

Editor's Introduction

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This special issue of *The Korean Journal for the History of Science* focuses, as the title indicates, on the circulation of scientific knowledge in East Asia in the seventeenth and eighteenth centuries. This focus represents an important advance over the previous framework within which much of the world history of science has been written, namely the “science and civilization” approach predominant during the twentieth century. My comments here will be divided into three sections. The first section presents a brief critical overview of the assumptions underlying the “science and civilization” framework, and, in particular, important ramifications for the study of the history of science in East Asia in the seventeenth and eighteenth centuries. The second section provides an outline of the approach to the circulation of scientific knowledge proposed here, along with comments on related trends in recent research. The third section offers summaries of the four articles in this special issue, focusing on the ways in which they each contribute to the reconceptualization of world history of science.

“Science and Civilization”

During much of the twentieth century, the dominant approach to world history of science can perhaps be best summarized by the phrase “science and civilization,” a phrase used by Joseph Needham in the title of his pioneering studies of the history of Chinese sciences.¹ The “science and civilization” approach to world history of science served as an important corrective to the view that science was unique to the West. Research on non-Western science pursued within the science and civilization framework contributed enormously to our understanding of world history of science outside of what has been called “the West.” Without that pioneering work, current research on the history of non-Western sciences would scarcely have been possible. This “science and civilization” framework, however, brought with it a focus on civilizations, and in particular an anachronistic projection onto the historical past of the twentieth-century preoccupation with “civilizations.” In fact, studies of world history of science too often focused primarily on civilizations as such, and too little on sciences and their history.

This effect was especially pronounced in studies of the history of East Asian science, and in particular, the asserted “first encounter” of East Asia with Western science brought by the Jesuits beginning in the early seventeenth century. Previous

¹ Joseph Needham, ed., *Science and Civilisation in China*, 7 vols. (Cambridge: Cambridge University Press, 1954–2008).

accounts of the history of science in East Asia during this period can perhaps be roughly summarized as follows: the Jesuits, seeking to convert East Asian scholarly elites, used science to impress these elites and attract followers; a select group of farsighted East Asian scholars, thus impressed by the superiority of Western science, worked closely with the Jesuits and converted to Catholicism; the majority of East Asians, however, being both xenophobic and conservative, clung to Confucian orthodoxy despite the clear superiority of Western science. These accounts have been justly criticized as Eurocentric: too often they were based primarily on documents in European languages written by Europeans, and Europeans were often portrayed as the central protagonists; as a result, too often these accounts adopted as historical conclusions views not unlike those of their European protagonists. In particular, a dominant theme of these previous accounts was providing social or political explanations for alleged East Asian rejection of modern Western science. With the grand narrative thus given, selectively chosen historical facts were proffered to support the preordained conclusions. But as the articles in this special issue demonstrate, the historical record does not support this grand narrative, and it is for this reason that alternative approaches must be developed.

Circulations of Scientific Knowledge

Inquiry into the circulation of scientific knowledge fundamentally reorients our analysis, on a number of levels: instead of a known, one-way transmission, we now trace contingent, fortuitous, and unpredictable routes; instead of presuming “East” and “West” as a fundamental dichotomy, we analyze dynamic social groupings as they emerge and transform; and instead of naturalizing the adoption of Western science, we contextualize its dissemination historically through the analysis of a complex set of political, social, and institutional factors.

This approach to the circulation of scientific knowledge has developed in conjunction with several important trends in recent historiography, and it may therefore be helpful to provide at least a brief outline of some of the most important contributions toward this emerging approach. In the late twentieth century, several seminal studies focused on economic circulations around the world before the so-called “rise of the West.”² Important studies analyzed the circulation of knowledge, both within Europe³ and between East Asia and the West.⁴ Research turned also toward the circulation of

² Janet L. Abu-Lughod, *Before European Hegemony: The World System A.D. 1250–1350* (New York: Oxford University Press, 1989); R. Bin Wong, *China Transformed: Historical Change and the Limits of European Experience* (Ithaca, NY: Cornell University Press, 1997); Andre Gunder Frank, *Reorient: Global Economy in the Asian Age* (Berkeley: University of California Press, 1998).

