

THE HUMAN FACE OF EARLY MODERN ASTRONOMY IN CHINA

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Ask anyone in a Western country what they know about Chinese astronomy, and the chances are that you may not get an answer or—at best—a reference to Chinese “record keeping”¹ or the discovery of a supernova explosion (an exploding massive star) in 1054, which was visible with the naked eye for about two years. Yet, there is so much more to the early days of modern science in China. While in Europe new ideas were suppressed by the Church (think of Giordano Bruno’s ideas of an infinite Universe, and also of Galileo Galilei), Chinese science made rapid advances. The early history of modern science in the Far East is replete with fascinating personalities, politics, and discoveries. This is poorly known internationally—certainly not to the “general public”—except to a handful of dedicated scholars, but it is a story of discovery and perseverance worth telling.

Chinese astronomers have observed, recorded, and interpreted celestial events since ancient times, as far back as the 13th century BCE. Making astrological/astronomical predictions—which were linked at early times, just like in Europe—was the purview of Emperors and their advisors. In the 16th Century AD, China was of great interest to Europeans. The arrival of the Jesuit (Catholic) missionaries opened a cultural window that permitted Europeans the first truly accurate accounts of the Chinese empire. They introduced to the Chinese things that were new, and things that were not really new, but had been forgotten. As an area of mutual Chinese–European interest, science became an important tool for evangelisation in China.

¹ In ancient times, Chinese astronomers at the Imperial courts collected very complete records of celestial phenomena, such as solar and lunar eclipses.



Figure 1: Kunyu Wanguo Quantu (坤輿萬國全圖), A Map of the Myriad Countries of the World, by Matteo Ricci, printed on request of the Wanli (萬曆) Emperor in 1602. (Source: Wikimedia Commons)

The early Jesuits realised that the Ming empire was a very different place than other mission areas they were engaged in, such as in South America. China was vast

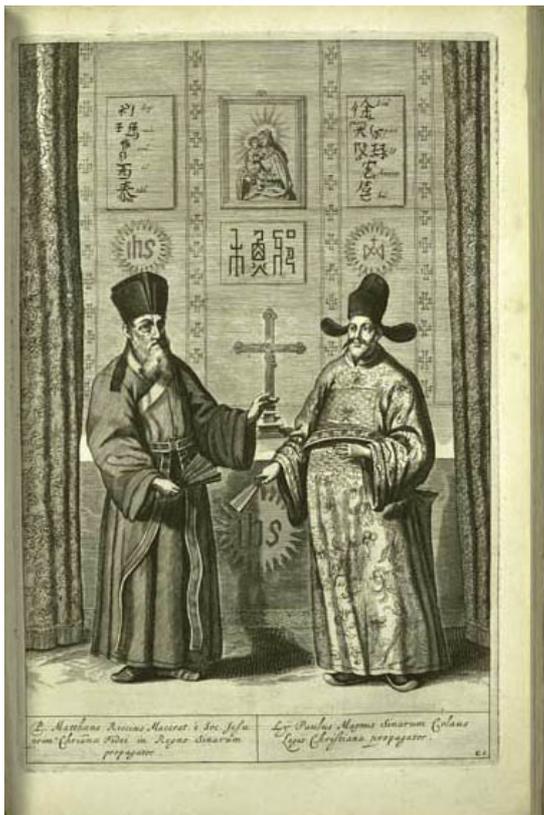


Figure 2: Matteo Ricci and Xu Guangqi (Source: China Illustrata, Athanasius Kircher, Amsterdam, 1667).

and historically ancient, with a highly developed and complex society, government, culture, and language. In many ways, China was technologically equal or superior to European society. Chinese respect for books and scholarship had been noted since Marco Polo's day, in the mid-13th Century AD. Jesuits were required to learn to read, write and speak Chinese. The most illustrious of the early Jesuits was Matteo Ricci (利瑪竇), widely regarded as the founder of Western Sinology. His linguistic talents, prodigious memory, and skills in cartography, mathematics and music, plus his personal qualities, kindly demeanour and respect for Chinese culture allowed him unprecedented access

to a wide range of people and places. He made the first world map in Chinese and introduced the Western system of longitude and latitude to his Chinese counterparts.

