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Adam Schall von Bell's *Investigations of the Earth's Interior* (*Kunyu gezhi* 坤輿格致, 1639–1640): Recent Achievements and Future Prospects

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Abstract: This article explores Adam Schall von Bell's *Investigations of the Earth's Interior* (*Kunyu gezhi* 坤輿格致, 1639–1640), a significant Jesuit work aimed at reforming the Chinese mining and smelting industry by introducing relevant European technologies

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This research is part of "Translating Western Science, Technology and Medicine to Late Ming China: Convergences and Divergences in the Light of the *Kunyu gezhi* 坤輿格致 (*Investigations of the Earth's Interior*; 1640) and the *Taixi shuifa* 泰西水法 (*Hydromethods of the Great West*; 1612)," a project supported by the German Research Foundation (DFG) from 2018 to 2025. The project is being carried out at the Department of Chinese Studies at Tübingen University, Germany. For a close review of our essay and for numerous suggestions for improvement we are indebted to our Research Project Collaborator Sabine Kink, MA (Department of Chinese Studies, Tübingen University), and Associated Researcher Dr. Alexander Jost (Department of History, Salzburg University) as well as to the two anonymous reviewers of the journal.
Note on the use of Chinese characters and punctuation: When quoting from Chinese primary sources or when referring to secondary literature by authors from Taiwan or Hong Kong, we have kept to the traditional form of characters or their variants, just as we encountered them in these texts. In the case of secondary literature by authors from other places of the People's Republic of China, we have adopted the same strategy, which is keeping the characters in their simplified form. The only divergence from this path concerns the text of the Nanjing version of the KYGZ. In this text, for particular reasons secretive homonyms or characters close to homonyms were used for the names of metals. These we have changed back to their regular names. In the case of unpunctuated premodern Chinese texts, we have added punctuation. When premodern texts were already punctuated, but we came to the conclusion that the punctuation is wrong, we have corrected it.

during the late Ming period. After being lost for centuries, the recent rediscovery of a partial manuscript housed in the Nanjing Library has reinvigorated scholarly interest in this treatise. The authors present findings on the manuscript's origins, dating, and its reliance on Georgius Agricola's *De re metallica* alongside other Renaissance works, such as those by Lazarus Ercker or Vannoccio Biringuccio. They challenge claims that the *Investigations of the Earth's Interior* introduced the Western concept of "minerals" (*kuangwu* 礦物) to China, arguing that the term retained its traditional meaning of "ores and materials." Additionally, the article presents new historical documents revealing attempts to implement the treatise's methods and the bureaucratic challenges that prevented its widespread adoption. These topics shed light on the *Investigations of the Earth's Interior*'s role in early global knowledge transmission and its potential impact on China's mining and metallurgical practices during the Ming-Qing transition.

Keywords: Adam Schall von Bell, *Kunyu gezhi* 坤輿格致, mining and smelting technology, *De re metallica*, Jesuit transmission, Ming-Qing transition, European science in China

摘　要：明末来华的耶稣会士汤若望（Adam Schall von Bell，1592～1666）所著《坤輿格致》一书，旨在通过引进相关欧洲技术，改革中国的采矿和冶炼业。在失传数百年后，该书的部分抄本在南京图书馆惊现于世，重新激发了学术界对此书的兴趣。本文探讨了该抄本的缘起、年代及其知识来源，包括阿格里科拉（Georgius Agricola，1494～1555）的《矿冶全书》（*De re metallica*，1556）以及其他文艺复兴时期的学者拉扎勒斯·埃克（Lazarus Ercker，1528/30～1594）、万诺乔·比林古乔（Vannoccio Biringuccio，1480～1539）等人的作品。作者对《坤輿格致》将西方的"矿物"概念引入中国的说法提出质疑，认为书中的"矿物"一词仍是"矿石和材料"的传统含义。此外，文章还通过分析新的史料，展示了历史上对于实施《坤輿格致》中矿冶方法的尝试，以及政府官僚主义对于其广泛推行的阻碍。上述初步研究成果揭示了《坤輿格致》在早期全球知识传播中的作用及其对明清鼎革之际中国采矿和冶金实践的潜在影响。

关键词：汤若望，《坤輿格致》，采矿和冶炼技术，《矿冶全书》，耶稣会士，明清之际，西学东渐

Among the surviving works authored or co-authored by Adam Schall von Bell (1591–1666) introducing Western thought and knowledge to Chinese audiences, one title stands out as having been subject to a peculiar fate since its compilation. This treatise, the *Investigations of the Earth's Interior* (*Kunyu gezhi* 坤輿格致, 1639–1640; hereafter "KYGZ"), is mentioned in a number of communications at the imperial court during the last years of the Ming period (1368–1644). It aimed at contributing to the rescue of state finances by means of reforming the Chinese mining industry through the application of European technology. From the Ming-Qing transition onwards, however, traces of it were lost for three and a half centuries. The recent rediscovery of a large portion of it, however, has allowed new insights into its content and fate. These will be discussed here in this contribution, together with an account of past and recent results of KYGZ research as well as highlighting further prospects for investigation.

In this article, we will concentrate on presenting the preliminary results of our research into the history of the KYGZ. After introducing the state of the field, we will then first report on some of our findings on which we will dwell more extensively in our forthcoming book publication. These findings concern questions related to the content and, subsequently, the dating of the Nanjing KYGZ manuscript, as well as the information from European sources that was incorporated into the KYGZ, with special regard to its chapters 2A and 2B on assaying. Moreover, we will argue that the term "mineral" (*kuangwu* 礦物) was not first introduced to China in the KYGZ. In relation to these questions and arguments, we will also briefly discuss recent Chinese contributions to KYGZ research, namely, those of Han Fengran 韩凤冉 (2015), Fu Yu 付裕 (2018), Dong Qi 董琪 (2019), and Yan Bichen 严弼宸 (2021). In the later parts of the essay two new Chinese documents of a bureaucratic nature will be introduced and translated into English. These two bureaucratic communications, which inform us on the further fate of the KYGZ, have to date not been duly considered in relevant research. Finally, we will also provide some information of a contextual nature, especially about intentions or attempts to implement the methods described in the KYGZ in some of China's mining regions during the late Ming and early Qing periods, and the military, political and social reasons why this was not successful.

1 The state of the field

With just a single mention of the title KYGZ in a late Qing bibliography work,[1] which did not spark further interest in the topic at the time, it was only from the 1930s onwards that modern historians became increasingly aware of the KYGZ as a work chiefly authored by Schall von Bell[2] and—as it was subsequently more or less correctly assumed—based on Georgius Agricola's (1494–1555) *De re metallica libri XII* (Twelve Books on Mining, hereafter "DRM"; 1556), the German mining classic published in 1556. In his often quoted 1933 biography of Adam Schall von Bell, Alfons Väth mentions the KYGZ of 1640 among Schall's Chinese mathematical and astronomical works as consisting of—eventually—four "small volumes" (*Bändchen*). Väth notes that on July 31, 1639 Dr. Petrus Li T'ien-king (Li Tianjing 李天經, 1579–1659), then head of the Calendrical Bureau (*liju* 曆局),[3] recommended in a memorial to the throne Schall von

1 A much more detailed account of the history of research on the KYGZ in East and West will be given in our forthcoming book publication. Here, we will only present a few highlights.

2 For the copious research literature on Schall von Bell, see the *Chinese Christian Texts Database* (*CCT-Database*) at KU Leuven (https://www.arts.kuleuven.be/chinese-studies/english/cct). Many facets of his life, activities, and contexts are highlighted in Malek (1998). For two more recent studies on this German missionary, see Gimm (2021) and von Collani (2024).

3 For a biographical account of this scholar-official in English, see J. C. Yang (1943, vol. 1, 488b–489a). For a monographic work, see Ru (2011).

Bell's translation of a European illustrated work on physical geography that deals with subterranean treasures (*Bodenschätze*) and their exploitation, adding that in the West it was considered a classic. In addition to the three small volumes submitted, Li also requested permission to translate a practical treatise on the extraction of metals from ores. This was granted on August 4, 1639, and on July 20, 1640, the translation was proffered up to the throne, the complete work thus consisting of four small volumes. Its (imperial) receipt was confirmed by July 24, 1640 (Väth 1991, 367). Väth's description of the historical events, especially the dates, was basically correct. Shortly thereafter Henri Bernard, in an article published in 1938 on Schall von Bell's astronomical works in China, pointed out that on July 31, 1639, Li Tianjing had made the promise to the emperor to provide him with the translation of a book on mines famous in the West and that this was indeed Agricola's DRM (Bernard 1938, 462). These short statements by Väth and Bernard were subsequently—though not always correctly—taken on board by other Western scholars, including Joseph Needham (1900–1995).

It appears that in China note was taken only somewhat later of the role of Agricola's DRM in the Middle Kingdom. Probably the first modern Chinese scholar to do so was Fang Hao 方豪 in 1953/1954. In an article published for the first time in 1953 in Taiwan in which this eminent historian dealt with Johann Schreck (1576–1630) and Wang Zheng's 王徵 (1571–1644) *Record of the Best Illustrations and Descriptions of Wonderful Machines from the Far West* (*Yuanxi qiqi tushuo luzui* 遠西奇器圖説錄最, 1627), he pointed out that in the first chapter of this work the person of Agricola is highlighted, alongside Vitruvius (80/70–15 BCE), Simon Stevin (1548/49–1620), and Agostino Ramelli (1531–1600).[4] His Latin name is rendered there as Gengtian 耕田, literally "Field Tiller," and he is praised in this context as an excellent (technical) illustrator of the West.[5]

In the Chinese mainland, a new level of KYGZ research began in 1962, though it was short-lived due to the political turmoil that already was gaining momentum during that period. This upsurge was prompted by the increased attention being paid to the two memorials of 1639 and 1640 in which Li Tianjing had reported on the progress of the compilation of the KYGZ. These two documents had been included for the first time in a modern critical edition of the collected works of Xu Guangqi 徐光啟 in 1909 edited by Xu Yunxi 徐允希, followed by the edition of Xu Zongze 徐宗澤 in 1933.[6] Subsequently, the eminent historian of Chinese mathematics and science Yan Dunjie 严敦杰 (1917–1988) brought this topic to the attention of Zhang Zigao 張子高 and Yang

4 Other research on *Record of the Best Illustrations and Descriptions of Wonderful Machines from the Far West*, however, has shown that it was not Vitruvius that was meant, but rather Guidobaldo del Monte (1545–1607). See, for example, Zhang, Tian, et al. (2008, vol. I, 93).

5 See, for example, Fang (1969, vol. 1, 291).

6 See Xu (1909, ch. 4, 63a–66a); Xu ([1933] 1962, ch. 4, 85–88). The first edition of Xu Guangqi's works, that is, Xu (1896), did not contain Li Tianjing's memorials. We are indebted to one of the anonymous reviewers for this clarification.

Gen 楊根. These two historians of chemistry then took it up in 1964 in an article about the introduction of Western chemistry to China before the Opium War. In this article, they quote both of Li Tianjing's memorials *in extenso* and discuss their contents as well as other aspects that had to do with the KYGZ (Zhang and Yang 1964, 4–6).

Following the conclusion of the "Cultural Revolution" (1966–1976), Pan Jixing 潘吉星 (1931–2020), famous historian of Chinese science, relaunched research on the KYGZ, dedicating a special article to it. He was also the first to directly relate the compilation of the KYGZ to the surviving DRM volume in the Beitang Library in Beijing and to consult this book for his research. According to his own account, Bo Shuren 薄树人 (1934–1997), a well-known scholar of the history of Chinese astronomy, had pointed out to him as early as 1963 that the KYGZ translation had been carried out under the supervision of Li Tianjing, then head of the Bureau for Calendar Reform. As a result, he took up research on this theme and drafted an article in Chinese.[7] It was not, however, until 1981 that he was able to publish this work in the *Journal of Maritime History Studies* (*Haijiaoshi yanjiu* 海交史研究) (Pan 1981), which he then followed up with an expanded version in the prominent journal *Studies in the History of Natural Sciences* (*Ziran kexueshi yanjiu* 自然科学史研究) in 1983, including all the historical documentation known up to that time (Pan 1983). Six years later, in 1989, Pan's detailed research became more accessible in the West through a long article in English by Pan Jixing, Hans Ulrich Vogel, and Elisabeth Theisen-Vogel, which appeared in the *Journal of the Economic and Social History of the Orient* and which included some new material. This was to remain the state of KYGZ research for the next twenty-five years,[8] supplemented only by Peter J. Golas' (1937–2019) contribution of 1995, in which the author assumed that, due to the complexities of DRM, only small parts of it had been translated into Chinese (Golas 1995). In hindsight, this assumption has proved to be true.

A completely new phase in KYGZ research began in spring 2015. On April 26 of that year Han Fengran 韩凤冉, compiler and editor of the Jiangsu Phoenix Publisher (Jiangsu fenghuang chubanshe 江苏凤凰出版社),[9] wrote in a newspaper article that he had discovered a manuscript copy of Schall's KYGZ. Han had come across this manuscript copy (see Figure 1) preserved in the Nanjing Library (Nanjing tushuguan 南京图书馆) during his professional editorial work, quickly making it public to the

7 See Pan (1983, 37). We were informed about this also in a private email dated August 27, 2019 from Prof. Shi Yunli 石云里, a former student of Bo Shuren.

8 For other articles in English on the basis of the 1983 and 1989 publications, see Pan (1991); Pan (1998); Vogel (1989).

9 For Han Fengran's editorial credo, see https://www.bookdao.com/editor/226258/ (accessed October 27, 2024). Among the works overseen by him is *Collected Works in Chinese Language by Western Missionaries during the Ming-Qing Transition* (*Ming Qing zhi ji Xifang chuanjiaoshi Hanji congkan* 明清之際西方傳教士漢籍叢刊) (Nanjing: Jiangsu Phoenix Publisher, 2013).

scholarly world.[10] In the same year, he published the first scholarly article in Chinese about his discovery, "A First Investigation into a Manuscript of Adam Schall von Bell's *Kunyu gezhi* as Collated by Yan Jie [1763–1843] and Stored in the Nanjing Library" (Han 2015b). Two years later, in 2017, he completed the collation and punctuation of the KYGZ text, which was then published in transcribed form in a collection of Jesuit missionary texts written in Chinese.[11]

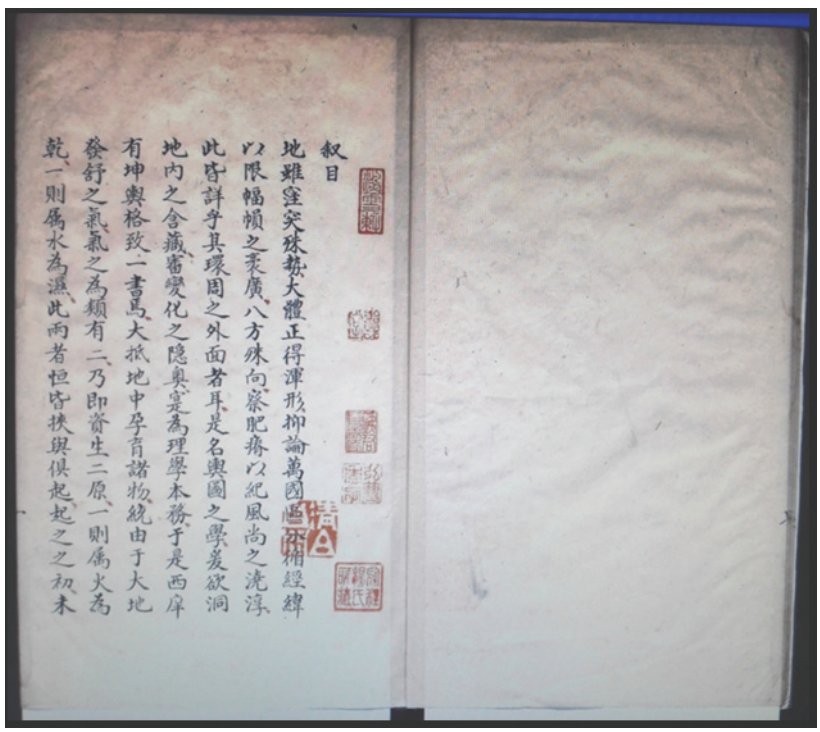

Figure 1: "Preface and Contents," with seals of manuscript owners and readers in the Nanjing *Kunyu gezhi* [1639]. (KYGZ, manuscript copy of the Nanjing Library, "Preface and Contents" [Xumu 叙目], 1a. Photo by Cao Jin, June 2015, courtesy of Nanjing Library.)

