INDIAN JYOTIṣA THROUGH THE LENS OF CHINESE BUDDHIST CANON

BILL M. MAK*

ABSTRACT This paper attempts to compare the astronomical content of the Chinese Buddhist texts with the extant Indian astronomical works in Sanskrit, and to thereby analyze the development of Indian astronomy from a historical and text-critical perspective. Based on this analysis, the author points out that Indian astronomy may be divided largely into three periods: 1. Old (Vedic period to 3rd century CE); 2. Transitional (ca. 6th century), and; 3. New (8th century onward). Within the Chinese Buddhist corpus, each of these three periods is characterized by different equinoctial coordinate (vernal equinox), astral system and descriptions of asterisms and planets and so on. This paper focuses in particular on the Mahāsannipatākṣastra which demonstrates the transitional nature of Indian astronomy between the 4th and 6th century and how such transformation might have taken place.

KEYWORDS Indian Astral Science, Indian Astronomy, Indian Astrology, Buddhist Astronomy, Chinese Buddhist Texts

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The origin and development of the Indian astral sciences, like all other bodies of knowledge in ancient India, was shrouded in mystery. Historical events, though meticulously and even laboriously narrated, were often conveniently placed in the mythological past; if dates and numbers are at all given, only the diehard literalists would take the fantastic figures seriously. Thus, as brilliant as works such as the *Paśchastiddhāntikā* (PS) and *Brhatasthānīta* (BS) by the polymath Varāhamihira (505–578 CE), different bodies of astral knowledge were simply juxtaposed against each other with little effort from the author’s part to clarify their precise interrelation. Nevertheless, the evolution of ideas, which knew no sectarian, ethnic or national boundaries, often took place within a complex network of exchange, while disparate elements of the science were accumulated, conflated and distilled naturally through time - a process well observed by philologists and scholars in the history of science. As we attempt to reconstruct a genealogy of ideas, some precautions must however be made. While the internal textual evidences are often the most intuitive, an overreliance on them proves to be extremely hazardous, especially since later writers consciously or unconsciously blur bodies of knowledge into a homogenous whole, with motives ulterior to the texts themselves and are not immediately apparent to the readers. This is particular true for the ancient Indian texts which are full of organic interpolations, and whose authors had very little historical sense.

As far as the extant *jyotisa* literature is concerned, external evidences often shed new lights. These include parallel materials in works outside the textual lineage, as well as translations in other languages. One of the most remarkable bodies of materials which has so far been largely overlooked and is yet to be thoroughly examined is the Buddhist *jyotisa* tradi-

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1 The paucity of historical documents in all fields of Indian studies is generally noted (Sen 2005: 176). As Kieschneck pointed out, this could be due to the “ephemereness of the materials writing is inscribed on,” such as palm leaves and birch bark (Kieschneck 2003: 166). In the case of *jyotisa*, as with the rest of the traditional Vedic lore, much of the knowledge was perhaps transmitted orally and preserved through a sophisticated system of mnemonic which called for a formidable feat of memory, instead of written forms which were generally deemed unorthodox or unworthy (Staal 1986).

2 Varāhamihira’s seminal work on Indian astronomy, the PS, consists of five different treatises, Pañcāśī, Rūṣāla, Vāśisṭha, Śāraṇa, and Vaiśakha. Their contents overlap with each other. Similarly, the BS contains chapters describing horoscopy or solar-based astrology, juxtaposed against the more archaic lunar astrology. On the positive side, as some may argue, this reflects the Indian’s penchant for intellectual pluralism, as illustrated by the variety of calendars which existed in the subcontinent throughout the millennia (Sen 2005: 317–333).

3 Notable works in this direction with focus on the Chinese materials were pioneered by Needham, as presented in his monumental *Science and Civilization in China*. However, as such comparative studies of parallel materials benefit from what Sen described as “asymmetry of records”, Needham’s results inevitably depend on the “chronological priority” of materials, which does not necessarily reflect the historical reality (Sen 2005: 176).

4 Some preliminary but notable attempts to analyze this body of Buddhist astral materials have been made by Eberhard 1940, Zehra 1956 and Niit 2004. Eberhard and Zehra’s approach is largely philological, while Niit’s scientific. Arguably, both approaches are necessary and in addition, a thorough comparison with the parallel materials in the Sanskrit sources is a desideratum.

