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RESEARCH ARTICLE

Science, Religion and Sino-Western Exchanges: Literati-Jesuit Translation of Euclidean Geometry and Its Reception from Late Ming to Mid-Qing

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Abstract

This essay explores the interlocking roles of science and religion in Sino-Western exchanges by examining China's encounter with Jesuit mathematics in the seventeenth and eighteenth centuries. It first focuses on late Ming by studying the joint translation of Euclidean geometry by high-ranking scholar-official Xu Guangqi (1562–1633) and Italian Jesuit Matteo Ricci (1552–1610). Then it studies how this encounter affected later literati-scholars, with a special attention to Mei Wending (1633–1721), the leading mathematical astronomer of early Qing. I argue that Xu's appropriation of Western mathematics not only helped strengthen the basis of Confucian statecraft in the milieu of late Ming crisis but also contributed to later reconstruction and renaissance of Chinese classical tradition through Qing-dynasty evidential studies. Far from predetermined, this cross-cultural encounter represents a trial-and-error process of contested accommodation dictated by different personal agendas, changing socio-political circumstances, evolving intellectual trends as well as shifting global balance of power.

Keywords: science and religion; Sino-Western exchange; Xu Guangqi; Matteo Ricci; Euclidean Geometry

This essay explores the interlocking roles of science and religion in Sino-Western exchanges by examining China's encounter with Jesuit mathematics in the seventeenth and eighteenth centuries. It first focuses on the closing decades of the Ming dynasty (1368–1644) by studying the interaction between the prominent scholar-official Xu Guangqi 徐光啓 (1562–1633) and the legendary Italian Jesuit Matteo Ricci (1552–1610). Widely recognized as the pioneers of East–West dialogue, the duo collaborated in translating the first six books of *Elements of Geometry* (hereafter *Elements*) compiled by the ancient Greek mathematician Euclid around 300 BCE. The 1607 publication of this classic work (under the Chinese title *Jihe yuanben* 幾何原本) not only brought about the first climax of Jesuit activities in the Middle Kingdom but also

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inaugurated the first great influx of European science.[1] To illuminate its profound historical legacy, this article contextualizes the Xu–Ricci encounter in two great waves of transmitting Western science to late imperial China. It pays special attention to Mei Wending 梅文鼎 (1633–1721), the most prominent mathematical astronomer of early Qing (1644–1912), who contributed directly to the renaissance of Chinese mathematics in the eighteenth century. Standing on Xu's shoulders but departing from him in significant ways, most importantly, Mei fully expounded the nativist theory of *Xixue zhongyuan* 西學中源 (the Chinese origins of Western learning), which guided the second great importation of Western culture in the Ming–Qing dynasties.

In addition, Xu Guangqi and Matteo Ricci were two crucial figures in the history of Chinese Catholicism. The former was one of the earliest generations of Chinese literati who opened their eyes to the Western world. Baptized as Paul in 1603, this "prototype Confucian Christian" and high-ranking official provided the Jesuits with powerful patronage, which earned him the reputation as a great pillar of Ming Catholicism.[2] Being the first Chinese to "have a face" in Western sources, moreover, Xu studied and collaborated with Ricci, the first missionary to be accepted by both China's learned circles and the imperial court in Beijing.[3] Seeking bureaucratic protection and hoping for a snowball effect, this self-professed Western Confucianist (*xiru* 西儒) adopted a top-down strategy of indirect proselytization based on maximum accommodation and scientific dissemination. This two-pronged approach encouraged all China Jesuits to establish rapport with local interlocuters by acquiring a thorough knowledge of their language, history and philosophy; on the other, it called on those scholar priests to use their distinctive scientific expertise to cultivate the literati and attract their patronage for the ultimate purpose of missionizing China. Though highly controversial, this passive yet pragmatic strategy paid off handsomely overall. It not only rendered Ricci the de facto founder of the Roman Catholic mission in China but also made the Middle Kingdom one of the most successful of the Jesuit missions in Asia.[4]

Besides adopting the new faith, with Ricci's help, Xu raised the banner of learning from Western science and became its first systematic Chinese promoter. Prior to this historic collaboration, direct scientific communication between the two ends of Eurasia had been piecemeal, scarce, and ambiguous. Under much of the Ming, in particular, the court had imposed a strict policy of maritime prohibition to crack down on foreign trade and other exchanges, which resulted in little contact with the West before the

[1] Peter M. Engelfriet, *Euclid in China: The Genesis of the First Translation of Euclid's Elements Books I–VI and Its Reception up to 1723* (Leiden: Brill, 1998); Masahiro Ogawa, "Xu Guangqi and the Chinese Translation of Euclid's *Elements*: Some Problems of Terminology and Their Cultural Context," *HERSETEC* 5 (2011), 13–33.

[2] Michela Fontana, *Matteo Ricci: A Jesuit in the Ming Court* (Lanham: Rowman & Littlefield, 2011), 266; Besides Xu, Ricci also gained immense support from two other prominent convert-officials: Li Zhizao 李之藻 (1571–1630) and Yang Tingyun 楊庭筠 (1562–1627); see Willard Peterson, "Why Did They Become Christians? Yang T'ing-yün, Li Chih-tsao and Hsü Kuang-ch'i," in *East Meets West: The Jesuit in China, 1582–1773*, edited by Charles E. Ronan and Bonnie B.C. Oh (Chicago: Loyola University Press, 1998), 129; Liu Yu, "The Spiritual Journey of an Independent Thinker: The Conversion of Li Zhizao to Catholicism," *Journal of World History* 22 (2011), 433–53.

[3] Catherine Jami, Peter M. Engelfriet, and Gregory Blue, "Introduction," *Statecraft and Intellectual Renewal in Late Ming China: The Cross-Cultural Synthesis of Xu Guangqi (1562–1633)*, edited by Jami, Engelfriet, and Blue (Leiden: Brill, 2001), 1.

[4] Sheila J. Rabin, "Early Modern Jesuit Science: A Historiographical Essay," *Journal of Jesuit Studies* 1 (2014), 102.

Jesuit arrival during the late sixteenth century. As true trailblazers, Ricci and Xu made the first significant attempt at scientific and religious interaction between Confucian China and Catholic Europe that profoundly affected their understanding of each other. Their multifaceted dialogue, moreover, shaped the Ming–Qing reception and appropriation of what the Chinese labeled Western learning (*Xixue* 西學) or Heavenly Doctrine (*Tianxue* 天學). This vast corpus of exotic knowledge mixed science with religious teaching, with neither operating independently of the other. How the two intermingled and shaped cross-cultural synthesis in different parts of the world is a topic that has long interested scholars from various disciplinary and intellectual backgrounds.[5]

Xu's most significant engagement in Jesuit science, to be sure, took place in the interlocking fields of mathematics and astronomy. In addition to the joint translation of Euclidean geometry, he also orchestrated an astronomical reform during the last four years of his life (1629–1633) with the assistance of Ricci's successors, including Nicholas Longobardo (1559–1654), Johann Terrenz Schreck (1576–1630), Johann Adam Schall von Bell (1592–1666) and Giacomo Rho (1593–1638).[6] This reform not only created a new calendar that was later adopted by the subsequent Qing dynasty; it also led to the compiling of *Chongzhen lishu* 崇禎曆書 (Astronomical Treatise of the Chongzhen Reign), a "great encyclopedia of European astronomy" that signifies a peak in Sino-Western intellectual exchanges.[7]

Despite the popularity of such grand phrases as East–West dialogue and Sino-Western exchanges, it is important to bear in mind that neither China nor Europe should be deemed "cultural monoliths" or "disembodied abstractions."[8] The cross-cultural encounter between the two, furthermore, involved a wide variety of historical agents, ranging from different factions of Chinese scholar-officials, to various denomination of Christian missionaries and Manchu conquerors, as well as foreign states and traders. This process was also shaped by a wide range of factors, the most important of which were science, religion, politics, and trade. The complex and changing interplay among these variables still awaits thorough investigations by generations of scholars. It would be impossible to do justice in the current article to these important facets or the internal diversity within Chinese literati and European Jesuits.

Hence I should add a few caveats regarding the focus of my analysis and what cannot be covered here. With a primary concern for science, this article deals mostly with mathematics, while addressing astronomy in passing, despite the close link between the two, which will be elaborated later. My strong emphasis on the Ricci-Xu translation of Euclidean geometry and its trans-dynastic impact, moreover, does not suggest that the Ming–Qing reception of Jesuit mathematics can be reduced to the two iconic figures

[5]Chicheng Ma, "Knowledge Diffusion and Intellectual Change: When Chinese Literati Met European Jesuits," *The Journal of Economic History* 81 (2021), 1052–97.

[6]Keizo Hashimoto and Catherine Jami, "From the *Elements* to Calendar Reform: Xu Guangqi's Shaping of Mathematics and Astronomy," in *Statecraft and Intellectual Renewal*, 263; Longfei Chu, "From the Jesuits' Treatises to the Imperial Compendium: The Appropriation of the Tychonic System in Seventeenth and Eighteenth-century China," *Revue d'histoire des sciences* 70 (2017), 20; Keizo Hashimoto, *Hsü Kuang-ch'i and Astronomical Reform: the Process of the Chinese Acceptance of Western Astronomy 1629–1635* (Osaka: Kansai University Press, 1988), 30.

[7]Yunli Shi, "From the Western Techniques to the Imperial Techniques: Official Absorption of Western Astronomy in the Ming and Qing Dynasties," in *Western Influences in the History of Science and Technology in Modern China*, vol. 5, edited by Xiaoyuan Jiang (Singapore: Springer, 2021), 125.

[8]Huiyi Wu, Alexander Statman, and Mario Cams, "Introduction," *East Asian Science, Technology, and Medicine* 46 (2017), 18.

or one single work. Neither do I suggest that the literati–Jesuit relationship can be fully represented by the interactions between Xu and Ricci. Much more research is needed to understand how many other Jesuit scientists introduced and translated various mathematical works to Ming–Qing China, though some of them will be briefly examined here in relation to *Elements*. Most broadly, Jesuits were not the only Western actors who shaped the circulation of knowledge between pre-modern China and Europe. Other catholic orders like the Franciscans and Dominicans (both strong critics of the Jesuits' accommodation policy), as well as other organizations like The Society of Foreign Missions of Paris, also contributed to the spread of Western learning in China. Their missionary science differed in terms of logics and nature, though this difference is beyond the scope of this article.[9]

Religion and Science in Sino-Western Exchanges

Before proceeding to a discussion of Xu's encounter with Jesuit mathematics, I should briefly examine the broader context of Sino-Western exchanges and the main approaches to study them. Much of the early literature on this topic belongs to the classical Christian missiology which deems the Jesuits "uniformly heroic" and the Chinese empire "unchanging" in a one-way movement of European "civilizing mission."[10] Viewed from this paradigm of "Western impact, Chinese response," Xu Guangqi appears little different from "a passive albeit enthusiastic pupil" under Jesuit instruction. This partial and long outdated interpretation has been challenged by many scholars who have shown that Xu engaged in scientific studies mostly by his own impulse and for his own purpose.[11] Focusing on this Christian convert rather than the missionaries from afar, my article stresses the China-centered process of reception and appropriation, which reflects a paradigm shift from the classic Eurocentric to the Sinocentric approach over the past four decades. Meanwhile, it seeks to give a more balanced account of what took place by bringing the two aforementioned bodies of literature (transmitter-oriented and receiver-focused) in closer dialogue.[12] Borrowing Nicolas Standaert's four frameworks of cross-cultural analysis (see italicized below) and weaving them into an organic whole, I consider Sino-Western exchanges as a mutually responsive and transmuting process of "*interaction and communication*" that might change the knowledge being circulated ("*invention*"); it is thus necessary to view Xu and his Jesuit interlocutors as each other's "observers," "observed," and transformers. This integral and reciprocal approach will not only restore their agency as "active producers of scientific knowledge in an intercultural and interactive context" (in Qiong Zhang's words), but also reconcile the tension between Western "*transmission*" and Chinese "*reception*."[13]

[9]Catherine Jami, *The Emperor's New Mathematics: Western Learning and Imperial Authority during the Kangxi Reign (1662–1722)* (Oxford: Oxford University Press, 2012), 102.

[10]Liam Brockey, *Journey to the East: The Jesuit Mission to China, 1579–1724* (Cambridge, MA: Harvard University Press, 2007), 13; Nicolas Standaert, "Books on Cultural Exchange between China and the West in the Late Ming and Early Qing," *China Review International* 2 (1995), 19–28; Standaert, "Xu Guangqi's Conversion as a Multifaceted Process," in *Statecraft and Intellectual Renewal*, 171.

[11]Hashimoto and Jami, "From the *Elements* to Calendar Reform," 264.

[12]Paul Rule, "The Historiography of the Jesuits in China," in *Jesuit Historiography Online*, edited by Robert A. Maryks (Leiden: Brill, 2016); Benoît Vermander, "Jesuits and China," *Oxford Handbook of Global Religions*, edited by Mark Juergensmeyer (Oxford: Oxford University Press, 2015).