10 See Han (2015a). See now, for example, https://kknews.cc/culture/88aexg.html (accessed October 27, 2024). Hans Ulrich Vogel became aware of this article during a Research Fellowship at Erlangen University as part of the "International Consortium for Research in the Humanities: Fate, Freedom and Prognostication—Strategies for Coping with the Future in East Asia and Europe" from February to July 2015. A text reading seminar in which Prof. Lü Lingfeng 呂淩峰, then one the Chinese co-fellows at Erlangen, reported on his studies on the *Calendrical Treatises of the Chongzhen Reign-Period* (*Chongzhen lishu* 崇禎曆書), the famous astronomical compilation of the late Ming period, prompted him to undertake one of his periodic searches for the KYGZ on the internet.

11 Cf. Schall von Bell ([1639] 2017).

After Hans Ulrich Vogel had read the report of the discovery of the KYGZ manuscript by Han in 2015, he immediately contacted Cao Jin 曹晉, then Academic Director at the European Center for Chinese Studies at Peking University, the former branch of the Sinological Departments of Tübingen University and Erlangen University in the People's Republic of China. Dr. Cao, a specialist in the history of mining and monetary policy in late imperial China, was likewise thrilled about this discovery and subsequently made enquiries to the Nanjing Library. As it turned out that a scanned version would be freely accessible at the library, Cao Jin immediately travelled by high-speed train from Beijing to Nanjing and typed the whole text of more than two-hundred pages into her laptop. This she completed within one week and as a result we came into possession of an excellent digital version of the manuscript.[12]

Prof. Vogel subsequently organized a project in the premodern Section of Sinology at the Department of Chinese Studies at Tübingen University entitled "Translating Western Science, Technology and Medicine to Late Ming China: Convergences and Divergences in the Light of the *Kunyu gezhi* 坤輿格致 (*Investigations of the Earth's Interior*; 1640) and the *Taixi shuifa* 泰西水法 (*Hydromethods of the Great West*; 1612)," generously funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) for the years 2018 to 2025, with additional financial input from the Sino-German Center for Research Promotion (Chinesisch-Deutsches Zentrum für Wissenschaftsförderung 中德科学中心), Beijing.[13] The aim of this research project is to fully explore and highlight the history of the transmission and partial rendering into Chinese of DRM and other KYGZ-relevant Western sources to the Middle Kingdom. Thus far, we have finished a complete draft translation of the Nanjing KYGZ and have traced the origin of the information contained in almost each and every paragraph. Based on this translation and our contextual studies we have also established a critical edition of the Nanjing manuscript copy, which will amend the shortcomings of Han Fengran's modern edition of 2017. Two examples may suffice here to demonstrate differences in punctuation between our version and those of Yan Jie and Han Fengran. The first is the following passage:

12 In a later visit in 2023 Cao Jin again cross-checked her own version against the Nanjing manuscript, noting in particular differences with the transcription published by Han Fengran in 2017.

13 The latter is a three-year grant (2020–2022) for the establishment of a Sino-German Mobility Program (2020–2022) dealing with the "Transfer of Technical and Scientific Knowledge between Europe and China during the Early Modern Period" (近代早期中欧技术科学知识的转移)." This program, which was extended by two years until 2024, was assigned to Prof. Hans Ulrich Vogel, Chinese History and Society, Department of Chinese Studies, Tübingen University, and Prof. Zhang Baichun 张柏春, Center for Comparative Studies, Institute for the History of Natural Sciences (IHNS), Chinese Academy of Sciences, Beijing.

Yan Jie 嚴杰 (1763–1843):[14]
鑽形長圓，邊如刀刃，長柄皆鉄柄末鉄圈，加横木于内，以便紐進，
Han Fengran:[15]
鑽形長圓，邊如刀刃，長柄，皆鐵柄，末鐵圈，加横木于内，以便紐進。
Vogel et al.:
鑽形長圓，邊如刀刃，長柄皆鉄，柄末鉄圈，加横木于内，以便紐進。
The shape of the drill is long and round, with edges (*bian* 邊) resembling knife blades. Its long handle (*bing* 柄) is entirely [made of] iron and ends up in an iron ring, into which a wooden cross bar (*hengmu* 横木) is inserted in order to make the turning and entering [of the drill into the trunk] convenient.[16]

The tool that is described here was going to be depicted in one of the illustrations to be included in the KYGZ. It was based on an illustration in DRM, as shown in Figure 2:

14 See Schall von Bell et al. (1639, ch. 3B, 6a).
15 KYGZ, 2017 edition, 190.
16 The translation of the KYGZ will be published as a separate volume by Prof. Dr. Hans Ulrich Vogel, Dr. Cao Jin, and Sabine Kink, MA, with the assistance and/or contributions of Dr. Alexander Jost, Dr. Beatriz Puente Ballesteros, Dr. Sebastian Demuth, Dr. Edward Yong Liang, Dr. Ailika Schinköthe, and Prof. Dr. Christine Moll-Murata. The translation is the result of a translation seminar held by Vogel, Cao, and Kink, which in recent years took place weekly during the teaching period and was also open for MA and PhD students. Other members of the premodern section of the Department of Chinese Studies at Tübingen University who took regularly part in these sessions and offered their critical comments include Guo Aiting, MA, Prof. Dr. Achim Mittag, and Anna Strob, MA, as well as more recently Jonas Schmid, MA, Christian Buskühl, MA, Sheng Jia, MA, and Han Qijin, MA. For each session the translation of a section of the text was prepared by an individual member of the group and was then collectively discussed. Hans Ulrich Vogel, Cao Jin, and Sabine Kink were then responsible for the final revision and editing of the translation, with important input provided by Alexander Jost, who was responsible for searching for the origins of relevant information in Western sources. As for the longer documents quoted and translated in this article, the division of labor was as follows:
- Preface and Contents: Cao (transl.), Vogel, Jost & Kink (rev. & ed.)
- Li Tianjing's memorials and communication; Note of Yan Xun: Vogel (transl.), Cao & Kink (rev. & ed.)
- Ch. 1, 9a–b: Jost (transl.); Vogel, Cao & Kink (rev. & ed.)
- Ch. 2A, 2a–b: Demuth (transl.); Vogel, Cao & Kink (rev. & ed.)
- Ch. 2B, 6a: Vogel (transl.); Jost, Cao & Kink (rev. & ed.)
- Ch. 3A, 19a, 19b: Liang (transl.); Vogel, Cao & Kink (rev. & ed.)
- Ch. 3B, 4a: Demuth (transl.); Vogel, Cao & Kink (rev. & ed.)
- Ch. 3B, 6a, 9a, 13a: Kink (transl.); Vogel & Cao (rev. & ed.)
- Ch. 3B, 20a: Moll-Murata & Vogel (transl.); Cao & Kink (rev. & ed.)
- Communication (*jietie* 揭帖) [from the Ministry of War to the Three Palace Academies]: Cao (transl.), Vogel & Kink (rev. & ed.)

Figure 2: First type of force-and-suction pump, with detail of borer with auger and wider borer, in *De re metallica* (1556). (Georgius Agricola, *De re metallica libri XII* [Basileae: Froben, 1556], 135. The Chinese enumeration refers to descriptions in the KYGZ.)

The second example reads as follows:

Yan Jie 嚴杰 (1763–1843):[17]
因而水多，雖上管加數層，以至數丈之高，亦可管居箱中，并心懸**樞**，入內者皆如癸形。
Han Fengran:[18]
因而水多，雖上管加數層，以至數丈之高，亦可管居箱中，并心懸**樞**，入內者，皆如癸形。
Vogel et al.:
因而水多，雖上管加數層，以至數丈之高亦可。管居箱中，并心懸**樞**入內者，皆如癸形。
As a consequence, there is a lot of water [raised by this implement], and this is also possible even if the upper pipe were extended by several levels and thus reached a height of several *zhang*. [How] the pipes are situated within the [pump] case and [how] at the same time the core [piston rods] are hanging on the **pivot** and entering inside is all like it appears [with the mark] *gui* [in the illustration].

In addition, our project throws new light on the political, economic, social, cultural, and ideological circumstances of the historical events surrounding the KYGZ and, by taking the *Taixi shuifa*—a Chinese translation of Western hydrological knowledge of a somewhat earlier date—into account, will make a contribution to a comparative history of early globalization. This project is based on existing research on the Jesuit transmission of Western scientific, technological, and medical knowledge to late Ming (1368–1644) and

17 KYGZ, manuscript copy of the Nanjing Library, ch. 3B, 9a.
18 KYGZ, 2017 edition, 192.

early Qing China (1644–1911), which will serve as a backdrop for our own investigations. At the same time, our case studies in micro-history critically link up with ongoing debates about the emergence of Small Divergences in Europe and in China and of the Great Divergence between Europe and China during the early period of globalization.[19]

2 The Nanjing manuscript copy is not a complete textual version of the KYGZ

It is well known from research carried out prior to the re-discovery of the Nanjing manuscript that the KYGZ was compiled in two phases:[20]

The first phase took place between 1638 to around July 1639, during which Schall von Bell with the support of two Chinese assistants Yang Zhihua 楊之華 (?–1641?)[21] and Huang Hongxian 黃宏憲 (1598–1680)[22] in the Calendrical Bureau finished the first three chapters. This manuscript was submitted by Li Tianjing to the throne on July 31, 1639 (Chongzhen [hereafter "CZ"] 12/7/2) together with his first memorial on this matter. Four days later, on August 4, 1639 (CZ 12/7/6), an imperial decree was issued ordering the continuation of the translation and thus to finish the KYGZ.

The second phase lasted from around August 1639 to the beginning of July 1640, followed by the second relevant memorial by Li Tianjing, which together with the final four-chapter version of the KYGZ he presented to the emperor on July 20, 1640 (CZ 13/6/2). Again, four days later, on July 24, 1640 (CZ 13/6/6), the emperor confirmed receipt of it.

19 For the homepage providing information about the project's content, participants, scholarly exchanges, events, and especially publications, see https://uni-tuebingen.de/fakultaeten/philosophische-fakultaet/fachbereiche/asien-orient-wissenschaften/sinologie/forschung/kunyu-gezhi-taixi-shuifa-dfg/.

20 See, for example, Pan, Vogel, and Theisen-Vogel (1989, 165–176).

21 We know very little about Yang Zhihua's personal history from extant documents, except that he came from Hubei. He joined the Calendrical Bureau as a "required and recommended Confucian scholar" (*fangju rushi* 訪舉儒士) on CZ 4/1/16 (January 16, 1631) and became one of the main members of the bureau who compiled the *Calendrical Treatises of the Chongzhen Reign-Period* (*Chongzhen lishu* 崇禎曆書).

22 Huang Hongxian (1598–1680), with the courtesy name Wenfu 文甫 and pseudonym Sanhe 三和, came from an educated family in the Renhe District 仁和縣, Hangzhou, Zhejiang province. He joined the Calendrical Bureau as a "required and recommended Confucian scholar" (*fangju rushi* 訪舉儒士) on CZ 5/8/? (September 14–October 13, 1632) and, like Yang Zhihua, became one of the main members of the Bureau who compiled the *Calendrical Treatises of the Chongzhen Reign-Period*. During the period of the Ming-Qing transition, he left the Calendrical Bureau, but returned shortly after. Although he was one of the few "meritorious officials" who stayed in the Bureau after the beginning of the Qing Dynasty, he later chose to resign and retire. After returning to his hometown, Huang made a living by teaching students, and had many disciples.

From Li Tianjing's first memorial to the throne, dated July 31, 1639 (CZ 12/7/2), we learn the following about the reason for the two phases of translation:[23]

> ...邇者傳習已完，然膏繼晷，謹先撰譯繕繪，得坤輿格致三卷，彙成四冊， 敬塵 睿覽。尚有煎煉爐冶等諸法一卷，工倍于前，匪能一朝猝辦，...
> Recently, however, after transmittance and practicing [of calendar matters] had come to an end, he [i.e., Schall von Bell] carefully gave priority to the preparation of the translation and the composition of the illustrations, and this even under candle light and during late hours of the clepsydra. Thus, three chapters (*juan* 卷) of the *Kunyu gezhi* were obtained, which were bound in four volumes (*ce* 冊) and which are [herewith] respectfully submitted [together with my memorial] for the Emperor's Sagacious Inspection. There is still one chapter on the methods of roasting and smelting (*jianlian* 煎煉) as well as of the furnaces and smelters (*luye* 爐冶), but which requires double the work than the former [three chapters] and thus cannot be done rashly within one morning.[24]

As is clearly argued by Li Tianjing, the reason that only three chapters were submitted was that the chapter on roasting and smelting was especially difficult and thus required more time. This issue of the previously missing fourth chapter is again highlighted in Li Tianjing's second memorial of July 20, 1640 (CZ 13/6/2) together with which he presented the final KYGZ version:

> ...盖開採，不惟察尋地脉有法，試驗有法，採取有法，即煎煉爐冶，其事較難，其法較窘。前所進書，雖備他法，而煎煉爐冶之法，書尚未成。既奉 明旨，纂輯續進，微臣曷敢少緩，因即督同遠臣湯若望及在局辦事等官，次第纂輯，務求詳明，晝夜圖維。于今月始獲卒業，為書四卷，裝潢成帙，敬塵 聖覽。...

