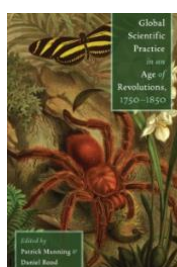


Creating Knowledge

Unpublished essay, 2021

Prologue

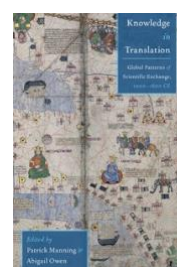
Supported by a grant from the Andrew W. Mellon Foundation, the World History Center published three conference volumes that combine the insights of world history and history of science. These broad studies of the past millennium trace the exchange and growth of knowledge. Three book reviews, by [Diarmid Finnegan](#), [Neeraja Sankaran](#), and [David Spanagel](#), show the response of readers to these works. I offer a long-term survey of advances in knowledge that relies on insights developed out of the three volumes; I argue that the three volumes provide important new insights on knowledge in history and show the need for further study of knowledge at the global level.



[Global Scientific Practice](#)



[Global Transformations in the Life Sciences](#)



[Knowledge in Translation](#)

Essay

This concise outline of a world-historical approach to knowledge, in four long periods, combines the most advanced levels of science with basic community-level knowledge. The established field of history of science explores the uniqueness of the great innovations in theory. The approach here seeks to set the history of science in the broader context of the changes in human knowledge at all levels of society and over the full history of human speech communities. In this broader context, it is important to emphasize innovation at all levels of human society, plus the benefits of conservative traditions that preserve the wisdom of the ages. Here are brief discussions of some major issues addressing the place of knowledge in human society and its transformations.

Syntactic Speech Expands Knowledge

The emergence of syntactic language appears to have been rather sudden, since both the complexity of syntax and the groups that shared in creating it had to be created at once. But the effort of confirming the sudden nature of the transition to speech also confirmed the long and gradual development of the preconditions to speech—the experience of communication through gestures and through the use of protolanguage (which relied on a small vocabulary of isolated words), the development of tools and the learning of skills for making them, and the physical changes in the human larynx that permitted the creation of a wider range of sounds. That is, the tactile and practical knowledge that developed gradually, over many thousands of years, enabled the creation of oral knowledge—the complex, syntactic language that emerged within just three or four generations of inventive work.

With syntactic speech, humans spoke in full sentences rather than isolated words. Vocabulary expanded, not just in nouns and verbs, but in the other words about place, time, and relationships. Spoken language became

a representation of the world in which people lived. That is, language itself was knowledge about the world. Knowledge expanded greatly along with real-world experience and with the verbal discourse about that experience. Oral knowledge became a new sort of knowledge—it rapidly became the main medium for knowledge, and it remained so until the media of writing and print came to supplement it.

With practice, innovations in the use of speech and memory expanded the knowledge on which speaking people could draw. Knowledge could be codified as lists, poems, vocabularies, and descriptions of procedures for fishing foraging, manufacture, and visual art. The memory was able to hold increasing quantities of information; it could be passed on by apprenticeship, in which younger persons worked and studied with elder experts. As specialized studies developed—in plant life, health, religion, weather, and the night skies—experts arose who directed workshops of younger students. Networks linked these experts to each other through their meetings or exchanges of apprentices.

Oral culture was eventually able to support new areas of human activity. Small-scale artistic work, with both abstract and realistic representations, developed steadily in their size and skill of representation. By 50,000 years ago, humans in several parts of the world were creating panoramas in rock art—in caves and open-air shelters, including exquisite representations of animals but with simplified humans. Later on and equally impressively, in the period from 15,000 to 6000 years ago, oral culture brought the development of agriculture and animal husbandry. These major advances in technology brought a rise in population. Relying on oral exchange, communities expanded their division of labor, deepened their knowledge of the care and reproduction of plants and animals, constructed towns as population centers, and built public works, as for water supply. Astronomers in every region of the world traced the stars and planets, using the positioning of stones to mark the solstices that showed the high and low points of the sun in summer and winter.

