Islands of Knowledge

Science and Agriculture in the History of Latin America and the Caribbean

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ABSTRACT

This essay explores the participation of Latin America and the Caribbean in the construction and circulation of tropical agricultural science during the nineteenth century and the first half of the twentieth century. It uses the term "islands of knowledge" to underscore the idea that each producing region across the global tropics, including Latin America and the Caribbean, was instrumental in the creation, adoption, and application of scientific procedures. At the same time, it emphasizes the value of interchange and interconnection between these regions, as well as the many and heterogeneous local areas, for analyzing what it calls "global archipelago agricultural scientific knowledge." This focus challenges the traditional center/periphery hierarchy and opens it to a wider vision of science and practice in agriculture. This essay shows how writing in related areas of research—specifically, commodity histories, biological exchange studies, and knowledge exchange studies—introduces approaches and case studies that are useful for the history of tropical agricultural science. In particular, this work provides analytical frameworks for developing studies of exchanges across the Global South.

IN RECENT DECADES, historians have started to explore the connections between science and agriculture in Latin America and the Caribbean in the context of imperial expansion and the consolidation of liberal nation-states.[1] It could not be otherwise, when

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[1] In this region, "liberal" generally refers to the nation-states of Latin America during the period from independence up to, roughly, the 1930s. See Victor Bulmer-Thomas, *The Economic History of Latin America since Independence* (New York: Cambridge Univ. Press, 1993); and Stuart McCook, *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760–1940* (Austin: Univ. Texas Press, 2002), esp. pp. 1–10, 20–25.

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we consider that the region's agricultural exports—coffee, cacao, rubber, sugar, and countless others—were key to European expansion and to the development of capitalism as a world system. In a historiography that has been marked by the center/periphery debate, it is important to go beyond terms such as "colonial science," "colonial science in a national context," and "imperial science."[2] One avenue of inquiry is the participation of Latin America and the Caribbean in the process of creating and disseminating scientific agricultural knowledge that transcends the borders between the center and the periphery and between empires and (ex-) colonies. Such work departs instead from the intersection between the global and the local in a given space.

For these purposes, the methodology that I propose involves identifying a group of practices and problems common to scientific agriculture that can illustrate the value of local contexts and, at the same time, of the multiple exchanges among the many different knowledge networks across Latin America and the globe. All areas of production—including those found in Latin America and the Caribbean—have acted as "islands of knowledge." Each "island" (whether literal or metaphorical) has been engaged in creating, adopting, and applying scientific procedures in which "traditional" and "modern" practices are merged. Thanks to the breadth and diversity of connections across these islands, they constituted what could be called a "global archipelago of scientific knowledge."

These connections expanded and deepened during the nineteenth and twentieth centuries, when world production and trade of tropical staples was expanding. This expansion of tropical commodity production required the introduction and adoption of new scientific and agricultural knowledge so that producers could compete on world markets—and also to help them face common problems related to the concomitant pressures on ecosystems (soil erosion, agricultural epidemics, etc.). This tropical commodity boom of the long nineteenth century also made it possible for all of these areas that produced tropical agricultural commodities to become places where knowledge was created, disseminated, and exchanged across the Global South. This history is gradually emerging in the historiography of the agricultural science of the region. Some elements related to this are found in the literature about tropical agriculture in the era that coincides with the consolidation and decline of the agricultural export model of Latin America and the Caribbean in the nineteenth and twentieth centuries, which has garnered considerable attention from historians working in areas related to the history of science.

In what follows, I would particularly like to enter into a dialogue with historical writing in three related areas: commodity histories, biological exchange studies, and knowledge exchange studies. These methodologies introduce elements, agents, and connections that are generally useful to the history of agricultural science, and they offer frameworks of analysis that can be useful for larger comparative studies. Nevertheless, their main goal is not to analyze the production and dissemination of knowledge pertaining to the agricultural science of Latin America and the Caribbean on its distinct global, regional, and local levels. Similarly, they fail to examine the interactions with other sources of knowledge that are essential for constructing a science of tropical agriculture.

