Thinking Without the Scientific Revolution: Global Interactions and the Construction of Knowledge

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Abstract

Amongst the many narrative strategies in the recent “global turn” in the history of science, one commonly finds attempts to complement the single European story by multiplying histories of knowledge-making in as many different regional and cultural contexts as possible. Other strategies include attempts to generalize the “Needham Question” of why the Scientific Revolution occurred only in early-modern Europe to the exclusion of other parts of the world, or to challenge the diffusionist vision of the spread of modern science from Europe by attempting to show that non-European scientific traditions already had an understanding of recent European discoveries. These latter strategies seek simply to pluralize the Scientific Revolution without actually unpacking the latter concept itself.

This article seeks firstly to show that the “Scientific Revolution” was in fact a Cold War invention intended to bring the freshly decolonized world into the ambit of the West by limiting the conception of modern science to Europe-specific activities thus delegitimizing other knowledge domains and using the term as a spatially circumscribed chronological marker. Using a broader understanding of scientific activity in the early modern period, and mobilizing relational methodologies, such as circulatory and connected historiographies, the paper then re-examines the well-known history of the *Hortus Malabaricus*, one of the most celebrated seventeenth-century botanical works, to show the short- and long-range knowledge circulations, intercultural interactions and connections involved in its making to bring out the global nature of scientific activity of the period and illustrate relational approaches to global history.

Keywords

“Scientific Revolution” – Eurocentrism – Periodization – universal history – Global History and Historiography – the “early modern” – the “Needham Question” – Post-colonial theory – Relational Historiography – *Hortus Malabaricus*

Introduction

Europe's unique role in the emergence of modern science starting with the Scientific Revolution of the sixteenth and seventeenth centuries seems so obvious to us today that we need constantly to be reminded that the construction of this “historical fact” is barely seventy-years-old, the handiwork of the fledgling discipline of the history of science that itself began to be institutionalized only a century ago. This is not to argue that western Europeans did not already have a sense of scientific superiority—the trope of European scientific superiority, and superiority *tout court*, is commonly encountered in European thought from the eighteenth century onwards. Indeed, cultural and moral superiority were very much in play in the European colonial enterprise, forming the ideological basis of religious and political assimilationist policies of proselytization and Westernization of colonized peoples. However, *pace* Lewis Pyenson, the *mission civilisatrice* did not significantly mobilize science in its legitimizing discourse, even though colonization itself was massively based on scientific expertise, geographical and geological exploration, astronomy, agronomy, medicine, military and other material technologies, such as land and marine transport systems and telegraphy, not to mention science-based racial theories.¹

This sense of superiority and the wide deployment of scientific expertise and technologies in the pursuit of empires notwithstanding, it was only in the course of the twentieth century that science came to embody the values of modernity and freedom, becoming the exclusive marker of civilization itself. It was in this context that the articulation of modern science with history was

1 Lewis Pyenson, *Civilizing Mission: Exact Sciences and French Overseas Expansion 1830-1940* (Baltimore, 1993). See Alice Conklin, *A Mission to Civilize: The Republican Idea of Empire in France and West Africa* (Stanford, 1997); Brenda S. A. Yeoh, *Contesting Space: Power Relations and the Urban Built Environment in Colonial Singapore* (Kuala Lumpur, 1996); Daniel Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York, 1981); and Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca, 1989).

reworked in a novel way immediately after World War II by the emerging discipline of the history of science, mainly in the United States and Britain, setting a recently invented and exclusively Eurocentric notion—the Scientific Revolution—as its founding stone. The Scientific Revolution thus began its scholarly life in the wake of western Europe's Pyrrhic victory in World War II, inaugurating a period with an ever-diminishing role on the global scene for the Old Continent, confronted on the one hand with the loss of its empire, and sandwiched on the other between the United States and the Soviet Union in an escalating Cold War. In a surprising twist, then, the systematic construction of a Eurocentric history of science was coeval with attempts that were to coalesce into postcolonial theory which called into question and reassessed self-congratulatory European histories and historiographies. Eurocentrism in the history of science, and postcolonial attempts to unravel it, were strictly contemporaneous!