Literacy: Preserving and Sharing Knowledge

Literacy, which began some 5000 years ago, and which became widespread in much of Eurasia and Africa as of 3000 years ago, enabled preservation of language and exchanging language across space and time, beyond the reach of one's voice. Initially, written language served to preserve basic economic and socio-cultural information. In Egypt, Mesopotamia, and then China, written language eventually became able to express the full complexity of spoken language—except for the subtleties of intonation. At this level, written language became able to preserve the complex analyses of religion, society, and the natural world. With the textual presentation of knowledge, the practice of visual art expanded: illustrations as well as text now shared the space of papyrus or inscriptions on stone. Workshops were the principal institution for teaching literacy and then for recording and exchanging knowledge. A logical next step was the creation of libraries, institutions for retaining knowledge recorded as text.

Literacy spread and changed—from the founding literary centers of Egypt, Mesopotamia, and north China—but according to two main patterns. In one pattern, Chinese characters, each representing a syllable, were gradually revised and expanded, but maintaining their original organization. In the other pattern, the original scripts underwent periodic major change. Between Egypt and Mesopotamia, a new and simplified writing system arose with the closely related Phoenician and Aramaic languages: each of these relied on an “abjad” (alphabet) with roughly 20 sound-characters that were combined into words. Phoenician spread west, giving rise to the scripts of Greek, Latin, and others. Aramaic spread east, giving rise to the many writing systems of South and Southeast Asia, notably Sanskrit. In Ethiopia, the Aramaic and Sanskrit systems met and brought the invention of yet another type of script. (Meanwhile, the Mayan writing system arose in Mesoamerica in the first millennium BCE.)

The spread of literacy contributed to innovations in institutions of knowledge: institutions of preservation, teaching, and translation. In preservation and teaching, states and religious faiths set up centers of study and built libraries of knowledge. Especially in the first millennium CE, universities arose to support religion, administration, and eventually medicine—within Buddhism, Hinduism, Persian Zoroastrianism, Chinese imperial culture—and later within Christianity and Islam.

Translation later arose as a mechanism of exchange of knowledge across the boundaries of language. Indeed, one of the earliest-known major works in literature survives mainly through translation. *Gilgamesh*, the epic

of the king of Uruk, is known from its translation into Akkadian (ca. 1200 BCE), while the original was composed in Sumerian (ca. 2100 BCE). This process of passing ancestral cultural traditions from language to language has continued up to the present. Scholars in Greek antiquity drew on earlier Egyptian writings. Latin-speaking scholars under the Roman Empire translated many works from Greek. In the early Christian era, Syriac-speaking scholars (using a language close to Aramaic), translated many texts from Greek to Syriac. As the Islamic world took form and Baghdad became its capital, a major campaign of translation centered on translations from Syriac to Arabic (especially of texts originally in Greek) and also on translations from Sanskrit to Arabic (including mathematical and natural science works). From Arabic, many works were translated into Persian (as written in Arabic characters) and to Hebrew, as those three languages had great overlap in the early second millennium.

For Chinese language, the single Chinese script encompassed most writings until the second millennium, when the patterns of Chinese translation began to resemble those to the west. Japanese and Korean, after long reliance on Chinese script, became separate scripts supported by campaigns of translation. In the thirteenth and fourteenth centuries of Mongol domination, imperial administrators worked in all main written languages—for instance, printing calendars according to every religion and script to assist in tax collection in every region. As a result, a major program of translation of Persian texts into Chinese took place in Beijing.

Far to the west and also in the second millennium, a campaign expanded for translation from Arabic into Latin, the written language for Christian Europe. Scholars of Islamic, Christian, and Hebrew religion worked in parallel and in cooperation, bringing the cultural legacy of ancient Greece and India, along with the more recent analyses of the Islamic world, into Latin. In later centuries, these same works were translated again into the vernacular languages of Europe and Asia.