5 While Brahmanism prima facie remains the main point of reference for much of the subsequent development of Buddhism, some recent research suggests that a significant amount of Buddhist materials may be connected to the Greater Magadha or the “pre-Aryan” substratum culture of the South Asian subcontinent. At present, we do not have enough knowledge to identify the source of the indigenous Indian *jyotisa* (hence, also Buddhist *jyotisa*), Vedic or pre-Vedic. For discussion on the Greater Magadha culture from which Buddhism was born, see Bronkhorst 2007: 265–275.

6 The question why *jyotisa* materials, often irrelevant, if not antithetical to the Buddhist teachings, were incorporated into the Buddhist texts is a curious one and a number of strategies may be seen in the examples (pp. 8–9). The topic will be dealt in depth in another paper of mine in print, titled “Indian *jyotisa* (astronomical/astrological) materials in Chinese Buddhist Translations: Why they were there in the first place?” presented at the symposium “Cross-Cultural Transmission of Buddhist Texts: Theories and Practices of Translation”, University of Hamburg, Jul 23, 2012.

7 The astronomical materials have been treated extensively in Zehra 1957. At the present, only a few Sanskrit fragments of the relevant passages have been identified (Hoernle 1906: 100–108, passim; Searle 2005: 5–10).
pliances associated with the Vedas (vedânga). Its contents correspond roughly to our modern understanding of astrology and astronomy which were originally not so clearly distinguished from each other as in most ancient civilizations. The prevalent classification of jyotisa works follows the tripartite scheme of ganita (mathematical astronomy), horâ (genethlological astrology or horoscopy) and samhitâ (miscellaneous divinations). From the little that is left within the Vedic corpus, we know that jyotisa was originally conceived as a science concerning matters such as agriculture, religious rites and the mantic lore, affairs which fall within the domain of the "Vedic priestly astronomers". As it gradually developed into a specialized and practical science which all traditional pundits were trained into, it is but natural that the materials were classified according to their applications.

A more historically rigorous but contentious approach was attempted by Pingree, who classified Indian jyotisa based on the assumed places of origin of the materials, which fall largely into five historical periods: i) Vedic (ca. 1000–400 BCE); ii) Babylonian (ca. 400 BCE–200 CE); e.g., Vedângajyotisa (VJ)); iii) Greco-Babylonian (ca. 200–400 CE); e.g.,

Yavanajâtaka (YJ); iv) Greek (ca. 400–1600); e.g., Aryabhatiya, PS; and v) Islamic (ca. 1600–1800). Pingree's scheme is the fruit of a lifetime's work dedicated to the comparison of astronomical materials of different ancient cultures, including Babylonian, Egyptian, Greek, Indian and Arabic. While many of Pingree's arguments are sound and logical, some critics maintain that "the problem of transmission is far too complex to be settled or explained."

A less speculative and more scientific way of classifying the jyotisa texts is to examine the scientific contents described therein. Due to the precession of equinoxes (at about one degree in seventy-two years), the shifting point of reference in different jyotisa texts have been noted: a) Kritikâ (1250 BCE); Taittirîyasa, Athravadaparâsarsya, VJ; b) Bhrânti (1300 BCE); VJ; c) Asvini (300 BCE); BS. Although this phenomenon is well recognized by scholars of Indian texts, its implication has not yet been examined thoroughly, possibly since the materials of the different stages appear to be hopelessly conflated. Nonetheless, this observation is in fact not only helpful toward disentangling the confused Indian materials, but turns out also to be a unique way of making sense of the Chinese corpus as we shall see.

A summary of the above three types of classification of Indian jyotisa materials is as follows:

1. The earliest Sanskrit astral text of Greco-Babylonian origin, was thought to be the Yavanajâtaka dated by Pingree to be 2409/250 CE, with an Greek exemplar dated possibly earlier in 149/150 CE (Pingree 1960: 8–11). These dates however have been shown to be apocryphal in Mak 2013a, 2013b, and 2014 and the alleged antiquity and "Greekness" of the work need to be re-examined. Nonetheless, the Greek-Indian astral science can be said to be firmly established in India by the fourth century as the zodiacal coordinate was adopted in the Aryabhatiya (499 CE).

