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Remarks on the History of Science and Technology in Nineteenth-Century Camaguey City

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Abstract

Context: The current province of Camaguey, in the Nineteenth Century. All science and technology with a broad perspective.
Aims: To systematize science and innovation; identify their major manifestations, figures, and institutions; to study the socioeconomic conditions that originated it; to show the landmarks and regularities that define the historical timeline.
Methods: Theoretical (historical-logical, analytical-synthetic, and inductive-deductive), empirical (documentary review and discussions with historians in the province of Camaguey).
Results: The study distinguished two stages in science and innovation in the province. 1) 1813-1868, with two periods (1813-1856, and 1857-1868), characterized by the activity of Amigos del Pais Economic Society. 2) 1869-1898, in which the number of manifestations was much lower because the two independence war scenarios did not favor this trend or the preservation of evidence.
Conclusions: Various evidence of science and innovation in the nineteenth Century was found, though there were no records of scientific institutions or professional researchers, as well as no effective support for research. Science was conducted by a reduced number of local figures or individuals temporarily settled in the community, who thanks to their wealth, could acquire solid academic education and engage in this area out of their personal and spontaneous motivations, sporadically, usually encouraged by their foreign scientific acquaintances.

Keywords: *local historiography, Cuban colonial period, Santa María del Puerto del Príncipe, Amigos del Pais Economic Society.*

Introduction

Research on science and technology development locally is critical today, particularly because it generates basic information that could support the following:

1- Patriotic, civic, and cultural education of a broad range of social sectors, by stimulating assessment as a singular element of the contribution made by local personalities and institutions, as a complement to the national (specific) and international (general) aspects.

2- Postgraduate professional education in social topics of science, which, at least in Cuba, constitutes a requisite to obtain scientific grades and teaching and research categories.

In Camaguey, there are few studies in this direction, which have mostly focused on fact analysis (Crespo, 2016), a review of relevant personalities (Méndez, 2017) and institutions (Falcón et al., 2009; Varcacia et al, 2004, as well as a followup of specific scientific disciplines (Méndez and Balboa, 1999; Quintana et al., 2005; Terrero & Brito, 2010; Vila, 2010; Gómez et al., 2014). So far, there is no general assessment that contributes to a panoramic vision of the process.

This contribution deals with part of the latter. In the Nineteenth Century, the objectives were, 1) To establish the stages of science and innovation locally.

2) To identify the major manifestations of science and technology in the province, including the relevant personalities. 3) To conduct broader studies of the socioeconomic conditions that brought about scientific and technological breakthroughs in the province during that stage. 4) To stress the deeds and regularities that might support a historic-trendy analysis.

Development

Theoretical and practical background

Studying the history of science and technology, or some of its branches is always a complex task, at least for two reasons:

1- It is important to assume certain starting theoretical and methodological conceptions.

2- The necessary sources are not always available.

Considering the previous grounds, the following decisions were made in this paper:

1- Considering a broader concept of science, that deals, on one hand, with its historic differences from technology; and on the other, with their unity.

2- Focusing on the Nineteenth Century, despite there being less information about more recent periods. Before that date, no evidence of scientific activity in the territory has been found, so the existence of some isolated facts, not necessarily locally, has been thought of as a background. A similar study on the pseudo-republican stage, and another covering the events following the triumph of the Cuban revolution, go beyond the possibilities of this project.

3- Based on the evidence available, some remarks will be made about the most significant moments linked to the production, diffusion, and implementation of knowledge. To a lesser extent, some references will deal with innovation and technology transfer, to set up the basis for validation and certainly, be studied further in the future.

Three theoretical methods were used: 1) Historic-logical, to assess the chronological evidence about science in the province, and to interpret the results with a theoretical perspective of the approach Science, Technology, and Society. 2) Analytical synthetic, to study the meaning of the different scientific events in detail, and to identify their links and regularities. 3) Inductive-deductive, to establish generalizations derived from historical and contextual premises, and to come to conclusions driven by general principles, depending on the circumstances.

The empirical methods used were documentary review and discussions with historians in the province of Camaguey.

Background

The oldest background associated with technology in Camaguey dates back to the pre-Hispanic times. Although among the Aboriginal population, knowledge was empirical, at least in technology, different stages of development can be identified.

One example is the evolution of agriculture in the agro-pottery communities, which started using the oldest systems (*de roza*) through the most updated (*bulk cropping*). The latter was introduced in the Antilles in the late Nineteenth Century and was much more efficient than the previous. It increased yields 15-fold compared to *de roza* and resulted in significant social and cultural development (Tabío, 1989). Although it was not exclusive in the part of the archipelago where Camaguey is, the location of agro-pottery aboriginal settlements shows that during that stage, knowledge was spread and put into practice locally.

Another analysis would also include the Spanish colonization, despite its thieving character. It was different from the English colonization, which did transfer technology to its colonies, and was defined by Jose Marti in his plea *Mother America*, on December 19th, 1889: “North America was born from the plow, while Hispanic America was born from a prey dog...” (Martí, 1963, p. 136). Even though, the colonial domain meant a pivotal change in the spreading and application of knowledge, the ways of doing things, and the organization of production. In the settlement of Puerto Principe, as in the rest of the country, cattle raising was started, and new plant species were brought from other parts of the world. The two activities demanded technology that was brought from overseas. The diversification and development of production took place based on unknown knowledge in the territory. Particularly, the specialization of certain items initiated during the conquest led to a flourishing of enlightenment and the first manifestations of science in the following centuries.