Travel and Translation: Steps Toward Global Exchange of Knowledge

The voyages of Christopher Columbus (1492) and Vasco da Gama (1498) gained celebration for centuries by Europeans who portrayed them as the discovery of the world and the opening of a new era, which they envisioned as the beginning of social and intellectual progress under European leadership. Indeed, there is an element of truth in these claims. European long-distance shipping opened connections with all the shores of the world, rather suddenly, as of about 1500. Further, European military and commercial shipping continued to dominate the long-distance routes until the late twentieth century. That is, European shipping opened oceanic ties for the Americas, western Africa, and the eastern Pacific; Europeans dominated the Atlantic, most of the Pacific, and dominated routes linking the Indian Ocean to Europe, the Americas, and western Africa.

But drawing a sharp line in world history at 1500 misstates, in many ways, the long-term processes of historical change. In the short term, the population density and commercial nexus of the Indian Ocean and the Western Pacific remained, before and after 1500, the world's most active region of shipping, commerce, industry, and cultural production. For the long term, the whole period since the expansion of literacy in about 1000 BCE was a time of steady expansion in innovation, travel among regions of the Eastern Hemisphere, and translation to facilitate the exchange of cultural heritage among regions of the world. Further, the expanded connections of 1500—in travel, exchange, and translation—were typical of the expansion in connections that had taken place for the preceding 2500 years, except that 1500 brought the final step. It was only at that time that humans were able to confirm the limits of the Earth and hope to visit every part of the Earth.

Throughout the 2500 years of expanded connections in knowledge through literacy, new institutions of knowledge were created, shared, and (of course) destroyed. As an example, the European campaign of translation from Arabic to Latin brought creation of new institutions. From the sixteenth century, Italian cities supported the work of urban academies that linked intellectuals in their study and exchange. From the seventeenth century, royal academies were formed in the emerging national monarchies of France, England, Sweden, and Russia. Printing, which had been well established in East Asia, reached Europe in the sixteenth century and brought a dramatic expansion in the publication and reading of books.

Galileo's new work in astronomy and in mechanics stands well for the innovations in scientific research that expanded in early modern Europe. Yet the institutional basis for such research was the time-honored structure of the workshop, organized by an inspired leader able to gather funding from wealthy supporters, assembling

assistants and apprentices who enabled the completion of small-scale investigations. This same institutional structure supported the later work of Newton, Linnaeus, and Lavoisier. While all of these figures held university degrees, universities before the nineteenth century were primarily for study of religion, law, and medicine.

Universities and Public Schools

It was the nineteenth century that brought the creation of universities and universal public schools, the two institutions that did the most to expand levels of knowledge to its present level. A key step forward took place in Germany—in the Prussian capital of Berlin, in 1809 and 1810. King Frederick William III, stung by the weakness of Prussian institutions as they were crushed by Napoleon’s army, made plans for long-term change. He called on Wilhelm Humboldt, a noted linguistic scholar, to design an educational system for Prussia. Within a year, Humboldt had designed a system of universal primary education, technical high schools for selected secondary training, and a university to train students in a full range of relevant fields of study.

Humboldt’s program was adopted, implemented, and it gradually came to be emulated throughout Europe and the world. It did not work as well as planned, especially because landowners declined to give the university substantial landed property to guarantee its revenue. Nevertheless, by 1850, the Frederick William University (now the Humboldt University of Berlin) had reached a level of global intellectual leadership. Step by step, prominent scholars were granted professorships in fields we know as natural science, social science, and humanities; with time, these single scholars hired others who became members of a department focusing on a discipline.

Thus, the rise of the university gave support to the formalization of the disciplines of modern academic knowledge. Depending on the discoveries in one field after another, scientific disciplines took form and spread their discoveries and methods to other disciplines. Before the nineteenth century, the leading fields of study had included astronomy, mechanics, navigation, and geography. During the nineteenth century, geology was long the leading field of study, but it was accompanied by new work in chemistry, thermodynamics, economics, and the physics of electricity and magnetism. Biology gained great attention with the discoveries of Darwin, but it took until the twentieth century for biology to become an established, university-level discipline.

