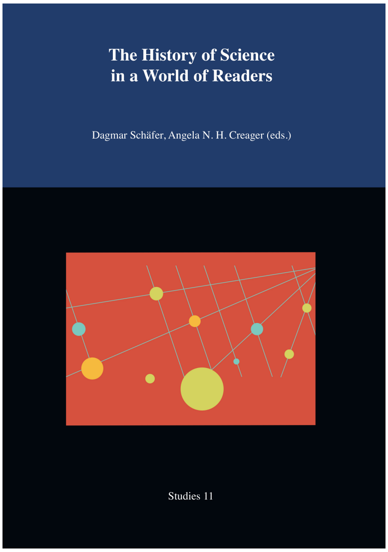
Max Planck Research Library for the History and Development of Knowledge

Studies 11

Angela N. H. Creager and Dagmar Schäfer:

History of Science in a World of Readers: Frames of References for Global Exchange



In: Dagmar Schäfer and Angela N. H. Creager (eds.): *The History of Science in a World of Readers*
Online version at http://mprl-series.mpg.de/studies/11/

ISBN 978-3-945561-42-3
First published 2019 by Edition Open Access, Max Planck Institute for the History of Science under

Printed and distributed by:
PRO BUSINESS digital printing Deutschland GmbH, Berlin
http://www.book-on-demand.de/shop/15800

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at http://dnb.d-nb.de

History of Science in a World of Readers: Frames of References for Global Exchange

Dagmar Schäfer and Angela N. H. Creager

The idea for this collection was born on a foggy day in March 2015 during a scholarly retreat on the outskirts of Berlin. A photo of a reader sitting in a crowded bookshop in Shanghai, China, holding the 1990 Chinese translation of Joseph Needham's introductory volume, *Science and Civilisation*,[1] elicited a lively debate about the purpose, themes, and reception of translations in the globalizing discipline of the history of science, technology and medicine.[2] What role should historians of science have in communicating their own body of literature—its methods and concerns—across linguistic boundaries?

This anthology, published in both English and Chinese, is an initial response to that debate, reflecting a wish to counteract and complement both market-driven and individual efforts with a collective reflection on some of the influential literature in this field published in English since 1990. The Max Planck Institute for the History of Science (MPIWG), Berlin, and the History of Science Society (HSS) organized a selection committee including representatives from six other societies—the American Association for the History of Medicine (AAHM), the British Society for the History of Science (BSHS), the Division of the History of Science and Technology of the International Union of History and Philosophy of Science and Technology (DHST/IUHPST), the European Society for the History of Science (ESHS), the Society for the History of Technology (SHOT), and the Society for the Social History of Medicine (SSHM). Twelve chapters were selected for translation into Chinese based on an online poll that ran between October and December 2015. This version features seven chapters in their original form, as the other five were unavailable for publication due to copyright restrictions.[3]

The selection committee reviewed, evaluated, and ranked an initial shortlist of 78 articles before deciding on the final list. Given how geographically dispersed English-language historians of science are, this arrangement enabled the committee to use current global technologies to crowd-source candidate publications while ensuring an appropriate balance of articles on science, technology, and medicine over a range of time periods and regions, as well as a diverse group of authors.

We believe that translations—in the linguistic sense of the word—serve an important function as a scholarly practice in internationally competitive research, which is characterized by an increasing number of diverse, multilingual actors on the one hand, and an increasing tendency towards a hegemonic linguistic approach on the other.[4] Literary translations, in contrast to collaborative monolingual publications (often produced by authors from varied

[1] Needham ([1954] 1990).

[2] If not otherwise indicated, history of science is hereinafter used to include history of technology and history of medicine.

[3] Rosenberg (1992); Kohler (1999); Blair (2003); Galison (2003); Green (2008).

[4] Gordin (2015, 219). See also the statistics of the European Union on translation activities (https://www.ceatl.eu/current-situation/translation-statistics).

language backgrounds), make explicit their negotiations over content, format, and meaning. Agreements, compromises, and misunderstandings are laid bare, as decisions have to be made about which word best represents another, and which socio-cultural associations and historical or political contexts need to be taken into account to make the meaning clear.

Historians have assigned translations an important, though not always unambiguous, role in the historical dynamics of scientific development—especially in discussions of exchanges between China and "the West" (Europe and North America). The research focus has shifted from the expansion of "Western science" to one of multilateral effects. For instance, the story of the Chinese Euclid, once solely emphasizing how the Jesuit Matteo Ricci (1552–1610) taught Xu Guangqi (1562–1633) Western science, has turned into the study of a reciprocal process that affected various European groups as much as it affected the Chinese and other East Asian actors. While early studies once concentrated on the transmitted contents of books and their reception, Harold Cook and Sven Dupré have recently emphasized the hugely important historical role of translators and their roles as "brokers" and "go-betweens." Bettina Dietz has shown how translators' one-off situational choices turned into terms that others legitimized by usage: in this way, Linnaean botanic terms have developed into a global standard since the twentieth century.[5] Thus, the translator's expertise matters.

Such insights also resonated with the selection committee while producing this volume. Special attention was given to the historical dynamics that shaped word choices and conceptual frameworks. By offering an expansive index, this volume also acknowledges the historical insight that the

> scientific term is not formed at once, every word or better say every new thing is constructed gradually using works of predecessors. … [T]here are some terms which are invented in special fields and it [the scientific understanding and meaning that this term now carries] will take time to become popular and common among all experts.[6]

Each article translated from English into Chinese underwent several reviews by experts with multiple language skills from the relevant fields. In its production, the volume illustrates a point which the growing discipline of translation studies has repeatedly emphasized—that translation is far more than a simple act of transmission or transfer: its interpretative character and effects cannot be ignored.[7] Over the last two years, conversation among the various participants has generated new ideas and forged new scholarly connections. Moreover, the selection exercise stimulated individual and joint reflections about how the history of science, technology, and medicine has evolved and where it is heading. We hope that these productive debates will continue and the publication will help advance methodological developments in the globalizing field of the history of science.