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[2] An excellent analysis of the state of the study of science and imperialism and current debates is found in Camilo Quintero Toro, "En qué anda la historia de la ciencia y el imperialismo? Saberes locales, dinámicas coloniales y el papel de los Estados Unidos en la ciencia del siglo XX," *Historia Crítica*, 2006, *31*:151–172.

The emergent field of commodity history offers analytical tools and useful concepts, as well as case studies that can identify common agro-industrial problems and agents for a history of the participation of Latin America and the Caribbean in creating and spreading tropical agricultural science. The importance of the methodological perspective of commodity histories is that they consider tropical agricultural products (sugar, coffee, cocoa, etc.) as the main factors in socioeconomic, political, and cultural processes. From this point of view, these works privilege the complex sociocultural relationships generated in the course of the life histories of the commodities, from production to sale on the world market.[3] This therefore allows the many aspects that are involved in their distribution to be taken into consideration. This focus also underlines the idea that the Latin American and Caribbean region was not simply a recipient of agricultural and industrial knowledge in the diverse contexts of the expansion of empires and world capitalism and throughout the consolidation and decline of the agro-export model.[4]

Particularly useful are studies gathered under the heading "commodities of empire," a concept that documents the distribution networks for tropical commodities at different levels between empires and colonies and their impact on both sides of the Atlantic.[5] These analyses focus on local processes in the colonial world and their influence on the development of the world economy. They use a comparative approach, which above all examines the experience of the people subordinated by different imperial hegemonies.

Commodity histories offer insight into the agents who spread agricultural knowledge across the tropics and the networks in which they traveled. For Cuba, these studies highlight, among other topics, the group of engineers and specialists who were hired by landowners to modernize sugar production on the island in the mid-nineteenth century.[6] These engineers, most of whom came to the Antilles from the industrial centers of England, the United States, and France, brought their knowledge and experience in installing and supervising steam machinery, the flagship of the Industrial Revolution. These "indispensable aliens" propagated a type of technical knowledge that was imported at the behest of local elite landowners, whose strategy for industrializing the sugar industry was key to catapulting Cuba into first place in world production of the sweetener. These agents became channels for spreading "scientific" knowledge within the framework of global processes like industrialization and migration in colonial regions.

At the same time, their knowledge was not diffused in a simple, linear way. The engineers interacted with the many other local agents engaged in sugar production. They

[3] Sidney Mintz, *Sweetness and Power: The Place of Sugar in Modern History* (New York: Viking, 1985); Jean Stubbs, *Tobacco on the Periphery: A Case Study in Cuban Labour History, 1860–1958* (Cambridge: Cambridge Univ. Press, 1985); Steven C. Topik and Allen Wells, *The Second Conquest of Latin America: Coffee, Henequen, and Oil during the Export Boom, 1850–1930* (Austin: Univ. Texas Press, 1998); William G. Clarence Smith, *Cocoa and Chocolate, 1765–1914* (London: Routledge, 2000); Arnold J. Bauer, *Goods, Power, History: Latin America's Material Culture* (Cambridge: Cambridge Univ. Press, 2001); and Topik, Carlos Marichal, and Zephyr Frank, *From Silver to Cocaine: Latin American Commodity Chains and the Building of the World Economy, 1500–2000* (Durham, N.C./London: Duke Univ. Press, 2006).

[4] In approaching the region, studies inspired by the work of anthropologists are particularly fruitful; see esp. Arjun Appadurai, ed., *The Social Life of Things: Commodities in Cultural Perspective* (Cambridge: Cambridge Univ. Press, 1986). For the case of Latin America see Camilo Quintero Toro, "Entendiendo los objetos y las mercancías en perspectiva histórica," *Hist. Crít.*, May–Aug. 2009, *38*:14–19; and Quintero Toro, "Objetos y mercancías en la historia (II)," *ibid.*, Sept.–Dec. 2009, 39:9–10.

[5] Sandip Hazareesingh and Jonathan Curry-Machado, "Editorial: Commodities, Empires, and Global History," *Journal of Global History*, 2009, *4*:1–5.