Universities and public-school systems, for the nations that were able to support them, built an intellectual infrastructure that connected with other institutions in transforming the world. There are many stories of the rise and transformation of schooling since 1850: here is one. In the United States, the national government adopted the Morrill Act in 1862. This act granted federal land to the states so that states would create land-grant universities with a broad curriculum, supported by the value of the land they were granted. In a century, the implementation of this plan generated universities that became powerful research centers as well as enabling access to them for talented students of various backgrounds.

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INSPIRATION FOR THIS ESSAY:

Finnegan reviews Global Scientific Practice

Review of *Global Scientific Practice in an Age of Revolution* by Diarmid Finnegan (Queen's University Belfast) in *British Journal of the History of Science*

Patrick Manning and Daniel Rood (eds.), *Global Scientific Practice in an Age of Revolution, 1750–1850*. Pittsburgh: University of Pittsburgh Press, 2016. Pp. 416. ISBN 978-082294456. Doi:10.1017/S0007087417000437.

This collection of essays emerged from a conference held at the University of Pittsburgh's World History Centre. The event was the first in a series aimed at forging a 'world history of science'. The inaugural conference pivoted around a period marked by the 'great divergence' in economic growth between Europe and China, starting from the mid-eighteenth century. The editors of the published essays are candid about the difficulties of bringing all the papers under that particular rubric. Nevertheless, the effort has produced a fascinating set of explorations of 'global scientific practices' that repay close reading.

The two chapters that explicitly engage with the thesis of the great divergence are placed in a section at the end of the volume, but are worth highlighting first. Both bring world economic history and the global history of science into a single frame. Jessica Ratcliff's careful discussion of alignments between global economic and scientific practices is suggestive and cautionary. The proposal that a 'great data divergence' might be correlated with an economic divergence of the same magnitude is certainly worthy of further detailed investigation. It is not hard to envisage a plausible case for a dramatic increase in long-distance flows of information about the natural world in European spheres of influence from the late eighteenth century on. Ratcliff points to various ways to place this alongside economic concerns, noting, for example, the work of Jan de Vries on the 'industrious revolution'. The potential limitations of this approach are also signalled. As Ratcliff notes, while bringing into better focus peripheral centres, colonial subjects and global networks, the thesis falls short of a polycentric analysis of the accumulation and exchange of natural knowledge.

Daniel Rood's essay also points towards a synthesis between world economic history and a history of science attuned to global patterns of exchange. Rather than working with large-scale trends in data flows, Rood sets out an agenda for what he calls a 'global labor history of science'. The long-distance management of 'data collectors' provides a core theme, allowing parallels to be drawn between global labour relations in general and those operating within the field sciences. What Rood wants to avoid—and, I think, for good reasons—is collapsing the logics of scientific labour into economic functionalism. The large-scale management of scientific labour should not be thought of as driven by economic imperatives *tout court*. Even so, labour history might well provide some useful modes of analysis and some examples of substantive overlap to offer a way forward for constructing a novel and fruitful world history of science.

The essays in the book's earlier sections are generally less explicit about linking, conceptually or empirically, world economic history and the global history of science. All, however, make significant contributions to a history of eighteenth- and nineteenth-century science that are alert to the 'global', however that abstract noun might be understood. Part I on 'Exchanges among ways of knowing' includes three stimulating chapters examining the precarious and polysemic character of natural knowledge made in, and moved from, regions at a distance from imperial centres. That knowledge concerned *Cinchona* plantations in present-day Ecuador (Matthew Crawford), hurricanes in Louisiana (Eleanore Rohland) and bird-eating spiders originally observed and drawn in Dutch Surinam (Kay Etheridge). In each case, indigenous knowledge and practices entered into the production and utility of natural knowledge in ways that were later obscured or lost entirely. Part II takes the development and implementation of the 'Linnaean vision' as its central concern. The three essays in this section provide insights into the ambitions, reach and often less-than-global realities of classifiers and collectors. Kenneth Nyberg's account of Linnaeus's 'apostles' shows how those long-distance travellers adopted a classificatory system designed, at least in part, to give Sweden an economic advantage over its competitors and used it for much more diffuse scientific purposes. As

Hannah Hodacs shows in the subsequent chapter, the ability of Linnaean taxonomy to travel was made possible through embodied mnemonic and organizational practices. In the section's final chapter, Göran Rydén investigates the detailed descriptions by a Swedish mercantilist of British industrial and economic practices and places them within a form of travel and describing akin to the observant and classificatory practices of Linnaean science.