[13]Nicolas Standaert, *Methodology in View of Contact between Cultures: The China Case in the 17th Century* (Hong Kong: The Chinese University of Hong Kong, 2002), 1–64; Qiong Zhang, *Making the*

But why mathematics? To answer this question, one should first grapple with the fundamental relationship between science and religion. Both are crucial ways of conceptualizing and representing the world which are tied together in the long march of human civilization. By and large, this tie was clearly more intimate in pre-modern Europe than Confucian China as the latter tended to dissociate science from theology. Widely regarded as the source of all knowledge prior to the Renaissance, the powerful Catholic Church had long dominated education while uniting science (its loyal handmaiden) and theology (the highest realm of eternal truth) into an integrated, hierarchical system of thought. In many cases, the Church sought to market their religion through science by turning the latter into a proselytizing tool. But when the two were in conflict, religious values galvanized the Church into suppressing certain body of scientific knowledge like heliocentrism.

This entangled relationship is best epitomized by the Jesuits whose educational and proselytizing program was tightly interwoven as a global enterprise. As a multi-national group of devout and learned priests, they were most competent in dressing religion in the robes of science by using their knowledge about the physical world as a major instrument in propagating Catholicism. Since its founding in 1540 by Ignatius of Loyola (1491–1556), the Society of Jesus had become the "educators of Europe" by investing heavily in establishing colleges across the continent.[14]

As a key specialty of their scholarly religious order, mathematics had long been an essential part of the Jesuit system of learning (*Ratio Studiorum*) and the foundation of "quantitative science." Along with physics, which offers a qualitative explanation of natural phenomena, it largely constituted Renaissance science and pushed forward the Scientific Revolution. In the scholastic tradition of early modern Europe, mathematics included the four fields of the quadrivium: geometry, arithmetic, astronomy, and music, all of which led directly to God. Despite this general link, as a matter of fact, mathematics and astronomy were rather specialized endeavors for the practitioners of science at both ends of Eurasia. Hence this essay takes the two as interlocking but different branches of knowledge, mostly for the sake of analysis.[15]

In China's first serious encounter with Western learning, it was also mathematics and astronomy (rather than Christianity) that aroused the most interest due to their clear objectivity and wide applications. Over the course of the seventeenth century, as Tsuen-hsuin Tsien pointed out, the Jesuits had translated 120 European scientific works into Chinese, most of which belong to these two interlocking fields. Obviously, focusing on mathematics and astronomy not only helped Jesuits to accommodate wide differences between European and Chinese learning, it also brought them their greatest reputation in the Middle Kingdom. But to their great disappointment, Chinese respect for Jesuits' techno-scientific expertise often did not lead to respect for (let alone acceptance of) Christian faith.[16]

As a keen observer of Chinese culture and society, Ricci quickly realized the grim challenges of missionizing China and thus adopted a more realistic strategy of

New World Their Own: Chinese Encounters with Jesuit Science in the Age of Discovery (Leiden: Brill, 2015), 14.

[14]Agustín Udías, *Jesuit Contribution to Science: A History* (Dordrecht: Springer, 2015), preface.

[15]Jami, *Emperor's New Mathematics*, 5; Jose Kalapura, "East–West Interaction and Development of Modern Science in India: Jesuit Mediation during 16–19th Centuries," *Proceedings of the Indian History Congress* 66 (2005), 494.

[16]Tsuen-hsuin Tsien, "Western Impact on China Through Translation," *The Far Eastern Quarterly* 13 (1954), 307.

proselytization. Specifically, he sought to "make his Christian message more palatable to Chinese taste" by repackaging it "in Confucian colors and further strengthening its appeal" through association with both Chinese emphasis on moral cultivation and Western achievement in utilitarian science.[17] As Ricci put in his journal: "Whoever may think that ethics, physics and mathematics are not important in the work of the Church, is unacquainted with the taste of the Chinese, who are slow to take a salutary spiritual potion, unless it be seasoned with an intellectual flavoring."[18] This far-sighted Jesuit called on his superiors in Europe to send more books on mathematical sciences as well as more missionaries well-versed in those fields.[19] Unlike their experience in other parts of the globe (like Japan, India, Persia, Southeast Asia, and the New World), the Jesuit missionaries relied heavily on their erudite knowledge in mathematics and astronomy to establish themselves in the Middle Kingdom. Hence, not surprisingly, these two subjects constituted much of the "Western Learning" in the eyes of Ming–Qing educated elites. Together they open an unparalleled window onto the scientific-religious exchanges between Chinese literati and Jesuit priests, a process profoundly shaped by both the evangelical goals of Catholic missions as well as the Confucian intellectual concern over statecraft learning (*jingshi* 經世) and evidential studies (*kaozheng* 考證), as will be discussed below.[20]

Mathematics and astronomy, long considered technical disciplines of specialized learning, were the most important part of China's traditional "studies of symbols/images and numbers" (*Xiangshu zhi xue* 象數之學). When combined together, the two best exemplified the utmost objectivity and practical utility of Western learning in terms of measurement, calculation, prediction, and observation. Under the influence of Jesuit science, Xu Guangqi subsumed both fields under the new label of "*Dushu zhi xue*" 度數之學 (Studies of measures/magnitudes and numbers) that was crucial for the management of state and society. In his view, "there is nothing which the use of *measure and number* does not penetrate (my emphasis") as these "two instances of quantity" constitute the essence of numerical arts and represent the hidden yet solid principles undergirding the universe. Just in this sense, *Dushu zhi xue* encompasses a myriad array of objects and phenomena through a shared approach of measurement and calculation hinged on the common basis of exactitude.[21]

To make sense of Ming–Qing mathematics, one should also understand its time-honored intellectual tradition and contemporary social, political and economic contexts. In other words, scholars and their works need to be studied in their broad historical settings as well as the long scholarly tradition they inherited and/or contributed to. Seen from this vantage point, Xu Guangqi was not merely the first literati promoter of Western science and an early convert to Catholicism; he was foremost a devoted scholar-official and a statecraft reformer searching for ways to rejuvenate the ailing Ming dynasty. His achievements in "studies of symbols and numbers" showcase his devotion to the time-honored Confucian statecraft tradition of "ordering the world

[17]Donald L. Baker, "Jesuit Science through Korean Eyes," *The Journal of Korean Studies* 4 (1982), 207.

[18]Matteo Ricci, *China in the Sixteenth Century: The Journals of Mathew Ricci, 1583–1610*, translated by I. J. Gallagher (New York: Random House, 1953), 325.

[19]Benjamin A. Elman, *On Their Own Terms: Science in China, 1550–1900* (Cambridge, MA: Harvard University Press, 2005), 89.

[20]Nathan Sivin, "Copernicus in China," *Science in Ancient China: Researches and Reflections* (Aldershot: Variorum, 1995), 63.

[21]The ancient concept of "Chouren" 疇人 showcases the close link between mathematics and astronomy as it refers to those well versed in both fields of knowledge; Engelfriet, *Euclid in China*, 294.

and promoting utility" (*Jingshi zhiyong* 經世致用), which became the main driver of Xu's various scientific endeavors in general.

Whereas statecraft ideas had universal appeal in eras of both disorder and stability, they were most popular during times of crisis when Confucian literati imparted the greatest impulse to order the world. Take late Ming as an example: the deteriorating realities of its politics and society provided the fertile ground in which *jingshi* activism grew. Not surprisingly, it saw a major revival of statecraft tradition that stressed practical learning as the most effective way of "saving the world" (*jiushi* 救世). Closely tied to various utilitarian fields like mathematics for land surveying and astronomy for calendrical reform, this type of *jingshi* ideal advocates useful knowledge for improving the actual conditions of state and society, rather than personal moral cultivation that could hardly address the pressing problems as many literati believed.[22] Such a strong sense of pragmatism permeated late-Ming statecraft writings and was reinforced by the importation of Jesuit science, both of which had profound impact on mid-Qing evidential research in the long eighteenth century.[23] It is important to note that, as Timothy Brook comments on the sinology of Joseph Needham, science is not "a pure form of disembodied knowledge," but comes "embedded in" and "profoundly shaped by" its broader historical contexts.[24] In relating it to society, state and culture, this article seeks to integrate the internalist history of science into the general context of late imperial China for an in-depth understanding of Xu's cross-cultural synthesis as well as its diversified impacts on Ming–Qing reconstruction of Jesuit science.

Jihe yuanben and Chinese Mathematical Tradition

Like many literati of his time, Xu Guangqi was first attracted to Matteo Ricci by his erudite knowledge about the outside world and Western sciences in particular. Their joint translation of the first six books of *Elements,* dictated by the latter and transcribed by the former, was based on its Latin edition of 1574, which includes the personal commentaries of Christopher Clavius (1537–1612). This famous German mathematician, who was Ricci's Jesuit instructor at the Roman College, has been called the "Euclid in the sixteenth century" and "the most influential teacher of the Renaissance."[25] These six books deal with the fundamental proposition of plane geometry related to geometric algebra, circles, regular polygons and the arithmetic theory of proportion. With Ricci's preface and Xu's prelude, *Jihe yuanben* became the first substantial translation of a European text into Chinese.[26] Why did the two devout Christians choose this mathematical work instead of the Bible or other gospel preaching literature?

[22]Albert Chan, "Late Ming Society and the Jesuit Missionaries," in *East Meets West*, 162; Elman, *On Their Own Terms*, 53–55; Ogawa, "Xu Guangqi," 28.

[23]For example, Feng Yingjing 馮應京 (1555–1606) published *Huangming jingshi shiyong bian* 皇明經世實用編 (Collections of statecraft writings of the Ming) in 1603. Chen Zilong 陳子龍 (1608–1647) and others compiled *Huangming jingshi wenbian* 皇明經世文編 (Collected writings on statecraft of the Ming dynasty) in 1638.

[24]Timothy Brook, "The Sinology of Joseph Needham" (In Memoriam), *Modern China* 22(1996), 343.

[25]Dennis C. Smolarski, "Teaching Mathematics in the Seventeenth and Twenty-First Centuries," *Mathematics Magazine* 75 (2002), 261.

[26]Xu's prelude and Ricci's preface to *Jihe yuanben* are included in *Xu Guangqi quanji* (Collected Works of Xu Guangqi), vol.4, edited by Weizheng Zhu and Tiangang Li (Shanghai: Shanghai guji chubanshe, 2010), 4–6, 9–11; For the English translation of both, see Joseph W. Dauben, "Chinese Mathematics,"

To answer this question, it is necessary to introduce the general historical context, cultural tradition and intellectual milieu that together shaped the mindsets and agendas of both translators. When Ricci arrived in China in 1582, the Ming dynasty was gradually passing the height of its glory. The cascade of crises on multiple fronts demanded new ideas and realistic actions, which challenged various orthodoxies and provided fertile soil for the spread of Jesuit knowledge. The worsening realities of social, political, and economic life inspired widespread discussions about how to "save the world," which created a period of great cultural diversity and intellectual openness. This new climate of opinions was characterized by a growing popular sentiment against empty talks about human nature and heavenly principle, a key feature of Neo-Confucianism that had become China's official ideology since the Yuan dynasty (1271–1368). Scholars increasingly realized that the inward metaphysical speculation and transcendental philosophical argumentation of Neo-Confucianism had brought literati to a state of incompetence and neglect of practical duties. Some of them criticized Zhu Xi 朱熹 (1130–1200) for his unhealthy preoccupation with moral introspection and his self-indulgent search for personal sagehood in the so-called "Study of the Way/Principle" (*Daoxue* 道學/*Lixue* 理學); others faulted Wang Yangming's 王陽明 (1472–1529) "Study of the Heart/Mind" (*Xinxue* 心學) for its futile effort to find the principles of the universe within oneself. There was an increasing call for "solid learning/concrete studies" (*shixue* 實學) that focused on practical, textual, or historical matters, which could offer real solutions to specific problems facing state and society at different levels. This growing appeal for substantial, verifiable knowledge helped revive an orientation toward natural, statecraft, and evidential studies, which were increasingly unified as legitimate default concerns for late imperial literati. Xu and Ricci used this urgent need for solid, utilitarian learning, born of the late Ming crisis, as well as its empiricist and reformist implications, dictated by the inner logic of Chinese intellectual development, to defend and promote Western studies.

In general, Ming China was less open to outside influences in comparison with the previous Yuan dynasty. As soon as Zheng He's fleet completed its last voyage in 1433, the former abruptly turned inward by imposing a strict policy of maritime prohibition to crack down on foreign trade and communications. The sea ban was partially lifted in 1567, thanks to the so-called "Longqing Opening" (*longqing kaiguan* 隆慶開關) that allowed merchants in Fujian to conduct private maritime trade. Though limited and inconsistent, this opening up not only promoted Chinese commercialization but also offered a favorable environment for scientific exchange and knowledge acquisition (especially in coastal areas). It was under such circumstances that Jesuits accompanied European traders into China. They brought in Catholicism as well as knowledge of Western science and technology, which gave the literati new impetus to natural studies and classical learning. Simply put, it was the late Ming's intellectual effervescence and broader historical context that created a more welcoming environment for the introduction of Jesuit science, of which mathematics was a key foundation.