2. Subbarayappa 2008: 60–1. Indeed, Pingree's over-emphasis on Babylonian elements in Indian jyotisa has been shown to have led the much admired savant into making some grave mistakes. The most striking example would be Pingree's edition of the 79h chapter of the Yavanajâtaka (YJ), which Pingree emended heavily. As K.S. Shukla later pointed out, most of Pingree's emendations are incorrect and unnecessary; the original readings in Pingree's apparatus were in fact mostly correct (Shukla 1989). For a summary of criticisms and new interpretations of the YJ based on the evidences from a newly discovered manuscript, see Mak 2013a, 2013b, 2014. Indian scholars in general are not in favor of simple periodization although "newer elements" such as planetary astrology (horai) are generally recognized to be of foreign origin and placed sometimes in a period as late as the sixth century CE (Subbarayappa 2008: 51, 59–62).

3. Yano 2011: 130. Subbarayappa gave a slightly earlier date of 1600 BCE based on the description of the summer and winter solstices in the VJ (C. 1200 BCE) at the middle of Aškêl and the beginning of Dhanishtî respectively (Subbarayappa 2008: 61, 459). Pingree on the other hand, appeared to have disregarded this fact and somewhat arbitrarily dated the VJ as ca. 400 CE on the ground of various features of the language of the text as well as its astronomy which "reflects that of Mesopotamia in the Achaemenid period" (Pingree 1981: 10).

a. Based on genre (Varāhamihira, 6th century CE)
   i) Gaita: Pañcasiddhāntika (PS)
   ii) Hork: Bṛhatājātaka (B)
   iii) Samhitā: Bhṛatsamhitā (BS)

b. Based on origin (Pingree 1978)
   i) Vedic (ca. 1000–400 BCE)
   ii) Babylonian (ca. 400 BCE–200 CE): Vadan-gyotisa (VJ)
   iii) Greco-Babylonian (ca. 200–400 CE): Yavanajātaka (YJ)
   iv) Greek (ca. 400–1600 CE): Aṣṭabhaṇjya, PS
   v) Islamic (ca. 1600–1800 CE)

c. Based on the position of the vernal equinox
   a) Kṛttīkā (350 BCE): Taṭṭirīyā-s, Atharvaveda parisīṣṭa, VJ, BS
   b) Bhārani (1300 BCE): VJ
   c) Aṣvini (300 CE): PS, BS

**Chinese Translations of Jyotisa Materials**

One of the key advantages working with the Chinese Buddhist translation is that the materials are often dated and their textual history (at least the translations, and in some cases, also the original) are carefully documented. The earliest surviving text containing extensive jyotisa materials is Zhi Qian’s translation of Śrīdāla-kāravadvāda (SKA), titled Modengjia jing 勝登伽經 (320 CE).17 In this work, the twenty-eight nakṣatras or the Indian lunar mansions, the nine luminaries (gra-ha-s), as well as astronomical measurements such as the so-called Metonic cycle and the gnomonic measurements throughout the year are given.18 Subsequently, for the next four hundred years or so, new jyotisa and more sophisticated materials such as the planetary descriptions and the Zodiac were progressively introduced. By the eighth century, most of the basic Indian jyotisa materials attested in the works of Varāhamihira and Aṣṭabhaṇjya, such as the Hellenistic weekday order, the horoscopes, the ephemerides, and basic calendrical techniques are all found in the Chinese translations.

Within this corpus, the MSN represents a transitional stage between the old and the new, where new materials were tentatively introduced without much elaboration.

An overview of the key Chinese translations containing Indian jyotisa materials are given as follows (Fig.1):

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17 The astral materials are found in the last three parivaṣṭa-s (5, 6, 7) of this text. T1300/21.404b–405b.
18 T1300/21.399c–400b.
The Transitional Character of MSN

Within the Chinese translation of the MSN, three chapters (parivarta-s) – Ratnaketu, Sūryagarbha and Candragarbha, contain materials relevant to the present study.20 While all of them contain materials of Indian jyotisha unmistakably in character, they each have a different “flavor”, reflecting likely their different sources, dislocated in place and time. The differences among the three chapters will be discussed under the following headings: a) Intertextuality; b) Representation of the lunar mansions; c) Number and order of the luminaries; d) Zodiac; e) Astronomical measurements.