[6] Jonathan Curry-Machado, *Cuban Sugar Industry: Transnational Networks and Engineering Migrants in Mid-Nineteenth-Century Cuba* (London: Palgrave Macmillan, 2011).

taught some industrial skills to the slaves, for example. They had a more contentious relationship with the sugar masters, the people traditionally in charge of directing the process of sugar manufacture in Cuba. Though in principle the specialized "modern" knowledge of the engineers was meant to complement and coexist with that of the local sugar masters, the process of integration was not always smooth. In 1900, for example, the local sugar-related press on the island covered the tensions between the former sugar masters and these engineers. The construction and dissemination of knowledge must be analyzed as a process of learning and negotiation, in which many actors became involved—actors both institutional and private, with differing levels of training, motivations, expectations, research agendas, career opportunities, and financial resources. The "intervention" of applied science in Cuban sugar cultivation was the response of landowners, agronomists, naturalists, scientists, and colonists to the problems arising from competition from producers of beet sugar, industrial restructuring, the abolition of slavery, and the low agricultural yields seen at the end of the nineteenth century. The local elites, the engineers, the sugar masters, and the slaves were all part of the cadre of agents who contributed to the industrial knowledge that made it possible for Cuba to become the world leader in sugar production in the nineteenth century.[7]

Similarly, scientists could also be agents for the diffusion of knowledge. The experience of the American mycologist and agronomist Franklin S. Earle is another example of the interaction of bodies of knowledge during Cuba's transition from the Spanish to the American empire and, later, to a republic. Earle was the first director of the Central Agronomic Station of Cuba. He and his team of American scientists were the "indispensable aliens" in the introduction of plant-breeding techniques into the country, as well as in instituting studies on diseases and pests of tropical crops. Nevertheless, their knowledge also built on the experience and expertise of local botanists and agronomists educated at the Escuela de Agricultura del Círculo de Hacendados (Landowners' Association Agricultural School) between 1878 and 1891; this demonstrates the prior roles of local landowners, agronomists, and scientists in launching their own research agenda.[8]

Agricultural knowledge could also be diffused across the global tropics. Following the history of sugar on the local and the global levels, some historians compare two successful areas of production: Cuba and the Dutch colony of Java (also a major producer of sugar and a center for innovation in sugar science and cultivation). These historians explore the strategies employed regarding work, capital, and technology. Growers and scientists on the two island colonies regularly shared knowledge about sugar cultivation. For example, Dutch sugar growers in Java introduced and adapted a sugar cultivation system developed by the Cuban agronomist Álvaro Reynoso in Cuba.[9] This case of the remote application of a system of cultivation shows the transfer of knowledge created in one producing region to another such region, where it was adopted as a method for competing in the world market. For the history of agricultural science, it is necessary to explore what means made this possible and how these bodies of knowledge interacted with those that already existed on Java.

In general, commodity histories tend to privilege social relations over ecological

[7] Leida Fernández Prieto, *Cuba agrícola: Mito y tradición, 1878–1920* (Madrid: CSIC, 2005).

[8] Leida Fernández Prieto, *Espacio de poder, ciencia y agricultura: El Circulo de Hacendados de la isla de Cuba, 1878–1917* (Sevilla/Madrid: Diputación de Sevilla/CSIC, 2008).

[9] Ulbe Bosma and Jonathan Curry-Machado, "Two Islands, One Commodity: Cuba, Java, and the Global Sugar Trade," *New West Indian Guide*, 2012, *86*(3–4):237–262; and Álvaro Reynoso, *Ensayo sobre el cultivo de la caña de azúcar* (Havana: Imprenta del Tiempo, 1862).

relations, although the homogenization of agricultural systems during the Latin American agro-export boom produced severe environmental consequences (deforestation, soil exhaustion, etc.).[10] These new agricultural and environmental challenges required that new scientific knowledge be developed.[11] Applied chemistry and botany were implemented for the benefit of agriculture in Latin America and the Caribbean by authorities, local elites, farmers, company agents, naturalists, and agronomists. This happened in several ways: through experiments with a range of organic and chemical fertilizers by landowners on their plantations; through the creation of private and state institutions (botanical gardens, agriculture schools, experimental stations); and through hiring scientists at transnational corporations such as the United Fruit Company. Scientists were not the only ones to innovate: members of the rural workforce also responded to environmental changes that affected the sugar industry and to the application of scientific procedures, which suggests approaches for future research centered on the labor market, beyond slavery.[12] The new agro-environmental problems revealed the interchanges of microorganisms and pests around the tropics. These diseases were also an important factor in the creation and dissemination of local bodies of knowledge that made up the overall knowledge of scientific tropical agriculture.