As Xu stated in his prelude to *Jihe yuanben*, China had a long-established mathematical tradition that could be traced back to remote antiquity. Before discussing the translated work, a brief overview of this time-honored tradition is in order. Over its pre-modern history, the Middle Kingdom had produced a large body of mathematical works and knowledge, though a considerable part of which were lost, forgotten, or only

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The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Sourcebook, edited by Victor J. Katz (Princeton University Press, 2007), 366–74.

partially transmitted. As early as the Zhou dynasty (1050–221 BCE), mathematics had become one of the Six Arts (*liuyi* 六藝) that constituted the foundation of traditional education and statecraft. Largely problem-driven and application-oriented, the development of this knowledge field was directly tied to the real-life need of land surveying, civil engineering, tax collection, divination, astronomical prediction and so on.[27]

However, according to Xu, China's rich mathematical tradition had almost died out due to the famous book burning during the Qin dynasty (221–206 BCE). Among the few surviving texts of Chinese mathematics, the oldest and most complete one is *Zhoubi suanjing* 周髀算经 (Mathematical Classic of the Zhou Gnomon). Composed in the Zhou period, this work was later recompiled and elaborated in the subsequent Han dynasty. As the most ancient Chinese classic of mathematical astronomy, *Zhoubi suanjing* shows how to measure the positions of heavenly bodies using shadow gauges like gnomons, the primary instrument of early Chinese astronomers.[28]

With regard to the most important work in China's mathematical canon, it is none other than *Jiuzhang suanshu* 九章算術 (Nine Chapters on the Mathematical Art), a practical handbook compiled from the Zhou to Han (206 BCE–220 CE) dynasties before it was finalized around 100 CE. This "classic of classics" had played a foundational role in the development of Chinese *Xiangshu zhi xue* (Teachings on symbols/images and numbers), similar to the status of Euclid's *Elements* in Western mathematical tradition. Yet the two works are qualitatively different in terms of methodology and argumentative styles, which laid the foundations for their respective mathematical, scientific, and even intellectual traditions. Whereas *Elements* deduces propositions from an initial set of abstract axioms while offering rigorous proofs, more specifically, *Jiuzhang suanshu* discusses 246 everyday problems of mathematics (loosely grouped in nine chapters on land surveying, engineering and so on) while presenting its solution methods (algorithms) with little justification.[29] To make up for this deficiency, the great mathematician Liu Hui 劉徽 (ca. 220–280 CE) added his own commentary on the classic work in 263 CE, which inaugurated "the first golden age of Chinese mathematics" as Philip D. Straffin points out. Specifically, Liu sought to elucidate "the logical structure of mathematics" by proving the correctness of original algorithms through theoretical reasoning based on both prose and pictures (though he did not set out to prove theorems as ancient Greek mathematicians did because the Chinese concept of proof was different from that of axiomatic Euclidean one).[30] This important period of mathematical theorization, however, ended in the Sui (581–618) and Tang (618–907) dynasties, largely as a result of the rise of "an examination system that depended more upon memorization and the repetition of established knowledge than upon innovation or novel solutions to traditional problems." Consequently, Liu Hui's works were gradually lost, until they were rediscovered and reprinted by the imperial library of the Song dynasty (960–1279).[31]

[27]The other five arts were rites, music, archery, chariot racing, and calligraphy, all of which have close links to mathematics; *Xu Guangqi quanji*, vol. 4, 4–6; Engelfriet, *Euclid in China*, 96, 292, 430, 451.

[28]*Xu Guangqi quanji*, vol. 4, 4–6; Christopher Cullen, *Astronomy and Mathematics in Ancient China: The Zhou Bi Suan Jing* (Cambridge: Cambridge University Press, 1996).

[29]Kangshen Shen, John N. Crossley, and Anthony Wah-Cheung Lun, *The Nine Chapters on the Mathematical Art: Companion and Commentary* (Oxford: Oxford University Press, 1999), 351.

[30]Philip D. Straffin, "Liu Hui and the First Golden Age of Chinese Mathematics," *Mathematics Magazine* 71 (1998), 163–81.

[31]Dauben, "Chinese Mathematics," 187.

The next, equally brief, flowering of creative mathematics occurred in the thirteenth century, thanks largely to the rise of algebraic computation during the late Song and early Yuan dynasties. Many renowned mathematicians excelled in this newly developed field, including the four great masters—Qin Jiushao 秦九韶 (1202–1261), Li Ye 李冶 (1192–1279), Zhu Shijie 朱世杰 (1249–1314) and Yang Hui 楊輝 (1261–1275). It was also during the Mongol-ruled dynasty that Muslim astronomers brought Arabic numerals to China along with other new mathematical knowledge from the outside world. This great influx of foreign knowledge included trigonometry (an essential part of mathematical astronomy) and probably Euclidean geometry; the latter, however, failed to take root until the 1607 publication of *Jihe yuanben*.[32]

The short burst of native creativity during the Yuan dynasty and its acquisition of foreign knowledge pushed Chinese mathematics to its summit, after which it started to decline until the Xu–Ricci collaboration. Due to its growing commercial prosperity, the Ming dynasty saw the new development of popularized mathematics (practical arithmetic in particular) that focused on abacus calculation and business transaction, most of which was not practiced by scholars. As a result, more and more traditional mathematical works fell into oblivion while no new influential ones appeared.[33] As early-Qing scholar Pan Lei 潘耒 (1646–1708) bemoaned, mathematical learning was so neglected that it "had almost become extinct by late Ming." He ascribed this crisis to the stultifying effects of civil service examinations that focused too narrowly on writing the standardized Eight-Legged essays. Those who did employ mathematical skills just followed established rules of calculation (*fa* 法) while neglecting their underlying principles (*yi* 義) and logical reasoning based on proof (*lun* 論).[34] Consequently, many traditional methods (like the Four-Origin algebras—*Siyuan shu* 四元術—developed by the aforementioned Yuan mathematician Zhu Shijie) became incomprehensible or even forgotten during the Ming. In general, mathematics had become an increasingly empirical craft, only stressing the results and method of data operations while overlooking the formal process of logical inference that reveals whys and wherefore. For Pan, this was why Ming mathematics was inferior to its Western counterpart.[35]

This gloomy opinion was probably first voiced by Xu Guangqi who lamented the scarcity of knowledge about pre-Ming mathematics as well as the long absence of reasoning which could elucidate the underlining logic of methods and principles. Consequently, Xu wrote, "the studies of mathematics have fallen to waste over the last several hundred years." What he blamed, however, was the corrupting influence of mystical numerology, magical arts as well as the vague metaphysical speculation of Neo-Confucianism, which together led to a neglect of concrete learning and practical applications.[36] Within the

[32]It is worth noting that the Arabic translation of *Elements* also aided the rediscovery of this classic work in early modern Europe, which represents another Muslim contribution to global intercultural exchange; Yibao Xu, "The First Chinese Translation of the Last Nine Books of Euclid's Elements and its Source," *Historia Mathematica* 32 (2005), 4–32.

[33]Engelfriet, *Euclid in China*, 99; Shen, Crossley, and Lun, *The Nine Chapters*, 353.

[34]Limin Bai, "Mathematical Study and Intellectual Transition in the Early and Mid-Qing," *Late Imperial China* 16 (1995), 37.

[35]Peng Yoke Ho, *Li, Qi and Shu: An Introduction to Science and Civilization in China* (Hong Kong: Hong Kong University Press, 1985), 105; Xiaochao Wang, *Christianity and Imperial Culture: Chinese Christian Apologetics in the Seventeenth Century and Their Latin Patristic Equivalent* (Leiden: Brill, 1998), 174.

[36]Xu Guangqi, *Ke Tongwen Suanzhi Xu* (A Preface for Publishing Tongwen Suanzhi); see Roger Hart, *Imagined Civilizations: China, the West, and Their First Encounter* (Baltimore: John Hopkins University Press, 2013), 82, 205.

mathematical field of traditional China, most knowledge was presented in the lecture format of "question–answer–algorithm," with little or no explanation provided as to how or why the solution was developed. Not surprisingly, it became increasingly difficult to make sense of the advanced methods from the earlier tradition, like the Song–Yuan system of algebra for polynomial equations (*Tianyuan shu* 天元術). Consequently, many great mathematical works of earlier Chinese history ceased to be comprehensible to most Ming readers; some others, like *Jiuzhang suanshu*, were no longer available in their complete version.[37]

As both Ricci and Xu saw it, the Chinese weakness could be remedied by the strength of Jesuit science, which justified their joint effort to promote Western learning. Ricci's pioneering work in this regard led directly to the publication of four mathematical books between 1607 and 1614, two of which were in collaboration with Xu—*Jihe yuanben* and *Celiang fayi* 測量法義 (Explanations on the Approaches and Principles of Measurement, 1608). The other two were in collaboration with Li Zhizao 李之藻 (1565–1630), another renowned Ming convert official and great pillar of Ming Catholicism, including *Tongwen suanzhi* 同文算指 (Rules of Arithmetic Common to Cultures, 1614) and *Yuanrong jiaoyi* 圜容較義 (The Meaning of Compared [Figures] Inscribed in a Circle, 1614). In his preface to *Tongwen suanzhi*, the first mathematical work to introduce Western written (paper-and-pen) calculations into China, Xu claimed that Ricci's mathematical talent was many times that of Han–Tang scholars (an argument that was challenged by Mei Wending).[38] While maintaining his modesty, Ricci was most emphatic about the value of *Elements*, which, in his opinion, was no less useful than any works of China's Hundred Schools of philosophy. His preface to *Jihe yuanben* points out the lack of "solid roots and firm fundaments" in Chinese mathematical works which could elucidate why a certain solution could be reached. Consequently, as Ricci criticized in his journal, any Chinese could "exercise his wildest imagination relative to mathematics, without offering a definite proof of anything."[39]

For the purpose of "ordering the world," Xu was determined to rehabilitate China's mathematical tradition by recovering its lost principles and obscure methods. The first step was to translate classical Western works that offered logical explanations as to why certain methods or solutions were correct, thus adding much-needed clarity and sound theoretical foundation to its Chinese counterparts. Once logically apprehended and widely transmitted, he believed, these native principles could be better implemented in various fields of practical science, which contributed to the general revival of China's statecraft studies.[40] A key intellectual contribution of *Jihe yuanben*, simply put, was its promotion of explanatory reasoning as part of the main texts, which had become a "staple feature" of most Chinese mathematical treatises by the mid-seventeenth century.[41]

[37]Liu Hui's commentary on *Jiuzhang suanshu* was not reconstructed until the *Siku quanshu* project in the 1770s; Engelfriet, *Euclid in China*, 99–100, 326; Jiang-Ping Jeff Chen, "A Systematic Treatment of 'Linear Algebra' in 17th-Century China," *The College Mathematics Journal* 49 (2018), 169.

[38]Xu Guangqi, *Ke Tongwen Suanzhi Xu*, in *Xu Guangqi Ji* (Collection of Xu Guangqi); *Xu Guangqi quanji*, vol. 5, 5; Yiwen Zhu, "How Were Western Written Calculations Introduced into China?—An Analysis of *Tongwen Suanzhi*" (Arithmetic Guidance in the Common Language, 1613), *Centaurus* 60.1–2 (2018), 69–86.

[39]*Xu Guangqi quanji*, vol. 4, 10–11, see Dauben, "Chinese Mathematics," 367, 371; Ricci, *China in the Sixteenth Century*, 476–77.

[40]Nicolas Standaert, "The Transmission of Renaissance Culture in Seventeenth-Century China," *Renaissance Studies* 17 (2003), 367–91; Engelfriet, *Euclid in China*, 459; Fontana, *Matteo Ricci*, 250, 257.

[41]Chen, "A Systematic Treatment," 170.

It must be noted that the Jesuits' relative success in late Ming and early Qing was due largely to their useful techno-scientific knowledge, not to the glory of god. "In fact," as Matthias Schemmel writes, "nowhere in the world did the Jesuits make such systematic use of science to support their mission as they did in China where they were confronted with a highly developed, self-contained and stable cultural system—a nut they were ultimately unable to crack."[42] Whereas religion had predominant and all-encompassing impact on pre-industrial Europe, it was often secondary to the political, social, and moral concerns in the Middle Kingdom. Moreover, Confucian literati rarely accepted religious teachings as a symbol of high culture. Under these circumstances, the Jesuits' only means of access to the Ming–Qing court was their technological expertise and scientific knowledge that could directly benefit Chinese society and state.[43]

The most important knowledge these China missionaries could rely on were none other than mathematics and astronomy. The precision and rigor of the two interrelated fields, in Ricci's words, could bolster the authority of Catholicism by exemplifying its "higher" truth and "superior" logic; they could thus be used as excellent "bait" to entice proud literati and reluctant scholar-officials. Once they became impressed by the usefulness and accuracy of Jesuit science, Ricci reasoned, these educated elites would realize the perfection of the Christian God and accept Catholicism. As Jacques Gernet wrote, "If what the Western literati say of the visible world were actually proved to be true, the Chinese should also believe what they say about the invisible world … Secular science and religion lent each other a mutual support." The introduction of European science was thus a necessary first step to win the Middle Kingdom for Christ.[44]

For Ricci, there was no better starting point than mathematics, a fundamental discipline that served as the basis for all scientific inquiries. It also opened a crucial avenue to Catholic conversion by holding the key to the gate through which one must pass to attain true knowledge. At the heart of this discipline was geometry, he believed, which was greatly advanced by Euclid's classic work *Elements*. This foundational text in Western science became the cornerstone of logic in using mathematical theory to explain the natural world. "For depth and solidity, nothing surpasses the knowledge that springs forth from the study of mathematics," Ricci wrote in his preface to *Jihe yuanben*, "anyone who devotes himself to the study of mathematics should use this work as a 'ladder.'" Xu was equally confident about the primacy of mathematics in general, and *Jihe yuanben* in particular, taking the latter as "the Ancestor of Measures and Numbers" (*Dushu zhi zong* 度數之宗) and "the basis of all applications" (*Zhongyong suo ji* 眾用所基). His most urgent goal was to save the world through solid learning, the foundation of which was Euclidean geometry.[45]

Moreover, both translators pointed out that *Jihe yuanben* used *yi* (underlying principles) to validate *fa* (established methods), which not only distinguished Western mathematics from its Chinese counterpart but also helped the latter to overcome its

[42]Matthias Schemmel, "The Transmission of Scientific Knowledge from Europe to China in the Early Modern Period," *The Globalization of Knowledge in History*, edited by Renn Jürgen (Berlin: Max Planck Institute, 2012), 275.

