

From Ricci's World Map to Schall's Translation of *De Re Metallica*: Western Learning and China's Search for Silver in the Late Ming Period (1583-1644)

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1 Monks from Afar

Common in every part of the land and especially so among the more influential classes [...] is an effort to produce silver from other metals. [...] It is a daily

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and a public spectacle to see the wealthiest among them reduced to poverty after spending a great sum of money in attempting to verify this fraud.²

What Matteo Ricci (1552-1610, Chinese name Li Madou 利瑪竇) observes and records in his journal with detestation is the perpetual pursuit of Chinese (as at times also of Western) practical alchemy to turn cheap materials into precious metals which pervaded and fascinated all layers of society. By the time Ricci entered China in 1582, the golden Age of Chinese alchemy as a part of Daoist body-spirit cultivation was long over,³ but belief in practices related to alchemist traditions persisted and during Ricci's time especially attempts to create silver for practical as well as for spiritual purposes were widely popular.

The huge importance of silver within the Chinese monetary system throughout the late Ming period was responsible for this. During its first decades – as under the preceding Yuan Dynasty – the use of paper money remained mandatory, while the circulation of gold and silver as currencies was officially prohibited. Already by the early fifteenth century silver had nonetheless achieved a dominant position marking the beginning of the Chinese “silver economy.”⁴ In 1436, the silver ban was released, and silver was used for the payment of agricultural taxes,⁵ a development which continued over a series of taxation reforms, most notably the so-called “single-whip law” (*Yi tiao bian fa* 一條鞭法) of the sixteenth century⁶. As a result, in late Ming China silver fulfilled the two basic monetary functions as unit of account as well as medium of exchange and was considered the leading currency in contemporary monetary theory and legislation.⁷

² Ricci and Gallagher (tr.) (1953), 90.

³ The 5th to 9th century are commonly counted as the golden age of Chinese External Alchemy (*waidan* 外丹) see e.g. Ho (2007), 2.

⁴ Glahn (1996), 79-83.

⁵ *Ming shi*, 1964.

⁶ The “single-whip law” (*Yi tiao bian fa* 一條鞭法) implemented in China had transformed the relationship between the central and local authorities as well as that between the government and the people. The reform aimed primarily to simplify the complex fiscal levies by commuting most obligations towards the central government - from land and poll taxes to the labour obligations of the peasantry and the tributes of prefectural and district officials - into a single silver payment. Thus, silver was specified as the major payment of tax and subsequently played a prominent role in state finance and administration. The maintenance of the ruling machinery and bureaucratic system relied heavily on silver which laid the fiscal foundation of the government, see Chen Chunsheng and Liu Zhiwei (2010), 65-81.

⁷ In 1487, Qiu Jun 丘濬 (1421-1495), Minister of Rite, proposed a tripartite currency system in which silver would serve as the primary currency and yet be relegated to the largely ceremonial role of providing a standard of value. In this system, “silver is the top currency, paper money is the middle currency, and coin is the bottom currency; the middle

The following rapid development of the domestic commodity economy and the widespread circulation of silver determined that objectively a large amount of silver was needed as a currency.⁸ After a short but “substantial boom” of domestic silver mines during the 15th century,⁹ their output soon proved insufficient. The discovery of large silver deposits in Iwami 1526, remarkably increased the production in traditionally silver-poor Japan.¹⁰ Around the same time, the Spanish began to mine silver in Mexico and, more importantly, in 1545 in Potosí (modern-day Bolivia), which would become the world's largest silver provider for centuries to come. Silver influx into China had two stages: the first was the period of Japanese silver, which began in the 1520s and peaked in the 1540s. Japanese silver played an important role in the initial demand for silver as the main currency for circulation in the early years of the Jiajing 嘉靖 reign (1522-1566). The second was the period of American silver, which gained momentum when the first Manila galleons regularly crossed the Pacific in the 1570s.¹¹ Both origins of silver inflow converged and reached the climax during this time.¹² Spectacular profits arose throughout the worldwide supply chain, which resulted in the unprecedented shipment of thousands of tons of silver to China. This was the first “silver cycle” which could be labelled as the Potosí/Japan Silver Cycle, spanning a “silver century” from the 1540s to 1640s, and during which a preponderance of the world's silver production was concentrated at mines in Potosí and Japan.¹³

and bottom currencies are used both by public and private, and the top currency sets the standard to fix them.” In 1567, an imperial decree was given that “for buying and selling goods, if the value of the goods is more than one qian [of silver, ca. 3.7 gram], both silver and coins can be used. If the value is less than one qian, coins must be used only.” This order showed that silver gained its legal status. See also Peng Xinwei (1958), 452-453.

⁸ Qian Jiang (1985), 96.

⁹ Glahn (1996), 114.

¹⁰ Glahn (1996), 114.

¹¹ Although impressive amounts of annually two to three million tons of silver crossed the Pacific on these galleons and singular sources mention numbers as enormous as twelve million tons in 1597, in the last consequence only about 25% of all American silver which reached China was shipped directly on this route. The majority first crossed the Atlantic to continue over multiple steps around the Cape of Good Hope, through the Middle East or Russia into China. For more details on these estimates, see e.g. Flynn and Giráldez (1995), 440. At any rate, the Manila galleons were the most direct and thus most easily perceivable link between the American silver mines and China.

¹² Wan Ming (2013), 83.

¹³ The reason of global silver flow and the influx to China is excellently explained by the theory of the “Arbitrage Phases” raised by Dennis O. Flynn and Arturo Giráldez. They compared the worldwide gold/silver ratio, for example, in the early sixteenth century, around 1:12 in Europe, 1:10 in Persia, and 1:8 in India; later in the 1590s, the gold/silver

With the increasing availability of silver in China, quantity demand for silver increased even further. Many literary works of the late Ming period widely reflect this hunger and thirst for silver¹⁴ not only frequently describing how silver was used, pursued and stored in daily life, but also attaching emotions, life, spirit, and even abilities to change its appearance to it, which deserve to be worshipped and eulogized in prose and poetry.¹⁵

Having gained such high practical importance along with transcendental connotations, methods of obtaining silver were certainly of great interest for everybody. Many believed in alchemist ideas about existence of magical methods which could turn base metals like copper, tin, or lead into gold and silver by using certain agents, generally called “the art of yellow and white” (*huangbai (zhi) shu* 黃白(之)術), referring to colors of the two precious metals. Ling Mengchu 凌濛初 (1580–1644), one of many critical voices explains this term as follows:

What is the so-called “art of yellow and white”? Diviners (*fangshi* 方士) and alchemists (*danke* 丹客) cheat people into the refining of elixirs (*lian dan* 煉丹). They say that after raising yellow sprouts, and then growing white snow, one uses an agent to transform (*dianhua* 點化) [it] into an elixir. Then lead, quicksilver and so on can all be changed into yellow gold and white silver. Thus, this kind of refining elixirs is called the “art of yellow and white.”¹⁶

何謂黃白之術？方士丹客哄人煉丹，說養成黃芽，再生白雪，用藥點化為丹，便鉛汞之類皆變黃金白銀。故此煉丹的叫做黃白之術。

Interest in this art indeed reached the very top of Chinese society: Already in 1481, eager to obtain precious metal, for instance the Chenghua 成化 emperor (reign 1465-1487) believed a report from a commoner of Taizhou 泰州, who claimed that he was taught the technique of changing lead into silver eternally by an alchemist. The emperor sent eunuchs to observe his trial. The experiment lasted for over five months, but of course failed in the end.¹⁷

True to the Chinese saying that “monks from afar give the best summons” (*wailai de heshang hui nian jing* 外來的和尚會唸經), since their first arrival in China, Jesuit missionaries were believed to be particularly powerful

ratio was 1:5.5 or 1:7 in Canton, while in Spain at that time the exchange ratio was 1:12.5 or 1:14 and bimetallic ratios were about 1:10 in Japan and 1:9 in Moghul India at that time. Since merchants simply purchased silver where it was cheap (e.g. near production centers in Japan and Spanish America) and transhipped it to where silver was dear (especially in China). See Flynn and Giraldez (2004), 81-108; (2002), 391-427; (2008), 359-387.

¹⁴ For examples, see Ma Ning (2016) and Shao Min (2010).

¹⁵ Wang Li (2000), 57-64; Liu Weiyong (2003), 67-71.

¹⁶ *Erke pai an jingqi*, 201.

¹⁷ *Ming Xianzong shilu*, vol. 229, Chenghua 18 nian, 7 yue, *jiasben*, 3927.

masters of alchemy. Already in 1589, one of Ricci's first and most important followers, convert Qu Rukui 瞿汝夔 (1549-1612), had been attracted to Ricci and his teachings because of desire to make profit by turning mercury into silver, while Ricci was reputedly a wonder-working alchemist who knew how to do so.¹⁸ When introduced to the court in Beijing nine years later by the Nanjing Minister of Rites Wang Honghui 王弘誨 (1542-1615), the Eunuch who met Ricci was disappointed when Ricci declared that he had no alchemist knowledge and denied to help him get in contact with the emperor.¹⁹ Alchemy must have been a frequently raised topic by Chinese counterparts, but Ricci held it in low regard. He may have detested it, not only because creation of precious metals could be motivated by material greed but also because it corresponded to the other great aim of Daoist alchemy, pursuit of immortality, which stood in stark contrast to Christian ideas of eternal life and religious salvation.²⁰

One reason Ricci was considered an alchemist despite his repeated rejections can be seen from a note by scholar Yuan Zhongdao 袁中道 (1570-1626) upon reading about Ricci's death in the government newspaper in 1610:

“His income was little but still he often gave silver or gold (*jīn* 金) to other people, bought a house and had many servants. People suspected him to possess alchemist recipes like Wang Yang²¹ did. Matteo in fact was skilled in many occult arts, it is regrettable that I did not investigate this.”²²

所入甚薄，而常以金贈人。置居第僮僕甚都，人疑其有丹方若王陽也。然竇實多祕術，惜未究。

Chinese must have seen that Jesuits never lacked money although they lived honestly, were not involved any business, and did not receive visible alms or donations. Those with closer contact to Jesuits, however, got to know more about actual origins of financial means, as Xu Shijin 徐時進

¹⁸ Engelfriet (1998), 60. Li Madou (2014), 161.

¹⁹ Ricci and Gallagher (tr.) (1953), 314. “The palace eunuch, and everyone else, was highly pleased with the presents. He had heard that the Fathers could turn quicksilver into genuine silver metal and this seemed to please him more than anything else. He said he knew that this also would be the King's first interest. There is no question of satisfying human cupidity for wealth, even for the fabulously wealthy King of China, and when his servants heard that the Fathers were possessed of no such magic power, he was done with their petition. He told them that for various reasons he could not speak to the King on behalf of foreigners.”

²⁰ Mungello (1989), 71.

²¹ Wang Yang 王陽 was a Confucian scholar from the Han Dynasty who could produce gold, see *Han shu* 漢書, 3068.

²² *Kexuezhai ji*, book 3, 5: 1200.

