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# ISLAMIC ASTRONOMY AND CALENDARICAL SCIENCE IN CHINA

From Song to Qing Dynasties

*Min Ke-qin*<sup>1</sup>

## Abstract

*Islamic astronomy, Huihui tianwen in Chinese, once had a splendid time in the history of Chinese sciences. It was in practical usage parallel with Chinese traditional astronomy for almost four centuries. It spread to China since the beginning of Northern Song dynasty (960-1127), and officially abolished by Manchu Qing authority in 1669. During this approximately seven hundred years, Islamic astronomy played the roles of either adding astronomical values into that of Chinese astronomy or of running as independent establishment alongside Chinese astronomical bureau. In this short article we intend to briefly delineate the rise and fall of Islamic astronomy in China*

**Keywords:** astronomy, astronomer, calendar, Chinese, Song, Yuan, Ming, Qing, Muslims, Jesuits

## Commence of Islamic Astronomy in China

Most researchers in the field advocate that Islamic astronomy spread to China during Yuan dynasty (1271-1368), however, new investigations show that the spread might be much earlier. Ma Zhao-zeng, a prolific writer, holds the view in his article “Anhui ‘Huaining Mashi Zongpu’” (Genealogy of Ma’s at Huaining, Anhui),<sup>2</sup> that Islamic astronomical knowledge might have been

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<sup>2</sup> Ma Zhao-zeng 马肇曾, “Anhui ‘Huaining Mashi Zongpu’” 安徽 “怀宁马氏宗谱” (Genealogy of Ma’s at Huaining, Anhui), 38-40.

spread to China during Northern Song dynasty (960-1127), in the second year (961) of Jianlong 建隆 reign<sup>3</sup> (r. 960-963), three hundred years earlier than the former's claim. Ma Zhao-zeng says that a Muslim astronomer named Ma Yi-ze 马依泽 (921-1005) landed on the soil of newly established Song dynasty in 961, most probably as a member of diplomatic envoy sent by 'Abbāsīd caliphate, or of business delegation. Nevertheless, it is claimed in the genealogy that he was invited by the first emperor, Zhao Kuang-yin 赵匡胤 (927-976), the founder of the Northern Song dynasty (960-1127), to work on astronomical matters for his dynasty. In echoing to the invitation by the new emperor, Ma Yi-ze, hailed from Rome,<sup>4</sup> along with his three sons, came to China. Some investigators cast doubt to this claim, advocating that he might have come as a member of a political emissary or economic delegation dispatched by a Muslim authority of Islamic political domain, who had chance to meet the Chinese emperor. During an audience, upon query, the emperor found Ma Yi-ze was acquainted with Islamic astronomy, the knowledge badly needed by his new dynasty, thereby asked Ma Yi-ze to stay on in his new dynasty, for assisting in compilation of a new calendar, headed by Wang Chu-ne 王处讷 (d. 982), then the director of the Imperial Astronomical Bureau of the dynasty. According to genealogy, that event was in the second year (961) of Jianlong reign (960-963). Ma Yi-ze accepted the offer. Two years later, a new calendar was compiled in cooperation with Wang Chu-ne 王处讷, who handed it over to the emperor. The emperor praised it, named the calendar as *Yingtianli* 应天历 (Echoing Heaven Calendar), and appointed Ma Yi-ze as the director of the Imperial Astronomical Bureau, meanwhile, granted him an inheritable title of Marquis (houjue 侯爵). Ma Yi-ze, according to the genealogy, was born in 921 in Rome, and passed away in 1005. He at his old age built his residence at Yong'an town, Jingyang county, Xi'an prefecture, Shaanxi. Wherefrom his offspring gradually emigrated

<sup>3</sup> Jianlong 建隆 was the reign title for Zhao Kuang-yin 赵匡胤 (927-976), the founder of the Northern Song dynasty (960-1127), also the first reign title for the dynasty.

<sup>4</sup> Rome here denotes the Muslim land once under the sway of Roman empire before the rise of Islam.

nationwide. As stated in the genealogy, Ma Yi-ze had three sons, Ma E 马额 (courtesy name Zhao-ming 昭明), Ma Huai 马怀 (courtesy name Wang-ming 望明), and Ma Yi 马忆 (courtesy name Si-ming 思明). The eldest Ma E inherited the title of Marquis from his father, also the position of the director of the Imperial Astronomical Bureau. The second Ma Huai was granted a title of sinecure officer *chendelang* 承德郎, cum deputy director of the Imperial Astronomical Bureau. The third Ma Yi was granted with a military title: the brave general (Longhu Jiangjun 龙虎将军), cum the deputy-general of imperial army.<sup>5</sup>

*Yingtianli* 应天历 was completed in the 4<sup>th</sup> month, 4<sup>th</sup> year (963) of Jianlong reign (960-963), soon was issued in circulation by the emperor. Modern investigators find that in this calendar, for the first time in Chinese calendrical history, included the elements of Islamic astronomy. Thence from, those elements were retained as essential parts in Chinese calendars.<sup>6</sup>

*Yingtianli* 应天历 was used as the official calendar until 6<sup>th</sup> year (981) of Taipingxingguo 太平兴国 reign (r. 976-984), when it was replaced by *Qianyuanli* 乾元历<sup>7</sup> (the Universal Calendar) which already had absorbed those elements of Islamic calendrical system. Although Song emperors, including those of Southern Song (1127-1279), promulgated new calendars frequently, Islamic

<sup>5</sup> Chen Jiu-jin 陈久金, Ma Zhao-zeng 马肇曾, "Hui ren Ma Yi-ze dui Songchu Tianwenxue de Gongxian" 回人马依泽对宋初天文学的贡献 (Contributions of Ma Yi-ze to the Astronomy in the beginning of the Northern Song), 3-11; Ma Zi-shu 马自树, Ma Zhao-zeng 马肇曾, "Ma Yi-ze yu Songchu 'Yingtianli' jiqi Zhuyao Houren" 马依泽与宋初 "应天历" 及其主要后人 (Ma Yi-ze and The Echoing Heaven Calendar), 11-16; Ma Zhao-zeng 马肇曾, "Anhui 'Huaining Mashi Zongpu'" 安徽 "怀宁马氏宗谱" (Genealogy of Ma's at Huaining, Anhui), 38-40; cf. Ma Zhao-zeng 马肇曾, "'Huaining Mashi Zongpu' ji Lidai Zhuyao Renwu Kao" "怀宁马氏宗谱" 及历代主要人物考 (上) (Ma's Genealogy of Huaining and Main Figures in Successive Dynasties, part A), 20-31.

<sup>6</sup> For discussion on the elements adopted into Chinese calendar, see Cen Jiu-jin 陈久金, Ma Zhao-zeng 马肇曾, "Hui ren Ma Yi-ze dui Songchu Tianwenxue de Gongxian" 回人马依泽对宋初天文学的贡献 (Contributions of Ma Yi-ze to the Astronomy in the beginning of the Northern Song), 3-11.