A further irony is that this “new” history, which contributed significantly to the creation of a new European geography and identity, was largely made from outside Europe—the work of U.S. academics eager, on the one hand, to figure as part of a long, radiant and dominant European heritage, and, on the other, to consolidate the recently wrought Transatlantic, or Western, Alliance against the Soviet Union, and communism in general.

The emergence of the Scientific Revolution on the intellectual scene was also contemporaneous with the emergence of a new breed of practitioners of the discipline—professional historians of science instead of professional scientists of the previous epoch.² It was in this context that the “revolutionary” vision started prevailing, and the discipline of the history of science underwent a dramatic shift. Last but not least, the prism of the Scientific Revolution redrew the historical geography of science in Europe, limiting it to the north-western segment of the continent and relegating the rest to what is referred to as the “European periphery.”³

2 Peter Dear, “The History of Science and the History of the Sciences: George Sarton, *Isis*, and the Two Cultures,” *Isis* 100, no. 1 (2009): 89–93. For a history of the institutionalization of the domain, see Arnold Thackray, “The Pre-History of an Academic Discipline: The Study of the History of Science in the United States, 1891–1941,” *Minerva* 18, no. 3 (1980): 448–473; Robert Fox, “Fashioning the Discipline: History of Science in the European Intellectual Tradition,” *Minerva* 44, no. 4 (2006): 410–432; and Joy Harvey, “History of Science, History and Science, and Natural Sciences: Undergraduate Teaching of the History of Science at Harvard, 1938–1970,” *Isis*, 90, Supplement (1999): S270–S294.

3 See Kostas Gavroglu, Manolis Patiniotis, Faidra Papanelopoulou, Ana Simões, Ana Carneiro, Maria Paula Diogo, José Ramón Bertomeu-Sánchez, Antonio García Belmar and Agustí

The focus of this essay is not the history of the emergence and ubiquity of the Scientific Revolution in the history of science, nor its reappraisal.⁴ Rather, it is an attempt to lay out the conceits underlying the notion in order to explore the possibility of another history of science, one that brings the rest of the world into the folds of the discipline, where the Rest is not just treated as an object of study, rather as a knowing subject in its own right. In what follows, I shall start by reviewing previous major attempts to globalize the history of science during the century of its existence as a discipline before laying out what the history of early modern science might be like without the prism of the Scientific Revolution.

Global History of Science *avant la lettre* ...

In its early decades the discipline of the history of science, as seen through the pages of its founding journal *Isis* founded in 1913, projected itself as a universal history. Indeed, George Sarton (1884-1956), often referred to as the father of the discipline, famously characterized the history of science as “the *only history* that can illustrate the progress of mankind.” He went on to assert that “We can thus reconstruct, or help to reconstruct, as it were, the development of the human genius, that is, not the intelligence of any single man or group of men, but that of mankind as a whole.”⁵

In addition to mathematics, physics, chemistry, biology, mechanics and so on, the contents of *Isis* thus included the history of archaeology, ethnology, geography, medicine, the occult sciences, Buddhism, Tantrism, navigational astronomy, commercial arithmetic, cookery, arts and crafts, etc. Their geographical span stretched from India, Japan, the Arab world and China to ancient Egypt, and of course Greece, to name but a few. To be sure, Sarton admitted that the history of modern science occupied the most space, partly because its development “is so important and of such exuberance in every

Nieto-Galan, “Science and Technology in the European Periphery: Some Historiographical Reflections,” *History of Science* 46, no. 2 (2008): 153-175.