³ Stephen Jay Greenblatt, *Shakespearean Negotiations: The Circulation of Social Energy in Renaissance England* (Berkeley: University of California Press, 1988).

⁴ Lydia H. Liu, *Translingual Practice: Literature, National Culture, and Translated Modernity—China, 1900–1937* (Stanford, CA: Stanford University Press, 1995).

scientific knowledge: exemplary studies focused on circulations within Europe,⁵ and, of particular importance, disaggregated Europe, focusing on the local character and changing fortunes of centers of scientific circulation and exchange, such as the role of the “low countries,”⁶ and the function of “go-betweens” in these circulations.⁷ Other studies linked exploration to developments in science,⁸ and explored the relation between science and empire-building.⁹ More recent research explored circulations between India, Islam, and Europe.¹⁰ One particularly important implication of this body of work is the need for a more accurate historical analysis of the discoveries that have been credited to the European “scientific revolution.”¹¹

This interest in circulation is also supported by a wide range of critical studies that undermine the asserted identification of science, modernity, and the West. Recent theoretical works have reconceptualized cultures as multiplicities,¹² problematizing previous simplistic East/West binaries. Postcolonial studies have decentered Europe,¹³ and similarly, critiques of Sino-centrism have decentered China.¹⁴ Modernity is itself multiple;¹⁵ the asserted “Great Divide” between cultures is imaginary.¹⁶ Science studies have sought to replace science back into its historical context,¹⁷ resulting in

⁵ Pamela H. Smith and Paula Findlen, eds., *Merchants & Marvels: Commerce, Science and Art in Early Modern Europe* (New York, NY: Routledge, 2002).

⁶ Sven Dupré and Christoph Herbert Lüthy, eds., *Silent Messengers: The Circulation of Material Objects of Knowledge in the Early Modern Low Countries* (Berlin: LIT, 2011).

⁷ Simon Schaffer et al., eds., *The Brokered World: Go-Betweens and Global Intelligence, 1770–1820* (Sagamore Beach, MA: Science History Publications, 2009).

⁸ Amir R. Alexander, *Geometrical Landscapes: The Voyages of Discovery and the Transformation of Mathematical Practice* (Stanford, CA: Stanford University Press, 2002).

⁹ Jorge Cañizares-Esguerra, *Nature, Empire, and Nation: Explorations of the History of Science in the Iberian World* (Stanford, CA: Stanford University Press, 2006).

¹⁰ Avner Ben-Zaken, *Cross-Cultural Scientific Exchanges in the Eastern Mediterranean, 1560–1660* (Baltimore: Johns Hopkins University Press, 2010); idem, *Reading Hayy Ibn-Yaqzan: A Cross-Cultural History of Autodidacticism* (Baltimore: Johns Hopkins University Press, 2011); Arun Bala, *Asia, Europe, and the Emergence of Modern Science: Knowledge Crossing Boundaries* (New York, NY: Palgrave Macmillan, 2012).

¹¹ George Saliba, *Islamic Science and the Making of the European Renaissance* (Cambridge, MA: MIT Press, 2007).

¹² Michel de Certeau, *Heterologies: Discourse on the Other*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1986); idem, *Culture in the Plural*, trans. Tom Conley (Minneapolis: University of Minnesota Press, 1997).

¹³ Dipesh Chakrabarty, *Provincializing Europe: Postcolonial Thought and Historical Difference* (Princeton, NJ: Princeton University Press, 2000); Partha Chatterjee, *Nationalist Thought and the Colonial World: A Derivative Discourse* (Minneapolis: University of Minnesota Press, 1993).