[43]Qi Han, "Astronomy, Chinese and Western: The Influence of Xu Guangqi's Views in the Early and Mid-Qing," in *Statecraft and Intellectual Renewal*, 361.

[44]Sivin, "Copernicus in China," 65; Jacques Gernet, "Christian and Chinese Visions of the World in the Seventeenth Century," *Chinese Science* 4 (1980), 3.

[45]See Ricci's preface and Xu's prelude to *Jihe yuanben*, in Dauben, "Chinese Mathematics," 367, 370, 372; R. Po-chia Hsia, *A Jesuit in the Forbidden City: Matteo Ricci 1552–1610* (Oxford: Oxford University Press, 2010), 16; Engelfriet, *Euclid in China*, 292; Ogawa, "Xu Guangqi," 27.

theoretical weakness in logical reasoning. A hallmark of traditional European science, Schemmel claims, is the Aristotelian "deductive organization of knowledge by means of definitions, postulates, axioms, theorems and proofs."[46] This Greek-style interpretation is best illustrated in Euclid's *Elements*, which promotes a hypothetico-deductive way of systematic reasoning that exposits the method used to arrive at certain results. By clarifying "why mathematics gets what it gets," Ricci surmised in his journal, this classic in logical inference would implant Western reason in the Chinese due to their lack of axiomatic-deductive thinking based on rigorous proof (like their counterparts in Mesopotamia, ancient Egypt, India, and the Islamic world). After reading *Jihe yuanben*, they could learn "propositions presented in order and so definitely proven that even the most obstinate could not deny them." This clarity, as Ricci saw it, conveyed a sense of irrefutability when it came to the diffusion of his mathematical knowledge and religious teachings.[47]

Nevertheless, Ricci was too optimistic about the immediate and "revolutionary" influence of Euclidean geometry. Its dissemination in China did make it possible to transmit and apply abstract principles to various fields of practical science, including agriculture, hydraulics, geography, and astronomy. This Western classic, according to Jeff Chen, also brought about "the rise of reasoning" (in the form of explication embedded in main texts instead of separate commentaries) within the Ming–Qing mathematical tradition; yet it is debatable whether this sort of explanatory texts can be qualified as rigorous proofs in the Western sense. As fundamentally an empirical science, moreover, Chinese mathematical knowledge remained organized mostly in traditional treatises, preoccupied with laying out algorithmic procedures rather than elaborating the principles hidden within them.[48] Little wonder that many readers of *Jihe yuanben* found it difficult to tease out the reasoning behind the complicated steps of algorithmic solutions to paradigm questions or exemplary examples. More broadly, Weimin Sun and Wen-yuan Qian claim, most Neo-Confucian literati preferred analogical reasoning and correlative thinking based on the induction of a specific principle from many observations rather than the converse process of abstract argumentation and causal thinking based on deductive Aristotelian logic.[49]

By the same token, Jean-Claude Martzloff also highlighted the Chinese emphasis on the operational aspects of science (like calculations, trigonometry, logarithms) while downplaying its logical, theological, or demonstrative features (like geometry). This pragmatic attitude seems rather common among the seventeenth-century literati readers of *Jihe yuanben*; it was also clearly reflected in various Qing handbooks of geometry, most of which continued to stress numerical examples and solution problems while curtailing demonstrations of propositions and proofs (the very core of Euclid's work).[50] For most literati readers, these lengthy elaborations and abstruse argumentative

[46]Fontana, *Matteo Ricci*, 270; Engelfriet, *Euclid in China*, 454, 458; Schemmel, "The Transmission of Scientific Knowledge," 287.

[47]This is why Xu and Ricci chose the word "*Yuanben*" 原本 (origin or foundation) for the title of their translated work. Ricci, *China in the Sixteenth Century*, 476–77; Hart, *Imagined Civilizations*, 199.

[48]Chen, "A Systematic Treatment," 169–70.

[49]Weimin Sun, "Chinese Logic and the Absence of Theoretical Sciences in Ancient China," *Dao: A Journal of Comparative Philosophy* 8 (2009), 403–23; Wen-yuan Qian, *The Great Inertia: Scientific Stagnation in Traditional China* (London: Croom Helm, 1985), 65.

[50]Martzloff, "Space and Time in Chinese Texts of Astronomy and of Mathematical Astronomy in the Seventeenth and Eighteenth Centuries," *Chinese Science* 11 (1993–94), 71; For a list of these handbooks, see Ogawa, "Xu Guangqi," 30.

styles could not add any truth or value to the field. Some ultra-conservatives even argued that they were "reminiscent of religious 'quibbling,' Christian or Buddhist … and the root of all evil in view of its uselessness and indulgence."[51] Joseph Needham also noted that traditional Chinese mathematics was largely algebraic and performed on counting boards, unlike its Western counterpart whose originality was based mainly on geometry. For most Ming–Qing readers of *Jihe yuanben*, the learning curve was quite steep, as demonstration of propositions became unnecessarily intricate and circuitous when applied to Chinese problems of algorithmic solutions. While recognizing the utility of Western computing techniques and predictive systems, most of them had little interest in the abstract procedures and deductive conceptual structure upon which these specific methods were built.[52]

Arousing more perplexity than enthusiasm, the Euclidean approach of deductive reasoning did not make a decisive impact on Ming–Qing science until the late nineteenth century. Neither did *Jihe yuanben* "become a model in the Chinese tradition, not even in the case of geometry" as Schemmel contends. Once introduced to China, like its native counterpart, Jesuit mathematics was largely confined to the rank of technical skills, with its underlying logic and rational systemization of thought neglected or sidelined. This result not only suggests the highly selective reception of Western learning based on what was needed and preferred in China; it also explains why Jesuit knowledge could not transform the traditional Chinese conception of science and its internal logic (let alone its socio-institutional embedding). Consequently, Chinese science was decoupled from "almost all of the developments that characterize European modern science," including the rise of symbolic algebra and calculus that made the development of experimental science possible.[53] This claim directly challenges Needham's optimistic assessment that around 1600 CE "there ceases to be any essential distinction between world science and specifically Chinese science." In any event, the publication of *Jihe yuanben* did offer Ming–Qing literati a "crash course" in deductive logic, which broadened their intellectual horizon and promoted "a trend towards generality" in terms of augmentative propositions and epistemological integration.[54]

Well aware of the intellectual challenges posed to its Chinese readers, Ricci sought deliberately to use *Jihe yuanben* to advance his primary mission of proselytization. He hoped that the translation of this Western classic, the first work written in Chinese that the educated elites found hard to comprehend, could humble literati pride and bring down their arrogance.[55] Eventually they would welcome this exotic work, Ricci surmised, as it complemented Confucian studies by demonstrating how Western learning could help solve myriad practical problems that mattered to the Ming state and society. By exemplifying the mathematical approach to scientific truth, most importantly, *Jihe yuanben* held the key to the highest realms of

[51]Martzloff, "Space and Time," 71.

[52]Ogawa, "Xu Guangqi," 30; Joseph Needham, "Mathematics and Science in China and the West," *Science & Society* 20 (1956), 323; Jean-Claude Martzloff, *A History of Chinese Mathematics*, translated by Stephen Wilson (New York: Springer, 1997).

[53]Schemmel, "The Transmission of Scientific Knowledge," 283–87.

[54]Joseph Needham, *Science and Civilisation in China*, vol. 3 (Cambridge: Cambridge University Press, 1995), 437; Jim-Hong Su and Jia-Ming Ying, "What Did They Mean by 'Calculation Principles'?: Revisiting Argumentative Styles in Late Ming to Mid-Qing Chinese Mathematics," *The Korean Journal for the History of Science* 38 (2016), 351–76, here 374; Jami, *The Emperor's New Mathematics*, 391.

[55]Fontana, *Matteo Ricci*, 273.

knowledge—the ultimate theological truths about the Lord of Heaven. "Without this book," Ricci sighed, "we would be unable to achieve anything."[56]

Two deviations on both sides need to be stressed here. On the one hand, Ricci was more interested in utilizing Euclidean geometry to propagate Catholicism than in diffusing the scientific work itself; on the other hand, his co-translator was most keen on putting the Jesuit knowledge into the service of statecraft instead of studying *Jihen yuanben* for its pure scientific or religious value.[57] In his prelude to the work, Xu described the highest purpose of the Jesuit mission as "self-cultivation to serve Heaven" (*xiushen shi tian* 修身事天). While embracing this "great usefulness" of "Heavenly Learning," he actually paid more attention to its "small usefulness"—"Investigation of things to fathom principle" (*gewu qiongli* 格物窮理). This attitude was driven by his pragmatic desire to "give priority to what can easily be believed" as well as the urgent need to "extend knowledge" (*zhizhi* 致知) and to "order the world" (*jingshi* 經世).[58] Since its formulation by the Neo-Confucian master Zhu Xi, the concept of "Investigation of things to fathom principle" had become the most important foundation of moral cultivation as well as the paradigm grid for intellectual endeavors in traditional China. Like Xu, many Ming–Qing scholars referred to Western science as "the learning on investigation of things and extension of knowledge" (*gezhi xue* 格致學). In so doing, they used the latter as a rationale for embracing the former into Confucian learning.[59]

After their arrival in late Ming, the Jesuits began to appropriate *gewu qiongli* "as a necessary way station" to their final destination of a Christianized China. For this purpose, they integrated their scientific expertise into the indigenous conceptual framework by presenting Western learning as an alternate form of the "investigation of things" (*gewu*), which conveyed the experience of God. Their literati collaborators, meanwhile, also used *gewu* as a rationale for incorporating Western knowledge into Confucian learning while reconstructing it as a confirmation of native natural and classical studies.[60] For instance, as Wann-Sheng Horng points out, Xu hoped to apply Western mathematics to the study of "all objects with shapes, and all phenomena involving measures and numbers (*xiangshu* 象數)." This effort not only promoted statecraft learning but also helped elucidate the core concepts of Neo-Confucianism like *Li* 理 (Principle) and *Dao* 道 (Way). Most importantly, in Benjamin Elman's words, it provided a more "scientific" and integrative interpretation of the "symbolic structures of meaning [of *Lixue* or *Daoxue*] in which all human experience would be related."[61] Seeking to transform each other for their own purposes, both literati and their Jesuit interlocutors shifted the Confucian investigative focus "from a pathway to sagehood to a more rigorous methodology for extending all knowledge."[62] Their joint use of basic Confucian

[56]Engelfriet, *Euclid in China*, 66, 85, 289, 297.

[57]Roger Hart, "Translating the Untranslatable: from Copula to Incommensurable Worlds," in *Tokens of Exchange: The Problem of Translation in Global Circulations*, edited by Lydia Liu (Durham: Duke University Press, 1999), 61.

[58]*Xu Guangqi quanji*, vol. 4, 4–6, see Dauben, "Chinese Mathematics," 373.

[59]Hart, *Imagined Civilizations*, 244; Yung Sik Kim, *Questioning Science in East Asian Contexts: Essays on Science, Confucianism, and the Comparative History of Science* (Leiden: Brill, 2014), 140.

[60]Benjamin Elman, "Jesuit Scientia and Natural Studies in Late Imperial China, 1600–1800," *Journal of Early Modern History* 6 (2002), 217–18.

[61]Wann-Sheng Horng, "The Influence of Euclid's *Elements* on Xu Guangqi and His Successors," in *Statecraft and Intellectual Renewal*, 389; Benjamin Elman, "Early Modern or Late Imperial Philology? The Crisis of Classical Learning in Eighteenth Century China," *Frontiers of History in China* 6 (2011), 6.