(1549-1632) recorded after visiting and questioning Ricci about Europe as early as 1600:

“Having left their countries for this long, their wallets must be hanging down [empty]. Because they still live sincerely and honestly, people suspect that they are skilled in the art yellow [gold] and white [silver] to supply themselves but when I looked around in their houses, there were no furnaces and cauldrons. When I asked him further, he said, the people from his country often travel to Folangji²³ from time to time there are people from Portugal who come to Yuedong²⁴, through them it will be sent.”²⁵

去國既久，囊應垂，又恭謹無旁，人疑有黃白術取充，而瞰室中無爐鼎。余問之，雲其國人多游佛郎機，佛郎機時有往來粵東者，從彼卻寄。

The *Baike wenda* 拜客問答 (Questions and answers during a guest’s visit)²⁶, a Chinese textbook for newly arrived Jesuit missionaries that must have been compiled during early years of Ricci’s stay in Beijing after 1601²⁷, lists common questions asked of Jesuits by Chinese visitors and followers and suggests appropriate answers. Consequently, the topic of alchemy appears:

“Question: We have heard that you, old master, have [...] a secret magic method [...] we don’t know where that comes from what you pay for the expenses of your house, therefore there is this kind of talk. Answer: I, the student, have never believed that this method exists, I am afraid in the world there is no human who can achieve this. Even if this method should exist, I, the student, and my friends do not value these kinds of pursuit.”²⁸

問：聞老先生有個秘蜜[密]的妙法，人見家裡費用不知所從來，所以有這個說。

答：學生從來不信有這個法，恐怕普天下沒有人做得來。就是有這個法，學生與鄙友不重這樣的事。

Already in the earliest years of accommodation, the official policy of Jesuits was to demonstrate distance from all alchemist practices and refute

²³ Folangji 佛郎機 usually refers to Portugal, at times also to Spain. See Jin Guoping (2014), 209-223.

²⁴ Yuedong 粵東, i.e. Guangdong.

²⁵ Gong Yingyan (2015), 84.

²⁶ *Baike wenda* 拜客問答, wrongly read as *Shike wenda* 釋客問答, Bibliothèque nationale de France, MS chinois 7204. In other slightly different manuscript versions also in the Archivo Histórico de la Provincia de Toledo de la Compañía de Jesús under the title *Instrumento de visitante de los Mandarines* (Caja 101, China (II), N. 33 (Lg. 1042.14) and in the Bibliotheca Vaticana (MS Borg.cin. 316 and 503). See Li Yuzhong (2015), 133-167.

²⁷ Hsia (2010), 212-213.

²⁸ *Baike wenda*, 33.

speculations in this direction, which apparently continued to arise. Instead the fathers were advised to provide rather precise information on the origin of their metals:

“Question: You, old master, have arrived here twenty years ago, your expenditures are also high, where do they come from?

Answer: They come from my country. Once every two or three years friends from the same order as mine send it here. [...]

Question: Your friends entrust what kind of people with the sending of this silver?

Answer: Ships from the Indian Ocean (xiao xi yang) arrive every year in Guangdong. A merchant is entrusted with bringing the silver, we dispatch somebody to go and pick it up. [...]

Question: How much do they send at once?

Answer: They send enough for our needs.”²⁹

問：老先生到了這邊二十年，費用亦大，是那裡來的？

答：是鄙國來的。兩三年一次，同會之朋友寄來。[……]

問：貴友托甚麼人寄這個銀子？

答：小西洋的船年年到廣東，銀子托一個商人帶，我們差人去取。[……]

問：一次寄多少？

答：寄夠用。

Thus, Jesuits did not conceal the foreign origin of their metals but interestingly withheld information on the nationality of ships transporting silver and about the arrival port. This may have been because the Portuguese settlers in Macau were seen as both traders and pirates, so it could not be in the interest of Jesuits to reputedly receive money based on piracy.³⁰ The *Baibe wenda* also contains numerous questions on silver prices and the exchange of precious metals in the west, which imply that it was surely known that silver was cheaper in the west and that westerners brought substantial amounts of silver to Guangdong. When asked about this topic, the suggested answer was careful to deny speculations on alchemy but also to avoid revealing the geographical origin of silver in the New World:

“Question: This much silver, where does it come from?

Answer: It all comes out of mines, it is not created through melting [by alchemists].”³¹

問：這許多銀子，是那裡來的？

²⁹ *Baibe wenda*, 32-33.

³⁰ Frost (2017), 28.

³¹ *Baibe wenda*, 34.

答：都是鑛裏出來，不是煉的。

At last, a question is asked, why western merchants would then buy mercury in Guangdong. This question implies that purchased mercury may be directly transformed into silver by alchemist methods. In fact, as Ricci notes, at that time Chinese suspected Westerners had access to a special herb which allowed the creation of silver from mercury.³² The suggested answer does not deny the relation between mercury and silver production, but again denies involvement of any secret methods for silver creation. Moreover, Jesuits in China by then were already aware of the importance of amalgamation techniques in silver production.³³

“Question: The merchants who come to Guangdong buy this much mercury. Why and what do they do with it?
Answer: The gold and silver newly extracted from inside the mines is together with earth in blocks, if one doesn't use mercury, one cannot separate it [from the earth]. That is why they buy mercury.”³⁴

問：來廣東商人買這許多水銀，做甚麼緣故？

答：鑛裏新取的金銀與土在一塊，不用水銀分別不來，所以要買水銀。

After Nanjing Jesuits around Alfonso Vagnone (1568-1640, Chinese name Wang Fensu 王豐肅, since 1620 Gao Yizhi 高一志) had been arrested in 1616, Diego de Pantoja (1571-1618, Chinese name Pang Diwo 龐迪我) and Sabatino de Ursis (1575-1620, Chinese name Xiong Sanba 熊三拔) upon initiative of their adversary Shen Que 沈澹 (?-1623)³⁵ were accused of multiple misbehaviors in Beijing, again including allegation of using alchemist methods to create gold and silver.³⁶ Pantoja responded to this issue with the following repudiation:

“One [allegation] is about us being skilled at crafts of creating gold and silver and therefore spending gold like mud. As to the art of creating gold and silver: there is no such thing in the world. In western lands those studying the things and investigating their principles have also repeatedly investigated and researched this and believe that for sure it does not exist. In former years when

³² Spence (1985), 186.

³³ Mercury from China was purchased by Spanish and Japanese through Portuguese for amalgamation process, see Souza (1986), 71-73; Schottenhammer (2018), 159-193.

³⁴ *Baike wenda*, 34

³⁵ Shen Que's memorials see *Shengchao poxie ji*, chap. 1, 南宮署牘, 57-67.

³⁶ *Jie Pang Divo Xiong Sanba*. The explained issues were: “大西國”，“天主”，“天體七重”，“祖宗祭祀”，“費財與人”，“左道亂政，佯修善事，煽惑人民，師巫小術”，“戎夏之防”，“工為黃白，揮金如土”，“香山澳夷商細作”，“南京住房”，“招倭番海鬼諸惡夷”，“釋道二氏流傳既久，猶僅存之天堂地獄之說有助於儒術”，“江浙閩廣，處處布列，煽惑從教，受人朝拜”。

we had just arrived, people sometimes heard such wrong rumor and came to ask. We persuaded them not to believe it. For a long time since then we were left alone about it. We are afraid there are still people being confused and indulged in this, suspecting that we have secrets we do not make public and this eventually causes complaints and defamations. Try to imagine: If we could just [create gold and silver by] burning and melting, why would we still wait for people from far away to give and send them then? If our aim would be gold and silver and we could produce them ourselves, why would we risk danger and defamation, why then bear troubles and hardships? [...]³⁷

一解工為黃白，揮金如土。黃白之術，世無此理。西土博物窮理之事，蓋亦反覆窮究，信其必無。昔年初至，或誤聽來問。勸令勿信。久已釋然矣。恐有迷惑沉痾者，猶疑秘而不傳，亦致怨致謗之端也。試思，既能燒煉，又何待遠人賞送耶？志在黃白，而能自作，曷為冒險冒謗，受勞受苦耶？

Diego de Pantoja and Sabatino der Ursis were expelled from Beijing and together with *confratres* brought to Macau that same year, a result which after all had little or nothing to do with presumed alchemist activities.³⁸ These examples, however, illustrate how strongly during early decades of silver influx into China, the only westerners whom Chinese officials or intellectuals beyond southern port cities were ever likely to contact with, were associated with obscure methods of creating precious metals in an attempt to explain their stable financial supplies, but also other phenomena such as purchase of mercury by Portuguese in Guangdong in exchange for impressive loads of silver from Japan or elsewhere.

2 Mountains in the East

2.1 Ricci's World Map

Although suspicions about magical methods of silver production applied by westerners persisted, with dissemination of first western maps and alongside vague initial knowledge about landmasses previously unknown, it became apparent that the origin of western silver was primarily a geographical issue.

Western world maps, which entered China first via Ricci, displayed revolutionary discoveries and knowledge gained during the preceding century, such as the sea route from Europe to India, American continents, and crossing of the Pacific Ocean. However, it took time for maps to reach a level of detail exceeding mere display of earth and its continents, including finally providing more precise information on resources.

³⁷ *Jie Pang Divo Xiong Sanba*, 13b-14b.

³⁸ Brockey (2007), 63.

In 1583 Ricci began to live and preach in Zhaoqing 肇慶 Prefecture, Guangdong Province and a map he brought from Europe immediately drew the interest of Chinese surrounding him, especially the local prefect Wang Pan 王泮 (*jinsbi* 1574).³⁹ With Wang's advice and help, Ricci painted his own world map adapted to Chinese taste the next year. The map was named *Daying quantu* 大瀛全圖 (Complete map of the Great Oceans). According to Tang Kaijian's 湯開建 research, this map (lost today) should have mainly depicted the oceans, as the title suggests.⁴⁰ A copy was produced by Zhao Kehuai 趙可懷 (1541-1603) in 1597 and carved onto a stele in Suzhou, with its name changed to *Shanhai yudi tu* 山海輿地圖 (Map of the mountains, seas, and the earth). Although those two maps are both lost, we know from Zhao's preface⁴¹ to the latter that they contained Chinese names of some mountains and waters.⁴² On his first travel to Beijing in 1598, Ricci brought along a map as a gift to the Wanli 萬曆 emperor (reign 1573-1620), but eventually failed to meet him. After returning to Nanjing, he revised this map into the *Shanhai yudi quantu* 山海輿地全圖 with advice of Wu Zhongming 吳中明 (?-1608). In this map, first printed in 1598, Ricci corrected many mistakes on preceding versions and added new legends, notes and descriptions, but no mention of silver deposits or other mineral resources can be found on it.⁴³

On January 24, 1601 Ricci reached Beijing for the second time and again brought along gifts for the Wanli emperor, among them a "great book" (*juce* 鉅冊)⁴⁴ containing "details of mountains, rivers, natural barriers and frontiers, as well as local customs" (*shanchuan xingsheng tusu zhi xiang* 山川形勝土俗之詳).⁴⁵ This book was received and kept in the palace. It was later mentioned by Pantoja and de Ursis in their report under the somewhat confusing name *Wanguo ditu* 萬國地圖 (Map of ten thousand countries) which implies that it was one painting or map rather than a book.⁴⁶ In the same year, the later convert Li Zhizao 李之藻 (1565-1630, baptized as Leo) noticed a world map with the title *Dadi quantu* 大地全圖 (Complete map of the Great Earth) hanging on the wall of Ricci's house when he

³⁹ Li Madou (2014), 108-109.

⁴⁰ Tang Kaijian and Zhou Xiaolei (2015), 294-315.

⁴¹ Zhao Kehuai: *Shanhai yudi tu shuo*, in *Ertan leizeng*, wenzun pian 文尊篇, chap. 33, 203-204.

⁴² Tang Kaijian and Zhou Xiaolei (2015), 302.

⁴³ Tang Kaijian and Zhou Xiaolei (2015), 307-308.

⁴⁴ This book was likely to be Ortelius's Atlas *Theatrum Orbis Terrarum*. See Huang Shijian and Gong Yingyan (2004), 30, 69. The *Theatrum Orbis Terrarum* is included in Verhaeren's *Catalogue de la Bibliothèque du Pé-T'ang* in two editions, Antverpiaie 1570 (#2355) and Antverpiaie 1595 (#2356).

⁴⁵ *Zhifang wujii*, preface by Li Zhizao 李之藻, 1a-1b.

