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Historical Note

The Origin of the 28 *Nakṣatras* in Early Indian Astronomy and Astrology

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Abstract

The reason for the selection of the original lists of 28 *nakṣatras* or lunar mansions for the lunar zodiac of ancient India and China has remained an unexplained mystery for more than 2,000 years. This paper sets out to explain when and why these 28 divisions of the lunar zodiac were initially selected and show how they were linked to the Indian and Chinese Bronze Age calendars and the Vedic year of 360 days.

It has been almost universally presumed by modern astronomers and assyriologists that this early 360 day year or calendar adopted by the ancient cultures from Egypt and Mesopotamia to the Orient was merely used as a schematic guide for calculations and astrological predictions but with little impact on more general day to day life and with no proper link to the correct movements in the ancient skies of the sun or moon or stars.

However this study of early Vedic Indian astronomical systems will show that the development of their unique set of *nakṣatras*, *tithis*, and other systems for keeping track of the moment of Moonrise were all founded on and related to an acceptance that the Vedic calendar of 12 months of exactly 30 days did reflect a virtual or true astronomical reality. Once it is understood that their astronomical developments were based directly on a 360 day year it can be seen that their systems were both accurate and precise. Please note that references made to monthly and daily movements of the Moon will relate only to average movements, and not to exact daily movements which are quite variable.

Key words: Amenhotep I, Assyria, Babylon, Bronze Age, Chinese lunar mansions, Coral growth rings, Enuma Elis, Indian astronomy, Jupiter cycle, Mul Apin, *Muhūrta*, *Nakṣatra*, Sidereal month, *Tithi*, Eruption of Thera, 360 day year, Ur III, Vedic calendar.

1. Introduction

The study is based on a range of texts referring to the 360 day calendar and early astronomical developments. W. St Chad Boscawen's 'The Bible and the Monuments...' discusses early Mesopotamian literature including an account of the Deluge from the Epic of Gilgames and descriptions of the astronomical calendar from the Enuma Elis. Rev John Jackson is a good source of pre Roman Latin traditions concerning the chaotic state of the lunar calendars before the reforms of King Numa.

'Issues in Vedic Astronomy and Astrology' ed. Pandya, Dikshit and Kansara, covers many different aspects of the early Indian astronomy, while the work by Peng Yoke Ho looks at Lunar Mansions from a Chinese perspective. Japan, Korea, Tibet, Mongolia, and Arabia all have associated astronomical and astrological traditions of a lunar zodiac and of lunar mansions. The 360

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day year has been widely discussed in relation to early Hebrew and Christian traditions. Mayan and other South American cultures had a very rich selection of ancient calendars. Their use of a 360 day year was noted by William Whiston in his work from 1696. It is unlikely that ancient Indian and Babylonian astronomical themes and their own 360 day year could have spread to the New World by diffusion.

2. *Nakṣatras*

> 'The Sun and Moon were shut in Darkness and the 28 *nakṣatras* were fixed.'
>
> Song of the Snow Ranges, Milarepa, (trans)

The true nature of the 360 day calendar of the ancient World has been a matter of dispute for centuries but irrespective of the role they played in astronomy there must have been a date and a year when they were first introduced. These calendars were very precise with a solar year of 360 days composed of exactly 12 months of 30 days. Calendars of this design appeared in the records and traditions of more than a dozen ancient civilisations. Assyriologists and modern astronomers argue they represented some sort of schematic device, with the 30 day months providing only a rough approximation for the true lunar cycles. They always prefix the 360 day year with terms such as ideal or model with the implication that such ancient calendars in no way reflected real astronomical observations of the movements of the Sun and the Moon.

The widespread occurrence of records of a 360 day year together with links with the story of the Biblical Deluge, encouraged William Whiston in 1696 to argue that a real 360 day year had existed before the Flood. Since then Christian and Hebrew scholars and certain Catastrophists such as Immanuel Velikovsky, J G Radolf, and Donald Patten have looked for evidence that could establish the reality of the 360 day year, hoping to find evidence of catastrophic past events to validate stories from the scriptures or for catastrophic myths recorded by Seneca and other classical authors.