The first scientific event known so far was related to the production of knowledge (not generated by the local natives) and dates back to August 15th, 1714, when Marcos Antonio Riaño Gamboa[1], on his way

[1] Marcos Antonio Riaño Gamboa (1672-1729). These actions, including the one performed in Trinidad, on May 28th that same year, Riano (who is not very well known), responded to a request from the Spanish government to determine the geographical position of the most important points of their overseas colonies, some of them Cuban cities and ports. According to López Sánchez (1989), personalities like Alejandro

through Puerto Principe, made observations of northern stars and measured the first satellite in the shadow of Jupiter, using a 10-foot telescope (López, 1989). Later, (August 20th), he measured the northern height of Antares and calculated the Villa's latitude.

Other similar events took place, such as scientific expeditions that explored and studied the territory in the late Eighteenth Century. One of them consisted of the hydrographic study of Nuevitas port, in 1791 by a team led by Ventura Barcaiztegui[2]. Another instance was the stay in Nuevitas (1797) of the Royal Guantanamo Expedition[3], led by the Count of Mopox and Jaruco[4], whose botanist Baltasar Boldo[5], collected plants from the surroundings of that city, and Sierra de Cubitas (Boldo & Estévez, 1990; Méndez & Balboa, 1999).

Also relevant are several events and evidence, such as The settlement of the first hospitals in the Seventeenth Century (Varcacia et al., 2004). The oldest news heard of (Eighteenth Century) about a doctor and a pharmacist who worked permanently in Puerto Principe (Pérez & Sed, 1990). These data demonstrate the existence of a cocoa plantation in Ciego Najasa (1742)[6], just another example of the early interest of farmers to diversify agriculture, even using crops that would eventually lose ground to other economic items in the territory. The first petition from Camagueyans to the King, to create a university dates to the late Eighteenth Century[7].

These events and others that may come to light, though isolated and unrelated, were the threshold of relatively frequent scientific activity in the territory by the Nineteenth Century, having some degree of articulation and institutionalization, based on technology transfer, which included the generation of knowledge, spreading, and application.

Historical background

The causes of an incipient scientific activity in Camaguey in the Nineteenth Century are associated with the flourishing of other areas of culture and the evolution of the most radical political ideas with the advent of the wars for independence in 1868.

Such advances in the superstructure were supported by a particular economic base, which, on one hand, allowed the ell-to-do Camagueyan youth to have access to the most prestigious universities in different parts of the world; and on the other, encouraged the wealthy class to embrace some scientific and technological breakthroughs that could boost production, and therefore, their wealth.

On the island, the economic development of Puerto Principe stood out for cattle raising, along with sugar manufacturing. However, the natural conditions of the territory (large prairies with plenty of grass), as well as the broad demand for foods and sub-products from cattle led to a sustained increase in this sector, which differed from other settlements in the country.

Additionally, ransom activities or smuggling had been practiced in the territory since the Sixteenth Century, with the participation of local landowners, business people, and the local authorities, to the point of becoming one of the most influential economic activities in the region.

In the early Eighteenth Century, there was a significant increase in production. The sugar industry was boosted with the arrival of animal-operated mills, including groups of 6-12 slaves[8]. In 1715, the town council acknowledged the existence of 61 sugar mills that manufactured 735, 454 tons of sugar in 1760, which were produced regularly until the late 1700s, when the output dropped to 446,000 tons in just 55 mills (Moreno Fraginals, 1964).

But equally important was the direct influence of sugar manufacturing in cattle raising, according to Moreno Fraginals (1964, p. 68). The industry demanded a high number of oxen for the mills, as well as jerked meat to feed the slaves, which was undertaken by the Cuban administrations in Puerto Principe, Bayamo, and Trinidad, as the major producing areas in the Antilles.

This economic momentum was soon reflected in the social arrangement (concentration of property, fabric of family relations, social groupings), as well as in the culture, collective habits, architecture, and the

de Humboldt and Ramón de la Sagra considered him the firast Cuban astronomer.

[2] Ventura Barcaiztegui (¿?). Spanish sailor and scientist. To learn more about his expedition of Cuba, refer to González-Ripoll (1991).

[3] The Royal Commission of Guantanamo worked in Cuba between 1797 and 1802. It aimed to study the conditions that would permit the creation of new communication ways and settlements in remote communities. Refer to, San Pío & Puig Samper (1999); Quinto Centenario, CSIC, et al., (1991).

[4] Joaquín de Santa Cruz y Cárdenas, Count of Santa Cruz de Mopox and San Juan de Jaruco (1769- 1807). Born in Cuba, he was a military, brigadier, expeditionary, and Knight of the Calatrava order. He led the Royal Commission of Guantanamo.

[5] Baltasar Manuel Boldo Tuced (1766-1799). A Spanish physician and botanist in charge of botanical expeditions conducted by the royal Commission of Guantanamo.

[6] Historical Provincial Archives of Camaguey, Book 2, Mortgage Accounting, Volume 192, number 779, September 28th, 1742.

[7] A file containing the personal and pecuniary services performed at the Santa Maria del Puerto del Principe for the King, Our Master, from the beginning to 1817. The document was consulted at the personal archives of Gustavo Sed Nieves.

[8] Provincial Historical Archive Camaguey. Book 2, 3, and 4 at the former Mortgage Accounting Office

arts. The first literary works were published in the early Seventeenth Century (Álvarez et al., 2014). By 1774, Puerto Principe had more than 30,000 inhabitants, the second city in Cuba, and one of the most important cities in Latin America (Moreno Fraginals, 1964).

For that reason, the crown decided to move the Royal Audience of Santo Domingo to Puerto Principe, when the former was conceded to France through the Treaty of Basilee (Tejada, 2014). That event brought about favorable consequences (Pezuela, 1863; Méndez, 2017), as the economic order (the number of wealthy suitors), and cultural (the lawyers settled in the city had an active participation in the economy, education, arts, and science). The first newspapers began to circulate in 1810, with the printing press (Labrada, 1987), which played an active role in the spreading of knowledge.

