

SEMINAR REVIEW

The history of Atlantic science: Collective reflections from the 2009 Harvard seminar on Atlantic history¹

Marcelo Aranda, Katherine Arner, Lina del Castillo, Helen Cowie, Matthew Crawford, Joseph Cullon, Marcelo Figueroa, Claire Gherini, Melissa Grafe, Sarah Irving, Ryan Kashanipour, Carla Lois, Adrián López-Denis, Bertie Mandelblatt, Iris Montero Sobrevilla, Kathleen Murphy, Eric Otremba, Christopher Parsons, Heather Peterson, Emily Senior, Teresa Vergara, Kelly Wisecup, and Anya Zilberstein

The 2009 International Seminar on the History of the Atlantic World, 1500–1825, at Harvard University took as its theme “The Americas in the Advancement of European Science and Technology.” The seminar brought together junior scholars from Argentina, Canada, Cuba, England, Peru, and the United States to present and discuss their work on the history of various aspects of scientific, technological, and medical knowledge production, including cartography, astrology, shipbuilding, natural history, medicine, and public health. Several invited senior scholars, whose research interests resonated with those of the participants, offered commentary, suggestions, and probing questions. Lively debates ensued concerning the similarities and differences of the various geopolitical Atlantics, as well as the epistemological and methodological implications of looking at the history of science and medicine from an Atlantic perspective.

Although most of us had arrived at Harvard prepared to discuss the role of the Americas in “the advancement of European science and medicine,” a great deal of what we did actually served to challenge the assumptions implicit in the seminar’s title. We came to be far more interested in understanding how transatlantic interactions shaped and were shaped by processes of knowledge production, and we became fascinated by the implications of using the Atlantic as a unit of analysis in the history of science, medicine, and technology. As a result, much of our discussion focused on recent models developed by scholars in Atlantic history could recast the received narratives of the history of science and medicine – an enterprise we might call an Atlantic history of science.² Equally intriguing for us, however, was the notion of a history of Atlantic science: rather than importing a methodology from Atlantic history, we felt we could create a new series of questions by redefining what knowledge was in the first place and questioning the circumstances of its production.

For the purposes of this review essay, which seeks to capture the spirit of those early conversations in Cambridge, we propose calling the assemblages and interactions of the peoples, objects, institutions, and techniques that resulted in and from colonization during the early modern period “Atlantic science.” We recognize, of

course, that not all colonization was bounded by an Atlantic frame. However, in terms of timing, scale, and scope, no other cluster of imperial enterprises can be compared with the conquest and colonization of the Americas in the sixteenth, seventeenth, and eighteenth centuries. What made colonization in the Atlantic unique was that it involved the voluntary migration of more than two million Europeans, the forced migration of more than ten million Africans, the creation of a vast network of interconnected centers, and the political incorporation of much of the hemisphere into the Western world, all between 1500 and 1825. Nothing of this scale has happened anywhere else in the early modern period. The Atlantic Ocean, rather than Europe, became the center of that world. And so, we see the Atlantic world as an outcome of this colonizing process.

Colonization in the Atlantic gave rise to distinctive processes of knowledge production. The very first paper of the seminar by Carla Lois (discussed below) helped us to begin our discussions with a clear sense of how the Atlantic world itself was a product of these ways of knowing.³ The colonization of the Americas was a knowledge-intensive enterprise. It required huge amounts of expertise, but it also produced equally impressive amounts of information, and some of that information was recycled back into the colonization process in the form of new expertise. In this way, colonization was central to the production of scientific, medical, and technical knowledge in the Atlantic world. In some cases, Atlantic science took place in the colonies, very close to the sites where information was gathered. In other cases, various forces colluded to displace the production of knowledge and expertise to places such as Mexico City, Paris, Havana, London, Philadelphia, or Madrid. Most of the time, however, knowledge emerged from a kind of epistemological friction created as people and objects moved around the Atlantic – to and from the colonies as well as within and between them. For this reason, much of what has been previously called European science, American science, or Creole science may be better characterized under the rubric of Atlantic science. And yet, it is important to emphasize that Atlantic science was only a subset (although a very important one) of the different forms of scientific, medical, and technical knowledge produced in the Atlantic world.

Even as we use Atlantic science as a rubric for understanding our common interests, we recognize that taking the Atlantic as a unit of analysis could be inherently problematic. Indeed, this point is the premise for these reflections, rather than our conclusion. Recognizing the potential faults of this category may be much more productive than traveling from one epistemic comfort zone to another, along an axis of certainty provided by allegedly stable categories. We harbor no illusions that the Atlantic paradigm represents an improvement over many existing historical categories. However, we can enrich our explorations of science, technology, and medicine by keeping both the prospects and the problems of the Atlantic firmly in view. The history of Atlantic science is intrinsically linked to the history of the Atlantic world. But rather than taking this world as a given, we are interested in understanding how it came together as a series of historically contingent arrangements.

This collaborative essay, which emerged out of the papers and discussions at the seminar and afterwards, attempts to capture some of the productive tensions of three main threads of our conversation. Much of the discussion focused on two key questions: Who produced knowledge, and where? As we attempted to formulate answers, it became clear that we needed to take greater account of the epistemological

significance and consequences of movement, a central feature of the Atlantic world. Consequently, the first section of this essay, "Itinerant Epistemologies," treats movement itself as a mode of knowledge production, calling attention to the epistemological productivity and ontological flexibility resulting from the varied and contingent itineraries of people and objects. This approach emphasizes the assemblages and networks created by the people and objects in motion that constituted and were, in turn, constituted by the Atlantic world.