- 4 For a history of the Scientific Revolution “paradigm,” see Kapil Raj, “Quand d’Amérique inventa la science européenne,” in Jakob Vogel, Thomas Serrier and Étienne François, eds., *Europa: notre histoire* (Paris, 2017), 1089-1102. For critical evaluations of the Scientific Revolution, see David C. Lindberg and Robert S. Westman, eds., *Reappraisals of the Scientific Revolution* (Cambridge, 1990); Steven Shapin, *The Scientific Revolution* (Chicago, 1996), esp. 3-5; and Margaret J. Osler, “The Canonical Imperative: Rethinking the Scientific Revolution,” in Idem, ed., *Rethinking the Scientific Revolution* (Cambridge, 2000), 3-24.
- 5 George Sarton, *The Study of the History of Science* (Cambridge, MA, 1936), 5.

direction,” and partly because “the authors of papers on oriental science [...] prefer to publish them in special journals where the philological basis of their work can be appreciated by competent scholars. [...] I tried to correct that situation [...] to make our readers realize that an account of science and culture in the fourth century BC, or in the fifth century or in the ninth after Christ was essentially incomplete, if the Chinese, Arabic, Hindu, Japanese elements were left out.”⁶

Notwithstanding its resolutely positivist and cumulative history of ideas approach to science—light years from present-day conceptions—the philosophy behind Sarton’s *Isis* was resolutely that of the unity of mankind encapsulated in what he labelled “the New Humanism.” The aim of the discipline and its flagship journal was thus to offer an account of how peoples all over the world had contributed to one great project that could elevate them above their petty nationalistic and religious differences.

The introduction of “The Scientific Revolution” into the scholarly life of the discipline was to radically change this universalistic Comtean perspective. This Revolution, as is well known, was predicated upon “a veritable ‘mutation’ in human thought,” in the words of its inventor, Alexandre Koyré (1892–1964).⁷ “The scientific revolution of the seventeenth century,” he wrote, “was without doubt such a mutation; one of the most important, perhaps even *the* most important, since the invention of the Cosmos by Greek thought, it was a profound intellectual transformation of which modern physics (or more precisely classical physics) was both the expression and the fruit.”⁸ Koyré argued that the new physics consisted of “the mathematisation of nature and its valorisation of experience and experimentation.”⁹

Now, holding up physical theory and experimentation as the canonical examples of the great mutation has effectively skewed the representation of early modern scientific activity, and occluded other domains of specialized knowledge which in fact constituted an important—if not the major—portion of scientific activity during the period. These notably included natural history, medicine, geography, practical mathematics, navigational astronomy,

6 Sarton, “Why Isis?,” *Isis* 44, no. 3 (1953): 232–242, on 241–242.

7 Alexandre Koyré, *Galileo Studies* (Atlantic Highlands, NJ, 1973 [French original: *Études galiléennes* (Paris, 1939)]), 1.

8 *Ibid.*, 1–3.

9 Koyré, *Du monde clos à l’univers infini* (Paris, 1973 [originally published in English, 1957]), Preface to the French edition, 14 (my translation).

alchemy and ethnography.¹⁰ Indeed, as Roy Porter cautions us, “our reading of The Scientific Revolution is bound to govern our reading of the rest of science ... The idea of the Scientific Revolution, so often taken for granted, is in fact highly loaded.”¹¹

In minimizing the role of these other fields, this “revolutionary” portrait of science, created in the context of the Cold War, wilfully favored north-western Europe at the expense of other parts of the world where many of the above-mentioned fields of knowledge were also practiced, but where the mathematization of knowledge was not a fashion. They flourished, for instance, in large parts of early modern South Asia, China, Japan, Oceania, the Americas and Africa, not to mention Europe itself.