a) Intertextuality

The jyotisha materials in the three chapters of MSN were “weaved” into the text as part of the Buddhist narrative, attributed all to different sources, giving thus MSN its mixed and intertextual character: i) Jyotirasa (Ratnaketu)21; ii) Jyotirasa/Kharoṣṭha/Garga (Sūryagarbha); iii) Buddha/Brahma (Candragarbha). Broadly speaking, jyotisha materials were incorporated into the Buddhist texts somewhat apologetically in the early phase.22 Thus in the Ratnaketu, the astrological and astronomical knowledge expressed through the mouth of Jyotirasa, was shown to be inferior to Buddha’s knowledge and was thus repudiated. However, according to the Mahāyāna worldview, jyotisha, as with the case of other non-Buddhist knowledge, is considered a form of expedient (apāya). So long as such knowledge was employed for the benefits for sentient beings, though not considered as genuine Buddhist teachings per

20 Only fragments of some chapters of the MSN in Buddhist Sanskrit survived. The Chinese and Tibetan translations are our only source of this text which is said to be an important Mahāyāna work containing 100,000 stotras according to Chinese records (T49:103a, T50.434b, T55.550a). For the textial history of the translation and the various redactions, see Husawawa 13001: 35, Tsubasaki 1978, Braarvig 1993: xx-xii. The extant Sanskrit materials and the philological issues involved with their translations are discussed in my forthcoming paper “Silk Road Transmission of Astronomical Lore to China - Indian, Chinese and Central Asian elements in Mahāsaṃghikā-Puṣpadātu” (T3997). It appears that some of the parivarta-s of the MSN were circulating independently in both its Indic form and in Chinese translation before the final compilation of the Chinese MSN was made toward late sixth century CE. An example of this would be an abridgement of the Ratnaketu, which was retitled as Baoxing tingjiao jing (Jing Jiao Jiao Jing) (T402). See also remarks on other abridgements in Kaiyuan Shi jiaosu lu (Kaiyuan Shi Jiao Su Lu) (T2154:55.652a).

21 Lévi was amongst the first who proposed the reconstruction Suvirasu on the basis of the Chinese translation guangwei 光辉 (Lévi 1905: 253–255). Other reconstructions such as Dvīparāśra have also been suggested (Zenba 1957: 116, fn.8). The name Jyotirasu, however, is well attested in the Gilgit ms. as the name of a Brahmin sage who later became a Buddhist bodhisattva. Elsewhere in the MSN, jyotirasu appears also as the name of a kalpa (Sāgaramati-parivarta T3902:68c–69a, T10001:512b–513a). In other Mahāyāna texts, it was also the name of a deity, a Nāga king, other Brahmin sage(s) and Bodhisattvas, as well as the name of a gem as widely attested in the Sanskrit epics.

22 Similarly, also the Śīka. The Buddha (cf. Śrūnabhūpihulasutta) and the vinaya forbade the monastics to practice astrology as a living and astrologers were often made fun of especially in the Pali Canon and the Abgama texts.

23 While the question of whether the unequally-spaced twenty-eight nakṣatras system precedes the equally-spaced twenty-seven one or vice versa remains unsettled, earliest descriptions of the nakṣatras-s as in the Tattvartha-samhitā (4.301–3) and the Aharavaveda (AVS9.7.1–5) enumerate twenty-eight instead of twenty-seven. The twenty-eight nakṣatras system is found only much later in the Chinese translation, suggesting as far as Buddhist jyotisha is concerned, the twenty-eight nakṣatras system appears to precede the twenty-seven nakṣatras system. This, however, does not necessarily contradict the claim that the nakṣatras-s have an indigenous origin in India as many of their names suggest close connection to the Indian agricultural and ritualistic practices (Subbarayappa 2008: 84). The system(s) of lunar mansions can simply be based on the natural observation of lunar position against the stars, hence the sidereal cycle between twenty-seven and twenty-eight days (c. 27.32 days).

24 T(397)33.276a. The passage begins with the sage Kharoṣṭha describing how Kṛttikā was placed as the prime among the nakṣatras-s. But the astrological description begins with Bhūrāṇī – which as the text describes, because the Moon conjuncts with the nakṣatras at the beginning of kṣapa of the eighth month (full moon day closest to autumnal equinox). This system is likely inherited from a later time when Bhūrāṇī replaced Kṛttikā as the equinoctial point, reflected also in the “updated” coordinates of Vṛṣabha (Yano 2011: 126–7).