The inhabitants of Camaguey published the best initiatives implemented in the capital city to boost local progress. In 1813, only 16 years following the Mother Society, the Patriotic Deputation of Puerto Principe was founded as a branch of the Patriotic Society Friends of the Country (Amigos del Pais) in Havana (Set et al., 1993; Ávalo & Batista, 2016; Méndez, 2017). It embodied the most important efforts aimed at fostering economic progress and developing culture. From that moment on, the different attempts to engage in science and technology were somehow stimulated by at least one institution, which coordinated and planned these efforts.

The events that took place during the rest of the Nineteenth Century[9] could be split into two stages. One between 1813 and 1868, which was the most productive producing the most evidence. The other (1869-1898) was less fruitful due to the political and economic instability created in the territory by the wars of independence, and having less hard evidence (unless it was found to support this study).

First stage: 1813-1868

It began with the Patriotic Deputation of Puerto Principe and ended with the unleashing of the Ten-year war. It can be split into two periods. One comprises the 1813-1856 period, during which the Patriotic Deputation of Puerto Principe functioned as the branch of the Economic Society Friends of the Country, in Havana. The other was between 1856 and 1868, whose landmark was the independence of this society from the main organization.

[9] Some of the evidence include local personalities or individuals who settled permanently in the city, as well as other renown researchers (even internationally), who lived in Camaguey for a limited period of time.

The 1813-1856 period

The evidence found shows the interest of the enlightened aristocracy in embracing science and technology as part of the local culture. Hence, cultural entities, such as the Philharmonic Society[10] or the public library founded educational institutions with some level of specialization. At the same time, the local media published scientific documents using the printing press to publish books and booklets about agriculture, economy, and mining. A small group of enlightened representatives of the wealthy class set cooperation relations with relevant scientists nationally and overseas, and some of them engaged in the production of new knowledge in natural sciences and history. At the same time, the interest to change the ways things had been done so far and to transfer new technologies to the city was linked to the efforts to diversify the economy. The most relevant activity, according to the evidence found was observed in the spreading of knowledge, reaching momentum in the 1830s and 1840s.

In 1814, only a few years following the foundation of the Patriotic Deputation, French-born immigrant Don Luis Cabanis proposed the City Hall to create a botanical garden and encourage the teaching of astronomy (Crespo, 2016). Among the first activities of the new institution was the establishment of the Academy of Mathematics, to instruct and illustrate the young in this science, which also renovated the efforts to found a university in the city[11].

The presence of the Royal Audience led to the inclusion of what was later known as the social sciences. Accordingly, on May 18th, the San Fernando Academy of Jurisprudence was founded "for the involvement of bachelors in the practice of all sorts of processes, ratify forensic studies, and inspire the moral and political virtues to the ones practicing law" (Campusano, 1818, p. 2). Years later, Manuel de Monteverde[12] and Eusebio Pérez[13] founded a school of humanities (El Siglo), which taught Civil Law and Political Economy, and was acknowledged by Domingo del Monte[14] as "... a

[10] The Philharmonic Society of Puerto Principe Artistic and literary association founded in 1830 To more about it, refer to: Villabella (2014).

[11] Legacy No.5 A, 1813, file 1390. Historical Archive of Ignacio Agramonte Provincial Museum (AMPIA)

[12] Manuel de Monteverde y Bello (1798-1872). Dominican who settled in Puerto Principe. For more information, refer to: Méndez (2017).

[13] Eusebio Pérez (?). From Puerto Principe, who practiced the teaching of several disciplines, and was the principal of renown schools in Puerto Principe. A collaborator of Manuel de Monteverde y Bello in education.

[14] Domingo del Monte (1804-1853), born in Venezuela with family roots in Santiago de los Caballeros, Santo Domingo. At seven, he was brought to Cuba by his parents, and settled definitively on the island, where he has been recognized as one of the most outstanding personalities of the national culture.

scientific and enlightening center... for the young who wanted to engage in legal sciences...” (Del Monte, 1838, p. 88).

In 1832, through the mediation of the Patriotic Deputation, the first public library was founded (Freyre, 1832), located in the Merced Convent, because “*... every good and improvement is sterile by disgrace if they lack the knowledge that only the books provide*. Books are too expensive for the average citizen to buy and acquire the least bit of instruction...”[15].

In the 1840s, cattle and crop exhibitions appeared in the La Vigia neighborhood, whose goal, besides competition and exhibition, was to boost farm production by embracing and implementing significant breakthroughs in science and technology.

The scientific and technological development also spread to the production of knowledge. In the area of science cognition, the local contribution mainly focused on the natural sciences, agriculture, and history.

The natural sciences were the most relevant, though. Manuel de Monteverde and Tomás Pío Betancourt[16] cooperated with the Havana Botanical Garden and its director, Ramon de la Sagra[17], by sending plants, seeds, and information. It was made official when, on November 15th, 1831, the Ordinary Board of the Friends of the Country Economic Society issued a patent to each as “Corresponding Partner of the Botanical Garden”, which also chose them to be part of a commission that would send a comprehensive collection of woods to the Isla del Rey of Spain (Zambrana, 1832).

He helped with the arrival of local plants to Europe, many of which were cited by Achilles Richard[18], book 11, Physical, Political, and Natural History of the Island of Cuba, edited by Ramón de la Sagra (1845), and considered as the most important work about the Cuban flora ever published then.