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23 We quote Li Tianjing's memorials from the Nanjing KYGZ manuscript copy. They are also preserved in the *Origins of the Regulations of the Calendar* (*Zhili yuanqi* 治曆緣起) part of the *Calendrical Treatises of the Chongzhen Reign-Period* (*Chongzhen lishu* 崇禎曆書). We checked these two memorials in the *Memorials of the Ming Period* (*Ming tishu* 明題疏), ch. 12, 42a–44b, and ch. 13, 17a–19b. Moreover, they were reproduced in Xu Guangqi 徐光啟 et al. (n.d.a), *Computational Treatises on the New [Calendrical] Methods* (*Xinfa suanshu* 新法算書), edition *Siku quanshu* 四庫全書, *Diaolong* database, CrossAsia Project, Staatsbibliothek Berlin, ch. 7, 11a–13a and 25a–26a. However, they are not contained in the Ming Chongzhen printed version of the *Origins of the Regulations of the Calendar* held by the National Library of China as the last memorial collected therein is one of CZ 12/5/16. One may also refer to the comparison of the various *Origins of the Regulations of the Calendar* manuscript and printed versions in Xu et. al. (2017, vol. 1, 38, 40). As mentioned above, the first modern editions can be found in the second and third critical editions of Xu Guangqi's works, i.e., *Collected Works of Sir Xu Wending (Xu Guangqi), Revised and Expanded* (*Zengding Xu Wending gong ji* 增訂徐文定公集), edited by Xu Yunxi in 1909 and by Xu Zongze 徐宗澤 in 1933, respectively. For a modern edition based on the *Calendrical Treatises according to the New Methods from the Western Ocean* (*Xiyang xinfa lishu* 西洋新法曆書) of 1645 and the Nanjing KYGZ, see also Chu and Shi (2020, 343–344, 366–367). We will deal with the minor differences between the various editions in another publication.

24 See KYGZ, manuscript of the Nanjing Library, [memorials and communication of Li Tianjing], 2b.

> As a matter of fact, opening and working mines not only implies having methods for investigating the ground and searching for veins (*cha xun di mai* 察尋地脉),[25] having methods for assaying and verifying (*shiyan* 試驗) [the Five Metals], and having methods for extracting [the ores] (*caiqu* 採取), but [also implies] that in comparison [to the other mining methods] matters related to roasting and smelting (*jianlian* 煎煉) as well as of the furnaces and smelters (*luye* 爐冶) are difficult and that methods related to them are hermetic (*mi* 密). Although in the book [i.e., the KYGZ] submitted before all the other methods have been completely provided, the book was not yet finished with respect to methods of roasting and smelting as well as of the furnaces and smelters. Since an Enlightened Imperial Edict was received [ordering the remaining part] to be compiled and then to be re-submitted, how could Your petty subject dare to create the slightest delay!? Hence Your subject has guided Tang Ruowang, the subject from afar, and the [Calendrical] Bureau's apprentices (with the [additional] titles [of Official Students and Office Managers of the Court of Imperial Entertainments]) to compile one piece after the next [of the remaining part], striving by any means to be detailed and clear, and planning and deliberating [it] day and night. It was only in this month that we finally could complete the task, create a book of four chapters (*juan*), bind them into volumes, and respectfully submit it [together with my memorial] for [the Emperor's] Sagely Inspection.[26]

These passages make clear not only that the final version of the KYGZ consisted of four chapters, but also that the Nanjing manuscript copy is incomplete. Let us first take a look at the table of contents of the Nanjing redaction, presented in Table 1:

Table 1: Table of Contents of the Nanjing KYGZ [1639]

Chinese	English
[目录，缺首頁]	[Table of contents, first double page missing]
[嚴勳識語]	[Note of Yan Xun (1845?–1914)[27] of 1879]
督修曆法加光祿寺卿李天經題為代獻蒭蕘以裕國儲事	Li Tianjing, Supervisor of the Revision of the Calendrical Methods and, in addition, Chief Minister of the Court of Imperial Entertainments, submits in lieu [of Schall von Bell] a memorial with amateurish and worthless proposals for enriching the State Treasury [CZ 12/7/2 (July 31,1639)]

25 This is probably interlocking parallel style, i.e., *cha xun di mai* = *cha di xun mai*.

26 See KYGZ, manuscript copy of the Nanjing Library, [memorials and communication of Li Tianjing], 3b–4a.

27 Yan Xun 嚴勳 (1845?–1914), also known as Yan Liangxun 嚴良勳, courtesy name Ziyou 子猷, was a native of Wu District 吳縣, Jiangsu Province. He studied astronomy, arithmetic, and English at the School of Foreign Languages in Shanghai (Shanghai Guangfangyanguan 上海廣方言館) and the School of Combined Learning in Beijing (Jingshi tongwenguan 京師同文館) and worked as an interpreter at the Jiangnan Arsenal in Shanghai. Upon the invitation of the Minister of Naval Affairs (*chuanzheng dachen* 船政大臣) Wu Zancheng 吳贊誠 (1823–1884), Yan went to Fujian to assist Wu's naval work there in 1879. In 1886, he was appointed Prefect of Funing 福寧, later serving as Prefect of Tingzhou 汀州, Quanzhou 泉州, and Fuzhou 福州, all in Fujian Province.

continued

督修曆法李天經題為遵旨續進坤輿格致以裕國儲事	Li Tianjing, Supervisor of the Revision of the Calendrical Methods, in obeisance to an Imperial Edict submits a memorial about the submission of the continuation of the *Kunyu gezhi* in order to enrich the State Treasury [CZ 13/6/2 (July 20, 1640)]
回祠司手本	Communication [of Li Tianjing] answering to the Bureau of Sacrifices [of the Ministry of Rites] [CZ 16/11 (December 11, 1643–January 9, 1644)]
敘目	Preface and Contents
第一卷 論礦脉外顯之跡 礦脉透山之跡 徵礦貧富 倣金異跡	FIRST CHAPTER On Traces about Outer Manifestations of Ore Veins Traces of Ore Veins Penetrating Mountains Verifications of Ore Tenor Strange Traces Pretending Gold
第二卷上 試礦砂法 試礦藥方 試金銀器皿 金銀公試法 試銀礦法 試金礦法	SECOND CHAPTER A Methods for Assaying Ore Gravel Recipes for Agents for Assaying Ores Tools and Vessels for Assaying Gold and Silver General Method of Assaying Gold and Silver Methods for Assaying Silver Ores Methods for Assaying Gold Ores
二卷下 試銅礦法 試鉛礦法 試錫礦法 阿鉛等礦試法 强水法 分五金	SECOND CHAPTER B Methods for Assaying Copper Ores Methods for Assaying Lead Ores Methods for Assaying Tin Ores Methods for Assaying Antimony and other Ores Methods with Strong Liquids Separating the Five Metals
[嚴杰識語]	[Remark of Yan Jie (1763–1843)[28]]
第三卷上 論開山　定開山之處 測井與洞 論器具 採礦 山內支撐	THIRD CHAPTER A On Opening Mountains / Deciding on Places for Opening Mountains Measuring Shafts and Adits On Tools Mining Ore Supports within the Mountain

28 Yan Jie 嚴杰 (1763–1843), courtesy name Houmin 厚民, pseudonym Oumeng 鷗盟, was a native of Yuhang 餘杭, Zhejiang Province. He repeatedly failed the imperial examinations but devoted himself to the study of the Classics. When Ruan Yuan 阮元 (1764–1849) was Education Intendant of Zhejiang, he gathered together more than thirty scholars from the province to compile the *Collection of Glosses to the Classics* (*Jingji zuangu* 經籍纂詁). Yan Jie was one of the participants. When Ruan became governor-general of Liangguang, Yan followed him to Guangzhou and became editor-in-chief of the *Commentaries on the Classics in the Qing Imperial Dynasty* (*Huang Qing jingjie* 皇清經解). During this period, he was extensively involved in the literati circles in Guangzhou. *Shufu lou* 書福樓 (Chamber of Book Fortune) was Yan Jie's private library.

continued

第三卷下 運山內礦料大器 論出水 論出山中毒氣 論採之當忌	THIRD CHAPTER B Large Devices for Transporting Ore and Materials in the Mountain On Water Drainage On Removing Poisonous Vapours in the Mountain On What Should Be Shunned during Mining

Source: Reconstructed on the basis of the KYGZ, manuscript copy of the Nanjing Library, in which the first page of the table of contents is missing.

Notes: Highlighting in grey indicates that these are notes added later by owners of the manuscript. They will be not discussed in this article, but in our forthcoming book.

Here and also later in the Nanjing KYGZ manuscript copy, secretive homonyms or characters close to homonyms, such as *yin* 引 for *yin* 銀, *yan* 奄 for *yan* (or *qian*) 鉛, or *chong* 銃 for *tong* 銅, were used for naming metals. This was probably for purposes of making it more difficult to recognize that the KYGZ was dealing with mining and smelting, i.e., activities that were often prohibited in late imperial China. We have corrected them, because they were certainly not written in this way in the original KYGZ version.

Table 1 makes clear that the Nanjing manuscript copy consists of only three main chapters, which are chapters 1, 2 (2A and 2B), and 3 (3A and 3B). It contains chapters on assaying (*shi* 試) different metallic ores, assaying (*shi*) gold and silver, separating (*fen* 分) metals, as well as on assaying tools, vessels, and agents (2A and 2B). The chapter on roasting and smelting (*jianlian* 煎煉), however, is indeed missing.

Moreover, there is a passage in the Nanjing manuscript copy that provides incontestable evidence of the existence of the missing fourth chapter. At the end of chapter 3B dealing with the removal of poisonous vapours in a mine it is stated that the construction of a certain type of bellows (*fengxiang* 風箱) also used for mine ventilation "will later be described fully in the text about smelting ore" (*gai zhifa shi zai yu hou zhi liankuang shu zhong* 盖製法寔載于後之煉礦書中**),** no doubt the missing fourth chapter on roasting and smelting. However, no such chapter follows chapter 3B in the Nanjing manuscript copy, nor is the construction of such bellows described in the preceding chapters.

Hence, we do not share Han Fengran's assumption that chapter 2 (2A and 2B) of the KYGZ—apart from corresponding to contents in DRM's chapters 7 (assaying ores), 10 (separating precious metals), 11 (separating silver from copper), and 12 (salt, soda, alum, vitriol, sulphur, bitumen, and glass)—also contains information from DRM's chapter 9 (smelting ores) (Han 2015b, 62). Rather, we conclude that the Nanjing KYGZ copy is not complete and therefore does not represent the final version of the text with four chapters. We consider it to be closer to the 1639 redaction, which had only three chapters and thus to the version of the first phase of translation and compilation that

ended in July 1639. Hopefully, one day the full version containing the fourth chapter may come to light, as well as the illustrations, of which the Nanjing copy includes only a small number in very rudimentary form (see Figure 3).

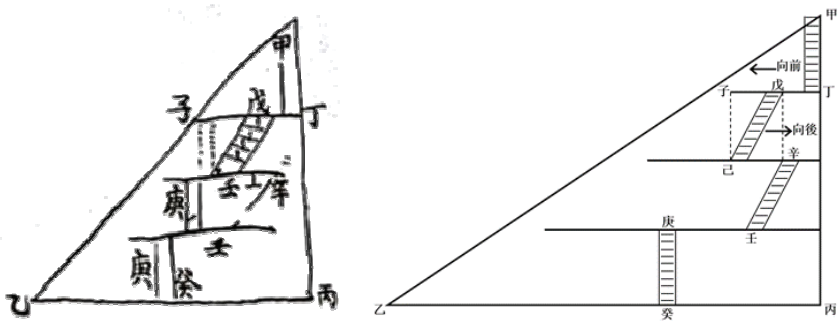

Figure 3: Detail showing a geometrical drawing made by hand in the Nanjing KYGZ [1639]. On the left side: KYGZ, manuscript copy of the Nanjing Library, ch. 3A, 14b, detail showing hand-made geometrical drawing of the interior of a mine for measuring purposes (Photo by Cao Jin, June 2015, courtesy of Nanjing Library). On the right side: Our modern reconstruction according to the description in the KYGZ text.

The idea that the Nanjing manuscript copy consists only of the first three chapters of the KYGZ and thus represents only the first phase of its compilation up to 1639 was proposed by Hans Ulrich Vogel in an article published in 2019 (64–67, 70). This was then explicitly taken up[29] and further elaborated by Yan Bichen (2021) in a recently published article. In his essay Yan agrees with our conclusion that the Nanjing KYGZ manuscript copy only contains the three chapters submitted by Li Tianjing in 1639, and that it does not include the fourth chapter on roasting and smelting of the 1640 version. He rightfully highlights the importance of chapter 2 (2A and 2B) on assaying within the KYGZ. This was the first attempt to introduce Renaissance assaying methods to China and that hence the content of this chapter could have had an innovative impact. Yan points out that assaying is clearly different from smelting, as it—in contrast to smelting—involves only small quantities of ore or metals and small-scale equipment and is a process that is characterized by metrological precision (Yan 2021, 525–527). He therefore—in our view, rightly so—criticizes Han Fengran (2015) and, in his wake, also Fu Yu (2018) and Dong Qi (2019) because they all confused assaying with smelting, thus implying that the Nanjing manuscript copy represents the 1640 version (Yan 2021, 524, 528).

Thus far we agree with Yan's arguments, but disagree over other issues. One such issue has to do with a contradiction in the Nanjing KYGZ manuscript copy. At the end

29 See his reference to Vogel (2019) in Yan (2021, 525, 531).

of its "Preface and Contents" (Xumu 叙目), the Nanjing KYGZ states that it is composed of five chapters, which is clearly at odds with the actual chapter divisions as listed in Table 1. According to the "Preface and Contents,"

- the first chapter (*juan* 卷) "discusses the hows and whys of the formation of the individual distinct natures [basically of metals] and their being contained in the earth,"
- the second chapter "discusses the various kinds of earth juices (*diye* 地液) [i.e., salts, petroleum etc.],"
- the third chapter "discusses all the signs and traces for extracting [the ores] (*caiqu* 採取)" and "also discusses the methods of assaying (*shi* 試),"
- the fourth chapter "discusses the methods of opening [mountains] and extracting [ores] (*kaicai* 開採),"
- the fifth chapter "discusses the methods of smelting (*lian* 煉)."[30]

When comparing the "Preface and Contents" listing with the actual chapter divisions in the Nanjing manuscript copy it becomes clear that the former's chapters 1, 2, and also 5 on smelting are missing in the latter, that the former's chapter 3 became the latter's chapters 1 and 2 (i.e., 2A and 2B), and that the former's chapter 4 is the latter's chapter 3 (i.e., 3A and 3B).

As the addition of the chapter on smelting to the final version of the KYGZ has been clarified beyond doubt above, a crucial question remains: what happened to chapters 1 and 2 mentioned in the "Preface and Contents"? Yan Bichen hypothesizes that—apart from the missing chapter on smelting—the contents of chapters 1 and 2 mentioned in the "Preface and Contents" may have been added to the final four-chapter version submitted by Li Tianjing in 1640, that is, that they eventually would have been integrated into chapter 1 of the Nanjing manuscript copy, making it much richer in content (Yan 2021, 532). While his hypothesis at the present stage cannot be ruled out completely, we think that this is not a very probable scenario for the following two reasons. First, in his 1640 memorial Li Tianjing provides a summary of the final KYGZ chapter divisions that rather neatly matches the actual chapter division of the Nanjing manuscript copy. We repeat here what he wrote in this respect:

30 KYGZ, manuscript copy of the Nanjing Library, "Preface and Contents," 4a–4b:
第一卷，論蘊于地及各成異性之所以然。...
第二卷，論諸種地液。...
第三卷，論凡採取兆跡。...
第四卷，論開採諸法。...
第五卷，論煉法。...