Many of the foreign place names used by the Chinese today trace their origin to his maps. He went on to do much more to introduce Western ideas to China, including fixing Beijing's latitude at 40° North.

Ricci travelled to Macau via Goa (India). In 1583, he obtained permission to settle in Zhaoqing (肇庆; Mainland China), because its governor had heard of his skills as a mathematician and cartographer. Ricci became a much sought-after figure by officials and local gentry. He noted the great curiosity his visitors expressed about the unusual items in his rooms and their fascination with maps. In particular, on display at Zhaoqing was a world map of which he made copies in Chinese. He wrote his famous *Treatise on Friendship*, translated the first six books of Euclid's *Elements* into Chinese, and wrote influential texts on memory techniques, East–West ethics, mathematics, catechisms and discourses using classical Chinese examples; he created the first Chinese–Western dictionary and built musical instruments. His letters and notes back to Europe became the foundation for the field of Chinese studies. He stayed in Zhaoqing from 1583 to 1589, when a new viceroy decided to expel him. Eventually, he ended up at the Imperial court in Beijing as the first Westerner to be allowed almost unrestricted access to the Forbidden City, the Emperor's palace. He was particularly instrumental in establishing the ancient astronomical observatory in Beijing as well as Sheshan Observatory near Shanghai.

Although Ricci was a pivotal early scientist, his efforts and breakthroughs are hardly known outside of scientific circles, yet he has had an unsurpassed influence on the development of early modern science—including astronomy, mathematics, and cartography—in the Far East. He was, perhaps, the first scientific ambassador from Europe during the Renaissance to an increasingly open China, which at the time already had a long history of scientific achievements. This fresh European influence gave a boost to Chinese science, leading to a newly dominant position for the Middle Kingdom. Matteo Ricci was a flamboyant personality with an interesting personal story, trained by the famous mathematician Clavius.

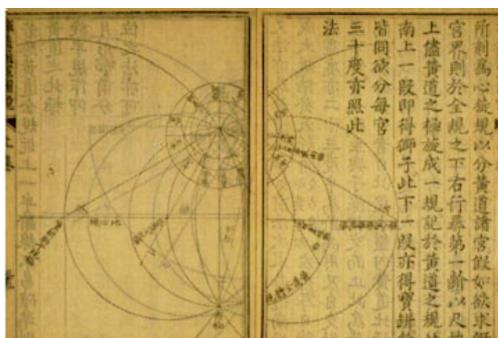


Figure 3: Matteo Ricci's technical explanation in Chinese of European astronomy. (Source: US Library of Congress)

His work was followed up by his two important successors, Johann Adam Schall von Bell (汤若望) and Ferdinand Verbiest (南懷仁).

Although the importance of Ricci's contributions is generally understood, the stories of his successors are less well known. To remedy this situation, my team (based at Peking University, Beijing Planetarium, and the Beijing Ancient Observatory) was awarded 'Public Understanding of Science' funding by the National Natural Science Foundation of China to produce a documentary focusing on the human aspects of Chinese astronomy. The first part of this documentary will, we anticipate, focus on the early Jesuit missionaries. In order to inform our script-writing efforts, I interviewed two leading scholars on the life and work of both Schall von Bell and Verbiest. My list of questions emphasised the personality aspects of these early modern European scientists in China. I talked with Dr. Noël Golvers ("NG") from Leuven University (Belgium) about Ferdinand Verbiest, and with Dr. Claudia von Collani (University of Würzburg, Germany; "CvC") about Johann Adam Schall von Bell. I also exchanged emails with Dr. Jean-Claude Martzloff (formerly of the Research Centre of Asian Civilizations in Paris, France; "JCM") about the reliability of the ancient Chinese astronomical records. Here, I would like to share a selection of their responses.