[62]Elman, *On Their Own Terms*, 60.

notions like *gewu* and *qiongli* showcases Ricci's strategy of accommodation to suit those he most wanted to convert. This painstaking tactic, though highly contested (both within and without China), fostered a new culture of mutually transformative learning that hallmarked the Jesuit-literati interaction during the seventeenth century.[63]

With regard to the most basic scientific investigation in traditional China, it was none other than the study of measures/magnitudes and numbers (*Dushu zhixue*) that could apply knowledge to a broad range of fields pivotal for social life and state administration. According to Xu, *Jihe yuanben* identifies geometrical conceptualization as a major means of explaining the logical reasoning behind myriad principles; hence it not only epitomizes the fundamental way of thinking that underlies Western learning but also offers many secular benefits like utmost objectivity and wide applicability. In his opinion, this work provided not only "a most firm base to turning Chinese sciences to practical use" but also "a new way of totalizing thinking essential for the moral and spiritual renovation of individuals and society."[64] In particular, as Willard Peterson points out, Xu was "looking for new intellectual bases" to train people's mind, to lead them back to morality and to "fortify traditional values which had been eroded in late Ming," all of which could be aided by a new scientific and Christian reading of the Chinese classics.[65] In particular, as Xu saw it, Euclidean geometry could strengthen "Confucian rigorism" and statecraft efficacy because its "precise and lucid way of reasoning … was an excellent anti-dote against the empty speculations in which some of the philosophical schools … of his time were engaged." Simply put, along with Christianity, *Jihe yuanben* could provide a new foundation of logic and virtue for improving both the spiritual and material dimensions of Confucian life.[66]

Just in this sense, Xu put forward the strategic idea of using this exotic religion and its scientific accoutrements to "supplement Confucianism and supplant Buddhism" (*buru yifo* 补儒易佛). He sought to integrate the two interlocking branches of Western learning into the overarching framework of nativist thought, which created a preliminary form of the Chinese origins narrative that later developed into the *Xixue zhongyuan* theory.[67] For a different reason, Ricci also sought to meld Chinese and Western culture by using the logical sophistication of Jesuit science and the metaphysical ideas of their religion to support the moral-social doctrine of Confucianism. He made a similar assertion that Western learning could "do away with Buddhism and complement Confucianism [*Qufo buru* 去佛补儒]," a catchphrase that partly guided his primary mission of evangelism. Yet, ironically, this ultimate goal was overshadowed by Ricci's utilitarian strategy of promoting Western science as it was the latter that piqued the most interest among Chinese literati.[68]

Prior to the Jesuit arrival, Xu had already been researching and promoting Chinese mathematics needed for surveying, water control, agricultural production and mapmaking, an effort central to a wide range of practical learning discussed in his earlier statecraft works. This justification of mathematics by its wide applications was not only in

[63]Kim, *Questioning Science*, 140.

[64]Yu Liu, "The Intricacies of Accommodation: The Proselytizing Strategy of Matteo Ricci," *Journal of World History* 19 (2008), 478; Ogawa, "Xu Guangqi," 27–28.

[65]Peterson, "Why Did They Become Christians?," 147.

[66]Engelfriet, *Euclid in China*, 295.

[67]Elman, *On Their Own Terms*, 174.

[68]Ogawa, "Xu Guangqi," 27-28; Xu Guangqi, *Taixi shuifa xu* (Prefaces to the Hydromethods of the Great West), in *Xu Guangqi quanji,* vol. 5, 289–90.

accordance with late Ming emphasis on *Jingshi* studies; it was also a commonplace argument in Renaissance Europe as Hashimoto and Jami point out.[69] Xu's encounter with Ricci further stimulated his earlier interests, which motivated him to not only translate Euclid's *Elements* but also complete a few more works about surveying and measurement. In this sense, as Peter Engelfriet and Siu Man-Keung point out, Xu used *Jihe yuanben* "as the basis from which to launch the introduction of mathematical knowledge of a practical kind." One year after the publication of *Jihe yuanben*, for instance, the two translators collaborated again in composing *Celiang fayi* 測量法義 (Explanations on the Approaches and Principles of Measurement), which introduces fifteen practical problems on surveying and explains their solution with Western geometrical methods. In the same year (1608), Xu used these Western approaches to confront ancient works of mathematics and wrote *Celiang yitong* 測量異同 (Similarities and Differences in Measurement between East and West). As a follow-up to *Celiang fayi*, this book compares six methods of measurement expounded in the former with similar approaches practiced in pre-Ming China. One year later (1609), Xu collaborated with his student Sun Yuanhua 孫元化 (1582–1632) on another important book, *Gougu yi* 勾股義 (On the Principle of Right-Angled Triangle, referred to by Westerners as the Pythagorean Theorem).[70] The traditional method of *Gougu* was not only widely used in various domains of Chinese socio-economic life, it also became a key subject of ancient geometrical studies, widely discussed in classical works like *Zhoubi suanjing* and *Jiuzhang suanshu*. Much of that traditional knowledge (especially its line of reasoning), nevertheless, was lost in transmission over time. Consequently, in Chinese mathematical works from the third to the sixteenth centuries CE, there was no clear elucidation of the "principle" (*yi*) for handling the problems that required computations in a right-angled triangle, let alone its underlying logic based on proof (*lun*). To remedy these problems, Xu and Sun directly tackled this almost forgotten rule by elucidating it with the propositions of *Jihe yuanben* as will be seen below. The resulting book *Gougu yi*, in other words, seeks to provide a new theoretical foundation for surveying and other activities that relied heavily on this traditional Chinese method.[71]

All three of Xu's works above seek to "use the newly introduced Western mathematics to create a more solid basis for Chinese mathematics".[72] More specifically, Masahiro Ogawa argues, they "apply a deductive demonstration to some models of Chinese algorithmic solutions," which in turn represents a further elaboration and utilization of *Jihe yuanben*.[73] Xu's overall purpose was to synthesize Western and Chinese mathematics, which can be done by using Euclidean geometry and its logical reasoning to vindicate and revitalize native formulas. His *Gougu yi*, for instance, is primarily concerned with expounding the *yi* (principles) behind the fifteen *gougu*-related problems deriving from ancient Chinese sources, which represents the first attempt to elucidate this time-honored approach in terms of any Western methods. When rendering Ricci's dictation of *Elements*, moreover, Xu often referred to the expressions and objects that epitomized

[69]Hashimoto and Jami, "From the *Elements* to Calendar Reform," 269.

[70]Peter Engelfriet and Siu Man-Keung, "Xu Guangqi's Attempts to Integrate Western and Chinese Mathematics," in *Statecraft and Intellectual Renewal*, 280, 282, 307.

[71]Hart, *Imagined Civilizations*, 244; Engelfriet, *Euclid in China*, 85; Dun Liu and Joseph W. Daube, "China," in *Writing the History of Mathematics: Its Historical Development*, edited by Joseph W. Dauben and Christoph J. Scriba (Basel: Birkhäuser, 2002), 300.

[72]Engelfriet and Man-Keung, "Xu Guangqi's Attempts," 279

[73]Ogawa, "Xu Guangqi," 27.

the origin and use of mathematics in his own tradition rather than adopting directly transcribed Western concepts or other newly coined ones.[74] To take its Chinese title, *Jihe yuanben*, as an example, Xu used "*jihe*" 幾何, a classical term (literally meaning how much) widely used in China's ancient mathematical texts, to designate the whole of Europe's quadrivium, of which geometry was a key part. This deliberate choice, as Ogawa puts it, not only showcases Xu's "firm intention of adapting Western mathematics to Chinese context" but also constitutes "the greatest linguistic merit of this translated book."[75]

For late Ming converts like Xu, the Jesuit-mediated Western studies were not only a sort of practical learning in the service of statecraft; they also offered the incentives and means to retrieve the lost tradition of ancient Chinese mathematics and astronomy. The convergence of these two efforts promoted a sort of intellectual genealogy on native science in the spirit of solid learning, which laid the foundation for the predominance of the *kaozheng* studies in the long eighteenth century. It also set the stage for the subsequent rise of *Xixue zhongyuan* 西學中源, an autochthonous theory claiming that Western learning was ultimately derived from China.[76] Mei Wending, the leading mathematical astronomer of early Qing, played a key role in both developments mentioned above. The following part will discuss his key contributions in relation to Xu's legacy.

Mei Wending and the Legacy of *Jihe Yuanben*

Four years after its first publication, *Jihe yuanben* was reprinted with minor revisions in 1611. Although its impact on the development of Ming–Qing mathematics was not revolutionary, this classic work did stimulate literati interest in Western science and affected how they engaged with it. The process of adapting and assimilating European mathematics and astronomy initiated by Xu Guangqi continued on various levels over the closing decades of the Ming dynasty and into the subsequent Qing. The most salient example is Mei Wending, a self-taught scholar who wrote more than eighty works on mathematics and astronomy, which made him the most renowned Qing expert on the two disciplines. With no Christian background or any official position, this extraordinary polymath was nonetheless strongly influenced by Xu and patronized by the Qing emperor Kangxi 康熙 (r. 1661–1722). In 1689, Mei was invited to Beijing to work on the calendrical treatise for the official *Ming History* project (*Mingshi* 明史). This high-profile job in the capital enabled him to win the patronage of a powerful official, Li Guangdi 李光地 (1642–1718), who later studied with Mei and brought his talents to Kangxi's attention.[77]

Like Xu, Mei not only lamented the lack of reasoning in Chinese mathematics but also acknowledged the significance of *Jihe yuanben* in remedying this weakness. Both advocated the use of Jesuit knowledge to advance native "studies of measures/

[74] Catherine Jami, "Heavenly Learning, Statecraft and Scholarship: the Jesuits and Their Mathematics in China," in *Oxford Handbook of History of Mathematics*, edited by Eleanor Robson and Jackie Stedall (Oxford: Oxford University Press, 2009), 67.

[75] Ogawa, "Xu Guangqi," 24–25.

[76] For a brief introduction of the *Xixue zhongyuan* theory, see Minghui Hu, "Provenance in Contest: Searching for the Origins of Jesuit Astronomy in Early Qing China, 1664–1705," *The International History Review* 24 (2002), 2.

[77] Willard Peterson, "Changing Literati Attitudes Toward New Learning in Astronomy and Mathematics in Early Qing," *Monumenta Serica* 50 (2002), 381; Jami, *The Emperor's New Mathematics*, 216.

magnitudes and numbers" for the purpose of rejuvenating China's mathematical and astronomical traditions. Both believed that progress was a universal pattern of intellectual exchange, which not only motivated them to engage with various projects of scientific exchange but also committed them to the highest goal of "integrating the new knowledge with the Chinese tradition" (*huitong* 會通).[78] As they saw it, this phrase entailed thoroughly understanding Western approaches before incorporating them into the Chinese tradition, with the ultimate goal of creating a new comprehensive, unified body of knowledge based on *fa* (rule), *yi* (principle) and *lun* (logic reasoning based on proof).[79] Such comprehensive unity is clearly shown in Mei's *Zhongxi suanxue tong* 中西算學通 (The Synthesis of Chinese and Western Mathematics, 1680), a collection of his nine treatises that puts various forms of Confucian thought in dialogue with Jesuit science. Thanks to such syncretistic efforts, Horng argues, both Xu and Mei proposed a more "scientific" interpretation of fundamental neo-Confucian concepts like *Li* 理 or *Dao* 道. Therefore, according to Limin Bai, they facilitated a larger shift of intellectual fashion from "the Song-Ming Neo-Confucian emphasis on moral cultivation to seventeenth- century 'practical learning' [statecraft studies] and then to [mid-Qing] evidential scholarship," of which philology of science was an important facet. The result, as Ying-shih Yü pointed out, was the replacement of Confucian moral philosophy by a new critical academic discourse based on fact and empiricism.[80]

Thanks to the progress of seventeenth-century scholarship on mathematics and astronomy, Mei was better-positioned to achieve a more comprehensive knowledge and deeper understanding of the two fields than his Ming predecessor. Notwithstanding Xu's influence, Mei had developed a different view of the cross-cultural synthesis, which motivated him to steer a distinct course between the native and Western systems. Whereas the former embraced both Jesuit science and their religion whole-heartedly, the latter sought to untangle the two while rejecting the claim of Western superiority in either field. Like Xu, he did recognize the advantages of some Western scientific approaches (especially in terms of measurement and prediction) over those attained by China. Yet in Mei's eyes, his Ming predecessor and the Jesuits overly praised the logical rigor of European geometry while disparaging Chinese methods/proofs and neglecting the native strength in *Suanshu* 算數 (techniques of calculating), the arithmetic and algebraical parts of mathematics.[81] A good example is *Fangcheng* (simultaneous linear equations), which was one of the "*jiushu*" (Nine Subjects Concerning Number) emphasized in pre-Qin Confucian education. In 1672, Mei wrote his first book *Fangcheng lun* 方程論 (On Simultaneous Linear Equations) to showcase the problem-solving power of Chinese methods on this long-developed subject. By contrast, this area of study, equivalent to the modern-day systems of linear equations and Gaussian elimination, was still in its infancy in contemporary Europe.[82] As Mei complained to one of his friends, "I am disgusted by those Western missionaries who exclude traditional Chinese mathematics, and therefore I wrote this book about

[78]Elman, *On Their Own Terms*, 159; Engelfriet and Man-Keung, "Xu Guangqi's Attempts," 279.