<sup>7</sup> *Qianyuanli* 乾元历 was compiled by Wu Zhao-su 吴昭素, whose life unclear, an officer in the Imperial Astronomical Bureau, in charge of official ceremonials held in winter.

calendrical elements already firmly inserted in Chinese calendars thenceforth.

Although the abovementioned Arab astronomer Ma Yi-ze and his sons held official positions in Chinese astronomical bureau, their names are left out in *Song History* (Songshi宋史), the official annals by the Chinese compilers for some unclear reasons. This is not the case in Yuan dynasty (1271-1368), in its annals (Yuanshi元史) many Arab and Persian astronomers whose names are clearly registered.

### Thrive of Islamic Astronomy in China

Despite the significant influence of Islamic calendrical knowledge to that of Chinese during Song, it was put in the shade by its later development during Yuan (1271-1368) and Ming dynasties (1368-1644). New investigations show that already before Yuan was officially established in 1271 at Dadu大都 (modern Beijing) by Mongol power, some Muslim astronomers mostly hailed from Central Asia already served in their astronomical establishment for some time. Exact time for this establishment is now unknown, it, however is said that Kublai consulted Zhamaluding (Jamāl al-Dīn)<sup>8</sup> on astronomical matters in 1264, before he ascended to the throne of Yuan, in 1271, when he promulgated the establishment of Yuan, and soon in the same year announced erection of Huihui observatory at Dadu, whereat later established the Huihui Astronomical Bureau headed by Jamāl al-Dīn and stuffed by mostly Muslim personae specialized in Islamic astronomy and astrology. This observatory was one of a few Islamic institutions wherein important observations were carried out at a large scale. It was in this observatory that Muslim astronomers made very important original astronomical observations, thus, contributed to Chinese astronomical knowledge. Thenceforth, Muslim Astronomical Bureau co-existed in parallel with the traditional Chinese Bureau.<sup>9</sup>

Unlike Song in whose annals no trace of Ma Yi-ze was found,

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<sup>8</sup> Benno van Dalen in his research holds a view of that Zhamaluding's full name is Jamāl al-Dīn Muhammad ibn Tahir ibn Muhammad al-Zaydi al-Bukhari. See his article "Zhamaluding: Jamal al-Dīn Muhammad ibn Tahir ibn Muhammad al-Zaydi al-Bukhari", 1262-1263.

<sup>9</sup> Ibid.



in the annals of Yuan, especially *Yuan Mushujianzhi* 元秘书监誌 (Registry of the Secretariat of Yuan), Jamāl al-Dīn, the astronomer, together with other Muslim astronomers like Shansiding 苦思丁 (Shams al-Dīn) their names were clearly registered. Shams al-Dīn al-Dīn later replaced Jamāl al-Dīn as the director of Huihui Astronomical Bureau when the latter passed away about 1307 [4<sup>th</sup> year of Dade 大德 reign (r. 1297-1308)]. Jamāl al-Dīn was a versatile man, not only proficient in Islamic astronomy but also in making astronomical instrument, in Chinese and world geography, local and world mapping, as well as library management. Records testify that he, most probably in collaboration with his Chinese counterpart, in 1267 [4<sup>th</sup> year of Zhiyuan reign (r. 1264-1295)] made seven astronomical instruments, which were installed in the Huihui Astronomical Bureau at Dadu (Beijing). Those instruments were identified as *dhatu al-halaqi* (armillary sphere), *dhat al-shubatai* (azimuth), *kura-i-sama* (celestial globe), *kura-i-ard* (globe), *al-ustarlab* (astrolabe), *rukhmah-i-muwaja* (equinox sundial), *rukhmah-i-mustawiya* (solstice sundial).<sup>10</sup> He also compiled in the same year an Islamic calendar called *Wannianli* 万年历 (A Millennium Calendar), and presented to Kublai Khan (d. 1294), who immediately promulgated official issue nationwide. This calendar was perhaps the first Islamic calendar officially issued for circulation in China. The feats of Jamāl al-Dīn in astronomy are still pale in comparison to his contributions as the first supervisor to Mishijian 秘书监 (the National Secretariat Bureau or the National Archive), which was established about Jan. 1273 [1<sup>st</sup> month, 10<sup>th</sup> year of Zhiyuan reign (1264-1295)]. Although two astronomical bureaus of both Chinese and Muslims were soon attached, on decree of the emperor, to the National Archive, its main function was collecting and publishing books. Most books previously stockpiled in the royal libraries of Liao 辽 (907-1125), Xia 夏 (1038-1227), Jin 金 (1115-1234), the Northern Song 北宋 (960-1127), and later the Southern Song 南宋 (1127-1279) were, upon their breaking ups by

<sup>10</sup> Yongxiang Lu, *A History of Chinese Science and Technology*, 103; Yu Li-zì 羽离子, “Jinian Yuandai Jiechude Bosi Yuanhua Kexuejia Zhamaluding” 纪念元代杰出的波斯援华科学家扎马鲁丁 (In Memory of Jamal al-Dīn: The Eminent Persian Astronomer of Yuan), 9.

Mongol power, brought to Dadu, and carefully tagged and cataloged in this National Archive. It was a huge project, requiring tremendous strength and manpower, who did works like repairing, hand-copying, redaction, painting, tagging, framing etc. The workload reached such amount that, as recorded in *the Registry of the National Secretariat Bureau*, in January 1277, a worker named Jiao Qing-an 焦庆安 alone repaired 6762 volumes of books, painted 854 pieces of paintings for books.<sup>11</sup> The books and documents collected in the Bureau were nicely bound, carefully stored, and meticulously cataloged. Its catalog was entitled *Bianlei Chenghaozhi Bu* 编类成号置簿 (Classified Catalog Book), which unfortunately could not be handed down to us. Not only Chinese books were produced by the Bureau, the books and calendars in other languages such as Mongolian and Persian, whose framing and binding look similar to that of Arab and Persian books, also were block printed (published).<sup>12</sup>

Among the books cataloged in the Bureau there are 195 Huihui books (Arabic and Persian books), as clearly recorded in *the Registry*. The title of each book is put in firstly Chinese transliteration, followed by its translation in Chinese. For instance, Wu-hu-lie-de-si-bo-suan-fa-duan-shu 兀忽烈的四擘算法段数 (Euclid), of which Wu-hu-lie-de 兀忽烈的 is its transliteration in Chinese while si-bo-suan-fa-duan-shu 四擘算法段数 is its translation in Chinese; another instance, Mei-zhe-si-de-zao-si-tian-yi-shi 麦者思的造司天仪式 (Almagest), of which Mei-zhe-si-de 麦者思的 is its transliteration in Chinese while zao-si-tian-yi-shi 造司天仪式 is its translation in Chinese; still another, Te-bi-yi-jing 忒毕医经 (Tibb), of which Te-bi 忒毕 is its transliteration in Chinese while yi-jing 医经 is its translation in Chinese. These instances lay a testimony to that the trial of translation of those books into Chinese might have taken place since that time, or at least Muslim astronomers working under Jamāl al-Dīn in the Huihui Astronomical Bureau already had a mind to translate them into Chinese. Very unfortunately, no one such work is handed down to us. The themes of those books are diverse, including Islamic astronomy, Arabic medicine, mathematics, algebra, geography, alchemy, chemistry,

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<sup>11</sup> Ibid., 10.