⁴⁶ Jie Pang *Divo Xiong Sanba*, 3a.

visited Ricci together with others.⁴⁷ It was Li who eventually helped Ricci with compilation of his most famous *Kunyu wanguo quantu* 坤輿萬國全圖 (Complete geographical map of ten thousand countries, hereafter: “KYWGQT”), which was printed and published in Beijing in autumn 1602.⁴⁸

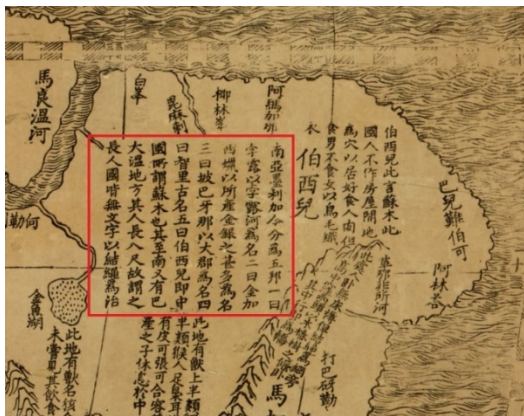


Figure 1: Close up of South America in *Kunyu wanguo quantu* 坤輿萬國全圖, 1602.⁴⁹

Since he made the first map in Zhaoqing, Ricci's maps underwent a long development process. He made sure that “the characters, map scales, time, and place names were all consistent with Chinese customs.”⁵⁰ As maps improved, more and more detailed annotations, descriptions and legends were added to correspond best with interests of Chinese readers. With this increase in detail, it can be observed that on the 1602 *Kunyu wanguo quantu* map, mineral deposits, particularly silver mines, are highlighted for the first time. This is most prominently the case in its description of South America (See Figure 1):

“Nan yamolijia [South America] is today divided into five countries: The first one is Bolu [Peru], which is named after the Bolu river. The second is Jin jiaxila

⁴⁷ *Zhifang waiji*, preface by Li Zhizao 李之藻, 1a-1b.

⁴⁸ See Huang Shijian and Gong Yingyan (2004), 30-33. Ricci's preface was dated on the first day (*jidan* 吉旦) of the seventh month (*mengqiu* 孟秋) of the *renyin* 壬寅 year in the Wanli reign-period, which was August 17, 1602.

⁴⁹ United States Library of Congress's Geography & Map Division under the digital ID g3200.ex000006Za.

⁵⁰ Li Madou (1986), 60.

[Golden Castile], which got its name from the great amount of gold and silver it produces. [...]”⁵¹

南亞墨利加，今分為五邦，一曰孛露，以孛露河為名；二曰金加西蠟，以所產金銀之甚多為名 [.....]

On the continent of South America, there is another spot, which is most explicitly associated with silver deposits, namely Potosí, at that time home to the world’s largest and most productive silver mine (see Figure 2). The legend reads briefly:

“Beiduxi [Potosí] mountain. This mountain has much silver ore.”⁵²

北度西山，此山多銀礦。



Figure 2: Close-up of Potosí.

There is one more description mentioning gold and silver production. It is located in eastern Africa around the equator and states among others that this place does not produce iron but gold, silver and ivory.⁵³

Though these patches of information are not detailed and did not stand out visibly among the multitude of other legends and descriptions, to a knowledgeable Chinese reader of this time the map could have provided a distinct indication on sources of western silver. Moreover, the fact that Ricci and Li decided to include gold and silver mines on the map shows

⁵¹ KYWGQT.

⁵² KYWGQT.

⁵³ KYWGQT.

that they saw an interest among Chinese readers for information on this topic.⁵⁴

2.2 The Expedition to Luzon

An important avenue for New World silver imports into China led through the Philippine Island of Luzon. In 1521 Ferdinand Magellan had first crossed the Pacific Ocean westward and claimed the Philippines for Spain. After 1565, when Alonso de Arellano and Andrés de Urdaneta had succeeded to return eastward, the route of the so-called Manila galleons had been established, maintaining direct trade between Luzon and the port of Acapulco in Mexico (with few interruptions) for two hundred and fifty years to come. On this route, silver from various places in the Americas, most importantly from Mexico and Potosí annually arrived at the port of Cavite near Manila, to be transported further to China and other East Asian countries.⁵⁵

Although Chinese settlers in the Philippines were involved in practically all steps of the galleon trade as shipbuilders, harbor personnel and even sailors on ships to Acapulco,⁵⁶ it appears that none of their presumed knowledge about the origin of silver they transported spread into spheres of the Ming court and its officials. For many decades, no Chinese sources appear to mention more than that Spanish (Ganxila 干係臘/幹係蠟, Gansila 幹絲臘, Shibanya 是班呀/牙 or generally Folangji 佛郎機)⁵⁷, or Portuguese (generally Folangji)⁵⁸ traders brought silver, and that enormous amounts of it could be found in Luzon (Lüsong 呂宋).

The latter information gained significance when in autumn 1602, almost at the same time of initial publication of the KYWGQT, a memorial reached the Wanli emperor suggesting – rather unusual for this phase of

⁵⁴ For more information on Latin America in Chinese geographical works as well as on early sino-peruvian relations in general, see Schottenhammer (???) , ‘East Asia’s Other New World, China and the Viceroyalty of Peru: A Neglected Aspect of Early Modern Transpacific History’, in ????. ??-?? et al.

⁵⁵ Fish (2011), 128. While Luzon was the western terminus of practically all Manila galleons, and thus the only Asian harbor maintaining direct and regular connections across the Pacific, not all silver which reached Luzon and only a minor share of all American silver which reached China travelled through this route. For more details concerning these quantities, see e.g. Flynn and Giráldez (1995), 440. So also Flynn and Giráldez (2001).

⁵⁶ Fish (2011), 139-140.

⁵⁷ E.g. *Haiguo wenjian lu jiaozhu jiaozhu*, 41-42, 67.

⁵⁸ E.g. *Dong xi yang kao*, 94.

Chinese maritime policy – a naval expedition to Luzon that aimed to obtain great amounts of gold and silver.⁵⁹

Due to demands of famine relief in northern China, but also to satisfy the emperor's own luxury desires, the imperial treasury was in urgent need of additional revenue. Trusted eunuchs were dispatched all over the country to function as overseers of mining (*kuangjian* 礦監) or tax commissioners (*shuisbi* 稅使) in order to thus contribute to consolidation of state finances.⁶⁰ Gao Cai 高案 (ca. 1599), who soon gained a reputation of extreme greed and ruthlessness in acquisition of profits, was sent to Fujian Province. He resolutely supported an initiative for a naval expedition proposed by military official Yan Yinglong 閩應龍 and local Fujian merchant or craftsman Zhang Yi 張巖.⁶¹ In a memorial to the Throne they claimed that just off the coast of Haicheng 海澄 district “on the island of Luzon there is a certain Jiyi Mountain (Jiyi shan 機易山) on which golden beans grow all by themselves. If one would send people to pick them up, immensurable profit could be reaped without limits”⁶². He proposed preparation of ships, workers and capital ready to take off in two months and bring back a profit of as much as 100,000 tael of gold and 300,000 tael of silver per year.⁶³ Against advice of his conservative officials,⁶⁴ who continued to advocate a strict sea ban, the emperor accepted gladly.⁶⁵ The Jiyi Mountain suggested for exploitation, however, was merely a misspelling of *Jiayi cheng* 加溢城, the Chinese name for the Spanish harbor and fortress of Cavite, where Manila galleons used to arrive.⁶⁶

⁵⁹ The earliest mention of this memorial was on September 12, 1602, when Censor-in-chief Wen Chun 溫純 strongly disagreed against it in his memorial, see *Ming shilu*, Shen-zong: juan 374, 9b-11a. Wade (tr.), <http://www.epress.nus.edu.sg/msl/reign/wan-li/year-30-month-7-day-27>.

⁶⁰ Tang lizong (2009), chap. 2.

⁶¹ Yan Yinglong was a Company Commander (*baibu* 百戶) of the Left Guard of the Palace Guard Cavalry (*Yulin zuowei* 羽林左衛) and 張巖 was a local merchant from Fuzhou. See Zhao Shiqing 趙世卿, “Jiuqing Jiyishan kaicai shu” 九卿機易山開採疏, *Ming jing-shi wenbian*, book 5, 411: 4458b-4459b. Spanish source says that Zhang Yi was a carpenter, see Blair and Robertson (1906), Vol XII, 106. For more detailed information concerning the role of Fujianese merchants in maritime long-distance trade during this time, see e.g. Ptak & Hu (2013).

⁶² *Dong xi yang kao*, 91.

⁶³ *Ming shi*, 28: 8371.

⁶⁴ *Ming shi*, 28: 8371. See also *Ming shilu*, Shen-zong: juan 374, 9b-11a. Wade (tr.), <http://www.epress.nus.edu.sg/msl/reign/wan-li/year-30-month-7-day-27>.

⁶⁵ *Ming shi*, 28: 8371.

⁶⁶ *Dong xi yang kao*, 94: “Jiayi Fortress 加溢城: Originally denoting a mountain, the barbarians (*yi* 夷) took it as their base. Fearing the roaming-around of the Dutch (*hongmao* 紅毛, lit. “red-hair”), they began to build a fortress and to place cannons inside of it. When

Immediately after the emperor's decision to send ships to Luzon to inquire about Jiye Mountain, several officials sent memorials expressing harsh opposition to this plan. Censor-in-chief Wen Chun 溫純 (1539-1607) called the report about Jiye Mountain "a lie, just really like a comedy" and daringly continued that he "did not expect that even someone as wise as the emperor would mistakenly listen to this." He did not believe their promises and accused them of suggesting this only to evade the sea ban and to cooperate with barbarians for their own profit against the public interest.⁶⁷ Minister of Revenue Zhao Shiqing 趙世卿 (1538-1615) went even further, warning that the real reason for this suggestion was fivefold: to gather an army of bandits, to monopolize profits from sea trade, to loosen the sea ban policy, to collaborate with invading Japanese Pirates and to harbor foreign fugitives.⁶⁸ Gao Kezheng 高克正 (*jinsbi* 1592), examining editor of the Hanlin academy (Hanlin yuan jiantao 翰林院檢討) and himself a native of Haicheng, protested as well and argued that even people in his hometown would not know where Jiye Mountain was.⁶⁹

It is remarkable that none of these many elaborate writings of presumably educated and well-informed scholars tried to explain where the gold and silver of Luzon really came from, and none even mentioned the presence of Spanish on the island. Their arguments relied exclusively either on general rationality or common ideas of conservative statecraft.

The further development of events is recorded in the *Dong xi yang kao* 東西洋考 (A study of the Eastern and Western Oceans, 1617), a seventeenth-century Chinese geographical work. Due to discussions at court, the delegation, including vice magistrate of Haicheng Wang Shihe 王時和, Company Commander Gan Yichang 幹一成 as well as Zhang Yi, departed with some delay in the fourth month (i.e. May or June) 1603. The Spanish worries about arrival of the fleet were eased by explanations from Chinese living in Luzon assuring them that no invasion was planned, and envoys were received with great honors. The scene when the topic of the Jiye Mountain and its precious metals arise is depicted as follows:

"The foreign chief [...] asked the vice-magistrate [Wang Shihe]: 'You Chinese say you want to exploit a mountain. Every mountain has its owner. How can you exploit ours? Besides: what kind of tree is it that grows out these golden

the bandits arrived, they used those cannons to shoot at them, so that they dispersed and did not dare to look [back]. What Zhang Yi called 'Jiye Mountain' seems to be a misspelling of 'Jiayi'."

⁶⁷ *Ming shilu*, Shen-zong: juan 374, 9b-11a. Wade (tr.), <http://www.epress.nus.edu.sg/msl/reign/wan-li/year-30-month-7-day-27>.

