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"European Science in China" or "Western Learning"? Representations of Cross-Cultural Transmission, 1600–1800*

The Argument

The circulation of science across cultural boundaries involves the construction of various representations by the various actors, who each account for their involvement in the process. The historiography of the transmission of European science to China in the seventeenth and eighteenth centuries has long been dominated by one particular narrative: that of the Jesuit missionaries who were the main go-betweens for these two centuries. This fact has contributed to shaping Western images of China's history and science up to the present day.

To retrieve the multifaceted history of this transmission, more than one discourse needs to be taken into account. Even within the Society of Jesus, representations changed with the evolution of patronage of the mission, and the concomitant building up of state-sponsored science in Europe. Chinese sources yield different pictures, accounting for the reception of Western learning — rather than "European science" — in terms of integration rather than of conversion, and legitimizing it first by the Jesuits' status as scholars, then by the idea that Western learning was of Chinese origin. This shift corresponded to the imperial appropriation of this learning.

In the sixteenth century, Catholic missionaries reached Asia in the wake of the European overseas expansion. The Jesuits played a major role in the evangelization enterprise in that part of the world, which the pope had attributed to the Portuguese (Alden 1996). The first Jesuit entered China from Macao in the 1580s, and the Society was to remain, for the next two centuries, the main channel through which Europe and China learnt from each other.[1] The Jesuits aimed at converting the literati elite and, through them, reaching the emperor. For this purpose they used

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[1] For a bibliography, see Zürcher et al. 1991. Gernet 1982 and Etiemble 1988–89 discuss the encounter from the points of view of Chinese and European intellectual history, respectively.

their scientific knowledge as a means to arouse scholars' interest in their religion. Because of this strategy, science played an important part in the reception of European culture in China.

The story of the encounter between Europe and China has been told many times since the Jesuits first advertised their proselytization, often divorced from the wider context of world history. The Jesuit narrative has long been dominant in Western historiography, and also in Chinese historiography when writers took Western sources into account.[2] However, there were other missionary orders active in China, but their role in the spread of Christianity has long been underplayed. Rejecting the Jesuits' elitist strategy, these other missionary orders had little or no use for science in their work. Their standpoint differed from that of the Jesuits, as did the standpoint of European scholars who read the missionaries' accounts, and of kings who sponsored the missions. Similarly, on the Chinese side, there was a considerable variety of views, depending on the individual standpoint: scholars who became disciples of the Jesuits, opponents of Christianity, and the various patrons of scientific and technical learning — all had different interpretations. On both sides science depended on patronage. Therefore in my discussion I shall distinguish between those engaged in transmission, translation, and study and those who commissioned them to undertake such work; although, as will be seen below, in China translators could act as patrons and emperors could turn into students.

A number of narratives were constructed to account for the circulation of knowledge across the boundaries of cultures. Their variety, their authors' status, and the audiences for which they were intended (apart from writings in Chinese by missionaries, most of the available sources were aimed at readers belonging to the same culture) need to be taken into account if we want to gain a nuanced understanding of this circulation and leave behind the usual timeless counterposing of "China" and "the West." Since we are dealing with a rather lengthy period of time, over which representations changed, this paper will focus on some of those representations in the vast literature.[3] Before turning to them, it seems advisable to provide a simple periodization.

Between 1582, when Matteo Ricci (1552–1610, the founder of the Jesuit mission in China) was first allowed to reside in China, and 1629, teaching, translation, and publication were undertaken on the joint initiative of the missionaries and the Chinese scholars interested in their teaching, with the latter acting as private individuals rather than in their official capacity. The most famous translation carried out during this period was that of the first six books of Euclid's *Elements of Geometry*, published in 1607 (Engelfriet 1998). Other mathematical textbooks, world maps, and Ptolemaic cosmological treatises were also published by Jesuits and their disciples in China at the time.

[2] Zürcher 1995 analyzes the evolution of European scholarship from missiology to Chinese studies.
[3] On the notion of representation, see Chartier 1989.

From 1629 to 1635, some Jesuits worked at the Imperial Astronomical Bureau (Qintianjian) preparing a reform of the calendar, an astronomical compendium, through the compilation of various existing treatises. They had been commissioned to do so by the Chongzhen emperor (r. 1628–44), following the recommendation and under the supervision of Xu Guangqi (1562–1633), a higher official who had converted to Christianity and translated Euclid with Ricci (Hashimoto 1988).

When the Ming dynasty fell and the Manchus established the Qing dynasty in 1644, one of the first imperial edicts was the promulgation of a calendar that relied on the Jesuits' compendium. Under the first Manchu emperors, not only did some Jesuits serve as official astronomers, but others also worked as court savants, under direct imperial patronage and supervision. This was especially important during the Kangxi reign (1662–1722), when the emperor showed a keen interest in scientific learning which he regarded as a major tool for statecraft.

In 1688 five French Jesuits arrived in China as envoys of Louis XIV to the Kangxi Emperor, with the title of "the King's Mathematicians." This challenge to the Portuguese monopoly over the control of Asian missions resulted in the introduction of new elements of scientific knowledge. The French Jesuits presented these elements as specifically French science. This became a major issue in the conflicts between them and the other Jesuits in China, who had all sworn allegiance to the king of Portugal. These conflicts, as well as those between Manchus and Chinese and among the various court factions, contributed to the shaping of court science until Kangxi's death in 1722 (Jami 1995).

After 1722, although some Jesuits still resided in Beijing, little new knowledge was introduced from Europe; those who worked at the Imperial Board of Astronomy or at court seem to have been out of touch with most of those Chinese scholars versed in science outside the Imperial Astronomical Bureau. After the pope dissolved the Society of Jesus in 1773, missionaries of other orders assumed the rule of official astronomers.