Part III turns to descriptive and taxonomic practices in a more general sense. It begins with Iris Montero Sobrevilla's excellent essay on the hummingbird. Long a symbol of tropical torpor, both natural and human, this image of the bird was overturned in 1790 by the *criollo* naturalist José Antonio Alzate. Sobrevilla argues that this intervention helped cultivate a 'Creole science' and offered greater recognition of the place of indigenous knowledge in natural-historical practices. Marcelo Fabián Figueroa's account of the ornithological investigations of the Spanish military engineer Félix de Azara examines the pursuit of natural-historical inquiry as a practice operating on the margins of the 'imperial geostrategy' of Spanish Bourbon reformers at the end of the eighteenth-century. Azara's collection of Paraguayan birds was only possible because of his involvement in a Spanish boundary expedition and in that sense was entirely contingent upon imperial projects. Yet as supernumerary to the expedition, bird collecting fell outside the metrics of imperial utility. The final essay, by Irina Podgorny, tracks the provenance, shipment and classificatory histories of specimens of *pichiciegos* (a species of armadillo) that found their way from southern South America to museums in North America and Europe. Among other things, Podgorny argues that the contests and confusions surrounding classification point to the fundamental epistemic instability that existed at those metropolitan centres too often typecast as places where nature gathered from peripheral spaces was put to order.

Part IV brings together three essays dealing with 'Logistics, management, and planning'. Leida Fernández-Prieto examines nineteenth-century 'sugar science' by exploring agronomic practices and experimentation in the Hispanic Caribbean. The chapter is concerned with the complex relations between an 'archipelago' of local practices and a more 'global' (but by no means uniform) agronomic science. The flows of expert knowledge associated with the tropical sugar industry trouble a historiography based on reified categories such as imperial or peripheral, Western or indigenous. The next chapter, by Stuart McCook, offers a fascinating material history of global plant transfer by telling the story of the Wardian case and its use, for a limited period between c. 1830 and 1880, to transport live plants across the world. Although the case allowed botanists and more commercially motivated actors to successfully move plants over long distances, it also facilitated the global spread of pathogens. Tighter phytopathological regulations spelled the phasing out of its use. Darker histories of globalizing practices are also in evidence in Devyani Gupta's compelling chapter on the Imperial Post Office and its transformative effect on the political economy of colonial India. Gupta positions the imperial postal system within a wider array of scientific and economic practices that eroded local custom and market arrangements to the benefit of British imperial and private commercial interests (not least the opium trade). Those scientific and economic practices were generated, developed and implemented in India, making the imperial periphery crucial to the creation of powerful regulatory regimes.

As these uniformly excellent essays demonstrate, the task of constructing histories of science that provide cogent narratives about scientific practices might be described, in one way or another, as 'global' is hugely demanding. That task may, rather unnervingly, place the historian on the same footing as some of the actors they study—on a quest for an all-encompassing 'global' view. It need not, of course, be framed in quite this way. A global history of science might entail the study of science's growing global influence, or alternatively involve a critical examination of the global ambitions or imaginaries of past scientific practitioners. Looking at efforts to operate across multiple linguistic and cultural boundaries can be used to underline the fragility, failure and partisan politics of past efforts to 'upscale' science to offer explanations of planetary-level phenomena and processes. As some critics have pointed out, however, even this project can risk eliding actors who were untouched or excluded by 'global' practices. Despite these and other conceptual and methodological challenges, the essays reviewed here represent an exciting beginning to a larger project with much promise.