¹⁴ Pamela Kyle Crossley, Helen F. Siu, and Donald S. Sutton, eds., *Empire at the Margins: Culture, Ethnicity, and Frontier in Early Modern China* (Berkeley: University of California Press, 2006).

¹⁵ Matei Calinescu, *Five Faces of Modernity: Modernism, Avant-Garde, Decadence, Kitsch, Postmodernism* (Durham, NC: Duke University Press, 1987).

¹⁶ Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge, MA: Harvard University Press, 1993).

¹⁷ Mario Biagioli, ed., *The Science Studies Reader* (New York: Routledge, 1999); Steven Shapin, *Never Pure: Historical Studies of Science as If It Was Produced by People with Bodies, Situated*

increased interest in networks and translations.¹⁸ Increased attention to globalization, not just in the social sciences,¹⁹ but also in history,²⁰ has led to further inquiries into global circulations in the premodern period, and in particular, between East Asia and the West.²¹ The articles presented here in this special issue, then, seek to contribute to this broader research agenda through a reconceptualization of the circulation of scientific knowledge in East Asia.

Summary of the Articles

Because the shift toward tracing the circulation of scientific practices represents a fracturing of previous Eurocentric accounts—accounts in which the transmission of knowledge was too often conceptualized as fundamentally monolithic and unidirectional—it should not be surprising that newer alternatives are diverse in their approach and points of departure. In particular, although the four articles in this special issue take issue with the previous accounts of the introduction of Western science into East Asia, they each take a different approach to reconceptualizing the circulation of scientific knowledge. In the following summaries of the articles included in this special issue, I will place particular emphasis on the contribution made by each to the reconceptualizing of the world history of science through a focus on alternative approaches to the circulation of scientific knowledge.

Lim Jongtae's 林宗台 article presents a fundamental reassessment of what has been viewed as the adoption of Western astronomy in seventeenth-century Korea. Lim replaces these events back into their historical context, namely, concerns of the Joseon 朝鮮 (1392–1910) court about their tributary relationship to their threatening neighbor, the newly established Qing 清 dynasty (1636–1912). He shows that continuing the proper tributary relationship with the Qing was of paramount importance to the Joseon court—it was not for scientific reasons, but rather to maintain proper rituals dictated by the Qing that the Joseon adopted the Jesuit-inspired Shixian calendar (*Shixian li* 時憲曆) after its adoption by the Qing in 1645. It was for this reason, Lim demonstrates, that the Joseon court was determined to “immediately launch a project to master the secrets of the new Jesuit calendar.” Lim’s article contests received accounts on several points: Western astronomy was adopted not because it was

in Time, Space, Culture, and Society, and Struggling for Credibility and Authority (Baltimore: Johns Hopkins University Press, 2010).

¹⁸ Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005).

¹⁹ Arjun Appadurai, *Modernity at Large: Cultural Dimensions of Globalization* (Minneapolis, MN: University of Minnesota Press, 1996).

²⁰ A. G. Hopkins, ed., *Globalization in World History* (New York: Norton, 2002); A. G. Hopkins, ed., *Global History: Interactions between the Universal and the Local* (New York: Palgrave Macmillan, 2006).

²¹ Yvonne Dold-Samplonius et al., eds., *From China to Paris: 2000 Years Transmission of Mathematical Ideas* (Stuttgart: Franz Steiner Verlag Wiesbaden, 2002); Florence Bretelle-Establet, ed., *Looking at It from Asia: The Processes that Shaped the Sources of History of Science* (New York: Springer, 2010).