Jesuit Narratives and the Shaping of European Representations

The mass of literature and correspondence produced by the Jesuits of the China mission (and by some of their fellows in Europe) is so overwhelming, and has been discussed so extensively, that it has tended to obscure other narratives. That Jesuit literature has until recently been the main — if not the only — source used in Western countries for writing the history of science in China during that period reflects the extent to which it has contributed to shaping European historiography of China. Major issues still discussed in the twentieth century, and some of the implicit assumptions on which they rely, can be traced back to the way in which China was discussed in eighteenth-century Europe. Let me illustrate this by way of a famous example relevant to the history of science: the "Needham problem," an issue that has been widely debated. Needham stated it as follows:

> Why did modern science, the mathematization of hypotheses about Nature, with all its implications for advanced technology, take its meteoric rise *only* in the West, at the time of Galileo? (Needham 1969, 16)

This is a question about Europe. In *Science and Civilisation in China*, however, it is mirrored by attempts to explain "why modern science has not developed in Chinese civilisation" (Needham 1954–). In Needham's view, modern science is universal rather than specifically "Western." The question he raised, however, has been interpreted in a slightly different way. After China's defeat first by Western powers and then by Japan in the nineteenth century, the idea that the Chinese intellectual tradition as a whole, and the science that had developed in it in particular, had failed because they had not enabled China to successfully meet the challenge of foreign intrusion became widespread among Chinese intellectuals; it has remained so until the present day. Against this background, the Needham problem appeared as an elaborate phrasing of a question usually worded as "Why has China fallen behind?" Interestingly, such phrasing seems to echo the assessment of Chinese science by Voltaire, whose general assessment of China was extremely laudatory (Adas 1989, 84–89):

> It is surprizing that this ingenious nation never went beyond the elements of geometry, that they were ignorant of semitones in music, that their astronomy and all their sciences were at the same time so ancient and so limited. (Voltaire [1751] 1782, 1–16)

The accuracy of Voltaire's statements will not be discussed here. Although he was an enemy of the Jesuits, they were his main source of information on China. His view anticipates the present-day commonly held notion that after a millennium of brilliant progress, science stagnated, or had a slow pace of development in late imperial China. Indeed, one can reasonably argue that Chinese mathematics and astronomy, for example, declined after the Song (960–1279) and Yuan (1279–1368) dynasties. But should this decline be interpreted as an aspect of China's general "failure" to develop along the same path as Europe? This idea of failure and decline has been dominant both in nineteenth-century Western literature on China (Adas 1989, 177–93), and also in more recent literature on the history of Chinese science. It is still widely accepted, not only among historians of science who are not working on China, but also in China itself.[4] One should be aware of the underlying presupposition: Europe and its history set the standards by which all other human civilizations are to be assessed. Not surprisingly, the resulting appraisal of "non-Western"[5] civilizations is invariably one of failure to reproduce the European

[4] Since Sivin 1982 has pointed out the limits of "why not" questions, there have been increasing attempts to understand the historical development of Chinese science in its own terms, as a process rather than merely in terms of its results or in comparison with Europe. For a brief survey of the debate on the Needham problem in the People's Republic of China after the Cultural Revolution, see Jami 1999, 271–75.

[5] This term encapsulates the whole characterization of "other" civilizations by what they are *not*, what they do *not* have, and what they have *not* achieved.

model; the fewer points of resemblance found, the greater is deemed to be the extent of this failure. Science is one of the main yardsticks used in such assessments.[6]

This approach to the history of Chinese science could well be a legacy of the role that China's Jesuits gave to Europe in their missionary enterprise: that of a model to be followed. Conversion to Christianity was of course the main aspect of this imitation, and missionaries were to instruct the Chinese on how to conform to the model. But their mission also entailed the transmission of other matters: they were the first in a series of Europeans and Americans acting as teachers and advisers in China.[7] As far as science is concerned, the superiority of what Jesuits taught was intended to bear witness to the excellence of their religion. In keeping with this, they seem never to have studied Chinese science, which they tended to dismiss (Jami 1993). Thus Matteo Ricci wrote in his diary:

> Our arithmetic ... is much easier and more methodical than theirs. The latter all in all consists of an instrument of strung beads on which it is practised, without using pen or paper; although it is sure, it exposes one to mistakes and amounts to very little. (D'Elia 1956, 165)

The main conclusion that can be drawn from Ricci's description of the Chinese abacus is that he never learnt how to use it. Instead, he had come to teach pen calculation — which had to be accommodated into "brush calculation" (*bisuan*).[8] There is no evidence that Ricci ever turned to Chinese mathematical or other scientific treatises as potential sources of new knowledge. Had he and his fellows taken those treatises seriously — as seriously as they took Greek science in the form that it had been rediscovered since the Renaissance — they would have found in them methods and results that were not known in Europe at the time (Chemla 1996). Their ignorance was the consequence of the role they had carved out for themselves in China: they were teachers, not students. They described how their disciples studied with them, but did not dwell on how they themselves learnt what they needed to know to survive in China: at the very least they were supposed to study one spoken Chinese language. Ricci and some of those who, after him, sought to convert the elite, also learnt the classical written language. Science was an important step toward religion and therefore a field in which they could only be teachers. Unlike Voltaire and twentieth-century intellectuals, Ricci did not need to wonder why the Chinese had not developed an arithmetic as "easy and methodical" as the one he was teaching them: his mission to preach the true religion made it his duty to teach the science granted by God.

