the founding statutes, in which the work tasks were defined "to promote agriculture and trade, the rearing of

[61] This quotation is printed in: Antonio Bachiller y Morales, *Apuntes para la historia de las letras y la instrucción pública en la Isla de Cuba*, Vol. 1 (La Habana: Cultural, 1936), p. 98.

[62] *Memorias de la Sociedad Económica de la Habana* 104, 18 (1844), pp. 8, 320–321, 502–503. The foundation of this school is further discussed by the Cuban government from 1857 and realized in 1860 (Establecimiento de una Escuela Especial de Agricultura en Cuba. AHR. Ultramar, 51, Exp. 1).

[63] "Informe de la Comision encargada de la ejecución del proyecto del establecimiento de una escuela de mecánica aplicada á las máquinas de vapor," *Memorias de la Real Sociedad Economica de la Habana*, 1 (1844), pp. 15–21.

[64] Bachiller y Morales, *Apuntes para la historia*, 1936, pp. 99–100.

livestock and simple industry, and, when the opportunity arises, the education and instruction of young people."[65]

The society in Havana developed in part from the *Sociedad Bascongada*, which had been registered in Havana since 1773.[66] The Basque society also led the aforementioned *Seminario de Bergara*. The example of the Industrial and Trade Exhibition of 1847 shows precisely the liberal spirit of the Cuban *Sociedad Económica* by the admission of exhibitors and recognition of achievement regardless of social status. A prize was awarded for particularly innovative and efficient production methods and recommended for imitation. Moreover, the dominant sugar production sector, which was for the most part politically conservative, was only one of many industries on display. The society's aim was to make various sectors visible and to promote them. With the exhibition, the society also confronted conservatively producing companies with innovations from other companies in order to stimulate economic life on the island[67]

> The genius of art and industry sleeps also among us, in a peaceful sleep of childhood, but it will awaken with the roar of applause given to those who, crowned with triumph in this competition, will be remembered in the pages of our history as the first ones to strive for the prize. When our craftsmen see that every improvement they present will be rewarded, when they are convinced that with devotion and perseverance in their work they have the right to present themselves in a public competition; when they see that their colleagues can display the insignia of their victory on their products and on the doors of their workshops … . then, exhausting all their strength, they will hastily run to the exhibition grounds to compete for the prize awarded to the winner. Then we will see the development of the industry, and we will remember this solemn day, and our children will remember it.[68]

Between the publication of the decree and the opening of the exhibition, there was a change in the government of the island. O'Donnell was dismissed from his post and became head of the infantry school in Toledo. The reins of government were handed over to the Conde de Alcoy who, like his predecessor, advocated a limited liberal policy. He, too, supported the industrial show and took over the patronage. For this

[65] „promover la Agricultura, y Comercio, la crianza de Ganados é Industria Popular, y oportunamente la Educación é Instrucción de la Juventud[…]." Estatutos para una Sociedad de Amigos en la Ciudad de S. Cristóbal de la Havana …, *Memorias de la SEAP*, Primera seria, Vol. 1 (1793), p. 87; quoted in: Lilian Vizcaíno González, "Las Memorias de la Sociedad Económica de Amigos del País, una fuente para la historiografía cubana," *Santiago* 81/82 (1997), pp. 235–261; quote on p. 235.

[66] Jesús Astigarra Goenaga, "La expansión de la RSBAP por América," in: *La Real Sociedad Bascongada y América*. III Seminario de Historia de la Real Sociedad Bascongada de los Amigos del País, Bilbao 1992, pp. 91–104, especially. p. 97; Manuel Moreno Fraginals and José J. Moreno Maso, "La RSBAP vista a través de sus socios en la Habana," in: *ibd*., pp. 187–204, especially. p. 191.