This distortion in favor of exclusively west European scientific activities implied different ways of thinking globally about the history of science than the scientific *Weltanschauung* of the earlier decades of the discipline. Two perspectives were to be markedly influential in the post-war period, and although widely criticized, they have determined thinking amongst most historians and sociologists of science, in particular on topics outside the West. The first of these was expressed by the biochemist and historian of science, Joseph Needham (1900-1995), through what has come to be known as his “Grand Question”: intrigued by the momentous scientific and technological achievements of China until the fifteenth century, Needham asked why the Scientific Revolution did not take place there, but in Europe. He thus set himself a transcontinental comparativist agenda to identify precisely what constituted this putative uniqueness of Western Europe. And, although he spent a large part of his life in reinstating the scientific status of China, he framed

10 For an assessment of domains considered worthy of attention by two early modern learned academies, see Judith Ellen Friedman, “‘Solid and Usefull Knowledge’: An Analysis and Comparison of the *Philosophical Transactions* and the *Journal des Sçavans*, 1665-1670,” (Unpublished M.A. Thesis, University of Alberta, 1997, Edmonton), Appendices 2 and 3. It is also noteworthy that in listing the aims and achievements of the Royal Society, its first historian, Thomas Sprat, placed “Experiments, they [the Royal Society] have tried,” only in fourth place, after respectively, “Queries and Directions, they have given abroad,” “Proposals and Recommendations, they have made,” and “Relations, they have received.” See “An Account of Some Books. *The History of the Royal Society of London for the Advancement of Experimental Philosophy*, by Tho. Sprat,” *Philosophical Transactions* 2 (1667): 501-506, on 502.

11 Roy Porter, “The Scientific Revolution: A Spoke in the Wheel?” in Roy Porter and Mikulaš Teich, eds., *Revolution in History* (Cambridge, 1986), 290-316, on 294.

his method using the highly problematic notion of civilization as the unit of comparison between China and Europe.¹²

The second global perspective was formulated in 1967 by a then little-known historian of technology, George Basalla. His now famous article, "The Spread of Western Science," succinctly presented this theory in the prestigious review *Science* in 1967.¹³ Basalla there asked how modern science, the preserve of a handful of western European nations where the Scientific Revolution was staged—Italy, France, England, the Netherlands, Germany, Austria, and the Scandinavian countries—spread to the rest of the world—Asia, Africa, the Americas, but also Eastern Europe. His three-stage diffusionist model of scientific acculturation, largely inspired by the economist and Vietnam war-hawk Walt Whitman Rostow's five-stage model of economic growth based on modernization theory, comprises seven "tasks" for countries aspiring to become "scientific," including: eradicating traditional "philosophical and religious beliefs," establishing "native" scientific organizations patterned on Western ones, not to mention importing Western technologies.¹⁴

The "Global Turn"

The recent so-called "global turn" in the social sciences has affected all branches of history, not least the history of science, as the rising number of articles, special issues of learned journals and books, international conferences, and university teaching programmes on the theme attest.¹⁵ *Isis* alone has published at least three of its focus sections—introduced by Bernard Lightman, when he became editor of the journal in 2004, to "take the lead in shaping the field through more proactive discussions on emerging and provocative developments"—on global themes.¹⁶

12 For a critique of Needham's civilizational approach, see Kapil Raj, "Rescuing Science from Civilisation: On Joseph Needham's 'Asiatic Mode of (Knowledge) Production,'" in Arun Bala and Prasenjit Duara, eds., *The Bright Dark Ages: Comparative and Connective Perspectives* (Leiden, 2016), 255–280.

13 George Basalla, "The Spread of Western Science," *Science*, NS, 156, no. 3775 (1967): 611–622.

14 *Ibid.*, 617.

15 These are now too numerous to be listed here, but see, for example, the various contributions to "Focus: Global Histories of Science," *Isis* 101, no. 1 (2010): 95–158; and Fa-ti Fan, "The Global Turn in the History of Science," *East Asian Science, Technology and Society* 6 (2012): 249–258.