[6] Adas 1989 discusses assessments not only of China but also of India and Africa.

[7] On these persistent endeavors to improve China, see Spence [1969] 1980, the first chapter of which is devoted to Jesuit astronomers. This work's title, *To Change China*, nicely epitomizes the motivation of these endeavors.

[8] The success of brush calculation among Chinese scholars may well be related to the fact that it was a distinctively literate calculating device, one that distinguished their arithmetical practice from the popular one. The abacus, which required neither pen nor paper, made numeracy accessible independent of literacy.

The role that Ricci and his successors assumed in China was modeled on the one played by their order in Europe: it was in great part through its network of colleges where the elite were educated that the Society of Jesus gained a prominent position there. Ricci, as well as several of his fellows, had been students of Clavius at the Roman College. For their scientific teachings and writings, they mainly relied on the latter's textbooks. The calendar reform on which Jesuits worked between 1629 and 1635 (Hashimoto 1988) was another case of such modeling. A reform proposal had already been submitted to the throne by several Chinese officials in 1610. Ricci, who died in that year, had suggested that members of the Society trained in astronomy be sent to China for this purpose. Again, it was his master Clavius who had done the computations for the Gregorian calendar reform in 1582. In short, Clavius seems to have been the role model followed by China Jesuits in the shaping of their image.

Asia Missions and European Rivalries

The Jesuit mission in China is often discussed as a unique enterprise, isolated from the context in which it was set up and maintained. Although it formed part of the Jesuit hierarchy as a whole and reported to the order's generalate in Rome, it was from the outset also closely dependent on the Portuguese maritime empire. Jesuits traveled on Portuguese ships until 1685 and stopped at Portuguese ports on their way to China. But Goa and Macao were no mere ports of call on the way to China, they were places of residence, of study, and of teaching. There, just as in Portugal, news of developments in the sciences circulated and could find their way into the teaching of Jesuit colleges. The education system, on which they had a monopoly in Portugal, the Jesuits extended throughout the Portuguese empire and, tentatively, beyond, into China and other countries.

This is apparent from the itineraries of Jesuit missionaries. For example, the Portuguese Manoel Dias Jr. (1574–1659) left Europe for Goa in 1601, where he completed his studies. From there he went on to Macao, where he taught theology for six years before entering China in 1611 (Pfister 1932–34, 106–11). One of his Chinese works, the *Tianwen lüe* (Epitome of questions on Heavens), an introduction to Ptolemaic cosmology, concluded with a brief description of observations of the moon, the phases of Venus, the shape of Saturn, and the four satellites of Jupiter made by Galileo with his telescope. Dias's work was completed in 1615, whereas Galileo's observations had been published in 1610 and they were confirmed by the Jesuit astronomers of the Roman College the following year (Van Helden 1989, 84–92). This suggests that information traveled rather quickly through the network of the Society in the Portuguese empire and was thus available to its missionaries in China.[9]

[9] Several of Galileo's works published in the 1610s are listed in the Beitang Library Catalogue (Verhaeren [1949] 1969). This library included the works in Western languages kept by the Jesuit mission in Beijing.

Only a minority of the Jesuit missionaries whose names are associated with scientific activities in China were Portuguese. The itineraries of others before their embarkation for Asia reflect the international dimension of the Society in Europe. Thus Antoine Thomas (1644–1709), born in Namur, first studied at the Jesuit college of his native town and started his novitiate in Tournai in 1660 (Thomaz de Bossierre 1977, 4). In 1670 he applied for the China mission, arguing that, being well versed in mathematics, he was ideally prepared for it. He was accepted only seven years later, when he was still in the Jesuit Franco-Belgian province. He then went to Portugal, where he taught mathematics at Coimbra while studying Portuguese (the *lingua franca* of Europeans in the Indian Ocean). When he set sail for Asia two years later in 1680, he had completed a mathematical treatise, the title of which indicates that it was especially designed for those preparing for the China mission (Thomas 1685; Bosmans 1924). The dedication of this work to the Duchess of Aveiro (1630–1715) reminds us that patronage of missions was not exclusively royal (Thomaz de Bossierre 1977, 9–13). During the next two years, we find Thomas in Goa, where he undertook astronomical observations and cartographic surveys, and then in Siam. From 1682 to 1685 he was in Macao. During these years he did his best to find a way to Japan, which was then closed to all Europeans except Dutch merchants, and especially strictly forbidden to missionaries (ibid., 32–34; Pfister 1932–34, 404). In 1685 he was called to Beijing to serve as an astronomer, and for the rest of his life he put his scientific skills at the service of the Kangxi Emperor.

China was by no means the only country where the Jesuits put their scientific abilities to use in the service of proselytization. Alexandre de Rhodes (1593–1660) has remained famous for having spread the Roman alphabetization of the Vietnamese language. When he arrived in Macao in 1623, Japan was already inaccessible to missionaries. He was therefore sent to Tonkin, where, following the example of his colleagues in China, he used mathematics and astronomy, as well as clocks, as an approach to the king. Back in Macao between 1630 and 1640, he was sent to the Philippines and then to Cochin China. Expelled from there in 1645, he headed back to Europe. His search for support for the Vietnam mission eventually led to the foundation of the *Société des Missions Étrangères* in Paris in 1659, thus contributing to the development of missionary enterprise in Asia outside the Society of Jesus and the patronage of Portugal. Rhodes died in Persia, where he had been sent in 1655 (Alden 1966, 138–40; Pfister 1932–34, 184–86).