[67] Memoria dirijida al Excelentisimo Señor Conde de Alcoy Gobernador Superior Civil de esta isla, por la Junta nombrada para calificar los productos de la Industria Cubana presentados en la esposicion publica de 1847, Havanna 1848, p. 2.:

[68] "Duerme aun entre nosotros el genio de las artes y de la industria, en el sueño apacible de la infancia, mas él despertará con el estruendo de los aplausos que se tributarán á los que coronados con el triunfo en este certámen (sic), figurarán en las pájinas (sic) de nuestra historia como los primeros que corrieron á alcanzar el premio. Cuando nuestros artesanos vean que cualquier mejora que presenten será recompensada, cuando esten (sic) persuadidos que con su aplicacion (sic) y perseverancia en el trabajo tienen derecho á presentarse en un concurso público; cuando vean que sus compañeros pueden ostentar en sus artefactos y á las puertas de sus

reason, the *Memoria de la esposicion publica*, printed one year after the fair in Havana, is dedicated to him.

As previously mentioned, exhibits at the 1847 Industrial Exhibition were judged by three jurors, and prizes were awarded to honor achievements in the island's various economic sectors. The Mechanical School received a prize.

> For the good execution of forged iron and several steam engine mechanisms (No. 63), all of which were made by the students of the Mechanical School of this Royal Society under the direction of their teacher, Mr. Pedro Teodoro Vaurigaud, the Board of Directors of the school awarded the silver medal.[69]

It is difficult to estimate the significance of the jury's judgment. According to their own statements, the jury was unable to assess the innovative character of the machine built by Pedro Teodoro Vaurigaud and his students of the very recently established teaching establishment. However, the members believed they could assess the extent to which a machine demonstrated its practical suitability to the Cuban industry. The jury also awarded prizes to a sugar bottling machine, another that picked tobacco, and a third that ran on only one track during the coffee harvest.[70] The documentation of the objects shown at the industrial exhibition also reveals that contemporary knowledge from Europe had already been established on the sugar island, such as the daguerreotype and Aloys Senefelder's lithograph.[71]

The industrial exhibition in 1847 showed, on the one hand, the results of Cuban mechanical engineering, which was still in its infancy. On the other hand, the memoria from 1848 documents the knowledge available on the island in various branches of production, such as agriculture, chemistry, and leather processing. This source reveals the fields of study and methods of teaching used at the Escuela Mecánica, and reflects which areas of education and especially vocational training the officials of the liberal, cosmopolitan, and avant-garde *Sociedad Económica* found insufficient.

From the very beginning, the memoria addresses the problem of an underdeveloped industry on the island and attributes this issue to the fact that the production steps in agricultural industries (such as sugar, tobacco, and coffee) were not separated from each other. Rather, the production of the raw material as well as its derivatives were handled by a single entrepreneur. They warned against rejection of technical innovation in the production process, as this decision would have an

talleres la insignia de su victoria … entonces agotando todas sus fuerzas, correrán presurosos al campo de las exposiciones á disputar el lauro consignado al vencedor. Entonces veremos desarrollada la industria, y recordaremos este dia (sic) solemne y lo recordarán nuestros hijos." (Memoria de la esposicion publica, 1848, p. 16). Unless otherwise stated, all translations are my own.

[69] "Atendiendo à la buena ejecución de un tono de hierro forjado y de varios mecanismos de máquina de vapor (núm. 63), obra toda de los alumnos de la escuela de maquinaria de esta Real Sociedad, hecha bajo la dirección de su maestro D. Pedro Teodoro Vaurigaud, la Junta adjudicó à la escuela la medalla de plata." (Memoria de la esposicion publica, 1848, p. 52).

[70] Without quoting the exhibition report, Guerra y Sánchez attributes a particularly important role to these very innovations in the renewal of the Cuban tobacco industry (Guerra y Sánchez, *Historia de la nación cubana*, Vol. IV) p. 216.

[71] Memoria de la esposicion publica, 1848, p. 52.

impact on the entire production chain. The authors of the memoria supported their argument with the example of the successful implementation of steam engines in the tobacco processing industry in England and France. In addition to the problems with production methods, the authors also complained that the infrastructure in Cuba did not permit the transport of large quantities of goods. Goods could only be transported to the nearest port by a cart; therefore, trade was seriously impacted by the size and weight restrictions. At the port, only very small ships could dock, further limiting trade possibilities.