1. Johann Adam Schall von Bell: the man straddling superstition and science

Q: What motivated Schall von Bell to emigrate to China? Were there any personal reasons involved?

CvC: Schall's main motivations were both scientific and religious: he was interested



in converting the Chinese population, in his role as missionary.

Figure 4: The internal dome at the Collegio Romano, 1854 (*Source:*

As a young man of about 14 years old, he was educated at the Jesuits' headquarters at the Collegio Romano in Rome (Italy). His main mentor was Christopher Grienberger, who worked with him over the course of some 10 years. After Matteo Ricci's death in 1610, the Flemish Jesuit priest Nicolas Trigault (金尼閣) was sent back from China to Europe by his "Superior General" Niccolò Longobardo (龍華民), who had been appointed as successor to Ricci, to look for the next generation of Jesuits in China. At the time, few Jesuits were left in China, so the mission needed new staff, funds, books, and other materials.

The Jesuits also wanted to separate their missionary activities in China from those in Japan. They needed to get authorisation from the Pope in Rome to have the Eucharist (a Christian rite also known as the Holy Communion or the Blessed Sacrament) translated into classical Chinese, wear the *Jijin* (祭巾; the traditional Chinese hat) during Mass where the Eucharist was used, and also to translate the Bible into classical Chinese. Trigault applied for several of these permissions in Rome; he obtained most. He then set off on a tour of Europe, visiting different princes' courts in Madrid (Spain), Munich, Würzburg and Cologne (Germany), the Jesuits' mission headquarters in Antwerp (in what was then called the Southern Netherlands), as well as the book fair in Frankfurt (Germany), where he bought many scientific books. Meanwhile, he tried to recruit new missionaries with scientific backgrounds. One of the latter was Johannes Schreck (邓玉函), also known as Terrenz, who had links to Galilei and to other Jesuits, and who was interested in going to China. Trigault next went to Rome and met Schall, who had almost finished his education at that time. Schall became interested in the China mission. He was interested in calendar reform, which was only possible with permission from the Emperor, so they needed to wait until the dynasty change in 1644, when the new Manchu Emperor, Chongzhen (崇禎), was inaugurated.

Q: How did he feel about the historical astronomy records accumulated by that time in China?

CvC: Schall saw his role as astronomer as his heavenly calling. When Beijing was conquered by rebels and the Manchus, most of the city was burnt. However, the mission was spared and the house containing the astronomical tables survived, so he took this as an omen from heaven.

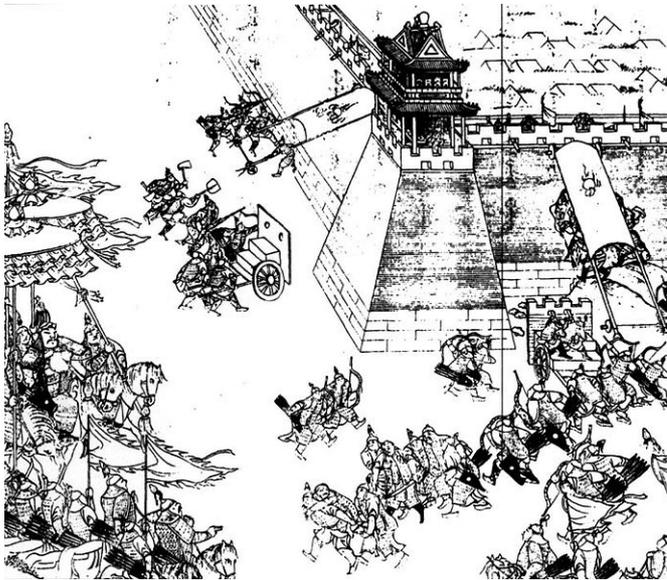


Figure 5: Battle of Ningyuan (宁远), located just north of the Great Wall, during the Manchu conquest (Source: *Wikimedia Commons*).