⁶⁸ "Jiuqing Jiyishan kaicai shu", *Ming jingshi wenbian*, book 5, 411: 4458b-4459b.

⁶⁹ Gao Kezheng 高克正: "Zhe Lüsung cai jin yi" 折呂宋採金議, in *Dong xi yang kao*, 222-223.

beans?⁷⁰ The vice-magistrate had nothing to respond and instead shot several glances at Zhang Yi. Zhang Yi replied: “This place is full of gold, there is no need to ask where the beans come from.” [...] The foreigners all laughed.⁷⁰

酋[……]問丞曰：“汝華言開山，山各有主，安得開也？且金豆是何樹生來？”丞無以對，數目竄。竄云：“此地皆金，不必問豆所自。”[……]夷人皆大笑。

The *Dong xi yang kao* assumes, that Zhang Yi had originally planned to invade and occupy Luzon, whereas he was taken captive and threatened with death by the Spaniards. Upon intervention of other Chinese he was eventually released and the expedition returned on their ships to China, where Wang Shihe could not recover from his experience and soon died, while Zhang Yi was executed due to his false report and harmful suggestions.⁷¹ The Spanish grew increasingly suspicious about Chinese intentions towards Luzon, which eventually resulted in a brutal massacre of almost the entire Chinese population in Luzon, circa 20 000 people altogether.⁷² The event caused much hostility against the Spanish in Beijing, leading Ricci to fear association with them, and thus subject to revenge, as he wrote to his friend Maselli in Rome two years later.⁷³

Spanish documents add details and, in some points, lend a distinct perspective to events. There is for instance a preserved Spanish translation of a letter originally written in Chinese, which was said to have arrived four days ahead of the delegation in the hands of the Spanish governor. In this letter, Chinese military official Gan Yicheng (here rendered as *Chan-chian*) describes prior discussions in China and most importantly indicates that he himself believed that Zhang Yi (here called *Tio Heng*) lied about the gold mountain and promised that the Chinese intended to leave the island after a short stay only.⁷⁴ There are, however, certain details indicating that knowledge of the Chinese could have been somewhat closer to the truth than can be assumed from their own sources. In this letter, Cavite is called

⁷⁰ *Dong xi yang kao*, 92.

⁷¹ Three records in the *Ming shilu* concerning the later punishment of Zhang Yi and Yan Yinglong.

Shen-zong: juan 390.4b, Zhong-yang Yan-jiu yuan Ming Shi-lu, volume 113, 7338. Wade (tr.), <http://www.epress.nus.edu.sg/msl/reign/wan-li/year-31-month-11-day-12>.

Shen-zong: juan 403.2b, Zhong-yang Yan-jiu yuan Ming Shi-lu, volume 114, 7536. Wade (tr.), <http://www.epress.nus.edu.sg/msl/reign/wan-li/year-32-month-11-day-11>.

Shen-zong: juan 404.3a-b, Zhong-yang Yan-jiu yuan Ming Shi-lu, volume 114, 7547/48. Wade (tr.), <http://www.epress.nus.edu.sg/msl/reign/wan-li/year-32-month-12-day-13>.

⁷² *Dong xi yang kao*, 92. For detailed information on the massacre, see Borao (1998), 22-39.

⁷³ Spence (1985), 216.

⁷⁴ Blair and Robertson (1906), Vol XII, 87-94.

“one lonely mountain in the midst of the wide-spread sea”⁷⁵ and it is stated that the people living close to this mountain “store [the gold] up to trade with the Sangleys (i.e. Chinese living on the Philippines) who come there to trade so that they may buy their property.”⁷⁶ According to these passages, a stretch of sea needed to be crossed to reach the mountain, which was obviously done by Chinese in the Philippines who sold Chinese products to obtain precious metals. As is known, Chinese from the Philippines did occasionally sail on Spanish galleons to Acapulco and may thus have been a source of Zhang Yi's surely still incomplete information.⁷⁷

Moreover, golden beans appear in said letter as well, but not growing on trees by themselves. Instead it is said:

“In that place (i.e. the mountain), is collected much gold and silver. The vassals of that mountain spend gold as freely as if it were chick-peas or lentils. He (i.e. Zhang Yi) has seen that the vassals of that mountain of Cavite dig and gather it from the earth.”⁷⁸

According to this understanding, the precious metals seem to be mined regularly and the mention of bean or the like only serves as a metaphor for its cheapness and abundance rather than introducing a legendary way to procreate them.

In a petition concerning treatment of the Chinese delegation, written by fiscal of the Royal Audiencia Geronimo de Salazar y Salcedo, it is mentioned that Chinese emissaries brought their *alguazils* (i.e. court clerks) to enact justice upon Chinese in Luzon. As Salazar observes, this took place in that Chinese “flogged a Sangley in his own house; and another one they put to the hand torture”⁷⁹. It does not seem reasonable that they would have carried out trials, or even criminal investigations during their brief stay in a place not under their authority. What seems more reasonable is that they employed harsh physical methods to force some Chinese residents they assumed to possess detailed information on whereabouts of gold to reveal knowledge.

Miguel Benavides, Archbishop of Manila, relates the story in a letter to the Spanish King, describing how the delegation arrived at the presumed gold mountain as well, and provides possible details of the conversation:

“They went there [to the mountain] and took with them the said chair-maker and carpenter Tienguen [another rendering of Zhang Yi], whom they brought from China for this purpose. The mandarins commanded Tienguen, when

⁷⁵ Blair and Robertson (1906), Vol XII, 88.

⁷⁶ Blair and Robertson (1906), Vol XII, 88.

⁷⁷ Fish (2011), 133.

⁷⁸ Blair and Robertson (1906), Vol XII, 88

⁷⁹ Blair and Robertson (1906), Vol XII, 96

they arrived at Cavite, to show them where the gold was and have done with it. The man answered with good courage in a word and said to them, 'If you choose that this be gold, gold it will be; but if you do not, it will not be gold. I tell you that you should cut off the heads of the Indians (i.e. the indigenous Filipinos) and you will find their necks all covered with chains and necklaces of gold.'"⁸⁰

If Zhang Yi did say the words quoted, this may suggest a military conquest of the Island.⁸¹ Likely, he also refers to the custom of parts of the Luzon population "to wear cotton and silk garments, and gold pieces and brooches to fasten them; and rich necklaces, pendants, ear-rings, finger-rings, ankle-rings, on the neck, ears, hands, and feet - the men, as well as the women" and "even used to, and do yet, insert gold between their teeth as an ornament."⁸²

Considering sources from both sides, it appears that Zhang Yi likely had somewhat more accurate knowledge about the situation than he showed in his communication with related Chinese officials and the court. He may have been clear that the great gold and silver⁸³ mountain was not exactly at the island of Luzon, but needed to be reached by another ship journey. Nonetheless, he mixed up the name of the mountain with the arrival port of Manila galleons which led Spaniards to believe that he was looking for a mountain. In its vicinity, however, a silent volcano named *Pico de Loro* (i.e. golden peak) is located, to which Chinese may have been brought instead but which (despite its name) is not known to contain any gold deposits or ever having been mined for gold. Zhang Yi's information about this may have come from Chinese living in Luzon and having returned to Fujian, who had witnessed the Manila galleons' arrival and departure and heard about existence of legendary gold and silver mines across the ocean. His plan to exact more precise information from resident compatriots in Luzon, however, failed partly because of unwillingness of Spanish authorities to allow him to do so.⁸⁴

⁸⁰ Blair and Robertson (1906), Vol XII, 106.

⁸¹ This would be supported by Borao (1998), 12, who argues that Argensola has a similar understanding.

⁸² From a letter sent by the Jesuit Pedro Chirino to the general of his society Claudio Aquaviva, see Blair and Robertson (1906), Vol XII, 186.

⁸³ The fact that many, especially the Spanish sources only mention gold and no silver in this context has to be understood from the fact that the character *jin* 金 can stand for gold or for metals in general, only as *huangjin* 黄金 it explicitly refers to gold alone. The Spaniards may thus have expected that the Chinese speaking about *jin* were only looking for gold.

⁸⁴ For more details on the relations between the Spanish Philippines and China see e.g. Ollé (1999).

The massacre against the Chinese population of Luzon indeed, as Ricci had feared, caused much anger in China.⁸⁵ However, since the emperor was at that time not capable of any efficient military reaction, and after all Chinese as well as Spaniards were interested in continuation of trade, normality returned rather quickly. Chinese traders and other immigrants soon began to settle in Luzon again.⁸⁶ In a letter to the governor of Fujian Xu Xueju 徐學聚 (*jinsbi* 1583), Left Vice Minister of Rites Li Tingji 李廷機 (1542-1616), a native from Quanzhou prefecture 泉州, concluded about the case and Chinese who fell victim:

“They always took some cheap and bad stuff, traded it against their silver coins and returned with fruitful results, always became rich. Some of them regarded [Luzon] as the land of happiness and stayed forever. Soon they got stuck in that incident about the inspection of some [Ji]yi mountain. The foreigners said ‘how come China knows about this mountain? It must be from these people. They got angry and killed them. Those willing to get close with barbarians are not worth our sympathy. Since [the massacre], the foreigners will definitely not allow our people to stay, and our people dare neither to stay nor to go there, this means indeed a shutdown of this trade route for China. What if we give every ship a license, order the captain and his companions to guarantee for each other? If ten go but only nine return, they will all be punished.”⁸⁷

所通乃呂宋諸番，每以賤惡什物質其銀錢，滿載而歸，往往致富，而又有以彼為樂土而久留者。頃因某易山一勘，彼謂中國何知有此山，乃此等所為，遂憤而殲之。甘心就夷之民，無足憐惜，而自此彼必不容留吾人，即吾人無敢留，亦未敢往，實為中國閉絕此路也。或欲隨船給批，責令船頭伙伴相保結，如十人往而九人歸，連坐之。

2.3 Silver Coins and Overseas Silver in Chinese Sources

Although no new attempt to look for the origins of the precious metals coming from Luzon was undertaken, interest in the question persisted as can be seen from the fact that nearly every description of Luzon, that can be found until long after the massacre mentions it in one or another way. Around the time of the massacre, Governor Xu could only answer that “people of Zhangzhou 漳州 only knew that there was silver [in Luzon] and

⁸⁵ Articulated for example in the memorial by Dong Yu 董裕 in 1605, in: *Ming shilu*, Shen-zong: juan 404.3a-b, Zhong-yang Yan-jiu yuan Ming Shi-lu, volume 114, 7547/48. Wade (tr.), <http://www.epress.nus.edu.sg/msl/reign/wan-li/year-32-month-12-day-13>.

⁸⁶ Borao (1998), 10-12.

⁸⁷ *Li wenjie ji*, chap.14, 報徐石樓. This letter should be written shortly after the Luzon massacre, presumable 1603-1604, when Li was the Left Vice Minister of Rites, see *Ming Shen-zong shilu*, vol. 386, Wanli 萬曆 31 nian, 7 yue, *xinyou*, 7254.

that silver could be procured from there.”⁸⁸ In his statement evaluating events around the massacre cited above, Li Tingji apparently does not consider the information about the legendary Jiyi Mountain itself wrong, but only the unlucky fact that Chinese in Luzon were blamed by Spaniards for selling this information to China. Only *Dong xi yang kao* written fourteen years after the incident by Zhang Xie 張燮 (1574-1640) comes to a different conclusion, stating that Zhang Yi based his idea of golden beans from Jiyi Mountain on no more than hearsay that two hundred years earlier during the Yongle 永樂 reign period (1403-1424), Luzon once delivered a tribute of gold.⁸⁹ Zhang continues with a detailed description of silver coins used in Luzon, which precisely matches archaeological findings from Nan’an 南安 district in Quanzhou prefecture⁹⁰ (see Table 1), and he eventually states that these silver coins were “all brought from Folangji”.⁹¹ Although he still does not distinguish between Spain as the home country of the Folangji and South America as origin of silver, he is well aware that silver was produced neither at Jiyi Mountain nor Luzon.