> As a matter of fact, opening and working mines not only implies having methods for investigating the ground and searching for veins (*cha xun di mai* 察尋地脉), having methods for assaying and verifying [the Five Metals], and having methods for extracting [the ores] (*caiqu* 採取), but [also implies] that in comparison [to the other mining methods] matters related to roasting and smelting (*jianlian* 煎煉) as well as to the furnaces and smelters (*luye* 爐冶) are difficult and that methods related to them are hermetic (*mi* 密).[31]

Nothing is said here about a chapter that would present the whys and hows of the formation of minerals in terms of natural philosophy or about the "various kinds of earth juices."

There is, in our mind, a second argument, albeit of a more hypothetical nature, that speaks against the integration of chapters 1 and 2 of the "Preface and Contents" into the final 1640 four-chapter version of the KYGZ. We think that, after all, the KYGZ was intended primarily to be a practical handbook for officials who were expected to transmit the methods described in it to miners and smelters and have them put into practice, or, in the words of Li Tianjing in his first memorial of 1639:

> ...一面敕發各鎮所在開採之處，一一依法採取，...
>
> [The *Kunyu gezhi*] 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 according to the methods [expounded there].[32]

Apart from the design of the KYGZ as primarily a practical guide, one may also hypothesize that in the wake of the Nanjing persecution 1616–1617 the initiators of the KYGZ project may have wished to avoid dedicating much space to Aristotelian natural philosophy as this would have implied discussing such contested topics as the European Four Elements (*si yuanxing* 四元行) in contrast to the Chinese Five Phases (*wuxing* 五行), the elevation of *qi* 氣 or Air to one of the Four Elements, and the dropping of Metal from the ranks of the Elements. Yet, around 1633 Alfonso Vagnone (1589–1653) appears not to have hesitated too much to raise such issues again, as in chapter 1 of his *Investigation into Phenomena in the Atmosphere* (*Kongji gezhi* 空際格致) he dedicated a special paragraph entitled "The Question whether Metal and Wood are Primary Elements or not" (*Wen jin mu wei yuanxing fou* 問金木為元行

31 KYGZ, manuscript copy of the Nanjing Library, [memorials and communication of Li Tianjing], 3b.
32 KYGZ, manuscript copy of the Nanjing Library, [memorials and communication of Li Tianjing], 2b.

否) to this topic and asserted that metal is not a primary element.[33] Therefore, a more convincing reason for not dwelling too much on issues of natural philosophy may have been that an Aristotelian explanation on the orogenesis of metals had been given already in chapter 3 of Francisco Furtado (1589–1653) and Li Zhizao's 李之藻 (1571–1630) *Explanations on what Exists in the Universe* (*Huanyou quan* 寰有詮) of 1628, that is, in the paragraph "About whether or not the Five metals and the various species do not contain life but are bestowed [it] by Heaven" (*Lun wujin yu zalei zhi bu hanshengzhe yao tian shi fou* 論五金與雜類之不含生者繇天施否).[34] Hence, Schall von Bell and/or Li Tianjing may eventually have decided to drop the first two chapters mentioned in the "Preface and Contents" and touch on questions of natural philosophy only briefly in the introductory part of the treatise. While in terms of its content the Nanjing KYGZ manuscript copy very much reflects the state of the project up to the summer of 1639, it is certainly not the final version that was submitted to the emperor, but a draft that still needed to be revised, finalized, streamlined, and provided with illustrations. The "Preface and Contents" and its outline of chapter divisions thus may well have been among the parts that required editing and may represent an earlier stage of planning.

3 The KYGZ is not exclusively based on Agricola's DRM

Another issue requiring a different approach to that of Yan Bichen concerns the inclusion of information from other European works than DRM. As far the alignment of the content included in the KYGZ with that to be found in DRM is concerned, he is certainly right in stating that KYGZ chapter 1 finds its parallel in DRM chapters 2 and 3, KYGZ chapter 2 in DRM chapter 7, KYGZ chapter 3 in chapters 5 and 6, and the KYGZ missing chapter 4 in DRM chapters 8, 9, 10, and 11.[35] He also made the keen observation that the KYGZ opted for a different sequence in its descriptions than DRM in order to reflect the natural flow of mining and smelting operations, that is, from prospecting to assaying and then to mining and smelting in the KYGZ as opposed to from prospecting to mining and then assaying and smelting in DRM (Yan 2021, 532).

33 For a discussion and contextualization of this paragraph, see Strob (2024, 104–114, 237–245). In her work, Strob presents not only insight into the state of the field, but also highlights the antecedents to the Jesuits' attempts to replace the Five Phases theory by that of the Aristotelian Four Elements. Such intentions can be already traced back to Matteo Ricci (1552–1610).

34 We are grateful to one of the anonymous referees for pointing out this important argument to us.

35 Pan Jixing, despite not having the Nanjing manuscript copy at his disposal, had already come to a similar conclusion when he stated that KYGZ chapters 1–3 correspond to DRM chapters 1–8 and KYGZ chapter 4 to DRM chapters 9–12. See Pan (1983, 83).

Although Yan acknowledges our discovery of the inclusion of information taken from other European Renaissance assaying literature into the KYGZ,[36] we think that he somewhat underestimates the quantity and quality of these passages when he writes:

> It should be emphasised that the contents that came from other [sources] than DRM chapter 7 were all supplements to the assaying methods, and were absolutely not extraneous branches or new topics (Yan 2021, 530).

Based on our translation work we can confirm that the KYGZ is indeed to a large part based on Agricola's mining classic DRM. This certainly holds true for chapters 1 and 3 (3A and 3B), and—in all probability—also for the missing chapter 4. However, as has been shown in the first article specifically addressing this topic published by Alexander Jost,[37] the picture is substantially different when it comes to chapter 2 (2A and 2B) dealing with assaying. Though this chapter also contains information taken from DRM, substantial parts had their origin in the two following treatises:

Ercker, Lazarus. 1580. *Beschreibung der Allerfürnemisten Mineralischen Ertzt und Bergkwerks arten* [Description of the Most Prominent Types of Mineral Ores and Mines]. Frankfurt: Feyerabend.

Fachs, Modestinus. 1595. *Probierbüchlein. Darinne Gründlicher Bericht vormeldet. wie man alle Metall, und derselben zugehörenden Metallischen Ertzen und Getöchten ein jedes auff seine Eigenschafft und Metall recht Probieren sol* [Assaying Book: Therein Careful Report on How to Correctly Assay All Metals and their Related Ores in Respect to their Qualities and Metal Content]. Leipzig: Zacharias Berwald.

Thus, as will be highlighted in the contribution of Cao Jin to this issue of *Chinese Annals of History of Science and Technology*, the sub-chapter on "strong liquids" in chapter 2B of the Nanjing KYGZ manuscript copy is not based at all on DRM, as was assumed by Yan Bichen (2021, 529), but almost completely on Ercker. Moreover, a few passages in the KYGZ can be traced to two other works, namely:

Biringuccio, Vannoccio. 1540. *De la Pirotechnia libri X* [Ten Books about Fire Technology]. Siena: C. Navò.

de Acosta, José, SJ. 1590. *Historia natural y moral de las Indias* [Natural and Moral History of the Indies]. Sevilla: Juan de León, 1590, i.e., its translation into Latin in Theodorus de Bry. 1602. *Americae Nona et postrema Pars* (Ninth and Last Part about America), Frankfurt: Matthias Becker.

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36 Cf. Yan (2021, 530). He mentions Vogel (2019), but had not yet to hand the article by Alexander Jost published in the same year as his own. See Jost (2021).

37 Cf. Jost (2021). For the origin of the KYGZ's content from different European sources see also, somewhat briefly, Cao (2018, 122).

In addition, it would not come as a surprise if it turned out that some information in the KYGZ came from another work available in China at the time:

> Meyer, Georg. 1595. *Bergwercks Geschöpff, vnd wunderbare Eigenschafft der Metallsfrüchte* [The Creature of a Mine and the Wonderful Qualities of its Metallic Fruits]. Leipzig: Abraham Lamberg & Henning Gross.

Let us give here only two examples of the use of other European works in the composition of the KYGZ. The first is a portion of text from the sub-chapter "Verifications of Ore Tenor" (Zheng kuang pinfu 徵礦貧富) which demonstrates how suddenly paraphrases taken from DRM are continued by content originating from Biringuccio's *Pirotechnia* (see Synopsis 1).

Synopsis 1: Origins of European information in a passage of the sub-chapter "Verifications of Ore Tenor" (Zheng kuang pinfu 徵礦貧富) in KYGZ ch. 1.

…又以礦中石徵之。皇黄金多與石青與砒及緑石等同脉，甚且蔓延于火石及奇巧諸石，與夫易燒化之石。上為長線形、與藤茨無異，故石面多顯嶔欹不平之跡，如鋸齒然。又或童其山，絕無草木，藏金必多。但諸石中，青石為富，黄石必窮。…	... Moreover, [one] uses rock in the ore to indicate it [i. e. gold]. Yellow gold is often in the same veins with azure (*shiqing* 石青), arsenic [sulphides] (*pi* 砒) and "green stone" (*lüshi* 緑石), it even creeps and extends over quartz (*huoshi* 火石, lit. "fire stone") and "strange stone" (*qishi* 奇石) and "ingenious stone" (*qiaoshi* 巧石) and to those stones which are easily consumed by fire. On the top it presents the form of long threads, which show no difference from rattan (*teng* 藤) or grass (*ci* 茨). Therefore, the surface of the rock often shows traces of ruggedness (*qinqi* 嶔欹) and unevenness. like saw teeth. Moreover, if it sometimes makes its mountain bald [so that] it absolutely has no grass and trees, then it is certain to conceal a lot of gold. However, among all the stones, in the case of blue-green stones [a deposit] is rich, while in the case of yellow stones, it definitely is poor. ...	... Quoqcque succi concreti aurum in se continere solent caeruleum, chrysocolla, auripigmentum, sandaraca: quin idem aurum purum uel rude modo multum, modo paucum silicis, lapidis fissilis, marmoris glareae inhaeret: atcque etiam lapidis, qui facile igni liquescit, maxime fecundi generis: qui nonnunquam ita cauernofus eft, ut exesus esse uideatur: vi dico chel si genera in varie spetie di pietre in asprissimi monti, & che di terra darbori, & derbe son al tutto scopti, & di tutte li pietre dital miniera la migliore e vna pietra azurra chiamata Lapis Lazuli hal suo colore quale pietra azurro simile a zaffiro, ma non si transparente ne si dura. [...] Dicano anchora che sene generai vna altra pietra [...] chel suo colore e giallo con alcune machie rosse p dentro. ...	… The solidified juices, azure, chrysocolla, orpiment, and realgar, also frequently contain gold. Likewise native or rudis gold is found sometimes in large, and sometimes in small quantities in quartz, schist, marble, and also in stone which easily melts in fire of the second degree, and which is sometimes so porous that it seems completely decomposed. I say that gold is generated in various kinds of rocks in the most rugged mountains that are completely barren of soil, trees, and grasses. And of all the rocks for such metal the best is a blue stone called lapis lazuli, which has a blue colour similar to the sapphire, but is neither so transparent nor so hard. [...] They also say that it is generated in [...] another rock whose colour is yellow with many red specks in it. ...

Source: KYGZ, manuscript copy of the Nanjing Library, ch. 1, 9a–b.
Notes: Columns from left to right:
- KYGZ-Text
- Our English translation of the KYGZ text
- European sources: Agricola, *De re metallica*, in Latin (yellow) or Biringuccio, *De la Pirotechnia*, in Italian (violet)
- English translations of the European sources: Hoover and Hoover (1912), *Georgius Agricola* for DRM or Smith and Gnudi (1990), *The Pirotechnia* for *De la Pirotechnia*.

The synopsis was made by Dr. Alexander Jost.

The second example demonstrates the use of illustrations from works other than DRM, in this case from Lazarus Ercker's *Beschreibung der allerfürnemsten Mineralischen Erzt und Bergwerksarten*, in the sub-chapter "Methods with Strong Liquids" ("Qiangshui fa" 强水法, i.e., *Scheidewasser* or *aqua fortis*) in KYGZ chapter 2B (see Figure 4). Although the Nanjing KYGZ manuscript copy only contains a very limited number of illustrations and these only in rudimentary form (see Figure 3), the text itself makes numerous references to illustrations that were intended to be included in the work. This is done in the text by the explicit mention of relevant illustrations (*tu* 圖) and detailed descriptions of individual parts of tools and devices to which numbers expressed in the ten Heavenly Stems (*tiangan* 天干) were attributed. This allows us to identify the relevant illustrations with great confidence, either in DRM or in other works.

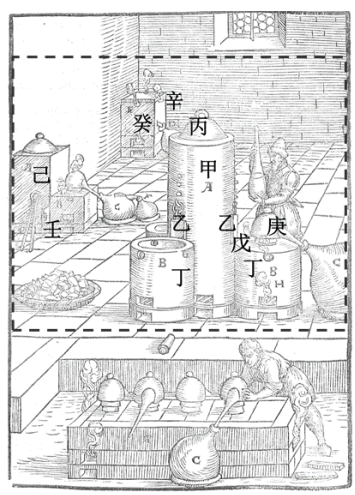


Figure 4: Equipment for the distillation of *aqua fortis* (*Scheidewasser*) in Ercker's *Beschreibung der Allerfürnemisten Mineralischen Ertzt und Bergkwerks arten* (1580), as mentioned in the Nanjing KYGZ mss. (Ercker 1580, 71; Jost, "Beyond Agricola," 78.) The Chinese enumeration was reconstructed on the basis of indications in the KYGZ text. It seems that only the upper part of the picture was to be reproduced in the final KYGZ version.

4 The term "mineral" (*kuangwu* 礦物) was not first introduced to China in the KYGZ

In his article dealing with a first investigation into Schall von Bell's KYGZ Han Fengran came to the conclusion that *kuangwu*—which crops up twice in this work—was used there already in the sense of the Western term "mineral"[38] and thus provides evidence

38 From today's perspective and in simplified terms, a mineral, in contrast to a rock, is a single

of the early introduction of this term to China (Han 2015b, 63). In our view, this is, however, not the case, because *kuangwu* in the KYGZ has the meaning of "ores and materials" and thus is in overall agreement with premodern Chinese mining terminology.