25 That is, about 1° eastward shift per year along the ecliptic, or about 936 years per each of the twenty-seven equally-spaced nakṣatras-s, or roughly 929 years per each of the twenty-eight nakṣatras-s if they are evenly divided.

26 See fn. 12 for problem of the dating of the Yavanajātaka, supposedly the Greco-Indian work in Sanskrit which contains the earliest references to the horoscope which begins with Aries (meṣa, whose astronomical coordinate is equivalent to Aṣvinī).
<table>
<thead>
<tr>
<th>Chapter</th>
<th>First mansion</th>
<th>Contents (D=descriptive; P=predictive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T397–9</td>
<td>Jiao 仼 (- Kṛttikā)</td>
<td>D: mole in body part</td>
</tr>
<tr>
<td>T402</td>
<td>Mao 皁 (- Kṛttikā)</td>
<td>P: On individual (character and longevity) based on birth</td>
</tr>
<tr>
<td>T397–14 Sūryagarbha</td>
<td>Mao 皁 (- Kṛttikā)</td>
<td>D: i) Presiding deity; ii) Name; iii) Number of stars; iv) Shape of asterism; v) Span in degrees; vi) Objects for worship</td>
</tr>
<tr>
<td>T397–14 Sūryagarbha Fasc. 41</td>
<td>Wei 鬢 (- Bhaṣṭra)</td>
<td>P: i) General Divination; ii) On sickness; iii) On individual based on birth; iv) On individual based on conception...</td>
</tr>
<tr>
<td>T397–15 Candragarbha</td>
<td>Jiao 仼 (- Kṛttikā)</td>
<td>D: Kārnavāvihāra - two sets of correspondence between mansions and Asian kingdoms</td>
</tr>
</tbody>
</table>

Fig.2 Lunar mansions in the MSN

27 By later standard, the Chinese translation Jiao 仼 is associated with the nakṣatra Citra, not Kṛttikā. However, by comparing the original text with Kṛttikā indeed. The Chinese lunar lodge system begins with Jiao customarily (Śīrāj-Tiawangzhu 52.6.1.7.8.), Narendranayak has must mixed the two systems together. The discrepancy was noted by Congyì 釁 about five hundred years later (Xu 2008: 201c). Zhuo noted also the discrepancy but did not make any connection between the two systems (Zhuo 1957: 105). For the differences between the Chinese lodge and the Indian lunar mansion, see Neetham 1959: 242f. A comparison of T397–9 and T402 is given as follows. (The numbers follow the conventional Indian order as presented in AV 19.7.1–5, Kārnavāvihāra of BS 14.1, and Nakṣatrayās of BS 15):

<table>
<thead>
<tr>
<th>T397–9</th>
<th>T402</th>
</tr>
</thead>
<tbody>
<tr>
<td>E: 仼 (12), 月 (13), 仼 (14), 仼 (15), 仼 (16), 仼 (17), 仼 (18)</td>
<td>E: 仼 (1), 仼 (2), 仼 (3), 仼 (4), 仼 (5), 仼 (6), 仼 (7)</td>
</tr>
<tr>
<td>S: 仼 (5), 仼 (6), 仼 (7), 仼 (8), 仼 (9), 仼 (10), 仼 (11), 仼 (12)</td>
<td>S: 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10)</td>
</tr>
<tr>
<td>W: 仼 (16), 仼 (17), 仼 (18), 仼 (19), 仼 (20), 仼 (21)</td>
<td>W: 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10)</td>
</tr>
<tr>
<td>N: 仼 (19), 仼 (20), 仼 (21), 仼 (22), 仼 (23), 仼 (24), 仼 (25)</td>
<td>N: 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10), 仼 (10)</td>
</tr>
</tbody>
</table>

28 This later retranslation is practically identical to T397–9 with the notable exception that it contains twenty-seven nakṣatra-s instead of twenty-eight. As expected, Alijiit was missing; its customary Chinese correspondence Niu 牝 was however present, corresponding instead to Sūrya. Zheten considered this a mistake of the translator’s part trying to fit the twenty-seven nakṣatra-system into the twenty-eight one. It appears to me that the translator must have considered his version to be more precise, given that Alijiit and Niu do not refer to the same stars after all (Yano 1980a: 81–2). Moreover, the Indic version which T402 was based on could have been revised already since text like XJ of roughly the same period shows an unambiguous preference for the twenty-seven nakṣatra system.