16 Bernard Lightman, "Editorial," *Isis* 95, no. 3 (2004): 357–358, on 357. The relevant focus themes are: "Colonial Science," *Isis* 96, no. 1 (2006): 52–87; "Global Currents in National

In addition to the continued deployment of Needhamian and Basallaesque strategies, other recent approaches to globalizing the history of science include a multiplication of narratives of knowledge-making in different linguistic, national and regional contexts, to complement the traditional, European, narrative of the history of science. In fact, this concatenation constitutes nothing more than a repackaging of traditional area studies, or a relabelling of what was previously called “non-Western” science. Although some authors have included what they term “indigenous knowledge” as part of this widening of the span of inquiry, a vast majority, notably from West, South, and East Asia, focus on domains dictated by classic Euro-centred history of science—mathematics, physics, chemistry, astronomy, etc.—their anachronism or inapplicability notwithstanding.¹⁷

Given the ideologically and politically charged historical context in which the Scientific Revolution was introduced as the organizing principle of the history of modern science, and the conscious desire to limit its theatre of operability to northwestern Europe, then, any rethinking of the history of science in a global context cannot but call into question the construct itself, and the distorted definition of science it implies. In addition, since the Scientific Revolution also constitutes a chronological marker, the starting bloc for “modern science,” we also need to find another term for this denotation.

Starting with the latter question, it is clearly of no help here to revert to the earlier more general historiographical and equally Eurocentric counterpart, the “Renaissance-Reformation” couple. Fortunately, and independently of our own attempts to go beyond the scientific revolution, the duo has come under close scrutiny by the historical profession itself. Very briefly, the Renaissance and Reformation have been increasingly replaced in recent decades by another chronological marker, the “early modern” to cover the period between roughly the mid-fifteenth and the late eighteenth centuries. As with the Renaissance, and in contrast to the Reformation, the “early modern” aims to focus on social, cultural and intellectual issues. Although coined by European historians in the 1970s, the notion has been appropriated by historians of other regions. Sanjay Subrahmanyam, for instance, has persuasively argued for a large definition encompassing not only Eurasia and Africa, but also pre- and post-Columbian America. He defines this period as the emergence of a new sense of the limits

Histories of Science: The ‘Global Turn’ and the History of Science in Latin America,” *Isis* 104, no. 4 (2013): 773-817; “Bridging Concepts: Connecting and Globalizing History of Science, History of Technology, and Economic History,” *Isis* 106, no. 4 (2015): 835-874.

17 To cite just one example, see the entries in Helaine Selin, ed., *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures* (Dordrecht, 1997).

of the inhabited world entailing momentous changes in conceptions of space (and cartography), and the emergence of new empirical “ethnographies”: long-term structural conflicts between settled urban and agricultural groups on the one hand, and nomadic societies on the other, leading to large-scale effects on global trade flows—the large-scale African slave trade, cash crops, etc.; the emergence of the idea of universal empire embodied in the projects of the Timurid tradition in Central Asia (with effects across all of Asia including the Ottoman conquest), the Spanish Habsburgs, pre-Columbian America, Southern and Central Africa, the major trading companies and eventually Britain; the emergence of new notions of the individual and medical and biological knowledge; a new public space for culture; and critical political thought. These phenomena, as the list itself suggests and a number of scholars have shown, were not limited to Western Europe, but were global in nature. I would thus suggest that we adopt for a start the early modern as the period within which to study knowledge-making on a global scale, as against the loose term “modern” which rings no bells for the period beyond the narrow bounds of our discipline.¹⁸

This chronological marker has a number of significant cascading implications. To start with, it posits a very different vision of science, from one advancing in revolutionary leaps based on putative conceptual changes necessarily located in a specific location, to one shaped instead by wider social, cultural and economic dynamics of societies in interaction. This interactive perspective in turn dictates historiographical strategies that take their distance from diffusionism, comparativism, and the multiplication of historical voices, to focus instead on the relational dimensions of history—as exemplified in recent crossroads, connected, *croisée*, or circulatory historiographies.¹⁹ This methodological choice implies investigation of those domains of scientific activity that are practiced across different cultures, including, of course, those of Europe itself. These notably include geography, natural history, medicine, ethnography, practical mathematics, navigation, and various skilled practices such as

18 Sanjay Subrahmanyam, “Connected Histories: Notes Towards a Reconfiguration of Early Modern Eurasia,” *Modern Asian Studies* 31, no. 3 (1997): 735–762. See also “Early Modernities,” special issue of *Daedalus*, 127, no. 3 (1998).