Table 1: Silver coins in Luzon as described in *Dong xi yang kao* and comparison to the Spanish coins

Chinese Transcriptions	Weight <i>qian</i>	Convert to <i>gram</i>	Nan’an Coins	Spanish Coins	Spanish Names
<i>Huangbi</i> 黃幣峙	7.2 ⁹²	(=26.856g)	25.8- 27.4g	1 Peso	Uno Peso
<i>Tuchun</i> 突唇	3.6	(=13.428g)	13.6g	1/2 Peso	Mitad
<i>Luoliaoli</i> 羅料釐	1.8	(=6.714g)	7g	1/4 Peso	Doe Real
<i>Huangliaoli</i> 黃料釐	0.9	(=3.357g)	3.2-3.3g	1/8 Peso	Uno Real

Remark: weight quantity in the Ming Dynasty⁹³

1 *jin* = 16 *liang* = 596.8g

1 *liang* = 10 *qian* = 37.3g

1 *qian* = 3.73g

⁸⁸ Xu Xueju 徐學聚, “Chubao hongmao fan shu: Hongfan tongshi” 初報紅毛番疏, 紅番通市, *Ming jingshi wenbian*, book 6, 433: 4726b.

⁸⁹ *Dong xi yang kao*, 94.

⁹⁰ See Zhuang Weiji (1975), 353. Author of this article calculated the gram with 1 *jin*=500g, this is not the case in the Ming Dynasty, when 1 *jin* in fact equals to 596.8g. See Qiu Guangming (1998), 447.

⁹¹ *Dong xi yang kao*, 94.

⁹² 七錢五分 should be a written mistake of 七錢二分.

⁹³ Qiu Guangming (1998), 447.

After publication of *Dong xi yang kao*, however, rumor about the Jiyi Mountain and Luzon as producer of precious metals was not off the table yet. In 1629 and 1630, He Qiaoyuan 何喬遠 (1558-1632), author of the *Min shu* 閩書 (Book of Fujian) and a local scholar generally knowledgeable of affairs of the province and its coast, provided a vivid description in two memorials:

“In the Eastern Ocean there is Luzon, its barbarians are the Folangji. This country has silver mountains and produces silver, which the barbarians cast into a unique abundance of silver coins.”⁹⁴

東洋則呂宋，其夷佛郎機也。其國有銀山出銀，夷人鑄作銀錢獨盛。

And later with more precision:

“In this place [Luzon] there is a Jiyi Mountain. Gold and silver come out of it by themselves, appearing in overflowing abundance, not like in China were they first have to be roasted, chiseled, smelted and refined! Therefore, people also do not cherish them very much. The barbarian coins which are nowadays used among the people [in China] are just made of this [material].”⁹⁵

其地有機翼山，金銀自出，充溢流露，不似中國須燒鑿煉冶，故彼亦不甚惜，今民間所用番錢是也。

As wrong as He Qiaoyuan is with this estimation, as well informed he is on the relation between Spaniards and their outpost in Luzon:

“The place of the Folangji is originally in the Western Ocean, Luzon is no more than a sea island like a floating bubble, and its people all live on farming. The Folangji have conquered this land and opened a market here.”⁹⁶

佛郎機之地，本在西洋，呂宋不過海島一浮漚耳，其民皆耕種為業，佛郎機奪其地，開市於此。

Despite detailed knowledge and widespread use of Spanish silver coins at least in parts of China and despite obvious interest Chinese sources show in the origin of their material, nothing indicates that their origin could be traced farther than Luzon during the late Ming period. This is all the more surprising since a remarkable book had already been printed in Hangzhou in 1623 which provided much information on mineral riches of Latin America and their exploitation, the *Zhifang waiji* 職方外紀 (Record of [lands] beyond the purview of the Bureau of the Operations).

⁹⁴ *Jingshan quanji*, 674. “Qing kai haishi shu” 請開海事疏, written in 1629.

⁹⁵ *Jingshan quanji*, 687-689. “Kai yanghai yi” 開洋海議, written in Nanjing in 1630.

⁹⁶ *Jingshan quanji*, 687-689. “Kai yanghai yi” 開洋海議, written in Nanjing in 1630.

The Eunuch Gao Cai, who had already been involved in the Jiyi Mountain incident of 1603, in 1612 obtained two pieces of a folding screen from a ship arriving in Fujian in 1612 that showed parts of a western world map. Knowing of the Wanli emperor's interest in world maps, he sent them "at top speed"⁹⁷ to Beijing. The Emperor sent for Diego de Pantoja and Sabatino de Ursis to check the two pieces to see if they showed the same kind of world map that recently deceased Matteo Ricci had presented to him before.

Jesuits replied that they belonged to a western world map originally consisting of four pieces, with the two pieces depicting the map of China (*Zhongguo tu* 中國圖) and the one of countries to the southwest (*xinan fangguo tu* 西南方國圖) missing.⁹⁸ They offered to create a new complete map including information about all countries of the world in Chinese language. For this purpose, however, they asked the Emperor to return the book called *Wanguo tuzhi* 萬國圖誌 (Illustrated record of ten thousand countries) presented by Ricci in 1601, which was in Latin and thus not readable to the emperor. At that time, this seemed to be the only work on western geography available which allowed an increase in detail towards the KYWGQT of 1603. Three days later, the Emperor sent a eunuch with the two screen pieces to the Jesuits so that Pantoja and de Ursis could afterwards fabricate a new world map mounted on four picture scrolls, which they called *Wanguo dihai quantu* 萬國地海全圖 (Complete map of lands and oceans of ten thousand countries). This map must have been made without the help of the *Wanguo tuzhi* because after presenting it, the Jesuits asked for the book once more, apparently with the aim of producing a larger, more detailed eight-folded world map screen.⁹⁹ It is unclear if the book was given to them after all, since Li Zhizao, who had already worked with Ricci on his *Kunyu wanguo quantu*, recorded that the project was still unfinished in 1614. Pantoja and de Ursis, however, had to leave Beijing and died soon thereafter. The screen pieces were kept in the Investigation Bureau (Chayuan 察院) in the Inner City and some parts had already been copied and spread among the gentry of the capital, as Li denoted.¹⁰⁰ It was, however, not until Jesuit Giulio Aleni (1582-1649, Chinese name Ai Rulüe 艾儒略) together with another convert named Yang Tingyun 楊廷筠 (1562-1627, baptized as Michael), based on preserved

⁹⁷ *Zhifang waiji*, preface by Li Zhizao 李之藻, 2b.

⁹⁸ *Zhifang waiji*, zoushu 奏疏, 2b. About Japanese world map screens of this time period, see Loh (2013).

⁹⁹ *Zhifang waiji*, preface by Li Zhizao 李之藻, 3b.

¹⁰⁰ *Zhifang waiji*, preface by Li Zhizao 李之藻, 4a.

notes from Pantoja and de Ursis as well as on western books available to them, finally published the complete work in 1623.

The *Zhifang waiji* was printed as a book and included a world map as well as separate maps of Asia, Europe, Africa, America and pole regions. Every continental map was followed by a detailed description of countries belonging to it. Concerning cartographical detail, translated place names, and general geographical information available in China, the *Zhifang waiji* marked a considerable step forward. It also includes the earliest actual description of silver and gold production in Latin America as well as of shipping routes from Spain to America, and importantly, across the Pacific Ocean from America to Asia. In the chapter on Spain (Yixibaniya 以西把尼亞), when describing an altar and a palace hall adorned with silver and gold in the city of Toledo, it is written that “the gold is what the people of this country brought from America (Yamolijia 亞墨利加) after they opened [the route] across the sea”¹⁰¹ About Peru (Bolu 孛露) it is stated that:

“the earth produces precious metal ore (*jinkuang* 金礦). When excavated, metal and earth are mixed with each other. After one separates them metal is more than earth. Therefore, gold and silver are extremely much. In the king's palace everywhere gold is made into boards for decoration. [...] Because this place has that much gold and silver, it can be excavated at will, so there is no robbery, theft, greed or meanness. People are also not aware of their wealth, on the contrary they do small and meaningless jobs for a living.”¹⁰²

地出金礦，取時金土互潤，別之，金多于土，故金銀最多，國王宮殿皆以黃金為板飾之。[……]因其地金銀最多，任意可取，故亦無竊盜貪吝，亦不自知其富，或反作細微無益之務以當業。

For the country of Brazil (Boxi'er 伯西爾), existence of alluvial silver deposits in the Rio de la Plata (Yinhe 銀河, literally “silver river”) is mentioned,¹⁰³ the longest description is devoted to the region of “Golden Castile” (Jin jiaxila 金加西蠟), actually the area of present-day Columbia, where precious metals had previously been mentioned in the *Kunyu wanguo quantu*:

“This place produces gold and silver, ranking the first all over the world. Its mine has four adits (*ken* 坑), the shafts are all two hundred zhang [ca. 640 m] [deep]. Local people use cowhide to make soft ladders to go down, normally there are thirty thousand corvee laborers (*yizhe* 役者) in service. From the obtained gold and silver, the king takes one-tenth, in seven days he gets about thirty thousand liang [ca. 1119 kg] of taxation silver. At the foot of the mountain there is a city called Silver City (Yincheng 銀城). All commodities are expensive [there], only silver is extremely cheap. For trade, five levels of silver

¹⁰¹ *Zhifang waiji*, 2: 12a.

¹⁰² *Zhifang waiji*, 4: 4a.

¹⁰³ *Zhifang waiji*, 4: 6b.

coins are used, the big ones weighing eight qian [ca. 29.84 g], the small ones until five fen [ca. 1.865 g]; also four levels of gold coins are used, the big ones weighing ten liang [ca. 373g] and small ones one liang [ca. 37.3 g]. Since the [shipping] route is open, Europeans trade with them every year and obtain a lot of gold and silver. Therefore, in the western countries gold and silver become gradually cheaper while rice, grain and items of daily use become more expensive. Those who know this think in the future they will be burdened by having too much gold. However, the profit is large and although people know [the problem] they still cannot stop it.”¹⁰⁴

其地出金銀，天下稱首。其鑛有四坑，深者皆二百丈。土人以牛皮造軟梯下之，役者常三萬人。其所得金銀，國王什取其一，七日約得課銀三萬兩。其山麓有城，名曰銀城，百物俱貴，獨銀至賤。貿易用銀錢五等，大者八錢，小至五分。金錢四等，大者十兩，小者一兩。歐邏巴自通道以來，歲歲交易，所獲金銀甚多，故西土之金銀漸賤而米穀用物漸貴，識者以為後來當受多金之累。然獲利既厚，雖知不能絕也。

The silver mine “ranking first all over the world” is without doubt Potosí, which at that time belonged to the province of Peru and has mistakenly been placed by Aleni in the territory of Golden Castile. This also becomes obvious from the description of cowhide ladders, a moderately spectacular detail appearing in José de Acosta’s Spanish *Historia Natural y Moral de las Indias* from 1590, the first extensive description of silver mining in Potosí available in Europe, which was translated and reprinted many times over following decades and may have been available to Aleni during writing of the *Zhifang waiji*.¹⁰⁵ It is not obvious, however, why Aleni makes this mistake, as he correctly locates Potosí on his continental map of South America, just as it had already been correctly placed by Ricci on the *Kunyu wanguo quantu*. Moreover, it is somewhat surprising that he does not mention the name Potosí in the description, as Potosí is among to the fewer place names not copied identically from the *Kunyu wanguo quantu* to the *Zhifang waiji*, and was actively changed by Aleni from Beiduxi 北度西 to Boduoxi 波多西.