In this catalog of complaints, however, the authors of the memoria omit the efforts already made to improve the transport infrastructure on the island. In particular, the construction of a 46-kilometer-long railway line from Güines to Havana in 1837 is a strong indicator of reform efforts. Coastbound, sugar and tobacco (as well as passengers) were transported directly from the interior of the island to the capital's port. Inland-bound, slaves and other workers from the city were sent to the plantations.[72]

The document describing the industrial exhibition specifically mentions the impact of the shortage of well-trained personnel on the island's economy. While professional chemists analyzed metals in Europe, in Cuba experienced men without professional training carried out such analyses.[73] The authors of the memorandum came to the conclusion that a renewed and this time far-reaching reform of Cuba's education sector was necessary. It needed people who could use steam engines and who were at the cutting edge of chemistry to advance the local economy. The unfortunate situation was that raw materials mined in Cuba were not processed on the island. The memoria made this clear using the example of copper ore extracted from Cuban mines but then exported to Wales, more precisely to Swansea.[74] But the script also gave encouraging examples. Cuban iron, for example, was processed in a forge in Havana, but compared to copper mining this industry was negligible. Only if more iron was imported to Cuba, the jury said, would it be possible to build machines on the island that could be used, for example, in agriculture and to help increase agricultural turnover.[75] Lastly, the members of the economic society addressed another sensitive subject—the fuel problem on the island. Further industrialization was limited by the island's scarce wood reserve, in their opinion. The little available wood was already in great demand by the shipbuilding industry. Up until that point, other local sources of energy like oil and "coal" had barely been used. The authors

[72] Michael Zeuske, *Die Geschichte der Amistad. Sklavenhandel und Menschenschmuggel auf dem Atlantik im 19. Jahrhundert* (Stuttgart: Reclam, 2012).

[73] Memoria de la esposicion publica, 1848, p. 47.

[74] Expediente general sobre explotación de minas en la isla de Cuba. AHN. Ultramar 77, Exp. 4. Compare for the Cuban export of copper to Swansea: Chris Evans, "El Cobre: Cuban Ore and the Globalization of Swansea Copper, 1830–70," *Welsh History Review* 27, 1 (2014), pp. 112–131; Also: Edmund Newell, "'Copperopolis': The Rise and Fall of the Copper Industry in the Swansea District, 1826–1921," *Business History* 32, 3 (1990), pp. 75–97; Stephen Hughes, *Copperopolis: Landscapes of the Early Industrial Period in* Swansea (Aberystwyth: Royal Commission on the Ancient and Historical Monuments of Wales 2000); Inés Roldán de Montaud, "El ciclo cubano del cobre durante el siglo XIX (1830–1868)," *Boletín Geológico y Minero* 119, 3 (2008), pp. 361–382.

[75] Memoria de la esposicion publica, 1848, p. 49.

claimed that this was primarily because a geological survey of the land had never been carried out.[76]

The authors did not only want to list the country's educational and economic shortcomings, but also wanted to use the publication to articulate a political position. They used the publication to address the governor directly and also reach a wider audience. The successful industrial exhibition was the start to more concrete reform in professional training, science, and subjects directly related to economic life. This part of the memoria, published independently of the report on the exhibition, lists the necessities of this educational reform:

> Science is the torch that casts its light on the workshops of industry to illuminate its activities with clear and bright light, avoiding the doubts, uncertainties, and clumsy tests of simple routine. How then should the chemical arts be advanced when chemistry is so far behind (the board will say more about this) and so little known and appreciated in this country? And yet, how many interesting industries do not depend almost exclusively on chemistry?[77]

1850

In December 1849, the government took responsibility for the specialized professional schools from the *Sociedad Económica*.[78] A new *Reglamento para el aprendizaje de artes y oficios* (Regulation for learning crafts and trades) was published in 1849.[79] The Cuban government sought to establish itself as the only legitimate authority sanctioned to regulate and approve apprenticeships. The government, like the *Sociedad Económica* ten years earlier, intended to control the training of apprentices in Havana. The new regulations stipulated that a government representative must be present at the signing of the contract between the *sociedad*, the teacher, and the student (or his legal representative.)