“Western” but because it was “Chinese”; the historical context was Joseon’s tributary relationship to Qing China, and the imperative for the Joseon to comply to the dictates of its hegemonic neighbor; the calendar was adopted not for greater accuracy but to conform with proper rituals. Lim’s article provides an especially cogent critical historicization of the received historiography, noting that “under the ideological imperative of national modernization that prevailed among Korean intellectuals of the twentieth century, Korean historians found in this late Joseon episode an earlier phase of the modernization of Korea, specifically a process of the conversion of pre-modern Koreans from ‘medieval Chinese’ to ‘modern Western’ sciences.” If a central theme of this special issue is to reassess the received historiography, a similar criticism can be made of most twentieth-century studies of the “first encounter” of China and the West, which projected on to the seventeenth century anachronisms from the nineteenth and twentieth centuries, including Western military, scientific, and technological dominance. In particular, many Chinese historical accounts in the twentieth century sought to portray the Chinese literati-officials who sought promotions in the Ming court by propagandizing for Western Learning as having presciently recognized the superiority of the West and patriotically supported the adoption of Western Learning to strengthen China.

Don Baker’s article presents a wide-ranging analysis of several aspects of the reception by Korean Confucians of Western mathematics introduced by the Jesuits. Here, in this brief summary, I will focus on what I consider to be the most important contribution of his article toward rethinking this episode, namely, his conclusive argument that among Korean scholars, the acceptance of Christianity and Western mathematics were inversely related: the elites who studied mathematics most seriously were the least interested in religion, and those who were the most religious were the least interested in mathematics. Baker notes that important recent studies by Florence Hsia and Liam Brockey,²² focused on European-language writings of the Jesuits, show that the Jesuits in China introduced mathematics and science “for one reason only—to convert Confucians to Christianity.” Mathematics and science were thus not a focus of the activities of most missionaries. Baker then examines the adoption of Western science and mathematics in Korea, analyzing several individual cases to support this conclusion. Examples of Korean scholars who promoted Catholicism but evinced little interest in mathematics include Yi Seunghun 李承薰 (1756–1801, who was executed for his Catholic activities) and Yi Byeok 李檠 (1754–1786). Korean scholars interested in Western science and technology but not Catholicism include Yi Gahwan 李家煥 (1742–1801), a noted geometer, who had to distance himself from Western mathematics, owing to his fear of persecution, which eventually cost him his life, and Jeong Yagyong 丁若鏞 (1762–1836), who employed Western technology. Baker concludes that among the small number of Korean Catholics, very few evinced interest in Jesuit science or mathematics; and among the scholar-officials interested

²² Florence C. Hsia, *Sojourners in a Strange Land: Jesuits and Their Scientific Missions in Late Imperial China* (Chicago: University of Chicago Press, 2009); Liam Matthew Brockey, *Journey to the East: The Jesuit Mission to China, 1579–1724* (Cambridge, MA: Belknap Press of Harvard University Press, 2007).

in Western mathematics, science, or technology, very few accepted Jesuit doctrines about the supernatural.