In 1840, Monteverde submitted botanic material to the first ever-known Cuban museum, founded at the request of the Patriotic Society by Felipe Poey y Aloy[19], in Havana (Poey, 1840).

In the late 1840s, Manuel de Monteverde and Tomas Pio Betancourt started a very close relationship based on scientific cooperation with Spanish explorer Miguel Rodriguez Ferrer[20]. Years later, the latter published part of the correspondence they kept, in which they described a new species of plant (Monteverde & Pío Betancourt, 1862; Méndez & Moya, 2021.), and made an accurate assessment of the possible use of Cuban vines to make caskets (Pío Betancourt, 1876; Méndez & González, 2023).

The continuous celebration of cattle and crop exhibitions in Puerto Principe influenced science and innovation. Further studies must be conducted in terms of training, the spreading of better practices, and technology transfer. It is known, for instance, that the Organizing Commission of the first edition of the Fair entitled Manuel de Monteverde introduced new cattle breeds from the US (Freyre, 1843).

However, this study identified another area influenced by these exhibitions: the fostering of science and technology by publishing scientific works in agriculture in the local media. New evidence was found, as taking place following 1857. However, one of the most significant of the first stage was published in the Puerto Principe Gazette, on July 6th, 1843, by Gaspar Betancourt Cisneros (El Lugareño[21]), which contained his assessment of the exhibition held in 1843 (Betancourt, 1843).

The occasional publication of booklets in the form of memoirs, written in a scientific style, covered topics linked to other economic items and some local populations. For instance, two works published by

[15] Minute of the session of the Patriotic Deputation of Puerto Principe held on January 29th, 1831. Records for the foundation of the Public Library. AMPIA, legacy No. 22, número 22.

[16] Tomás Pío Betancourt y Sánchez Pereira (1798-1863). It was one of the most prominent personalities of Puerto Principe in the first half of the Nineteenth Century. From a wealthy family, member of the Royal and American Order of Isabel the Catholic, he was a landowner, lawyer, Prosecutor, and Royal Councilor of Puerto Principe City Hall. He became notorious as a botanist and historian.

[17] Ramón de la Sagra y Peris (1798-1891). Spanish sociologist, economist, botanist, geographer, cartographer, writer, and politician. Was the director of the Havana Botanical Garden (1824-1832).

[18] Achilles Richard (1794-1852). French physician and botanist. He wrote the two books about flower plants for the work: Physical, Political, and Natural History of the Island of Cuba, edited by Ramon de la Sagra. Richard honored the work of Manuel de Monteverde as a collector, by naming a plant genus (*Monteverdia*), which now has more than 120 species around the world.

[19] Felipe Poey y Aloy (1799-1891). Cuban naturalist, philologist, and philosopher. Professor at the University of Havana.

[20] Miguel Rodríguez Ferrer (1815-1889). Spanish explorer, politician, writer, and publicist. Born in Lebrija, and became a Bachelor of Law at the University of Seville, in 1837. He visited Cuba twice. In his first stay (1846-1849), he explored different regions of the country, and studied the natural sciences (geography, geology, botany, zoology, mining, and meteorology), as well as social sciences (history, archaeology, anthropology). During the second stage (1851-1861), the Jurisdiction of Puerto Principe was founded, purchasing land for agriculture and engaged in public administration and the practice of law.

[21] Gaspar Betancourt Cisneros, El Lugareño (1803-1866). Perhaps the highest figure of the enlightened aristocracy of the time. His work as a social reformer has been widely acknowledged.

Carlos Auboin[22] in 1845 and 1846, about the Batayabo mines[23], and another book written by Juan Jerez[24], about the inhabitants of Santa Cruz del Sur[25].

Tomas Pio Betancourt also conducted social research. His History of Puerto Principe (1839), was first published in the section *Remarks about the History of the Island of Cuba",* in the Memoirs of the Royal Economic Society Friends of the Country. Although this work has a descriptive character due to the lack of critical opinions and the type of sources and anachronistic narrations for the time, it was one of the first contributions to the local Cuban historiography, which provides valuable information about the development of the village (Almodóvar, 1984).

However, the work of Pio Betancourt paved the way for other efforts in the region, such as the additional chapter of the History of Puerto Principe, entitled Cubitas, which was published in the Memoirs of the Royal Patriotic Society of Havana, in 1839[26]. The physical-geographical description of the prevailing landscape in this orographic accident of the moment drew interest, as it was a referent to evaluate the present conservation state.

In the 1840s, probably driven by the intellectual environment of the city, some locals, like Bernabé Mola[27] and Francisco Antonio de Agramonte[28] found human remains on the south coast of Vertientes. Perhaps the news was published in the local papers and then reproduced in the Memoirs of the Royal Patriotic Society of Havana (Anonymous, 1843)[29].

The broad diffusion given by the Royal Patriotic Society encouraged other scholars to engage in this topic, such as Miguel Rodriguez Ferrer, who, on a visit to Camaguey, collected a jaw, which he took to Havana and later to the Museum of Natural History of Madrid, in 1850. The study of that piece was presented at the Americanism Conference of Madrid, in 1881, with a long debate among scholars and further repercussions.

Mola and Agramonte's findings and their further publication contributed to shaping the existing rationale about human settlements in Cuba (Rangel et al., 2009). Moreover, Miguel Rodriguez Ferrer did studies as the starting point for a scientific assessment of Cuban archaeology, and his queries in the south of the jurisdiction meant that Camaguey was at the top of this type of research in the country (Terrero & Brito, 2010).

