Dialogue concerning Two Astral Sciences: Naṣīr al-Dīn al-Ṭūsī, a Sage of Cathay, and Their Chinese Calendar in the Zīj-i Īlkhānī (c. 1272 AD) (in Japanese)
Graduate School of Arts and Sciences, The University of Tokyo, 2015

Summary
This dissertation focuses on a Chinese calendar in Persian which Naṣīr al-Dīn al-Ṭūsī (1201-1274), a Muslim polymath, incorporated into his Zīj-i Īlkhānī (c. 1272 AD) through dialogue with a “sage of Cathay.” A comprehensive investigation into the calendar sheds light on a phase of cross-contact contact in Eurasia during the period of the Mongol empire. Furthermore, this analysis results in elucidating a long-standing two-way exchange of astral knowledge in Central Eurasia. Although astral sciences have received more scholarly attention than other sciences and technologies in Mongol Eurasia, we can identify few cases of, or results from, cross-cultural collaboration among astronomers/astrologers in that period. In fact, the coexistence of the Chinese and Muslim Bureaus of Astronomy in the Yuan dynasty (1271-1368) did not evolve to transform any of the existing astral traditions. Moreover, the Islamicate intellectuals at the Marāgha observatory under the rule of the Īlkhānids (c. 1260-c. 1335) were primarily concerned to improve the Ptolemaic understanding of the universe, and the eastern astronomical system contributed little to their efforts from this standpoint. In consideration of these circumstances, we should attach great importance to the Chinese calendar in the Zīj-i Īlkhānī as a rare case of...
direct dialogue concerning the two astral sciences.

The first chapter offers an overview on the intellectual context of the dialogue. The Mongols, who adhered to the worship of Tengri (Heaven), had an immense interest in “interpreters of the heavenly mandate.” Al-Ṭūsī, as the chief interpreter, initiated the construction of an observatory and the compilation of an astronomical handbook (zīj). Due to the Hülegü’s familiarity with the Chinese astral sciences, a chapter of the Zīj-i Īlkhānī was assigned for the description of the Chinese calendar. However, the zīj itself was left uncompleted in al-Ṭūsī’s lifetime, and later scholars embarked upon its completion and revision, in which the Chinese calendar also became a subject for revision and commentary. Throughout the Īlkhānid period, the Marāgha observatory functioned as the center of this kind of activity on the basis of substantial waqf endowments. There was, however, controversy in assigning such endowments to an observatory, and over the long term the project therefore rested on a delicate balance between Islamic tradition and Mongol priorities.

The second chapter deals with al-Ṭūsī, one side of the dialogue. Although he compiled the Zīj-i Īlkhānī on behalf of his masters, his own interest in the heavens oriented him in a different direction. His main concern was about the ‘ilm al-hay’a (science of configuration of the universe); representing heavenly motion with geometrical models. He created a mathematical device called the “Ṭūsī couple”—it would also appear in the Copernican celestial model—to resolve the discrepancy between Ptolemaic astronomy and Aristotelian physics. Al-Ṭūsī’s contribution to astronomy was by no means confined to this innovation; he engaged in the “rewriting” (taḥrīr) of the Elements and Almagest—the canons of mathematics and astronomy in pre-modern Eurasia, and a series of treatises called the “Middle Books,” i.e., the mathematical and astronomical treatises intermediating between the two aforementioned canons. A scrutiny of his “rewriting” of Euclid’s Data makes it clear that al-Ṭūsī strove for more concision and mathematical clarity than the original textual structure allowed. Al-Ṭūsī thus, through rewriting a series of mathematical and astronomical classics, paved the way for his successors to fully comprehend the Almagest and to carry out a fundamental revision of the canon.

