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INDIAN *JYOTIṢA* THROUGH THE LENS OF CHINESE BUDDIST CANON[§]

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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 *Mahāsaṃnipātasūtra* 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.[1] 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 *Pañcasiddhāntikā*(PS) and *Bṛhatsaṃhitā*(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.[2] 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 blend 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 *jyotiṣa* literature is concerned, external evidences often shed new lights.[3] 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 *jyotiṣa* tradition.[4] This heterodox tradition has all along emulated its mainstream Indian counterparts, preserving by and large an older form of Indian *jyotiṣa* which is no longer extant.[5] From the third to eleventh century CE, a large amount of these Indian Buddhist *jyotiṣa* materials was translated into Chinese and incorporated into various Chinese Buddhist canons. For a variety of reasons, both esoteric and exoteric, astronomical and astrological passages were incorporated in a number of highly popular Buddhist texts.[6] Thus, the Chinese Buddhist translations became a time capsule of Indian *jyotiṣa* materials, albeit an inadvertent one, throughout a large part of the first millennium of our era.

1 The paucity of historical documents in all fields of Indian studies is generally noted (Sen 2005: 176). As Kieschnick pointed out, this could be due to the "emphemerality of the materials writing are inscribed on", such as palm leaves and birch bark (Kieschnick 2003: 166). In the case of *jyotiṣa*, 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, Pauliśa, Romaka, Vāsiṣṭha, Sūrya, and Paitāmaha. 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 coexisted in the subcontinent through 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).

In this paper, particular attention is given to a text called the *Mahāsaṃnipātasūtra* (MSN), translated into Chinese at various stages from the late fourth to the late sixth century CE. This text contains extensive references to Indian *jyotiṣa* and appears to have been extremely popular in Central Asia where Buddhism spread from its native India to the rest of Asia. Leaving aside the Central Asian and Chinese influences which might have crept into the text by the time it was translated into written Chinese, the text consists basically of Indic exemplars no longer extant.[7]

Classification of *jyotiṣa* literature

Before we proceed to the Chinese materials, let us look at how the *jyotiṣa* tradition was understood within the context of Indian culture, both societal and intellectual, based on the textual materials extant. Traditionally, *jyotiṣa* was considered one of the six auxiliary disci-

4 Some preliminary but notable attempts to analyze this body of Buddhist astral materials have been made by Eberhard 1940, Zenba 1956 and Niu 2004. Eberhard and Zenba's approach is largely philological, while Niu'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 *jyotiṣa* (hence, also Buddhist *jyotiṣa*), Vedic or pre-Vedic. For discussion on the Greater Magadha culture from which Buddhism was born, see Bronhkorst 2007: 265–275.

6 The question why *jyotiṣa* 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 *jyotiṣa* (astronomical/astrological) materials in Chinese Buddhist Translations- Why were they 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 Zenba 1957. At the present, only a few Sanskrit fragments of the relevant passages have been identified (Hoernle 1916: 100–108, *passim*; Saerji 2005: 5–10).

plines associated with the Vedas (*vedāṇga*).[8] 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 *jyotiṣa* works follows the tripartite scheme of *gaṇita* (mathematical astronomy), *horā* (genethlical astrology or horoscopy) and *saṃhitā* (miscellaneous divinations).[9] From the little that is left within the Vedic corpus, we know that *jyotiṣa* 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".[10] 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 *jyotiṣa* based on the assumed places of origin of the materials, which fall largely into five historical periods:[11] i) Vedic (ca. 1000–400 BCE); ii) Babylonian (ca. 400 BCE–200 CE): e.g., *Vedāṇgajyotiṣa* (VJ); iii) Greco-Babylonian (ca. 200–400 CE): e.g.,