This introduction which was compiled in English first, reviews historical research on translations in the fields of science, technology, and medicine, and inquires into its role in the history of Chinese-English exchanges to illustrate some of the challenges and opportunities impacting international historical research. Then the selected works are contextualized within the broader landscape of Anglophone research in the history of science, technology, and medicine.

---

[5] Yu-lan Fung 馮友蘭 (1983); Engelfried (1998); Blue, Engelfried, and Jami (2001); Brockey (2007); Cook and Dupré (2012); Dietz (2016).

[6] Tabrizi and Pezeshki (2015, 1173–1174).

[7] Holmes (1988).

Translations, the History of Science, and East-West Exchange

Ever since the late 1980s, scholars and politicians in the People's Republic of China have been advocating the need to improve the general public and academics' understanding of both historical dynamics (*lishi gan*歷史感) and scientific change. This agenda is also part of the general education of scientists, a contemporary initiative which no longer has an equivalent in the US or most European universities but a generation ago was also ubiquitous there.[8]Historians themselves are increasingly branching out to provide an inclusive global view in their research, both regionally and with regard to time frames. As curricula are rethought, scholars are also beginning to analyze the historical dynamics that shape their methodological apparatus.

The beginnings of historical research into the sciences in China were characterized, as in most twentieth century nation-states, by a focus on China itself. From Ding Wenjiang 丁文江 (1837–1936) and Zhang Zehong 张资珙(1904–1968) to Joseph Needham (1900–97), twentieth century scientists were also historians who transferred scientific content not by itself, but supplemented with science histories (or stories) in order to illustrate how Western scientific knowledge was created. Often they exemplified ideals and modes of "modernization" in their prefaces and accompanying reports.[9] By the 1920s some English histories of science had already been translated by Chinese students studying abroad who translated their teachers' work into Chinese. One example of this is the contribution of Chu Cho-ching (竺可桢), founder of the Annual of the History of Science.[10]

Over the following decades, a confluence of individual interests and arbitrary encounters generated a rather motley selection of translated historical studies by Western writers, such as Florian Cajori, *A History of Physics* (1899), Edwin A. Boring, *A History of Experimental Psychology* (1929), J.R. Partington, *A Short History of Chemistry* (1937), W.C. Dampier, *A History of Science and its Relation to Philosophy and Religion* (1948), J.D. Bernal, *Science in History* (1954), and Morris Kline's compendium of *Mathematical Thought from Ancient to Modern Times* (1972).[11]

Most of these works remained in academic hands and brought heroic stories of Western scientists and sciences to China, thus transmitting viewpoints that the Anglophone community itself had begun to question and effectively deconstruct at the end of the Cold War era, a time when the frequency of international exchange increased.[12] Importantly, as many

[8]Shen Xianjia 申先甲 (1991, 306–291). See also Jiang Qian 蒋茜，Li Xinxin 李欣欣，Shen Xianjia 申先甲 (2013). Liu Bing 刘兵 (2011). For instance, he asserted that scientific education would lack stimuli if it did not impart students with a knowledge of history. Letter from D. K. Djang [?Chang Tzu-kung/Zhang Zigong] (1945) at Christ's College, Cambridge about his work on translations for a "Collection of Essays on History of Chinese Astronomy and Calendar Making" and other matters and related correspondence, SCC2/3/9.

[9]Li Yuese 李约瑟 (1975, 23).

[10]For an overview of science translations, see Li Nanqiu 黎难秋 (2000). Translators or authors often contextualized the works historically in their prefaces, while historical arguments were often part of scientific tracts at that time.

[11]For reasons of space, it is not possible to provide a comprehensive list here. Translations often targeted physics, chemistry, mathematics, and astronomy, such as Zhang Zigong 张资珙 (1952).

[12]Most of these works have been republished many times. For example, Dai Nianzu's 戴念祖 translation of Florian Cajori's *A History of Physics* has been published by at least three publishers: (1981, 2002, 2010); Gao Juefu's 高觉敷 translation of E. G. Boring's *A History of Experimental Psychology* was published four times: (1935, 1981, 2009, 2011); Li Heng's 李珩 translation of William Cecil Dampier's *A History of Science, and its Relations with Philosophy and Religion* was published twice: (1989, 2009); the translation of John Desmond Bernal's *Science in History* from Wu Kuangfu 伍况甫 et al. was also published twice: (1959, 2015); the translation of Morris Kline's three-volume *Mathematical Thought from Ancient to Modern Times* was published three times: (1979, 2002 , 2013).

scholars have discussed, the "scientific revolutionist," historian, and philosopher of science Thomas S. Kuhn (1922–1996) gained renown in the Asian academic community, first in Taiwan, Japan, and Korea, and then among Chinese scholars.[13] Shigeru Nakayama coined the term "scientific community determinism" for the perspective emerging in Asia during the post-Kuhnian era.[14] Marta Hanson explains how historians of China in both the East and the West considered Kuhn to be offering a "non-Eurocentric approach to science, the concept of normal science." This approach worked for scientific practice in the West as well as in East Asia, and Kuhn's concept of the paradigm opened up research on the mutually-constitutive basis of scientific communities and scientific knowledge.