He became director of the newly founded Imperial Bureau of Astronomy (Qintianjian; 钦天监). However, his acceptance of this office sparked long quarrels with his Jesuit colleagues, for two reasons. First, in Christianity, work on calendar reform in China was seen as linked to superstition. Christians were permitted to engage in certain astrological tasks, including “natural astrology”, navigation, and medicine. However, they should refrain from engaging in “bad superstition”, which included the use of horoscopes and which was seen as interfering with free will. Examples of bad astrology include assigning special days for special rites, as well as observing heavenly phenomena and using them for certain earthly purposes. Schall actually did the latter, but used these observations for educational purposes, as we will see below.

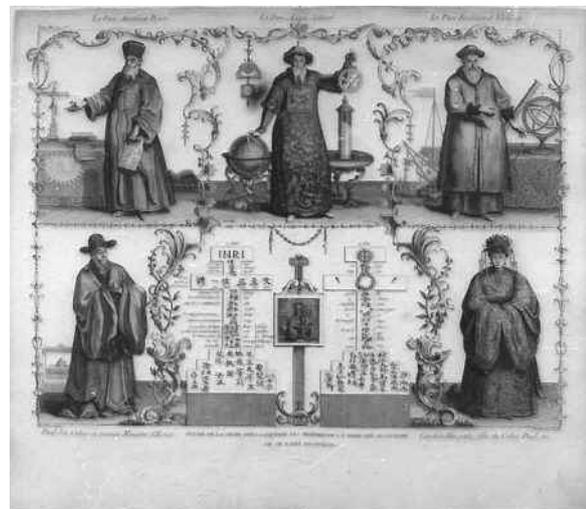
Second, Jesuits were not allowed to take certain offices of high status; they had to ask for permission from Rome. However, at the time he was offered this position, there was no one around to ask for permission, so he just accepted the appointment. He asked for permission at a later stage, which was granted because the authorities in Rome thought that this would be good for the mission.

JCM: The question about the methods used by the ancient Chinese is tremendously difficult to answer. Jesuit texts do not contain much information about Chinese

traditional astronomical methods. Overall, the Jesuits believed that the predictive methods used by the Chinese astronomers were poor. An objective comparison between Chinese, Chinese–Muslim, and Western astronomical predictive methods would be needed. The easiest and most straightforward way to get a first and solid appreciation of the situation would be to use the results of the predictive competitions organised by the Chinese (predictions of eclipses and the like): in all cases, the Western methods were demonstrably better and this is precisely why Western methods were deemed better by the Chinese. Various other isolated results are known. For example, we know that the ephemeris tables (which list the positions of astronomical objects) of a Danish disciple of Tycho Brahe, Longomontanus (Christian Severin), were used in China. Very important is the fact that in the Chinese methods the winter solstice—which marks the shortest day and the longest night of the year—was not distinguished from the solar perigee (the shortest distance between the Earth and the Sun) because of a belief in the *yin yang* structure of astronomical phenomena. Hence, unavoidable inaccuracies resulted. It is well known that, overall, the Jesuits stuck to Tycho Brahe’s system during the whole of the 17th Century AD and beyond.

Q: What can you tell us about the period between Matteo Ricci’s death and the arrival of Schall von Bell?

Figure 6: Xu Guangqi (bottom left) and Candida Xu (bottom right), along with three Jesuits (Ricci, Schall von Bell, and Verbiest – top row). (Source: Wikimedia Commons)



CvC: Ricci died in 1610. Matteo Ricci’s successor, Niccolò Longobardo (龍華民), was not as cautious as Ricci in his attempts to convert the Chinese population, which aroused the suspicion of Chinese officials. As a consequence,

Jesuits were locally persecuted and often expelled. Nevertheless, Xu Guangqi (徐光启) continued Ricci’s efforts in the background; he later became Prime Minister. Schall arrived in Macau in 1619, but he had to wait until the persecution of European missionaries had ended before he could enter Mainland China. Longobardo was obsessed with maintaining the purity of the Christian faith, but he had a strange

attitude towards Chinese terminology related to religion. He collaborated with Schall on his calendar reform. Terrenz died in 1630 or 1633; Schall was called to Beijing upon his death. In 1633, Xu Guangqi died, at which time only Schall was versed in astronomy, so he was the only person capable to take over the astronomical duties.