8 Jyotiṣa was compared to the head or the eyes of the Vedic science. VJ(R) 35, VJ(Y) 4; SŚ 1.1.1.10.

9 Pingree 1981: 1. Varāhamihira's terminology for the three branches of jyotiṣa is somewhat different: *jyotiḥśāstram anekabhedaviṣayaṃ skandhatrayādhiṣṭhitaṃ tatkārtsnyopanayasya nāma munibhiḥ saṃkīrtyate saṃhitā / skandhe 'smin gaṇitena yā grahagatis tantrābhidhānas tv asau horānyo' ṅgaviniścayaś ca kathitaḥ skandhas tṛtīyo 'paraḥ* || (BS 1.9). While the meanings of the first and the second categories are clear (*tantra* and *horā*), there was considerable confusion concerning the third. In his commentary to this verse, Utpala interpreted *aṅgaviniścaya* as synonymous to *horā (horā 'nyo' ṅgaviniścayaś ca kathita iti / pratiṣṭhāyātrāvivāhādīnāṃ lagnagrahavaśena ca śubhāśubhaphalaṃ jagati yayā niścīyate sā horā / anyo dvitīyo 'ṅgaviniścayaḥ / horākhyaḥ kathita iti / horāskandho dvitīyaḥ)*; the third category, according to Utpala, was not explicitly named by Varāhamihira. Utpala called this third category śākhā based a verse attributed to Garga (*gaṇitaṃ jātakaṃ śākhāṃ yo vetti dvijapuṅgavaḥ / triskandhajño vinirdiṣṭaḥ saṃhitāpāragaś ca saḥ //*). This interpretation was followed by some scholars and *aṅgaviniścaya* was glossed as "determination of the limbs - as it explains the method of ascertaining by calculation the ascendant and other houses in a natal chart") (Bhat 1981: 5). However, it seems to me that based on the placement of *ca* in Varāhamihira's verse itself *aṅgaviniścaya* is the third category, as it was understood also by some other scholars (Yano 1995: 14, 334 fn.7). Despite the confusion, at least according to Utpala, BS itself falls into this last category (*skandhas taṛtīyo 'para iti / aparas tṛtīyo' yaṃ skandho vakḥyamāṇaḥ śākhākhya iti*) and the contents of the BS suggest that it is simply a collection (hence, *saṃhitā*) of miscellaneous methods of divination. As Yano had pointed out, this view is collaborated in BS 2.2 when the tripartite scheme was reiterated: *grahagaṇitasaṃhitāhorāgranthārthavettā / grahagaṇite pañcasiddhāntikāyāṃ <u>saṃhitāyāṃ phalagranthe</u> horāyāṃ jātakādau granthārthavettā granthajño 'rthajñaś ca / sūtrārthapāṭhakas tadarthavid ity arthaḥ //*. Although some scholars have provided an alternative interpretation of this verse (Bhat 1981: 8), the term *saṃhitā* here appears to describe this third category and was thus glossed by Pingree as "omens" (in addition to the general sense of a "collection" as understood in BS 1.9) as generally understood by the Indians today.

10 Subbarayappa 2008: 2, 81–2.

11 Pingree 1978a: 534.

Yavanajātaka (YJ);[12] iv) Greek (ca. 400–1600): e.g., *Āryabhaṭīya*, 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".[13]

A less speculative and more scientific way of classifying the *jyotiṣa* 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 *jyotiṣa* texts have been noted: a) *Kṛttikā* (2350 BCE): *Taittirīya-s, Atharvavedapariśiṣta*, VJ, BS;[14] b) *Bharaṇī* (1300 BCE): VJ;[15] c) *Aśvinī* (300 CE): PS, BS.[16] 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 confounded 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 *jyotiṣa* materials is as follows:

12 The earliest Sanskrit astral text of Greco-Babylonian origin, was thought to be the *Yavanajātaka* dated by Pingree to be 249/250 CE, with an Greek exemplar dated possibly earlier in 149/150 CE (Pingree 1981: 8–11). These dates however have been shown to be spurious in Mak 2013a, 2013b, 2014 and the alleged antiquity and "Greekness" the work will need to be re-examined. Nonetheless, the Greco-Indian astral science can be said to be firmly established in India by the fourth century as the zodiacal coordinate was adopted in the *Āryabhatīya* (499 CE).