Since the 1990s, we can see that historical research in China and the West has paid increasing attention to the role of linguistic translation in scientific exchange. The discipline of translation studies has evolved across the globe simultaneously, creating a sustained academic interest in Asia, Europe, and the Americas and thereby reviving the reputation of an almost lost scholarly practice.[15] For instance, by the turn of the millennium, several groundbreaking historical studies on translation and scientific exchange in China and across East Asia were published in English. In an early discussion of scientific translation in Meiji-Japan, Scott Montgomery observed that "most people do not appreciate" the complexity of translation and its role in scientific exchange. Later in the same year, David Wright foregrounded translation's profound impact on the written language, generating or resuscitating scores of "new" characters in nineteenth-century Chinese chemistry.[16]

Around the same time, historians, philologists, and linguists in China and worldwide have expanded their views on the act of translation and its impact on scientific research itself across the globe.[17] Lydia Liu, for instance, emphasized its importance as "a reciprocal process of negotiating 'meaning-value' " and its role as "a primary agent of token making in its capacity to enable exchange, producing and circulating meaning as value among languages and markets."[18]

Although we find similar actors and stakeholders in these studies, the nature of their engagement shifted in the 1970s and 1980s, once the academic community in China more obviously began to promote the circulation of high-impact (Western science) writing, as demonstrated by the story of the early translation of Thomas Kuhn's writings. Since the opening of its markets and borders in the late 1990s, research into non-Chinese sciences, medicine, and technology has gathered pace in Chinese research, while at the same time the number of Chinese translations on such historical research published outside China has also increased. More recent examples of this trend are Steven Shapin's *The Social History of Truth* and Peter Burke's *Social History of Knowledge*.[19]

Also, early- and mid-twentieth century interventions and state institutional support—both in China and the West—often targeted monumental compilations such as Joseph Needham's edited series, *Science and Civilisation in China*, or Morris Kline's compendium of

[13] Wu Guosheng 吴国盛 (2012, 2005a, 2005b).
[14] Hanson (2012, 561–505).
[15] Cook (2010).
[16] Wright (2000, 246).
[17] Chinese academia is spearheading the field of translation studies.
[18] Liu (2000).
[19] Shapin (2002); Burke (2016). The translation of John Pickstone's *Ways of Knowing: A New History of Science, Technology, and Medicine* illustrates that readers' interests were considered important, see Pickstone (2008). The authors themselves also initiated translations of their works.

Mathematical Thought compiled by the Beijing University Faculty of Mathematics, Department of History of Mathematics, Translation Group. In the current decade, such efforts have also been made by individuals such as Zhang Butian 张卜天. Currently associate professor at the Chinese Academy of Sciences, Zhang was educated in thermal engineering and majored in physics before deciding to follow a doctorate program in the philosophy of science and then become a specialist in the academic translation debate. To date, he has produced more than thirty books in his *Translation Series on the Origins and Development of Science*, published by Hunan kexue jishu chubanshe, among others.[20] In 2016 he initiated a new series offering translations of classic Western scholarship on Chinese sciences: *The Grand Titration, Science and Society in East and West*, originally published by Joseph Needham in 1969.[21] Although his work includes Ancient Greece and the Middle Ages, it focuses on the sixteenth and seventeenth centuries, the period at the heart of debates about a "scientific revolution," concentrating on the continents of Europe, Africa, and Asia. It is Zhang's aim to introduce the history of science into China from the viewpoint of contemporary sciences, using historical experience as a means to critically analyze Western modernity as it appears in China.

Hence, while Western studies on China's sciences as well as some studies and overviews of science history outside China have been translated into Chinese, and while the landscape of history of science research studies translated from Western European languages (English, Latin, French, German, etc.) is rich, it remains the product of a somewhat arbitrary course of transmission. The choice of subject matter is defined by the serendipitous conjunction of academic collaborations, individuals' interests, and market forces, while, as of yet, there is a dearth of collective reflection on the field, the discipline's current position, its methodological choices, and the major and minor research questions and significant topics that could be interesting for curricula building and for furthering international scholarly exchange.

A Western View of the Development of Science, Technology, and Medicine

This anthology aims to offer Chinese readers a taste of intellectual influences in the history of science from the viewpoint of literature published in English. To that end, it is worth noting the major trends among English-speaking historians of science, technology, and medicine pre-1990. Thomas Kuhn's *The Structure of Scientific Revolutions* is usually acknowledged as the single most influential work on almost all subsequent histories of science.[22] Kuhn argued that the development of science was not cumulative and progressive, but rather discontinuous and reliant on the social organization of scientists into communities with shared beliefs. From this perspective, scientific knowledge was organized into "paradigms," which depended on key examples to illustrate how theories explained natural phenomena. According to this theory, anomalous findings that cannot be explained by these paradigms create a crisis for the community of practitioners, some of whom may try to resolve the problem by proposing a new paradigm. For example, the shape of the spectrum of black-body radiation was an anomaly for classical physics—at the highest frequencies, radiant energy is low, not infinite. Max Planck proposed the solution that electromagnetic radiation was emitted in

[20] For example, Grant (2010); Burtt (2012).
[21] Needham ([1969] 2016).
[22] Kuhn (1962).

quanta, and there could be no radiation below one quantum of energy. In this way, Planck contributed a key conceptual element to the new paradigm of quantum mechanics. The acceptance of any new paradigm entails a rejection of the old, even if some features of the earlier mode of explanation can be translated into the terms of the new paradigm. In this sense, knowledge is lost as well as gained when the paradigm shifts.