30 T(397–15)13.373a. The presentation of seven graha-s appears to be consistent throughout Candragarbha. Remarkably, although the seven graha-s were mentioned in the prose section only, the protective power of only the twenty-eight nakṣatra-s and the twelve rāja-s were emphasized in the verse section of T(397–415)13.342b.
31 The order of the luminaries in one passage in the Chinese translation of the Sūryagarbha resembles that of the Chinese, thus putting some doubt as to the source of the material. The five elements in the waxing Tāṭāy system corresponding to the five planets are typically presented in the order of wood (Jupiter), fire (Mars), earth (Saturn), metal (Venus) and water (Mercury) (Cullen 2011: 218–251).
33 The earliest Hellenistic weekday order (० जै गै यै बै) evident in the earliest Sanskrit work extant is found in YJ 79.52–54, dated during the early centuries of the common era (Pingree 1978: 1.3, see also remarks in Mak 2008: 116–119). For discussion on the order of the luminaries and the origin of the planetary weekday order, see Neugebauer 1969: 168–170.
34 Although there have been claims of vague references to the nakṣatra-s and the luminaries, the five planets were neither enumerated nor discussed in details in the Rgveda or even in the VJ (Subbarayappa 2006: 92). However, Pingrey’s comment that “there is no astronomical literature as such from this period” (Pingrey 1981: 8), discounting all possibilities of references of astronomical interests might have been too dismissive.
person. Naradrayāsa. Furthermore, in the Sūryagarbha, no definition or even mention was made with regard to the horoscope – one of the main purposes of the Zodiac. Horoscopy (or horā as it was known to the Indians from the Yājurveda onward) was certainly known and widely practiced in India at that time as it was gradually replacing the older lunar astrology, subsumed under the general category saṃhitā in Varāhamihira’s BS. Nonetheless, the astronomical/astrological passages in the Sūryagarbha indicate that the zodiacal signs were used as coordinates which were carefully incorporated into the lunar mansion-based astrology. At any rate, the enumeration of the twelve zodiacal signs beginning with Aries (equivalent to Avinī) represents the latest stage of astronomical observation if the precession of equinoxes is taken into consideration.

<table>
<thead>
<tr>
<th>Sign</th>
<th>English</th>
<th>Sanskrit</th>
<th>T397–13 Sūryagarbha</th>
<th>T397–14 Candragarbha (十二政)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☔️</td>
<td>Aries</td>
<td>meṣa</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☐️</td>
<td>Taurus</td>
<td>vṛṣa</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☊</td>
<td>Gemini</td>
<td>mithuna</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☋</td>
<td>Cancer</td>
<td>karkāṣτa(ka)</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☐️</td>
<td>Leo</td>
<td>śīna</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☜️</td>
<td>Virgo</td>
<td>kanyā</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☩️</td>
<td>Libra</td>
<td>tulā</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☐️</td>
<td>Scorpio</td>
<td>vṛṣcika</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☋</td>
<td>Sagittarius</td>
<td>dhanvin</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☩️</td>
<td>Capricorn</td>
<td>makara</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☩️</td>
<td>Aquarius</td>
<td>kumbha</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
<tr>
<td>☩️</td>
<td>Pisces</td>
<td>mīna</td>
<td>'aridhiṣṭhāna</td>
<td>'aridhiṣṭhāna</td>
</tr>
</tbody>
</table>

Fig.3 Zodiac in MSN

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Regardless of who the translators of these two passages actually were, the materials were apparently fairly new to the translator(s) since the translation style was not yet fixed at this stage. The phonetic transcriptions appear inconsistent, though it cannot be decided whether such inconsistency should be attributed to the translator or the scribe(s).