As these itineraries show, Macao was a center from which Jesuits were dispatched to various countries of East and Southeast Asia, where their scientific competence was put to use in the service of local monarchs, as well as to gather data that contributed to European knowledge of the Asian continent. To the best of my knowledge there is no evidence, however, that the Jesuits' first European patrons, the Portuguese kings, put special emphasis on scientific matters in their patronage of the Asia mission. From the second half of the seventeenth century on, the search of the China Jesuits for other patrons resulted in the development of links with the new state-sponsored scientific institutions of several European countries; the latter aimed at integrating China into the world under European exploration.

One prominent case is that of the French Académie Royale des Sciences, founded in 1666. In 1684 its members addressed to the China Jesuits a list of questions, which included the following:

> Whether they had made any observations of longitudes and latitudes in China? What was the state of sciences in China: mathematics, astrology, philosophy, music, medicine, and pulse-taking? About tea, rhubarb, and other drugs and curious plants. Whether the Chinese use tobacco. What they eat and drink, whether they have bread, wine, mills, turkeys, pigeons. (Pinot 1932, 3)

The academicians also asked about weapons, fortifications, ships, and soldiers, as well as the wealth and customs of these people and of their emperor. Their interest in the sciences appears to have been part of an "anthropological" interest in the Chinese, rather than a concern about what could be learnt from them. Paralleling the Jesuits' attitude mentioned above, European scholars by and large seem to have been interested in learning about China, rather than from China, let alone from the Chinese.

Several European academies, starting with the London Royal Society, received information from the China Jesuits (Han 1997a). However it was only in France that links with the academy formed part of a wider state strategy (Jami 1995). To extend France's diplomatic influence in Asia and to support its economic interests there, Louis XIV (r. 1643–1715) dispatched a mission of six Jesuits whom he sent to the Kangxi emperor in 1685 as "the king's mathematicians." Their task was threefold: evangelizing, working for the advancement of French science, and using it in the service of the emperor. That one of the six Jesuits remained in Siam — where the whole expedition stopped off between 1686 and 1687 — and got involved in politics there (Van der Cruysse 1991, 365–67), illustrates the fact that, for France as for Portugal, China was only one element of a wider Asian policy.

The "king's mathematicians" challenged the Portuguese monopoly on Asian missions, at a time when Portuguese maritime power had declined. That Jesuits be sent directly from one monarch (Louis XIV) to another was a novelty, and the French Jesuits had their own construction of their role at the Chinese court. When they presented Christendom and its learning to the emperor, a new actor appeared on the stage, playing the leading role: the French king, acting as patron of the arts and sciences, embodied the advantages that Christianity could confer on a monarch. This was nicely stated in a letter written from Beijing by one of the "King's Mathematicians," Joachim Bouvet (1656–1730), to another, Louis Le Comte (1655–1728), who was then in Fuzhou:

> If these two great monarchs knew each other, the mutual esteem they would have for each other's royal virtues could not but prompt them to tie a close

> friendship and demonstrate it to each other, if only by an intercourse in matters of science and literature, by a kind of exchange between the two crowns of everything that has been invented until now in the way of arts and sciences in the two most flourishing empires of the Universe. If Heaven graced us with the achievement of this goal, we would feel we had done a lot for the good of Religion which, under the auspices and protection of two such powerful princes, could not fail to progress considerably in this empire. (Bouvet 1691, 101r)

When he wrote this letter, Bouvet was teaching European sciences (including Euclidean geometry) to Kangxi. In the former's mind, his triple activity as missionary, correspondent of the French Academy, and tutor to the emperor formed a coherent project in the context of exchanges between France and China that would "naturally" lead to the evangelization of the latter. Such a representation reflects the direct implication of sovereigns in scientific patronage on both sides. The fact that we find it not only in the *Historical Portrait* of Kangxi that Bouvet wrote for Louis XIV (Bouvet 1697, 6–9), but also in the correspondence between two Jesuits, suggests that this was not merely an account set up for the benefit of a European audience; these were the very terms in which Bouvet understood his own enterprise.

That the king contributed, directly or through a minister, to the conversion of pagans through scientific patronage, was acknowledged by the most eminent scholars of the time. Thus Leibniz (1646–1716) wrote to Louis XIV's minister Colbert (1619–83) in 1675:

> The true discoveries of which you are the promoter are of all places and of all times. A King of Persia will cry out in admiration for the telescope's effect, and a Chinese Mandarin will be delighted and amazed when he understands the infallibility of a Geometer Missionary. What will these people say when they see this wonderful Machine which you have had built, which really represents the state of the heavens at any given time? I think they will have to acknowledge that human nature has something divine, and that this divinity is communicated especially to Christians. The secret of the heavens, the magnitude of the Earth and the measurement of time are all of that nature. (Klopp 1864, 212–13)

In other words, it was to patronage emanating from the king that one was indebted for the universalization of European science, this science's universality being, in turn, a proof sufficient to persuade the most obstinate pagans of the truth of the Christian religion. Very much in the line of the Jesuit strategy in China, it was for the benefit of pagan elites — the king of Persia, the Chinese mandarins — that this proof was administered. Although the two letters quoted above bring into play different actors, both illustrate the fact that by the late seventeenth century, China Jesuits were engaged in the transmission of "our" sciences (as Ricci had referred to them), and European savants interested in China by and large shared the understanding that this transmission, possible only thanks to state patronage, was an essential part of the enterprise of converting pagans to Christianity.