[79]Horng, "The Influence of Euclid's Elements," 386–88.

[80]Bai, "Mathematical Study and Intellectual Transition," 36–37, 50; Hart, *Imagined Civilizations*, 256; Harriet T. Zurndorfer, "China and Science on the Eve of the 'Great Divergence' 1600–1800: A Review of Recent Revisionist Scholarship in Western Languages," *History of Technology* 29 (2009), 81–102; Ying-shih Yü, "Some Preliminary Observations on the Rise of Ch'ing Intellectualism," *Qinghua Xuebao* 11 (1975), 105–146.

[81]Horng, "The Influence of Euclid's Elements," 385.

[82]Chen, "A Systematic Treatment," 169.

which even Matteo Ricci could not possibly say a bad word."[83] His confidence was based on the fact that the geometrical reasoning elaborated in *Jihe yuanben* did not work well for those *Fangcheng* problems illuminated in his book or for any other subjects considered to be computational. Much of Mei's *Fangcheng lun*, as Chen argues, was devoted to presenting a different mode of mathematical reasoning that was later widely applied in Qing nongeometric texts. Moreover, while Xu stressed both the applicability of Jesuit knowledge and how logically true it should be, Mei called for "the critical reception of Western science in a perspective centered on ancient Chinese scholarship," as Ogawa puts it, without the baggage of Catholic accoutrements. The overarching purpose of his critical engagement with intercultural synthesis, most importantly, was to reestablish an intellectual-scientific hierarchy with the Chinese over the Western.[84]

To achieve this restorationist goal, Mei set out to domesticate Western learning as a derivative of his native tradition while integrating the two into a unified whole. First, he identified the similarities between some widely used European formulas/rules and their Chinese counterparts in ancient mathematical works, which invalidated the novelty of the former that Xu and his Jesuit interlocutors insisted. In rejecting the missionaries' scientific arrogance, Mei also complained about their knowledge gaps (especially in terms of calculation) due to their relative deficiency in certain areas like simultaneous linear equations as well as their selective introduction of European science (like only translating the first six books of *Elements*). In response to this criticism, the Belgian Jesuit priest Antoine Thomas (1644–1709) introduced cossic algebra to China in 1700, the methods of borrowing root and powers (*Jiegen fang* 借根方), in his work "Calculation by Borrowed Root and Powers" (*Jiegen fang suanfa* 借根方算法). Whereas Xu strove to use Western mathematics to fill the hole in ancient Chinese texts, simply put, Mei was more interested in using native approaches to explicate its European counterparts.[85]

The impact of this effort was two-fold. On the one hand, Mei claimed that both Euclidian geometry and Jesuit arithmetic were an outgrowth of Chinese mathematics which should be repositioned on a higher plane than its Western counterpart. Actually he had written several books to comment on, clarify, and supplement the classic work of *Jihe yuanben*, including *Jihe tongjie* 幾何通解 (Complete Explanation of Geometry), *Jihe bubian* 幾何補編 (Complements of Geometry), *Gougu juyu* 勾股舉隅 (Illustration of the Right-Angled Triangle), and *Pingsanjiao juyao* 平三角舉要 (Essentials of Plane Geometry). All these works, as Horng argues, show "how Western geometry could be explained in terms of traditional [Chinese] concepts concerning the right-angled triangle (*gougu*)." *Jihe tongjie*, in particular, represents Mei's own approach to Euclidean geometry as it reinterprets the latter's sixteen propositions through various native concepts and methods related to *Gougu*. In his eyes, *Gougu* constituted the foundation of both Chinese and Euclidean geometry; it could thus validate all the theories expounded in *Jihe yuanben*.[86]

On the other hand, as Chen argues, Mei reframed the native approaches to mathematics as a reflection of the Principle/Way elucidated in Confucian classics, which

[83]Mei Wending, "To Fang Zhongtong," quoted in Liu and Daube, "China," 299.

[84]Chen, "A Systematic Treatment," 169, 178; Ori Sela, "Confucian Scientific Identity: Qian Daxin's (1728–1804) Ambivalence toward Western Learning and Its Adherents," *East Asian Science, Technology and Society* 6 (2012), 147–66; Ogawa, "Xu Guangqi," 31.

[85]Jami, *The Emperor's New Mathematics*, 93, 200–10.

[86]Horng, "The Influence of Euclid's Elements," 386; Ogawa, "Xu Guangqi," 31.

would or, elevate this traditional technical field to be on par with other branches of classic knowledge.[87] It was thus imperative to collect and collate the most important mathematical works of antiquity while adopting an evidential method to analyze and reconstruct them. For various reasons, ancient classics like *Zhoubi suanjing* and *Jiuzhang suanshu* had accumulated a lot of errors which impaired their transmission over the centuries. To retrieve the lost wisdom, Mei started the practice of seeking "external facts" from ancient texts for the purpose of corroborating new findings, which greatly facilitated the rise of a novel intellectual current that profoundly affected later mathematical and astronomical study by bringing both into the mainstream of classical scholarship.[88] In this *kaozheng*-based process of textual criticism, Harriet T. Zurndorfer claims, Confucian scholars not only honed their philological expertise but also found a more objective way of gauging the quality of their research. Furthermore, they used the new criterion of "science of words" to reevaluate the classic canon by identifying the most ancient and trustworthy sources, thus starting a movement of "returning to antiquity" (*fugu* 复古) that spread to neighboring Japan and Korea.[89]

This *fugu* movement, both fueling and fueled by the evidential research, as Benjamin Elman points out, played a significant role in retrieving lost or incomplete works of Chinese mathematics. Many of them were rediscovered, restored, or brought into the monumental project of *Siku quanshu* 四庫全書 (Complete Library of the Four Treasuries) completed in the 1780s, thanks much to Dai Zhen 戴震 (1724–1777), the famed Qing philologist and official compiler responsible for the mathematical section of this project.[90] Still more mathematical texts were recovered in the next several decades, thanks to the compilation of important works like *Chouren zhuan* 疇人傳 (Biographies of Mathematicians and Astronomers). Published under the patronage of Ruan Yuan 阮元 (1764–1849), a high-ranking official and a towering *kaozheng* scholar, this vast collection covers China's mathematical and astronomical achievements from the earliest times to the 1790s by following more than three hundred scholars, forty-one of whom are foreigners (including Ricci).[91] Zurndorfer highlights the milestone significance of *Chouren zhuan* because "the assimilation of Western science into the Chinese record took on its final formal encapsulation" in this very work. It attaches great importance to Ricci and *Jihe yuanben*, moreover, touting the latter as the most important mathematical work transmitted from the West to China.[92]

One unifying theme of *Chouren zhuan*, Horng argues, was the "foundation myth" of *Xixue zhongyuan* that anchored the appropriation of Western learning in a Sino-centric historical and intellectual narrative. It had commanded increasing scholarly-official attention since its formulation during the mid-seventeenth century, thus becoming

[87]Chen, "A Systematic Treatment," 177.

[88]Hashimoto, *Hsü Kuang-ch'i*, 58–59; Pingyi Chu, "Remembering Our Grand Tradition: the Historical Memory of the Scientific Exchanges Between China and Europe, 1600-1800," *History of Science* 41 (2003), 193–215; Benjamin Elman, *A Cultural History of Modern Science in China* (Cambridge, MA: Harvard University Press, 2006), 60.

[89]Zurndorfer, "China and Science," 93; Peter N. Miller, "Comparing Antiquarianisms: A View from Europe," in *Antiquarianism and Intellectual Life in Europe and China, 1500-1800,* edited by Peter N. Miller and François Louis (Ann Arbor: University of Michigan Press, 2012), 130.

[90]Elman, *A Cultural History of Modern Science*, 58–59, 61; Wann-Sheng Horng, "Chinese Mathematics at the Turn of the 19th Century: Jiao Xun, Wang Lai and Li Rui," in *Philosophy and Conceptual History of Science in Taiwan*, edited by Cheng-Hun Lin, Daiwie Fu (Dordrecht: Springer, 1993), 202.

[91]Horng, "The Influence of Euclid's Elements," 389.

[92]Su and Ying, "What Did They Mean," 353; Zurndorfer, "China and Science," 95.

the most significant interpretive strategy (though never the only one) to explain the exchange of ideas and practices between Qing China and early modern Europe. By drawing links between European science and certain parts of Chinese classics (which were considered the main source of learning), the *Xixue zhongyuan* doctrine claims that the former had its origin in the Middle Kingdom due to a westward transmission of native knowledge that could be traced back to remote antiquity. Viewed from this nativist perspective (revealed through textual evidence), all major importation of foreign science to China, including Arabic mathematics and astronomy in the Yuan as well as its Jesuit counterparts in the Ming and Qing, had emanated from much earlier diffusion of Chinese knowledge. Originally focused on the "Studies of measures/magnitudes and numbers" in the latter half of the seventeenth century, as Iwo Amelung points out, this self-glorifying theory gradually expanded over the next two centuries "to cover almost the entire range of Western knowledge, including Catholicism, which was said to have its origins in the Mohist notion of 'all-embracing love' (*jian'ai*, 兼爱)." Its persuasive power reached the peak in the eighteenth century as the dynasty entered its prosperous age of high Qing.[93]

Notwithstanding Xu's influence, the *Xixue zhongyuan* idea was derived directly from a new sense of conservatism during the crisis-ridden Ming–Qing transition, both of which can be viewed as a response to the consolidation of Manchu hegemony and to the technical prowess of the newly introduced Jesuits knowledge. With an implicit goal of promoting Han Chinese supremacy, this China-origins narrative was first formulated by the three great Ming loyalist scholars, Huang Zongxi 黄宗羲 (1610–1695), Fang Yizhi 方以智 (1611–1671) and Wang Xishan 王錫闡 (1628–1682), all of whom refused to serve the Qing regime.[94] As a highly accomplished mid-seventeenth-century mathematician and astronomer, Wang criticized those who were obsessed about the marvels of Western learning while overlooking the knowledge in native texts produced before the Jesuit arrival. They failed to understand that, in his own words, "these points involving numbers [in Western astronomy] were all contained within the old [Chinese] methods and were not something [the Westerners] alone had apprehended." Wang went so far as to contend that European knowledge had been *stolen* from China (*Zhongxue xiqie* 中学西窃).[95] This radical claim, formulated by Ming-loyalist scholars, had direct influence on Mei Wending who fully expounded the *Xixue zhongyuan* theory as a more sophisticated intellectual hypothesis without anti-Manchu implications. It was then endorsed and appropriated by the second Qing Emperor Kangxi, as will be explained shortly, who placed more emphasis on its political dimension "that intended to endow foreign knowledge with recognized 'membership'" in imperially certified scholarship.[96]

The rather ironic outcome mentioned above can be partly explained by the complex nature of the *Xixue zhongyuan* theory and its paradoxical effects on Qing cultural politics. On the one hand, this self-glorifying doctrine mocks the Jesuit claim of superiority by downplaying European science and religion as a Chinese derivative; on the other

[93]Horng, "The Influence of Euclid's Elements," 389; Iwo Amelung, "Weights and Forces: The Reception of Western Mechanics in Late Imperial China," in *New Terms for New Ideas: Western Knowledge and Lexical Change in Late Imperial China*, edited by Michael Lackner, Iwo Amelung, and Joachim Kurtz (Leiden: Brill, 2001), 213.

[94]Michael Lackner "'Ex Oriente Scientia?' Reconsidering the Ideology of a Chinese Origin of Western Knowledge," *Asia Major* 21 (2008), 186.

[95]*Wang Xishan wenji*, "*li ce*," quoted in Peterson, "Changing Literati Attitudes," 382–83.

[96]Leigh K. Jenco, "Histories of Thought and Comparative Political Theory: The Curious Thesis of 'Chinese Origins for Western Knowledge,' 1860–1895," *Political Theory* 42 (2014), 659.

hand, through pragmatic domestication at Kangxi's behest, it provides "a psychological compensation" for accepting the "barbarian" way of learning while justifying its selective use in various fields like mathematics and calendrical studies. The logic is clear: as Michael Lackner puts it, "if Western techniques are nothing more than a one-side perfecting of what the Chinese have provided, then China might see itself as justified in appropriating them back again."[97] This theory thus squares the circle by challenging not only the arbitrary difference drawn between the old and the new methods but also the "rigid binaries between indigenous and foreign knowledge" (in Leigh K. Jenco's words). In so doing, it interrogates the time-honored debate on the fundamental distinction between Chinese and non-Chinese (*yixia zhibian* 夷夏之辨), which offers a more eclectic formulation and a more inclusivist flavor welcomed by the Manchu rulers. In particular, Elman argues, the *Xixue zhongyuan* theory presented a compromise between those who advocated Western approaches enthusiastically (like the Catholic convert Xu Guangqi) and those who resented Western influence and insisted on traditional methods (like the staunch conservative Yang Guangxian 楊光先 1597–1669 who led the anti-Jesuit campaigns in the early Kangxi reign).[98] By tracing all progress to ancient China, the *Xixue zhongyuan* theory, in essence, represented a kind of intellectual conservatism or nativist backlash in response to the challenges from an increasingly assertive body of foreign knowledge and ideas during late Ming and early Qing. Lackner calls this doctrine a sort of "heteronomously-steered ethnocentrism" whose purpose was to safeguard Chinese/Qing supremacy by saving a sense of wounded pride. This in turn could be achieved by recognizing the secular (techno-scientific) utility of Western learning while seeking to domesticate it in native historical and intellectual framework.[99]

In addition, one cannot understand the rise of this nativistic theory without making sense of its mutually beneficial relationship with the simultaneous revival of evidential studies (*kaozheng*). If the newly imported Western science did indeed originate in China, as the logic goes, there should be traces of this knowledge in ancient Chinese classics. Unfortunately, as mentioned earlier, a large number of native methods or principles previously present in this textual tradition had been lost, forgotten, or obscured due to poor transmission. Their rediscovery and revitalization should be done through *kaozheng* research; such a painstaking effort, furthermore, would be aided by the so-called "new" ideas, "novel" tools and "fresh" perspectives introduced by the missionaries from afar. This assumption, according to Fa-ti Fan, led to a surge of interest among Qing scholars in both studying Western science and recovering the ancient studies on natural phenomena, whose convergence not only "nurtured a new attitude toward experiential research" but also helped turn evidential studies into the dominant intellectual trend during the eighteenth century. The Qing *kaozheng* scholars promoted a sort of empirical scholarship based on textual studies and historical criticism that, as Elman puts it, "sanctioned new, precise methods by which to understand the past and conceptualize the present."[100] This precise scholarship, when combined with natural

[97]Lackner, "'Ex Oriente Scientia?,'" 200.