The other two sections reflect on some of the implications arising from treating movement as a mode of knowledge production. In particular, if the history of science and medicine is no longer viewed from the solid ground of Europe or the Americas but instead from the perspective of polycentric and fluid networks of objects or processes in motion, what does this mean for considerations of authority and agency, concepts of central importance for Atlantic history? The second section, "Identity and the Geography of Authority," considers the methodological difficulties of making distinctions between peoples and places within the Atlantic. Here, we interrogate the categories and taxonomies deployed by both early modern actors and twenty-first-century historians as they have attempted to make sense of the Atlantic world. In addition, much of our discussion on this theme related to the difficulties and implications of employing geographic and cultural distinctions as the grounds for authority or epistemological value when those grounds are constantly moving and shifting. In this section, we attempt to keep the instability of identities and classifications firmly in view while emphasizing the ways in which various forces in the early modern Atlantic colluded to generate distinctions and differences between peoples and places with regard to their epistemological value.

The third and final section looks at the geopolitics of knowledge, asking what relationships existed between Atlantic science and the imperial and geopolitical formations in which it took part. In light of our commitment to following the complex and contingent itineraries of people and objects in the Atlantic, we suggest that some reconsideration of the geopolitics of knowledge is needed, especially of those conceptions that hold in the relationship between science and empire. If Atlantic science was at its core an enterprise of epistemological promiscuity, then there is no reason to assume that the formal agents of empire alone wielded the power of science and medicine. Thus, this third section, "Atlantic Agents and the Geopolitics of Knowledge," discusses the implications of starting from the assumption that *all* people and objects had agency. Such a starting point suggests that the geopolitics of knowledge, as well as the relations between politics and knowledge, were richer and more complex than we might have previously expected. The essay ends with some reflections on the geopolitics of our own roles as producers of knowledge, in which one of our primary products could be understood as the Atlantic world itself.

Itinerant epistemologies

Atlanticists have long pointed to movement and migration as formative in creating and maintaining the Atlantic world.⁴ Movement sustained the networks of people and things that shaped the Atlantic and became one of the pre-eminent modes of knowledge production in the region. An Atlantic perspective prompts us to reconsider the role of movement as a process involved in the creation of knowledge,

not simply in its dissemination. Movement across regional and political boundaries not only brought previously distanced systems of knowing, manipulating, and engaging with the natural world into contact with one another, but also resulted in the emergence of new knowledge, new ways of knowing, and new networks of knowledge making. Atlanticists emphasize several forms of movement. In terms of itineraries, many of the seminar papers reflected the primacy of transoceanic movement and maritime dynamics in the Atlantic world. In terms of the loci that constituted many of these itineraries, several papers focused on port cities as some of the major “centers of calculation” and exchange of information and objects. Other papers illuminated the decentered calculation that occurred alongside of the calculation done in various centers throughout the Atlantic. Admittedly, these emphases potentially efface other migrations and knowledge transfers occurring away from oceans and ports, as well as those on continents and in connection with other maritime communities outside the Atlantic basin.⁵

Transoceanic movement provided the motivation and the means for knowledge production. In some cases, it motivated the reassessment of understandings of the body and its relation to oceanic environments, as well as the production of medical treatments for the maladies that resulted from circumatlantic travel. For example, sailors’ bodies registered the challenges of traveling through environments characterized by extreme temperatures and unfamiliar food. Bertie Mandelblatt’s paper examined the seafarers pressed into service for the French Empire in the eighteenth century and showed the novel challenges that the new length of expeditions posed to their health. For example, while scurvy was well known as a dangerous repercussion of long-distance travel, the question of how to prevent the disease took on new urgency in the Atlantic. Transoceanic movement, in this case, stimulated the search for new dietetics to combat scurvy, although, as Mandelblatt demonstrated, limited knowledge about cures for scurvy had already been circulating in European maritime communities for well over a century.⁶

Transoceanic movement also produced new knowledge by shaping how information and objects were translated and transformed for different audiences. Matthew Crawford’s paper pointed to ways in which *quina*, a New World botanical medicament, circulated among networks of royal agents, native bark collectors, and Creole administrators in Spain and South America, infusing the bark with varying levels of symbolic and political significance.⁷ Movement of the bark in the Atlantic made possible the conflict over epistemological authority between different communities, and raised questions about the right to claim knowledge about the uses and properties of the bark of the cinchona tree. Crawford’s paper illustrated the challenges that transoceanic exchange dealt to the stability of a natural object and its cultural meaning. The understandings placed upon objects and, by extension, the owner’s control over those objects were often contested. Various groups attempted to appropriate such objects in order to promote their own networks of knowledge production and their distinctive understandings of, and interest in, these objects. As both the cases of *quina* and scurvy cures suggest, transoceanic travel comprised mobile sites of knowledge production. Scurvy cures were not just dietary regimes, and *quina* was not just a medicament. Rather, both were nodes that tied together heterogeneous networks of knowledge making, circuits that constituted and reinforced what would come to be understood as an Atlantic world.