In terms of technology transfer during that stage, the work of the Patriotic Deputation in Puerto Principe was associated with two relevant events: the introduction of railroads in 1846 (the second in the country), and the utilization of the steam engine in the sugar mills, during the 1940s. The former has been studied by several scholars (see Moyano, 1991), but there is still no sufficient ground to refer to the impact on the particular development of the jurisdiction and its repercussions on every social sector. The latter was not a particular case of Camaguey, but this process was very specific in the region and deserved further study.

Likewise, the proposals made by the Lugareno to replace slave-based plantations with white migrant colonies are worth assessing as a form of farm management. These ideas have been analyzed with a social perspective, as an alternative to slavery and an expression of the national liberal reformists to prevent the replication of the Haitian revolution, though there is no comprehensive scientific, technological, or social assessment.

In 1831, efforts were made to purchase weather instruments. Manuel de Monteverde y Bello sent a letter to Ramon de la Sagra instructing him to purchase a box containing such instruments in France, which was later bought in 1833[30]. This fact should be considered among the first efforts to develop meteorology in Camaguey, where it has been significantly developed.

The telegraph was introduced in the mid-1950s, but few details related to its deployment and operation have come to light.

[22] Carlos Aubouin (?). Mining engineer. Was the then director of the Batayabo mines.

[23] Batayabo mines The copper mines known as San Antonio and La Fortuna, located on Batayabo hill, near the village of Redencion, municipality of Minas.

[24] Juan Jerez Arreaga (¿). Military engineer. Was responsible for the conception of the project and construction of the Principal Theater, founded in 1850.

[25] Gustavo Sed Nieves referred to this deed (personal communication). However, it was not located for this research. The text refers to the renown experience about this topic.

[26] The document did not refer to the author. At the end, there is just an indication of *G de P.P*. Upon consulting different Camagueyan historians, it was convened that it belonged to Manuel Arteaga Betancourt, though no evidence of that was found.

[27] Bernabé Mola (?). Local resident of Puerto Principe with a broad education, according to Rodriguez Ferrer. He was attributed all the merits of the success. Although he was the one who first talked about it before being published in the Memoirs of the Patriotic Society of Havana, he is nor recognized as the author of the. He also acknowledged having come across that information through Antonio de Agramonte.

[28] Francisco Antonio de Agramonte (?). Local resident of Puerto Principe who also praised the work of Rodriguez Ferrer. Those who usually think of him as having a less relevant role, though he was the one who first saw the remains.

[29] It was often attributed to Bernabe Mola, though in the paper there is no mention of his autghorship.

[30] Legacy No.8, 1833, file No. 1003, AMPIA, Camagüey.

The 1857-1868 period

By 1857, the actions of the Patriotic Society of Puerto Principe had achieved considerable results. One of the most outstanding members, Manuel de Monteverde claimed in 1856, that the Camagueyan branch "*...had the honor or fortune of anticipating all the other branches on the island in embracing the breakthroughs from advanced civilizations and intelligent industries."* [31]

However, in this area, there were contradictions between the locals and Havanan members, as the society's main office in Havana set compelling regulations in the provisions that governed the internal work of the local deputation, which in addition to the difficulties of the distance separating them and the limitations for communication. In light of that, the Camagueyans reacted with the liberal spirit that characterized them, and from 1850 on, they fought for an independent status from the Havanan Patriotic Society, which was finally accomplished in 1857 (Set et al., 1993).

Having their leadership, the Puerto Principe Economic Society Friends of the Country, like the ones in Havana and Santiago de Cuba, fostered culture. This study showed that during the time until the Ten-Year War, not only the main trends observed in the precedent period remained, but also, they became stronger. The evidence shows a connection to the science of farming, particularly, publishing.

The Economic Society Friends of the Country in Puerto Principe immediately created three commissions: Farming and Statistics, Trade and People's Industry, and History (Set et al., 1993). The analysis of their specific actions shows the many achievements of science and technology in that period.

The Farming and Statistics section was set to establish honorific and cash awards to people who stood out in planting, sowing, breeding, gathering, and circulation of products. Hence, in 1856, the Cattle and Crop Exhibitions were reinstated and then organized by the Board of the Casino Campestre. Upon the modification of their rules in 1863, Manuel Monteverde and Gabriel Fortun[32] were inspired by "... the principles of the science studied in the light of experience, the weather conditions, and the general needs of the country [...] due to the relative obsolescence of the theory and practice of the then first industry ..."[33].

Another task of Agriculture consisted of introducing new seeds, adapting plants, and making charts explaining the best procedures to make good of the land. In response to that call, several valuable scientific and technical publications appeared.

In 1856, Miguel Hinojosa Rodríguez[34] published a study about agriculture in the Fanal de Puerto Principe, entitled *Farming Miscellaneous;* Gregorio Pérez y Migueloa[35]published a booklet about horse breeding in Cuba, in 1860; Juan Arteaga Borrero[36] wrote several articles for the local papers about cattle raising, including a booklet entitled *Agricultural Studie on Cattle* (1864).

In this context, there was also a group of significant papers written by Manuel Monteverde y Bello, which were published in 1856 and 1864. The former was entitled *Practical Studies of the Economic Conditions of Livestock Production in the District of Puerto Principe* (1856), which contained a deep analysis of the local production methods through economic calculations, which demonstrated the cost of production was higher than the market price. In 1857, he published a series of articles under the heading *Letters on Flower Care by amateurs*, in Fanal de Puerto Principe, which dealt with practical gardening with an advanced approach for the time. However, the most relevant paper was the one entitled *Memoirs of the Fair and Exhibition of Cattle and Farming Products*, held in Puerto Principe on *1-13 September 1857*, which was published in 1858, and dealt with several novel aspects then that still have a remarkable practice, including criticism to monocropping[37].

[31] Monteverde, M. (1856). Letter from July 8th to the Royal Economic Society of Havana. Legacy No.14, No. 5, 1857, AMPIA, Camagüey.