<sup>12</sup> Ibid.

mechanic, cosmology, and treasure stone, etc., of which mostly are science books.<sup>13</sup> Jamāl al-Dīn was promoted, largely due to his professional feats, to the post of royal scholar and adviser. 1285 (22<sup>nd</sup> year of Zhiyuan reign), Jamāl al-Dīn appealed to the emperor for compiling a monumental geographical work displaying the unity and peace of Yuan dynasty, to which the emperor approved and gave his decree to compile *Dili Zhi* 地理志 (The Annals of Geography), which includes all territories under the sway of Mongol power then. These geographical annals were later incorporated into a still larger work entitled *Yuan Dayitong Zhi* 元大一统志 (the Annals of Union Yuan) comprising the administrative divisions (provinces, prefectures, counties, towns, and villages) of Yuan territories, of their geography, mountains, rivers, produces, local customs and sceneries, relics, notables, and officials. Many places especially its important locations were illustrated with colorful drawings and maps. In mapping they already applied the angular coordinate, with latitude and longitude, then the most advanced science in geography. This colossal work, later, after Jamāl al-Dīn, was finally completed by other Chinese compilers in 1013 [7<sup>th</sup> year of Dade reign (r. 1297-1308)], which comprised 1300 *juan*, 600 volumes; of which only some dozens survived today.

Afore mentioned that in *The Annals of Union Yuan* included maps which were illustrated by, or under direct guidance of Jamāl al-Dīn, who also, as stated above, made a color *kura-i-ard* (the globe), on which the author already employed the most advanced science of geographical coordinate with latitude and longitude. He used the same technique in drawing maps, of which *Caise Dili Zongtu* 彩色地理总图 (The General Color Map of Yuan) was most magnificent. Very unfortunately, this map is no longer existing. Only division maps were emulated, at the last days of Yuan, by Buddhist monk Qing Jun 清濬 (d. 1392) and Korea geographer Li Ze-min 李

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<sup>13</sup> Yu Li-zi 羽离子, op. cit.; Benno van Dalen, op. cit.; Ma Jian 马坚, “‘Yuan Mishujiazhi Huihui Shuji’ Shiyi: 1949-1979” 元秘书监志·回回书籍 (Islamic Books Cataloged in the National Archive of Yuan), in Ma Shou-qian 马寿千 (ed.), *Huizushi Lunji* 回族史论集 (Collection of the Articles on Hui History), (Yinchuan: Ningxia People’s Publisher, 1984), 193-198.

泽民 (d.?) and bequeathed to us.<sup>14</sup> It should be noted that, of this monumental work, Jamāl al-Dīn was the initiator and officer in charge of the program, he had many personae specialized in their own field helped him. He was also aided, on the emperor's decree, by scribes and translators, since he was a Persian, not well versed in Chinese language.<sup>15</sup>

A remarkable development notwithstanding, Islamic astronomical works, during Yuan, were not translated into Chinese, thus it did not give a greater impact to Chinese astronomical knowledge. The reasons for this might be many folds, but to the fore, the high official like Jamāl al-Dīn and his like did not lay emphasis on undertaking of translating those works into Chinese; furthermore, did not cultivate young scholars to carry out this work. In hindsight, this is in sharp contrast with Italian Jesuits Matteo Ricci's (1552-1610) treatment about four hundred years later, when starting his missionary work in China, he was actively involved in learning Chinese, translating Chinese classics into the western languages, making friends with local elite gentries and scholars, who helped him translate many important works, scientific and Christian doctrinal, into Chinese, laying down a solid foundation for further development in China. Amongst the early translated works by Jesuits, *Euclid* was for the first time fully translated into Chinese, and widely circulated among Chinese people, although the book (perhaps in Persian translation) was already brought to China and catalogued in the National Archive of Yuan, yet casted in oblivion.

After Jamāl al-Dīn, his position as supervisor to the National Archive was taken by another Muslim Kemalading 可马刺丁 (Kamāl al-Dīn), whose life and wellbeing unclear to us. His position as the director to the Huihui Astronomical Bureau was taken up by a Muslim named Shansiding 苫思丁 (Shams al-Dīn) in 1307 [4<sup>th</sup> year of Dade reign (r. 1297-1308)], who in his later life rose to the position of prime-minster; of whom we have no further information. It is reasonable that most personae, including deputy director and lower officials in the Bureau, were Huihui (Muslims) who could read and understand Huihui language (Arabic and Persian), because all

<sup>14</sup> Yu Li-zi 羽离子, op. cit., 13.

<sup>15</sup> Ibid., 11-13.

references in the Huihui Bureau were written in those languages. Thus, Islamic astronomy has become a branch of Chinese official astronomy parallel to Chinese traditional astronomy.

As in Yuan, Ming authorities pushed Islamic astronomy to a still higher status. During Hongwu 洪武 reign (r. 1368-1398), the Huihui Astronomical Bureau run in parallel with Chinese astronomical bureau by Muslims, whom some already localised, and some others newly came from the outside of the country. The dynasty founding emperor Zhu Yuan-zhang (1328-1398), upon his enthronement in Jan. 1368, issued a decree to employ the officials of the former dynasty who worked in the Huihui Astronomical Bureau, like Heide'er 黑的尔 (Khidr), Adula 阿都刺 (Abdullah), Dieliyueshi 迭里月实 (Darwish), and other eleven persons (together fourteen) to work in the Huihui Astronomical Bureau of the new dynasty. Next year, another eleven persons (totally twenty-five) were employed to the Huihui Bureau. The independent Huihui Bureau run for thirty years from beginning of the dynasty, till 1398 [31<sup>st</sup> year of Hongwu reign (r. 1368-1398)], when a structural adjustment to the astronomical bureau was carried out by the Ming authority, in which the Huihui Astronomical Bureau was reduced to the Hui Astronomical Branch (or Division), parallel to Chinese Datong Division, both subordinating to Chinese Astronomical Bureau, in which status it operated until the end of the dynasty, and the beginning decades of Qing dynasty (1644-1911). It is until today not clear that why this adjustment took place, it might have had economic considerations. At any rate, that change does not relegate the inherent values of Huihui bureau, on the contrary, the founding emperor praised the accuracy and precision of Islamic astronomy and ordered officials to make good use of this knowledge. 1382 (15<sup>th</sup> year of Hongwu reign), the emperor gave audience to the officials from Huihui astronomical bureau, Haidar, Atau al-Dīn, Mashaikh, and Mahmud and more, together with Chinese officer from the office of the Royal Academy, Li Chong 李翀 and Wu Bo-zong 吴伯宗 (d. 1384), ordered them to translate, in collaboration, the Islamic books on astronomy and astrology into Chinese. Next year, Feb. of 1383, the first book entitled *Tianwenshu* 天文书 (also *Mingyi Tianwenshu* 明译天文书) (Astrology) was completed; another two years later, in

