

SAW Exploratory Workshop: Astral Sciences, Mathematics and Rituals

March 19-20, 2015

The exploratory workshop is organised by **Karine Chemla** (Sphère, CNRS & University Paris Diderot, SAW Project), **Sho Hirose** (Sphère, CNRS & University Paris Diderot, SAW Project), **Agathe Keller** (Sphère, CNRS & University Paris Diderot, SAW Project) and **Daniel P. Morgan** (Sphère, CNRS & University Paris Diderot, SAW Project)

Venue: Paris Diderot University, Condorcet Building
4 rue Elsa Morante 75013 Paris or 10 rue Alice Domon et Léonie Duquet
75013 Paris, <http://sawerc.hypotheses.org/practical-information>

Room 483A

9.30 am-1 pm

I. Description

Ritual is a science of precision. Like any proper performance or game, ritual choreographs action to the beat and bounds of time, and it manipulates symbols with rigorous rules of accounting. The calendar, the timepiece, the tokens, the altars, the counts—to mathematics and the astral sciences are owed the rigor of ritual, one might say, and to ritual, one of the very meanings of these sciences. In this workshop, we will reflect upon the interdependence of ritual, mathematics, and astronomy in the ancient world, giving special attention to the question of astronomical and computational practices unique to the context of ritual.

Which textual resources could help us in this reflection? Chinese sources suggest that this question is worth asking. Indeed, as Zhu Yiwen has established in the context of the SAW project, many ancient commentaries on Confucian Classics develop computations precisely in relation to questions of rituals. Moreover, a 6th century mathematical Classic dealing with the

mathematical knowledge required for Confucian canons gives rituals pride of place. Why and what for? How can the articulation of mathematics and ritual in this context be understood?

Were there specific mathematical computations developed for ritual? In India a Kerala tradition of astrologers using cauri shells both for computations and for casting horoscopes is known—how localized are such practices? Have they developed specific ways of computing or casting horoscopes?

What were the relations between astral sciences and mathematics in the context of ritual? In the Indian subcontinent, for example, the very first texts on astral science (*jyotiṣa*) and mathematics (*ganita*) are related to Vedic ritual, while being wholly distinct in terms of aims and textual genre. When and how then are mathematics or astral science involved in “Vedic” rituals? What are their connections in this context? How different is this from the situation of “Hindu” rituals? Are there Hindu ritual texts containing references to astral science and/or requiring mathematical activities? What about Jain texts?

Further, how did developments in astronomical knowledge affect the timing, contents, or performance of rituals? For example, in early imperial China, the state astronomical office was a subsidiary of the Ministry of Rites, its task being to “observe the phenomena/signs and grant the seasons” according to the sacrosanct precedent of the Sage Kings of old. In practice, this translated to the operation of an observatory for the purposes of observation, testing, record-keeping, omen-interpretation, and briefing as well as a staff of computers, whose job it was to produce a calendar that would realize the synchronization of humanity, the spirits, and Heaven above. Later detached from the Ministry of Rites, how much of this office’s activities went into state ritual *per se*? What other than symbolism was the substance of debate as concerns the role of the astral sciences in ritual? Equally important, what was the situation like beyond the state ritual apparatus, in the performance of personal and popular rites, or in the great religions of Buddhism and Daoism? In the Indian subcontinent, how much did the introduction of horoscopes affect the assessment of “auspicious days” for rituals?

We also need to better understand how different sub-topics within the astral sciences (e.g. astronomy, horoscopy, divination ...) could be related to rituals, and in which circumstances they involved computations. For instance, what elements of the Indian almanach, the *pañcāṅga*, are specifically required for the performance of ritual?

How were technologies like water clocks, calendars, and ephemerides used to regulate ritual time? What sort of empirical questions were raised about these technologies in the context of ritual, and how were they resolved?

The realm is very large according to the definition given to "ritual", and taking into account the long historical span of both India and China, papers then will be on specific case studies addressing some of these questions.

II. Programme

March 19, 2015

9.30 am - 1 pm

Michio Yano (Kyoto Sangyo University, Japan)