[32] Gabriel Fortún (?), landowned from Puerto Principe. He had active engagement in the Patriotic Deputation of Puerto Principe, and the Casino Campestre Board. In both scenarios, he was a close collaborator of Manuel de Monteverde y Bello. Antonio Perpina, in his book about Camaguey, made a detailed description of one of his farms.

[33] Legacy No.5A, 1813. File No. 1390, AMPIA.

[34] Miguel Hinojosa Rodríguez (?). Born in Puerto Principe. Associated with the conspiracy against the colonial power surrounding the Masons congregated at Tinima No. 16.

[35] Gregorio Pérez y Migueloa (?). According to Trelles (1918), he was a senior military professor of veterinary.

[36] Juan Arteaga Borrero (1822-1866). Born in Puerto Principe, Medicine doctor, graduated in Paris.

[37] "... those engaged in sugar manufacturing, the ones who think that our situation is the most favorable and have nothing to envy; this is an item that requires enormous capital and the conditions of this industry are so poor that beet, sorghum, maple, and whatever can be used as sweetener, make it shake. the least commercial, political or financial crisis strikes it and compromise it so much that New Orleans, Brazil, Manila, Mauritius Island, the Hindustan, and others see it as the enemy and struggle to death in every market... when each inhabitant has a piece of bread, a potato, or banana, or a slice of cassava along with two eggs, a piece of meat or fruit every day, surely, because the countryside o changing crops, or hunting can provide, we will be truly richer than with our *2 000 000 boxes of sugar* (Monteverde, 1858, pp. 27-28).

Equally important were Montevere's recommendations to introduce different types of animals and plants for production, and to improve the already-existing breeds and varieties. Eight years before the development of genetics and 50 before it was consolidated as a science he suggested a method named "blood crossing", consisting of back-crossing, still used for these purposes[38].

In 1859, a publication entitled *Memoirs of Cattle Infection in Puerto Principe, 1857"*, deepened on the sanitary conditions that caused the epidemic and the related damages. Finally, in 1869, he published a booklet on cattle production.

The work of Manuel Monteverde has been studied in recent years, though emphasis has been placed on his biography (Méndez, 2017) and his contributions to natural sciences (Méndez & Puig, 1997; Méndez, 2008). However, his proposals to stimulate farming should be studied as well in the future, which only Funes (2011) has done partially. If his real contribution in this area is elucidated, there may be reasons to consider this author among the most important farming reformers in Cuba, possibly next to Ramon de la Sagra and the Count of Pozos Dulces[39].

The interest in publishing a yearbook containing the memoirs of the fairs on Casino Campestre corresponds to this period, it stimulated the ideas about local development in the exhibited items and areas. The Memoirs of the 1863 Fair was written by Ignacio Agramonte Sanchez[40] and Juan Arteaga, Borrero, which stood out for its detailed analysis. These sources are still undervalued by contemporary authors.

He suggested the creation of a section devoted to agriculture and established a chair of Botany or Practical Farming. This idea was materialized in 1864, with the foundation of the Implementation Institute of Puerto Principe, where he used to teach Natural Sciences and Agriculture. That institution, later called the Institute of Second Education (the highest level of education in the province), also hosted a museum of natural sciences, and there were departments of Physics and Chemistry.

The demands of the section for collecting news with statistics of the real and progressive richness of the country led to the publication of several memoirs, such as the one made available in 1865 by Gabriel Roman y Cermeno[41] about the status of the primary institution.

In turn, the Trade and People's Section set out to foster the arts and trades of all kinds, which was endorsed by a publication of Clodomiro Betancourt[42], in 1868, with the publication of a manual to produce sugar. Moreover, the efforts to search for and bring inventions and discoveries from other countries that could be efficiently used in our conditions and costumes explains the fact that by 1860 El Cercado sugar mill was erected, which belonged to Tomas Pio Betancourt, using the technology known as *tren derosne"*, the first one in all the territory (Robello, 1860).

The favorable results brought about by the Nuevitas railroad inspired others to build another track to the south coast. this project appeared in a booklet published by Miguel Rodriguez Ferrer, in 1861, who had already settled in Camaguey permanently[43].

Second stage: 1869-1898

In this second moment, the Ten-Year War erupted, which drastically changed the pace of development (slow and gradual) of science and technology in the territory. This period ended with the American intervention since the interest of the powerful northern neighbor to submit the island of Cuba to its interests was seen in all the society, and obviously, it also affected science and technology. Although the particularities of the intervention in Camaguey have not been fully studied, there is certainty that it represented a pivotal point that ended the former stage.

[38] "*...the method must link bulls and cows with the same blood grade, and start crossing 1/4 so there is a gradual progression from the least to the most, placing the quartered females with purebred bulls resulting in 5/8 offspring, then again until reaching 7/8, which would mean the the two breed merged into a third one with the advantages of the imported breed and the rusticity of the national breed"* (Monteverde, 1858, p. 20).

[39] Francisco Frías y Jacott, Count of Pozos Dulces (1809-1877). Cuban agronomer, researcher, scientific promoter, and reformer.

[40] Ignacio Agramonte y Sánchez-Pereira (1813-1896). Born in Puerto Principe. Father of Major-General Ignacio Agramonte Loynaz.

[41] Gabriel Román y Cermeño (1819-1899). A Spanish-born educator who used to teach at the Institute of Second Education in Puerto Principe.

[42] Clodomiro Betancourt (¿?). Master of sugar manufacturing from Camaguey, according to Trelles (1918).