1385 *Huihui Lifa* 回回历法 (Islamic Calendar) was completed. The themes of *Tianwenshu* 天文书 were mostly not found in the Chinese traditional astronomical compositions. The new terms such as longitude and latitude which were already employed by Muslim astronomers of the time to calculate solar and moon eclipse and encroachment of five stars (Saturn, Jupiter, Mars, Venus, and Mercury) with the sun and moon, were fresh and new to Chinese astronomers.<sup>16</sup>

### **Decline of Islamic Astronomy in China**

Thus far we have seen that Islamic astronomy has played a significant role in Chinese astronomy and astrology for nearly six centuries. However, approaching the end years of Ming dynasty, the officers from the Ministry of Rites and other ministries often complained to the emperor, especially during last years of Wanli 万历 reign (r. 1573-1620), that computation of events like lunar eclipse by both divisions of the Bureaus of the Imperial Astronomy were inaccurate, thus, necessitated a serious recension. For instance, in 1594, Zhu Zai-yu 朱载堉 (1536-1611), a prince from royal family, an almanacist-cum-music theorist during the late Ming, memorialized to the throne for a calendar reform, to which the throne although gave a great praise, but took no action for the appealed reform. In Feb. 1597 (24<sup>th</sup> year of Wanli reign), Xing Yun-lu 邢云路 (1549-?), the local prosecutor of Henan, a friend of Zhu Zai-yu, also appealed to the throne for a calendar reform, to which the throne passed to the Ministry of Rites, which was then under directorship of Zhang Ying-hou 张应侯 (d.?), who paid least attention to it. The predictions made by the divisions were wrong again for the solar eclipse set on Dec. 15. 1610.<sup>17</sup>

1612, upon the error in prediction of the lunar eclipse set on May 15, the Ministry of Rites decided to make an astronomical

<sup>16</sup> Chen Jiu-jin 陈久金, "Madeluding Fuzi he Huihui Tianwenxue" 马德鲁丁父子 and 回回天文学 (Madr al-Dīn and Sons and Huihui Astronomy), 28-36.

<sup>17</sup> Lü Ling-feng 吕凌峰, "Eclipse and the Victory of European Astronomy in China", pp. 128-129; Wang Miao 王淼, "Xing Yun-lu yu Mingmo Chuantonglifa Gaige" 邢云路与明末传统历法改革 (Xing Yun-lu and Traditional Calendrical Reform at the End of Ming), 79-112.

reform and issued a writ to employ specialists from all over the country. Xing Yun-lu and Li Zhi-zao 李之藻 (d. 1630) were summoned to Beijing for carrying out the purported reform. Nevertheless, Xing followed his “new method” while Li adopted the western astronomy advocated by Jesuit missionaries.<sup>18</sup>

In 1620, Xing Yun-lu submitted his thesis *Cezhi Lishu* 测止历数 (The Best Observation of Calendrical Astronomy), in accordance with that what he called a “new method”, soon he predicted the solar eclipse set on May 21, 1621, unfortunately, his prediction was not better than that made by Chinese Datong Division and Huihui Division of Astronomy under the Ministry of Rites. He, following his “new method”, made another prediction of the lunar eclipse set Oct. 8, 1623, the result of observation also was proved different from the predictions of all parties involved, his error was even greater than that made by other two astronomical divisions. All in all, at beginning, the situation looked not favorable to the reformist. However, the scale began turning to the latter’s side in 1628, when young Chongzhen emperor (r. 1628-1644) was enthroned. The young emperor was ambitious, intended to install the empire to its previous glory, thus, he accepted petitions by officials, and appointed the deputy prime-minister Xu Guang-qi 徐光启 (1562-1633) to prepare a proposal for the astronomical reform. Moreover, inaccuracy of the prediction of solar eclipse for June 21 of 1629 by both divisions further strengthened his volition for the reform; thereby the emperor issued an edict for the reform to *Datongli* 大统历 (Great Unification Calendar), which was used since beginning of the Ming dynasty without any redaction (adjustment). Xu was appointed to supervise the program. By that time, Xu was already baptized by Jesuits. His conversion was very significant for Jesuits mission in the country. He played a very significant role in discarding the Chinese traditional astronomy, replacing it by the western astronomy, later causing forthright downfall of Islamic Astronomy in China at the hand of Jesuits in 1657, and its total abolishment in 1669.

In Dec. 1629, an independent body called “Liju” 历局 (Calendar Bureau) was established for revising *Datongli*. Although headed by Xu Guang-qi, it was staffed by mostly Xu’s Jesuit friends

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<sup>18</sup> Lü Ling-feng 吕凌峰, op. cit., 129.

who were, beside their missionary dignity, well versed in the western astronomy newly developed in Europe, and who were no less personae than the figures like German Johann Adam Schall von Bell (d. 1666), Portuguese Giacomo Rho (d. 1638), Swedish Johann Schreck (d. 1630), and Italian Nicholas Longobardi (d. 1654), including some Chinese astronomers (of mostly convert to Catholicism). One can best expect from this team that their work was mostly at first place the translation of the western astronomy into Chinese. In the end 1634, the team came up with an astronomical book entitled *Chongzhen Li* (Chongzhen Calendar), which comprised in general two parts: theories on astronomy and various astronomical tables in accordance with the theories. The new calendar adopted Danish astronomer Tycho Brahe's (d. 1601) geocentric theory, and his ways of calculation; also adopted geometrical knowledge into astronomical calculation.<sup>19</sup>

Afore mentioned that during Yuan, and in the early Ming, Huihui Astronomical Bureau enjoyed important status in Chinese state affairs. Muslims enjoyed some privileges in Chinese imperial governmental affairs, especially in the prediction of celestial phenomena, which were closely related to royal activities. Jesuits, especially Matteo Ricci (d. 1610) when arrived at Nanjing in 1598, also in 1560, he must have noticed this, must also have learnt the dispute of inaccuracy in calculating eclipses of both the Sun and Moon, among Ming officials. This is testified by his letter to his superior, in which he wrote that Chinese emperors "look high of the knowledge of celestial phenomena, of calculation of eclipses, also of the personae who has prowess in this field of knowledge," thereby he soon, in 1605, requested his superior to send some Jesuits missionaries who were also well versed in astronomy and astrology.<sup>20</sup> In doing this, Jesuits decided at very beginning to interfere into the astronomical affairs of Ming (and later of Qing), which were in dispute between Chinese emperor and his officials, of

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<sup>19</sup> Song Jun-ling 宋军令, "Mingmo Liju yu Xixue Dongjian" 明末历局与西学东渐 (Calendar Bureau at the End of Ming and Spread of the Western Astronomy to the East), 123.