Some of the richest sources for the 360 day calendar are the Indian *Ṛgveda* texts and the Mul Apin and Enuma Elis traditions of ancient Assyria. Mesopotamian records were more concerned with the solar zodiacal divisions, while Indian astronomers and astrologers divided their zodiac into lunar mansions or *nakṣatras*. These roughly daily divisions of the lunar zodiac originally became an important element of ancient astrology and remain a key feature of Oriental astrology to this day. But whereas many Indian astrologers have adopted a list of 27 mansions, Chinese astrologers remained loyal to an older list of 28 lunar stations known as Hsiu, or Xiu. The stations of the Moon were of limited interest to the Greeks, Egyptians and the Babylonians but they did represent a special feature of Arabian astronomy. There they were named Manazils (Manzil sing.) and it was the older complete set of 28 mansions that Arabian astronomers searched for amongst the stars of the night skies of the Arabian Desert.

Today it is widely accepted that the later list of 27 *nakṣatras* had been derived from the number of days it takes the Moon to complete a 360 degree orbit of the Earth. This is known as the Moon's sidereal orbit and it takes on average 27.27 days (this interval should not to be confused with the longer 29.5 day of the full synodic month). But this leaves unanswered the question of why initially lists of 28 mansions were adopted. Their purpose, and the reason why there had originally been the extra 28th Indian *nakṣatras* named Abhījit appeared to have been lost in the mists of time, but the key to understanding the need for this additional Abhījit has always remained concealed but hidden near by but tangled up within the tradition

In modern times with our 365 day year the Moon travels on average 13.2 degrees in a single day, and it takes close to 360 ÷ 13.2 = 27.27 days

to complete a 360 degree sidereal cycle. As already noted this number is widely accepted as the number which is rounded down to produce the shorter list of 27 *nakṣatras*. But in Vedic times the 365 day solar year wasn't recognised and wasn't used. They exclusively used the 360 day calendar with a year composed of exactly 12 months of 30 days. For a Vedic year we must change the calculation to establish a different sidereal period.

We know that for the Vedic year the Moon would have moved 13 degrees in a day so to calculate the time required for the Vedic lunar sidereal period we just need:

$360 \div 13 = 27.69$ days

This is why 28 lunar mansions were adopted in India and China and the other regions that numbered their lunar mansions at the time when they had a year of exactly 12 x 30 days. Later when the 365 day solar year was introduced some Indian astrologers switched to the shorter lists of 27 *nakṣatras*, but in China and neighbouring regions the original list of 28 mansions was retained. These two different lists of lunar mansions still remain of fundamental importance in Oriental astrology.

3. The Origin of the 12 Degree Definition of the *Tithi*

At the same time that the new list of 27 *nakṣatras* was introduced the alternative lunar division known as a *tithi* was revised. These divisions had previously represented 1/30th of a lunar month. Today the *tithi* is said to have no logical link to sensible celestial rhythms but its role as a measure of Vedic time could not have been clearer. As 1/30th of a Vedic month a single *tithi* equalled one whole day or a period of 30 *muhūrtas*. Even though its lost some of its significance with the change to a 365 day calendar Indian astronomers and astrologers decided to retain this 1/30th division of the synodic month.

Today a technical definition for a *tithi* is that it is the time taken for the Moon to separate or move 12 degrees in relation to the position of the Sun. With the Vedic year there would have been a 390 degree lunar orbit each synodic month with the Moon on average traveling 13 degrees each day. Meanwhile in this 360 day year the Sun must move just one degree each day. This meant that in Vedic times the Moon would on average move exactly 12 degrees away from Sun for every 24 hour interval or 12 degrees for each Vedic day of 30 *muhūrtas*. So the current '12 degrees of separation' definition for a modern *tithi* matches the precise 12 degree definition for a *tithi* in Vedic times. Needham noted a similar tradition in ancient Chinese astronomy which noted that the Moon moved 13 degrees in a single day, while the Sun moved just one degree.

4. The Vedic Origin of the Indian System used for Naming the Months

Assyrian scholars like to claim that the Babylonian 360 day year was just a schematic aid for bureaucrats although unrecognised in the wider Mesopotamian society. But developments in Indian astronomy demonstrate that the 360 day year and calendar was not only widely accepted it was also used to provide names for the Indian months. In many regions the months are named after the central *nakṣatras*, or mansion, occupied by the month's Full Moon. P V Vartak (p.126) notes in *'Issues in Vedic Astronomy and Astrology …'*.