The seminar participants also considered the limits of transoceanic scales of movement for understanding the production of knowledge in the Atlantic basin and beyond. For example, Christopher Parsons' paper on the study of ginseng by Jesuit missionaries in New France and China demonstrated how the collection, interpretation, and circulation of objects and information could proceed on a scale that included both Atlantic and Pacific networks.⁸ While Joseph-François Lafitau, the Jesuit who took credit for the discovery of ginseng in Canada, used botanical knowledge of ginseng to publicize in Europe his missions to indigenous communities, the East Indian ginseng trade took precedence over Atlantic trade routes. Thus, the story of ginseng in the early modern period owes much to the modes of knowledge production central to the articulation of the Atlantic but cannot be understood with reference to the Atlantic alone. The work of Parsons and others illuminates the wider itineraries and circulations that an exclusive focus on transoceanic and Atlantic movements potentially elides.

What is more, overemphasis on oceanic travels might lead to overlooking Atlantic world movements that took place on land, such as riverine and continental exchanges and itineraries. The seminar papers that gave consideration to these non-oceanic itineraries provided a glimpse into a wide and complicated set of land-based networks. They highlighted the important place of topography and sovereignty in shaping the process of information acquisition. Marcelo Figueroa's paper examined Alejandro Malaspina's expedition in the Rio de la Plata region, where the unevenness of Spain's sovereignty over the River Plate basin influenced how court-appointed collectors gathered information and the types of data they were able to extract from locals.⁹ Figueroa demonstrated that the epistemology of imperial collecting practices shifted across space as a result of the contingent character of the Crown's power. Moreover, such approaches reveal pathways that linked individuals, cities, and centers outside of strictly imperial and national frameworks. As borne out by Figueroa's analysis, itineraries also underscore the fragile and fragmented nature of scientific and medical knowledge, highlighting the contingency of European dominance. Perhaps even more importantly, they place peripatetic individuals who move within, between, and outside of empires at the center of the entire process.

Port cities were key nodes in Atlantic itineraries and networks, many of which served as cosmopolitan places characterized by the confluence of multiple types of information and practices. For example, the process by which ships were constructed and maintained was polyglot, a feature that reflects the labor demands of transoceanic expeditions, as discussed in Joseph Cullon's paper.¹⁰ When a vessel put in at port, sailors brought with them a shared culture that was an amalgamation of the knowledges and traditions of various maritime communities scattered throughout the Atlantic. This interaction of ideas and practices within Atlantic ports resulted in a substantial archive of early modern Atlantic knowledge, including such documents as port books, duty logs, ship manifests, and provincial court records. For historians, such sources are a record of the knowledge production induced through the cross-fertilization of ideas and practices in Atlantic ports, but they must be treated with care since many of these sources attempted to codify and inscribe these ideas and practices into the pre-established knowledge paradigms of Europe. For these reasons, port cities provide one useful set of contexts in which to examine the genesis and evolution of hybridized knowledge that characterized much of early modern science and medicine.

Several papers and discussions at the seminar also focused on migration as a fundamental form of movement in the Atlantic paradigm that had both human and scientific consequences. In many instances, forced migrations motivated forms of knowledge that worked to maintain inequality. The Atlantic world was largely an unfree world. Its very creation rested upon forced migrations of indentured servants, convicts, slaves, and religious refugees that were state-controlled or state-sponsored, a process that supplied labor to fledgling colonies. Medicine, in particular, was often the handmaiden of forced migration. For example, the inoculation of slaves was part of a program to discipline laboring bodies as they were moved around the Atlantic. Meanwhile, the adaptation of double-book accounting to plantation work logs, the quantitative leap undertaken by doctors serving slave societies, and prominence of actuarial discourses to evaluate the reliability of medical novelties speak to the interplay between the developing technologies of labor control and the types of unfree migration that occurred in the Atlantic world.

Claire Gherini's paper – among others – alerted us to the importance of slave migration in shaping natural knowledge in the Atlantic. Using the notion of “overlapping cultural circuits,” Gherini cast colonial Charleston as an important node in the overlapping cultural circuits of migrants – in this instance, African slaves and an Irish physician, James Kilpatrick. This overlap proved to be epistemologically productive for Kilpatrick as the local slave population came to play a crucial role in a debate over inoculation between Kilpatrick and local physicians. Gherini observed that “the racial categories used to organize numerical data suggest that the economy of slavery, rather than a universal set of categories for predicting inoculation's collective outcome, shaped the ways in which Kilpatrick selected and organized his evidence.”¹¹ Although Kilpatrick's claims about inoculation were ultimately shaped by the cultural idiosyncrasies of Charleston, he modified these claims to fit new places. Kilpatrick returned to London, where he repurposed his (largely unsuccessful) efforts in Charleston as an experience that made him an authority on inoculation.

Such studies demonstrated that the unfree nature of Atlantic migrations exerted a profound influence on the manner, type, and processes of knowledge production. The ideas and technologies that traveled best were often those that could be employed to exploit local unfree populations. The subsequent entrenchment of such ideas and practices would then, in turn, deepen the region's commitment to servitude and slavery, often by incentivizing the creation of technologies that facilitated the migration of unfree peoples to fledgling colonies.