[43] Santiesteban Freixas said that in 1888, Francisco Arguilagos Ginferrer "*... presented his project for the construction of the Puerto Principe-Santa Cruz del Sur railroad, and managed to get the donations to start works in Camaguey, following the design of engineer Jose Primelles Agramonte. The preliminary work on the terrain was supports by his elder sons* (*adolescents*) *who worked alongside. In those years, he was promoted to the post of managing director of the anonymous South Railroad company, with the economic support of the inhabitants and some authorities, for no retribution*" (2015, p. 47). Argilagos was one of Jose de la Luz y Caballero's pupil in El Salvador School, and graduated as an ophthalmologist in France. He invented the red-free light filter or aneritro, to better examine the bottom of the eye. Hes also held the position of secretary of the first Universal Ophthalmology Society, in 1861; a writer, historian, polyglot, a scholar of the culture and languages of Colombia and Haiti, and a Colonel in the Ten-Year War. For his courage, Maximo Gomez ordered him to fight by the side of Cespedes, Agramonte and Henry Reeve.

During that period also, Catalan Pio Religious Father Antonio Perpina made an extensive tour in the provinces of Camaguey and now Granma, in 1866. His annotations were published in 1889, which though not strictly scientific and featured images unrelated to Cuban nature (Cueto, 2015), had a special value for the detailed description made of the settlements, farms, sugar mills, forests, flora, fauna, coasts, ports, and rivers, along with the life of the inhabitants, their traditions and costumes (Caballero & Lapinet, 2010).

The scientific evidence found locally was more scarce than in the previous period, which was somehow understandable, as the new conditions did not favor science and technology or the conservation of testimonies that might have supported it. The relationship between the results and the efforts of the Economic Society Friends of the Country or any other similar entity was not so visible. On this occasion, the educational institutions took a more relevant role, maintaining the work of the local media actively (including the printing press) in the spreading of scientific content.

When the Ten-Year War broke out, many figures with active participation in previous periods took to the countryside, while others migrated. the ones that stayed in Puerto Principe suffered precarious conditions that threatened their efforts in science and technology. However, further studies should be conducted on the role of creation, replacements and technological innovation, and political and military education on the battlefields[44].

At the end of hostilities, the conditions were created for a gradual recovery of science and technology in Camaguey, though the previous level of results would never be seen again (especially between 1830 and 1840, and 1857 and 1868). The limited sources show that there were contributions in the diffusion of knowledge and scientific research and that within the latter, there were contributions in the cognitive-scientific area, as well as in technology transfer.

In the 1880s several contributions to knowledge were observed as well. The first news is from 1880 when Gabriel Roman y Cermeno published a farming and trading chart for primary education.

In 1881, Leopoldo Barrios Carrion published A Geographical and Military Outline of the Province of Puerto Principe, in Barcelona, which gathers the author's experience in the General Staff of the Army in Spain. He focused on the location between rivers Jatibonico and Los Negros (west), and Jobabo (east), currently part of provinces Ciego de Avila and Camaguey. Today, it is useful to reconstruct the environmental history of this part of the country, with a description of their coasts and basins, as well as testimonials about the growing deforestation at the time (Primelles & Méndez, 2018).

In 1882, the Institute of Second Education was opened, with the reinstatement of the Museum of Natural Sciences and the Departments of Physics and Chemistry. The former saw the active engagement of Dr. Biosca y Vinolas[45], who became relevant as a malacologist, increasing the zoological collections, and collaborating with other local personalities.

In 1882, he became the president of the Pia Schools, Father Francisco Clerch[46]. During his stay in Puerto Principe, he collected rock and mineral samples, which he later took to the Museum of Guanabacoa Pia School. Among the specimens from the island this scholar exhibited in the Exhibition of Barcelona, in 1888 (Bau, 1957), were some samples from Camaguey. From August 20th, 1884, he published the Fanal de Puerto Principe newspaper, for over half a year, containing articles about religion and science.

In the mid-1880s, Father Pio Galtes worked in the Pia Schools[47]. During his permanence in Cuba, he explored areas of bio-geographic interest and published the results of his research. Between March 1 and 5, 1886, the results of an expedition to Sierra de Cubitas were published in the magazine La

[44] The military deeds of Ignacio Agramonte must be studied as well. According to Ramon Roa, in the military camp under the command of Agramonte, "*... each team had a teacher, and* (...) *they learned Reading Moralitos, most of the times. Writing. Grammar. Arithmetic. English, and higher studies, namely, Anatomy. External pathology. Surgery, and others. lessons for practitioners. some of them became famous and stood out as if they were interns in a hospital or qualified physicians.* (...) *The efforts to master culture and progress was best observed in the first figure of the camp, who having gotten a book of 16º Military Tactic from Montecucculi, in English, showed up to take lessons from two of his officials until he learned to translated in six months, and got to learn the content by heart. He used to keep his little book on the side of his right boot, and if we were marching, at his sign of stop, he instinctively took it out..."* (Roa, 1974, pp. 370-372).

[45] Federico Biosca y Viñolas (¿?). Born in Barcelona, with a doctorate in Natural Sciences at the University of Havana. For many years, he was a professor of Natural Sciences at the Institute of Second Education, in Camaguey. He made a group that managed the construction and startup of the clinic known as Spanish Colony of Camaguey, currently the Eduardo Agramonte Pina Children's Hospital.

[46] Francisco de la Caridad Clerch (1829-1900). Born in Catalonia. Pia School father, a professor of natural sciences and a man of sciences, who was said to have a broad knowledge about science. He stood out in mineralogy and malacology, in which he devoted a great effort throughout his stay in Cuba. He lived in the country between 1857 and 1887, and in Camaguey, in the 1882-1885 period.