[98]Jenco, "Histories of Thought," 659; Horng, "The Influence of Euclid's Elements," 385; Elman, *On Their Own Terms*, 155.

[99]Lackner, "'Ex Oriente Scientia?,'" 200; Zhang, *Making the New World Their Own*, 9.

[100]Fa-ti Fan, review of *On Their Own Terms*, *Isis* 97 (2006), 537; Benjamin Elman, *From Philosophy to Philology: Intellectual and Social Aspects of Change in Late Imperial China* (Cambridge, MA: Harvard University, Council on East Asian Studies, 1984), 28.

studies, provided both a firm basis for reconstructing the most ancient sources available and a solid foundation for administering the large empire. Its painstaking search for certainty on the basis of proof and verification, rather than sagehood or moral perfection, constituted a revived understanding of knowledge called "searching truth from facts" (*shishi qiushi* 實事求是), a clarion intellectual call that remains hugely popular in modern China. The Qing literati's interest in Western exact sciences, to be sure, was a key driver and element of this quest for truth and certainty, which in turn boosted the numerical, technical aspects of China's classical tradition in general and the Song-Ming neo-Confucianism in particular. In this sense, the Jesuits' knowledge diffusion added precision to the Ming-Qing "investigation of things" and facilitated its scientific production (at least in the long run).[101]

The rise of late imperial statecraft and evidential studies constituted a key part of the Chinese approach to empirical knowledge by making precise scholarship, rather than reason, the most important source of acceptable learning. The Chinese "science of words" in the form of *kaozheng* studies, in particular, reveals affinities with the European "science of measures, numbers and symbols," as both sought exact knowledge through empirical study. Yet the two were qualitatively different in their epistemological goal and tool kit. Restorationist instead of creative in nature, the Qing *kaozheng* scholarship motivated eighteenth-century Confucian scholars to go back to the original sources of textual knowledge, which they believed was the most reliable way to reconstruct the classical tradition and to retrieve its real *Dao* 道 or *Li* 理.[102] This conservative empirical scholarship, moreover, offered a rather rigorous approach to sundry scholars of precise knowledge in various fields. Philological studies of mathematical and astronomical texts, in particular, became a fundamental approach to restore China's scientific past and thus remained high priorities in the *kaozheng* research agenda. It can be argued that the full ascendency of this "philological grid for classical learning" (in Elman's words), and its close integration with natural studies, were largely dictated by the internal logic of Chinese intellectual history.[103] That being said, one can also view the two interlocking developments as a multifaceted intellectual effort to cope with the external threat of Jesuit science (as shown by their dominating influence over the Qing Astronomical Bureau from 1669 to 1826). Decisively nativistic in nature, this intellectual effort aimed to reassert China's cultural-scientific superiority by domesticating the whole system of Western knowledge.

Whereas "Chinese effaced Western learning with native traditions of investigating things and extending knowledge, which would allow them to assert that European learning originated from China and thus was assimilable," the Jesuits did the opposite by "effac[ing] the classical content of the investigation of things with Western European natural studies" and, furthermore, by appropriating Confucianism to complement Christianity.[104] Besides facilitating their own religious reinterpretations of traditional Chinese learning, these missionaries also appealed to the literati by tailoring their evangelistic message to suit local needs and by embedding it in the translation of Western science works. For example, Ricci used the Christian idea of a rational God-endowed soul to reinforce the Confucian emphasis on the innate goodness of human nature, which lent indirect support to the *Xixue zhongyuan* theory. These seemingly

[101]Elman, "Early Modern or Late Imperial Philology?," 7; Elman, *On Their Own Terms*, 149.
[102]Elman, *From Philosophy to Philology*, 31.
[103]Elman, "Early Modern or Late Imperial Philology?," 6.
[104]Elman, *On Their Own Terms*, 113, 248.

contradictory efforts of accommodation and contestation showcase a complicated approach of cultural adaptation and appropriation as both sides tried to incorporate the other into their own tradition by offering new interpretations of each other.

To understand Kangxi's support of the *Xixue zhongyuan* theory, one should also study his growing tension with the Roman Catholic Church in the last two decades of his sixty-year reign, which represented a pivotal stage in the China mission as well as its transmission of European science to the Middle Kingdom. Actually, according to his first Jesuit tutor Ferdinand Verbiest (1623–1688), this Manchu monarch had developed "a great passion" for Western scientific knowledge, mathematics and astronomy in particular, probably more than any other ruler in Chinese history.[105] Impressed by the contributions of European methods to various fields, he was very friendly with the missionaries in his early reign and even hired several as his personal science teachers. It was under such circumstances that a group of five French Jesuits from Paris's Royal Academy of Sciences arrived in Beijing in 1688, including Jean de Fontaney (1643–1710), Claude Visdelou (1656–1737), Jean-François Gerbillon (1654–1707), Joachim Bouvet (1656–1730), and Louis Lecomte (1655–1728). Most of them were more accomplished in mathematics and astronomy than their predecessors like Ricci. Dubbed "the King's Mathematicians," as Qi Han points out, these French priests were sent by Louis XIV on a multi-faceted mission to aid Jesuits' scientific endeavors in the Qing, to assert the autonomy of the French church vis-à-vis the Vatican, to compete with Portugal over the role as patron of China missions, and to extend France's global influence. The scientific dimension of this mission turned out to be more successful than its other goals, as these erudite French Jesuits created the second climax of Western scientific activities in China.[106]

Two members of this group, Gerbillon and Bouvet, were selected to stay at the Qing court as Kangxi's new tutors and imperial mathematicians. Favoring French science (as produced under the auspices of its Royal Academy of Sciences) over traditional Jesuit science (as advocated by Ricci and his immediate successors), they successfully persuaded Kangxi to place the former at the heart of his study of Western learning, which directly led to the founding of *Suanxue guan* 算學館 (Academy of Mathematics), as will be seen below. It is worth noting that the first European book that Kangxi studied was none other than *Jihe yuanben* under the tutorial of Verbiest. To help the Manchu emperor better understand Euclidean geometry, Gerbillon and Bouvet translated *Éléments de Géometrie*, a 1671 rewriting of *Elements* by their French confrère Ignace Gaston Pardies (1636–1673). Albeit adopting the exactly same title *Jihe yuanben*, this second Chinese version of *Elements* has a different style and emphasis in comparison with the works of the Greek mathematician and other ancient authors.[107] To appeal to Qing imperial taste, as Elman points out, it not only prioritizes pedagogy over logical rigor (by offering a clearer, easier, and more efficient access to the subject) but also stresses its affinity with native Chinese learning. The

[105]Catherine Jami and Qi Han, "The Reconstruction of Imperial Mathematics in China during the Kangxi Reign (1662–1722)," *Early Science and Medicine* 8 (2003), 95.

[106]Qi Han, "Knowledge and Power: A Social History of the Transmission of European Mathematics in China during the Kangxi Reign (1662–1722)," *Proceedings of the International Congress of Mathematicians* (Seoul, 2014), 1217; Liam Brockey, "'A Vinha Do Senhor': The Portuguese Jesuits in China in the Seventeenth Century," *Portuguese Studies* 16 (2000), 142; Agustín Udías, "Jesuit Astronomers in Beijing, 1601–1805," *Quarterly Journal Royal Astronomical Society* 34 (1994), 474–75.

[107]Jami, *The Emperor's New Mathematics*, 119, 140, 143, 162–62, 384–85; Hu, "Provenance in Contest," 14–15.

Ricci-Xu edition, by contrast, highlights the revolutionary nature of *Elements* by presenting it as "a new Western learning and an unprecedented way of reasoning." The choice for Kangxi was clear: he did not hesitate to use the former to replace the latter as his geometry textbook.[108]

To make sense of Kangxi's evolving attitude toward Western learning, it is also necessary to examine the changing politics of cross-cultural learning (both Qing court and Papal authorities as well as their mutual interactions) during his sixty-year reign. The emperor had long been contending with a group of anti-Christian bureaucrats who did not accept the high position Jesuits held at the Qing court. More specifically, this Manchu monarch used his command of the Jesuit-transmitted knowledge as a tool to disparage his conservative Han officials while reinforcing the legitimacy of his minority rule. This dual goal was achieved by commenting on the Chinese literati's incompetence in science and by "defeating" them at their own game. In so doing, he presented himself as both a sage ruler who brought together all mathematical knowledge under Heaven and an imperial teacher who cast this knowledge into the learning system familiar to the Chinese.[109] Meanwhile, he also served as the intermediary and arbiter between the Jesuits and the literati by deciding what Western learning should circulate, who could access it, and how to make sense of it. In this process Kangxi found a variety of ways to put Jesuits' skills to good use, ranging from mathematical astronomy and cartography to weaponry and diplomacy. In recognition of their great service and scientific contributions, the Manchu emperor issued an unprecedented edict in 1692 formally proclaiming the Qing's toleration policy toward Catholicism. Its China mission soon reached the peak in 1701, with the number of Jesuit missionaries reaching as many as ninety-six. Meanwhile, the scientific methods they introduced had played an increasingly important role in various native fields, especially in astronomy and mathematics.[110]

This cozy relationship nonetheless ended shortly afterwards, due largely to the sudden change of European church politics unfavorable to the Qing court. An obvious turning point can be found in the 1705 papal mission to Beijing, which aimed to extend the Vatican's authority over Chinese Christians, but to no avail.[111] In the next several decades, Rome doubled down with a series of papal bulls prohibiting Chinese Christians ancestral worship, veneration of Confucius, and other traditional ritual practices by Chinese Christians, which directly repudiated Ricci's accommodation strategy and alienated his fellow Jesuits in China. Deeply aware of local conditions, most of those missionaries would rather tolerate such time-honored ceremonies, taking them as civil not religious rites that constituted the core values and foundations of Chinese society. The ill-advised papal decrees, most importantly, angered the Kangxi emperor and confirmed his worst suspicions about Western religion and knowledge diffusion. On the one hand, they exacerbated the tension within the Catholic Church and escalated its century-long theological battle known as the "Rites Controversy"; on the other hand, they also set up a protracted standoff between Rome and Beijing while galvanizing anti-Jesuit sentiments on both sides.[112]

108Elman, *On Their Own Terms*, 177.

109Han, "Knowledge and Power," 1219–20.

110Catherine Jami, "Western Learning and Imperial Scholarship: The Kangxi Emperor's Study," *East Asian Science, Technology, and Medicine* 27 (2007), 166; Nicolas Standaert, "The Jesuit Presence in China (1580–1773): A Statistical Approach," *Sino-Western Cultural Relations Journal* 13 (1991), 14.

111Han, "Knowledge and Power," 1220–21.

112Joanna Waley-Cohen, "China and Western Technology in the Late Eighteenth Century," *The American Historical Review* 98 (1993), 1532.

This important change in diplomacy also affected the Qing's policy on foreign trade. During its early years the Manchu regime imposed a ban on sea-borne activity which reached a peak in its protracted campaign against the Taiwan-based rebel regime of the Zheng family. In 1662, the newly enthroned Kangxi enacted a draconian policy of forced coastal evacuation in a desperate effort to cut the rebel regime off from its support on the mainland, which worked miraculously but at great price to the Qing economy. Soon after conquering Taiwan in 1683, Kangxi began to encourage and institutionalize maritime trade by setting up four custom administrations along coastal provinces. This great opening to the ocean, undoubtedly, facilitated the Jesuits' missionary and scientific enterprises in China. During the last few years of his reign, however, Kangxi's trade policy became inward-looking again as he issued a series of restrictions on ships going abroad and strengthened checks at coastal ports. Besides his increasing distrust of Jesuits, the aging emperor was deeply concerned about the collusion of anti-Qing forces within and without China, which was made possible by the liberalized trade. In order to further control foreigners' activities in China, Kangxi's grandson the Qianlong emperor (乾隆 r.1736–1796) closed all other trading ports to Western trade except for Canton in 1757, a stringent policy that lasted until the first Opium War of 1839–1842.