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Biological exchange studies have generally placed particular emphasis on explaining how the transfer of plants, animals, pathogens, humans, and artifacts between empires and (ex-) colonies took place.[13] In the last few decades, a focus of study has been the way that the homogenization and reconfiguration of ecosystems created the environmental conditions that favored the spread of microorganisms.[14] Nonetheless, the microorganisms' impact on the production and transfer of scientific knowledge on different scales (global, regional, local) still needs to be studied. The control and eradication of agricultural pests were key factors in creating local knowledge that reached beyond national borders and became part of global scientific agricultural knowledge. More generally, during the long nineteenth century the Greater Caribbean was experiencing the "neo-Columbian exchange," involv-

[10] David Watts, *The West Indies: Patterns of Development, Culture, and Environmental Change since 1492* (Cambridge: Cambridge Univ. Press, 1987); Richard P. Tucker, *Insatiable Appetite: The United States and the Ecological Degradation of the Tropical World* (Berkeley: Univ. California Press, 2000); and Reinaldo Funes Monzote, *From Rainforest to Cane Field in Cuba: An Environmental History since 1492*, trans. Alex Martin (Chapel Hill: Univ. North Carolina Press, 2008).

[11] Christian Brannstrom and Stefania Gallini, eds., *Territories, Commodities, and Knowledges: Latin American Environmental History in the Nineteenth and Twentieth Centuries* (London: Univ. London, Institute of Latin American Studies, 2004); and Gallini, "Historia, ambiente, política: El camino de la historia ambiental en América Latina," *Nómada*, 2009, no. 30, pp. 83–94.

[12] Thomas D. Rogers, *The Deepest Wounds: A Labor and Environmental History of Sugar in Northeast Brazil* (Chapel Hill: Univ. North Carolina Press, 2010).

[13] Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900–1900* (Cambridge: Cambridge Univ. Press, 1986); Crosby, *The Colombian Exchange: Biological and Cultural Consequences of 1492* (Durham, N.C.: Duke Univ. Press, 2003); William McNeill, *Plagues and Peoples* (Garden City, N.Y.: Doubleday, 1976); J. H. Drake *et al.*, eds., *Biological Invasions: A Global Perspective* (Chichester: Wiley, 1989); Noble David Cook, *Born to Die: Disease and New World Conquest, 1492–1650* (Cambridge: Cambridge Univ. Press, 1998); Philip Curtin, "Disease Exchange across the Tropical Atlantic," *History and Philosophy of the Life Sciences*, 1993, *15*:169–196; Jared Diamond, *Guns, Germs, and Steel: The Fates of Human Societies* (New York: Norton, 1997); and Diamond, *Collapse: How Societies Choose to Fail or Succeed* (New York: Penguin, 2011).

[14] John McNeill, "Biological Exchange and Biological Invasion in World History," in *Making Sense of Global History*, ed. Solvi Sogner (Oslo: Universititsforlaget, 2001), pp. 106–119; and McNeill, "Biological Exchanges in World History," in *The Oxford Handbook of World History*, ed. Jerry H. Bentley (Oxford: Oxford Univ. Press, 2011), pp. 325–342.

ing not only the accidental exchanges of diseases and pests but also an intensification of the deliberate movement of plants, animals, people, and knowledge.[15]

The intensification of commodity production systems in different ecological environments favors the rise of commodity diseases. This is a useful concept, developed by John Soluri, that integrates the relationships created by biological, social, political, and economic processes that operate on different scales. Work in this vein shows the close connection between Europe, the United States, and Latin America during the time when the agro-export model was being consolidated. In this context, Stuart McCook coined the term "liberal epidemics" to describe the appearance of commodity diseases throughout Latin America and the Caribbean as a consequence of the liberal development strategies of governments and local elites.[16] Both the notion of commodity diseases and that of liberal epidemics highlight aspects common to agriculture across the global tropics, not just in Latin America and the Caribbean. There are opportunities here for comparative analyses focusing on the actions of those responsible for the appearance of pests and diseases, which are themselves drivers of the creation and dissemination of new knowledge.