Kuhn's book received fierce criticism from philosophers and scientists, who felt that it presented scientific change as "irrational" (Kuhn referred to the shift from one paradigm to another as a matter of "conversion"), and milder criticism from historians who thought that the kind of dramatic discontinuities his theory posited—revolutions—could not account for the numerous incremental changes in scientific knowledge.[23] Kuhn himself moved towards a more evolutionary understanding of science later on in his career. Today, few (if any) scholars would still try to apply Kuhn's *Structure of Scientific Revolutions* to their historical case studies, but his underlying depiction of science as resting on communities of like-minded practitioners engaged in puzzle-solving and transmitting their approaches and methods through textbooks and teaching permeates the literature from the 1970s. It still remains a theoretical touchstone, but it also served to catalyze other influential schools of thought.

In the late 1970s and 1980s, the sociology of scientific knowledge, especially as articulated by British scholars in Edinburgh and Bath (such as Barry Barnes, David Bloor, and Harry Collins), extended Kuhn's sense of scientific communities, arguing that scientific knowledge reflected the broader social and economic interests of its creators.[24] Classic examples of this scholarship are the depictions of phrenology and eugenics as representations of certain social and class interests in Victorian and Edwardian England.[25] In the history of medicine, this kind of reference to social history would mean taking patients' views into account, as well as the sociology of the professionalization of physicians and other healthcare workers.[26] In the history of technology, this exploded the traditional view, which had focused on the world of design and production (usually featuring male engineers and entrepreneurs), to include the activities of users as well—including workers, consumers, and, consequently, women.[27] Ruth Schwartz Cowan argued that users shape how technologies develop by adopting or rejecting them at the "consumption junction."[28]

This new attention to the "social" in science, technology, and medicine became ever more localized in the 1980s and 1990s, focusing on particular spaces and institutions. A forerunner of this trend was Bruno Latour and Steve Woolgar's *Laboratory Life* (1979), which articulated a new focus on the actual sites of production of scientific knowledge.[29] Along similar lines, Karin Knorr-Cetina emphasized the artificiality of laboratory conditions as well as the wide differences in experimental practices among the various branches of science (physics and molecular biology, for example).[30] Steven Shapin and Simon Schaffer's *Leviathan and the Air-pump* (1986) offered a view of the scientific revolution that centered on a specific apparatus—the early vacuum pump—to argue that both live demonstrations of

[23]Gutting (1980); Daston and Richards (2016).
[24]Barnes (1974); Bloor (1991); Collins (1985).
[25]MacKenzie (1976); Shapin (1979).
[26]Porter (1985); Numbers (1988).
[27]Bijker, Hughes, and Pinch (1987); Oldenziel (1999).
[28]Schwartz Cowan (1987).
[29]Latour and Woolgar (1979).
[30]Knorr Cetina (1983, 1999).

experimental findings and their documentation through written publications served as key ways to establish credible knowledge. Scientific disputes, notably those among members of the Royal Society of London, could be settled using these methods, in part due to their shared gentlemanly culture.[31] In presenting this picture, Shapin and Schaffer argued that the methods developed for resolving scientific disputes and authenticating reliable knowledge resulted in a lasting separation of (English) civil society into politics on the one hand (represented by Thomas Hobbes) and learning on the other (represented by Robert Boyle).

Presenting an instrument as the focus of *Leviathan and the Air-pump* inspired other scholars to think about the importance of experimentation and its key technologies. After this, it was no longer sufficient to situate scientific knowledge in terms of broad class interests or social beliefs; scholars reconsidered the significance of materiality in order to understand how knowledge was created and extended. There remained—and remains—a lively debate about how best to account for the relationship between material agency and social realities in the worlds of science, technology, and medicine. The essays in this volume reflect that ongoing conversation. They are also indicative of the increasingly close integration, both methodological and institutional, of the history of science with general history. With their detailed attention to contexts beyond the narrowly scientific, almost all of the articles chosen for the reader strongly reflect this trend.

This Collection

The articles in this collection were all published between 1990 and 2015, and are presented according to date of publication rather than grouped by subfield or theme. Each responds to the earlier literature outlined above and the key problems it identified. For example, since *Leviathan and the Air-pump* was published in 1985, scholars' widespread focus on knowledge as *local* rather than universal has raised the question of how scientific theories and findings travel. This provides the central problem in James Secord's essay, "Knowledge in Transit." Secord suggests that scientific communication, including translation, has a fundamental impact on how knowledge is generalized. Other authors in this anthology also focus on the transmission of scientific knowledge, especially—since antiquity—through written texts. Reviel Netz's "Deuteronomic Texts" and Ann Blair's "Reading Strategies for Coping with Information Overload" show how learned readers in the early modern West canonized certain texts through updated editions, commentaries, note-taking, and excerpts. These methods of book history enrich the traditional tools of intellectual history by enabling scholars to trace the reception and transmission of knowledge at the level of individual texts and readers (often through written marginalia). Looking at different spheres of learning (mathematics and humanism), Netz and Blair show how scholars wrestled with the issue of establishing the reliability of knowledge given that an over-abundance of texts and theories had accumulated by the early modern period. Pamela Long and Peter Galison also look at the transmission of scientific knowledge through texts, but focus on authors, openness, and credit. Pamela Long's "The Openness of Knowledge" examines the emergence of printed technical manuals about mining and metallurgy in sixteenth-century Germany and Italy, which codified and transmitted craft knowledge. This information was not only useful for miners but also for investors. Even more significantly, these manuals' authors began

[31] Shapin and Shaffer (1985).

asserting the importance of *open* knowledge, which became an enduring scientific value. Galison's "The Collective Author" examines publications from a very different time and place—particle physics in the late twentieth century. Experiments in this field involved literally hundreds of scientists and engineers, so assigning credit through authorship was complicated. When a finding resulted from the collective work of 500 researchers, who should be named the discoverer? Was there any single knowledgeable creator? Galison suggests that both the conventional understanding of scientific epistemology and the responsibility of authorship have been fundamentally reshaped by this kind of collective scholarly activity.