The existing vocational training system was reformed. Finances as well as the institution's performance records were scrutinized. A report by the governor and captain general states that vocational training has not yet borne the fruit expected at its establishments. Many Cuban young people whose families could afford it were still studying at foreign universities. These affluent young men rarely chose subjects that were connected to production, industry, or economics on the island. There was the additional problem that 600 foreign engineers were already working in

[76] Memoria de la esposicion publica, 1848, pp. 65–67; see Helge Wendt, "Coalmining in Cuba. Knowledge Formation in a Transcolonial Perspective," Helge Wendt ed. *The Globalization of Knowledge in the Iberian Colonial World* (Berlin: Max Planck Research Library, 2016), pp. 261–296; Helge Wendt, "Transfer of Knowledge, the State, and Economy in the Cuban Coal Question (Nineteenth Century)," in Lothar Schilling and Jakob Vogel eds. *Circulating State-Related Knowledge in the 18th and 19th Centuries* (Berlin: De Gruyter, 2019), pp. 34–47.

[77] "Las ciencias son la antorcha que vierte su resplandor en los talleres de la industria, para alumbrar con clara y brillante luz todas sus operaciones, evitando las dudas, la incertidumbre y los torpes ensayos de la simple rutina. ¿Como pues han de estar adelantadas las artes químicas, cuando tan atrasada (la Junta dirá aún más) tan poco conocida y apreciada es la química en el país? Y sin embargo ¿cuantas é interesantes industrias no dependen, casi exclusivamente de la química?" (Memoria de la esposicion publica, 1848, p. 65).

[78] Reforma del aprendizaje de Artes y Oficios en Cuba. AHN. Ultramar, 27, Exp. 4, pp. 1–1 v.

[79] Reforma del aprendizaje de Artes y Oficios en Cuba. AHN. Ultramar, 27, Exp. 4, Doc. 2.

agriculture, industry, and transport in the country so that the possibilities for locals to find jobs were rather limited.[80]

The governor's report states that in 1849 about 50 pupils were enrolled in the Mechanical School. Since its establishment, 67 students had graduated. In 1850, the captain general reallocated funds from the *fondo de emancipados* (which supported impoverished children) for the purpose of repairing the San Isidro building in Havana and relocating the escuela there. It remains unclear in this context in which building the school was housed until then. In the course of these measures, the facility was meant to become more attractive to students from outside of Havana. In order to enable them to attend school, the governor issued a decree exempting the Mechanical School students from the cost of transport on trains and steamboats and, if their social situation so required, waiving tuition, as several letters of gratitude from students to the head of government confirm.[81]

The captain general's bundle of reforms brought the school closer to a military order. However, it still is unanswered whether this meant that the school now fell under military command or whether only its internal organization, as in many educational institutions of the time, was military in nature. In any case, the number of high-ranking soldiers on the school's board of directors increased, and 17 soldiers enrolled in the school.[82] At the same time, a plan to increase the total number of students to 240 developed. The government was pleased to see an improvement in the new school in San Isidro.

> These circumstances show that in these schools of the arts and crafts and mechanics the morals that we proposed at the time of their foundation have grown and the love of work blossoms paired with honorable ambition.[83]

Among other things, according to the government report, the students in the mechanics classes had devoted themselves particularly keenly to the study of the steam engine. In order to put the theory into practice, the students were invited to participate in the sugar harvest the following year. The sugar harvest (called *Zafra*) was one of the most important events of the year in Cuba. As sugar cane was sold to Spain and to the United States, the island's economic welfare relied heavily on a fruitful harvest.[84] Participating in a responsible position at zafra was an honorable and challenging task for teachers and students of the *escuela*. They took over the supervision of the steam engines and helped solve any problems, breakdowns, and damages as quickly as possible. In order to make this on-site assignment more