<sup>20</sup> Xu Shu-jie 许淑杰, "Ming Qing zhiji de Yisilanjiao yu Jidujiao" 明清之际的伊斯兰教与基督教 (Islam and Christianity during Transition of Ming to Qing), 151.



especially the Astronomical Bureau. This decision later approved to be right and bright. Mateo Ricci himself, beside his prowess in Catholicism, was also well versed in the western astronomy, an emerging science in Europe at that time. He, when he was in Nanchang, already predicted the sun eclipse set in 1596 (24<sup>th</sup> year of Wanli reign), later, after he arrived at Beijing in 1601 (29<sup>th</sup> year of Wanli reign), he accurately predicted both sun-eclipse and moon-eclipse several times. This, in sharp contrast with the predictions by two astronomical divisions, earned him tremendous fame among high officials in Beijing. At the same time, the fame of the western astronomy also spread widely. Unfortunately, Ricci died in 1610 at his fifties, left his overriding important missionary work to his coreligionists; among whom German Johann Adam Schall von Bell (d. 1666) was best.

Schall, a recalcitrant priest, intolerant of other beliefs beside his Christianity, by request of Xu Guang-qi, was taken in 1630 to Liju to replace Johann Schreck who died on May 11, 1630. Later, as we shall see bellow, when Manchu Qing rose to Chinese political power, he became the director of the Imperial Astronomical Bureau, sooner after his ascension, he removed the head of the Huihui ke 回回科 (the Muslim Division) Wu Ming-xuan 吳明炫<sup>21</sup> from office,<sup>22</sup> and practically dissolved Huihui Division.

In the process of compiling *Chongzhen Lishu* (also *Chengzhen Li*), the Jesuit astronomers were frequently involved in dispute over astronomical matters with the astronomers from both Chinese Datong Division and Huihui Division. In the dispute, the parties involved always resorted to prediction of eclipses. Because the astronomy is highly scientific, commoners, including emperors could not comprehend the trivialities of this science. The only convenient prove that could be openly seen by them was to predict an eclipse and later confirmed it by unaided eye observation of them. The astronomers of all parties involved understood this well. When his Liju started

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<sup>21</sup> Wu Ming-xuan 吳明炫, whose life unclear, was a Hui Muslim astronomer, the head in the Huihui Division (Huihui ke 回回科) of the Astronomical Bureau in the late Ming dynasty (1368-1644).

<sup>22</sup> Li Xuetao 李雪濤, "The Opposition of Confucians to Catholicism in the Early Qing Dynasty: Yang Guang-xian and Kangxi Calendar Lawsuit (1664-1665)", 30.

working in the end of 1629, its leader Xu Guang-qi, and his Jesuits employees were frequently questioned by, sometimes quarreled with especially astronomers from both Huihui Division and Chinese Division, on astronomical matters. These quarrels of course were passed over to Chongzhen emperor. To dispel emperor's doubt, Xu wrote a memorial to him, stating: "The astronomical accuracy can be easily testified by observation of eclipses. If our prediction is in fine conformity with the result of observation, then, our work is justified."<sup>23</sup> To settle scores with their rivalries, the competitors (or opponents) always resort to predictions of eclipses. Since then, competitions on the prediction of eclipses of both the Sun and the Moon between the old and the new dominated the activities of the astronomical bureaus and observatories. The observations were sometimes joined by the emperor, who would give a final judgement, which would decide the career fate of officials, especially of the head of a division, even of the bureau. During the competition, Datong Division and Huihui Division stood together against the western bureau. For this reason, in many records, only Chinese Division and the western bureau was mentioned. The competitions (the disputes) enumerated eight times, but most decisive ones were three.

The first was the eclipse of the Sun predicted for June 21, 1629; the error resulted from the prediction by both Datong Division and Huihui Division availed Chongzhen emperor (r. 1627-1644) of a resolute decision on reforming *Datongli*. The error also, on the other hand, almost caused the life of the leaders of the astronomical divisions. After the same event, Xu Guang-qi was nominated to supervise over the Bureau of Astronomy, and to prepare for revision of the calendar. Soon, an independent body Liju 历局 (Calendrical Bureau) was established specially for compiling a new calendar. No doubt, this event has triggered the compilation of *Chongzhen Lishu* (Calendrical Book of Chongzhen).<sup>24</sup> In retrospect, however, modern scholars of the field like Lü Ling-feng, Shi Yun-li and more,

<sup>23</sup> Lü Ling-feng 吕凌峰, Shi Yun-li 石云里, "Mingmo Lizheng zhong Jiaoshiceyan Jingdu zhi Yanjiu" 明末历争中交食测验精度之研究 (A Study on the Accuracy of Lunar Eclipse at the End of Ming Dynasty), 128.

<sup>24</sup> Lü Ling-feng 吕凌峰, "Eclipse and the Victory of European Astronomy in China", 131.

re-calculated the result of this solar eclipse, and found that the actual result was not as Xu and Jesuit astronomers claimed as that their prediction was “exactly tallying with the observation” which was joined by all astronomers of three divisions (Datong, Huihui and the Western). The new study<sup>25</sup> shows that “the error of the maximum phrase and last contact of the Western Bureau is much larger than that of the Datong Li, whereas the error of the magnitude and first contact of the Western Bureau is smaller than that of Datong Li.”<sup>26</sup> As for the Huihui astronomers their performance was worse than that of Chinese division and the Western division.<sup>27</sup> Now, question is, whereas the result showed that the performance of the Western division was poorer than that of Chinese Division, why yet the emperor still wanted the purported reform? The only reasonable explanation, in retrospect, is that the emperor already made up his mind for the reform due to Datong Division’s and Huihui Division’s previous inaccurate predictions, and numerous grumbles by the officials from varied departments. At any rate, Liju was erected, also a team of astronomers, which includes almost all Jesuits astronomers, headed by Xu Guang-qi was set up, specifically for reforming Datong Li and Huihui Li. But actual work carried out by Liju was not much of “reforming”, rather than translation into Chinese of the western astronomical work compiled by European astronomers, especially Tycho Brahe (d. 1601) and his student Johannes Kepler (d. 1630), and others, bound with thitherto the latest updated astronomical knowledge. Records testify that, during their compilation, they, the Jesuit astronomers in the Liju had many discussions and quarrels with Chinese and especially Huihui astronomers headed by Wu Ming-xuan 吴明炫 (whose life unclear), who bore brunt of the direct blame and crowd-out by Jesuit astronomers. This observation is evinced by modern researchers of the field, like Xu Shu-jie 许淑杰 in his article “Islam and Christianity

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<sup>25</sup> Ibid., 132.