Another way to move beyond the local nature of knowledge is to examine specific moments when new knowledge and its applications cross borders, to ask *why* certain technologies are adopted or exported. Two articles look at the national and geopolitical purposes behind the development and transfer of new technologies. Gabrielle Hecht's "Political Designs" examines how the development of French nuclear reactors—even down to the level of specific design choices—was shaped by the politics of postwar (and Cold War) reconstruction. Her nuclear case offers a convincingly positive riposte to Langdon Winner's classic question, "Do Artifacts have Politics?"[32] In "Peasant Friendly Plant Breeding," Jonathan Harwood considers the development of the Green Revolution through the US Rockefeller Foundation's programs for promoting science and technology in under-developed countries. The end result of the Green Revolution was the preference for large-scale industrialized agriculture in Mexico (and elsewhere in the developing world), at the expense of the needs and viability of small-scale farmers. Harwood shows that the Rockefeller Foundation officers on that project understood that subsistence farmers had distinct needs and constraints, but ultimately prioritized farmers who possessed the capital to adopt high-tech agricultural methods, to purchase agrochemicals and high-yield seeds. Hence, Harwood's analysis unearths continuities with the earlier period of colonial expansion, when European science and medicine was exported to colonies for their modernization and development, often at the expense of indigenous systems of knowledge and production.

Warwick Anderson's "The Possession of Kuru" also examines a colonial situation in Papua New Guinea, Australia's territory. Two teams of biomedical researchers worked there to identify the cause of a previously-unknown neurological disease, kuru, which was a common cause of death among the Fore people (including youths)—and thus of concern to the colonial administration. Anderson places special emphasis on the role of specific materials—such as human brain specimens—as particularly valuable objects in the encounter between scientists and the native peoples. He draws on notions of "gift exchange" from economic anthropologists (such as Marcel Mauss) to account for the social negotiations that enabled these materials to change hands. This explanation is particularly significant because the people of Papua New Guinea provided key ethnographic evidence that anthropologists used in positing this pre-capitalist means of exchange. In Anderson's hands, "gift exchange" provides another way to account for the way that science and its materials circulate. A closely related idea in the recent history of science literature is that of "moral economies" of science, which refer to the practices, norms, and expectations that characterize a discrete community or collaborative network of scientists. A prominent example of the approach in this anthology is Robert Kohler's article, which looks at how fly geneticists in the US developed habits of sharing strains and scientific credit during the early decades of the twentieth century. Kohler

[32] Winner (1980).

focuses on the renowned early-twentieth century biologist Thomas H. Morgan, whose laboratory contributed to the birth of genetic studies, particularly through its techniques for mapping genes to chromosomes through breeding experiments with visible mutations (such as white eyes). Kohler shows that Morgan's small group produced many more mutants than they could map themselves, leading to a culture of sharing strains with outside scientists and teachers in the expectation of reciprocal sharing of information and scientific credit. For Kohler, this way of doing science was not simply a product of American culture or genetic work habits, but derived simply from the fecundity of the fruit fly, a "breeder reactor" in the production of new mutants. His emphasis on the fruit fly's biological features—which, through genetic inbreeding and standardization, became a laboratory technology—reflects a broader interest in the role of the *agency* of experimental materials in science. Kohler's work on the fruit fly laid the groundwork for an entire genre of further historical studies of "model organisms" in biomedical research.

Charles Rosenberg's essay, "Framing Disease," is also a response to the new materialism of the early 1990s and the associated move away from the social constructivism of the 1980s. For Rosenberg, the notion of "framing" brings together several facets of how medicine operates: the initial biological experience, the encounter with a physician who identifies and treats a disease, and the collective making of the meaning around that disease. Social negotiation is part of each step, so that, for example, diagnosis is as much about the narrative of illness and expectations of a patient as about the scientific tests and expert judgment involved. Yet framing disease also enables historians to take into account the bodily, experiential nature of sickness, the particularity of disease entities, and the ways in which biomedical knowledge is employed by physicians.

The other two articles in the volume address longstanding assumptions about modern science, technology, and medicine. Monica Green's essay, "Gendering the History of Women's Healthcare," challenges the belief that knowledge about female reproduction was in the women's domain in the West before the Scientific Revolution. This idea was popularized during the 1970s, as feminists challenged male medical control of female bodies (through their professional dominance of obstetrics and gynecology). The notion that a previous "golden age" existed when female health was controlled and managed by and for women led many writers to overlook the more complex historical realities. Green argues against the assumption that only women possessed knowledge about female reproduction, using her extensive knowledge of gynecological treatises from the medieval and early modern periods to show that both men and women participated in this world of practical learning. Her contribution exemplifies how historians have drawn on feminist and gender theory to produce enhanced accounts of scientific and medical knowledge. For her part, Francesca Bray challenges the idea that technology should refer to the machines and products of industrial capitalism. In her elegant essay, "Technics and Civilization in Late Imperial China," she argues that the domestic shrine in medieval Chinese homes functioned as a key social technology. In this, she not only expands the realm of technology to include domestic objects, but also demonstrates how methods used in the history of technology can be effectively applied to pre-modern history, as well as to non-Western societies. She also shows how materiality imposes and reasserts values of knowledge categories along gender lines, binding the everyday to the female and profane and the universal to the scholarly patriarch. To fully understand the development of technology and medicine, Green and Bray remind us, one must pay attention to the users of knowledge as well as to learned texts. They also illustrate the attention to objects and materials that characterizes much of the best recent scholarship in the history of science, technology, and medicine—a theme highlighted above. These two essays, as well as Secord's "Knowledge in Transit" and Rosenberg's "Framing Disease," offer in-depth analyses of the major scholarly debates over the past few decades in the specific subfields of the history of medicine, history of technology, and history of science. Readers who are particularly interested in using these overviews to orientate themselves to the English literature that this anthology represents would do well to begin with these chapters.