13 Subbarayappa 2008: 60–1. Indeed, Pingree's over-emphasis on Babylonian elements in Indian *jyotiṣa* 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 79th chapter of the *Yavanajātaka* (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 interpretation 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 (*horā*) are generally recognized to be of foreign origin and placed sometimes in a period as late as the sixth century CE (Subbarayappa 2008: xv, 59–62).

14 Yano 2011: 126–7.

15 Yano 2011: 130. Subbarayappa gave a slightly earlier date of 1400 BCE based on the description of the summer and winter solstices in the VJ (c. 1200 BCE) at the middle of *Āśleṣā* and the beginning of *Dhaniṣṭhā* 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).

16 Yano 2011: 130.

a. Based on genre (Varāhamihira, 6th century CE)
   i) Gaṇita: *Pañcasiddhāntika* (PS)
   ii) Horā: *Bṛhajjātaka* (BJ)
   iii) Saṃhitā: *Bṛhatsaṃhitā* (BS)

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

c. Based on the position of the vernal equinox
   a) *Kṛttikā* (2350 BCE): *Taittirīya-s°*, *Atharvaveda pariśiṣṭa*, VJ, BS
   b) *Bharaṇī* (1300 BCE): VJ
   c) *Aśvinī* (300 CE): PS, BS

Chinese translations of *Jyotiṣa* 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 *jyotiṣa* materials is Zhi Qian's 支謙 translation of *Śārdūlakarṇāvadāna* (ŚKA), titled *Modengjia jing* 摩登伽經 (230 CE).[17] In this work, the twenty-eight nakṣatra-s or the Indian lunar mansions, the nine luminaries (*graha*-s), as well as astronomical measurements such as the so-called Metonic cycle and the gnomic measurements throughout the year are given.[18] Subsequently, for the next four hundred years or so, new *jyotiṣa* and more sophisticated materials such as the planetary descriptions and the Zodiac were progressively introduced. By the eighth century, most of the basic Indian *jyotiṣa* materials attested in the works of Varāhamihira and Āryabhaṭa, 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 *jyotiṣa* materials are given as follows (Fig.1):

17 The astral materials are found in the last three *parivarta*-s (5, 6, 7) of this text. T(1300)21.404b–405b.

18 T(1300)21.399c–410b.

230 CE	*Mātaṅgasūtra* 摩登伽經 (= ŚKA)	T1300 by Zhi Qian 支謙	twenty-eight nakṣatras from *Kṛttikā*, 9 *graha-s*, Metonic cycle, monthly gnomic measurement
265–316 CE	*Akālakālasūtra* 時非時經	T794 by Ruo Luoyan 若羅嚴	gnomic measurement by half-month
308 CE	*Śārdūlakarṇāvadāna* (ŚKA) 舍頭諫太子二十八宿經	T1301 by Dharmapāla 竺法護	Descriptions of twenty-eight nakṣatra-s, explanation of units
[396?]<586 CE	MSN 大集經	T397 by Dharmak ema/ Narendrayaśas	12 zodiacal signs
401–413 CE	*Mahāprajñāpāramitopadeśa* 大智度論	T1509 by Kumārajīva 鳩摩羅什	Four types of month
550–567 CE	Commentaries to *Abhidharmakośa*	T1559/1644 by Paramārtha 真諦	Reference to geocentric theory in India (*Āryabhaṭīya?*)
645–664 CE	Various works	T1545/1558/1563/ 1579 by Xuanzang 玄奘	comprehensive introduction of Indian cosmology, calendrics and planetary size
702 CE	*Mahāmayūrīdhāraṇīrāja* 孔雀咒王經	T985 by Yijing 義淨	Nine grahas
710–727 CE	Various tantric works	T1304,1310,1311 by Yixing 一行	Horoscopy
718 CE	**Navagrahakaraṇa* 九執曆	Gautamasiddha 瞿曇悉達	Siddhānta algorithms as in PS[19]
742–764 CE	*Xiuyao jing* 宿曜經	T1299 by Amoghavajra 不空	27 nakṣatra-s from Aśvinī, weekday astrology
806–866 CE	*Qiyao rangzai jue* 七曜攘災決	T1308 by *Kaṃkuṭa (?) 金俱吒	Planetary ephemeris