<sup>26</sup> Ibid.

<sup>27</sup> Lü Ling-feng 吕凌峰, Shi Yun-li 石云里, “Mingmo Zhongxi Lifazhenglun zhong Huihuile de Tuisuan Jingdu” 中西历法争论中回回历的推算精度 (Accuracy of Huihui Calendar during Calendar Disputes in the Late Ming), pp. 78-80.

during Transition of Ming to Qing”,<sup>28</sup> and Huang Yi-nong in his article “Dispute between Jesuit Astronomers and Huihui Astronomers at beginning of Qing”.<sup>29</sup> Although no blatant written proof to show the aims of Jesuits astronomers, but from their treatment of Huihui astronomers from the Huihui Division of the Bureau of Astronomy (Qintianjian 钦天监), their aim was clear: firstly to suppress Huihui astronomers, and eventually to abolish Huihui Division. Later encounter by Huihui Division rightfully testify this claim. The new calendrical book entitled *Chongzhen Lishu* 崇祯历书 (Calendrical Book of Chongzhen) (137 *juan*), was completed in 1634, and submitted to Chongzhen emperor, but was not officially promulgated, until 1644, when the emperor finally determined to promulgate, yet his dynasty Ming was toppled over by rebels in April, and on June 06, replaced by Manchu Qing.

The second was also a solar eclipse predicted for Sept. 01, 1644; the accuracy of Jesuits astronomers availed Shunzhi emperor (the first Qing emperor; r. 1644-1661) of the opportunity to appoint Jesuit astronomer Johann Adam Schall von Bell (Chinese name Tang Ruo-wang 汤若望, d. 1666) to the position of the director of Imperial Astronomy. This appointment was soon proved to be disastrous to Huihui Division and Muslim astronomers. Schall joined Liju in 1630, upon death of German Jesuit Johann Schreck (also Jean Terrenz, Chinese name Deng Yu-han 邓玉函) on May 11, 1630. When Qing established, Schall was introduced to Shunzhi emperor (r. 1644-1662), the first Qing emperor, to whom Schall submitted their new calendrical book and himself. He was immediately appointed by Shunzhi emperor to a position of the “reviser of the calendar” (Xiuzheng Lifa 修正历法). Schall was swift and astute (shrewd). He, by excellent skills of bribes and flattery, got chances to meet the emperor and high officials in key positions, during which he, through smooth telling, deliberately boosted advantages of their astronomy, and belittled that of *Datong Li* and *Huihui Li*. Soon, he predicted, together with Datong and Huihui divisions, the solar eclipse set on

<sup>28</sup> Xu Shu-jie 许淑杰, op. cit., 149-153.

<sup>29</sup> Huang Yi-nong 黄一农, “Qing chu Tianzhujiao yu Huijiao Tianwenjia jian de Zhengdou” 清初天主教与回教天文家间的争斗 (Dispute between Jesuit Astronomers and Huihui Astronomers at beginning of Qing), 47-69.

September 01, 1644, the first year of Shunzhi reign (r. 1644-1661), of which the Jesuits prediction was again reported “completely tallying” with the result of observation which was participated by all astronomers of three divisions, including the director of the Bureau of Astronomy, that of other two divisions were reportedly erroneous. Soon afterwards, Schall was appointed the director of the Bureau of Astronomy, in charge of all three divisions still existing then: Datong, Huihui and Western.<sup>30</sup> However, upon ascending to the position, the new director Schall always censured especially Huihui astronomers at the leadership of Wu Ming-xuan 吴明炫, alluding his strong disdain to Muslims. Since then, nightmares always befell especially Muslim astronomers. Almost immediately upon his ascend, he issued his first order: not allowing Huihui division to report (to him) the eclipses of the Sun and the Moon. Two years later (in May 1646), denied the calculations of encroachment of the stars, the main function of Huihui astronomy during Ming, by Huihui Division, virtually setting aside the Huihui Division and the Muslim astronomers, and closing-up the Division.<sup>31</sup> In March 1654 (11<sup>th</sup> year of Shunzhi reign), Wu Ming-xuan and other astronomers in Huihui Division, were officially deposed. Wu Ming-xuan, three years later, appealed to Shunzhi emperor to maintain Huihui Division, meanwhile denounced the western astronomy as erroneous and inaccurate, but he was charged with defiling Jesuits astronomers and sentenced to be hanged, however, he, by luck, was remitted. Seven years later, in 1664, he, in a cooperated effort joined with Yang Guang-xian 杨光先 (d. 1669), made his way back to his previous position for a brief period (four years).

The dispute between traditional astronomers (from Chinese Datong Division and Huihui Division) and the Jesuit astronomers might have been purely scientific if the former especially Huihui's was not ruthlessly treated by the latter. The ruthless treatment drastically changed the nature of the dispute. Later development testifies that the initial dispute on astronomical matters was extended to dispute in religious and cultural matters.

<sup>30</sup> Lü Ling-feng 吕凌峰, “Eclipse and the Victory of European Astronomy in China”, 133.

<sup>31</sup> Xu Shu-jie 许淑杰, *op. cit.*, 151.

Afore mentioned that Jesuits, during their struggle for ascendancy, have deftly exploited personal relations with high officials and especially with emperors. The appointment of Adam Schall to the directorship of the Bureau of Astronomy by Shunzhi emperor was, on the one hand, due to his prowess in the western astronomy, on the other, to his special relation with Shunzhi emperor himself, who explicitly showed his personal liking towards the western astronomy, thereby conferred Schall “Tongxuan Jiaoshi” (Divination Teacher) in 1653, also “Guangludafu” an entourage of the emperor, an extremely exceptional position for a foreigner in Chinese officialdom. In this situation, one can imagine that any impeachment of Schall would virtually be ended in failure. Just as what has been fallen on Yang Guang-xian, a doyen of the previous dynasty, also a retired military officer, who wrote in 1660 two memorials to the emperor for impeaching Schall and Jesuit astronomers, but his memorials did not even reach Shunzhi emperor. Nevertheless, failures did not strike him down, on contrary, he wrote extensively. He composed *Budeyi* 不得已 (No Other Choice), in which includes epistles titled as “Zhaimiulun” 摘谬论 (Revealing Fallacies), “Bixielun” 辟邪论 (Avoiding Devilish Teaching), “Xuanzeyi” 选择议 (Choosing an Auspicious Day), and many more memorial epistles, in which Yang criticized fallacies of Christian teachings, and errors of Jesuit astronomy.<sup>32</sup> 1661, Shunzhi died, his son Xuanye 玄烨 (reign title Kangxi), an eight-years boy, was enthroned, who was aided by four powerful Manchu regents, among whom was Oboi (Ao Bai 鳌拜 in Chinese, d. 1669), who practically controlled over state politics and military. This Oboi, a Manchu military general with strong conservative mind, disliked Jesuits, who, under the wings of Shunzhi emperor, despised courtiers, always talking to the courtiers in patronizing tone. With death of their protector: Shunzhi emperor, who died in his twenties on Feb. 5, 1661, of smallpox, Jesuit “courtiers” were left unprotected. Apprehensive of the other courtiers’ displeasure to them, Jesuits did not seek compromise, but merely waited for their destiny. In 1664,

<sup>32</sup> Xie Jing-fang 谢景芳, “Yang Guang-xian yu Qingchu Li’an de Zaipingjia” 杨光先与清初“历案”的再评价 (More Assessment to Yang Guang-xian and Astronomical Dispute in the Early Qing), 44.