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INSPIRATION FOR THIS ESSAY:

Sankaran Reviews *Global Transformations in the Life Sciences*

Review of *Global Transformations in the Life Sciences, 1945–1980* by Neeraja Sankaran (Utrecht University) in *Historical Records of Australian Science* 32 (2021): 105–106.

Patrick Manning and Mat Savelli (eds): *Global Transformations in the Life Sciences, 1945–1980*. University of Pittsburgh Press: Pittsburgh, 2018. 328 pp., ISBN: 9788022945277 (HB) USD\$45.00

The editors and writers of this volume are to be applauded for riding well ahead of the decolonization curve. *Global Transformations in the Life Science* showcases its importance, both in the sciences and in their histories. This theme was at heart of discussion on the state of the discipline at the recent (and first) digital festival of the British Society for the History of Science. Exploring similar themes, this collection of 12 essays is based on papers first presented at a 2014 conference on post-World War 2 life sciences, held at the University of Pittsburgh’s World History Center.

One of the overarching aims of the World History Center event was a desire to ‘articulate the study of science (and technology) within world history and identify global perspectives in the history of science’. The theme is thus very broad—or even diffuse—for a collection that concentrates on the life sciences over a very small window of time. Spanning a mere 35 years, the essays cover varied topics in diverse places. Whereas some chapters focus on specific places, the major emphasis is on global developments, giving new life to the maxim popularized by microbiologist René Dubos: ‘think globally and act locally’.

Moreover, as Patrick Manning, one of the editors of *Global Transformations in the Life Sciences* makes clear, the term ‘global’ has been used in more than merely a geographical sense. In his scheme, the ‘global’ frame is implicit to analysing the history of science at ‘various scales of social and academic life’. These scales are made evident in the various contributions herein: David Wright, Sasha Mullally and Renée Saucier explore the Indian ‘brain drain’, while Frank Stahnisch details the less familiar ‘brain gain’ in post-war North America. Smallpox eradication, sexology and racism through the rare lens of fingerprint research in East Asia are also fair game in this fascinating and diverse volume.

The insertion of science into post-war history is clarified by Joanna Radin, who positions the life sciences as ‘central to imagining the human future on a planet that they had already irrevocably transformed’. I can fully understand the desire to consider the post-World War 2 transformations in the life sciences. But why stop at 1980? In reviewing the chapters, I am tempted to think that the bookend may simply be an artefact of circumstance, the particular case studies presented here. If the choice was explained, I missed it. Calling attention to it in the title was perhaps not necessary; the phrase ‘after World War 2’ might have been a better choice, as most insights offered by the authors transcend the nominal date range. Indeed, some of the essays, notably, the concluding contribution by Jon Agar about the Sixth Extinction, are certainly not time-bound in any way. This extinction is still ongoing today, at an accelerated pace.

This minor burr aside, the collection makes good on the promises offered in the introduction. For instance, it highlights the complex evolution of the life sciences after the Second World War. The contributors also elaborate the innovative ways in which decolonization motivated local developments that both ‘contributed to and relied substantially on the main line of evolving biomedical knowledge’. Daniele Cozzoli’s examination of post-war research on curare is a great example that shows how the investigative enterprise in France and Italy was dependent on the networks established with South Americans. Lijing Jiang reverses the axis of influence, asking how international developments in cancer research were interpreted in China.

I make no apology here for mentioning just two essays from the many excellent contributions. This is a strong and cohesive volume that well justifies its place within the series of conferences hosted by the World History Center on the globalization of science. I leave the actual reading of the individual essays to scholars and students alike, who may be sure that they are well worth the effort.

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INSPIRATION FOR THIS ESSAY:

Spanagel Reviews Knowledge in Translation

Excerpt from a Review of *Knowledge in Translation* and *Global Transformations in the Life Sciences* by David Spanagel (Worcester Polytechnic Institute) in *Journal of World History* 31 (2020): 621–622.