Fig.1 Key *jyotiṣa* materials in Chinese Buddhist translation

19 See also discussions on Indian calendars (Sen 2005: 179)

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 *jyotiṣa* 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 *jyotiṣa* 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) Jyotīrasa (*Ratnaketu*)[21]; ii) Jyotīrasa/Kharoṣṭha/Garga(*Sūryagarbha*); iii) Buddha/Brahma (*Candragarbha*). Broadly speaking, *jyotiṣa* 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 *Jyotīrasa*, was shown to be inferior to Buddha's knowledge and was thus repudiated. However, according to the Mahāyāna worldview, *jyotiṣa*, as with the case of other non-Buddhist knowledge, is considered a form of expedient (*upāya*). So long as such knowledge was employed for the benefits for the sentient beings, though not considered as genuine Buddhist teachings *per* *se*, it was generally tolerated and in some cases even encouraged. Thus in the *Sūryagarbha*, *jyotiṣa* knowledge was employed to relieve the plight of the *Nāga*-s. In the later texts, *jyotiṣa* knowledge was often embedded within Buddhist materials of esoteric nature and was blatantly presented as authentic teachings of the Buddha with no justification given. Such is the case of the *jyotiṣa* materials found in the *Ratnaketu* where such knowledge was simply presented as an exchange between the Buddha and Brahma. The different contexts in which *jyotiṣa* materials were incorporated in the three chapters of the MSN largely coincide with this general development. As we shall see, there are further evidences which suggest the transitional character of the MSN, resulting in the heterogeneity of its *jyotiṣa* materials.

b) Lunar mansions

In almost all cases where the lunar mansions were mentioned, *Kṛttikā* was given as the first of the twenty-eight *nakṣatra* (Fig.2).[23] In one case, *Bharaṇī* was unexpectedly mentioned as the first.[24] As mentioned already earlier, the changing order of the lunar mansions (from *Kṛttikā* of 2350 BCE to *Bharaṇī* 1300 BCE) reflects the shift of vernal equinox, i.e. the precession of 26000 year-cycle.[25] The MSN thus reflects largely the old *jyotiṣa* materials which took *Kṛttikā* as the first *nakṣatra*. In India, some time during the early centuries of the common era, *Aśvinī* (equivalent to Aries) was established as the first *nakṣatra*.[26] This is in fact reflected in the order of the zodiacal signs, which as we will see later, was adopted in the *Sūryagarbha*, as well as in almost all Chinese translations made after the MSN.

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 ślokas according to Chinese records (T49.103a, T50.434b, T55.550a). For the textual history of the translation and the various redactions, see Hasuzawa 130(1): 35, Takasaki 1978, Braarvig 1993: xxv-xli. The extant Sanskrit materials and the philological issues involved with their translations are discussed in my forthcoming paper **"Silk Road Transmission of Astrological Lore to China - Indian, Chinese and Central Asian elements in Mahāsaṃnipātasūtra (T397)."** 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 retranslated as *Baoxing tuoluoni jing* 寶星陀羅尼經 (T402). See also remarks on other abridgements in *Kaiyuan Shijiao lu* 開元釋教錄 . T(2154)55.652a.

21 Lévi was amongst the first who proposed the reconstruction *Śucirasa* on the basis of the Chinese translation *guangwei* 光味 (Lévi 1905: 253–305). Other reconstructions such as *Dyutirasa* have also been suggested (Zenba 1957: 116, fn.8). The name *jyotīrasa*, however, was well attested in the Gilgit mss. as the name of a Brahmin sage who later became a Buddhist bodhisattva. Elsewhere in the MSN, *jyotīrasa* appears also as the name of a *kalpa* (Sāgaramati-parivarta T(397)13.68c–69a, T(400)13.512b–513a). In other Mahāyāna texts, it was also the name of a deity, a Nāga king, other Brahmin sage(s) and Bodhisattva(s), as well as the name of a gem as widely attested in the Sanskrit epics.

22 Similarly, also the ŚKA. The Buddha (cf. *Sāmaññaphalasutta*) and the *vinaya* forbade the monastics to practice astrology as a living and astrologers were often made fun of especially in the Pāli Canon and the Āgama texts.