36 T(397–14)3.373n. Also l3.342a for alternate transcriptions.

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e) Astronomical measurements

One of the most intriguing pieces of information we can glean from the astronomical passages of the Sūryagarbha of the MSN concerns the gnomonic measurements and the day-night ratio (Fig.4):

<table>
<thead>
<tr>
<th>Month</th>
<th>Night-length (muhārta)</th>
<th>Day-length (muhārta)</th>
<th>Length of shadow at midday (pada)</th>
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<tbody>
<tr>
<td>1</td>
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<td>14</td>
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<td>6</td>
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<tr>
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<td>5</td>
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<td>0.5</td>
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<tr>
<td>12</td>
<td>17</td>
<td>13</td>
<td>10</td>
</tr>
</tbody>
</table>

Fig.4 Day-night ratio and gnomonic measurement in MSN

Although rather unfortunately the height of the gnomon itself is not given in the text, the day/night ratio at the summer solstice described (18:12) is possible only when observed at around 32°30' N. As this ratio has been noted in a number of other Mahāyāna texts, some scholars had suggested that these works could have been composed or at least mainly circulated near the Northwest frontier of present India, where it is now known as the Gandhāra re-

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38 T(397–14)13.280b–281a. For the application of the gnomon to establish the east-west line and cardinal in traditional Hindu astronomy (e.g., Sūryasiddhānta), see Subbarayappa 2008: 179f, 181f–185, 187f–189. The height of the gnomon is almost invariably 12 angula in works as early as the Arthashastra (Il.20.10), a tradition attested also in some Chinese jyotisha texts. Note the unit in the MSN is given as pada rather than angula 4f.  
39 The “month” here is assumed to correspond to the Indian ones. The enumeration begins with the eighth month when the day and the night are of equal length, hence autumnal equinox.
40 Figure for the twelfth month is emended here from the original twelve. The function here, with the assumption of the fifth month and the eleventh month as the summer and winter solstices respectively, suggests that the figures for the tenth and twelfth month should be identical (Nita 2004: 167 fn.11).
CONCLUSION

The jyotisa materials gleaned from the Chinese Buddhist translations (ca. 250–1000 CE) captured the evolution of Indian Buddhist jyotisa throughout the first millennium of the common era in three distinct stages: old, transition, and new (Fig. 5). Without venturing into the questions of the true sources of Buddhist jyotisa, the old and new types of materials can be readily distinguished through criteria such as the presentation of the nakṣatra-s, the luminaries and the Zodiac. Unlike the traditional Indian jyotisa materials where materials disjunct in locale and time were often conflated, some of the ancient Indian jyotisa materials were preserved in the Indian Buddhist jyotisa texts as a result of the orthodox character of the Buddhist texts. As Indian Buddhist jyotisa underwent its own development, lagging often a few centuries behind its Hindu counterpart, the Chinese translations preserved nonetheless many popular texts once in circulation in India and subsequently exported to China through Central Asia and the Silk Roads, resulting in a rich and valuable collection of "historical snapshots."

41 Similar measurements are found also in other Chinese Buddhist translations such as the Shifangjā jìng (時奉紀) (1794) and the Modengjīng jìng (Modeaôo-ki) (1360). Since the length of the gnomon was given in 1360, some Japanese scholars have claimed the location of the text to be at 43° N, suggesting Samarthartha to be a potential candidate for the place of origin of the text or at least the interpolation. See Shino Shinza, 賀茂寺， "Nōjūkōchūshû-ko no den'ya", in Tōyō tetsugakusshi kenkyū, 近東史学研究 (Kyoto: Kōbunsha, 1928). Quoted also in Yabuishi Kiyoshi, "Indian and Arabian Astronomy in China," in Silver jubilee volumes of the Zhihuan-Kagakukokushin kōgaku (Kyoto: Nishihara, 1954), 585. With a different set of calculations taking into consideration the errors, Nis measured the latitude to be around 90° N instead (Nis: 2004: 122–113). It should be noted that the day-night ratio given in the Sūryagrabha is essentially the same as T1300.

42 Thus according to Pingree, the Indian authors were simply "copying blindly" the ratio which is of Babylonian origin, due to what Yano put rather mildly as "conservatism" (Pingree 1963: 232; Yano 1968b: 24–26). For the history and the arithmetico-astrological implication, see Neugebauer 1957: 183. It is worth noting that the Almagest itself did not adopt this simple ratio and as Neugebauer remarked, the "primitive schemes" of the Babylonians were not tolerated by the Alexandrians.

43 It may be noted even in the Vrṣamīyadeśa, conflicting sets of data may juxtapose against each other. Thus, while Vṛṣamīyadeśa presented the standard 2:3 ratio of longest/shortest day, Vṛṣamīyadeśa presented another set of data which suggests a lower, and therefore, more accurate geographical latitude (Pingree 1979b: 11: 238–410).