A greater novelty than information Aleni provided about silver mining in South America was that it is the earliest Chinese language source to explicitly mention that Spanish ships crossed the Pacific from America to Luzon and farther. Thus, a careful reading of the *Zhifang waiji* would have at least facilitated the conclusion that Spanish ships were likely to bring great amounts of silver from Latin American mines directly to Luzon.

¹⁰⁴ *Zhifang waiji*, 4: 8b.

¹⁰⁵ The relevant part of d’Acosta’s work is included in a Latin translation in Vol. 9 of Theodore de Bry’s *Peregrinationes*, which is a part of the Beitang collection in Beijing (#1133) and should have arrived in China with the collection of Trigault in 1619, see Verhaeren (1949), 322.

After describing shipping around the Cape of Good Hope from Europe to China, Aleni describes the two possible routes for European ships to reach China from an eastern direction:

“If they are coming from the East, from Spain on the Mediterranean sea (Dizhonghai 地中海) they cross the Straits of Gibraltar (Ba'erde xia 巴爾德峽) towards the territory of America. There are two routes: either through the Strait of Magellan (Mowalanijia xia 墨瓦蠟尼加峽) into the Pacific Ocean (Taiping yang 太平洋), or through the territory of New Spain (Xin Yixibaniya 新以西把尼亞)¹⁰⁶, anchoring the ships, through the land route to the Sea of Peru (Bolu hai 孛露海). Then they pass the Moluccas (Malugu 馬路古), Luzon and other islands until they reach the Great Ming Sea (Daming hai 大明海) and arrive in Guangzhou.”¹⁰⁷

若從東而來，自以西把尼亞，地中海過巴爾德峽，往亞墨利加之界，有二道，或從墨瓦蠟尼加峽出太平洋，或從新以西把尼亞界，泊舟，從陸路出孛露海，過馬路古、呂宋等島，至大明海，以達廣州。

The description continues with the vastness of the Pacific Ocean, the scarcity of its islands and the technique of sailing with sea charts, gaining orientation from the compass.

The *Zhifang waiji* as a whole remained an influential source on world geography for a long time to come and was reproduced in various ways. Much of the text was reused by Ferdinand Verbiest (1623-1688, Chinese name Nan Huairen 南懷仁) in 1674 for his *Kunyu tushuo* (Explanation of the world map), and was reprinted in a number of collections, including Li Zhizao's collection of celestial studies¹⁰⁸, the *Siku quanshu* 四庫全書 (Complete library in four sections) and several 19th and early 20th century collectanea.¹⁰⁹ The chapter *Siji kao* 四裔考 (A study on the four frontiers) of the *Qingchao wenxian tongkao* 清朝文獻通考 (Comprehensive investigations based on literary and documentary sources of the Qing period) compiled on imperial command between 1747 and 1784 was still largely based on content of the *Zhifang waiji*. Ironically it calls the statement concerning existence of five continents in the *Zhifang waiji* “suspected of deception” and

¹⁰⁶ The introduction to New Spain (*Xin Yixibaniya* 新以西把尼亞) in *Zhifang waiji* is in the chap. 4, 9b-10a.

¹⁰⁷ *Zhifang waiji*, 6: 11b.

¹⁰⁸ *Tianxue chubian*, ed. by Li Zhizao, 1628.

¹⁰⁹ Beside *Siku quanshu*, *Zhifang waiji* is also included in several collectanea such as *Mohai jinbu* 墨海金壺 (comp. by Zhang Haipeng 張海鵬 in 1817), *Shoushangong congsu* 守山閣叢書 (comp. by Qian Xizuo 錢熙祚 (?-1844)), *Huangchao fanshu yudi congsu* 皇朝藩屬輿地叢書 (comp. by Pu Family 浦氏 in 1903), and *Congsu jicheng* 叢書集成 (compiled and published by the Commercial Press 商務印書館 in Shanghai between 1935 and 1937). See *Zhifang waiji jiaoshi*, 9-10.

states that “all this kind of content should be plagiarism and absurd. So, these words which are too much beyond [common sense] are now all deleted and will not be retained.”¹¹⁰

Specifically description of Golden Castile (and thus of Potosí) in the *Zhifang waji* attracted attention of contemporary scholars Fang Yizhi 方以智 (1611-1671), whose major work in natural studies *Wuli xiaozhi* 物理小識 (Preliminary records on the principles of things, completed in 1643) cites the passage in a shortened version, and Li Shixiong 李世熊 (1602-1686), who included it entirely into his *Qianshen zhi* 錢神志 (Record of the spirit of money, completed in 1645). They must have attached some importance to the text, selecting it for their own works, but still did not realize the connection between gold and silver produced in distant South America and the silver coins used in Luzon and even in parts of China. Although it seems that the *Zhifang waji* was a rather visible publication in 17th century China, beyond these two works, not much information about American silver mines and origins of silver in Luzon was conveyed to its audience, and nearly nothing found its way into contemporary Chinese literature. Wang Yun 王灃, who travelled around Fujian between 1652 and 1654 speaks about western silver coins arriving there on overseas ships without mentioning their origin.¹¹¹ Zhou Lianggong 周亮工 (1612-1672), 1647 Judicial Commissioner of Fujian knows that in countries of the Western Ocean (Xiyang 西洋), commonly a term for Europe, much gold and silver was produced and transported to Luzon for commercial exchange.¹¹² The same is confirmed by Qu Dajun 屈大均 (1630-1696) in 1678 from Guangdong, who additionally still insisted that Luzon also produced silver itself.¹¹³ The *Taiwan waji* 台灣外記 (Unofficial record of Taiwan), a novel from 1704 uniting fictional and non-fictional elements, includes a report about Luzon written by Zheng Dexiao 鄭德瀟 in 1683 with annotations by the book’s author Jiang Risheng 江日昇 (*juren* 1713). The text does not show any direct influence from the *Zhifang waji*, but encompasses new details compared with older Chinese sources. This concerned especially Spanish silver coins and their weights, where Jiang’s annotation shows a higher level of precision than the *Dong xi yang kao* and the *Zhifang waji* but like the latter it includes one smallest coin more than the former (see Table. 2). The report also points out a relation between silver money and the spread of catholic faith in Luzon, as Spaniards “lure people with silver

¹¹⁰ *Qingchao wenxian tongkao*, Siku quanshu version, 298: 16.

¹¹¹ *Manyou zilue*, 1: 5a, in *Biji xiaoshuo daguan*, 17: 4.

¹¹² *Min xiaoji*, 124.

¹¹³ *Guangdong xinyu*, 15: 406.

coins to join their religion at first; when people fall for their jugglery then they will tempt them with [the promise of] going to Heaven.”¹¹⁴

Table 2: Silver coins described in three sources.

Level of silver coin	<i>Dong xi yang kao</i> , 1617		<i>Zhifang waiji</i> , 1623		<i>Taiwan waiji</i> , 1704	
	Category	Weight (<i>qian</i>)	Category	Weight (<i>qian</i>)	Category	Weight (<i>qian</i>)
Large	“Huangbizhi”	7.5	Five levels	8	“Large Coin”	7.2
	“Tuchun”	3.6		-	“Middle Coin”, used per piece, regardless its size and weight.	3.6
	“Luoliaoli”	1.8		-		1.8
	“Huangliaoli”	0.9		-		0.9
Small		-		0.5		0.45

Only two centuries later, when the numismatist Ni Mo 倪模 (1750-1825) in his book *Gu jin qian lue* 古今錢略 (A brief introduction to coins through the ages, completed in 1809) quoted information concerning gold and silver coins from the *Zhifang waiji*, he made an unprecedented statement: “The gold and silver money used there [in Golden Castile] seems to be the [same as] the ‘foreign coins’ [*yangqian* 洋錢] circulating in Fujian and Guangdong.”¹¹⁵ This is the earliest existing Chinese record associating American gold and silver with coins circulating in China, six years before the last Spanish Manila galleon crossed the Pacific from Acapulco, and only sixteen years before Bolivia and thus Potosí gained independence from the Spanish motherland.

3 Methods from the West

“In the Extreme West there is a silver mine, which until today has already passed through 90 years [of operation] and from which every year a profit of more than 28,400,000 [real?] are extracted. [...] As in China ore mountains are

¹¹⁴ *Taiwan waiji*, 346-348.

¹¹⁵ *Gu jin qian lue* (completed in 1809), 19: 47b.

so numerous, such an abundance should not only be limited to one place; alone, one has not yet obtained here the [right] method to mine them.”¹¹⁶

極西有一引礦，至今歷九十年矣，每年取利二千八百四十餘萬。[.....]
如中土礦山甚多，如此之富亦不止一處，但採之不得其法耳。

These sentences belong to a description of Potosí in the *Kunyu gezhì* 坤輿格致 (Investigations of the Earth’s interior, hereafter: “KYGZ”), a translation project commissioned by the Chongzhen 崇禎 emperor (reign 1628-1644) and explicitly targeted the transfer of Western mining knowledge to China. Its compilation bears witness to a remarkable turn in attitudes of the Ming court towards acquisition of monetary metals during the last years of its existence.

Over the first decades of the 17th century, knowledge about overseas silver available in China had increased. The miracle of the golden beans of Jiayi Mountain in Luzon had been disproved, and it had become clear that foreign silver coins arrived there on Spanish ships. In maps and atlases introduced by Jesuits, silver mining areas of South America could be seen, and more details about them were provided. All this knowledge, however, could not be used by Chinese to procure overseas silver themselves. Between border wars and rebellions during the Chongzhen reign the state faced a severe financial crisis, precluding any ideas of maritime expansion, and at the same time exacerbating urgent need for any kind of revenue.

To generate additional revenues and improve the economic situation, policies in many fields became more pragmatic and offered opportunities for innovation and development. Prohibitions against domestic silver mining were loosened¹¹⁷ and scholars adapted new appreciation toward what in historians’ debates would be termed “useful and reliable knowledge.”¹¹⁸ As a prominent instance, the famous *Tiangong kainu* 天工開物 (Exploitation of the works of Nature) was published in 1637, a comprehensive illustrated encyclopaedia on various arts and crafts shaping the Chinese economy. Chapters on metallurgy in this work are particularly detailed and reflect the state of this art in China at this time.¹¹⁹ The primary method illustrated and explained in this work is the so-called “blowing ashes method” (*huichui fa* 灰吹法), known and practiced in the west as cupellation, a process that takes advantage of the chemical fact that certain metals such as lead and copper oxidise readily when heated in an ample supply of air while the noble metals, gold and silver, do not.¹²⁰ Heating of gold and silver together

¹¹⁶ *Kunyu gezhì*, 3a: 24a-25a. Translation: Vogel & Cao (rev. & ed.), Jost (transl.)

¹¹⁷ Tang lizong (2009), 183.

¹¹⁸ On useful and reliable knowledge for purposes of production see O’Brien (2009)7-28.

¹¹⁹ Song, Yingxing, translated with preface by E-Tu Zen Sun and Shiou-Chuan Sun (1966).

¹²⁰ See Golas (1999), 132.

with lead in a cupel (i.e., a vessel or shallow hearth) usually made of bone ash results in the bone ash absorbing the lead and the oxides of other metals, leaving behind a cake or globule of the precious metal. This method was suitable for working argentiferous sulphite ores, especially those already containing significant amounts of lead, which were the rule for most deposits in Europe and China.