Let us first take a look at the two passages in the Nanjing KYGZ manuscript which contain the expression *kuangwu*, with our punctuations and revisions and accompanied by our translation:

> KYGZ, ch. 2B, "Shi yankuang fa" 試鉛礦法 (Methods for Assaying Lead Ores), 6a:
> 其次，礦之黑而雜石或雜他**礦物**者，取出，先搗碎。質粗不能細，止可作麻子大塊。入瓦罐燒之，...
> Next, [we come to] such [lead] ore which is black and mixed with rock or which is mixed with other **ores and materials**. It is taken out and first pounded into pieces. As its substance is rough, it cannot be [pounded] finely, but can only be made into pieces of the size of hemp seeds. These are put into an earthenware crucible and heated. . . .

> KYGZ, ch. 3B, "Lun chu shui" 論出水 (On Water Drainage), 13a:
> ...因依前援**礦物**之法, ...
> Relying on the method for hauling out **ore and [other] materials** [described] before [in the text], . . .

That *wu* 物 in these two passages is independent and has the general meaning of "materials" or "things," like in the sense of the "Ten Thousand Things or All Things" (*wanwu* 萬物), and is not simply a part of a general binominal word, becomes clear by a number of other phrases in the KYGZ:

> KYGZ, "Xumu" 敘目 (Preface and Contents), 3a:
> ...乃顯于水、于石、于草木**諸物**，...
> . . . and thus appear in water, on rocks, and through grass, trees and **other things**.

> KYGZ, ch. 1, "Fang jin yiji" 倣金異跡 (Strange Traces Pretending Gold), 12a:
> 凡鬆土或石中承脉之**礦**、以之較于人身動植**諸物**之脉、...

---

element or chemical compound, the majority of which is inorganic, generally crystalline, and formed by geological processes. Rock, on the other hand, is a more or less solidified, naturally occurring, usually microscopically heterogeneous mixture of mineral grains, rock fragments, organic or inorganic excretions or residues of living organisms. Ores, on the other hand, are natural rocks or sediments that contain one or more valuable minerals, usually metals, that can be mined, processed and sold for profit. Mineralogy is the science of minerals, i.e., their formation, properties and composition. The beginning of a modern and scientifically based approach to mineralogy is usually attributed to Georgius Agricola. For more details and historical perspectives see Wikipedia, e.g., under the keywords "Mineral," "Gestein," "Erz," and "Mineralogie."

The reason that in general veins that contain ores in loose earth or rock are compared to the veins in **such things** like the human body, animals and plants is because . . .

KYGZ, ch. 2A, "Shi kuangsha fa" 試礦砂法 (Methods for Assaying Ore Gravel), 2a:
...用燒硃、紅土是、或銀鈦、或鉛礦、或生銅、紅銅是、或礬、綠與白、或透明白石**等物**，俱可令之速化。...
Using [the **materials**][39] burned cinnabar—this is red soil—or silver litharge or lead ore or raw copper—this is copper—or alum—green and white—or "transparent white stone" can in all cases have it [i.e., the ore] quickly transformed.

KYGZ, ch. 2A, "Shi kuangsha fa" 試礦砂法 (Methods for Assaying Ore Gravel), 2b:
...以秤**礦**藥**等物**。
. . . by which **things** like **ore** and alchemical substances are weighed.

KYGZ, ch. 3B, "Yun shannei kuangliao daqi" 運山內礦料大器 (Large Devices for Transporting Ore and Materials in the Mountain), 4a:
...若本處無水柴**等物**...
. . . [but] if there are not [the **materials**] water and firewood at that site, . . .

KYGZ, ch. 3B, "Lun cai zhi dangji" 論採之當忌 (On What Should Be Shunned during Mining), 20a:
西諺云：凡美必難得。况五金之美，甲于**諸物**，以其日用所必需也。...
There is a common saying in the West that all beautiful [things] are difficult to obtain, how much more so for the beauty of the Five Metals, which rank first among **[all] the things** because of their necessity for everyday use.

Furthermore, the wider context of the second *kuangwu*-passage, which refers to other mentions of "materials" earlier in the text, provides even stronger evidence that the *kuangwu* of this second passage means "ores and [other] materials," and not "minerals." What we can observe within this context is a reduction of the phrase ***kuang****liao shashi deng* ***wu*** **礦**料沙石等**物** ([the **things**] **ore** material, sand and rock) via ***kuang****tu deng* ***wu*** **礦**土等**物** (**ore**, earth and other **materials**) and *kuang deng wu* **礦**等**物** (**ore** and other **materials**) in sub-chapter 3A to ***kuangwu*** **礦物** (**ore** and [other] **materials**) in sub-chapter 3B:

KYGZ, ch. 3A, "Lun qiju" 論器具 (On Tools), 19a:
論盛**礦料沙石等物**出山之器，...
Speaking of the vessels for holding [the **things**] **ore material (*kuangliao* 礦料), sand and rock** and for bringing them out of the mountain, . . .

39 In documentary Chinese, an expression like "x 等物" would mean "x and other materials," while "xyz 等物" would normally translate as "[the materials] x, y, and z" or simply "x, y, and z."

KYGZ, ch. 3A, "Lun qiju" 論器具 (On Tools), 19b:
此即皆從井上援**礦土等物**之器也。或洞內路不甚遠，取**礦等物**推出愈便，即多用小車及木箱，...
All these are vessels used to pull up **ore, earth and other materials** [while standing] on top of a shaft. If it happens that the way within an adit is not very far and it is more convenient to take the **ore and other materials** and push it out [of the mine], then [miners] mostly use small wheelbarrows or wooden trolley, . . .

KYGZ, ch. 3B, "Lun chu shui" 論出水 (On Water Drainage), 13a:
...因依前援**礦物**之法, ...
Relying on the method for hauling out **ore and [other] materials** [described] before [in the text], . . .

Quod erat demonstrandum.

5 Two new documents that provide information about the fate of the KYGZ

As indicated above, former research on the KYGZ has demonstrated that it was submitted to the throne in two instalments. The first took place on July 31, 1639 (CZ 12/7/2) and was accompanied by a memorial by Li Tianjing, which in the KYGZ is entitled "Li Tianjing, Supervisor of the Revision of the Calendrical Methods and, in addition, Chief Minister of the Court of Imperial Entertainments, submits in lieu [of Schall von Bell] a memorial with amateurish and worthless proposals for enriching the State Treasury (*yu guochu* 裕國儲)." Among other matters, Li Tianjing informed the emperor in this document that the text of the KYGZ at that stage consisted of three chapters, and that the fourth chapter on smelting, which was especially difficult to translate, would be finished later, under the pre-condition that the Son of Heaven permitted the continuation of the project. This the emperor indeed did four days later, on August 4, 1639 (CZ 12/7/6). About one year later, in July 20, 1640 (CZ 13/6/2), the completed manuscript in four chapters was submitted, again accompanied by a memorial by Li Tianjing bearing the title "Li Tianjing, Supervisor of the Revision of the Calendrical Methods, in obeisance to an Imperial Edict submits a memorial about the submission of the continuation of the KYGZ in order to enrich the State Treasury." Its imperial receipt was acknowledged by July 24, 1640 (CZ 13/6/6). Both memorials are quoted in the Nanjing KYGZ manuscript copy,[40] with only slight differences in comparison to the versions contained in the collected writings of Xu Guangqi ([1933] 1962, vol. 4, 85–88).

40 See Table 1.

It is interesting to note that the argument about the potential of this work to "greatly enrich the State Treasury" (*da yu guochu* 大裕國儲) went back to a memorial of Schall von Bell and others written on January 11, 1639 (CZ 11/12/8),[41] in which, as far as we know, for the first time a KYGZ, here however almost certainly referring to DRM, is mentioned. Apart from pointing out this new reference to Schall's endeavours related to the production of the KYGZ, we want to dwell here on two new documents that provide important information about the fate of the book after 1640, the first of 1643/1644, which is also included in the Nanjing KYGZ manuscript copy, the second of 1644, now preserved in the Ming-Qing Archives of the Institute of History and Philology, "Academia Sinica," Taipei. Both will be presented here in Chinese and—for the first time—in complete English translations, accompanied by a short analysis of their contents and importance.

Now let us turn to the first document and its context. For this one has to know that following the submission of the complete four-chapter KYGZ by July 20, 1640 and the confirmation of its receipt by the emperor four days later nothing appears to have been undertaken regarding this matter within the next two and a half years. It was not until the beginning of 1643 that a court discussion about the practical application of the work at last took place, with, it seems however, a negative outcome. This was followed by a second, more intensive, but likewise controversial debate on January 11, 1644 (CZ 16/12/2), leading to an imperial decree on January 18 of the same year (CZ 16/12/9) in which it was stated that mining was going to be allowed under certain pre-conditions and at certain suitable places where the knowledge contained in the KYGZ should be applied:[42]

> ...發下坤輿格致全書，着地方官相酌地形，便宜採取，仍據實奏報。... 湯若望即着赴薊督軍前，傳習採法併火器水利等項。該部傳飭行。
>
> The *Complete Book on Investigations of the Earth's Interior* (*Kunyu gezhi quanshu* 坤輿格致全書) is to be forwarded down [to suitable localities], and local officials [there] are ordered to inspect the [geomantical] forms of the landscape, apply [the KYGZ] accordingly, and report according to the facts [the results of the inspection] in a memorial. . . . Tang Ruowang [Schall von Bell] is immediately ordered to go to the frontier of the army of the Supreme Commander (*zongdu* 總督) of Ji[-Liao] 薊[遼] to transmit and practice the methods of mining as well as those of firearms and hydraulic works. The relevant ministry shall transmit the Imperial Order for execution. (Ni n.d., ch. 10, 12a–b)

41 See *Memorials of the Ming Period* (*Ming tishu* 明題疏), ch. 12, 32b (473). This source is available at http://library.nao.ac.jp/kichou/archive/7012/kmview.html (accessed October 27, 2024).
42 For more details about the court discussions on the KYGZ in 1643 and 1644, cf. Pan Jixing, Vogel, and Theisen-Vogel (1989, 178–189).

The first new document we want to discuss here was written in connection with the controversial discussion in January 1644 about allowing mining in certain suitable regions. It is a transcript of an intra-bureaucratic communication from the eleventh month of the sixteenth year of the Chongzhen reign-period, that is, according to the Western calendar, from the period between December 11, 1643 to January 9, 1644. We are dealing in this communication with a reply from Li Tianjing to the Bureau of Sacrifices of the Ministry of Rites, which had most likely requested him to submit the manuscript of the KYGZ to his superior authority in preparation for the discussion of January 11, 1644. From Li Tianjing's communication we not only learn about the deep-seated reservations about mining, which were quite common at the time,[43] but are surprisingly also informed that the translated manuscript of the KYGZ had been destroyed. This "Communication [of Li Tianjing] answering the Bureau of Sacrifices [of the Ministry of Rites]" (Hui Cisi shouben 回祠司手本) reads as follows:

回祠司手本
督修曆法李， 為欽奉 上傳事。准禮部祠祭清吏手
本稱"奉
上傳'李天經所奏坤輿格致一書，著輔臣傳該部，速為
議覆。欽此。'移取原奏并書冊"等因，到寺。竊炤《坤輿格致》
一書，向因蒿目時艱，未能仰佐司計一籌，乃值修曆遠
臣湯若望，簡有本國携來此書，誠有裨于國計者，遂爾
翻譯，兩次繪圖繕進，以抒仰承
皇上招徠至意。本寺爰有《代獻葑菲》一疏，恭塵
御覽，以聽
聖明採擇耳。然前書譯稿無存，盖恐好事者竊取抄傳，
以滋弊竇。僅有西庠原本，悉属西字，使之重譯，抑又浩
繁未能。合將進書原奏抄白送閱，庶知開採之梗概。為
此合用手本，前去
貴司，煩為據寔呈堂，以憑議覆。倘或鑒其可行，不妨明
白題勅遠臣湯若望盡授其法，仍責成原譯局員等一
一秖領其傳，便可分任其事，則匪類不能私擅妄行，而

43 On these reservations against mining, see details in Pan, Vogel, and Theisen-Vogel (1989), 181–185 and 195–196. In sum, military officials at the time were largely in favor of promoting mining for the purpose of harnessing ancillary fiscal revenues and thus to help defray military costs, while civilian officials mostly showed antipathy towards it. The reasons often put forward against mining were the difficulties of administrative and military control of the mostly remote mining communities, fears of adverse social and ecological effects on agriculture, which was considered the economic base of the empire, the rise of social unrest and economic crises when mining productivity declined, the opportunities presented to officials and their subordinates for personal enrichment and manipulation of tax revenues, as well as the disastrous effects on the geomantic structures of the landscape and the impairment of the geomantic location of burial sites.

善法不為偽傳者淆溷矣。再按，目今四郊多壘、民不聊生之際，遠臣抒忠為國，盡譯開採一書者，以摻括不若生聚為可久長耳。今試于深山窮谷之中，取造物自然之利，不弟濟軍需而裨國計，即飢寒迫身、易于為盜之民，使之傭作以安其生，庶可杜潢池之弄，未始非收拾人心之一機也。

計開　進書疏稿抄白二折。

崇禎十六年十一月日行。[44]

Communication Answering the Bureau of Sacrifices [of the Ministry of Rites].

Li [Tianjing], Supervisor of the Revision of the Calendrical Methods, received—in matters of [the Ministry of Rites] having [respectfully] received an Imperial Summons—a communication by the Bureau of Sacrifices (*ciji qingli [si]* 祠祭清吏[司])[45] of the Ministry of Rites stating that an Imperial Summons was [respectfully received] stating that with regard to this one book, the *Kunyu gezhi*, that had been submitted [three years ago] to the Throne, His Majesty orders the Grand Secretaries (*fuchen* 輔臣)[46] to summon the respective ministries to discuss it quickly and respond [to the Emperor in this matter].[47] [This Imperial Summons] is to be respected and hence [a communication from the Bureau of Sacrifices] was sent [here to me, Li Tianjing,] at the Court [of Imperial Entertainments] (*[guanglu]si* [光祿]寺) ordering [me] to pick out [and transmit to the Bureau of Sacrifices] the original memorials together with the fascicules of the book. I venture to inform you that while having been watching with deep concern the troubles [in our country] and indeed not having been able to assist the Account Keepers (*siji* 司計) in one [single item of the state] budgets,[48] it happened that Tang Ruowang, the subject from afar and Calendar Reviser, had [indeed] selected this one book, the *Kunyu gezhi*, from the books that had been brought along from his country. As it really is of benefit for the State's Budget (*guoji* 國計), [we] had it subsequently translated and had it handed in twice to the Throne together with the illustrations in order to express [our] feelings of utmost [gratitude] for having been graciously welcomed and called upon by His Majesty. [I, Chief Minister of the] Court

44 See KYGZ, manuscript copy of the Nanjing Library, [memorials and communication of Li Tianjing], 5b–7a, with our revisions and punctuation. For other editions of this communication, see KYGZ, 2017 edition, 102–103; Chu and Shi (2020, 415–416).

45 This was one of the four top-echelon bureaus (*qinglisi* 清吏司) in the Ministry of Rites. It was responsible for arranging sacrificial rituals in conjunction with the Court of Imperial Sacrifices (*taichangsi* 太常寺) and was headed by a director (*langzhong* 郎中). See Hucker (1985, 557, no. 7551).