Despite the role of some forms of knowledge in the maintenance of inequality, both free and unfree peoples traveled with skills that they applied throughout the Atlantic world, contributing in this way to the production of new technologies. Eric Otremba's paper showed how Portuguese *conversos* and their skilled African slaves traveled between plantation economies and empires, facilitating the transmission of sugar-producing technologies from Dutch Brazil to the British Caribbean.¹² In this case, while unfree populations in Brazil helped negotiate this spread of sugar technology, their success ultimately engendered a greater demand for slaves to operate the region's proliferating sugar mills. Such contributions by enslaved and emigrant populations to the making of scientific, technical, and medicinal knowledge challenge the presumed universality of the modern liberal subject that has often been a basic premise in the history of science and medicine.

As many papers at the seminar showed, movement functioned as a constitutive factor in producing and authorizing many forms of early modern scientific and medical knowledge. Discussion of these papers suggested that a new perspective on the relationship between knowledge, movement, and value was needed. Those approaches treating knowledge as a commodity that travels merely because an individual actor somewhere in the Atlantic needed or wanted it overlook the important ways in which movement itself was a mode of knowledge production. Thus, it is not so much that valuable knowledge moved but that knowledge and its value arose through movement. Even the smallest movements could alter the meaning or significance of an idea or an object. As people moved in and out of port cities, along continental itineraries, and throughout the Atlantic, they carried books, trade goods, scientific specimens, and other objects that accrued new meanings as they entered new contexts and new networks. From this perspective, Europe is less the reference point for early modern science and medicine than an important node in Atlantic circuits of movement and migration. The approaches in this essay suggest that what many scholars have described as “European” science and medicine was actually “Atlantic” science and medicine from the very beginning: knowledge produced through the movement of people and things, forged through a network comprised of key nodes in the Americas, Europe, and Africa.

Identity and the geography of authority

Taking the “Atlantic” as a unit of analysis also pushes us to develop new conceptual tools and perspectives in order to examine the various people and places involved in the production of natural knowledge. Even so, because the Atlantic world was comprised of a unique assortment of individuals and communities who often defied neat professional or political labels, uniting these diverse peoples under the single rubric of “Atlantic” is a historiographical move fraught with difficulty. Moreover, as illuminated in the previous section, distinct geographic or spatial categories are often complicated by the multiple political and cultural affiliations held by people throughout the Atlantic world. Redefining the “center” of knowledge production as a series of fractured but vibrant networks, with nodes in places like Mexico City, Seville, Manila, London, Pernambuco, Paris, Charleston, and Goa, means redefining the geography of authority associated with knowledge production as well. The point is to distribute knowledge production, to insist on its contingency, and to break away from the geographies of center and periphery as a framework for classifying both people and knowledge.

Inspired by the work of David Livingstone and other recent scholarship, a number of papers presented at the seminar interrogated place and space as frameworks for studying the actors responsible for the production of new scientific knowledge.¹³ Where and by whom was natural knowledge of the Atlantic world produced? Did knowledge produced in the field have the same status as knowledge produced in the metropolitan museum or botanical garden? How was the credibility of knowledge influenced by the place and space in which knowledge about the natural world was created? Much previous scholarship on science in imperial and colonial contexts has focused on the intellectual division of labor between metropolitan Europe and colonial America, and has tended to take such divisions for granted.

While there were significant asymmetries of power in the early modern world, several papers encouraged us not only to interrogate the validity of such distinctions but also to ask which groups gave rise to this distinction, and why. For example, many people in the early modern period considered European capitals such as London, Paris, and Madrid to be *the* centers of knowledge production, where scientific institutions were founded, specimens were collated, and theories were formulated. Meanwhile, many of these same individuals worked hard to cast overseas colonies as sites for fieldwork, where objects and information were collected, leaving interpretation and analysis to be done back in Europe. Many came to regard the physical process of gathering, preserving, and transporting plants, shells, hummingbirds, and the odd globetrotting anteater as less intellectually demanding than the construction of botanical or zoological models and theories, even though such practices were (and remain) integral to the production of knowledge and the development of science and medicine. In many instances, actors mobilized such hierarchies so as to resolve the tensions between wanting to exclude African slaves and indigenous people, while at the same time appropriating their information and the objects they produced. Whilst grappling with the challenge of recognizing the uneven distribution of power in the Atlantic without replicating imperial perspectives, several papers and discussions at the seminar exposed some of the problems and inadequacies with conceptual oppositions such as center and periphery, and in the process questioned their suitability within an Atlantic context.

Heather Peterson's paper described the theories of heredity that Creoles in New Spain formulated to mark differences among European colonists, Native Americans, and Africans. Yet as Peterson showed, these theories circulated primarily among the Creole elite in the New World and constituted a form of local knowledge that existed in tension with environmental theories of difference prevalent in Europe.¹⁴ By the end of the eighteenth century, as Melissa Grafe demonstrated, the distribution of local medical knowledge made by American physicians served as a sufficient means of creating and reinforcing networks of knowledge among physicians in various American cities and towns.¹⁵ Grafe made clear that the Maryland physician John Archer and his networks were American-focused, with Europe functioning as their periphery. In each of these cases, the European metropole was not the primary arena in which American medical knowledge was debated, altered, and finally accepted, but just one forum in a series of interconnected places operating in the Atlantic world at the end of the eighteenth century.