Knowledge in Translation: Global Patterns of Scientific Exchange, 1000–1800 CE. Edited by PATRICK MANNING and ABIGAIL OWEN. Pittsburgh: University of Pittsburgh Press, 2018. 437 pp. ISBN 9780822945376. \$55.00 (hardcover).

These two books, along with the previously published *Global Scientific Practice in an Age of Revolutions, 1750–1850*, round out an impressive array of studies that were originally presented at three major conferences hosted by the World History Center at the University of Pittsburgh following its establishment in 2008 as a “center for research, institutional development, and teaching in world history.”¹ As indicated by the titles of the three volumes, each conference aimed to bring together scholars from various subfields, areas of geographical and cultural expertise, and differing methodological approaches, in order to explore and interact within an overlapping zone of contact between a broadly defined chronological era of world history and topics rooted in specific historical studies of the sciences.

Unlike what one finds in so many such edited conference volumes, the chapter authors in these books made a deliberate and concerted effort to highlight key points of comparison and contrast that both situate and distinguish their own particular findings in the light of those discussed by fellow contributors. While the conceptually omnivorous genius of the World History Center’s founding Director Patrick Manning shows itself explicitly through his participation in the co-editing teams responsible for all three volumes, his co-editors (Abigail Owen and Mat Savelli, respectively) helped him to articulate distinct, ambitiously coherent themes for each book. The clarity and analytical utility of these proposed themes combine to provide a remarkable framework for thinking about the challenges of even thinking about “world histories of science.” Manning and his colleagues should be proud of this collective achievement, especially considering the tremendous diversity and particularity of the scholarly narratives contained, respectively, within each book.

Knowledge in Translation: Global Patterns of Scientific Exchange, 1000–1800 CE explores the role of “translation in cross-cultural communications” (Manning and Owen, p. 1) through historical investigations of how three key categories influenced the nature of knowledge as it migrated and changed across time and place. In his Introduction, Patrick Manning names and distinguishes these categories as: (1) the dynamics of the communication modalities used, (2) prevailing global natural conditions, and (3) the context and practices of translation as an activity (Manning and Owen, p. 11).

Most of the chapters included in *Knowledge in Translation* deliver not only what Manning here promises but astonishingly more. In “The Global and the Maritime” (chapter 4), for example Robert Batchelor illuminates divergent cultural understandings of the pilot-navigator among all the contending powers who converged upon the Indian Ocean in the fifteenth and sixteenth centuries. I had no idea how much borrowing, adaptation, and even direct translation enabled Portuguese (and later Dutch and English colonizers) to supplant pre-established Ottoman, Arab, Mongol, South Asian, and East Asian networks of trade and communication throughout the Indian Ocean, which the late fourteenth century Timurid (Persian) statesman Abdur Razzaq had presciently called the *majma’* = “a meeting place, a place of concourse or assembly where messages were exchanged” (Manning and Owen, p. 80). Similarly, Irina Podgorny’s (chapter 8) linguistic dissection of various cultures’ medical legends about “the nail of the great beast” reveals a fascinating new lens that will surely complicate how we think about the Enlightenment’s species degeneration disputes.

¹¹ Patrick Manning and Daniel Rood, eds., *Global Scientific Practice in an Age of Revolutions, 1750–1850* (Pittsburgh: University of Pittsburgh Press, 2016), x.

Knowledge in Translation culminates particularly effectively with its five chapters on knowledge transmission and transformational practices in astronomy. In particular, I would recommend to all Renaissance historians that they examine and absorb the combined brilliance of Roxann Prazniak's (chapter 13) study of sources and consequences of thirteenth century scholarship done at the Mongols' Marâgha Observatory, Dror Weil's (chapter 15) intriguing narrative of fourteenth century Chinese reception of Arabo-Persian astronomy, and Pat Seed's (chapter 16) remarkable explanation for how the revolutionary fifteenth century Portuguese navigational breakthrough depended essentially on Jewish scientists being able to translate Muslim instruments and complex mathematical tables into practical tools for use on shipboard by ordinary Christian sailors. These three chapters cap the entire book's ambitious achievement.