Yang again memorialized his epistle “Qing Zhu Xiejiao Zhuang” 请诛邪教状 (Petition to Abolish the Strayed Cult), this time to the regents instead of the young emperor. The regents, upon discussion, accepted it and approved, thereafter, Jesuit astronomers serving in the Bureau of Astronomy, including Adam Schall, the director, and other three Jesuit astronomers, and five more Chinese astronomers (also converted Jesuits) were detained and put to jail. After almost a year investigation and interrogations, they were put to death. However, the foreign Jesuits were later exonerated from death, and they, except Ferdinand Verbiest (Nan Huai-ren 南怀仁 in Chinese, d. 1688), Ludovicus Buglio (Li Lei-si 利类思 in Chinese, d. 1682), and Gabriel de Magalhaes (An Wen-si 安文思 in Chinese, d. 1677), who were allowed to stay at the capital and retain their work in the Bureau of Astronomy, Beijing, were sent back to Macau. Schall died from the trauma soon after release. Moreover, all churches in the inner land were closed.<sup>33</sup> This incident dealt Jesuits a heavy blow, it seemed for them, since triumph of Mateo Ricci (d. 1610), that their mission in China finally suffered a total failure. Jesuits were so irritated and disappointed that later, some of them besmirched (defamed) in their writings the figure of Yang Guang-xian. For instance, Verbiest, the archenemy of Yang, portrays him as “impure slanderer and devil’s servant” in his writing *The Astronomia Europaea of Ferdinand Verbiest*.<sup>34</sup> Some much later writers like German writer Alfons Văth<sup>35</sup> (d. 1937) and Ernst Stürmer<sup>36</sup> and more, followed the reviling tone of Verbiest, depicting Yang as

<sup>33</sup> Ping-yi Chu, “Scientific Dispute in the Imperial Court: The 1664 Calendar Case”, 7-17.

<sup>34</sup> Ferdinand Verbiest, *The Astronomia Europaea of Ferdinand Verbiest*, S. J. (Dillingen, 1687), Noel Golvers (trans.), (Nettetal: Steyler Verlag, 1993), 55.

<sup>35</sup> Alfons Văth, Johann Adam Schall von Bell S.J: Missionar in China, kaiserlicher Astronom und Ratgeber am Hofe von Peking, 1592-1666: ein Lebens-und Zeitbild (Monumenta serica monograph series) (German Edition), trans. into Chinese by Yang Bing-chen 杨丙辰, vol. II, (Taipei: Commercial Press, 1960), 477-478; 485-486.

<sup>36</sup> Ernst Stürmer, *Meister Himmlischer Geheimnisse*, trans. into Chinese by Zhang Xiao-hu 张晓虎, edit. by Wei Yong-chang 魏永昌, (Beijing: China People’s University Press, 1989), 99-101.

“slanderer” and “evil man”, who had nothing else to do but slandering Jesuits.<sup>37</sup>

Yang attacked Jesuits from many aspects, which can be broadly classified into three domains: astronomical, cultural, and religious. On the level of astronomy, Yang claims that Chinese emperor must not follow western customs in astronomical matters, which came from the West, the Christian world. On the cultural level, Yang claims that Western cultures does not tally with Chinese Confucian culture, thus, it should not be adopted by Chinese, especially the emperor. On the religious level, Yang blames Christianity as erroneous and heretic, which leads people astray.<sup>38</sup> The downfall of Jesuits in 1664 accounts mostly to their sedition, as accused by Yang Guang-xian, rather than much disputed accuracy of prediction to the solar eclipse set on Sept. 1, 1664; of which Jesuits performance was a bit better than that of Datong and Huihui divisions but reported to the regents otherwise. Based on their “error” and sedition, Jesuits and their Chinese followers were put in jail, as already mentioned above. Upon the downfall of Jesuits, Yang Guang-xian was appointed to the position of deputy director (soon later director) of the Imperial Astronomical Bureau, who restored the Bureau to its previous status, and soon restored Wu Ming-xuan to the head of Huihui Division, who would perform all his previous routine works.

In Nov. 1668, Kangxi, after he gained his authoritative power from the regents, reinvestigated the 1664 calendar case (lawsuit), after series of ostensible observations and tests, including the solar

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<sup>37</sup> Xie Jing-fang 谢景芳, op. cit., 49.

<sup>38</sup> For the details of this calendar case, there are many investigations, old and new, readers can find detailed account on it, in Ping-yi Chu, “Scientific Dispute in the Imperial Court: The 1664 Calendar Case”, in *Chinese Science*, 14 (1997): 7-34; Catherine Jami, “Revisiting the Calendar Case (1664-1669): Science, Religion, and Politics in Early Qing Beijing”, in *The Korea Journal of Science*, 37-2 (2013): 459-477; Alfons Vöth, *Johann Adam Schall von Bell S.J.: Missionar in China, kaiserlicher Astronom und Ratgeber am Hofe von Peking, 1592-1666: ein Lebens-und Zeitbild* (Monumenta serica monograph series) (German Edition), trans. into Chinese by Yang Bing-chen 杨丙辰, vol. II, (Taipei: Commercial Press, 1960), 471-518; Stefano Salvia, “The Battle of Astronomers: Johann Adam Schall von Bell and Ferdinand Verbiest at the Court of Celestial Emperors (1660-1670)”, in *Physics in Perspective* 22, no. 2 (2020): 91-95; and many more.



eclipse set on Sept. 1, 1664, recalculated. Upon which Jesuits were announced all accurate and thus “victorious”, Jesuits astronomers, now headed by Flemish Ferdinand Verbiest (d. 1688) were restored to the Bureau of Astronomy. Yang Guang-xian was pardoned by Kangxi on the pretext of old age. Wu Ming-xuan was finally deposed, Huihui Division as well as Datong Division forever closed, 1669 calendar made by Wu Ming-xuan was pronounced “erroneous”, thereby replaced by the one made by Verbiest entitled “Qintianjian Zouzhu Yinzhao Shixian Liri” 钦天监奏准印造时宪历日 (Shixian Calendar Printed by the Astronomical Bureau with Emperor’s Authorization).<sup>39</sup> Thus, the disputes between parties (Chinese Datong Division and Huihui Division vis-a-vis Western division), which lasted for almost four decades were finally put to end. Chinese and Islamic astronomy both withdrew from the stage of Chinese history, replaced by the western astronomy.