By bringing together this collection of influential articles, we do not mean to suggest that Western science serves as a unitary sphere of knowledge. Indeed, the premise behind much of the scholarship presented in this volume is that natural knowledge is locally produced, and thus it is important to explain (rather than presume) the apparent universality of science and its applications. These articles represent very different fields, times, and places, and those particularities are critical for understanding each historical episode. That this contextualization has become axiomatic in the history of science is indicative of its integration into general history.

Nonetheless, there is an overall intellectual coherence to the anthology, diverse as its topics are. The studies in this volume demonstrate that knowledge (of sciences, technologies, and medicine) and its transmission are an integral part of social and cultural ideas and of the sociological imagination. The remarkable development of scientific results and technical achievements is not just the product of social-cultural dynamics, but also a contribution to the socio-technical development of diverse human societies. As the West and the East become ever more closely related through travel, trade, and—not least—the globalization of knowledge, we hope that these essays will stimulate new engagements between English and Chinese readers about the centrality of science, technology, and medicine to our histories and future.

Conclusion

Since the 1950s, the history of science, technology, and medicine has undergone several phases, internationally as well as in the Sinophone world. In a recent review of historical research on Post-Republican mathematics in China, Liu Qiuhua 刘秋华 identified the year 1976 as a watershed. In this interpretation the period from 1947 to 1976 then focused on Chinese classical mathematics, distinct from the period afterwards, when the new open-door policy enabled researchers to discover the modern era and began to publish in foreign languages. He himself supported an interpretation of modernity as beginning in 1904. Liu situates a substantial shift again in the 1990s, when foreign exchange increased and Chinese scholars increasingly published in European languages. Looking to the future, he identifies an urgent need to collate historical materials from the modern period (i.e., post 1900) and to internationalize this work.[33] This periodization also signifies changing attitudes towards the translated historical research on scientific change in China and elsewhere, approaching such works less as a tool of transmission than as one that facilitates a globally diverse research culture with new comparative methods.

In 2013 Lynn K. Nyhart described a fictitious meeting set in 2038, predicting a future where "the increasing outward looking of China, where the history and philosophy of

[33] Liu Qiuhua 刘秋华 (2011, 92).

Western science have long formed a compulsory part of the science and technology curriculum, has engendered closer interactions with technology-oriented institutions in North America."[34]

The collective endeavor of assembling this volume reveals that such conversations, multiplying in an increasingly internationalized community of scholars, have long surpassed Nyhart's dichotomous view of Chinese Western relations. Translations help both sides to develop new methods and train new researchers in innovative fashions. Like all collections, our selection of the chapters includes some biases. The decision to concentrate on English as the source language and Chinese speakers as the targeted community was a pragmatic one, which we hope will lead to a further series of translations providing up-to-date information on methodological and topical developments in the history of science, technology, and medicine across language boundaries. We are already preparing a corresponding volume of Chinese publications on the history of science translated into English.

Selection Process

A general invitation to nominate possible articles was disseminated over academic email-lists in France, Germany, the US, and the UK in October 2015. Over the following two months, members of the seven participating societies (in fact, anyone who wished) could nominate one article for each of the three sections: history of science, history of medicine, and history of technology. Each person could participate only once. The poll suggested a list of journals as a starting point but any other journal or edited volume could be added. The original article had to be published in English. In the first half year of 2016, the committee met in online conferences to discuss the selection of the 12 articles from 219 nominations and divided the process into five steps: 1) each committee member selected the 10 "most influential" articles. 2) Each committee member could select three additional articles to be included in the selection; they were then assigned to three more committee members for reading; an article would qualify for round 3 if at least one person voted for it. 3) Published works of committee members were excluded from the list for reasons of fairness. 4) The committee members graded all articles. 5) The committee discussed topic balance in the final score and selected the finalists.

Committee Members

- David Beck (University of Warwick)
- Angela N. H. Creager (HSS)
- Christopher Cullen (DHST/IUHPST)
- Lorraine Daston (MPIWG)
- Yao Dazhi (SHOT)
- Olga Elina (Institute for the History of Science and Technology, Russian Academy of Sciences)
- Florence Hsia (University of Wisconsin)
- David S. Jones (Harvard University)
- Jürgen Renn (MPIWG)

[34] Nyhart (2013).

- Dagmar Schäfer (MPIWG)
- Carsten Timmermann (SSHM)
- Hans-Jakob Ziemer (MPIWG)

References

Barnes, Barry (1974). *Scientific Knowledge and Sociological Theory*. London: Routledge & Kegan Paul.

Bernal, John Desmond (1959). 历史上的科学*[Science in History]*. Translated by Wu Kuangfu et al. Beijing: Kexue chubanshe.

——— (2015). 历史上的科学*[Science in History]*. Translated by Wu Kuangfu et al. Beijing: Kexue chubanshe.

Bijker, Wiebe E., Thomas P. Hughes, and Trevor J. Pinch, eds. (1987). *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press.

Blair, Ann (2003). Reading Strategies for Coping with Information Overload ca. 1550–1700. *Journal of the History of Ideas* 64(1):11–28.

Bloor, David (1991). The Strong Programme in the Sociology of Knowledge. In: *Knowledge and Social Imagery*. Ed. by David Bloor. Chicago: University of Chicago Press, 3–23.