Heavenly Learning in the Late Ming: Xu Guancqui (1562–1633)

On the other side, Chinese scholars' reception of "European science" was shaped by the main political concerns and intellectual trends of their time, quite divorced from what has been discussed above. The various fields covered in the Jesuits' Chinese publications finally came to be referred to as "Western learning" (*xi xue*). The first Jesuits and their Chinese disciples had called them "heavenly learning" (*tian xue*). As appears from the contents of the collection *Tian xue chu han* (First collectanea of heavenly studies) edited in 1626 by one of those disciples, Li Zhizao (1565–1630), "heavenly learning" included the whole of the Jesuits' teachings. Following the hierarchic division of these teachings into greater and lesser topics, *Tian xue chu han* was divided into two parts: "principles" (*li*) and "things" (*qi*, lit.: tools) (Peterson 1998, 832–33). Most works included in "principles" were directly relevant to the Christian religion, whereas topics covered by "things" included hydraulics, Euclidean geometry, arithmetic, astronomy, and cosmology. This division reflected the classification of "sciences" as understood in Europe at the time, and especially in the curriculum of Jesuit colleges: theology was at the top of the hierarchy of the sciences, and profane subjects were subservient to it. Li Zhizao, who was a convert, had taken up this hierarchy, which was to some extent consonant with the then predominant neo-Confucian view, according to which all fields of scholarship were subservient to "greater learning" (*daxue*) — i.e., moral philosophy (Elman 1984, 167).

The Jesuits' disciples and converts among the literati had a rationale of their own for adopting heavenly learning. To illustrate this, I shall briefly discuss the case of Xu Guangqi, the most famous and influential among them, concerning whom, three clichés pervade twentieth-century literature: he was a great scientist, a great patriot, and a pious Christian. His multifaceted activity has thus been sliced into modern categories — science, nation, and religion — that fit the disciplinary divisions. To historians of mathematics, Xu is known as the co-translator of Euclid (1607); to historians of astronomy as the organizer of the Chongzhen calendar reform (1629–35); to historians of agronomy as the author of a celebrated treatise, *Nongzheng quanshu* (Complete treatise on agricultural administration, published posthumously in 1639); to historians of religion as a "great pillar of Christianity in China";[10] to military historians as the leader of a lobby that tried to introduce Western artillery into the Ming army. All this has made Xu an ideal screen on which to project the European vision discussed above: he has been

[10] A phrase first used by Ricci.

viewed as a convert not only to the Christian religion but also to European science and technology, both conversions proceeding from the revelation of superior truths. On the other hand one need only pass over in silence his commitment to Christianity to obtain the portrait of a perfect precursor of today's China — that is, a promoter of science, rationality, and patriotism. To construct an account of Xu's scholarship and commitments that is historically more relevant, one has to understand how each of the features mentioned above met concerns that he shared with his contemporaries.

The last decades of the Ming dynasty (1368–1644), during which Xu lived, were a period of social, political, and military crisis. The development of a monetary economy, trade, and craft industry had been paralleled by that of a new urban culture that sought its inspiration outside scholarly traditions. Political life was marked by strife between eunuchs and literati, which came to a head between 1615 and 1627 with the bloody repression led by the notorious eunuch Wei Zhongxian (1568–1627) against the Donglin academy. Peasant rebellions in various parts of the empire and the Manchu threat on the northern border during the Chongzhen reign (1628–1644) finally caused the collapse of dynastic order. The intellectual response to this multifaceted crisis entailed a reassertion of the Confucian literati's commitment to preserving social order. There was renewed interest in scientific and technical knowledge, attested to by the publication, since the second half of the sixteenth century, of treatises on topics ranging from medicine to musicology, mathematics to technology. All these were central to the agenda of "real learning" (*shixue*):[11] not only practicality, but also a critical approach were essential to that trend of scholarship (Ge Rongjin 1994, 2:75–95). Confucian ethics made it the duty of the literati to apply all their learning to statecraft (*jingshi*, literally "ordering the world"); this was the political side of the agenda.

Xu Guangqi's own commitment to "ordering the world" was not merely scholarly. From the time he passed the metropolitan examination in 1604 until his death in 1633, his career in the civil service was interrupted only when the eunuch party had the upper hand. During the last five years of his life, he held high offices. It was in his capacity of vice president of the Ministry of Rites that he promoted and then supervised the calendar reform on which the Jesuits worked (Hummel 1943, 1:316–19; Hashimoto 1988, 7–73). In China the calendar was an imperial monopoly, the means through which the emperor — acting in his capacity of intermediary between the cosmos and the human realm — ensured that human and social life would harmonize with cosmic cycles. The need for a calendar reform had been felt since the end of the sixteenth century, and Xu's success came after a number of failed attempts at reform (Peterson 1986). As he pointed out in one of the memorials submitted to the throne in which he proposed to commission the Jesuits to reform the calendar, China had a long tradition of having foreign specialists for

[11] Also translated as "practical learning" or "solid learning"; *shi* was opposed to the emptiness (*xu*) of Buddhism.

calendar-making (Wang 1984, 373–74). Indeed, before the sixteenth century China had borrowed from "Westerners" in the field of astronomy: under the Tang dynasty (618–907) the "West" had referred to India; then under the Yuan dynasty (1279–1368) to the Islamic civilization (Yabuuti 1990, 177–242).

Like astronomy, the other fields of Xu Guangqi's scholarship belonging to "real learning" could directly be put to use for the restoration of political and social order. Agronomy, essential in preserving the economic and social balance of the empire, was a concern long shared by officials: one striking feature of Xu's contribution to this field was his experimental approach to the cultivation of some plants. Euclidean geometry was, among other things, a powerful tool for surveying, a topic on which Xu Guangqi had previously carried out some investigations using traditional Chinese geometry (Wang 1984, 57–62). It combined two features deemed essential by scholars of real learning: applicability to practical matters and verifiability. Xu's interest in Western artillery was part of a wider attempt to reorganize the Ming army for the empire's defense against the Manchu invasion; this attempt also entailed improving morality among the troops and economic self-reliance. Euclidean geometry also found direct applications both in astronomy and in military techniques, where it was used in ballistics (Huang 1996). In all these instances, we find Xu directly relating scientific and technical matters to socioeconomic concerns. The various aspects of Western learning in which he was versed met needs then felt by all officials concerned with the empire's survival and prosperity.