Astral sciences and rituals in India with reference to ayana

Abstract: The very primitive system of the *Jyotiṣavedāṅga* turned to a well-established branch of science, namely, *jyotiḥśāstra* ('science of stars'), and it made remarkable progress, especially after the introduction of western astronomy and astrology. We see a drastic change of Indian astrology after the *Yavanajātaka* was translated into Sanskrit some time around the 3rd or 4th century CE. Moreover, after the *Āryabhaṭīya* of Āryabhaṭa numerous texts on mathematical astronomy were produced until a quite recent time. Although the five year cycle (*yuga*) of the *Jyotiṣavedāṅga* was very crude, basic units of time were defined, namely, year, half year (*ayana*), month, half month (*pakṣa*), *tithi*, *muhūrta* (1/30 of a day), and *nāḍikā* (1/60 of a day). The meaning of *ayana* in the context of ritualism, astronomy and astrology changed in history. At the time of *Jyotiṣavedāṅga* the word *ayana* only meant 'a half year', a year being divided into two, *uttara-ayana* ('sun's northern course') and *dakṣina-ayana* ('sun's southern course'). With time, however, the change of the position of the solstices became known to Indian astronomers, and *ayanāṁśa* (degrees of motion of solstices) became an important topic. In the *nirayana* (sidereal) system, planetary longitudes are counted from the fixed ecliptic point *meṣādi* (the beginning of Meṣa) while according to the *sāyana* (tropical) system, the starting point of reference is the true vernal equinox. When one wants to compute the astronomical elements called *vyatīpāta* and *vaidhṛta* which are defined by the true declination of the sun and the moon, one must use the *sāyana* coordinates, while the *yoga*, as one of the five astrological elements, is computed by the *nirayana* system. The majority of traditional Indian calendars (*pañcāṅga*) give the planetary position in the *nirayana* system.

Whether Indian calendars should continue to use the *nirayana* system or switch to the *sāyana* system is a big issue among the traditional calendar makers and ritualists.

Bill Mak (Kyoto University, Japan)

Ritualistic cyclicality in Indo-Greek astral science – Expressions for various modes of time measurement in the Yavanajātaka

Abstract: As a prototypical work of Greco-Indian astral science, the *Yavanajātaka*, in particular, its last chapter (Ch. 79) on mathematical astronomy, encapsulates some key concepts on time measurements which would later become the mainstream elements in the Indian tradition of *jyotiṣa* . Some of these key concepts include the large astronomical cycle known as *yuga*, the smaller cycles of year, season, month, planetary week, day and *tithi*. What distinguishes the *Yavanajātaka* from other extant treatises of the first millennium CE, however, is the fluidity of expression of these astronomical cycles in the text, which suggests the ambivalence of the author in his attempt to blend a heterogeneous body of Greek and Indian astronomical and astral concepts, and to express them in a sound, mathematical manner. Two features of this important chapter which have been overlooked in past studies are: 1) The Indian elements as exemplified by the close resemblance of *tithi*-based astronomical algorithm and the description of the water clock to those of the *Vedāṅgajyotiṣa* and the *Arthaśāstra* respectively;¹ 2) The description of the Lords of year, *ayana*, season, month, week, day and hour which conclude the chapter before the colophon. In this presentation, I would like to suggest the expressions of cyclical time-measures in the text have an unexpressed ritualistic character, which lies beyond the scope of the Greco-Indian genethliacal astrology of the preceding 78 chapters. Beside his concern for comprehensiveness, its author Sphujidhvaja was clearly exposed to the ritualistic significance of these various time-measures from different traditions. While the computation of planetary longitude would be essential to the casting of horoscope, the reckoning of days (*ahargaṇa*) and various “Lords” suggests a synthesis of Greek and Indian rituals which focus on astral worship.

Respondent: *Daniel Morgan* (Sphère, CNRS & University Paris Diderot, SAW Project)

¹ Based on readings from new manuscript [Mak 2013].

March 20 2015
9.30 am- 1 pm

Yiwen Zhu (Sun Yatsen University, China)

Commentaries on ritual numbers through different mathematical knowledges in 7th century China

Abstract: Numbers of ritual [*Lishu*禮數] are a key part of ritual in ancient China. Some studies have been done on it based on ritual texts. On the other hand, Liu Hui劉徽, who commented on the *Nine Chapters on Mathematical Procedures* [*Jiuzhang suanshu*九章算術], understood this book as a derivant of *Rites of Zhou* [*Zhouli*周禮], and further as a part of Confucianism [*Ruxue*儒學]. This fact points to the relationship between ritual and mathematics in general. However, it is still not clear how scholars in the past understood this relationship in relation to numbers of ritual. On the basis of analyzing different commentaries on numbers of ritual respectively in a mathematical book called *Mathematical Procedures on Five Canons* [*Wujing suanshu*五經算術], and in Confucian canons, this talk aims at revealing different relationships between numbers of ritual and mathematical knowledges established by different scholars in seventh century China. Furthermore, the special role of numbers of ritual compared to other kind of numbers within the interdependence of ritual and mathematics will be discussed.

Setsuro Ikeyama (Kyoto Sangyo University, Japan)

The calculation of Vyatipata, an astrological phenomenon in Indian astrology

Abstract: *Vyatipata* is a special, basically bad, moment in Indian astrology. It is defined in relatively later treatises as the moment when the magnitudes of the declinations of the sun and moon become equal. I will introduce the explanation and calculation of *Vyatipata* described in the *Grahalāghava* and *Pāṭasāraṇī* both composed by Gaṇeśa, a 16th century Indian astronomer.

Respondent: *Sho Hirose* (Sphère, CNRS & University Paris Diderot, SAW Project)