Q: While in China, did Schall von Bell keep in touch with the order back in Europe? Did he send any personal reports? Did he interact with the common Chinese population?

CvC: He wrote letters to Europe, in which he reported on his adventures. These were written in the third person, so the prose was impersonal. Other Jesuits describe him as a complicated person with a strong personality; contemporaries saw in him either a bad or a good person. He lived in Beijing on his own, did things in his own way, and did not give people an easy time. However, he maintained good relations with the Emperor, so he had some power. There was some interaction with common people, mostly before his move to Beijing, but likely also while he was based in Beijing. He established the first Jesuit church in Beijing, at Nantang (南堂), the Cathedral of the Immaculate Conception (圣母无染原罪堂).

Q: What about his interactions with the high officials of the court and the Emperor?

CvC: During the time of the last Ming emperor, Chongzhen (崇禎), Schall had indirect contact with the court through eunuchs who baptised some ladies of the court. Later, he is known to have been “friends” with the first emperor of the Qing dynasty, Shunzhi (順治; who was very young; he became Emperor at the age of six), which probably implied that he could access the ruling elite fairly easily. As an astronomer, he was included among the official “Mandarin” offices at the Imperial court.



Schall used his influence partly indirectly to help the mission and to educate the Emperor. The Emperor was often involved with mistresses, which landed him in trouble with his mother, so Schall tried to admonish him (although not very successfully). It is thus likely that Schall was in direct contact with the Shunzhi Emperor. Rumours abound that Schall might have been a grandfatherly figure to the Emperor, who did not grow up in the presence of a father. The Emperor was very young, so Schall's influence was greatest during his childhood and early teenage years.

Figure 7: Shunzhi, third Emperor of the Qing Dynasty (Source: Palace Museum, Beijing; Wikimedia Commons).

In 1649, the Emperor's uncle, Dorgoon (多爾袞), wanted to build a new palace; in essence, he wanted to take over power. Schall helped the young Emperor by saying that the location chosen for the new palace was affected by bad *feng shui*, so it did not get built. This is an example where he used "bad astrology" for a good purpose.

Q: *Where there any other people (Chinese or Western) he confided in?*

CvC: Schall was a difficult person, who often quarrelled with his Jesuit brothers. Later in life, he may have confided to some extent in Verbiest. Verbiest shared Schall's prison and defended him at the legal court, but he was also groomed as Schall's successor. In my understanding, their relationship was friendly.

NG: This is actually a "modern" question: no one would have asked such a question in the 17th Century AD. At that time, hierarchical relationships were most important. Therefore, we don't know much about personal relationships except by reading "in between the lines" in the original sources. Verbiest wrote extensive "apologies" for Schall, but that was normal given the hierarchical nature of their relationship. He also remained on his side during Schall's physical difficulties, including his imprisonment,

and wrote his obituary—all of this could be seen as merely duty-bound. However, from our 21st Century perspective, I cannot imagine that he would have done all this to the full extent if their personal relationship hadn't been good, although “order discipline” also played an important role. Verbiest didn't leave any negative records about Schall, however.

CvC: Schall had a servant who played an important role in the household. Schall adopted the servant's son as his own son or grandson. He was accused by other Jesuits of maintaining homosexual relations with the servant, which eventually turned



quite ugly. For more than 15 years, he was involved in several legal cases against him, related to him having taking up the formal office he had been offered by the Emperor. It was eventually decided in Rome that this was fine, but he didn't get that message before his death...