23 While the question of whether the unequally-spaced twenty-eight *nakṣatra* system precedes the equally-spaced twenty-seven one or vice versa remains unsettled, earliest descriptions of the *nakṣatra*-s as in the *Taittirīya-saṃhitā* (4.10.1–3) and the *Atharvaveda* (AVŚ19.7.1–5) enumerate twenty-eight instead of twenty-seven. The twenty-seven *nakṣatra* system is found only much later in the Chinese translation, suggesting as far as Buddhist *jyotiṣa* is concerned, the twenty-eight *nakṣatra* system appears to precede the twenty-seven *nakṣatra* system. This, however, does not necessarily contradict the claim that the *nakṣatra*-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)13.276a. The passage begins with the sage Kharoṣṭha describing how *Kṛttikā* was placed as the prime among the *nakṣatra*-s. But the astrological description begins with *Bharaṇī* – which as the text describes, because the Moon conjoins with the *nakṣatra* at the beginning of *kṛṣṇapakṣa* of the eighth month (full moon day closest to autumnal equinox). This system is likely inherited from a later time when *Bharaṇī* replaced *Kṛttikā* as the equinoctial point, reflected also in the "updated" coordinates of VJ (Yano 2011: 126–7).

25 That is, about 1° eastward shift per year along the ecliptic, or about 963 years per each of the twenty-seven evenly-spaced *nakṣatra*-s, or roughly 929 years per each of the twenty-eight *nakṣatra*-s if they are evenly divided.

26 See fn. 12 for problem of the dating of the *Yavanajātaka*, supposedly the Greco-Indian work in Sanskrt which contains the earliest references to the horoscope which begins with Aries (*meṣa*, whose astronomical coordinate is equivalent to *Aśvinī*),

Chapter	First mansion	Contents (D=descriptive; P = predictive)
T397–9 *Ratnaketu*	*Jiao* 角 (~ *Kṛttikā*)[27]	D: mole in body part
T402 (*Ratnaketu* parallel)[28]	*Mao* 昴 (~ *Kṛttikā*)	P: On individual (character and longevity) based on birth
T397–14 *Sūryagarbha* Fasc. 41	*Mao* 昴 (~ *Kṛttikā*)	D: i) Presiding deity; ii) Name; iii) Number of stars; iv) Shape of asterism; v) Span in degrees.; vi) Objects for worship
T397–14 *Sūryagarbha* Fasc. 42	*Wei* 胃 (~ Bharaṇī)	P: i) General Divination; ii) On sickness; iii) On individual based on birth; iv) On individual based on conception…
T397–15 *Candragarbha*	*Jiao* 角 (~ *Kṛttikā*)	D: *Kūrmavibhāga* - two sets of correspondence between mansions and Asian kingdoms

Fig.2 Lunar mansions in the MSN

27 By later standard, the Chinese translation *Jiao* 角 is associated with the *nakṣatra Citrā*, not *Kṛttikā*. However, by comparing the astrological content presented here and those of ŚKA and Amoghavajra's XYJ, we can see that the original text starts with *Kṛttikā* indeed. As the Chinese lunar lodge system begins with *Jiao* customarily (*Shiji–Tianguanshu* 史記天官書), Narendrayaśas must have mixed the two systems together. The discrepancy was noted by Congyi 從義 about five hundred years later X(528)28.211c. Zenba noted also the discrepancy but did not make any connection between the two systems (Zenba 1957: 105). For the differences between the Chinese lodge and the Indian lunar mansion, see Needham 1959: 242ff. A comparison of T397–9 and T402 is given as follows. (The numbers follow the conventional Indian order as presented in AVŚ 19.7.1–5, *Kūrmavibhāga* of BS 14.1, and Nakṣatravyūha of BS 15):