19 For the crossroads approach, see Denis Lombard, *Le carrefour javanais. Essai d'histoire globale*, 3 vols. (Paris, 1990); for connected history: Sanjay Subrahmanyam, “Connected Histories ...”; and Idem, *Explorations in Connected History*, 2 vols. (New Delhi, 2005); for *histoire croisée*: Michael Werner and Bénédicte Zimmermann, “Beyond Comparison: *Histoire Croisée* and the Challenge of Reflexivity,” *History and Theory* 45 (2006): 30–50; for circulatory history: Kapil Raj, *Relocating Modern Science: Circulation and Construction of Knowledge in South Asia and Europe, 1650–1900* (Basingstoke, 2007).

plant collection, illustration, land surveying, cartography, mining, instrument making and calibration, etc.—the very domains that fell, as we saw, outside the spotlight of the Scientific Revolution and the elite learned institutions where it was supposed to have taken place. Already, a small but growing number of studies have adopted this perspective for early modernity in order to examine the growth of knowledge through short- medium- and long-range circulations and connections.²⁰ The deployment of relational histories, which implies the confrontation of European and non-European voices in the same narrative, also changes the nature of narratives to focus not only on European actors while reducing the latter to mere “informants.”

As a global micro-historian whose work has mainly been based on specific case studies, I would like, in closing, to use an example to show how relational histories can help “unskew” not only the picture of scientific activity in the early modern period but also the heterogeneity and roles of actors involved in its making on a global scale. In order to illustrate the usefulness and deployment of relational historiographies to study the production of knowledge in a global context, let us look briefly at the making of a herbal in South Asia in the second half of the seventeenth century, the renowned *Hortus Indicus Malabaricus*.

The Making of a Botanical *Magnum Opus*

In the 1670s, in response to a request for an inventory of local fauna from his superiors in the Dutch East India Company (VOC), the civil and military Commander of Cochin on the southwestern coast of India (conquered in 1662 from the Portuguese who were established there since 1503), Hendrik Adriaan Van Reede tot Drakenstein (1636-1691), had a gigantic work commissioned on the flora of this region. Its pen-and-ink-wash drawings of some 720 species were accompanied by a detailed description of each. The herbal was published

20 See, for example, Barbara E. Mundy, *The Mapping of New Spain: Indigenous Cartography and the Maps of the Relaciones Cartográficas* (Chicago, 1996); Laura Hostetler, *Qing Colonial Enterprise: Ethnography and Cartography in Early Modern China* (Chicago, 2000); Harold J. Cook, *Matters of Exchange: Commerce, Medicine and Science in the Dutch Golden Age* (New Haven, 2007); Allison Bigelow, “Incorporating Indigenous Knowledge into Extractive Economies: The Science of Colonial Silver,” *Journal of Extractive Industries and Society* 3, no. 1 (2016): 117-123. For Europe itself, see Larry Stewart, “Other Centres of Calculation, or, Where the Royal Society Didn’t Count: Commerce, Coffee-Houses and Natural Philosophy in Early Modern London,” *British Journal for the History of Science* 32, no. 2 (1999): 133-153.

in Latin, partly posthumously, under the title of *Hortus Indicus Malabaricus* in twelve folio volumes in Amsterdam between 1678 and 1693 and was soon to become the standard reference work for the flora of southwestern India. Indeed, Van Reede's work was to form one of Linnaeus's principal sources for the flora of Asia.