Only two years later on July 31 1639, Li Tianjing 李天經 (1579-1659), head of the Calendar Bureau (Liju 歷局) where Adam Schall von Bell (1592-1666, Chinese name Tang Ruowang 湯若望) worked, produced a proposal for enrichment of the state treasury. He introduced a book called the “*Kunyu gezhi* from the Western Ocean,”¹²¹ in reference to *De re metallica*, written in Latin by the German scholar Georgius Agricola (1494-1555), which – though first published as early as 1556 – remained the most comprehensive and advanced handbook on mining and metallurgy in the West.¹²² “If one is really able to open and work mines in an appropriate manner and to roast [ores] and melt [metals] according to [its] standards”, he continues “then all the different metals gold, silver, copper, tin, *plumbum* and iron can be taken to fulfil the needs of the state.”

In many instances the tone of the memorial shows that Li as an educated Confucian scholar was shy to speak about endeavours like creation of wealth through mining. He repeatedly justifies himself, emphasizing that the book is not “only subjective guesswork” and stressing its mathematical character. Yet, he continues, that outside of China “mines that have been opened and worked since years in the Western countries show all true success.” Based on this, *De re metallica* was compiled and “the subjects from afar [i.e. the Jesuits] took it with them and brought it here over a distance of tens of thousands of *li*.” After providing an overview of content, Li explains that the translation had been discussed in the Calendar Bureau since the preceding winter. It seems that communication about this with the court had taken place before, although not preserved today. He concludes that Schall von Bell already finished the first three chapters of the book, which are handed in to the emperor for inspection together with the memorial. He asks for an imperial order to finish the larger remaining part of the work with support of two junior scholars of the Calendar Bureau, Yang Zhihua 楊之華 and Huang Hongxian 黃宏憲. Apparently in reference to earlier communication, he adds that, after that the book “should be ordered to be sent to all the individual Defense Commands (*zhen* 鎮) which have opened and worked mines so that they adopt it item for item

¹²¹ Li Tianjing's memorial 題為代獻莠蕘以裕國儲事, in KYGZ, 1a-3a. See also *Zengding Xu Wendong gongji*, 4: 85-86. Translation: Vogel & Cao (rev. & ed.), Vogel (transl.).

¹²² Georg Agricola, *De Re Metallica*. Translated by Hoover & Hoover (1912).

according to the methods [expounded there].” The emperor issued an edict six days later that approved of Li’s ideas and ordered the work to be completed.

A year later on July 24 1640, Li could report that work on the *Kunyu gezhi* had been finished. He did so with words again with interesting reference to the context of alchemy, and remarks with almost ironic modesty that he had “the intention to serve the state, but was not able to [transmute other materials] into gold by projection, he had chosen this one item, the *Kunyu gezhi*, from the Western Ocean [...] and had it made into a book of three chapters.”¹²³ From one perspective, writing of the *Kunyu gezhi* was thus something like a replacement for masteries of alchemy and magic which had repeatedly been expected from Jesuits. From another perspective, his remark shows that the *Kunyu gezhi* was clearly considered something distinctly different from such masteries, that he did not even need to fear that his efforts would be understood the wrong way.

In Li Tianjing’s memorials, the Chinese *Kunyu gezhi* compiled by Schall von Bell and his collaborators is styled as a direct translation of one western book likewise called *Kunyu gezhi*. A closer look at text, however, shows that Schall must have supplemented information he found in *De re metallica* by translating or summarizing passages from at least four other western books: Vannoccio Biringuccio’s *Pirotechnia*, Lazarus Ercker’s *Beschreibung der Allerfürnemsten Mineralischen Erzt und Bergwerksarten*, Modestinus Fachs’ *Proberbüchlein* and Theodor de Bry’s *Peregrinationes*.¹²⁴ To do so, these rather specific books first needed to be at his disposal. Already Niccholò Longobardi (1559-1654, Chinese name Long Huamin 龍華民) had attached great importance to establishment of a more comprehensive library in Beijing in 1613¹²⁵ and the book collection of Nicolas Trigault (1577-1628, Chinese name Jin Nige 金尼閣) formed the foundation of the subsequently expanded later Beitang library.¹²⁶ Thus, it is thus not surprising that Schall had access to certain western standard works on different topics. What meets the eye is that during his book collection tour through Europe during the years 1616-18 with Johann Schreck (1576-1630, Chinese name Deng Yuhan 鄧玉函), Trigault acquired a larger number of books that

¹²³ Li Tianjing’s memorial 題為遵旨續進坤輿格致以裕國儲事, in KYGZ, 3a-5b, see also *Zengding Xu Wendeng gong ji*, 4: 86-88. Translation: Vogel & Cao (rev. & ed.), Vogel (transl.).

¹²⁴ Alexander Jost, “Beyond Agricola: The Western Sources of Adam Schall’s *Kunyu Gezhi* (1640)”, still unpublished paper presented at the Conference “Transfer of Scientific and Technical Knowledge between Europe and China during the Early Modern Period”, 30th March to 1st April, 2019, Beijing.

¹²⁵ Fang Hao (1969), 46-47.

¹²⁶ Verhaeren (1949), Golvers (2012), Zhao Daying (2015).

contained information on topics related to mining and metallurgy, including even two versions of Agricola's work, one in German and one in Latin.¹²⁷ This allows the assumption that Jesuits considered this topic already much earlier as a field of special interest for the court and wanted to be prepared for compilation of a work like the *Kunyu gezhi* more than twenty years earlier.

The *Kunyu gezhi* was one of several translation and knowledge transfer projects of its kind on useful and reliable knowledge and applied technology. Already before Schall began to work on it, for instance, Sabatino de Ursis completed *Taixi shuifa* 泰西水法 (Hydromethods of the Great West, 1612) and Johann Schreck *Yuanxi qiqi tushuo* 遠西奇器圖說 (Illustrations and descriptions of extraordinary devices of the Far West, 1627). Schall himself in 1643 also compiled another work called *Huogong qiexiao* 火攻擊要 (Essentials of firearms) introducing western weaponry and gunpowder technology.

Contents of the *Kunyu gezhi* generally followed chapter division similar to *De re metallica*, but proceeded selectively with numerous omissions and changes from the order of the original.¹²⁸ While many parts deal with general topics like geological theory, prospection, excavation and the construction of galleries or furnaces, others provide more specific information on individual metals as discussing ore tenor, assaying or smelting. Although in its title and preface the production of silver is not highlighted as a particular aim of the book,¹²⁹ yet the frequent description of methods and other knowledge related to silver show that translators were well aware of high interest in silver by its potential readers.

The chapter "Ore tenor" (*zheng kuang pinfu* 徵礦貧富)¹³⁰, treats identification and evaluation of silver ores. Most passages rely on direct translation from Agricola and Biringuccio. At the outset it is stated concerning the relation between the original weight of ore and resulting silver after smelting and refining, that "if less than three *jin* are obtained out of one hundred *jin*, then its vein is poor [but] it depends on the local labor price being expensive or cheap, [whether one] decides [to mine it or not]." Given Ming Chinese technology applied during this time, few silver mines in North Zhili 北直隸 and Liaodong 遼東 rose to this standard, while the vast majority were inferior.¹³¹ The text continues describing the visual nature of

¹²⁷ Golvers (2018), 175.

¹²⁸ Fu Hansi and Cao Jin (tr.) (2016), 73-87.

¹²⁹ KYGZ, *xumu* 敘目, 1a-4b. Translation: Vogel & Cao (rev. & ed.), Cao (transl.).

¹³⁰ KYGZ, 1: 9b-10a. Translation: Vogel & Cao (rev. & ed.), Jost (transl.).

¹³¹ Quan Hansheng (2011), 123-124. North Zhili's highest silver/ore ratio was 3% and Liaodong was 3-12%, while Potosí was 50%, New Spain was 5-25%.

silver ores worth mining, as well as poor ores and rocks that commonly surrounded them.

Unfortunately, chapters about large-scale smelting and refining, which ought to be included in the part Schall translated together with Yang and Huang after Li Tianjing's first memorial, have either not been preserved or have yet to be discovered. Therefore, in order to understand the techniques included in the *Kunyu gezhi* for this purpose, only chapters on probing and assaying provide reference. All techniques introduced under "Methods for Probing Silver Ores" (*shi yinkuang fa* 試引¹³²礦法)¹³³ make use of the so-called cupellation method. Silver ores are first distinguished according to hardness, which relates to silver content. In a second step, hardness and silver content determine the right amount of lead in the process. Other issues explained are the correct timing for addition of lead, ways of fire phasing (*huobou* 火候) and details concerning the composition, production and application of fluxes and other agents. Precise quantifications for the process and description of fluxes make it the clearest, technically advanced description of silver ore smelting available in China during its time.¹³⁴

While representation of silver smelting by cupellation surely contained useful and valuable information for the Chinese reader, it was mainly another method which helped extract riches of Potosí and other Latin American Mines in the early 17th century. The so-called "patio process" was an efficient, industrially applied method that made use of knowledge already described in Biringuccio's *Pirotechnia*¹³⁵ (and thus available to Schall) but had been developed to maturity only in Latin America. It was not applied

¹³² In the only preserved manuscript of the *Kunyu gezhi* in many places the characters for metals are replaced by other homophonous characters: *yin* 引 thus replaces *yin* 銀, *jīn* 槿 replaces *jīn* 金. The note added at a later point of time after the table of contents mentions that during the early Qing period mining was strictly prohibited and that for this reason all the characters denoting metals had been replaced so that it would be difficult to recognize that this was a treatise dealing with mining and smelting. See Fu Hansi and Cao Jin (tr.) (2016), 73-87.

¹³³ KYGZ, 2a: 14a-17a. Translation: Vogel & Cao (rev. & ed.), Cao (transl.).

¹³⁴ Comparison is made mainly with the description from *Tiangong kaiyuan*, see Song, Yingxing, translated with preface by E-Tu Zen Sun and Shiou-Chuan Sun (1966), 238-239. See also Xia Xiangrong, Li Zhongjun, and Wang Genyuan (1980), 295-297. Concerning the cupellation method, another account from the Southern Song period (1127-1279) preserved in Lu Rong's 陸容 (1436-1494) *Shuyuan zaji* 菽園雜記 provides detailed information too, see pages 175-176. Research on the silver smelting techniques during the Song period, see Wang Lingling 王菱菱, *Songdai kuangyeye yanjiu* 宋代礦冶業研究, pages 69-75.

¹³⁵ Hoover & Hoover (1912), 297, footnote 12.

in Europe until at least two hundred years later.¹³⁶ Despite this omission, the chapter entitled “Methods of Probing Gold Ores” (*Shi jinkuang fa* 試探礦法) described a process using amalgamation but probed critically, because “it is not as accurate as the fire assaying method. This is because squeezing with leather bags let gold come out together with mercury, besides, during refining gold can sometimes evaporate together with mercury, thus it is not perfect.”¹³⁷ Hence there is a possibility that amalgamation for silver was possibly excluded from the probing chapter, but may well have been included in the missing chapter.

At the end of a chapter entitled “Mining Ore” (*cai kuang* 採礦), which focuses on excavation techniques and gallery construction, an example of the layout and structure of a mine is given by describing a silver mine in the “Far West” (*jixi* 極西).¹³⁸ Neither name nor location of the mine is given, but it “has already passed through ninety years [of operation]” and “every year a profit of more than 28,400,000 [(no unit given)] is extracted.” The ore mountain itself is described as “approximately ten *li* wide at its foot and becoming increasingly pointed towards the top; its shape is round and its color is red.” From these pieces of information, it can already be inferred that Schall had not chosen among technologically advanced mines of central Europe described by Agricola, but instead had referred to the world's most productive silver mine in South America: Potosí. The Spanish had begun silver mining there in 1545,¹³⁹ ninety-five years before the *Kunyu gezhi* began to be compiled. The number 28,400,000 *reales* of silver produced in Potosí annually can be calculated from a description by José de Acosta in his Spanish *Historia Natural y Moral de las Indias* from 1590, which was available to Schall in Latin translation as part of Theodore de

¹³⁶ Guerrero (2016), 2-32. The patio process was a complex but efficient way specially suitable to obtain silver from chloride ores and certain leadless (“dry”) sulphite ores, which dominate in the Andean deposits of Latin America but are hardly found in Europe and China. It makes use of both chemical and physical reactions including mercury to break up silver chloride and to amalgamate silver. For detailed descriptions in theory and practice, see Guerrero (2017), 118-122.