46 See Hucker (1985, 515, no. 6819), stating that during the Ming this term referred to Grand Secretaries (*daxueshi* 大學士).

47 This is related to the meeting of the Grand Secretaries with other high officials, among them certainly also those from the ministries, to discuss the KYGZ and mining matters in CZ 16/12/2 (January 11, 1644). This communication at any rate was part of the preparation for this meeting.

48 This passage abbreviates the wording of Li Tianjing's memorial from July 31, 1639 (CZ 12/7/2).

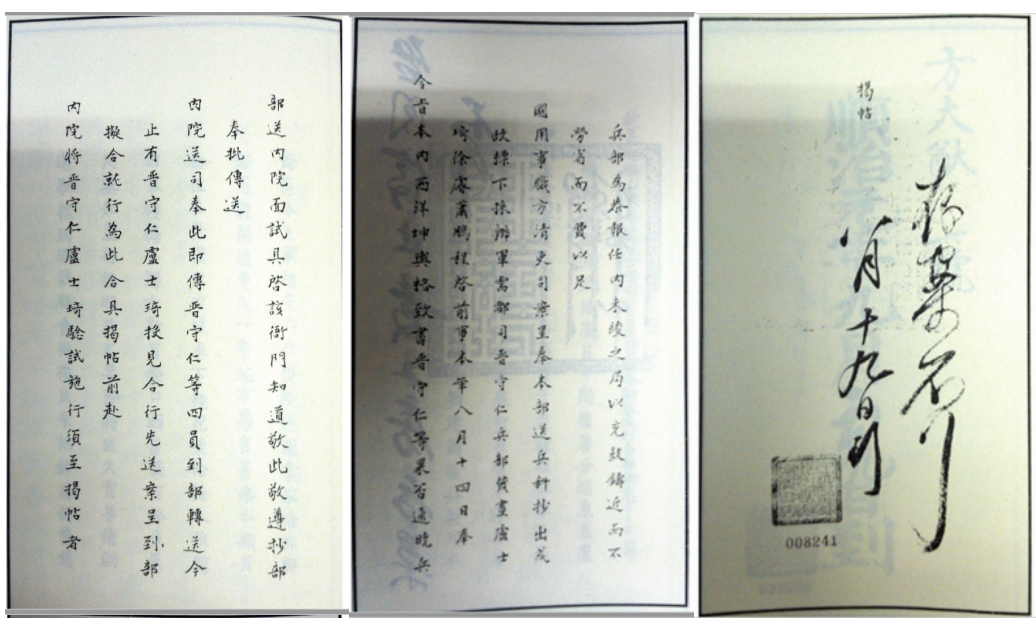
[of Imperial Entertainments] had thereupon submitted in lieu [of Schall von Bell] a memorial with amateurish and worthless proposals[49] by which I respectfully submitted [my suggestions] presented for Imperial Inspection, thus simply awaiting the [Emperor's] Sagely Intelligence to choose and pick [from them]. However, [now] the translation manuscript of the afore[-mentioned] book does not exist [here] anymore. The reason for this is that it was feared that tricksters might clandestinely steal it and have it copied and spread, thus giving rise to fraud and corruption. There is [therefore] only [left] the original version from the Western schools (*xixiang* 西庠) which is completely [written] in Western characters.[50] To have it translated anew would also be vastly complex and [thus] quite impossible. [Hence,] in accordance to [what is due] I have copied and transmitted for [your] reference [only] the [two] original memorials by which the book was submitted in order to provide you with a rough insight into the opening and working of mines. Therefore, in accordance to [what is due] I forward this to your Honourable Bureau [of Sacrifices] by means of a communication and thus trouble you to present this according to the facts to the Hall [i.e., the Ministry of Rites and other higher authorities] so that it [can] serve for the discussion and response [to the Emperor]. In case [the higher authorities] may perceive something that can be carried out, one might as well clearly submit a memorial [requesting the Emperor] to order Tang Ruowang, the subject from afar, that he completely imparts the methods [of the *Kunyu gezhi*] and that the officials of the Calendrical Bureau [that had participated] in the original translation are impressed upon to reverently receive his instructions one by one, thus making it possible to share the responsibilities in this matter. In this way riffraff will not be able to illegally act without authority and to carry out reckless actions, but also the excellent methods [of the KYGZ] will not be messed up by false transmitters. In addition, it might be remarked the fact that in a period with plenty of trouble on all Four Fronts and with people not having anything to live on the subject from afar has displayed his [great] loyalty to [our] country by exhaustively translating this one book on opening and working mines. This being the case, instead of using it as a means to rob [the people], should one not be better [using it] for making [the people's] reproduction and the accumulation [of goods] durable?! If one now tries out [these methods] in deep mountains and barren valleys and thus reaps benefits from [nature's] spontaneity in the creation of things (*zaowu ziran zhi li* 造物自然之利), then this will not only support the needs of the armies (*junxu* 軍需) and benefit the State's Budget (*guoji*), but will also have the effect that destitute and ruined people suffering from cold and hunger and thus prone to turn into bandits are getting employed and thus can secure their livelihood—with the result that the causes of rebellions are blocked up. [Therefore], it is not impossible that this can serve as one [crucial] device for winning the hearts of the people.

49 The wording "《代獻蘁薨》一疏" makes clear that this likewise refers to the first memorial submitted by Li Tianjing.

50 In other words, DRM.

> As enumerated there are [attached]: copies of the two manuscripts of the memorials by which the [two] book [versions] had been submitted.
> Dispatched on the day of the eleventh month of the sixteenth year of the Chongzhen reign-period [i.e., between 11 December 1643 and 9 January 1644].

Although in this document Li Tianjing states that the original translation manuscript had been destroyed, at least one more or less complete copy of it must have still been available somewhere, for otherwise neither the discussion on January 11, 1644 and the related imperial decree written seven days later would make sense, nor would the Nanjing KYGZ fragmentary copy be available to us now. Moreover, that copies of the KYGZ survived even the turmoil of war during the transition from the Ming (1368–1644) to the Qing (1644–1911) dynasty is clear from the second, also previously unknown, KYGZ-related document, which was written at the beginning of the reign of the Manchu Qing dynasty. It confirms the continued existence of the KYGZ text at the very start of the Qing, contrary to former assumptions that the manuscript(s) was lost during this chaotic period of dynastic change. This archival piece (see Figure 5) is again an internal bureaucratic communication, dated September 19, 1644, in which the Ministry of War reports to the Three Palace Academies on planned test trials using the KYGZ.



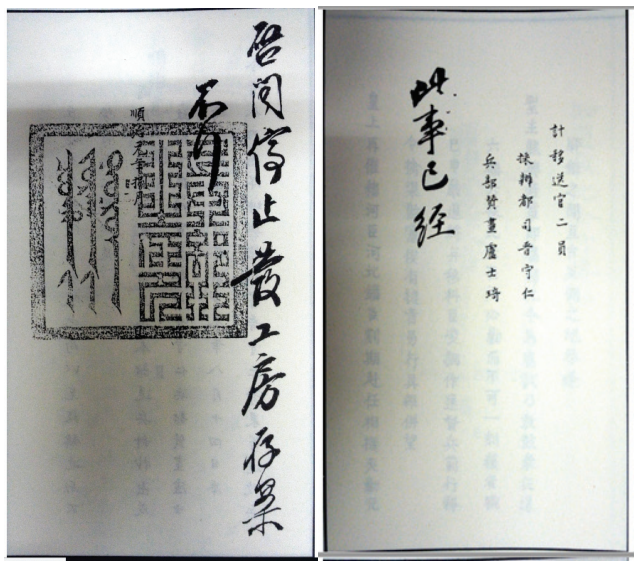


Figure 5: Facsimile of the communication of the Ministry of War to the Three Palace Academies, September 19, 1644. (*Neige daku dang'an* 內閣大庫檔案 [Archives of the Great Storehouse of the Grand Secretariat], 008241-00, or *Ming Qing dang'an* 明清檔案 [Archive of the Ming and Qing], A001-127, Institute of History and Philology of the "Academia Sinica," Taipei, see https://catalog.digitalarchives.tw/item/00/26/6d/d0.html [accessed October 27, 2024]. Courtesy of the Institute of History and Philology, "Academia Sinica").

Like Li Tianjing's communication of 1643/1644, this intra-bureaucratic communication is not easy to understand because of the specific conventions and particular terminology of Chinese documentary language. Therefore, in both the transcription and translation we will use punctuation and graphic means to highlight its syntax and communication structure. Colours have been applied for highlighting the different hierarchical and sequential levels in the process of this bureaucratic communication. Light grey indicates statements of the Ministry of War (*bingbu* 兵部), turquoise those of the Bureau of Operations (*zhifang qinglisi* 職方清吏司), light green the level of the Office of Scrutiny for War (*bingke* 兵科), yellow the matter petitioned by Jin Shouren et al., and red the central government, i.e., a decree by the Prince-regent Dorgon. Finally, notations added later to the document by the then archival registry are marked in rose:

揭帖

存案不行。
八月十九日到。

兵部為恭報任內未竣之局，以充鼓鑄，近而不

勞，省而不費，以足
國用事。職方清吏司案呈奉：本部送：兵科抄出：戎
政標下採辦軍需都司晉守仁、兵部贊畫盧士
琦、徐睿、蕭鵬程啟前事，本年八月十四日奉
令旨：“本內西洋坤輿格致書，晉守仁等果否通曉，兵
部送內院面試，具啟該衙門知道，敬此”，敬遵抄部。
奉批：傳送
內院。送司。奉此，即傳晉守仁等四員到部轉送。今
止有晉守仁、盧士琦投見，合行先送。案呈到部，
擬合就行。為此合具揭帖，前赴
內院，將晉守仁、盧士琦驗試施行。須至揭帖者。

計移送官二員
採辦都司晉守仁
兵部贊畫盧士琦

此事已經啟閱停止。發工房存案不行。

順治元年捌月

[兵部之印, *coohai jurgani doron*]

Our English translation using the same colours as the transcription reads as follows:

Communication (*jietie* 揭帖)[51] [from the Ministry of War to the Three Palace Academies]

To be kept in the files and not to be acted upon.
Arrived on the 19th day of the 8th month [of the first year of the Shunzhi reign-period, i.e., 19 September 1644].

The Ministry of War (*bingbu* 兵部) respectfully reports [to the Three Palace Academies] on a yet unsettled affair (*weijun zhi ju* 未竣之局) within the scope of its office in order to satisfy [the demand of] minting, [and on relevant measures] that are convenient and not troublesome as well as saving and not wasting in order to [supply] enough [funds] for national expenditures (*guoyong* 國用). [This concerns the following matter:]

The Bureau of Operations (*zhifang qinglisi* 職方清吏司)[52] has submitted a report (*ancheng* 案呈) stating that it has received [a message from the Ministry of War].

51 *Jietie* 揭帖, also written as 揭貼, is a designation for different types of documents during the Ming and Qing periods. Here it refers to a document of internal bureaucratic communication from a lower to a higher echelon.

52 *Zhifang qinglisi* 職方清吏司: Bureau of Operations, one of four top-echelon bureaus in the Ministry of War (*bingbu* 兵部), with functions comparable to those of the earlier *zhifang* 職方; headed by a Director (*langzhong* 郎中), rank 5a, in the Ming, by 4 Manchu and 2 Chinese Directors, rank variable, in the Qing. See Hucker (1985, 158, no. 979). A former *zhifang* was responsible for the maintenance of military maps, the manning of frontier fortifications and signal systems, etc. See Hucker (1985, 157–158, no. 978).

[This message] sent from the Ministry of War [to the Bureau of Operations] stated the following:

The Office of Scrutiny for War (*bingke* 兵科)[53] had [some time ago] sent [to the Ministry of War] a document copy referring to [the following affair]:

In the matter of what had been petitioned before by Jin Shouren 晉守仁, a Brigade Vice Commander [responsible] for Procuring Military Supplies (*caiban junxu dusi* 採辦軍需都司)[54] under the command of the Military Headquarters (*rongzheng* 戎政),[55] and the three Aiding Advisors (*zanhua* 贊畫)[56] in the Ministry of War, i.e., Lu Shiqi 盧士琦, Xu Rui 徐睿 and Xiao Pengcheng 蕭鵬程, [and what probably first had been transmitted by the Bureau of Operations to the Ministry of War and from there to the throne via the Office of Scrutiny for War], a decree (*lingzhi* 令旨) [from the Prince Regent, i.e., Dorgon 多爾袞] was received on the 14th day of the 8th month of this year [14 September 1644], which stated the following:

"As to the question whether Jin Shouren and the other [three officials] really thoroughly understand the book *Kunyu gezhi* from the Western Ocean mentioned in the report, the Ministry of War should send [these four men] to the [Three] Palace Academies (*neiyuan* 內院)[57] for a personal test. [The Office of Scrutiny for War] should submit this [decree] to the said yamen (*yamen* 衙門) [i.e., the Ministry of War] and thus let it know [this]. Respect this!"

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53 *Bingke* 兵科: Office of Scrutiny for War, one of the Six Offices of Scrutiny (*liuke* 六科). Cf. Hucker (1985, 383, no. 4676). *Liuke* is a cluster of major central government agencies staffed with Supervising Secretaries or Supervising Censors (both *jishizhong* 給事中) who were responsible for maintaining censorial surveillance over the Six Ministries (*liubu* 六部), especially for monitoring the flow of documents between the throne and the ministries; generally independent agencies until 1723, then made constituent units in the Censorate (*duchayuan* 都察院), after which Supervising Censor seems a more appropriate rendering than Supervising Secretary. Named after the Ministries for which they were separately responsible. See Hucker (1985, 317, no. 3793).

54 *Dusi* 都司: According to Hucker (1985, 542, no. 7285), *dusi* during the Ming period refers to *du zhihui shi* 都指揮使 or a Regional Military Commissioner, while during the Qing to a Brigade Vice Commander.

55 *Rongzheng* 戎政: According to Hucker (1985, 274, no. 3087), *rongzhengting* 戎政廳 or *rongzhengfu* 戎政府 is the Military Headquarters for the Capital Training Divisions (*jingying* 京營) at Beijing; established in 1550 as a coordinating agency for the several Training Divisions; headed by a Superintendent (*tidu* 提督) or a Supreme Commander (*zongdu* 總督).

56 Hucker, *Dictionary*, does not list this title. It appears often in the Chongzhen and early Shunzhi reign-periods as *junqian zanhua* 軍前贊畫 etc. These were civil officials, not military personnel in the true sense of the word.

57 See Hucker (1985, 349, no. 4229). *Nei[san]yuan* 內三院 is the Three Palace Academies, a collective reference to the Palace Historiographic Academy (*nei guoshiyuan* 內國史院), the Palace Secretariat Academy (*nei mishuyuan* 內秘書院), and the Palace Academy for the Advancement of Literature (*nei hongwenyuan* 內弘文院), each headed by a Grand Academician (*daxueshi* 大學士). From 1635 to 1658 the Three Palace Academies, which generally provided counsel and editorial assistance to the Emperor, were in the top echelon of the early Qing central government, along the with Six Ministries and the Censorate (*duchayuan* 都察院); but in 1658 they were reorganized into the Grand Secretariat (*neige* 內閣) and the Hanlin Academy (*hanlinyuan* 翰林院) according to the Ming pattern.