For example, a disease on coconut plantations originally arose in Cuba and Jamaica in the mid-nineteenth century and continued into the early twentieth century. The disease soon became a pandemic throughout the Caribbean, causing serious economic damage. It was the first agricultural epidemic studied at the Real Academia de Ciencias de La Habana (Royal Science Academy of Havana) by scientists, agronomists, and naturalists, both Spanish and Cuban.[17] Later, this disease was also analyzed by American scientists and agronomists. The study of this coconut disease illustrates the involvement of multiple agents, private and institutional.

Above all, these diseases revealed that some knowledge could *not* circulate globally, at least not from temperate regions to the tropics. Naturalists, botanists, agronomists, and scientists found that the models developed by their European colleagues to combat crop epidemics in temperate regions were not appropriate for the tropics. Moreover, the study of these tropical epidemics could neither be moved to nor replicated in research centers in France, England, or the United States. Instead, these naturalists had to create local codes of action to combat diseases and pests of tropical crops. All of these debates reveal the importance of the tropical space for documenting, experimenting on, and obtaining effective models and solutions to eradicate crop diseases. This work became part of the body of knowledge created about tropical agricultural pests and diseases over time—including under Spanish dominion, a phase that is frequently neglected in the study of science.

[15] Stuart McCook, "The Neo-Columbian Exchange: The Second Conquest of the Greater Caribbean, 1720–1930," *Latin American Research Review*, 2011, *46*(suppl.):11–31, esp. pp. 21–22. This is excellent work that points toward future research on each of the topics mentioned by the author. It also makes an important distinction between the existing definitions of the term "Caribbean basin" in Latin American and Anglo Saxon studies.

[16] John Soluri, "Something Fishy: Chile's Blue Revolution, Commodity Diseases, and the Problem of Sustainability," *Latin Amer. Res. Rev.*, 2011, *46*(suppl.):55–81; McCook, *States of Nature* (cit. n. 1); and Stuart McCook, "Las epidemias liberales: Agricultura, ambiente y globalización en Ecuador (1790–1930)," in *Estudios sobre historia y ambiente en América*, Vol. 2: *Norteamérica, Sudamérica y el Pacífico*, ed. Bernardo García Martínez and María del Rosario Prieto (Mexico: Colegio de México, Instituto Panamericano de Geografía e Historia, 2002).

[17] Leida Fernández Prieto, "Plagas, enfermedades y saberes agrícolas en el Caribe, un estudio de caso," *Arbor: Ciencia, Pensamiento y Cultura*, 2011, *187*(750):793–802; and Pedro M. Pruna, *La Real Academia de Ciencias de La Habana 1861–1898* (Madrid: CSIC, 2002).

At the same time, knowledge *could* be shared within and across the tropics. An analysis of the coconut disease in the Caribbean region, the area most affected today, allows the illustration of biological exchanges on an intraregional scale, although these were not unique. The Caribbean, although it has traits that are particular to tropical latitudes, became part of the homogenization of ecosystems that favored the rise of epidemics in Western Europe and other parts of the world.

Thus, I believe that another challenge is to study the creation and exchange of local knowledge in a comparative fashion, especially in regard to the way the control and eradication of epidemics highlights the existence of the many centers of knowledge that made up global agricultural knowledge. It is well known, for example, that the potato disease of 1845 was the beginning of plant pathology. In parallel, in 1840, the sugarcane disease arose on the French Reunion Islands and the British island of Bourbon; it would later affect the sugar plantations of the Caribbean. On the one hand, this sugarcane disease illustrates the transit of diseases through the sugar-producing tropical regions of the world; on the other hand, its presence in the sugar plantations of the Spanish colony of Puerto Rico in the 1870s prompted landowners, agronomists, and authorities to seek effective strategies for its control and elimination, as also happened in Cuba with the coconut disease. Nonetheless, this case also shows that exchanging sugar varietals—a practice that was common among producers—was prioritized over the eradication of the disease. Similarly, it brings to light the interregional exchanges through different means (private and institutional) that sought new varieties in Martinique, Cuba, and elsewhere and were accomplished through the routes of the empire.[18]

Studies of biological exchanges also highlight the range of agents involved in transmitting the knowledge that went with the crops. For example, slaves were the agents for transmitting botanical knowledge that was anchored in traditional African practices and for distributing these practices through the new agricultural spaces of the Americas and the Caribbean.[19] Slaves carried with them the knowledge system for cultivating rice, both for the subsistence agriculture that they engaged in on their own small plots and for production on the largest plantations in the south of the United States, in Latin America, and in the Caribbean.