Much has been written concerning Xu's conversion to Christianity. Two points should be mentioned here. First, the social dimension of his commitment: he saw Christianity as an alternative to Buddhism that would reinforce public morality. His suggestion to implement the former in a village in order to observe its positive effects on morality and social cohesion displays a typical combination of various features of real learning. First, he was proposing to experiment in the realm of "world ordering." Second, the way in which he linked the Jesuits' scientific and religious teachings together — Euclidean geometry, in particular, the accuracy of which the reader could check for himself — vouched for the reliability of the Christian faith, a domain in which verification was not directly possible. Xu's engagement in heavenly learning may best be epitomized by a paraphrase of the slogan he himself put forward at the beginning of the calendar reform: "Melt Western learning into the Chinese mold" (Wang 1984, 374–375).[12]

The pattern of Jesuit as teacher that Ricci and his successors adopted corresponded to another, regarded as essential in Chinese culture: the relationship between master and disciple. In his preface to the Chinese translation of Euclid, Xu pointed out that Ricci was the disciple of an illustrious master, Clavius, who belonged to a tradition of scholarship that — unlike the Chinese one — had never

[12] Various aspects of Xu Guangqi's scholarship, career, and religious commitment are discussed in Jami and Engelfriet forthcoming.

been discontinued since antiquity (ibid., 75).[13] The encounter between the two patterns of professorial authority first provided a role for the Jesuits to fit into literati circles. The precedents for entrusting the calendar to foreigners pointed out by Xu then rendered it possible to translate Clavius' model as calendar reformer into the office of imperial astronomer, thus opening a niche for the Jesuits in the civil service. In other words, the Jesuits' progress toward their aim — to the emperor through the elite — corresponded to successful adaptations of the Society's role in Europe to the Chinese context. In this context, it was no longer God, but the Jesuits' status as heirs to a long lineage of masters and disciples that — in accordance with Chinese representations and despite their being barbarians — vouched for the validity of their Jesuit knowledge. Only their few disciples among the higher officials could thus legitimize their authority in the Chinese cultural idiom.

By no means all late Ming scholars who came in contact with the Jesuits adopted their religion and learning, and only a very few committed to them to the same extent as did Xu Guangqi.[14] What we can conclude here is that for someone who adhered to all the aspects of the Jesuits' teachings, the reception of these teachings — whether they concerned "principles" or "things" — can be fully understood only in terms of the categories and concerns he shared with other Chinese scholars of his time.

Western Learning under Imperial Patronage: Kangxi (r. 1662–1722)

In contrast to late Ming students of Western learning, most early Qing scholars versed in this field were not disciples of missionaries.[15] The scope of their interests tended to be confined mainly to mathematics and astronomy. As the famous mathematician and astronomer Mei Wending (1633–1721) wrote in a poem, it became clear to them that "without serving Jesus, one could fathom their techniques" (Mei 1759, 17a). This reflected the beginning of a general specialisation in scholarship (Elman 1984, 67–85) as well as a lessening of receptivity to new ideas that went with the consolidation of the Qing dynasty. The dominant representation of the reception of Western learning evolved concomitantly. Xu Guangqi and Li Zhizao had understood their pursuit of heavenly learning as the integration of knowledge produced by a different civilization in which men had "the same heart and the same principles" (*xin tong li tong*) as the Chinese (Li [1613] 1614, 2a). Qing scholars, in contrast, came to view the reception of Western learning as the

[13] The assumption was that Clavius was heir to a tradition that had never been discontinued since Euclid. This is one example of the Jesuits giving a strongly idealized account of Europe and its history.
[14] In this respect, the famous scholar Fang Yizhi (1611–1671) was more representative (Peterson 1976).
[15] An exception was Xue Fengzuo (1600–1680), who studied mathematics and astronomy with the Polish Jesuit Nikolaus Smogulecki (1610–56), but did not become a Christian (Ruan Yuan 1982, 449).

retrieval of ancient Chinese knowledge that had been transmitted to the West before it had fallen into oblivion in China: by the eighteenth century, there was a general consensus that "Western learning was of Chinese origin" (*xi xue zhong yuan*) (Liu 1991; Jami 1993, 157–159).

This belief went together with a contrasted assessment of the two original components of heavenly learning. The catalogue *Siku quanshu zongmu tiyao* (Annotated general catalogue of the complete library of the four treasuries) (Guy 1987, 104–11), compiled in 1782, appraised them in the following terms:

> Indeed the techniques of the Europeans in astronomical computation are much more accurate, and their instruments much more ingenious than those of their predecessors [at the Astronomical Bureau]. But no other heterodox sect has ever gone so far in exaggerations, falsities, absurdities, and implausibilities. By choosing to take their techniques and to forbid the spread of their doctrine, our dynasty has shown deep wisdom. (Gernet 1982, 32)

This was a comment on the Ptolemaic cosmology introduced by the first Jesuits. The distinction made by imperial orthodoxy regarding Western learning was between "techniques" and "doctrines," rather than between two components of a set of teachings: techniques and instruments were thus denied the prestigious status of learning.