In respectful obeisance [to this decree] this [decree] was copied [by the Office of Scrutiny for War and sent] to the Ministry of War.

Upon receipt [of this decree copy ordering] to send [these four men] to the [Three] Palace Academies, [the Ministry of War] had [this order] transmitted to [the Bureau of Operations].

[Upon receiving this order from the Ministry of War, the Bureau of Operations has submitted the following report:] After having received this, [we] immediately had [this order] transmitted to Jin Shouren and the other three officials to go to the Ministry [of War] for being redirected from there [to the Three Palace Academies for this personal testing]. Presently, however, only Jin Shouren and Lu Shiqi have shown up so that—in compliance with the action to be taken—they should be sent ahead [of the other two still missing officials to the Three Palace Academies].

After this report [from the Bureau of Operations] was received at [our] Ministry [of War], we in compliance to duty acted immediately. Therefore, we—in accordance to what is due—dressed up this communication (*jietie*) and forward it [together with the now here present Jin Shouren and Lu Shiqi] to the [Three] Palace Academies so that there the experimental testing of Jin Shouren and Lu Shiqi [according to the methods proposed in the *Kunyu gezhi*] be carried out. This is why this communication [to the Three Palace Academies] is written.

Altogether two officials are transferred [by this communication to the Three Palace Academies, namely]:

Brigade Vice Commander [responsible] for Procuring [Military Supplies]: Jin Shouren
Aiding Advisor in the Ministry of War: Lu Shiqi

This matter has already been reported and examined, and was [afterwards] stopped. [Document] to be forwarded to the Secretarial Section (gongfang 工房)[58] *and to be kept in the files, and not to be acted upon.*

The eighth month of the first year of the Shunzhi [reign-period]

[Seal of the] Ministry of War

Let us now elucidate and analyse the chronology of events as they can be reconstructed from the message of the Ministry of War to the Three Palace Academies of September 19, 1644. This document presents us with a snapshot providing insight into the bureaucratic communication and discussion process related to the KYGZ and the further fate of this work at the very beginning of the Qing dynasty. In order to enhance understanding of the documentary flow, the reader may at the same time also consult Diagram 1:

58 According to Hucker (1985, 292, no. 3417), *gongfang* 工房 can be a variant or unofficial reference to the Ministry of Works (*gongbu* 工部). Here, however, a secretarial section handling documents within the Grand Secretariat may have been meant.

1. One military officer, Jin Shouren 晉守仁, and three civil officials of the Ministry of War (*bingbu*), Lu Shiqi 盧士琦, Xu Rui 徐睿, and Xiao Pengcheng 蕭鵬程,[59] had reported on their knowledge of the KYGZ to the Ministry of War. They had done this probably via the Bureau of Operations (*zhifang qinglisi*), a subordinate agency of the Ministry of War.
2. The Ministry of War, probably via its Office of Scrutiny for War (*bingke*), had forwarded the report of Jin Shouren et al. to the central government.
3. The central government, in the person of the Prince-regent Dorgon, issued a decree (*lingzhi*) in reply to this matter, stating that Jin Shouren and the three officials should be sent to the Three Palace Academies (*nei[san]yuan*) for personal trial testing regarding their knowledge of the methods contained in the KYGZ. It ordered the Office of Scrutiny for War to inform the Ministry of War about the decree.
4. The Office of Scrutiny for War thereupon made a copy of the regent's decree and sent it to the Ministry of War.
5. After the reception of the decree copy the Ministry of War sent an order to its Bureau of Operations to dispatch Jin Shouren and the three officials to the Ministry of War to be redirected from there to the Three Palace Academies.
6. In compliance with the order, the Bureau of Operations submitted a report to the Ministry of War and stated that only two of the four men, namely Jin Shouren and Lu Shiqi, had shown up and that these two would be sent ahead of the still two missing officials (Xu Rui and Xiao Pengcheng) to the Ministry of War to be transferred from there to the Three Palace Academies.
7. After the arrival of Jin and Lu at the Ministry of War, this agency sends these two men together with the communication (*jietie*) to the Three Palace Academies for the trial testing to be carried out according to the KYGZ methods.
8. The remarks added later to the document by a secretarial department strongly suggest that this matter was subsequently aborted, discontinued, and relevant documents were to be archived at a later moment in time.

In the light of the information presented above, it becomes clear that some copy of the KYGZ must have survived the upheavals of the Ming-Qing transition. Thus, it is not improbable that besides the Nanjing manuscript copy another, perhaps more complete and more final, version of the KYGZ may be discovered one day. Moreover, contrary to the conclusions of some former research,[60] it can almost certainly be ruled out that the KYGZ was ever printed. The likelihood of this now seems highly improbable given Li Tianjing's 1643/1644 remark about the destruction of the original translation manuscript.

59 So far, no biographical information is available on these men.
60 See, for example, Pan, Vogel, and Theisen-Vogel (1989, 185–186, 188, 190).

6 Jesuits, eunuchs, and the Military Headquarters for the Capital Training Divisions

In this and the following section we will provide some supplementary information on attempts to bring to fruition the information contained in the KYGZ as well as on the socio-bureaucratic and military environment within which this implementation was intended to take place in the final months of the Ming dynasty and the first months of Qing rule. To begin with, it is worth noting that Jin Shouren 晉守仁, the primary proponent reporting on September 19, 1644 about the book KYGZ, was under the command of the Military Headquarters (*rongzheng* 戎政). According to Hucker, the *rongzhengting* 戎政廳 or *rongzhengfu* 戎政府 was the Military Headquarters for the Capital Training Divisions (*jingying* 京營) at Beijing. It had been established in 1550 as a coordinating agency for these divisions and was headed by a Superintendent (*tidu* 提督) or a Supreme Commander (*zongdu* 總督).[61] During the Chongzhen reign-period (1628–1644), the management of it was jointly controlled by hereditary military commanders, eunuchs and civil officials (Cao 2023, 40).

A significant collaboration between the *rongzheng* and the Jesuits took place during a critical moment in the ninth year of the Chongzhen reign-period (1636) when the Manchu army was approaching Beijing. A memorial was filed by the Military Headquarters and the Censorate (*duchayuan* 都察院) suggesting that Giacomo Rho (Chinese name Luo Yagu 羅雅谷, 1593–1638) and Adam Schall von Bell should take charge of the so-called "miraculous weapons" (*shenqi* 神器), meaning European-style firearms.[62] After the desperate Chongzhen emperor gave his permission, Rho and Schall went up to the city walls every day to instruct the Chinese soldiers in the methods of operating canons, making gunpowder as well as improving the fortifications.[63] This effort proved effective, and the Qing army temporarily retreated. The Jesuits should as a result have been rewarded with land and property, but this in the end did not come to pass.[64]

Six years later, in the fifteenth year of the Chongzhen reign-period (1642), when the Ming dynasty was on the verge of collapse, another instance of cooperation took place as Schall was ordered again to cast canons. This time, he worked together with Chen Xinjia 陳新甲 (?–1642), the Minister of War, and Wu Weiying 吳惟英 (1605–1644), "Marquis of Respect and Obedience" (*gongshunhou* 恭順侯), Supreme Commander of

61 Hucker (1985, 274, no. 3087).

62 See the memorial by Rho and Schall von Bell of CZ 10/8/1 (August 18, 1637), "修政曆法遠臣羅雅谷湯若望等謹奏為聖明柔遠過渥微臣圖報未遑謹預辭欽允田房以表忠盡事" in Xu et al. (n.d.b, *Zoushu*, book 4, volume 11, 9a–12b).

63 See the memorial by Schall von Bell of CZ 11/12/8 (January 11, 1639), "湯若望敬獻微塵疏" in *Ming tishu* (ch. 12, 31a–33a, 471–473).

64 Cf. Bernard (1942, 35).

the Military Headquarters. Within a few months, Schall had overseen the production of 20 cannons that used 40-pound cannonballs, followed by the casting of 500 smaller cannons that weighed only 60 pounds.[65]

As for the eunuchs, the Jesuits had had dealings with them for a long time, involving both fruitful cooperation but also much discontent.[66] Numerous accounts of Schall's contact with eunuchs exist, especially during the making of instruments such as telescopes and the casting cannons, in which the eunuchs observed and sometimes participated (Väth 1991, 105, 113). In the late Ming dynasty, especially during the Chongzhen reign-period, the eunuchs' control over the army and various government departments grew (Zhou 1992). The Chongzhen emperor appointed them to monitor the various armies not only in the capital, but also in the provinces. Towards the end of his reign, in particular, vital positions in the border regions and the capital were supervised by his trusted eunuchs (Leng 1994).

In addition to military service, eunuchs were also heavily involved in the businesses of mining and metallurgy (Tsai 1996, 177–182; Tang 2009). During the casting of cannons, their excessive desire for metal astonished Schall von Bell. According to his own estimate, 50,000 pounds of copper and 5,000 pounds of tin would have been sufficient, but the eunuchs demanded 500,000 pounds of copper and 400,000 pounds of tin using Schall's name. The emperor granted everything. Although he later learned of this deception through Schall, he did not punish the eunuchs as he had to deal with immediate threat of the Manchus who were *ante portas* (Bernard 1942, 88–89). In the final years of the Chongzhen reign-period, the monetary system was in disarray, the government was in urgent need of financial resources, and large amounts of silver and other metals for coinage were required. Eunuchs, such as Wang Dehua 王德化, played an important role in a series of activities to promote monetary reform, including mining, minting and paper currency printing (Von Glahn 1999, 197–206; Zhang 2020). The eunuchs' enthusiasm for coin casting and their greed for metal strongly suggests that they must have had a great interest in the KYGZ and its methods.

This was the context in which the KYGZ book received renewed attention, and the official document "Communication [of Li Tianjing] answering to the Bureau of Sacrifices [of the Ministry of Rites]" (Hui Cisi shouben 回祠司手本) was produced. Not long after, the emperor ordered in an imperial decree that "the *Complete Book on Investigations of the Earth's Interior* (*Kunyu gezhi quanshu* 坤輿格致全書) be handed down [to suitable localities]"(Ni n.d., ch. 10, 12a–b).[67] It is therefore very likely that a search for a copy of the KYGZ was undertaken and that—once it was found—it was re-copied and circulated among officials and especially eunuchs in the capital. This was probably also the source of the copy of the KYGZ subsequently submitted by Jin Shouren.

65 See Väth (1991, 111–113). For doubts about the size of the cannons, see Huang (2022, 379).
66 See Laven (2012), which focuses on Matteo Ricci's interactions with eunuchs.
67 "發下坤輿格致全書。"

7 Schall's two journeys with the KYGZ before the fall of the Ming dynasty

As has been mentioned above, on January 18, 1644 (CZ 16/12/9) the emperor issued an imperial decree stipulating that mining was to be allowed under certain pre-conditions, at certain suitable places and that in these mining areas the methods described in the KYGZ should be applied. In the same imperial order, Schall von Bell was told "to go to the frontier of the army of the Supreme Commander (*zongdu* 總督) of Ji[-Liao] 薊[遼] to transmit and practice the methods of mining as well as those of firearms and hydraulic works" (Ni n.d., ch. 10, 12a–b).[68] In the final few months before the fall of the Ming dynasty, Schall von Bell indeed undertook two journeys which theoretically could have offered opportunities to put the KYGZ's methods into practice and to spread relevant knowledge of mining and metallurgy.

Which military region was precisely meant by "the frontier of the army of the Supreme Commander (*zongdu* 總督) of Ji[-Liao] 薊[遼]" (*Jidu junqian* 薊督軍前) in the imperial decree? The full title of the *Jidu* 薊督 was *zongdu Ji Liao Baoding dengchu junchu jianli liangxiang* 總督薊遼保定等處軍務兼理糧餉, which can be translated as "Supreme Commander of military affairs and rations of Jizhou 薊州, Liaodong 遼東 and Baoding 保定," stationed at Miyun 密雲,[69] about 70 kilometers northeast of the Forbidden City. However, due to wartime conditions, Wang Yongji 王永吉 (1600–1659), the Supreme Commander at the time, was constantly moving with his troops to other places in the area, for example, to Shanhaiguan 山海關 or Yongping 永平 (Tan 1647, ch. 79).[70] Thus, it is not certain exactly where the so-called "military front" (*qianjun* 軍前) was that Adam Schall von Bell visited. Whatever, it should have not been too far from Beijing, as Schall's own records state: "In the neighboring area, a viceroy had the task of stopping the Tartar irruptions. As the reputation of bronze cannons had reached him, he asked the emperor to send me to render him some service in this art too. I went. But, misfortune of this man! He imagined that these devices could be made with nothing. So, in disgust, I returned immediately without having done anything."[71] Clearly, this journey with its important military, hydraulic, and

68 "湯若望即着赴薊督軍前，傳習採法併火器水利等項。"

69 Cf. Zhang et al. (1739), ch. 73, "Zhiguan" 职官 (State Offices) 2, edition *Wuyingdian* 武英殿, in *Liufu wencang* 六府文藏, *Diaolong* database, CrossAsia Project, Staatsbibliothek Berlin.

70 "乙丑，聞建虜屯山海關外，總督王永吉趨山海、永平，發内帑金八萬，户部金十萬資餉。"

71 See Bernard (1942, 102). The pathetic "viceroy" described by Schall, i.e., Wang Yongji, in whom the Chongzhen emperor and many others placed such high hopes, went south after the collapse of the Ming dynasty and continued to serve the Southern Ming regime. He eventually surrendered to the Qing and continued to enjoy a successful career in the new dynasty, rising to the rank of Minister of Personnel. Cf. Zhao (1928, ch. 238, "Liezhuan" 列傳 [Collected Biographies)] 25, 8a–b).

mining missions turned out to be a complete failure, much to Schall von Bell's disappointment. It is worth noting that in his records he makes no mention at all of the fact that the primary task of this journey was to transmit mining methods.

Meanwhile, opposition to mining was growing in the imperial court, but the emperor remained determined (Wang et al. [after 1644] 2005, vol. 7, 237).[72] A month later, Schall von Bell was sent on a second journey with the KYGZ, this time to Shanxi together with the Ming army. At this time, Li Zicheng's 李自成 (1606–1645) rebel army had already crossed the Yellow River and was approaching Taiyuan, the seat of the Prince of Jin 晉王 Zhu Shenxuan 朱審烜. Li Jiantai 李建泰 (?–1649), the Grand Academician (*daxueshi* 大學士), volunteered to go to fight against the bandits and proposed that Schall accompany him, certainly in order to make use of his knowledge of firearms. Shortly before this, the Prince of Jin had also asked the emperor to order Schall to go to Shanxi to provide instruction in the matters of "firearms, opening up wasteland, hydraulics, as well as mining" (Fu [1695] 1993, book 21, vol. 166, 20a–21a).[73] The army was seen off by the emperor himself and set out on March 4, 1644 (CZ 17/1/26) with great ceremony (Zhang et al. 1739, ch. 253, "Liezhuan" 列傳 [Collected Biographies], 141). However, the army, including Schall, had just reached Zhending 真定 (around 270 km southwest of Beijing) when the rebels crossed the Juyong Pass 居庸關 of the Great Wall and approached the capital. Schall must have returned to Beijing shortly before the city was captured by Li Zicheng on April 25 (CZ 17/3/19), because he reports on the days leading up to the fall of the capital.