> They named the lunar months after the *nakṣatras* in the vicinity of which the full moon shone.

This is how the Indian Months got their names. But this system can only work for a calendar in which the twelve 30 day lunar months are synchronised exactly with the 360 days of the solar year. With synchronised months this system would work perfectly. With our modern year of 365 days this month naming system makes no sense. It is difficult to understand how this method

could ever have been applied unless the Vedic calendar was somehow based on real astronomical observations.

If we check Assyrian and Babylonian texts aspects of their lunar cycles match Vedic patterns. In Rising Time Schemes in Babyloian Astronomy 3.1, 2017, Prof John Steele notes an assumption from Mul Apin texts that the Solstices and Equinoxes 'take place on the 15th day of Months I, IV, VII and X in the schematic calendar'. Assuming that the months numbered are real lunar months these records show that there would have been 3 months of 30 days between the Vernal equinox and the Summer Solstice. If it was Full Moon on the 15th of the 1st month it would be Full Moon on the 15th of the IV month, on the 15th of the VII month and on the 15th of the X month.

5. The Vedic Algorithm for Measuring the Time of Moonrise Each day

For early Vedic astrologers and astronomers for whom special attention was given to the movements of the Moon an additional refinement was developed. In India sunrise or a time close to dawn was chosen for the start of a new day. It was different with Middle Eastern traditions where sunset could be regarded as the time to start not only the new day but the new month as well. Since an Indian day was divided into 30 *muhūrtas* they realised that if on the 1st day of the month the (invisible) Moon was rising just after the Sun then the next day the Moon would be rising 48 mins or exactly one *muhūrta* later. On the third day the Moon would rise in the 3rd *muhūrta* and so on until on the 15th day it would be the Full Moon would be rising in the 15th *muhūrta*. This system would have been invaluable for Indian astrologers wishing to enter the position of the Moon into their astrological calculations. The date of the month would act like an algorithm which would always provide a check for the time of Moon rise for every day of the month. With the 30 day month of the Vedic calendar this system would have worked perfectly.

A discussion of the past use of the 360 day year would be incomplete without mention of the strange figures from the *Pañcasiddhāntika* (see Michael Reade, SIS, Review). The tables in this text provide two clear sets of records for the synodical periods of the three outer planets, Saturn, Jupiter and Mars and the two inner planets Venus and Mercury. The tables expressed in days, provide sets of figures consistent with an Earth with a solar year of exactly 360 days. Modern astronomers reluctant to accept such a possibility insist that we should presume that the tables should be interpreted as being measured in degrees despite the authors clear intentions.

If the figures in *Pañcasiddhāntika* come from true astronomical observations they provide special information. The tables could be correct if a 360 day orbit had been derived from a slower spin rate for planet Earth but they do not match the expected figures if a 360 day year had resulted from a change to the Earth's orbit. The figures 372.6 and 393.3 days would still be correct for the outer planets Jupiter and Saturn but the 575.6 day figure for Venus could no longer apply. If the Earth was on a reduced orbit the time taken to circle the Sun would be shorter, so the inner planets would take more time to catch up to complete their synodic cycles. Instead of Venus taking 8 fewer days to catch up with the Earth, it would take 8 additional days so Venus would need close to 592.4 days, or 16 days more to complete its synodic cycle than the figure from the Hindu tables.

6. Dating the Introduction of the 360 day Vedic Year

If the 360 day calendar was such an integral part of the Vedic traditions and we could discover when the 360 day year was first introduced it should help to date the Vedic era. In Assyrian and Babylonian records the combined elements of the 360 day Mul Apin calendar start to appear in the records from Ur III. If dates for

Ur III are correct this would have been towards the end of the 3rd millennium or around 2,200 BCE. We know that Classical writers claimed that a 360 day year without intercalary months was used by the Hyksos rulers in Egypt during the 17th dynasty. It had also been noted that the Ebers Papyrus from the early 18th dynasty had months of 30 days and a year of 360 days without intercalation (Velikovsky, pp 316 – 32). Numerous Classical references state the 360 day solar year continued to be used until around 700 BCE when it was finally set aside by Numa one of the first Kings of Rome.