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For Latin American and Caribbean historians of science, studies of the production and dissemination of agricultural knowledge constitute a useful way to situate the region within current debates on global history. The examples chosen here show the existence of multiple "islands of knowledge" and the many exchanges that took place, on different scales, during the boom and decline of the agro-export model. I also note that in studying the creation of knowledge it is necessary to consider not only indigenous knowledge, but also that of other "local" agents who are less known for Latin America and the Caribbean. Traditionally, many studies of science and imperialism begin from the diffusionist thesis proposed by George Basalla, who insisted that occidental Europe was the center of the

[18] Humberto García Muñiz, "Interregional Transfer of Biological Technology in the Caribbean: The Impact of Barbados' John R. Bovell's Cane Research in the Puerto Rican Sugar Industry, 1888–1920s," *Revista Mexicana del Caribe*, 1997, 2(3):6–42.

[19] Judith A. Carney, *Black Rice: The African Origins of Rice Cultivation in the Americas* (Cambridge, Mass.: Harvard Univ. Press, 2001); and Carney and Richard Nicholas Rosomoff, *In the Shadow of Slavery: Africa's Botanical Legacy in the Atlantic World* (Berkeley: Univ. California Press, 2009).

creation and spread of modern science. In recent times, quite a few studies have begun to demystify this paradigm, exploring the construction and exchange of knowledge beyond the centers and their peripheries.[20]

Some studies, for example, highlight the influence of the British policy to the effect that the empire's Caribbean colonies should participate in creating and disseminating agricultural science on sugar.[21] The sugarcane mosaic virus is well known among researchers who analyze the contribution of the so-called new botany to the discovery and development of sugarcane hybrids and their importance in the recovery of the Caribbean sugarcane industry in the early twentieth century. Barbados (and particularly its botanical garden) was an "island center" for knowledge production and an axis for knowledge dissemination throughout the Caribbean during the scientific agricultural revolution of the end of the nineteenth century and the beginning of the twentieth century. The transfer of biological technology reflected the links between American and British sugar circuits in the Caribbean through the spread of hybrids from Barbados and the contracting of expert personnel by American companies seeking to save the Puerto Rican industry.[22]

At the same time, governments and farmers were concerned with controlling certain kinds of exchange, particularly to avoid the propagation of crop diseases. As with the disease that affected the sugar plantations of Puerto Rico at the end of the nineteenth century, the case of the sugarcane mosaic virus, which arose in the Caribbean in the beginning of the twentieth century, demonstrates how widely and how quickly diseases spread through the tropics. From the perspective of the Spanish Caribbean, in particular Cuba and Puerto Rico, the circulation of hybrid cultivars between Java and America contributed to propagating the disease more quickly.[23] Farmers responded to the introduction of new cultivars in accordance with their traditional practices and local conditions. Puerto Rico, for example, was relatively open to the introduction of hybrids because, among other reasons, farmers there had continued to cultivate the Otahiti variety of sugarcane, which was deeply affected by the disease. In Cuba, on the other hand, there were pockets of resistance to the spread of hybrids among sugar farmers who defended the continued cultivation of the Cristalina varietal, which was both resistant to the mosaic virus and better adapted to the exhausted Cuban soil. This variety had itself come from

[20] George Basalla, "The Spread of Western Science," *Science*, 1967, *156*(3775):611–622. For some of the work that demystifies Basalla's paradigm see Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Milton Keynes: Open Univ. Press, 1987); Donna Haraway, "Situated Knowledge: The Science Question in Feminism as a Site of Discourse on the Privilege of Partial Perspective," *Feminist Studies*, 1988, *14*:575–599; Adi Ophir and Steven Shapin, "The Place of Knowledge: A Methodological Survey," *Science in Context*, 1991, *4*:3–21; David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago: Univ. Chicago Press, 2003); James A. Secord, "Knowledge in Transit," *Isis*, 2004, *95*:654–672; Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Chicago: Univ. Chicago Press, 2005); and Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (Basingstoke: Palgrave Macmillan, 2007).