In addition to the challenges of classifying sites of knowledge production, many contributions to the seminar explored the difficulty of neatly classifying individual naturalists as either central or peripheral. Certainly, there were naturalists who worked solely in European museums, just as there were naturalists who spent their entire lives doing fieldwork in the Americas. But between these two poles there were also many individuals who operated in both locations for varying amounts of time and engaged in different forms of work. There were individuals like the Spaniard Félix de Azara, for example, who stayed for 20 years in the remote Spanish province of Paraguay, studying its birds and mammals, but subsequently returned to Europe and used the stuffed specimens in the Parisian Muséum d'Histoire Naturelle to perfect his zoological descriptions. There were also those like the Ecuadorian-born Pedro Franco Dávila, a natural history collector who lived in Paris for many years, donated his collection to the Spanish Crown as the nucleus for the newly founded

Royal Cabinet of Natural History, and then, as the institution's first director, superintended the process of acquiring natural productions from throughout the empire.¹⁶ These people worked at different times in their careers in centers of knowledge production in both Europe and the Americas, pursuing different types of research and blurring clear-cut distinctions between American and European knowledge. If individuals defied easy classification as "imperial" or "colonial," then so, too, did scientific establishments. Centers of calculation existed both in the Americas and in Europe.

This feature complicates the distinction between Europe as a place for research and the Americas as a source of novel specimens. How are we to categorize an anatomy theater in Lima, a cabinet of natural history in Guatemala, a botanical garden in St Vincent, or the Société Royale des Sciences et des Arts du Cap François in accordance with the center-periphery model? Were such places merely extensions of institutions in the metropolis, designed to disseminate European systems and knowledge throughout the empire? Or could they function as autonomous places of learning, subverting or challenging accepted European norms and offering a theoretical contribution to science? Moreover, were the more pertinent divisions in fact those between Europe and America, those between different empires in the Americas, or those between different regions or even different towns and cities? Ryan Kashanipour's paper examined the localized circulation of Spanish and indigenous medical remedies, which were integrated and transmitted in Spanish- and Maya-language texts.¹⁷ Even though European rhetorical practices for almanac books helped shape Maya books of medicine, indigenous healing practices continued to thrive in local and interethnic contexts. Kashanipour's paper, like many presented at the seminar, emphasized the polycentric networks of knowledge and the diversity of knowledge communities within the Americas.

The seminar provided an array of examples of the interactions among a wide variety of sociocultural groups that were underpinned by varying kinds of power relations and political stakes. Which knowledge came to be seen as scientifically credible, and which actors could be legitimately mobilized in its production, was often determined by the mode of encounter in these Atlantic interactions. Kathleen Murphy traced the process through which authority was attributed to natural knowledge in the context of colonial ambivalence toward African and Native American knowledge bases, highlighting the development of a British imperial narrative of knowledge production that required a rational western European approach to interpret the "rude experience" of Indians and slaves.¹⁸ Kelly Wisecup's paper showed how Native American theories about disease originating outside of the body – in bullet-like objects sent by supernatural beings – influenced colonists' descriptions of New World illnesses, while also providing empirical evidence that allowed colonists to authenticate scientific reports of colonial encounters.¹⁹ Yet such first-hand experience came with a potentially fatal premium in the context of yellow fever epidemics in the 1790s. In a related case, Katherine Arner followed the tripartite debate between physicians of England, North America, and the Caribbean, whose rivalry centered on the issue of whether British medical training or local experience treating yellow fever patients provided a superior knowledge base.²⁰ It is this variety of motivating factors and political interests which defines the character of Atlantic knowledge. If scientific knowledge was produced by and within the

circumatlantic movement of people, animals, objects, and ideas, it also emerged within the interstices of cultures and communities.

Other papers demonstrated a way to transcend the discourse of center and periphery by demonstrating the multiple valences of Atlantic identities. The multiple affiliations maintained by those involved in the production of scientific and medical knowledge in the Atlantic world are perhaps most poignantly illustrated by the quandaries of the Creole elite, who often had somewhat ambivalent feelings towards European science. Adrián López-Denis's paper followed the Spanish Crown's Royal Philanthropic Expedition to introduce the smallpox vaccination into colonies around the Caribbean, and found that the vaccination actually preceded the expedition in many cases. Focusing on the case of Cuba, López-Denis explored the significance of the double migration of African slaves and the smallpox vaccination to the island. He showed how, in Havana, the numbers of individuals vaccinated in the early nineteenth century tracked closely with the numbers of slaves imported to provide labor for Cuba's burgeoning sugar plantations. All of this highlights "the role of immunizing practices and discourses of immunity" in the construction of Creole notions of morality and paternal virtue. The Creoles in López-Denis's story, physician Tomás Romay, and his colleagues at Havana's Economic Society did not necessarily cast themselves as opposed to the Spanish Empire. Rather, they "operated under the assumption that imperial loyalty and scientific development were self-reinforcing rather than mutually exclusive historical forces."²¹ In certain instances, then, some Creoles actively contributed to imperial enterprises, showing that patriotism and participation in such enterprises were not necessarily mutually exclusive.