## Conclusion

Thus, the western astronomy ascends to the stage of Chinese cultural life, replacing both Chinese traditional and Islamic astronomy. In struggling to this ascend, Jesuit missionaries employed several tactical measures. First, they used their knowledge in sciences, of especially astronomy, to curry the favor of Chinese high officials and emperors, who would help them promote their knowledge among the high class of Chinese people. Second, they deliberately over-exaggerated the accuracy of their astronomy, meanwhile, belittled the function of Chinese Datong and Huihui divisions. In the process, they resorted to the tricks like eliminating all records unfavorable to them from *Xiyang Xinfu Lishu* (New Western Calendrical Book), keeping only those data favorable to them.<sup>40</sup> Those tricks are discovered in recent studies by investigators of the

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<sup>39</sup> The English translation for this book (with some amendment) is from Ping-yi Chu, op. cit. p. 23,

<sup>40</sup> Li Liang 李亮 et al, “Bei ‘yilou’de Jiaoshi: Chuanjiaoshi dui Chongzhen Gaili Shiqi Jiaoshi Jilu de Xuanzhexing Shanchu” 被遗漏的交食—传教士对崇祯改历时时期交食记录的选择性删除 (Omitted Eclipse: Selective Omission of Eclipse Record by Jesuit Missionaries during the Calendrical Reform of Chongzhen Reign), 312-313.

field, like Shi Yun-li, Lü Ling-feng, Li Liang and more. According to their study, Jesuits deleted more than one third of records of eclipses set during their compilation of *Chongzhen Lishu* (Calendrical Book of Chongzhen) from 1628 (2<sup>nd</sup> year of Chongzhen reign) on to 1643 (17<sup>th</sup> year of Chongzhen reign). The deleted records testify that the errors of prediction of eclipses by Jesuit astronomers were much greater than the errors made by the astronomers from Chinese Datong and Huihui divisions.<sup>41</sup> Deleting unfavorable data is not only a trick played by Jesuit astronomers during their ascending, they, even after grabbing the position of directorship of the Royal Astronomical Bureau, also changed records of eclipses, putting only, in many cases, “exactly tallying with the prediction” instead of honest statement of true statistics, as strictly required by higher authority. Because the true statistics do not lend strong support to their claim.<sup>42</sup> New studies show that, before employment of new instruments like three stage water-clock and clepsydra and more, the average error of eclipses prediction by Jesuit astronomers, although a bit better than that of Datong and Huihui, was fifteen minute, sometimes even much higher, not exactly tallying with the result of observations. Modern investigators still wonder why this discrepancy could retain for so long, yet without complaining or criticism from other courtiers.<sup>43</sup>

In another aspect, the knowledge of natural sciences is an ongoing process by the enduring effort of scientists. Astronomical science abides by this law. The accuracy for time calculation of eclipses improves with development of new theories, new method of measurement and use of new instruments. In the late years of Ming, both *Datongli* (Calendar made by Datong Division) and *Huihuili* (Calendar made by Huihui Division) were already used for more than two hundred years, yet without significant revision and improvement to the old method of calculation and measurement. Moreover, the astronomers of both divisions did not improve themselves in the field of their career. This stagnation in knowledge and conservatism of

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<sup>41</sup> For the details, see Li Liang 李亮 et al, op. cit.

<sup>42</sup> Lü Ling-feng 吕凌峰, Shi Yun-li 石云里, “Mingmo Lizheng zhong Jiaoshiceyan Jingdu zhi Yanjiu” 明末历争中交食测验精度之研究 (A Study on the Accuracy of Lunar Eclipse at the End of Ming Dynasty), 128-138.

<sup>43</sup> Ibid.

mind, of course, would surely lead them to backwardness and failure. This failure on the part of Chinese might be a chance to improve their astronomical knowledge, but on the part of Chinese Muslim was failure of cultural confidence. As a result, Islam was reduced to a very minor status, as nonexistent to majority Chinese. This was a negative impact of the failure. It also had positive impact upon Chinese Muslims. Frustrated by the failure, in sharp contrast to Jesuit success, some eminent Muslim scholars started reflections on the drastic changes of their status. Jesuits' success in spreading their teachings especially Catholicism in China during late Ming and early Qing might have inspired Muslim elite to follow the Jesuits way in spreading Islamic teachings in China, a mission which they (Muslims) have hesitated to take up in hitherto nearly a thousand years of their inhabitation in China. The failure also taught a serious lesson to the later generations that knowledge, especially of natural sciences, must always be refined, rechecked, and improved, before falling behind of others especially formidable rivalries.

## TRANSLITERATION TABLE

### CONSONANTS

Ar=Arabic, Pr=Persian, OT=Ottoman Turkish, Ur=Urdu

Ar	Pr	OT	UR	Ar	Pr	OT	UR	Ar	Pr	OT	UR
ء	‘	‘	‘	ز	z	z	z	گ	—	g	g
ب	b	b	b	ژ	—	—	ř	ل	l	l	l
پ	—	p	p	ژ	—	zh	j	م	m	m	m
ت	t	t	t	س	s	s	s	ن	n	n	n
ٹ	—	—	ṭ	ش	sh	sh	ş	ه	h	h	h <sup>1</sup>
ث	th	th	th	ص	ṣ	ṣ	ş	و	w	v/u	v
ج	j	j	c	ض	ḍ	ḍ	ž	ی	y	y	y
چ	—	ch	çh	ط	ṭ	ṭ	ṭ	ة	-ah	—	-a <sup>2</sup>
ح	ḥ	ḥ	ḥ	ظ	ẓ	ẓ	ẓ	ال	al <sup>3</sup>	—	—
خ	kh	kh	kh	ع	‘	‘	‘	<sup>1</sup> – when not final <sup>2</sup> – at in construct state <sup>3</sup> – (article) al - or l-			
د	d	d	d	غ	gh	gh	ğ				
ڈ	—	—	ḍ	ف	f	f	f				
ذ	dh	dh	dh	ق	q	q	k				
ر	r	r	r	ك	k	k/g	k/ñ	k			

### VOWELS

	Arabic and Persian	Urdu	Ottoman Turkish
Long	ا	ā	ā
	آ	Ā	—
	و	ū	ū
	ي	ī	ī
Doubled	ي	iy (final form ī)	iy (final form ī)
	و	uww (final form ū)	uvv
	و	uvv (for Persian)	uvv
Diphthongs	و	au	ev
	ی	ay	ey
Short	ا	a	a or e
	ا	u	u or ū
	ا	i	o or ö
	ا	i	ī

### URDU ASPIRATED SOUNDS

For aspirated sounds not used in Arabic, Persian, and Turkish add h after the letter and underline both the letters e.g. چھ jh گھ gh

For Ottoman Turkish, modern Turkish orthography may be used.

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