Together these changes caused a steady decline of the Jesuit mission in China, both in terms of religious proselytization and scientific transmission. Almost no new Western scientific knowledge was imported from the mid-eighteenth to early nineteenth centuries. Chicheng Ma estimates that the Confucian literati's scientific works grew four times in those prefectures with Jesuit scientists after 1580. This stimulating effect nonetheless died down after 1723 due to the expulsion of Jesuits by Kangxi's successors Yongzheng 雍正 (r.1723–1736) and Qianlong.[113] It should be noted that this expulsion order did not apply to those employed by the imperial court. Hence Jesuits in the Astronomical Bureau continued their scientific work until 1773, when the Pope dissolved the Society of Jesus, which ended its China mission for forty-one years (their remaining astronomical work in the Bureau was taken up by four Portuguese ex-Jesuits until 1805).[114] The intensifying "Rites Controversy" deepened the Qing emperors' distrust of the Jesuits and reduced their presence in China. Most importantly, it contributed to the Pope's temporary abolishment of their religious order, which put the Catholic China mission in great jeopardy. These external changes, together with the rise of the Canton trading system in 1757, delayed Western transmission of scientific knowledge to the Qing empire.[115]

Apart from rejecting the papal overreach, Kangxi also sought to avoid overdependence on the Jesuits by diluting their "undue" influence over Qing scientific matters. Increasingly concerned about the accuracy of European methods, Han argues, this Manchu emperor began to distance himself from his Jesuit tutors in 1704 while restricting their court activities. Meanwhile, with Li Guangdi's help, he started looking for mathematical talents among the literati whose expertise he had previously slighted. It was under such circumstances that Kangxi gave audience to the aging Mei Wending in 1705, whose doctrine of "Chinese origin of Western learning" struck a chord with

[113]Ma, "Knowledge Diffusion," 1052.

[114]The Society of Jesus was restored in 1814; Udías, "Jesuit Astronomers in Beijing," 474.

[115]Zurndorfer, "China and Science"; Xi Zezong, "Lun Kangxi kexue zhengce de shiwu" (On the Mistakes of Kangxi's Science Policy), *Ziran kexueshi yanjiu* (Studies in the History of National Science)19 (2000), 18–29.

him as it fitted nicely with his imperial agenda and cultural politics. To provide proofs for this native origin, both of them (along with Li) found it necessary to reconstruct imperial learning in both mathematics and astronomy by putting an inner coterie of native scholars in charge of technological knowledge in both subjects. As a prerequisite to such scientific self-reliance, ironically, it is necessary to cultivate a sufficient number of native talents who had considerable knowledge of Western learning.[116] Following the model of the French Academy of Sciences (instead of the Jesuit colleges), in 1713 Kangxi established his own Academy of Mathematics (*Suanxue guan* 算學館) independent from the court Jesuits who led the Astronomical Bureau. The emperor picked more than one hundred native talents to join his Academy, many of whom were influenced by Mei Wending and/or patronized by Li Guangdi. They were instructed to work on several major projects of translation and compilation which built upon but superseded those managed by Xu Guangqi and other Ming convert officials.[117] The most important undertaking of this new academy was a compendium of mathematical, astronomical, and musical texts (including the Jesuit-inspired ones) under the title of *Yuzhi Lüli yuanyuan* 御製律歷淵源 (Imperially Composed Sources of Musical Harmonics and Mathematical Astronomy). This three-part compendium, presided over by *Suanxue guan*, as Catherine Jami and Qi Han argue, not only sets imperial standards in the aforementioned fields but also represents the peak of Qing appropriation of Western learning by synthesizing its useful elements into a reconstructed Sino-centric learning.[118]

In 1723, a few months before Kangxi's death, the mathematical part of *Yuzhi Lüli yuanyuan* was concluded, with the publication of *Yuzhi Shuli jingyun* 御製數理精蘊 (Imperially Composed Essential Principles of Mathematics). As a grand synthesis of Western and Chinese knowledge in the field, this almost-5,000-page imperial canon was "the largest mathematical work ever printed in imperial China."[119] On the one hand, it opens with the claim of *Xixue zhongyuan* by tracing the origins of mathematical principles back to Chinese antiquity and, more specifically, by representing them as evolving from the *Yijing* 易经 (Classic of Change).[120] In this process of looking back it also rediscovered a series of advanced mathematical texts in Chinese history, especially from the Song and Yuan dynasties. On the other hand, *Yuzhi Shuli jingyun* not only included *Jihe yuanben* but also introduced European algebra, like the logarithmic table, the calculation of infinite series and the iterative method for higher-order equations, which changed the structure of the mathematics that the Jesuits had brought to China.[121]

Whereas *Jihe yuanben* presents a new system of axiomatic deduction, *Yuzhi Shuli jingyun* uses a range of native and Western methods to argue for its propositions. Moreover, the latter was compiled in a nativist and didactic way which "effectively effaced key Jesuit contributions to a mathematical field now thoroughly restructured according to the logic of an imperial ideology."[122] Consequently, the Qing study of mathematics had become a native-dominated and imperially controlled intellectual project by the 1840s. With no further Western mathematics introduced in the long

[116]Han, "Knowledge and Power," 1221; Elman, *On Their Own Terms*, 178–79.

[117]Elman, *On Their Own Terms*, 149, 178–79.

[118]Han, "Knowledge and Power," 1221; Jami, "Western Learning and Imperial Scholarship," 163.

[119]Jami, *The Emperor's New Mathematics*, 5.

[120]Jami, "Western Learning and Imperial Scholarship," 163, 166.

[121]Jami, *The Emperor's New Mathematics*, 139; Jami and Han, "The Reconstruction of Imperial Mathematics," 95, 103; Elman, *On Their Own Terms*, 179–80.

[122]Florence C. Hsia, review of Catherine Jami, *The Emperor's New Mathematics*, in *Journal of Jesuit Studies* 1 (2014), 316.

century since its publication (1723), *Yuzhi Shuli jingyun* remained a codified and "compulsory text" for mathematical learning as well as a universal reference work for mathematical research. From *Jihe yuanben* to this imperial canon, "Chinese mathematicians gradually used both deduction, though relatively intuitive, and induction, such as numerical examples" in their argumentation and problem solving. Seen from this vantage point, *Yuzhi Shuli jingyun* represented a culmination in the development of "Sino-Western mathematics," to borrow the phrase of Jim-Hong Su and Jia-Ming Ying.[123] This development, in turn, was justified by the imperially endorsed doctrine of *Xixue zhongyuan*. In reconstructing a new line of scientific transmission from ancient China to the West, the autochthonous theory justified the Manchu efforts to learn European mathematics and astronomy as an unproblematic way to rediscover what the Chinese literati had lost. Furthermore, it was a non-Han emperor who accomplished the unprecedented task of retrieving this lost learning, bringing its various branches of knowledge together and then bestowing them on the generations to come. Through his various patronage projects, more specifically, Kangxi appropriated Western learning as a key part of his imperially certified scholarship and presented Qing official-scholars with the means to understand them.[124]

Over the course of the eighteenth century, literati used the *Xixue zhongyuan* doctrine to domesticate European learning in an increasing range of knowledge fields, thus turning it into the prototype slogan of the second great wave of transmitting Western studies. During this high Qing period, China's classical scholarship achieved its full revival and was no longer interested in the foundations of Western learning. The self-glorifying thesis that saw "Western studies originating in China," along with its imperial endorsement, energized Qing scholars to reclaim Chinese leadership in the world of intellectual and scientific development; its wide popularity meant that few literati at this time would advocate the superiority of European studies as Xu Guangqi did. The goal of their engagement with this imported system was not to introduce anything foreign or creative but to restore the most authentic Chinese tradition in classical and natural studies. Just in this sense, it can be argued that Xu's eagerness to translate Western mathematical works and to apply their approaches to "concrete studies" contributed in a peculiar way to the "Chinese renaissance" of mathematics in mid-Qing as a "collateral branch of classical learning."[125]

Although not entirely without historical basis, Leigh K. Jenco argues, in most situations the Chinese roots postulated by the *Xixue zhongyuan* thesis appeared to be false. That being said, as Qiong Zhang puts it, "the rhetoric of the Chinese origin of Western learning did work to bring about a great wave of creativity and important breakthroughs in [a range of fields], precisely by prompting various attempts to integrate the new, Jesuit-mediated Western learning into the old, preexisting Chinese knowledge base, now reinterpreted and reconstituted in light of this new knowledge." These domestication efforts not only represent "the most uncontentious way [for the literati] to appropriate Western learning" (in Minghui Hu's words), they also offered a sensible response to the thorny question of cross-cultural learning by nativizing foreign knowledge as "an internal source of otherness" (in Jenco's words) which induced native scholars to reconsider the nature and structure of their own scholarly knowledge.[126]

[123]Su and Ying, "What Did They Mean," 368, 374.

[124]Horng, "Chinese Mathematics," 174; Elman, *On Their Own Terms*, 180.

[125]Elman, *On Their Own Terms*, 268.

[126]Jenco, "Histories of Thought and Comparative Political Theory," 677; Zhang, *Making the New World Their Own,* 359; Hu, "Provenance in Contest," 17.

Concluding Remarks

The literati-Jesuit translation of Euclidean geometry, to be sure, represents only a small fraction of the larger circulation of knowledge and ideas between early modern Europe and late imperial China; it nonetheless offers a remarkable case study of the mutually transformative process of Sino-Western exchanges by illuminating the complex interplay of cultural, scientific, political, economic, and social factors/actors at different spatial levels. As the shared yet different experiences of Xu, Ricci, and Mei suggest, global scientific progress evolves through "a complex process of negotiation, assimilation, and coproduction."[127] Far from predetermined, many of these cross-cultural encounters seem more like a trial-and-error process of contested accommodation dictated by different personal agendas, changing sociopolitical circumstances, evolving intellectual currents as well as shifting global balance of power. For instance, after a honeymoon period in much of the Kangxi reign, the window of China and Western Europe on each other was unexpectedly shattered due to the inadvisable papal decrees, the intensifying "Rites Controversy" and Rome's worldwide suppression of Jesuits. The case of "the King's Mathematicians," as Liam Brockey remarks, points to the internal rivalries within the Society of Jesus which were partly spawned by the constant tension between its "nationalistic impulses" and "a larger spirit of cosmopolitanism," a struggle that plagued the factionalized European Catholic church in general.[128]

Similarly important was the rise of *Xixue zhongyuan* doctrine in early Qing, which proclaimed a sense of "injured pride" that might evolve into "a form of proto-nationalism" after the Opium War.[129] This self-glorifying theory was not only marked by a heavy dose of Sinocentrism and backward-looking mentality, it was also characterized by a clear goal of political control and a textual-focused research, which together shaped the agenda of Qing scientific studies and hindered its development. The predominance of mid-Qing evidential studies, in particular, dictated that eighteenth century literati were not as interested in the foundations of Western learning (as illuminated in *Jihe yuanben)* as their seventeenth-century predecessors (like Xu) were. As long as they were the dominant actors in such cross-cultural encounters, Chinese receivers could ultimately decide what to adopt and how, which was increasingly not the case as Western aggression intensified after the Opium War. In so doing, Qing intellectuals developed their own discipline of science while bringing certain branches of it to a new height in the late eighteenth century. The philological studies on Chinese mathematics, for instance, had become a highly developed, specialized part of the history of science in China. It is thus imperative, as Elman emphasizes, to examine how the Chinese constructed and practiced science on their own terms, in their own contexts and for their own needs while interacting with their Western counterparts.[130]

Back to Xu and Ricci, these two bridge-builders had demonstrated great creativity, versatility, and tenacity in brokering the first serious intellectual transfer between the two ends of Eurasia. Both took a rather instrumentalist attitude towards the various knowledge systems available to them, seeking to transform "the other" into something else through selective appropriation. This troubled process of cross-cultural encounter

[127]Pamela H. Smith, "Science on the Move: Recent Trends in the History of Early Modern Science," *Renaissance Quarterly* 62 (2009), 371.

[128]Brockey, "'A Vinha Do Senhor,'" 127.

[129]Lackner, "'Ex Oriente Scientia?,'" 188.

[130]Elman, *A Cultural History of Modern Science*, 11; Fan, review of *On Their Own Terms*, 537.

continued into the high Qing period, in which a "China" and "Europe" of a different kind were being reconstructed through the other's eyes. The overall result is a lack of *effective* religious-scientific exchange between the two, which contributed to their widening technological "divergence" and the ultimate of the 190-year Jesuit mission. In the eyes of Jacques Gernet, neither science appropriation nor religious accommodation could bridge the huge cultural gap between the Confucian and Christian visions of the world.[131] Whether this fundamental incompatibility is true and what its implications are still await further comparative, interdisciplinary, and transnational research.

Conflicting interests

The author declares none

[131]Jacques Gernet, "Christian and Chinese Visions," 1–17.

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