Koo Mhan-ock's *구만옥* contribution to this special issue demonstrates that Confucianism was hardly an impediment to the spread of Western mathematics, and in fact, it was through Confucian "broad learning" (*bakhak* 博學) that interest in mathematics, calendrics, and harmonics developed. Koo begins with what might be viewed as a close reading of a single text, *Random Jottings from the Studio for Preservation of the Self* (*Yijae nango* 頤齋亂藁), a journal kept by the Korean Confucian scholar Hwang Yunseok 黃胤錫 (1729–1791), which spans a total of 53 years from 1738 to 1791, and covers an extraordinarily broad range of subjects from the Confucian classics to the sciences, both Chinese and Western. From this journal Koo reconstructs a very rich picture of scholarship in Korea during this period: the historical context, especially Confucian "broad learning," including commentaries on the Confucian *Classic of Documents* and *Classic of Changes*, the River Diagram, phonology, geography, poetry, military formations, painting, and miscellaneous arts; the connections of this Confucian "broad learning" to the sciences, including harmonics, calendrical astronomy, and mathematics; the mathematical treatises in circulation at the time—both Chinese and Western—including works by Song (960–1276) and Yuan (1271–1368) dynasty Chinese mathematicians Zhu Shijie 朱世傑 (1249–1314) and Yang Hui 楊輝 (c. 1238–c. 1298), along with Western mathematical treatises by Ming (1368–1644) dynasty Jesuit collaborators Li Zhizao 李之藻 (1565–1630) and Xu Guangqi 徐光啟 (1562–1633); the mathematical topics under study during the period, including Euclidean geometry, proportional compasses, logarithms, counting-rod calculations, and celestial origin algebra; Korean scholarly genealogies, which were formed through clans, intermarriage, and political networks; the numerous communities of scholars in Seoul specializing in Western mathematics, including the Seo clan, the "Near Seoul Southern faction," Jeong brothers, "Northern Learning," and "Western doctrines of the elder faction"; and contests among the scholarly elite for recognition and reputation through debates and the production of scholarly texts. Koo's central thesis is to demonstrate how Hwang's interest in Confucian "broad learning," stemming from the *Complete Collection on Nature and Principle* (*Xingli daquan* 性理大全), developed into the study of images and numbers, ritual and music, through the *Classic of Changes* and *Classic of Documents*, on to Song-Yuan mathematics, and then on to Western Learning and the sciences introduced into China by the Jesuits. Koo notes that Hwang viewed Western religion as heterodox. In sum, as Baker notes in his article, Koo's research presents a persuasive case against the stereotype that Confucians were uninterested in science or the West, and resisted Western science.

My own article analyzes the claims for the superiority of Western mathematics made by Xu Guangqi, Li Zhizao, and Yang Tingyun 楊廷筠 (1557–1627), who collectively are called the "Three Pillars" (*san da zhushi* 三大柱石) of Catholicism in late Ming China. I focus on the claims made by the most prominent of the Three Pillars, Xu Guangqi, who, in the preface he wrote for their purported "translation" of a European mathematical treatise brought by the Jesuits, asserted that

Western mathematics was in every way superior and denounced Chinese mathematics as “tattered sandals,” which could be “discarded.” I demonstrate that arguably the most “modern” problems in their “translation” were purloined—without comparison, without analysis, without criticism, and without any mention of the source—from the very Chinese mathematical treatises Xu execrated. This suggests that Xu, Li, Yang, and their collaborators did not themselves believe the assertions they presented in their prefaces extolling the superiority of mathematics from “the West.” Instead, their assertions were part of self-serving propaganda designed to promote “Western Learning” (*Xi xue* 西學) and with it their own careers. More broadly, I argue that extant mathematical treatises from this period should be viewed as epiphenomenal, preserving only fragments of mathematical practices. From extant mathematical treatises—which were written, compiled, circulated, and preserved by the literate elite—I reconstruct the mathematical practices of the period. My focus is on *fangcheng* 方程, or what we would now call linear algebra. The earliest extant written records of these practices are recorded in Chinese mathematical treatises dating from the first century CE, and these mathematical practices continued to be recorded in Chinese mathematical treatises throughout the imperial period. I argue that the literate elites who compiled mathematical treatises often had little more than a rudimentary understanding of the mathematical practices they recorded, especially for practices as complex as linear algebra. Using evidence preserved in extant texts, I reconstruct these practices as they were performed—with counting rods on a two-dimensional counting board. I show that *fangcheng* adepts were able to compute solutions to difficult problems involving n conditions and n unknowns with only an expertise with counting rods together with an understanding of a few simple two-dimensional patterns. Adepts of these practices, through repetition, would have been able to compute solutions through rote procedural memory, just as modern-day abacus adepts can compute with astonishing speed and accuracy. I then present evidence that specialized linear algebra problems with solutions so arcane that they can serve as “fingerprints” circulated across the Eurasian continent, and can be found in Italian texts from the thirteenth century. The advent of the Jesuits in China was thus hardly the “first encounter” of China and the West. Instead, I argue, world history of science must trace the global circulation of scientific practices.

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