T397–9	T402
E: 角(12), 亢(13), 氐(14), 房(15), 心(16), mūla尾(17), 箕(18)	E: kṛttikā昴(1), rohiṇī畢(2), mṛgaśirṣa觜(3), ārdrā參(4), punarvasu井(5), puṣya鬼(6), āśleṣā柳(7)
S: 井(5), 鬼(6), 柳(7), 星(8), 張(9), 翼(10), 軫(11)	S: maghā星(8), pūrvaphālgunī張(9), uttaraphālgunī翼(10), hasta軫(11), citrā角(12), svāti亢(13), viśākhā氐(14)
W: 奎(26), 婁(27), 胃(28), 昴(1), 畢(2), 觜(3)	W: anurādhā房(15), jyeṣṭhā心(16), mūla尾(17), pūrvāṣāḍhā箕(18), uttarāṣāḍhā斗(19), śravaṇa牛(20), dhaniṣṭhā女(21)
N: 斗(19), 牛(20), 女(21), 虛(22), 危(23), 室(24), 壁(25)	N: śatabhiṣaj危(22), pūrvabhādrapadā室(23), uttarabhādrapadā壁(24), revatī奎(25), aśvinī婁(26), bharaṇī胃(27)

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, *Abhijit* was missing; its customary Chinese correspondence *Niu* 牛 was however present, corresponding instead to *Śravaṇa*. Zenba 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 *Abhijit* and *Niu* do not refer to the same stars after all (Yano 1986a: 81–2). Moreover, the Indic version which T402 was based on could have been revised already since text like XYJ of roughly the same period shows an unanimous preference for the twenty-seven *nakṣatra* system.

c) Luminaries

Nothing much can be said about the planets, or literally luminaries of the MSN since no details except their enumeration is given. It is nonetheless noteworthy that eight and seven *graha*-s were represented in the *Sūryagarbha* and the *Candragarbha* respectively, with the notable omission of Ketu, in contrast to the nine *graha*-s which were already prevalent in India as seen in the work of Varāhamihira's works of roughly the same period:

Sūryagarbha[29]: Jupiter-Mars-Saturn-Venus-Mercury-Sun-Moon-Rāhu (8)
Candragarbha[30]: Sun-Moon-Mars-Jupiter-Saturn-Mercury-Venus (7)

In the case of the *Sūryagarbha*, while Rāhu was appended to the end as expected, Ketu was absent;[31] the order in the *Candragarbha* appears to be inconsistent and haphazard, characteristic of early Buddhist *jyotiṣa*.[32] Moreover, neither enumeration shows any trace of Hellenistic influence which is found in later Chinese works such as Amoghavajra's XYJ.[33] All in all, the way the luminaries were represented in the MSN reflects an early stage of Indian *jyotiṣa*, where the *graha*-s were not presented as astral objects of particular significance.[34]

d) Zodiac

The twelve zodiacal signs seen in the Chinese *Sūryagarbha* and *Candragarbha* of the MSN are the earliest representations of the Zodiac within the Chinese corpus extant. The names of the zodiacal signs were translated both by meaning and by their Sanskrit pronunciation in the two respective chapters (Fig.3), which were possibly spuriously attributed to the same

29 T(397–14)13.282a.

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 *raśi*-s were emphasized in the verse section of T(397–15)13.342b.

31 The order of the luminaries of one passage in the Chinese translation of the *Sūryagarbha* resembles that of the Chinese's, thus putting some doubt as to the source of the material. The five elements in the *wuxing* 五行 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).

32 See Yano 1986b: 27–28.

33 The earliest Hellenistic weekday order (☉ ☽ ♂ ☿ ♃ ♀ ♄) evident in the earliest Sanskrit work extant is found in YJ 79.52–54, dated during the early centuries of the common era (Pingree 1978b: I.3, see also remarks in Mak 2013b: 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 *Ṛgveda* or even in the VJ (Subbarayappa 2008: 92). However, Pingree's comment that "there is no astronomical literature as such from this period"(Pingree 1981: 8), discounting all possibilities of references to astronomical interests might have be too dismissive.

person, Naredrayaśas.[35] 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 YJ 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 *Aśvinī*) represents the latest stage of astronomical observation if the precession of equinoxes is taken into consideration.