Figure 8: Schall von Bell in Mandarin robes (Source: *China Illustrata*, Athanasius Kircher, Amsterdam, 1667).

From about 1664 (under the reign of the Kangxi Emperor, 1662–1722; 康熙), he was accused of delivering poor work, thus causing bad *feng shui*, by a Chinese Confucian scholar, Yang Guangxian (楊光先). The latter was concerned that Europeans had too much power in China, because they held the office of calendar making. Verbiest defended him. Heavenly omens, including earthquakes and fires, sustained this defence and should prove that he was innocent. The grandmother of the Emperor, a Mongolian princess, also intervened on his behalf.

Q: *Can you think of any other personal stories, reports, exclamations, or anything else related to the personal life of Schall von Bell that reveals him as a person?*

CvC: He was very proud to be from Cologne. He is reported to have said, “We people from Cologne don’t believe in hell; that’s nonsense”.

2. Ferdinand Verbiest: Imperial astronomer whether he liked it or not...

Q: *What motivated Verbiest to emigrate to China? Where there any personal reasons involved?*

NG: Verbiest originally wanted to go to South America—the area was known as “Nueva Granada”, currently roughly coincident with Peru—not to China. In fact, he made two attempts to go to South America. The first time he got as far as Cadiz (southern Spain), but he didn’t receive a passport to allow him passage to South America. The second time he spent a significant amount of time in the Jesuits’ centre in Seville (Spain), but his departure to South America was again delayed. Consider his drive to go to South America from a European perspective. Verbiest’s native Flanders (at the time known as the Southern Netherlands) was part of the Spanish empire, so it seemed natural to go to an overseas Spanish outpost. However, the Spanish didn’t like northern Europeans, because they didn’t really trust them to serve their faith truthfully.



Figure 9: Ferdinand Verbiest (based on a French wood carving from the 17th Century). (Credit: China Daily)

When his attempts to be sent to South America didn’t work, he requested a move to China. In fact, he made many attempts in the period 1630–1640, just like hundreds of other young Europeans who wanted to escape the situation in Europe, which was suffering from the 30-year War. Only eight (including Verbiest) were given permission to go. Although he didn’t want to go to China originally, he was fully committed to his task once he was sent out. This showed that he was a strong person, with a strong character.

The overall change in focus from the West Indies to China was dictated by the circumstances, and happened sometime between mid-1654 and June 1655.

Unfortunately, we don't know what caused this change. It is very important that it happened during the presence of Martino Martini in the Southern Netherlands, who had a large impact on the young Jesuits in places like Antwerp and Leuven. They consequently sent application letters to be sent to China "en masse" to the Jesuits' Superior General. My guess is that Verbiest—through correspondence with some of his fellow fathers in Brussels or Leuven—was inspired by this model.

Q: How did Verbiest feel about the historical astronomy records accumulated by that time in China?

NG: He didn't like the *contemporary* calculations (note, he doesn't refer explicitly to any records): he didn't consider them sufficiently accurate, because many were based on wrong or out-of-date ephemeris tables. In fact, these calculations were demonstrably poor owing to incorrect underlying assumptions. Chinese astronomers relied on old Arabic tables, but there were many more recent observations, obtained with telescopes, that were better. Verbiest also said that Western observations (e.g. those of Tycho Brahe) were not always good enough. In fact, Verbiest was a caretaker at the astronomical observatory: he only did the record-keeping as required for his job, adding nothing of scientific merit; he showed no scientific creativity. He was, in fact, the Emperor's engineer rather than the Emperor's astronomer. He built many devices and instruments, and designed hydraulic systems. He was a man who was looking for new applications of known techniques. He is often credited with designing an early predecessor of the modern car, but his description is not very useful for actually constructing such a contraption!