¹³⁷ KYGZ, 2a: 19b-20a. Other than silver amalgamation, this process was, however, included in *De re metallica*, see Hoover & Hoover (1912), 43-244. While in the described gold amalgamation process part of the mercury in fact evaporates, the main reason for mercury loss in silver production via the patio process is not evaporation but the production of calomel (mercury chloride), see Guerrero (2017), 187-190.

¹³⁸ KYGZ, 3a: 24a-25a. Translation: Vogel & Cao (rev. & ed.), Jost (transl.) The term *jixi* is in other instances of Jesuit writings indiscriminately used for “the West” and thus commonly associated with Europe. For example, in *Jie Pang Diwo Xiang Sunba*, 4a, when they explained the term “Da xiyang 大西洋” they wrote the following: “大西洋者……間稱泰西，或太西，猶言極西耳，以自別於回回之西域也。”

¹³⁹ The first Spanish mining claim in Potosí was filed by a certain Juan Villaroel in April 1545. See Robins (2011), 16.

Bry's *Peregrinationes*.¹⁴⁰ Finally, the shape of the Cerro Rico, the silver mountain of Potosí, matches exactly the description in the *Kunyu gezhi* (see Figure 3).



Figure 3: Potosí and the Cerro Rico. Note: The KYGZ's description is in reasonable agreement with the Cerro Rico's size, shape, and color.

Source: Wikimedia

The arrangement of adits and shafts in the mountain is also described in relatively high detail and in close accordance with d'Acosta's account, as are four different appearances of ore found on site. After that, double ladders already mentioned by the *Zhifang waiji* are brought up as well in context of labor arrangement in Potosí. Interestingly, Schall uses entirely different language than Aleni in the related passage, indicating that his account of Potosí was unrelated to its mention in the *Zhifang waiji* fifteen years earlier.

“Inside of [the shafts] they hang double ladders (*shuangti* 雙梯) made of cowhide more than ten zhang apart from each other, while left and right of them there must be benches installed for taking a rest with one's heavy load. The [ore] gravel is filled into ‘pronged bags’ (*chadai* 叉袋), one man carrying 50 *jin* on its back and bringing it out by climbing up in succession.”¹⁴¹

內挂牛皮雙梯，間十餘丈，左右必置板凳，為負載憩歇。其沙盛叉袋，一人負五十斤，連升而出。

¹⁴⁰ One Peso minted in Potosí was worth 13 1/4 Reales (other than usually eight) and the King's fifth amounted to daily 6000 Pesos (ANPP). If one calculates 6,000 x 13.25 x 365 the result is 29,017,500 Reales, if one uses the Chinese year with 360 days, the result is 28,620,000 Reales. If one omits the 1/4 of the Reales in one Peso, the result is 28,470,000, which comes very close to the “more than 28,400,000” of the KYGZ.

¹⁴¹ KYGZ, 3a: 25a. Translation: Vogel & Cao (rev. & ed.), Jost (transl.).

This description from d'Acosta was also picked up by de Bry and arranged as a copper engraving (Figure 4) in Volume nine of the *Peregrinationes*. Though nothing indicates that Schall wanted to use this illustration in the *Kunyu gezhi*, it may have caught the attention of Chinese collaborators' or visitors' attention eventually leading to inclusion in the text of the *Kunyu gezhi*.

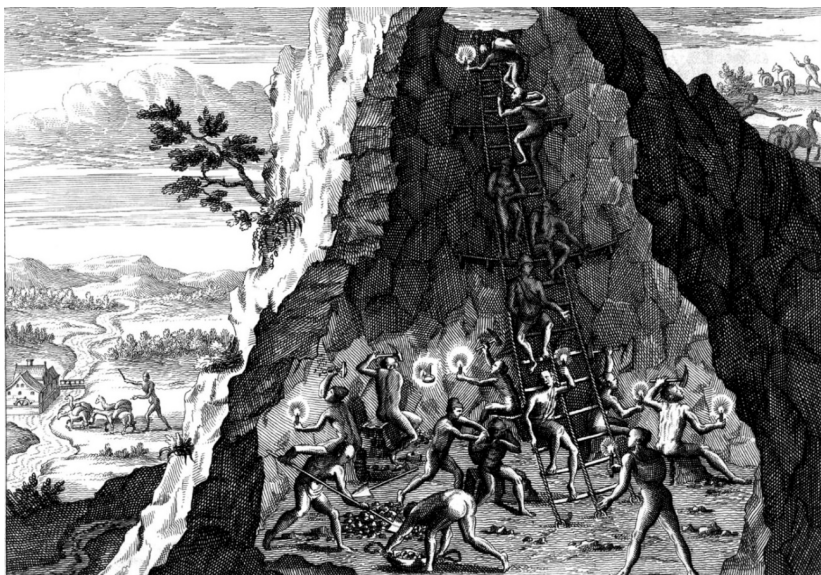


Figure 4: Illustration of Potosí Silver Mining in Theodore de Bry (1602)

Source: Theodore de Bry (1602), vol. 9, Illustration III. Note: See double ladders and resting platforms! Probably, the picture was not included by Schall, otherwise text would have referred to it, as was the case for other illustrations.

The text ends with the remark:

“As in China (Zhongtu 中土) ore mountains are so numerous, such an abundance should not only be limited to one place; alone, one has not yet obtained here the [right] method to mine them.”¹⁴²

如中土礦山甚多，如此之富亦不止一處，但採之不得其法耳。

This passage provides the most detailed Chinese account about the world's largest silver mine and thus could have finally brought some clarification to the vagueness of Chinese knowledge about the origin of silver flowing into their country. Moreover, more than any other place in the text it

¹⁴² KYGZ, 3a: 25a. Translation: Vogel & Cao (rev. & ed.), Jost (transl.)

directly justifies its mission to transfer Western mining technology to China. It is therefore even more odd that it is inserted between two purely technical chapters in the second-last volume of the work and stays entirely silent about the name and place of the described mine. Additionally, Potosí, where – as de Bry makes clear¹⁴³ – productivity heavily relied on exploitation of indigenous forced laborers under miserable and primitive technical conditions, was anything but a suitable example for superiority of western mining technology. It could have been a good instance of efficient application of amalgamation technology, but this remains unmentioned in the *Kunyu gezhi*. Schall must therefore have chosen Potosí because of its enormously high output and importance, the main function of which was to justify the statement that China still lacked the correct methods. It would only have disturbed this argument to mention that Europeans themselves had to sail thousands of miles to reach the legendary silver source, while, despite superior technology, production on the European continent was in decline.¹⁴⁴ It can furthermore be imagined that Schall did not include Potosí on his own initiative, but was asked to do so by other Chinese who had heard about that particular legendary silver mountain in the realm of the Folangji, had seen the entries about Bolu and Jin jiaxila on Ricci's map or had read respective chapters in Aleni's *Zhifang waiji*.

After the finished manuscript of the *Kunyu gezhi* had been handed over to the emperor in Summer 1640, it appears to have been shelved for some time. Only in late 1643 and early 1644 did it become a topic of court communication again, and it was finally decided to send the *Kunyu gezhi* to provinces in order to stimulate and promote mining. However, it was already too late for the work to develop any practical innovative impact, as only three months later the Ming dynasty collapsed under the double impact of domestic uprisings and Manchu invasion.¹⁴⁵ Though the book *Kunyu gezhi* itself did not fall completely into oblivion, since documentation proves that it was still known and probably discussed by the central government during early years of the Qing period.¹⁴⁶ Traces of it vanished soon thereafter, and it was considered lost, if not already during looting of Beijing by Li Zicheng 李自成 (1606-1645) and his rebels in 1644, then at least during chaotic first years of the Ming-Qing transition.

¹⁴³ De Bry (1598), 147-149.

¹⁴⁴ Central European mining was in a crisis from the mid-sixteenth to the end of the seventeenth century. See Suhling (1983), 167-177.

¹⁴⁵ For details see Pan Jixing (1983), 32-44; Vogel (1989), 41-62; Pan Jixing (1991), 114-118.

¹⁴⁶ On this see a communication document of Sept. 1644 (Shunzhi 1/8) with the title “Bingbu wei yisong guanyuan yanshi Xiyang *Kunyu gezhi* shu you” 兵部為移送官員驗試西洋坤輿格致書由 in the holdings of Ming-Qing archives of the Institute of History and Philology, Academia Sinica, in Taipei.

It was not until 2015, during work compiling a collectanea series, that Han Fengran 韓鳳冉 rediscovered a manuscript that appears to contain most original parts of the work, except chapters about smelting.¹⁴⁷ With this new source at hand, it is hoped that the intended knowledge transfer project of the *Kunyu gezhishi* can be reconstructed to a much greater level of detail, that the whereabouts of the manuscript over the last three hundred and fifty years can be clarified and that it can be investigated, if despite its disappearance from extant sources, it may still have impacted mining practices in Qing China.

4 Conclusion

From the second half of the 16th century onward, western ships brought three important phenomena to China: western religion via Jesuit missionaries, western knowledge through books on science and technology, as well as western-style money as Spanish silver coins mined from rich deposits of Latin America. Careful Chinese observers from the beginning realized possible connections among these three phenomena, and at first suspected Matteo Ricci and other early Jesuit missionaries to be masters of alchemy well versed in “arts of yellow and white”, that magically transformed base metals into gold and silver. Such assumptions were firstly fueled by observation that Jesuits clearly lacked a visible source of money but were never short of it. Secondly, it was observed that Portuguese took mercury away from Guangdong and returned with shiploads of silver. Suspicions about alchemist creation of precious metals by Jesuit missionaries could not be confirmed, however, and instead it became clear that much foreign silver entered China through the Spanish Philippines, which gave rise to new speculations. Chinese ships set out to grasp control of a legendary mountain in Luzon, where golden and silver beans grew, from which western coins were thought to be produced. The endeavor failed, leading to a bloody massacre against the Chinese population of Luzon at the hands of the Spanish. Around the same time the *Kunyu wanguo quantu*, Ricci's most detailed world map, displayed the mines of South America for the first time in China. In following decades, through numerous domestic Chinese publications but also through Aleni's geographic work *Zhifang waiji*, overseas origin of silver coins beyond Luzon was clarified and more detailed knowledge about the New World became available. This awareness arose at a time of crisis that terminated the Ming dynasty, however, so the aim of gaining control over the vaguely known silver deposits vanished. Instead, the idea became to increase domestic silver production and thus

¹⁴⁷ Han Fengran (2015), 58-64; Fu Hansi and Cao Jin (tr.) (2016), 73-87.

state revenue through the application of superior western mining and smelting methods, which brought about new hope and initiation of the *Kunyu geshi* translation project led by Adam Schall von Bell. After a concerted effort of two years, the emperor ordered the completed book to be distributed to all mining regions in order to reform the Chinese mining industry. This order exerted no influence, however, because the onslaught of Li Zicheng's rebel army and subsequent Manchu conquest preceded its execution. These cataclysmic events ended China's efforts to take action amidst global silver flows which had been shaping a new global economy. Qing efforts to maintain a certain level of monetary independence through a policy of economic isolation and strengthening of the copper cash sector throughout the 18th century could only reduce, but not abolish, China's dependence on foreign silver with all its consequences.

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