The story of this gigantic work is not new and has been told numerous times, mainly from the point of view of the legal author, Hendrik Adriaan Van Reede tot Drakenstein (1636-1691). These accounts do, of course, admit to the presence of people of indigenous origin, but they are commonly referred to as "informants," who respond as adequately as they are able to questions determined by European investigators, who in turn are designated as "collectors" or "travellers." This information is then supposedly transformed into certified knowledge in the European metropole and can then be disseminated *urbi et orbi*. Van Reede himself is presented as a genius who had developed a passion for botany and natural history during his childhood.²¹ Recently, however, this thesis has been contested, most notably by the environmental historian, Richard Grove, who argues that the *Hortus Malabaricus* was largely based on the *Ezhava* (a low caste from Kerala) system of botanical knowledge and classification.²²

Recourse to a relational historiographical approach, by bringing out the different voices in the text itself, helps tell a very different story. Van Reede himself is of particular help here. Not being a natural historian—"Having done nothing from the beginning of my fourteenth year but travel beyond the borders of my native country ... I excel neither in varied and profound learning nor in accurate knowledge of botany, spices or simple medicaments"—Van Reede felt obliged to justify the sources and validity of his work.²³ In the Preface to the third volume of the *Hortus Malabaricus* (1682), dedicated to the Raja of Cochin, he writes:

By my orders, [...] Brahmin and other physicians made lists of the best known and most frequently occurring plants in their language. On this

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- 21 See Johannes Heniger, *Hendrik Adriaan Van Reede Tot Drakenstein (1636-1691) and Hortus Malabaricus: A Contribution to the History of Dutch Colonial Botany* (Rotterdam/Boston, 1986).
 - 22 Richard Grove, "Indigenous Knowledge and the Significance of South-West India for Portuguese and Dutch Constructions of Tropical Nature," *Modern Asian Studies* 30, no. 1 (1996): 121-143.
 - 23 Hendrik Adriaan Van Reede tot Drakestein, *Hortus Indicus Malabaricus*, 12 vols. (Amsterdam, 1678-1693): Vol. 3 (1682), Preface, np.

basis, others classified the plants according to the season in which they attracted notice for their leaves or flowers or fruit. This 'seasonal' catalogue was then given to a certain number of experts, who were entrusted with the collection of the plants with their leaves, flowers, and fruit, for which they even climbed the highest tops of trees. These experts went out in groups of three to designated forests. Three or four draftsmen, who stayed with me in a convenient place, would accurately depict the living plants as the collectors brought them. To these pictures a description was added, nearly always in my presence.²⁴

However, already in the first volume, published in 1678, Van Reede had included three affidavits, the first, in Malayalam, in the *Aryaezuthu* script usually reserved for the higher castes, by the chief interpreter for the Dutch, a Luso-Indian named Emanuel Carneiro, followed by two others written by the physicians involved, in their respective languages and scripts, swearing to the veracity and exactitude of the information they had provided for the *Hortus Malabaricus*. The first is written in Malayalam, in the low-caste *Kolezuthu* script, by Itty Achudem, a well-known local medic from the *ezhava* caste who specialized in climbing palm-tress and in distilling alcohol. The second, a collective certificate in the Konkani language written in the Nagari script, is signed by three Brahmin physicians: Ranga Bhatt, Vinayaka Pandit, and Appu Bhatt of Konkani origin (the region of Goa), but settled in Cochin. They attest that their mastery of medical knowledge was gained from classical Ayurvedic texts. Each affidavit is followed by a Latin translation of its contents made by Christian Herman Van Donep, the civil secretary of the local Dutch administration.

Together, the translations make very interesting reading, for they open a window into the various stages of intermediation involved in the process of writing and communicating the plant descriptions and botanical and medicinal knowledge that the volumes contain. They tell us that they were first translated into Portuguese, the intermediary language between Indians and Europeans and between European nations as well in this part of India.²⁵ From the affidavits, we learn that Itti Achudem's knowledge—partly textual, partly orally or tacitly appropriated, and partly empirically acquired—was put into writing in Portuguese by Emanuel Carneiro. Equally, Carneiro rendered his own testimony as well as Achudem's into Portuguese, and the Bhatt's and Vinayaka Pandit's collective testimony was translated by the latter, since he had

²⁴ Ibid.