Blue, Gregory, Peter Engelfried, and Catherine Jami (2001). *Statecraft and Intellectual Renewal in Late Ming China: The Cross-Cultural Synthesis of Xu Guangqi (1562–1633)*. New York: Brill.

Boring, Edwin Garrigues (1935). 实验心理学史*[A History of Experimental Psychology]*. Translated by Gao Juefu. Beijing: Shangwu yinshuguan.

——— (1981). 实验心理学史*[A History of Experimental Psychology]*. Translated by Gao Juefu. Beijing: Shangwu yinshuguan.

——— (2009). 实验心理学史*[A History of Experimental Psychology]*. Translated by Gao Juefu. Beijing: Shangwu yinshuguan.

——— (2011). 实验心理学史*[A History of Experimental Psychology]*. Translated by Gao Juefu. Beijing: Shangwu yinshuguan.

Brockey, Liam Matthew (2007). *Journey to the East: The Jesuit Mission to China, 1579–1724*. Cambridge, MA: The Belknap Press of Harvard University Press.

Burke, Peter (2016). 知识社会史*[A Social History of Knowledge]*. Translated by Chen Zhihong and Wang Wanni. Hangzhou: Zhejiang daxue chubanshe.

Burtt, Edwin Arthur (2012). 近代物理科学的形而上学基础*[The Metaphysical Foundations of Modern Science]*. Translated by Zhang Butian. Changsha: Hunan kexue jishu chubanshe.

Cajori, Florian (1981). 物理学史*[A History of Physics]*. Translated by Dai Nianzu. Huhehaote: Neimenggu renmin chubanshe.

——— (2002). 物理学史*[A History of Physics]*. Translated by Dai Nianzu. Guilin: Guangxi shifan daxue chubanshe.

——— (2010). 物理学史*[A History of Physics]*. Translated by Dai Nianzu. Beijing: Renmin daxue chubanshe.

Collins, Harry M. (1985). *Changing Order: Replication and Induction in Scientific Practice*. London: Sage.

Cook, Guy (2010). *Translation in Language Teaching*. Oxford: Oxford University Press.

Cook, Harold John and Sven Dupré, eds. (2012). *Translating Knowledge in the Early Modern Low Countries*. Vol. 3. Münster: LIT Verlag.

Dampier, William Cecil (1989). 科学史及其与哲学和宗教的关系*[A History of Science, and its Relations with Philosophy and Religion]*. Translated by Li Heng. Beijing: Shangwu yinshuguan.

——— (2009). 科学史及其与哲学和宗教的关系*[A History of Science, and its Relations with Philosophy and Religion]*. Translated by Li Heng. Beijing: Shangwu yinshuguan.

Daston, Lorraine and Robert Richards, eds. (2016). *Kuhn's Structure of Scientific Revolutions at Fifty: Reflections on a Science Classic*. Chicago: University of Chicago Press.

Dietz, Bettina (2016). Linnaeus's Restless System: Translation as Textual Engineering in Eighteenth-century Botany. *Annals of Science* 73(2):143–156.

Engelfried, Peter (1998). *Euclid in China. The Genesis of the First Translation of Euclid's Elements in 1607 and its Reception up to 1723*. Leiden: Brill.

Fung, Yu-lan (1983). *The Period of Classical Learning from the Second Century B.C. to the Twentieth Century A.D.* Vol. 2. History of Chinese Philosophy. Translated by Derk Bodde. Princeton, NJ: Princeton University Press.

Galison, Peter (2003). The Collective Author. In: *Scientific Authorship: Credit and Intellectual Property*. Ed. by M. Biagioli and P. Galison. New York: Routledge, 325–353.