[80] Sostenimiento de Escuelas de Maquinaria y Artes de La Habana. AHN. Ultramar, 30, Exp. 32.
[81] Ibid.
[82] Ibid.
[83] "Esta circunstancia revela que en estos institutos de aprendizaje de artes y oficios y maquinaria han hecho germinar la moralidad que nos propusimos al crearlos y despuntado con noble ambicion el amor al trabajo." Ibid.
[84] Ramón de la Sagra, *Historia economico-politica y estadistica de la Isla de Cuba* (La Habana: Imprenta de las viudas de Arazoza y Soler 1831); Fernando Ortiz, *Contrapunteo cubano del tabaco y el azúcar: Advertencia de sus contrastes agrarios, económicos, históricos y sociales, su etnografía y su transculturación* (Barcelona: Ariel, 1940).

accessible for the students, they were exempted from the costs of traveling to the sugar plantations—after all, the government expected a profit from their technical skills. Despite the recent reforms of legislation, the government could not decide everything on its own. It cooperated closely with the Ministry of Development and the Sociedad Económica, and so a joint commission was formed to take over the administration of the school.[85]

1850

In the early 1850s, after the school had moved into its new premises and its organization had been radically reformed, it again became the subject of an intense exchange of letters between the Captain General of Cuba and the Spanish government in Madrid in 1857. Captain General José Gutiérrez de la Concha reported that there were two specialized mechanical schools now attached to the General Preparatory School. One was in Havana and the second in Santiago, on the eastern side of the island. At an earlier date, the foundation of two more schools in Matanzas had been planned, but they were not implemented.[86] The governor wrote that the theory and practice of agriculture, trade, industry, and architecture were at the center of the teaching concept. These two mechanical schools could compete with the *escuelas normales* and even with some of the specialized institutes at the University of Havana. Over the course of the 1850s, vocational training became solidly established on the island, as can be seen in the 1857 curriculum for the *Escuela Mecánica*:

> Elementary mathematics, elementary mechanics and practical mechanics. Principles of topography and descriptive and perspective geometry. Fundamentals of geography and history. Languages French and English. Double-entry accounting and bookkeeping. Linear and decorative drawing.[87]

It is difficult to find out what is meant by "elementary mathematics," for example, and lists of textbooks or more detailed school curricula are not mentioned in the sources. For the subject of geography, it can be assumed that the book *Elementos de geografía e historia de la isla de Cuba arreglados al alcance de los niños* (Havana 1852) was used in teaching. Its author, Pelayo González, was also the director of the school in Havana at the time. Mathematics was taught by José García de Arboleya who, according to his list of publications, was more a historian than a mathematician. The teacher of physics and chemistry— two subjects that were often taught together—was Ignacio Rodríguez. And Juan Nepomuceno Ortega headed the mechanics class and the machine workshop. When Ortega resigned in

[85] Sostenimiento de Escuelas de Maquinaria y Artes de La Habana. AHN. Ultramar, 30, Exp. 32.
[86] Expediente general de la Escuela General Preparatoria y Especiales de Cuba. AHN. Ultramar, 51, Exp.2.
[87] "Matematicas elementales, Mecanica elemental y practica. Principios de topografia y geometria descriptiva y de perspectiva. Elementos de geografia e historia. Idiomas francés é Inglés. Partida doble y Teneduría de libros. Dibujo lineal y de adorno." Expediente general de la Escuela General Preparatoria y Especiales de Cuba. AHN. Ultramar, 51, Exp.2.

1857, a certain Enrique Rey succeeded him. These teachers received a monthly salary of 1,500 pesos. The director earned 2,000 pesos.[88]

Juan Bautista Sagarra y Blez was the director of the Santiago school. He earned 1,500 pesos a month, only as much as a teacher in Havana. Sagarra y Blez had distinguished himself with publications on the public education system and founded the *Colegio de Santiago* in Santiago in 1841—possibly a predecessor to the local Escuela Mecánica.[89] Other subjects in Santiago were mathematics, physics and chemistry, French and English, and drawing and design. In Cuba, the value of these schools was seen in the fact that students, beginning at a fairly early age, were also educated to attend university. This distinction was particularly important because it resisted pressure from Madrid to merge these schools with the university.[90]