We turn to the East with the
third chapter which addresses a “sage of Cathay”—the other side of the dialogue—and the Chinese calendar in the Zīj-i Īlkhānī. Although we had far less information about this sage—a Daoist master—than about al-Ṭūsī, a newly-discovered source could identify him as Fu Ye 傅野—a court physician of Hūlegū—who seems to have come to Iran in accompany his master on the western expedition. Investigation into the Chinese calendar in the Zīj-i Īlkhānī clarifies its contents as a kind of amalgam including two main sources: the Revised Great Enlightenment Astronomical System 重修大明曆—the official astronomical system at the end of the Jin Dynasty (1182-1234), and the Astronomical System Tallying with Heaven 符天曆—an unofficial astronomical system complied in the middle of the Tang period (780-783). Along with the Revised Great Enlightenment Astronomical System—the official system in the early period of the Mongol rule in China—the Astronomical System Tallying with Heaven was also in continual use until the Yuan period. The profile of a “sage of Cathay” and the sources of the calendar require us to reconsider the calendar’s provenance. In previous studies, the eclectic nature of the calendar was attributed to the influence of the Uyghurs, who had famously played an important role in the nascent period of the Mongol Empire and surely contributed to Mongol acceptance of the Chinese calendar. In addition, it was entitled the “Chinese-Uyghur calendar” in a number of the latter zījes. This title cannot be connected with the role of the Uyghur people in eastern Turkistan, however, but with the people called “Uyghur” in Iran, who were Buddhist monks using the “Uyghur” language and the Chinese calendar. In other words, the term “Uyghur” in the later zījes cannot be ascribed to the provenance of this calendar, but to the group using this calendar in Iran.

The fourth chapter attempts to elucidate the reason for the continued use of the Astronomical System Tallying with Heaven, an “unofficial” astronomical system, until the Yuan period. For this purpose, we deal with the tenth-century Chinese divination text of a Dunhuang fragment (P. 4071) which provides insights into the historical context of the astronomical system in the Chinese astral tradition. This text concerns the horoscopic astrology of Mesopotamian origin which was transmitted into China in the Tang period (618-907), at the latest. The Astronomical System Tallying with Heaven, in the document, was used to calculate the positions of heavenly
bodies for casting a horoscope. The text includes multiple religious aspects and shows strong Daoist influences. The “western” astral knowledge was transmitted with “foreign” religions such as Buddhism and Christianity—especially the Church of the East—and naturalized in China in connection with Daoism, a Chinese indigenous belief. Viewing the Astronomical System Tallying with Heaven in this context, we are able to understand the fact that it appears as one of the main sources of the Daoist-informed Chinese calendar in the Zīj-i Īlkhānī. Some elements of this “western” astral knowledge transmitted into the realm of the Chinese dynasties, therefore, returned to the western regions during the Mongol period.

The fifth chapter pursues the socio-political context of the dialogue between Naṣīr al-Dīn al-Ṭūsī and the sage of Cathay. In the eastern realm of the empire, time was closely linked to the heavenly mandate, so considerable importance was attached to calendar-making as one of the foremost apparatuses to maintain legitimacy. The astronomical system li 曆 consisted of multiple components as follows: (1) “astronomical canon,” the compendium of astronomical computation, (2) “calendar,” defining the beginning, length and divisions of time, and (3) the “annual almanac,” which combined astrological annotation with the calendar and which was distributed annually over the whole realm. In contrast, the rulers of the western realm had not historically paid high regard to the regulation of time due to regional, cultural, and religious diversity. The zīj—one of the representative genres of astronomical literature in the Islamicate world—usually assigns a chapter to calendars and their mutual conversion. The incorporation of the Chinese “calendar” can be interpreted as an attempt to integrate the Chinese astronomical system into an Islamicate astronomical handbook. Among the multiple components of the li, however, only the aspect of the “calendar” was represented in the zīj. In the West, separated from its political connotations, the li was treated as “a” calendar in the zīj and included for conversion with other indigenous calendars. Al-Ṭūsī might not, however, have originally intended to accept the Chinese astral knowledge from the sage merely as “a calendar.” One of the main purposes of compiling the zīj was to cast horoscopes. The Astronomical System Tallying with Heaven—one of the two main sources of the Chinese calendar in the Zīj-i Īlkhānī—was for horoscopic astrology. While horoscope astrology
was transmitted into China in the Tang period, this branch of astrology had flourished in the Islamicate world since the early period of the ‘Abbāsid dynasty (750-1258). Under these circumstances, horoscopic astrology must have been the element that secured “commensurability” between the Muslim polymath and the sage of Cathay in their astronomical dialogue. This is why an unofficial astronomical system compiled in 8th century China came to be adopted as one of the “dialogue texts” in 13th century Iran. Al-Ṭūsī seems not to have been benefited much through this dialogue, however. The development of the zījes can be regarded as a series of challenges to improve the Ptolemaic astronomical canons such as the Handy Tables used by East Syrian Christians, who likely had an important role in transmitting western astral sciences into China. In consideration of this context, it is natural that Ṭūsī should not be satisfied with the “out-of-date” knowledge brought by the sage of Cathay. This phase of the cross-cultural dialogue between the Muslim polymath and the sage of Cathay is reflected in the contents of the Chinese calendar in the Zīj-i Īlkhānī.