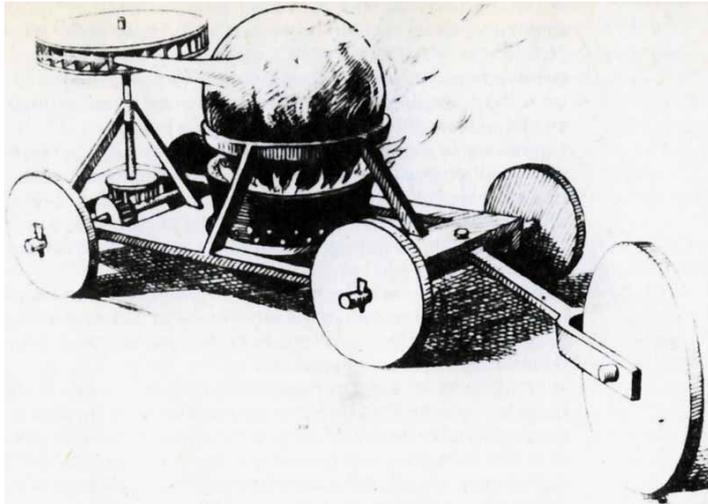


Figure 10: Verbiest's steam machine, 18th Century print (Source: Wikimedia Commons).

Q: Verbiest was the successor to Schall von Bell. Did the men know each other well? Did they get along or was there rivalry?

NG: Let us first briefly sketch Verbiest's career. In April 1654, he obtained his doctorate in Seville (Spain). He was subsequently sent to Genoa (Italy) and arrived in Macau in December 1658. Next, in 1659, he spent up to a year in Xi'an (西安), where he engaged in missionary work with common people. Schall called him to Beijing in 1660. The Emperor needed a successor to Schall who could meet his requirements regarding Western insights in mathematics.

Schall, who hailed from Cologne (Germany), had been working with his Portuguese predecessors and found that he couldn't work with southern Europeans. When a successor was called for, he was probably given a selection of candidates to choose from. More probably, he based his choice on "oral information" on the background of some of the small number of possible candidates circulating in China. We know indeed from François de Rougemont, a contemporary Jesuit also based in China, that Verbiest's reputation as a "good mathematician" had been spread in China when he arrived, perhaps intentionally. Since southern Europeans followed the Church's doctrines more closely than the northern Europeans Schall was used to, he probably felt that he might get along better with Verbiest.

Q: While in China, did Verbiest keep in touch with the order back in Europe? Did he send any personal reports?

NG: The only documents we still have from Verbiest's hand are official documents he sent to his superiors in Rome. There are no personal letters anymore, and nothing he may have sent to his family. Upon the death of a Jesuit priest, their personal papers were usually burnt. We know that he kept a diary, but this no longer exists either. We depend on the old sources, which are, of course, coloured by his own perspective; there are no unbiased sources to complement his writings.

Jesuits were "Europeans" not Sinologists; they took that attitude to China. They reacted as late-humanist, European intellectuals, and they adapted their approach to the Chinese situation, but they were never fully "assimilated". Obviously, one should differentiate according to the individual, but as a rule they acted as an "intermediary" between West and East, despite the sincere interest of several of them in some aspects of Chinese culture and society.

Q: What did he like most about his life and work in China? What least? What did he miss most from his former life in Europe?

NG: From 1660, he dealt with interactions with the Imperial court only. He was locked into the rituals of the court, although he said at one point that he would have preferred to deal with the common people, as he did while based in Xi'an. The source of this latter statement is a letter of 23 January 1670 to François de Rougemont, written in Latin and Dutch since this was kind of a "secret language" for communicating feelings and opinions that should not be circulated widely.

A rough translation of this passage from Old Dutch reads as follows:

"My dear Father Franciscus, be assured that although the Emperor has honoured me greatly, and although I have been appointed to the office of Great Mandarin, in my heart I would have much preferred to live the life of our late father Xaerius Faber (= ?unidentified), who dealt directly with the mission and engaged with poor Christians as well as Mandarins. However, I

have now taken this path and I cannot and may not backtrack from this direction.”