Schall's trip to Shanxi failed to accomplish its aims, but the topic of mining in Shanxi resurfaced soon after the establishment of the new dynasty. On June 26, 1644 (Shunzhi [hereafter "SZ"] 1/5/22), Wu Weihua 吳惟華, the younger brother of the previously mentioned Supreme Commander of the Capital Training Divisions Wu Weiying 吳惟英, who had cooperated with Schall before, surrendered to the new dynasty as soon as the Qing army occupied Peking and soon volunteered to go to Shanxi to carry out the work of pacification.[74] On September 12 (SZ 1/8/12), Wu Weihua submitted a memorial from Shanxi claiming that there was a silver mine in Wutaishan 五臺山 and requesting that the government undertake mining there.[75] On almost the same day, Jin Shouren presented the copy of KYGZ to the Ministry of War.[76]

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72 "兵科給事中吳甘來疏諫開礦。不聽。"

73 "十七年正月，賊渡河急，特遣大學士李建泰出山西勦撫，題薦若望，而晉王審烜亦疏請命若望前往山西指授火攻及屯田水利開採諸事。"

74 *Da Qing Shizu Zhang huangdi shilu* 1739, ch. 5, 6a, SZ 1/5/*jiyou* (June 26, 1644). See also *Neige daku dang'an* 006853: "恭順候為招撫晉地事。"

75 See *Neige daku dang'an*, 185048-015, Shunzhi 1/8/12 (September 12, 1644): "恭順侯題為請開山礦事。" This document is incorrectly registered under the date Shunzhi 6/8/12 in the database.

76 The *jietie* which we have translated above states that the decree from Dorgon was received on September 14, 1644, which suggests that Jin Shouren presented the book shortly before that date.

The almost simultaneous occurrence of Wu Weihua's mining proposal and Jin Shouren's presentation of a monograph on mining and metallurgy should not be considered entirely coincidental, but rather a reflection of the new dynasty's urgent need for metals during this period and the existence of earlier ties between the protagonists involved (Liu 2023).

8 Why did the KYGZ have no impact and why did it disappear?

Given the events at the end of the Ming dynasty, it is obvious that opportunities for the implementation of mining, assaying, and smelting methods based on the KYGZ were practically nil. Regardless of the precarious circumstances surrounding the preservation of the text of the KYGZ as described in the communication of Li Tianjing dated CZ 16/11 (December 11, 1643 to January 9, 1644), in the same month in which the emperor had ordered it to be sent to the provinces (CZ 16/12/9; January 18, 1644), the armies of the rebel Li Zicheng invaded Shanxi Province, going on to occupy Beijing in CZ 17/3/19 (April 25, 1644). The last emperor of the Ming dynasty hanged himself on Coal Hill behind the Forbidden City, and many high government dignitaries perished—some also through suicide—during that period. In May 1644, the Ming general Wu Sangui 吳三桂 (1612–1678) allied with the Manchus and advanced on Beijing, which was captured from the rebels on June 5, 1644. Thus, the plan to send the KYGZ to at least some areas for the purpose of testing the methods described in it could no longer effectively come to fruition due to these political and military upheavals.

Although the communication from the beginning of the Qing dynasty dated SZ 1/8/19 (September 19, 1644) makes clear that the KYGZ still existed at that time and that there was some interest in implementing it, the notes added to this document strongly suggest that the Manchu government eventually put the matter of the KYGZ to rest. During the first two decades of their reign the Manchu rulers were predominantly engaged in consolidating their rule, and as a result mining was not yet regarded as a political or economic matter of high priority.[77] On the contrary, because mining was perceived as having the potential to threaten social stability and provoke political unrest, it was tolerated to only a very limited degree. The few references to this industry during the Shunzhi reign-period (1644–1662) in Qing historiography are explicit enough to demonstrate some marked characteristics of early Qing mining policy. According to these references, the Manchus were well aware of the disastrous mining policy that had been adopted by the late Ming rulers, who had entrusted eunuchs with the direct supervision of, and tax collection at, the mines. This had led to widespread extortion by the eunuchs and finally resulted in miners' demonstrations

77 These remarks on the early Qing mining policy are based on Vogel (1983, ch. IV.2.b).

and uprisings. This was the reason why the Manchu emperor did not permit mining in the following case of 1652:

> 工部奏言，直隸保安人王之藩，忽倡開礦之議。查故明萬歷時，差官開礦，徒虧工本，無裨國計，而差官乘機射利，偏肆索詐，掘人塚墓，毀人田廬，不勝其擾。前事甚明，應嚴行禁止。……上是之。
>
> The Ministry of Works reported in a palace memorial that Wang Zhifan 王之藩 of Bao'an 保安, Zhili Province, ignorantly espoused a proposal for opening mines. [The ministry] stated after investigation that during the Wanli reign-period [1573–1620] of the [already] fallen Ming officials were dispatched to open mines. This resulted only in wastage of production costs (*gongben* 工本) and was of no benefit to the state's economy (*wu bi guoji* 無裨國計). The officials sent on that business made use of the opportunity to profiteer and to extort and cheat recklessly. Graves were dug up and houses and agricultural land destroyed, so that the disturbances were unbearable. As these antecedents are clear, it should be strictly prohibited. The Emperor agreed to this. (*Da Qing Shizu Zhang huangdi shilu* 1739, ch. 7, 6b, SZ 9/12/*xinyou* [January 22, 1653])

Without exception, the opening or closing of mines required the approval of the emperor. Thus, when in 1647 Zhang Shang 張尚, Governor of Gansu, memorialized that he had reopened the mines at Shanggu Castle 上古城堡 in Liang Department 凉州, the emperor reprimanded him for not having asked him for prior permission in this important matter (*zhongwu* 重務). Though these were only small mines that had been closed during the uprisings at the end of the Ming period, the emperor criticised Zhang for his unauthorized move and demanded the Ministry of Personnel to deliberate on his punishment. Eventually Zhang was demoted by one rank and transferred to another post.[78]

The extent to which mining was considered unconducive to the well-being of state and society and thus as a basically harmful and undesirable activity during the late Ming and early Qing dynasties cannot only be seen from Li Tianjing's defensive stance in his communication from 1643/1644 translated above, but also from the ensuing controversial discussion at court at the beginning of January 1644.[79] That this negative attitude towards mining was a well-known fact can be gleaned from a note by Yan Xun 嚴勳 (1845?–1914) added to the KYGZ manuscript copy in 1879 (see Figure 6), which reads as follows in our English translation:

> 己卯，客三山，訪主人於蜦海廔，示此以證西法。惜其圖已佚，擬覓西字本為譯補之。書中金銀銅鉛錫諸字，率以槿引銃奄心等字代之。盖　　國初開採之禁嚴，此書世不敢傳抄，藏者特易字以讳其迹也。
>
> [In the year with the cyclical signs] *jimao* [1879] I travelled to the Three Mountains

78 *Da Qing Shizu Zhang huangdi shilu*, ch. 32, 1a–b, SZ 4/5/*guimao* (June 5, 1647) and ch. 33, 31a, SZ 4/8/*xinsi* (September 11, 1647).

79 For details, see Pan, Vogel, and Theisen-Vogel (1989, 178–189).

(Sanshan 三山 [i.e., Fuzhou in Fujian])[80] where I visited the [Baiqing] Master[81] in [his] Serpent Sea Chamber (Lunhailou 蝀海廔). He showed it [i.e., the KYGZ] to me, and it [indeed] bears witness of Western methods. Because, regrettably, its illustrations were already lost, [he] intended to search for the [original] version [written] in Western characters for complementing the [Chinese] translation. In the book all the characters for gold (*jin* 金), silver (*yin* 銀), copper (*tong* 銅), *plumbum* (*qian*, *yan* 鉛), and tin (*xi* 錫) had been replaced by *jin* 僅, *yin* 引, *chong* 銃, *yan* 奄, and *xin* 心, respectively. The reason for this is because at the beginning of Our State [i.e., the Qing dynasty] the prohibition of opening and working mines was strict, so that for generations nobody dared to transmit this book. Whoever had copied and stored it changed [these] characters on purpose in order to conceal any traces.[82]

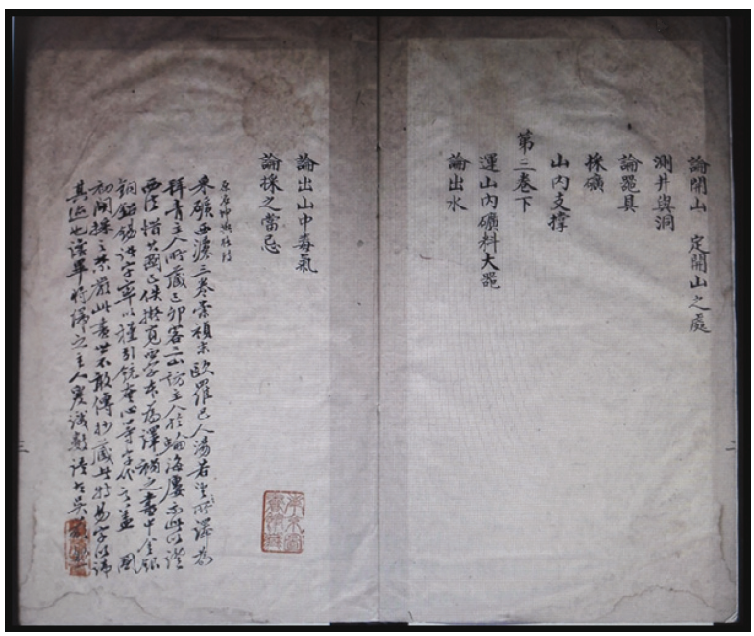

Figure 6: Nanjing *Kunyu gezhi* [1639]: End of the table of contents, with seals as well as with the note added by Yan Xun in 1879. (KYGZ, manuscript copy of the Nanjing Library, [table of contents, Note of Yan Xun of 1879], 2b–3a. Photo by Cao Jin, June 2015, courtesy of Nanjing Library.)

80 Three Mountains are part of Fuzhou's 福州 city landscape, that is, Minshan 閩山 in the west, Jiuxianshan 九仙山 in the east, and Yuewangshan 越王山 in the north. Hence, Three Mountains is another name for Fuzhou.

81 Baiqing Master 拜青主人 was the sobriquet of Lin Huishu 林泂淑, who was a *juren* of 1875 and a grandson of the famous Opium Commissioner Lin Zexu 林則徐 (1785–1850). His mansion and thus library was called Dragon Sea Chamber (Lunhailou 蝀海樓). It was destroyed by marauding troops in the wake of the Battle of Fuzhou (23 August 1884) during the Sino-French War (1883–1885).

82 See KYGZ, manuscript copy of the Nanjing Library, [table of contents], 3a.

9 Final remarks

The discovery of the KYGZ manuscript copy held in the Nanjing Library provides an excellent opportunity for a micro-historical and philological case study on this text and the circumstances related to its compilation. In comparison with other Chinese treatises written by the China Mission's Jesuits and their Chinese collaborators we not only know a good deal about which European books served as sources of information for the compilation of this text, but also about the historical events surrounding its composition. Now that the KYGZ is at our disposal—though incomplete and in manuscript copy only—as well as the availability of digitized collections of source material, new avenues and approaches have been opened up for a reconsideration of previous research results. The aim of this presentation of our recent forays into the KYGZ and its history is to show the potential of this and similar investigations. We concentrated here on demonstrating that the Nanjing manuscript copy is not a complete textual version of the KYGZ, but rather represents the first translation phase of 1639 or even a somewhat earlier stage, that besides Agricola's DRM information from other Renaissance mining and metallurgical classics was used, and that the Western term "mineral" (*kuangwu*) was not introduced to China by this treatise by Schall von Bell and his collaborators. Moreover, we presented and translated two new Chinese bureaucratic communications that inform us about the fate of the KYGZ in the years 1643/1644 and, among other things, prove that although the KYGZ survived into the beginning of the Qing dynasty, it is highly improbable that it was ever printed. Finally, we highlighted some of the military, political, and social circumstances that prevented the methods described in the KYGZ being implemented to any substantial degree and thus having an impact on China's mining and smelting industry of that period. Alongside the largely source and text critical approach presented here, our future research will further analyse the contents of this Chinese mining and metallurgical treatise, focus more deeply on the events related to its compilation, and embed it more substantially into its narrower and broader contexts. Last, but not least, we will also publish a complete edition and translation of the Nanjing KYGZ manuscript copy according to critical philological standards and accompanied by explanatory annotations.

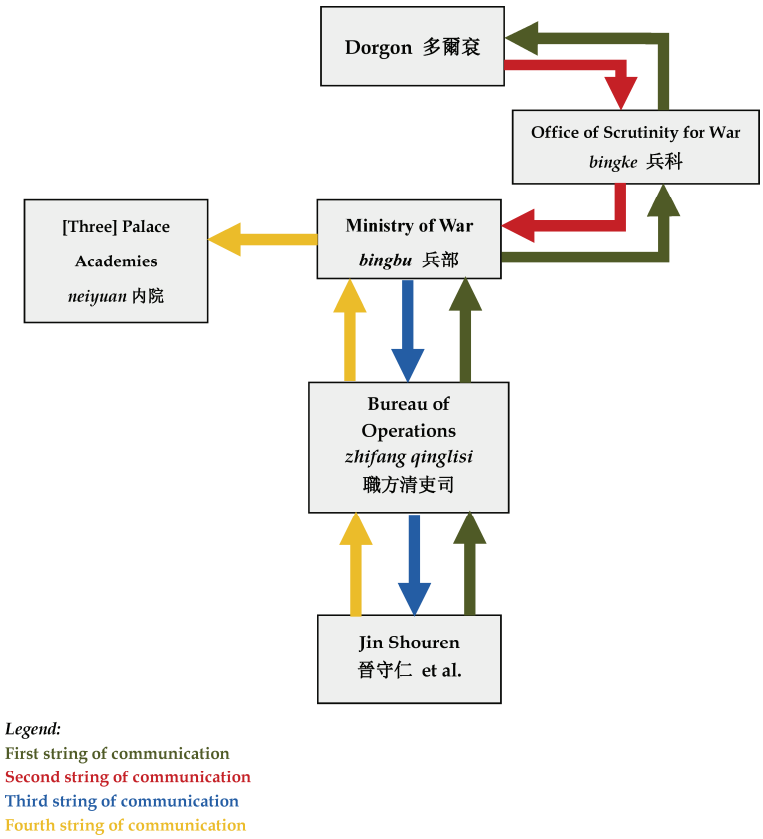

Diagram 1: Flow of information about the *Kunyu gezhi* according to the communication of the Ministry of War to the Three Palace Academies, 19 September 1644

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