As patriotic Americans, Creoles at times also took offense at the European theories that disparaged or discredited their homelands – such as the Comte de Buffon's argument that New World plants and animals were smaller and weaker than their Old World counterparts – and they rallied to defend America from unwarranted slander, drawing alternately on their own experience and the expertise of indigenous peoples. Iris Montero Sobrevilla's paper demonstrated how the Creole Mexican naturalist José Antonio Alzate used his on-the-spot authority to challenge the theory of hummingbird torpor, propounded in the Spanish version of the *Encyclopédie Méthodique* (1782–1832).²² But Alzate's project also had a complex intellectual and cultural genealogy. By following a visual and textual tradition on hummingbirds developed by Fray Bernardino de Sahagún, Francisco Hernández, and José Antonio Alzate from the sixteenth to the eighteenth centuries, Montero showed that these writers drew heavily upon "pre-Columbian cultural vestiges," in which hummingbirds were used "to evoke cosmological truths, moral virtues or religious mysteries."²³ Ultimately, her paper concluded that "the case of hummingbird torpor destabilises the well-established assumption that the encounter with New World animals – creatures that did not have a history in the classical tradition – propelled the emergence of an empiricist understanding of nature."²⁴ Rather, some European and Creole observers drew on local (pre-Colombian) knowledge and traditions to create empiricist-looking descriptions of American nature, a practice that invites further reflection on the category of "experience" in the early modern period.

Perhaps the key conclusion drawn from these discussions was that the categories assigned to different individuals and forms of knowledge, whilst helpful to think with, are not necessarily mutually exclusive, and they carry the risk of being too reductionist to appropriately frame such interactions and identities. Helen Cowie showed us how

a natural philosopher born in Colombia—in this case, the astronomer-botanist Francisco José de Caldas—might feel himself to be American when responding to Buffon’s invective against New World fauna.²⁵ But he might equally feel Spanish when faced with Nicholas Masson de Morvillier’s withering critique of the scientific achievements of the Hispanic world in his article “Espagne” in the *Encyclopédie Méthodique*.²⁶ He might feel Colombian again when contesting the findings of rival botanists Hipólito Ruíz and José Pavón in neighboring Peru. And, finally, he might assert his racial identity as a Creole when differentiating his fieldwork from the superstition and empiricism of his Indian accomplices. “Local” and “imperial” can, therefore, assume different meanings in different contexts. The Atlantic world, with its unique and complex blend of ethnicities, affinities, languages, and landscapes, offers an ideal environment for observing these conflicting identities in action.

Atlantic agents and the geopolitics of knowledge

Taking its cue from both the seminar and the preceding sections, this final section considers two sets of interrelated problems. First, it explores how the seminar papers and discussions reshaped our understanding of the politics of knowledge production in the Atlantic world. While the previous section focused on the difficulties of identifying and classifying the agents of Atlantic science, this section asks: What relation did these agents have to the empires and other political formations of the Atlantic world? To what extent were the agents of Atlantic science also agents of Atlantic empires? Several of our debates centered on the nature of the complex collective agencies that resulted from interactions between European and non-European people. Other conversations were informed by tensions, conflicts, or synergies between metropolitan and colonial subjects or between representatives of different imperial powers. In some cases, the papers were explicitly organized around the politics of epistemic contact and cultural overlap, chronicling appropriations, misunderstandings, absences, or silences. Second, the final and concluding section of this essay captures a reflexive turn in our discussions about agency and geopolitics. The seminar participants highlighted the need for a greater awareness of how geopolitical contexts inform our own work as knowledge producers and shape our characterizations of the Atlantic world.

A paper by Sarah Irving illuminated the relationship between Protestant theology, seventeenth-century instrumentality, and the British colonization of the New World. Natural philosophy was so intimately linked to Protestant principles, she argued, that evangelizing the Americas and extending to the colonies the civilizing benefits of scientific instrumentality became two sides of the same religious mission. The New World was much more than a source of raw data to be systematized and processed in Europe. The work of colonial scholars like Cotton Mather and John Winthrop, Jr. gave substance to the ideals of universal redemption and social utility at the core of seventeenth-century natural philosophy. “The American colonies provided an ideal opportunity to construe natural philosophy as a work of Christian charity, and thus as an endeavor that was useful to mankind,” she commented. “In this way they helped give birth to one of the defining features of modern science.”²⁷

Carlos de Sigüenza y Góngora, a seventeenth-century polymath from Mexico City, used mathematical and optical instruments to establish his legitimacy as

a natural philosopher. In his paper, Marcelo Aranda invited us to think about Sigüenza “not as a marginalized figure in the trans-Atlantic Republic of Letters, but instead as an effective actor in his own local and imperial networks.”²⁸ For this Creole, intellectual, precise measurements were central to the production of facts about the natural world. Sigüenza corresponded with some of the leading mathematicians and astronomers of his time, sharing with them the results of his observations. While setting academic controversies with other experts within the empire, he argued that empirical observations made with scientific instruments would produce a result that was intrinsically superior to what other scholars could arrive at using a combination of traditional doctrines and naked-eye estimates.

The natural philosophy that these scholars produced was also shaped by their involvement in the parallel construction of colonialism as a scientific venture and science as an imperial enterprise. The ultimate artifact to be born out of this dialectical process was the Atlantic itself. In her paper, Carla Lois traced “the long road to the geographical unity of the Atlantic Ocean” through a close reading of cartographic sources.²⁹ The role of maps in creating surfaces and the contested nature of the labels associated with those surfaces brings to the forefront the notion of ocean building. Moving away from teleological narratives, this paper showed how the existence of the Atlantic world as a series of interconnected land masses brought together by colonization precedes that of the Atlantic Ocean itself, a vast surface pieced together out of regional seas through the erasure of boundaries and the reconfiguration of coastal references.