Sign	English	Sanskrit	T397–13 Sūryagarbha[36]	T397–14 Candragarbha（十二辰）[37]
♈	Aries	meṣa	持羊之神	彌沙
♉	Taurus	vṛṣa	持牛之神	毘利沙
♊	Gemini	mithuna	雙鳥之神	彌偷那
♋	Cancer	karkaṭa(ka)	蟹神	羯迦吒
♌	Leo	siṃha	師子之神	線呵
♍	Virgo	kanyā	天女之神	迦若
♎	Libra	tulā	秤量之神	兜邏
♏	Scorpio	vṛścika	蝎神	毘梨支迦
♐	Sagittarius	dhanvin	射神	檀尼毘
♑	Capricorn	makara	磨竭之神	摩伽羅
♒	Aquarius	kumbha	水器之神	鳩槃
♓	Pisces	mīna	天魚之神	彌那

Fig.3 Zodiac in MSN

35 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(397–13)13.281a.

37 T(397–14)13.373a. Also 13.342a for alternate transcriptions.

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 gnomic measurements and the day-night ratio (Fig.4):[38]

Month[39]	Night-length (*muhūrta*)	Day-length (*muhūrta*)	Length of shadow at midday (*pada*)[40]
1	16	14	8
2	15	15	6
3	14	16	4
4	13	17	2
5	12	18	0.5
6	13	17	2
7	14	16	4
8	15	15	6
9	16	14	8
10	17	13	10
11	18	12	12
12	17	13	10

Fig.4 Day-night ratio and gnomic 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 be composed or at least mainly circulated near the Northwest frontier of present India, where it is now known as the Gandhāra re-

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: 119ff, 179–180, 188–190. The height of the gnomon is almost invariably 12 *aṅgula* in works as early as the *Arthaśāstra* (II.20.10), a tradition attested also in some Chinese *jyotiṣa* texts. Note the unit in the MSN is given as *pada* 腳跡 rather than *aṅgula* 指 .

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 (Niu 2004: 107 fn.1).

gion.[41] This claim, however, could be spurious since the 3:2 ratio for the longest and shortest days in a year is a parameter generally adopted among Indian texts, from the YJ (79.31) to the *Arthaśāstra* (II.20.39–42) and could belong to a much older tradition whose origin is outside India.[42] What we can say with much greater certainty is that this particular set of data is the legacy of the intellectual exchange between India and its foreign neighbors and the Buddhist texts preserved the older materials which were generally eroded away in the mainstream Indian *jyotiṣa* texts.[43]

Conclusion

The *jyotiṣa* materials gleaned from the Chinese Buddhist translations (ca. 250–1000 CE) captured the evolution of Indian Buddhist *jyotiṣa* 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 *jyotiṣa*, 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 *jyotiṣa* materials where materials disjunct in locale and time were often conflated, some of the ancient Indian *jyotiṣa* materials were preserved in the Indian Buddhist *jyotiṣa* texts as a result of the orthodox character of the Buddhist texts. As Indian Buddhist *jyotiṣa* 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 *Shifeishi jing* 時非時經 (T794) and the *Modengjia jing* 摩登伽經 (T1300). Since the length of the gnomon was given in T1300, some Japanese scholars have claimed the location of the text to be at 43° N, suggesting Samarkhand to be a potential candidate for the place of origin of the text or at least the interpolation. See Shinjō Shinzō 新城新藏. "Nijūhachishuku-no denrai" 二十八宿の傳來 in *Tōyō tenmongakushi kenkyū* 東洋天文學史研究 (Kyōto: Kōbundō, 1928). Quoted also in Yabuuti Kiyosi. "Indian and Arabian Astronomy in China." In *Silver jubilee volume of the Zinbun-Kagaku-Kenkyusyo Kyoto University* (Kyoto: Nissha Print, 1954), 585. With a different set of calculation taking into consideration the errors, Niu measured the latitude to be around 39° N instead (Niu 2004: 112–113). It should be noted that the day-night ratio given in the *Sūryagarbha* 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 1986b: 24–26). For the history and the arithmetic/astronomical 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 YJ, conflicting sets of data may juxtapose against each other. Thus, while YJ 79.31 presented the standard 3: 2 ratio of longest/shortest daylight, 79.26 presented another set of data which suggests a lower, and therefore, more accurate geographical latitude (Pingree 1978b II: 228,410).