As a sixth century compilation of Mahāyāna texts, the Mahāsāṃnipātasūtra (MSN) preserved much of the old Vedic (or possibly pre-Vedic) jyotisa materials (e.g. the lunar astrology of twenty-eight nakṣatra-s) as its predecessors did, while at the same time introducing new elements such as the Zodiac and the new astronomical coordinates. The three chapters containing jyotisa references reveal the accretive and interpolative nature of the materials, as suggested by the mixture of the heterogeneous and apparently incompatible astronomical and astrological data. Parallel development may also be noted in the contemporaneous Bhūtaśrīlīlī of Varāhamihira where the older lunar astrology and the newer horoscope were juxtaposed against each other, with the former gradually supplanted by the latter and eventually subsumed under the general category "samhitā". Such new materials in the MSN, on the other hand, appeared to be rather tentative, suggesting possibly that the Buddhist authors and compilers did not yet have full access to the most advanced Indian jyotisa at that time. It was only by the eighth century CE when the tantric astrological works began to capture the attention of the Indian, Serindian and Chinese Buddhists, leading to an astonishing outpour of new materials in Chinese translation related mostly to horoscope (hōn). This new science demanded a more sophisticated form of calendrics (e.g. avara-se) and mathematical astronomy (e.g. ephemerides for determining planetary positions needed in the casting of horoscopes). The Chinese unfortunately never showed sufficient interest in their underlying principle to develop a local tradition of Buddhist astral science. As a result, this form of astral science failed to rival its indigenous counterparts in East Asia. The East Asian Buddhist astral tradition nonetheless survived most notably in Japan where traces of this legacy of intellectual exchange may still be noted today.

<table>
<thead>
<tr>
<th>Chinese translations</th>
<th>Astrology</th>
<th>Astronomy</th>
<th>Indian correspondences</th>
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<tr>
<td>Old</td>
<td>&gt; 300 CE</td>
<td>Lunar astrology/ twenty-eight nakṣatra-s</td>
<td>VE=Kṛttkā (2530 BCE), 5 years yuga</td>
</tr>
<tr>
<td></td>
<td>Sūryagrabha</td>
<td></td>
<td>Tattvātīṣaśāhī, AVŚ, Gargaśāhī</td>
</tr>
<tr>
<td>Transitional</td>
<td>ca. 600 CE</td>
<td>Lunar astrology/ Zodiac / 7–8 grasbs</td>
<td>VE=Kṛttkā/ Bhaṛaṇi (1300 BCE)</td>
</tr>
<tr>
<td></td>
<td>Sūryagrabha</td>
<td></td>
<td>VJ, BS</td>
</tr>
<tr>
<td>New</td>
<td>ca. 800 CE</td>
<td>Horoscopies based on 9 grasbs/27 nakṣatra-s</td>
<td>VE=Āśvinī (ca. 300 CE), śiddhānta, ephemerides</td>
</tr>
</tbody>
</table>

Fig.5 Three stages of Indian jyotisa in Chinese Buddhist translation during first millennium CE.
Abbreviations


ŠKA Sārdvadakaravādāna. Various Chinese transl., including T1300 by Zhi Qian.

SS Siddhāntārṇavani of Bhāskara II.


XYJ Xiuyao jing 信耀經 by Amoghavajra 不空. T1299.

YJ Yavanājñātaka by Sphujidhvaja. Edited by Pingree 1978b. For critical remarks and analysis of the last chapter, see Mak, Bill M. 2013a, 2013b, 2014.

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漢譯佛典中的印度天文學

論文摘要 本文以漢譯佛經為出發點，對現存梵語印度天文學典籍進行比對，並從歷史與文獻角度分析印度天文學的發展軌跡。作者指出印度天文學大致可分為三個階段，分別為前期（吠陀時代至公元三世紀）與後期（約六世紀）和後期（八世紀後），其中每一階段在漢譯佛經皆反映出不同的星辰數字。系統、星宿描述等具體性質的內容。本文以《大集經》為例，說明印度天文學於四至六世紀如何轉型，並在轉型期的佛教文獻中留下各種線索。

關鍵詞 印度天文學 印度星占佛教天文學 漢譯佛經

* 作者為日本京都大学佛教学研究中心／人文科学研究所副教授
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