The creation of the Atlantic Ocean parallels that of the Western world as a geopolitical abstraction dominated by connections between northern Europe and North America. Anya Zilberstein demonstrated that these connections were not the inevitable outcome of pre-existing similarities but the result of a series of epistemic negotiations that took place in the late eighteenth century. According to a classical understanding of the links between climate and well-being, the temperate zones of the Old World were ideally suited for the development of human civilization. The extreme cold of the Arctic and the excessive heat of the tropics made those regions inhospitable. Placing the northern colonies in the same biogeographical zone as the temperate belt of Europe became a priority of the local elites. They needed to prove that familiar plants and animals could thrive in New England and Nova Scotia in order to attract potential immigrants, but they also had to make the territories themselves intelligible. Establishing this homology was not only a matter of economic survival, it also gave them intellectual confidence and geopolitical prestige. Or, as the author put it in the closing lines of her paper:

While North Americans aimed to be detailed and comprehensive in compiling knowledge of local ecologies, they were especially devoted to the practice of natural history insofar as it could place their own localities in the center, rather than the margins, of British science and empire.³⁰

While northern lands seemed cold and uninviting, British colonial geographers often placed them within a temperate belt, setting in motion an enduring association between their climate and that of civilized Europe. The Caribbean, on the other hand, for some early modern observers and commentators, presented itself as an inviting garden, full of life and economic opportunities. Even so, as Emily Senior

stated in her paper, “the visually pleasing surfaces of the islands were understood to mask a host of terrible diseases which awaited European travelers to their shores.”³¹ Eighteenth-century landscape aesthetics in the tropics were intimately linked to the findings of medical geography. Doctors established strong connections between disease and place that painters and writers embraced in an attempt to bring deeper layers of artistic meaning to their work. In turn, these representations of the sickly Caribbean landscape informed medical characterizations of the region, creating a cycle of self-reinforcing metaphors. The Atlantic medical aesthetics resulting from this convergence would eventually dominate all representations of the tropics (and its inhabitants) within the British Empire.

The relationship between the production of knowledge and the consolidation of empire also deserves a second look. In 1808, José Gavino Chacaltana, a native surgeon trained at a local hospital, became the first Chair of Surgery at the Royal School of Medicine in Lima. A paper by Teresa Vergara on the participation of this and other indigenous practitioners in the institutional consolidation of medical training at the University of San Marcos challenged many received certainties about the politics of knowledge production in contact zones. “In the last decades of the eighteenth century,” Vergara commented, “the fact that Indian people were admitted in a university was the consequence of both a long fight of the Peruvian indigenous elites as well as the crown’s more open disposition to incorporate Indians into the Spanish institutions.”³² Native medical expertise in colonial Lima was not a form of knowledge defined by its opposition to European or Creole practices but by its integration into the same institutional circuits of formal education and practical training that defined elite experiences all across the Spanish Empire. An indigenous professor of surgery at a university attended by a melange of Spanish, Creole, and native students was situated at a different place in the hierarchies of Atlantic science than the anonymous native informants robbed of their botanical or geographical knowledge by European explorers. Stories of the relationship between cross-cultural exchange and knowledge production are more complicated than we thought, and revisiting our politics accordingly is long overdue.

In her paper, Lina del Castillo discussed the role of geography and cartography in nation building during the decades in which the Kingdom of New Granada became the Republic of Gran Colombia, only to break apart and eventually constitute the modern nations of Ecuador, Colombia, Panama, and Venezuela. Tracing the genealogy of *criollo* nationalism to the rise of enlightened ideals in the late eighteenth century, the author nonetheless refused to present this process as an ideological substitution of the old hegemonic tools of empire with new liberal ideals. The efforts of the elites to create a nation out of a colonial territory involved a remapping of the land that erased pre-existing administrative subdivisions. At the same time, they tried to dissolve the old *casta* system into a notion of universal citizenship while preserving their place at the top of the socio-economic and political hierarchy. In the works of geography and cartography that the *criollo* experts produced during those years, the territorial and ethnic unity of Gran Colombia was showcased not only in order to persuade the locals but also the international scientific community. Their attempts to generate political legitimacy through the use of geographic science were very similar to those of the Spanish imperial bureaucrats of the late eighteenth century, and they failed for very similar reasons. As Castillo commented:

Criollo elites longed for an international recognition of independence that allowed them to maintain a particular kind of social order, a problem that became increasingly difficult for those who had to bargain with subalterns in order to win military and political support for their cause. These tensions – visible in early Colombian geographies, and visible through map inconsistencies – combined with a long history of Venezuelan and Ecuadorian separatism, immense geographic distances, poor communications, and provincial resistance to central government concentrated in Bogotá.³³

Conclusion

The centrality of the scientific revolution in the genealogy of the history of science and “science studies” is one of the causes, and the most important consequence, of the fact that Anglo-American and northern European scholars have dominated the history of science as a profession and as a field during the twentieth century. According to their narrative, modern science was the result of a series of breakthroughs in astronomy, physics, anatomy, and chemistry that took place in northern Europe from the fifteenth to the seventeenth centuries. Several historians have established clear connections between these changes and the parallel rise of Protestantism and merchant capitalism. With few exceptions, the role of European expansion in the birth of modern science has been missing from this picture.³⁴ The incorporation of breakthroughs in long-distance navigation, cartography, natural history, materia medica, and ethnography into the narrative of the scientific revolution is altering our understanding of both the content and the intellectual geography of this momentous transformation. Disciplines that have been described as applied science and placed in an epistemologically subordinated position are coming to the forefront of the story. In addition, the Iberian empires, traditionally excluded from the genealogy of modern science, are now receiving a great deal of scholarly attention.