This is clear enough: he was part of the Imperial court whether he liked it or not, with all of its prescribed rituals, but he would have much preferred to be a simple missionary. However, his position at the Imperial court was of great importance for the long-term future of the Jesuit mission in China, so he could not refrain from his court duties.

He often wrote that he was overburdened with work. He needed to teach astronomy, and check calculations using the prevailing tables. The Emperor asked him to do many public jobs, mostly related to engineering. He also acted as intermediary to other religious orders. We know that the methods employed by the other orders were to his disliking. For instance, the Franciscans preached to convert by shouting their proclamations out on the streets and in public; they didn't know much about the cultural background of the population with which they worked, he felt. This jeopardised what the Jesuits had built up. Verbiest was in desperation about this—he felt that emphasis should be placed on diplomacy. This interpretation of his feelings is also a matter of combining many short sentences and implications “read between the lines”: we rarely find explicit warnings in his letters.

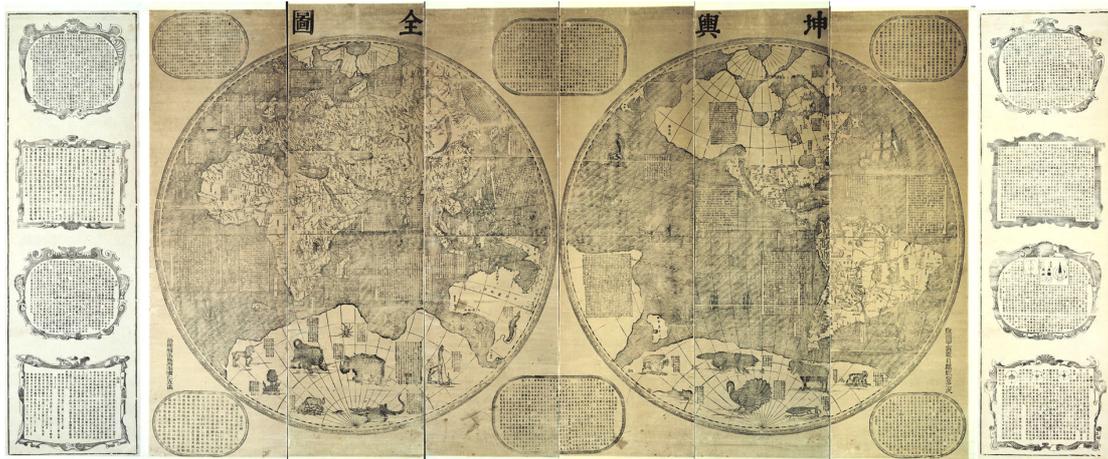


Figure 11: Kunyu Quantu (坤輿全圖) developed by Verbiest, 1674 (Source: Wikimedia Commons).

of Verbiest's works and strategy. Finally, it appears from careful research that he was responsible for Verbiest's "opening up" to Paris and the French Jesuits, which definitely gave the development of the mission another direction. In my appreciation, Thomas was, in the last five years of Verbiest's life (since his arrival in Beijing), a strong dynamic power behind Verbiest. This was a crucial period for the mission.

Q: Is it correct to say that Verbiest didn't have a true single successor, but that Fillipo Grimaldi more or less shared the duties with Thomas Pereira and Antoine Thomas? Can you tell us anything about their personal relations to Verbiest?

NG: In 1686, Fillipo Grimaldi was earmarked as Verbiest's successor. In fact, already in the mid-1670s Verbiest pleaded unequivocally for Grimaldi as his successor. However, since he was in Europe in January 1688 when he should have been ready to succeed, the Emperor requested Thomas Pereira (from Portugal) as temporary successor, given that the Emperor apparently felt that he could rely on him. However, Pereira was not well versed in mathematics or calendar science, which was reason to give him an "adjunct" who was familiar with the matters of the Astronomical Bureau: this was Antoine Thomas.

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