The textual criticism of the Chinese calendar in the Zīj-i Īlkhānī commences with the sixth chapter, which is assigned to the explanatory remarks for the edition, translation, and commentary of the text. At first, we explain the nine manuscripts of the Zīj-i Īlkhānī used for textual criticism, and categorized them into the five versions: the original, annotated (original with marginal annotation), embedded (annotation embedded into the text), revised (independently both of annotated and embedded versions), contaminated (by other) versions. Apart from the original and revised versions, each version shares some common annotation—which appears in the text in the embedded version. We should also pay close attention to the Persian transcription of Chinese technical terms in the contents, which has significant value from a linguistic standpoint. Persian transcriptions of Chinese terms are identified by considering the Chinese phonology of the period.

The seventh chapter provides us with the translation of the text of the Chinese calendar in the Zīj-i Īlkhānī, consisting of twelve sections. The description first defines the units of time. It then explains the year and its division according to the solar motion, and the beginning of the month according to the lunar motion. These sections are followed by discussion of the mean
motions of the Sun and Moon, and their anomalies. These enable us, in the tenth section, to define the intercalary month in a year to accord the solar year to the lunar month. The final two sections are assigned to astrology and its conversion to the Persian and Hijri calendars with an extensive table.

On the basis of the translation in the previous chapter, the eighth chapter provides a commentary on its contents. Through this commentary, it clarifies that, while the calendar basically follows the Revised Great Enlightenment Astronomical System—the official astronomical system in the period of the compilation of the Zīj-i Īlkhānī—in terms of the principal astronomical constants, it makes uses of some methods, derived from the Astronomical System Tallying with Heaven—the “western” astronomical system in the Tang period—to simplify the calculation. On the other hand, we also find a few elements which cannot be identical with any of the aforementioned astronomical systems. Al-Ṭūsī probably brought these elements from his observation data on which the major part of the Zīj-i Īlkhānī was based. Therefore, the Chinese calendar of the Zīj-i Īlkhānī cannot be considered the direct translation of some Chinese original, but the very product of the dialogue and of al-Ṭūsī’s own knowledge.

The final and ninth chapter is for the Persian edition of the calendar. The earliest extant manuscript in London is taken as the basic text of this edition. The edition also provides us with the variants of the other eight manuscripts both in texts and tables. Through the variants, we can trace the transition of the text as a “living document” from the original to the other versions.

Throughout the whole nine chapters, we can narrate a history of the Chinese calendar in the Zīj-i Īlkhānī, which can be expressed as the two-way exchange of astral sciences across Eurasia. The horoscopic astrology was transmitted into China in the Tang period along with “foreign” religions, and naturalized in China in congruence with Daoism. In this process, the Astronomical System Tallying with Heaven was compiled. Then, in the 13th century, knowledge of this astronomical system was brought back to the western regions by a Daoist sage of Cathay with the Mongols, and, as a result of the dialogue between the sage and al-Ṭūsī, several calculation methods of the system were reflected in the “Chinese” calendar in the Zīj-i Īlkhānī. Their dialogue might have been framed in terms of the horoscopic astrology, the element allowing them to
overcome the “incommensurability” of the two astral sciences. However, al-Ṭūsī was not satisfied with the sage’s outdated content. In consequence, the Chinese astral sciences were only represented as a calendar in the Zīj-i Īlkhānī. Even though the bulk of the dialogue between the sage of Cathay and the Muslim polymath concerning the two astral sciences remains unrecorded, a minute study of the calendar can broaden our understanding of cross cultural exchanges in Eurasian scale.

Post-Doctoral Fellow, ERC Project: “Mobility, Empire and Cross Cultural Contacts in Mongol Eurasia”, the Hebrew University of Jerusalem

イェルサレム・ヘブライ大学ERCプロジェクト「モンゴル時代における移動・帝国・文化接触」ポスドク研究員