Gordin, Michael (2015). *Scientific Babel: The Language of Science from the Fall of Latin to the Rise of English*. London: Profile Books.
Grant, Edward (2010). 近代科学在中世纪的基础*[The Foundations of Modern Science in the Middle Ages]*. Translated by Zhang Butian. Changsha: Hunan kexue jishu chubanshe.
Green, Monica H. (2008). Gendering the History of Women's Healthcare. *Gender & History* 20(3):487–518.
Gutting, Gary (1980). *Paradigms and Revolutions: Applications and Appraisals of Thomas Kuhn's Philosophy of Science*. Notre Dame: University of Notre Dame Press.
Hanson, Marte E. (2012). Kuhn's Structure in East Asia, Expanded. *East Asian Science, Technology and Society: An International Journal* 6(4):561–7.
Holmes, James S. (1988). *Translated! Papers on Literary Translation and Translation Studies*. Ed. by Raymond van den Broek. Amsterdam: Rodopi.
Jiang Qian [蒋茜], Li Xinxin [李欣欣], and Shen Xianjia [申先甲] (2013). 以史为学，教书育人−−物理学史家申先甲教授访谈录[History as Learning, Teaching and Educating People: An Interview with Professor Shen Xianjia, A Historian of Physics]. 广西民族大学学报（自然科学版）*[Journal of Guangxi University for Nationalities (Natural Science Edition)]* 2:1–7, 108–109.
Kline, Morris (1979). 古今数学思想*[Mathematical Thought from Ancient to Modern Times]*. Translated by Zhang Lijing et al. Shanghai: Shanghai kexue jishu chubanshe.
———— (2002). 古今数学思想*[Mathematical Thought from Ancient to Modern Times]*. Translated by Zhang Lijing et al. Shanghai: Shanghai kexue jishu chubanshe.
———— (2013). 古今数学思想*[Mathematical Thought from Ancient to Modern Times]*. Translated by Zhang Lijing et al. Shanghai: Shanghai kexue jishu chubanshe.
Knorr Cetina, Karin (1983). *Science Observed: Perspectives on the Social Study of Science*. London: Sage Publishers.
———— (1999). *Epistemic Cultures: How the Sciences Make Knowlege*. Cambridge, MA: Harvard University Press.
Kohler, Robert E. (1999). Moral Economy, Material Culture and Community in Drosophila Genetics. In: *Science Studies Reader*. Ed. by M. Biagioli. New York: Routledge, 243–257.
Kuhn, Thomas S. (1962). *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
Latour, Bruno and Steve Woolgar (1979). *Laboratory Life: The Construction of Scientific Facts*. Beverly Hills, CA: Sage Publishers.
Li Nanqiu [黎难秋] and Li Yashu [李亚舒], eds. (2000). 中国科学翻译史*[History of Chinese Sci-tech Translation]*. Changsha: Hunan jiaoyu chubanshe.
Li Yuese [李约瑟] (1975). 中国科学技术史*[History of Science and Technology in China]*. Vol. 1.1. Translated by Xiao Zuyi. 北京: 科学出版社[Science Press].
Liu Qiuhua [刘秋华] (2011). A Survey of the Studies on the History of Modern Mathematics in China since 1947 [1947 年以来中国现代数学史研究述评]. *Studies in Dialectics of Nature [*自然辩证法研究*]* 7.
Liu, Lydia H. (2000). The Question of Meaning-Value in the Political Economy of the Sign. In: *Tokens of Exchange: The Problem of Translation in Global Circulations*. Ed. by Lydia H. Liu. Durham: Duke University Press, 13–41.
MacKenzie, Donald (1976). Eugenics in Britain. *Social Studies of Science* 6:499–532.
Needham, Joseph [李約瑟] [1954] (1990). 導論[Introductory Orientations]. In: 中国科学技术史*[Science and Civilisation in China]*. Translated by Zhongguo kexue jishu shi fanyi weiyuanhui. Beijing and Shanghai: Kexue chubanshe, Shanghai guji chubanshe.
Needham, Joseph [1969] (2016). 文明的滴定*[The Grand Titration: Science and Society in East and West]*. Translated by Zhang Butian. Beijing: Shangwu yinshuguan.
Numbers, Ronald L. (1988). The Fall and Rise of the American Medical Profession. In: *The Professions in American History*. Ed. by Nathan O. Hatch. Notre Dame, IN: University of Notre Dame Press, 51–72.
Nyhart, Lynn K. (2013). The Shape of the History of Science Profession, 2038: A Prospective Retrospective. *Isis* 104(1):131–9.
Oldenziel, Ruth (1999). *Making Technology Masculine: Men, Women and Modern Machines in America*. Amsterdam: Amsterdam University Press.
Pickstone, John (2008). *Ways of Knowing: A New History of Science, Technology, and Medicine [*认识方式*:* 一种新的科学、技术和医学史*]*. Translated by Chen Chaoyong. Shanghai: Shanghai keji jiaoyu chubanshe.
Porter, Roy (1985). The Patient's View: Doing Medical History from Below. *Theory and Society* 14:175–98.
Rosenberg, Charles E. (1992). Framing Disease: Illness, Society, and History. In: *Explaining Epidemics and Other Studies in the History of Medicine*. Ed. by Charles E. Rosenberg. Cambridge and New York: Cambridge University Press, 305–318.

Schwartz Cowan, Ruth (1987). The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology. In: *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Ed. by Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch. Cambridge, MA: MIT Press, 261–280.

Shapin, Steven (1979). Homo Phrenologicus: Anthropological Perspectives on an Historical Problem. In: *Natural Order: Historical Studies of Scientific Culture*. Ed. by Steven Shapin. Beverly Hills, CA: Sage, 41–72.

——— (2002). 真理的社会史*: 17* 世纪英国的文明与科学*[A Social History of Truth: Civility and Science in Seventeenth-century England]*. Translated by Zhao Wanli. Nanchang: Jiangxi jiaozu chubanshe.

Shapin, Steven and Simon Schaffer (1985). *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life*. Princeton, NJ: Princeton University Press.

Shen Xianjia [申先甲] (1991). 增强物理教学的历史感，用物理史料进行方法论教育[Enhancing the Sense of History in Physics Teaching and Carrying Out Methodology Education with Historical Materials]. 物理*[Physics]* 5.

Tabrizi, Hossein Heidari and Mahshid Pezeshki (2015). Strategies Used in Translation of Scientific Texts to Cope with Lexical Gaps (Case of Biomass Gasification and Pyrolysis Book). *Theory and Practice in Language Studies* 5(6):1173–8.

Winner, Langdon (1980). Do Artifacts Have Politics? *Daedalus* 109:121–136.

Wright, David (2000). *Translating Science: The Transmission of Western Chemistry into Late Imperial China, 1840–1900*. Leiden: Brill.

Wu Guosheng [吴国盛] (2012). Kuhn Reviewed [再读库恩]. *Science and Culture Review [*科学文化评论*]* 4: 24–31.

——— (2005a). The Significance of the History of Science [科学史的意义]. *The Chinese Journal for the History of Science and Technology [*中国科技史杂志*]* 1:63–68.

——— (2005b). The Significance of the History of Science [科学史的意义]. *The Chinese Journal for the History of Science and Technology [*中国科技史杂志*]* 26(1):59–64.

Zhang Zigong [张资珙] (1952). 译者赘言[Translator’s Note]. In: 化学元素发见史*[Discovery of the Element]*. Ed. by Mary Elvira Weeks. Translated by Zhang Zigong. Shanghai: Zhongguo kexue yiqi tushu gongsi.