[47] Pío Galtés (1844-1911). Born in Catalonia. Geologist, anthropologist, religious. He lived in Cuba intermittently between 1873 abnd , most of his time as a rteacher and executive of the Pia Schools in Guanabacoa. He also worked in Camaguey in the 886-1887 period.

Enciclopedia. The topic had raised so much interest that it was again dealt with in a letter sent to the director of the magazine in 1887 before he returned to Barcelona.

His expedition to Sierra del Chorrillo in February 1887, was even more significant. He was then accompanied by Dr. Biosca Vinola. The significant collection of plant fossils from the site was sent to the Museum of Pia Schools in Guanabacoa and studied meticulously by the researcher himself. His results were published in La Enciclopedia during the same year, and the corresponding memoirs made him receive the Golden Medal of the Universal Exhibition of Barcelona, in 1888. Brother Leon (1929) commented on that work, saying that regardless of the empirical method used to determine the identity of the specimens, and for not using the scientific names of plants that are still alive today, it is the first contribution to the study of Cuban paleo-botany.

From July 8th, 1886, a new newspaper was edited in Camaguey: El Popular, about science, literature, general topics, and ads, directed by Francisco Aguero[48] and the active participation of Pompeyo Sariol[49]. In 27 of the 51 issues conserved today, the articles deal with several aspects of science and technology (Figaredo, 2002)[50], related to philosophy, sociology, geology, agriculture, chemistry, education, astronomy, aesthetics, economy, politics, and so on. The objectives of the publication were well defined in the first issue: *"TO raise the public spirit is one of the most plausible and commendable services rendered by the press in any country, by instructing the masses, patenting the benefits by the implementation of practical ideas, and if the society whom the paper is intended to be completely deteriorated, as ours, then developing this society is an indispensable work so that the public spirit grows on solid grounds that provide rational hopes for the future."*[51]

The interest of the Cuban media to publish scientific information was also evidenced in the 1890s, when the newspaper El Pueblo published the weather forecast daily, which was given by Florentino Romero[52], a local scholar who, among other things, studied the weather.

In terms of technology transfer, further studies need to be conducted. In 1889, a highly relevant technology was introduced for the benefit of science and citizen life: electricity. By 1890 there was an ice work in the city. During that period, sugar manufacturing saw the separation of agriculture and industry. The former was substituted by plantations (slave work) by the colony (using paid laborers), and the latter, the sugar mill replaced the factory. Further works should tackle the particularities of this process in Camaguey.

The war broke out again in 1895 and interrupted the increasing progress of science and technology. Again, an important part of these efforts was moved to the battlefield, particularly technological innovation for survival, resistance, and make progress with the libertarian ideals.

In the late Nineteenth Century, the Economic Society Friends of the Country in Puerto Principe had disappeared. With it, an important part of science and technology advancement had ended in Camaguey. Though the then results were not so relevant internationally, they were significant considering the conditions and the diversity of examples. Even when there were no scientific institutions, professional researchers, or effective research support, Camagueyans managed to study the natural sciences, technical sciences, agriculture, medicine, society, and humanities as far as they could. They were able to innovate and create their institutions to stimulate this activity, generating a movement for the spreading of scientific knowledge that significantly impacted the advances observed in the local culture.

Conclusions

This study found that a lot of evidence was found in the current province of Camaguey, taking place in the Nineteenth Century.

This activity was not so significant because it was developed in a small city that was relatively isolated in a Spanish colony, where the conditions were largely adverse for science and innovation.

Science was conducted by a reduced number of local figures or individuals temporarily settled in the community, who thanks to their wealth, could acquire solid academic education and engage in this area out of their personal and spontaneous motivations,

[48] Francisco Agüero (?). Camagueyan poet and journalist. He belonged to the Santa Cecilia Popular Society of Recreation. He was also the director of the Aguinaldo Cubano (1848), and ElPopular (1866). He joined the efforts of the Ten-Year War, and practiced journalism from the countryside camps.

[49] Pompeyo Sariol Silva (1842-1886). He was in charge of the scientific side of El Popular.

[50] According to Figaredo (2002), the scientific articles published in El Popular in 1886 were, *Lo maravilloso* (3 parts); *Protejamos la industria* (3 parts); *Aguas pluviales*; *La infancia de la Tierra*; *Conferencia científica*; *Los pequeños cultivos*; *A los artesanos de Camagüey*; *Análisis espectral* (4 parts); *Del progreso*; *Despertemos*; *Educación* (2 papers); *Origen del sistema solar*; *Manchas del sol*; *Valor de la creación*, *El planeta Marte*; *Estética* (2 parts); *Inteligencia y saber*; *El capital*, and *El trabajo*.

[51] El Popular 1866, No, 4, 22 July.

[52] Florentino Romero y Delgado (?). An educator who used to teach at the Institute of Second Education in Puerto Principe. He also published books about trigonometry.

sporadically, usually encouraged by their foreign scientific acquaintances. There were no records of scientific institutions or professional researchers, as well as no effective support for research.

The study distinguished two stages in science and innovation in the province. One stage was between 1813 and 1868, which, in turn, covered two periods (1813-1856, and 1857-1868), which was characterized by the efforts of the Economic Society Friends of the Country and a publication of knowledge, particularly in the 1830s and 1840s. The second stage (1869-1898), witnessed a much lower scientific level because the two independence war scenarios did not favor this trend or the preservation of evidence.

Author contribution statement

Isidro E. Mendez Santos: research planning, bibliographic review, redaction of the manuscript, final review of the manuscript.

Francisco Figaredo Curiel: research planning, bibliographic review, redaction of the manuscript, final review of the manuscript.

Conflict of interest statement

The authors state there are no conflicts of interest whatsoever.

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