These changes are forcing a profound reconfiguration of the field and the profession. The question of what constitutes science is intimately linked to the question of who gets to define it, in the past as well as in the present. The seminar was evidence of how far we have come in answering those two questions and how much work is still in front of us. Out of the 23 papers presented, 10 were related to the British Atlantic, another 10 to the Spanish Atlantic, two dealt with the French Atlantic, and only one was truly pan-Atlantic. That distribution echoes the changes described above, although a treatment of the Portuguese world was surely missed. In a similar vein, the bulk of the papers discussed theories and practices grounded in the realm of applied science, technology, or medicine. In many cases, however, authors struggled in their attempts to reconcile traditional heuristic models with the evidence coming from research on non-traditional areas and topics. At the end of this experience, many of us departed with a sense that we need ways of theorizing knowledge production that go beyond normative generalizations derived from studies of the development of core disciplines in northern Europe.

Such challenges in the history of the Atlantic and the history of science are not just matters of epistemology and methodology. They are also matters of social, disciplinary, and professional organization. The conversations and papers presented at the seminar thus also reflected the ways in which scholars must continue to commit to moving beyond their regional specialization and disciplinary training in order to engage with histories outside the Atlantic context most familiar to them. In

this way, the seminar demonstrated the utility of the Atlantic as a concept that continues to challenge scholars not only to think in new ways but also to interact in new ways. Just as the networks of the early modern Atlantic world gave rise to new knowledge and new ways of knowing, new networks of scholars working collaboratively across regions, across disciplines, across national boundaries, and across oceans seem a powerful way to engender new perspectives and new approaches to the histories of science and the Atlantic world. It is our hope that this essay will be taken as an invitation to further conversation and collaboration.

Notes

1. This essay was co-edited by Matthew Crawford and Kelly Wisecup. The editors of *Atlantic Studies* thank them for their hard work in bringing this piece to fruition. Please note that neither the International Seminar on the History of the Atlantic World, 1500–1825, at Harvard University, nor its financial sponsor, the Andrew W. Mellon Foundation, has any official connection with this collective essay. Rather, this seminar review reflects the spontaneous desire of the participants listed here to share some of the many ideas that were generated during their meeting. Participants of the Seminar wish to acknowledge Professor Bernard Bailyn for his insightful comments and critiques of the papers in the Seminar, and also for his invitation to participate. The collective reflections on the seminar would not have been possible without his assistance. Additionally, Professors Matthew Crawford and Kelly Wisecup wish to thank Lina Del Castillo, Anya Zilberstein, Ryan Kashanipour, and Bertie Mandelblatt for their editorial assistance in later drafts of the review essay and Melissa Grafe for lending her technological expertise to the project.
2. Recent works engaged in this enterprise include Delbourgo and Dew, *Science and Empire* and Safier, *Measuring the New World*.
3. Lois, “From *Mare Tenebrorum*.”
4. The works that argue for movement and migration as formative in the Atlantic(s) are extensive. We have attempted to cite the most recent here: Armitage and Braddick, “Introduction”; Banks, *Chasing Empire*; Carney, *Black Rice*; Greer and Mills, “Catholic Atlantic”; Newson and Minchin, *From Capture to Sale*; Putnam, “To Study the Fragments”; and Seeman, “Jews.”
5. On “centers of calculation,” see Latour, *Reassembling the Social*, 178.
6. Mandelblatt, “On the Excellence.”
7. Crawford, “European Science.” A revised version of this paper is published in this issue of *Atlantic Studies*.
8. Parsons, “I report”; see also Sivasundaram, “Focus.”
9. Figueroa, “Natural History.”
10. Cullon, “Geometrically and Arithmetically Performed.”
11. Gherini, “Rationalizing Disease,” 33. A revised version of this paper is published in this issue of *Atlantic Studies*.
12. Otreмба, “Inventing Ingenios.”
13. Livingstone, *Science in Its Place*.
14. Peterson, “Body in New World.”
15. Grafe, “Almost Infallible Remedy.”
16. For a discussion of Dávila’s colorful transoceanic career, see Pimentel, “Across Nations and Ages.”
17. Kashanipour, “Medicinal Mélange.”
18. Murphy, “Useful Hints.” A revised version of this paper will be published in the upcoming issue (8.1) of *Atlantic Studies*.
19. Wisecup, “Invisible Bullets.”
20. Arner, “Making Yellow Fever American.” A revised version of this paper is published in this issue of *Atlantic Studies*.
21. López-Denis, “Communities of Immunity,” 3, 20.
22. Montero Sobrevilla, “Lessons.”

23. Montero Sobrevilla, "Lessons," 25.
24. *Ibid.*, 25.
25. Cowie, "Sloth Bones." A revised version of this paper will be published in the upcoming issue (8.1) of *Atlantic Studies*.
26. Morvilliers, "Espagne."
27. Irving, "America," 17.
28. Aranda, "Comets, Colonies, and Bequests," 9.
29. Lois, "From *Mare Tenebrorum*," 3.
30. Zilberstein, "Cold Comfort," 34.
31. Senior, "Diagnostics of Description," 1.
32. Vergara, "Indian Medical Knowledge," 9–10.
33. Castillo, "Geographies of Independence," 20.
34. See, for example, Barrerra, *Experiencing Nature* and Cook, *Matters of Exchange*.

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