[21] Lucile H. Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Garden* (New York: Academic, 1979); Richard H. Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens, and the Origins of Environmentalism* (Cambridge: Cambridge Univ. Press, 1995); William Kelleher Storey, *Science and Power in Colonial Mauritius* (Rochester, N.Y.: Univ. Rochester Press, 1997); and Richard Drayton, *Nature's Government: Science, Imperial Britain, and the "Improvement" of the World* (New Haven, Conn.: Yale Univ. Press, 2000).

[22] J. H. Galloway, "Botany in the Service of Empire: The Barbados Cane-Breeding Program and the Revival of the Caribbean Sugar Industry, 1880s–1930," *Annals of the Association of American Geographers*, 1996, *86*:682–706; and García Muñiz, "Interregional Transfer of Biological Technology in the Caribbean" (cit. n. 18).

[23] McCook, *States of Nature* (cit. n. 1).

Java—just as did the hybrid POJ 2878, which would eventually replace Cristalina in the 1920s.

In the same way, this disease enables us to document the broad connections between the sugar circuits on different scales—local, regional, and global. From this perspective, focusing on the spread of more productive varietals and hybrids that were disease and pest resistant has also permitted exploration of the importance of scientific institutionalization and the role of networks of scientists, botanists, and agronomists in global knowledge exchanges.[24] In particular, studies on the virus and the introduction and spread of sugarcane hybrids show that many "islands of knowledge" existed (Java, Barbados, and Santa Cruz were some of these). American scientists traveled around the network of tropical stations in the area that were devoted to the study of crop diseases. This was the case with Earle, who worked in Puerto Rico and Cuba and proposed that the Uba variety of sugarcane, which was resistant to the mosaic virus, be introduced. Similarly, there were exchanges between Latin American and Caribbean scientists and agronomists, such as the Puerto Rican agronomist Carlos E. Chardon, who traveled to Cuba to share his knowledge and experience with sugarcane disease. For Puerto Rico, the struggle to deal with the mosaic disease was an opportunity for the consolidation of scientific agriculture, and so Puerto Rico became a model for agricultural science in the Spanish Caribbean.

The construction of "local" knowledge developed in a global context has not been much studied for the region, where work has been more focused on the contribution of "indigenous knowledge" to the construction of science.[25] In other words, there are other types of local knowledge, produced by nonindigenous farmers, planters, and scientists who were key for the agricultural science of the region. The Cuban agronomist Francisco B. Cruz, for example, was trained in Cuba before 1898 and served as the interim director for the Estación Experimental Agronómica de Santiago de las Vegas around the mid-twentieth century. Cruz never left the island, but he was nevertheless a figure who illustrated scientific connections, along various information pathways, at different local and global levels. Other socioeconomic agents organized their own scientific institutions to launch their research agendas, such as the aforementioned Escuela de Agricultura del Círculo de Hacendados. The knowledge that arose in other producing regions was also imported and adapted; consider the French government employee and refugee Pierre Laborie, who escaped to Jamaica after the Haitian revolution; there he wrote the foundational treatise on coffee cultivation, *The Coffee Planter of Santo Domingo*. This treatise was translated, adopted, and adapted as a model for other coffee-producing regions of the Caribbean. Caribbean coffee planters later introduced Laborie's model of coffee cultivation to Ceylon and southern India. The landowners of Puerto Rico were another example; they introduced and adapted several different sugar production models and technologies from other islands in the Caribbean.[26]

[24] Stuart McCook, "'The World Was My Garden': Tropical Botany and Cosmopolitanism in American Science, 1898–1935," in *Colonial Crucible: Empire in the Making of the Modern American State*, ed. Alfred W. McCoy and Francisco A. Scarano (Madison: Univ. Wisconsin Press, 2009), pp. 499–507.

[25] Diana Obregón, ed., *Culturas científicas y saberes locales: Asimilación, hibridación y resistencia* (Bogotá: Univ. Nacional Colombia, 2000).