As mentioned above, it was in 1629, when the compilation of the *Chongzhen Calendar Compendium* was undertaken, that European science first obtained imperial patronage. However, it was only after the Manchu dynasty took over in 1644 that some of the Jesuits became officials at the Imperial Astronomical Bureau. Others worked as court savants, sometimes without having a position in the civil service. All of them contributed to the construction of the Qing state. Besides the role of calendar as a symbol of dynasty legitimacy, this is also evident from the central part they played in the country's surveying and in the drawing of the maps of *Huangyu quanlan tu* (Complete maps of the Empire), 1718, known in Europe as the Kangxi Atlas (Foss 1988; Wang Qianjin 1995). Accordingly, in imperial discourse Western learning appeared mainly as a tool for statecraft. Beyond this general observation, the Kangxi emperor's study and use of Western learning deserve closer attention (Jami 1994).

Kangxi was the second emperor of the Qing dynasty. A major achievement of his reign was the reinforcement of Manchu control over China, not just through military campaigns and the introduction of new institutions but also through the reconciliation of the Chinese literati elite to their foreign rulers (Kessler 1976). He constructed his image in minute detail not only as a military leader but also as the embodiment of Confucian virtues and learning: he took up the tradition of imperial education in the classics. Thus between 1662 and 1684, more than one hundred scholars were appointed as lecturers and tutors to the emperor (ibid., 138–39). He commissioned a number of scholarly works; those expounding the imperial orthodoxy in philosophy were completed during the last decade of his reign. Also worthy of mention are the anthology *Quan Tang shi* (Complete poetry of the Tang dynasty, 1703), the famous *Kangxi zidian* (Kangxi character dictionary, 1716), the rhyme dictionary *Peiwen yunfu* (Rhyme repository of the Adorned literature studio, 1716), the encyclopedia *Gujin tushu jicheng* (Synthesis of books and illustrations, past and present, completed in 1728), and the dynastic history *Mingshi* (Ming history, started in 1679 and completed in 1735).

Kangxi's interest in Western learning was constant throughout his reign. He first expressed concern about the calendar in 1668; although he had officially assumed personal rule one year before, regent Oboi still retained actual power at the time. A severe dispute was raging between Jesuit astronomers and some Chinese scholars. Kangxi's settling of the dispute to the formers' advantage was a decisive step in the assertion of his power against Oboi (ibid., 58–64; Chu 1997). According to the account the emperor later gave for his sons' edification, having closely looked into the matter, he felt indignant at his ministers' ignorance of astronomy and ashamed of his own (Jami 1994, 198).

He subsequently began to study astronomy with the Jesuits, whom he had assessed as more competent than Chinese astronomers. His tuition in the European sciences, and in geometry in particular, has been described at length by Bouvet, not only in the *Historical Portrait* of Kangxi which he wrote for Louis XIV, but also in his diary (Bouvet 1697, 131–34; Deron 1995). For the emperor, this tuition just meant adding a few foreign tutors versed in the mathematical sciences to a great number of much more prestigious Chinese tutors versed in the classics.

Throughout his reign, Kangxi repeatedly asserted the prime importance of astronomy and set up institutions for the training of professional astronomers (Jami 1994, 203–5). His efforts were not successful from the outset. Until 1702, when Mei Wending was introduced to him by Li Guangdi (1642–1718), then governor of Zhili, he professed a very low opinion of the capacities of Chinese scholars in mathematics and astronomy (Han 1997b). From then on, he seems to have had more confidence in the possibility of finding some well versed in these fields. On the other hand, following the disastrous papal legation of 1708 (Mungello 1994), he gradually came to distrust the Jesuits and other missionaries. Toward the end of his reign, he sought to ensure that imperially sponsored specialists gained mastery of Western learning independently from the Jesuits so as to be able to do without the latter (Jami 1991, 158–160). Nevertheless, it was still the Jesuits who advised him to undertake a general cartographic survey of the empire, and who supervised it between 1708 and 1718. Cartography was one important application of astronomy.

Kangxi not only studied Western learning himself, he also had his sons schooled in it, again as part of a broader training. During the last ten years of his reign, it was his third son, Prince Yinzhi (1677–1732), who supervised scientific activities at court. In particular, he was put in charge of the Academy of Mathematics (*Suanxue guan*), created in 1713 for the compilation of *Lüli yuanyuan* (Source of harmony and calendar, 1723). This consisted of three works: *Lixiang kaocheng*

(Compendium of observational and computational astronomy), *Shuli jingyun* (Collected basic principles of mathematics), and *Lüli zhengyi* (Exact meaning of pitchpipes), all of which integrated Western learning. While no Jesuit belonged to the Academy of Mathematics, a group of scholars who had been trained by Mei Wending under Li Guangdi's patronage did work there (Han 1997b).

Throughout his reign, Kangxi acted as the supreme judge and arbiter of scientific matters. He personally revised the treatises mentioned above, and the savants working under his patronage acquired hardly any independence as regards the assessment of scientific issues (Jami 1990, 1995). In contrast with the autonomy of judgment that European scientific academies had gained by the end of the seventeenth century (Licoppe 1994; Biagioli 1995), in China all that related to mathematics, astronomy, cartography — Chinese or Western — remained under direct imperial control.