As a sixth century compilation of Mahāyāna texts, the *Mahāsaṃnipātasūtra* (MSN) preserved much of the old Vedic (or possibly pre-Vedic) *jyotiṣa* 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 *jyotiṣa* 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 *Bṛhatsaṃhitā* of Varāhamihira where the older lunar astrology and the newer horoscopy were juxtaposed against each other, with the former gradually supplanted by the latter and eventually subsumed under the general category "*saṃhitā*". 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 *jyotiṣa* 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 horoscopy (*horā*). This new science demanded a more sophisticated form of calendrics (e.g. *ahargaṇa*) 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.

	Chinese translations	Astrology	Astronomy	Indian correspondences
Old	> 300 CE ŚKA MSN-*Ratnaketu*	Lunar astrology/ twenty-eight *nakṣatras*	VE=*Kṛttikā* (2350 BCE), 5 years yuga	*Taittirīyasaṃhitā*, AVŚ, *Gargasaṃhitā*
Transitional	ca. 600 CE MSN-*Candragarbha* MSN-*Sūryagarbha*	Lunar astrology/ Zodiac / 7–8 grahas	VE=Kṛttikā/ Bharaṇī (1300 BCE)	VJ, BS
New	ca. 800 CE- **Navagrahakaraṇa*, *Xiuyao jing*, *Qiyao rangzaijue*	Horoscopy based on 9 grahas/27 *nakṣatras*	VE=*Aśvinī* (ca. 300 CE), siddhānta, ephemerides	*Yavanajātaka*, *Bṛhajjātaka*, *Pañcasiddhāntikā*

Fig.5 Three stages of Indian *jyotiṣa* in Chinese Buddhist translation during first millennium CE

Abbreviations

AVŚ *Atharvaveda*. Śaukana. Edited by R. Roth and W. D. Whitney. 1856. *Atharvaveda Saṃhitā*. Berlin.

BS *Bṛhatsaṃhitā* by Varāhamihira. Edited by Dvivedī, Kṛṣṇacandra. 1997. *Bṛhatsaṁhitā by Śrī Varāhamihirācārya with the Commentary of Bhaṭṭotpala*. Varanasi: Sampurnanand Sanskrit University.

MSN *Mahāsaṃnipātasūtra*. Chinese trans. by various translators. T397.

PS *Pañcasiddhāntikā*. Edited by David Edwin Pingree and Otto Neugebauer. 1970. *The Pañcasiddhāntikā of Varāhamihira*. København: Munksgaard. Also, edition by Kuppanna Sastry, T.S. 1984. *Pañcasiddhāntikā of Varāhamihira*. Madras: PPST Foundation, 1993.

ŚKA *Śārdulakarṇāvadāna*. Various Chinese trans., including T1300 by Zhi Qian.

SŚ Siddhāntaśiromaṇi of Bhāskara II.

T *Taishō Shinshū Daizōkyō* 大正新修大蔵経. Takakusu Junjirō, Watanabe Kaigyoku (eds.). Tokyo: 1924–1934.

VJ *Vedāṅgajyotiṣa by Lagadha* - (R) and (Y) Recensions. Edited by Kuppanna Sastry& K V Sarma. 1985. *Vedāṅga Jyotiṣa of Lagadha in its Rk and Yajus Recensions*. New Delhi: Indian National Science Academy.

X *Manji Zokuzōkyō* 卍續藏經. Based on Zokyōsho'in (Kyoto ed.) 藏經書院. Taipei: Shinwenfeng 新文豐, 1980. CBETA V3.10 2011/04/01 ed.

XYJ *Xiuyao jing* 宿曜經 by Amoghavajra 不空. T1299.

YJ *Yavanajātaka* 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

麥文彪*

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）、過渡期（約六世紀）和後期（八世紀後），其中每一階段在漢譯佛經都反映出不同的春分點座標、星占系統、宿曜描述等具標誌性的內容。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

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