[26] Leida Fernández Prieto, "Francisco B. Cruz: De la 'agricultura pródiga' a la revolución varietal azucarera en Cuba, 1878–1930," *Historia Ambiental de la América Latina y el Caribe (HALAC)*, 2013, *2*:244–266; Rafael Marquese, "Ilustração luso-brasileira e a circulação dos saberes escravistas caribenhos: A montagem da cafeicultura brasileira em perspectiva comparada," *História, Ciências, Saúde*, 2009, *16*:855–880; and Lizette Cabrera Salcedo, *De los bueyes al vapor: Caminos de la tecnología del azúcar en Puerto Rico y el Caribe* (Puerto Rico: Editorial Univ. Puerto Rico, 2010).

A quick look at work on the history of scientific knowledge in Latin America shows a continued emphasis on questions of power and politics.[27] Other scholars pay particular attention to agricultural institutionalization, but still within the focus of science and imperialism or colonial and national science. For the region, the role of the United States is a classic focus, especially the role of the Rockefeller Foundation in the spread of science and hybrids.[28] However, more emphasis must be given to studies on the institutionalization developed by other socioeconomic agents in their respective communities. The history of agricultural science in Latin America and the Caribbean is more than simply the history of colonialism and imperialism.

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I would like to conclude by reflecting on the idea of decentering science, beginning by conceiving of the existence of the many knowledge centers and the value of exchange. In this direction, analyzing the reciprocal exchange between productive spaces makes it clear that everyone benefits from some knowledge or procedure, whether or not it is applied on the island that produced it. For example, the Indonesian island of Java benefited from the doctrines of Álvaro Reynoso, and Cuba benefited from the use of varietals and hybrids developed in Java.

There is another example that illustrates what I want to say about the importance of exchange, beginning with Reynoso himself. In 1862, this Cuban agronomist wrote that the group of practices followed by farmers was known on the island as the "Louisiana system of cultivation"; he believed, however, that it should be spoken of as the "British or French system of cultivation," because it was initially used on the island colonies of those nations.[29] Thus the spread of innovations and applications adapted to each local context blurred the origin of the practices. This makes it possible for us to reconsider the importance of the multiple centers and the way they interacted, and of the many heterogeneous local spaces, in analyzing the global archipelago of scientific agricultural knowledge, breaking down the center/periphery hierarchy to illuminate a more open road for science and its practices.

[27] Stefan Pohl and Matiana González Silva, "La circulación del conocimiento y las redes del poder," *Memoria y Sociedad*, 2009, *13*(27):7–11.

[28] Deborah Fitzgerald, "Exporting American Agriculture: The Rockefeller Foundation in Mexico, 1945–1953," in *Missionaries of Science: The Rockefeller Foundation and Latin America*, ed. Marcos Cueto (Bloomington/Indianapolis: Indiana Univ. Press, 1994), pp. 99–125; Cueto and Jorge Cañizares-Esguerra, "Latin America," in *An Introduction to the History of Science in Non-Western Traditions*, ed. Robert DeKosky and Douglas Allchin (Seattle: History of Science Society, 1999), pp. 46–92; María Teresa Cortés Zavala, "Las Estaciones Agronómicas: Un modelo de desarrollo agrícola para Puerto Rico, 1880–1898," in *Sociedades locales y culturas en el tránsito en el Caribe español*, ed. Cortés Zavala (Morelia, Mexico: Univ. Michoacana San Nicolás de Hidalgo, Facultad de Historia, 2005), pp. 67–83; Nicolás Cuvi, *Ciencia e imperialismo en América latina: La Misión de Cinchona y las estaciones agrícolas cooperativas* (Saarbrücken: Editorial Académica Española, 2011); Wilson Picado, "En busca de la genética guerrera: Segunda Guerra Mundial, cooperación agrícola y Revolución Verde en la agricultura de Costa Rica," *Historia Agraria*, 2012, *56*:107–134; and Picado, "Las buenas semillas: Plantas, capital genético y Revolución Verde en Costa Rica," *HALAC*, 2013, *2*:308–327.

[29] Reynoso, *Ensayo sobre el cultivo de la caña de azúcar* (cit. n. 9).