²⁵ Alexander Hamilton, *A New Account of the East Indies*, 2 vols. (Edinburgh, 1727): vol. 1: xix-xx.

a good command of the language, hailing from the Goa region, a region under Portuguese rule or influence for over 150 years at the time. The whole work was then translated into Portuguese by Carneiro and his team of interpreter-translators, assisted perhaps by Vinayaka Pandit who, in addition to being a medic, served as interpreter and diplomatic negotiator (thanks to his mastery of Konkani, Sanskrit, Portuguese and, probably, Malayalam) to both the Dutch and the Raja of Cochin.²⁶ These letters seek to establish the credibility of the medics, the—diverse—sources and traditions of their knowledge and the trust one could invest in them as well as in their testimony. Their account largely corroborates Van Reede's, but with a few significant nuances: for instance, it was the Konkani doctors who sent the men out to collect the flowers, fruits and seeds of the desired plants, and it was they who compiled the descriptions from written sources as well from their own experience over a period of two years—not always in Van Reede's presence. These texts, and perhaps more written in other languages and scripts (as evident from the plant names in at least half a dozen different languages and scripts prominently inscribed in each of the *Hortus's* plant engravings) were finally rendered via Portuguese and Dutch (since we know from Van Reede's accounts that he himself made also made notes of many conversations with the medics) into Latin, the language in which the work was ultimately published. The latter translation was started by Van Donep and his team in Cochin, then continued in Batavia (now Jakarta) and was finally completed in the Netherlands. The drawings were transformed into engravings in Amsterdam where the whole work was published in twelve folio volumes over a period of fifteen years.

Conclusion

The story of the life of the *Hortus Malabaricus* itself could be continued, showing that its circulation in the Indian Ocean helped give form to botanical and medical knowledge making for Europeans and Asians alike. One could also add similar examples from the history of geography and terrestrial surveying, navigation, mining, assaying, instrument making, etc. Already, though, the difference with juxtapositional, diffusionist or comparativist histories should be clearly evident. This relational narrative involving circulations, encounters, interactions and connections helps put non-European actors back into the story as active participants in the knowledge making process and restores their agency. It thus contributes to rectifying the European great-man, heroic

²⁶ Heniger, *Op. cit.*: 43.

image on which the Scientific Revolution narrative is constructed as a singular European achievement, to the exclusion of all other peoples and cultures. More importantly, it shows that global scientific activity of the period defied the narrow confines of the Scientific Revolution ideals of physical theory and experimentation, as the above significant example clearly demonstrates. Finally, it also shows that science is not an isolated activity, but one constructed in the context of trade, diplomacy, wars and conquest, especially in the early modern world of increasing global interaction.

Each of these dimensions covered specific domains of knowledge. Trade, in the Indian Ocean region for instance, being based largely on spices, drugs and luxury commodities, required a detailed knowledge of the natural world, especially its flora and fauna; diplomacy involved an intricate knowledge of laws, customs, religious and social habits of the region's elites, and ways of enrolling them towards the specific ends of external interests; and wars and conquest, that of geography, logistics, the recruitment and organization of local armies, etc. However, there was a great deal of porosity between these activities. Finally, it also points to the dimension of translation as a crucial dimension of knowledge making in a multicultural world—where cultures need not necessarily be spatially distant—in which the process of understanding across cultures goes far beyond mere linguistic translation: translation itself constitutes the conditions for the possibility of new knowledge and innovation which is not the preserve of any one of the participating cultures. In sum, for none of these investigations do we need the Scientific Revolution either as a concept or as a chronological marker. As the Queen of Hearts would have said: "Off with its head"—a sound use of Ockham's razor, might I add!