The synchronised 30 day lunar month of the 360 day calendar may have had a much shorter life than the 360 day solar year. Clube and Napier (1982, p. 231), claimed that the 18th Dynasty Egyptian Pharaoh Amenhotep I had to make substantial changes to the lunar calendar to try to re-establish its connections with the seasons and solar year. We can date Amenhotep I as he reigned in Egypt a generation or so before the catastrophic eruption of Thera. We have dates from tree ring analysis and carbon dating which point to 1628 BCE. If correct this indicates Amenhotep would have revised his Egyptian lunar calendar in about 1700 BCE. From this time forward Bronze Age lunar calendars become increasingly inconsistent and chaotic until they were finally revised at the end of the Bronze Age.

Babylon didn't become an established power until later but the Babylonian Enuma Elis Creation texts describe similar themes and calendar cycles to those found in Mul Apin. A feature of these creation texts was an assumption for the emergence of Jupiter as the pre-eminent astral deities. The introduction of a 12 year Jupiter cycle common to Assyria, India, and China could also have been closely linked with the introduction of a calendar in which each of the twelve months would have been identified with one of the12 steps making up the 12 year Jupiter cycle.

If the 360 day year was discarded in 700 BCE a new list of 27 lunar mansions could have been introduced in India at the same time. The *nakṣatras* linked with the Winter Solstice and Vernal Equinox could also have been rebooted or reassigned in accordance with precession and the prevailing zodiacal signs. (See Maunder and Maunder)

7. Conclusions

I have tried to check how the so called model or schematic calendar was applied by Indian and Assyrian astronomers. In India the 360 day year and 30 day month underpinned almost all astronomical developments in Vedic times. It was not used as if it was a schematic or even virtual calendar it was used as if it represented observed astronomical reality. In part because of a focus on daily lunar divisions of the zodiac it was applied far more rigorously and more clearly than the Assyrian and Babylonian equivalents. Writing in '*Calendars and Years*' edited by John Steele, Lis Brack Bernsen (pp.83-100) proposes that originally the Babylonian 360 day year and 30 day month had been derived from an early 30 day pig rationing scheme (p.92). This seems improbable but so does the alternative that the 360 day calendar was employed in Vedic times because a slower rotation of the Earth's on its axis produced a Solar year with only 360 days.

Back in the 1960's it was believed past rates of rotation for the Earth could be measured through analysis of growth rings in fossil coral (John Wells 1963). However like manned lunar exploration since the sixties, useful advances for rotation data from fossil and coral and shell fish has stalled. Recently new studies have shown, that at least for one creature, an analysis of daily and monthly rings should resolve this problem and allow us to measure in days the length of past monthly and annual cycles (Viola Warter and Wolfgang Muller). Giant Clams can grow up to a meter in width, weigh 200 kg and live for decades.

Their unusual life cycle provide not just daily and monthly lunar tidal rhythms but additional diurnal growth increments. Rahman and Cowx in a study of the incremental growth rings in the otoliths of Hisla Shad went a long way towards demonstrating that the number of days in a lunar cycle can be accurately measured for modern specimens.

An analysis of growth rings for Giant Clams from the Miocene era until the Bronze Age should reveal the lunar cycles for our recent geological past. Later fossils should reveal whether any substantial disturbances happened in historical times. The development of accurate historical tree ring analysis by Prof Michael Baillie of Queens Belfast revolutionised archaeological studies and dating. Perhaps a new impetus could be provided for Bronze Age studies with the introduction of effective historical growth ring analysis from these gentle giants of the tropical seas. If we take recent studies of Giant Clams by Warter and Muller, 2016 there is every indications that their daily and monthly growth rings should provide an accurate record for pre Iron Age lunar astronomical cycles.

As noted at the beginning of this paper I believe the original list of 28 *nakṣatras* was derived from the 27.69, or 27.7 days that the Moon would have taken to complete a Vedic sidereal month. Then how can we be certain that the original older list of 28 lunar mansions was not simply achieved by rounding upwards from the 27.3 days for our modern sidereal month? Fortunately, we can. The Hindu records express the total time taken to complete the Vedic sidereal cycle in Indian *muhūrtas*. These time division similar to the hours used for Western time keeping except that while we have 24 hours in a Gregoria day, there are 30 *muhūrtas* in an Indian day, and each *muhūrta* represented 48 mins. This means that for data derived from the Vedic calendar the basic time unit of 1 *muhūrta* would have exactly matched $1/30^{th}$ of a day or the time by which (on average) the rising of the Moon would have been delayed each day.