In Cuba there was a lack of suitable teaching staff because the few university graduates were not attracted to the relatively poorly paid public education sector.[91] An exception was Álvaro Reynoso Valdés. In 1852, Reynoso received a scholarship to study at various European universities on the contractual condition that he would work in the public education sector in Cuba upon his return (in 1857). Discussions began in 1856 as to whether Reynoso would be better suited to a chair at the University of Havana or at the Escuela Mecánica.[92]

The political dimension of Reynoso's teaching location is particularly evident in the correspondence between Madrid and Havana when the establishment of a chair of Agrochemistry was discussed. Madrid hoped that this professorship would give the imperial capital direct access to production methods, while the Cubans tried to defend the autonomy of the *azucareros* (Sugar-producers).[93] Before Reynoso became a professor of chemistry at Havana University, he spent several years as a teacher at the Mechanical School in the Cuban capital.[94]

Reynoso's appointment to the *escuela* came at a period when new academic institutions were being established in Cuba and scientific activities were increasing. A physical-meteorological observatory was established[95] and the first comprehensive geological-geographical study, written by Policarpo Cia, appeared.[96] In the 1860s, schools of agriculture, marine science, and veterinary medicine were founded. Cuban

[88] Expediente general de la Escuela General Preparatoria y Especiales de Cuba. AHN. Ultramar, 51, Exp. 2.
[89] *Diccionario de la literatura cubana/Instituto de Literatura y Lingüistica de la Academia de Ciencias de Cuba*, Alicante 1999.
[90] Expediente general de la Escuela General Preparatoria y Especiales de Cuba. AHN. Ultramar, 51, Exp. 2.
[91] Guerra y Sánchez, *Historia de la nación cubana*, Vol. IV, p. 314.
[92] Expediente personal del catedrático de Escuela Profesional A. Reinoso. AHN. Ultramar, 30, Exp. 21.
[93] Ibid.
[94] Expediente general de la Escuela General Preparatoria y Especiales de Cuba. AHN. Ultramar, 51, Exp.2.
[95] Tirso Sáenz and Emil G. Capote, *Ciencia y tecnología en Cuba. Antecedentes y desarrollo* (La Habana: Edición de Ciencias Sociales, 1989); Reinaldo Funes Monzote, *El despertar del asociacionismo científico en Cuba (1876–1920)* (Madrid: CSIC, 2004).
[96] Policarpo Cía, *Observaciones geológicas de una gran parte de la isla de Cuba* (Madrid: Imprenta de la viuda de D. Antonio Yenes, 1854).

scientists maintained close contacts with scientists in Europe, as the example of medical anatomical collections shows.[97]

The funding of these institutions and scientific ventures remained uncertain, and some of them had to reduce their activities severely or cease operations altogether after only a few years. Nevertheless, the years before the first independence wars in Cuba, which broke out in 1868, witnessed a heyday in the professionalization of education thanks to the work of the *sociedad* and members of the Cuban government. In addition, the teaching staff was better trained than in previous decades, as can be seen in the example of the teachers and directors at the mechanical schools in Havana and Santiago, as well as the biography of Álvaro Reynoso. After all, there was a labor market, albeit small, for *escuela* graduates— whether in public administration and teaching or in the private (rural) economy.

The history of the *Escuela Superior Preparativa de Mecánica* and other professional schools shows that enlightened Cuban entrepreneurs and governments in Havana and Madrid were motivated to build a comprehensive education system on the island. This plan was fueled by the local needs to develop production methods in order to survive in a globalized market for agricultural products, such as sugar and tobacco as well as the copper industry. In the first half of the nineteenth century, the exchange of information on developments in education had become globalized. Thus, the idea of "mechanics schools" from England and France, together with the knowledge of vocational training that was developed by the economic societies in Spain, spread to Cuba and met the demand of enlightened circles for good practical education.

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[97] Armando García González, *Cuerpo abierto. Ciencia, enseñanza y coleccionismo andaluces en Cuba en el siglo XIX* (Madrid, Sevilla: CSIC, Universidad de Sevilla, 2010); For a comparison with developments within the field of medicine, see Michael Zeuske, "Doktoren und Sklaven. Sklavereiboom und Medizin als 'kreolische Wissenschaft' auf Kuba," *Saeculum* 65, 1 (2015), pp. 177–205.