Kangxi was always careful to keep a balance between the interests of Chinese scholars and those of the military aristocracy (consisting mainly of Manchus but also including some Mongols and Chinese) who had taken part in the conquest of China. Kangxi's use of the Jesuits and of their science was always pregnant with meaning in this respect. As noted earlier, his personal rule started with the adoption of Western rather than Chinese experts and methods for the calendar, and ended with the compilation of an atlas resulting from the survey of the empire by Westerners. How could he reconcile this with the image of himself as a Confucian monarch, promoting Chinese culture, which he strove to promote? This is where the thesis of the "Chinese origin of Western learning" (*xi xue zhong yuan*) came into play. When he gave an audience to Mei Wending in 1702, the two of them turned out to share this view, which both had previously expressed independently in writing. The old scholar thereafter devoted much energy to argument in favor of this thesis (Han 1997b, 24–28). Thus imperial support of European science could be integrated into the patronage of classical learning and contribute to, rather than hinder, the conciliation of the Chinese elite.

In short, in the context of a newly established dynasty's creation of new institutions and patronage of learning, the use of a Western calendar, the employment of a couple of Jesuits as tutors in Western knowledge, the making of an atlas, and the compilation of *Lüli yuanyuan* did not carry the same meaning as that attached to them by French Jesuits. The latter hoped that Kangxi, already "converted" to Western learning, would convert to Christianity. This outsider's view had very little to do with the representation that Chinese scholars came to accept as a result of the emperor's successful shaping of his image; in their eyes, he was simply fulfilling his imperial duty. By promulgating an accurate calendar, he put the human realm in harmony with the heavenly cycles; by commissioning an atlas, he symbolically ordered the territory of which he was master; by studying Western learning, he appropriated the means by which calendar and atlas were achieved; last but not least, by commissioning *Lüli yuanyuan*, he ensured that this learning would be handed down to posterity. Indeed, the emperor was emulating the sages of Chinese antiquity in such accomplishments.

Under the Yongzheng (1723–1735) and Qianlong (1736–1796) reigns, imperial patronage of science lost its primacy. Jesuits and other missionaries remained at court as artists or technicians, and continued to work at the Imperial Astronomical Bureau. Meanwhile, the center of gravity of mathematical and astronomical research moved away from the domain of imperially sponsored scholarship to the Jiangnan area, where it was integrated into evidential scholarship (*kaozhengxue*) (Elman 1984, 79–85). Research into the Chinese scientific tradition led to a reassessment of Western learning. Ruan Yuan's *Chouren zhuan* (Biographies of mathematical astronomers, 1799) is representative of such a reassessment: Western learning appears in it as one element in the (Chinese) history of science.

Conversion versus Integration

To conclude the above discussion, two general rationales might be contrasted. The Jesuits, but also many European savants, saw the transmission of "their science" as an enterprise of conversion. Such a term implies that once appropriately convinced, the neophyte would give up the errors in which he had previously indulged: just as there was only one true God and one way to worship him, there could only be one scientific truth and one appropriate scientific practice — even for performing elementary arithmetical operations. Xu Guangqi's conversion concerned both "things" and "principles," whereas Kangxi was an adept only of the former, through which it was hoped he would embrace the latter. Chinese disciples of the Jesuits, as well as later Chinese scholars versed in Western learning and the emperors, on the other hand, saw their own acceptance of things Western as the integration of some elements borrowed from the West into preexisting frameworks; these elements were appropriated in order to answer social, political, and intellectual concerns, all of which were local.

In other respects, however, the representations on both sides shared some features, which evolved with time. This is true regarding the definition of the body of knowledge that circulated. The narrowing of interest from heavenly learning to Western learning was matched, on the European side, by the specialization of the group that had produced this learning. In Clavius' view, the mathematical sciences were subservient to theology, and it is as such that they were an integral part of Jesuit education. A century later, no religious motivation was inherent in the French Académie's pursuit of the sciences, as befitted a secular institution. In both cases, Western learning was regarded in China as a tool for "ordering the world" and was therefore appropriated by those who thought this ordering was their affair. That Xu Guangqi took steps to reform society and thus to save the dynasty, that Kangxi personally studied Western learning and arbitrated controversies, reflected the meritocratic ideology that prevailed in late imperial China, as opposed to European *anciens régimes*, where birth rather than learning and sagehood legitimized power.

Corresponding to these two definitions and institutional provenances were different groups of recipients and modes of legitimization. To the God-granted Jesuit science taught by Ricci, Xu Guangqi and other converted literati gave the status of learning which could supplement that hitherto developed in China. As such, this science was worthy of the attention and respect of their peers. Its transmission was represented as taking place from one group of scholars, Jesuits, to another, literati, both groups being on an equal footing across cultural boundaries. To French academic science, bestowed by the Sun King, Kangxi granted the status of imperial learning — not only acceptable but also worthy of state patronage because it was, after all, originally Chinese. The foreign emperor was therefore not imposing foreign learning, but instead retrieving the lost knowledge of antiquity. The transmission was, then, a matter of diplomacy, a sovereign-to-sovereign relationship in which the go-betweens were servants of both, working for their power and glory, rather than merely "for the greater glory of God." The parallel evolution of representations on both sides reflected that of the status of science, which was more and more involved in the construction of the state — the rise of absolutism in France paralleled the institution of Manchu "authoritarian paternalism"[16] in China.

Only some of the many actors involved in the transmission have been discussed here: Chinese opponents to Christianity, European scholars who opposed the Jesuits, missionaries of other religious orders, have not been mentioned. All constructed different representations, which remain to be explored to complement the complex picture sketched here. I hope I have shown, however, that the cross-cultural transmission of scientific learning cannot be read in a single way, as the transmission of immutable objects between two monolithic cultural entities. Quite the contrary: the stakes in this transmission, and the continuous reshaping of what was transmitted, can be brought to light only by situating the actors within the society in which they lived, by retrieving their motivations, strategies, and rationales within this context.

[16] This is the heading under which Gernet 1972, 403–60 discusses Manchu rule.

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