Taking the total Hindu number of 831 *muhūrtas* for the Moon to complete a 360 degree sidereal orbit we would have;

831 / 30 = 27.7 days

Weixing notes 831 is the number of *muhūrtas* that has been passed down through Hindu texts (Niu Weixing, 1997) and it confirms that the original list of 28 *muhūrtas* must have originated from the 27.7 days it was anticipated that the Moon would take to encircle the Earth to complete a sidereal lunar cycle . The precision of the 831 sidereal measure demonstrates that the methods applied by early Hindu scholars could be both consistent and accurate when applied within the context of a year of 360 days and the 360 day year was clearly the only year that Vedic astronomers and astrologers recognised at the time of the Early Bronze Age in 2,000 BCE.

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Rejoinder by A K Bhatnagar, Delhi (Email: bhatnagar.ashok@gmail.com)

The Research note analyses the 360 day calendars devised by many ancient cultures, namely Babylonian, Vedic Indian, Chinese and similar calendars possibly used by Mayan and other south American cultures. Considering the common 360-day length of the calendar year then used globally, and the number of lunar Mansions or *nakṣatra* as 28 as used by early oriental astronomers, he puts forth a hypotheses that the solar year actually consisted of 360 Earth-days. In order to accommodate this length of the year, he suggests that the day was of slightly longer duration, implying a slower rate of spin during that period in Earth's history. He makes out a case for a study based on the growth rings for Giant Clams from the Miocene era until the Bronze Age that may reveal the lunar cycles for the recent geological past. In his opinion, their unusual life cycle may provide daily and monthly lunar tidal rhythms and other useful information.

In this connection, a reference is invited to the work of Abhyankar (1993, 1998 and 2005) and Bag (2015) which shows the evolution of the Calendar in India from the Vedic times. They show that the earliest Vedic calendar was tropical in nature consisting of 360 days counted from Winter Solstice. The marker for the event was heliacal rising of Aśvinī *nakṣatra* (star β Arietis). That the months were not lunar is evident from the oldest

tropical month names '*aruṇa, aruṇaraj…'* etc. (*Taittir. Brāh*. 3.10.1.4) and the other set of tropical month names *'madhu, mādhava…'* etc. (*Taittir. Saṃh*. 1.4.14). It is also shown that a correction of 5 or 6 days called *'atirātra'* was applied initially around the Summer solstice time with arrival of the first rains of the Indian summer monsoon at the site of observation . Later this correction was applied as an additional month (*mahasvan,* intercalary month) of 30 days after a cycle of 5 solar years to keep the year beginning in step with winter solstice. The lunar motion was also observed at the same time but was not part of the calendar. Later, the 28 and 27 *nakṣatra* divisions were followed for both the sun and the moon. It is shown by them that such a calendar would have been followed for about a 1000 years after which, the marker for year beginning changed to the full moon in Citra *nakṣatra* as precession had moved β Arietis away from WS. This gave rise to the luni-solar calendar in India, which has undergone numerous changes since then. It is thus clear that the 360 day year length was used for convenience of calculation, which had a correction applied to it so that the average length of the year remained around 365 or 366 days. The actual period of earth's revolution and rotation were more or less the same as they are now (within the accuracy of naked eye observations).

Further, the present studies based on records of ancient eclipses (from 720 BCE) show that the length of the mean solar day increases at an average rate of +1.8 ms per century. Even the rate predicted on the basis of tidal friction is +2.3 ms per century. These are in the sense of Earth's spin slowing down from that time to the present. The author's note suggests that the Earth's spin rate was actually slower than the present rate by an amount such that the Earth's orbital period would be 360 days. It works out to be about 24h 21m. Our present understanding about the underlying causes such as tidal friction and from an effect due to time-varying magnetic dipole of the Earth or other geophysical changes in Earth's core, all put together would not be able to explain the much larger change in the Earth's rotation rate, in reverse order, as required under his paper.

The note however does not provide any direct evidence of a longer Earth day during the Vedic period.

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