Records of *Ketu* in stone inscriptions

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Stone inscriptions seen all over India are engravings on stones giving details on grants, donations and the like. They serve as records of celestial events as well. Two stone inscriptions of AD *1295 (in Sanskrit from Cambodia) and* AD *1792 (in Persian from Srirangapattana near Mysore) refer to Ketu, generally used for the descending node of the Moon's orbit. The positions, as derived from eclipses of the same years, do not match in one case dated* AD *1295. As a coincidence, the second one points to the same location in the sky. Zanab, the word used may imply Ketu or a comet. A thorough search around the position yields the eruption of planetary nebula NGC 7662 as a possible recorded event.*

Stone inscriptions serve as valuable records for historians giving details on genealogy of the rulers apart from donations, grants, self-immolation and heroic deeds. They also trace the development of languages, literature and culture. One of the earliest inscriptions found in Vidisha, Madhya Pradesh, records the visit of a commandant of Alexander. A survey of such inscriptions for astronomical records[1] indicates that about 10% of the inscriptions contain valuable information on celestial events like eclipses. A handful of inscriptions provide details on planetary positions. Here, we discuss two of them with the word *Ketu*.

Ketu or tail is used to refer to the descending node of the Moon's orbit. The ascending node or the head is called *Rahu*. According to mythology, *Rahu* and *Ketu* are the head and tail of a demon attempting to swallow the Sun and the Moon during eclipses. It is fairly common to see the location of *Rahu* mentioned in many records, but not, *Ketu*[1]. This is because it is well known that *Ketu* is exactly 180° away from *Rahu*.

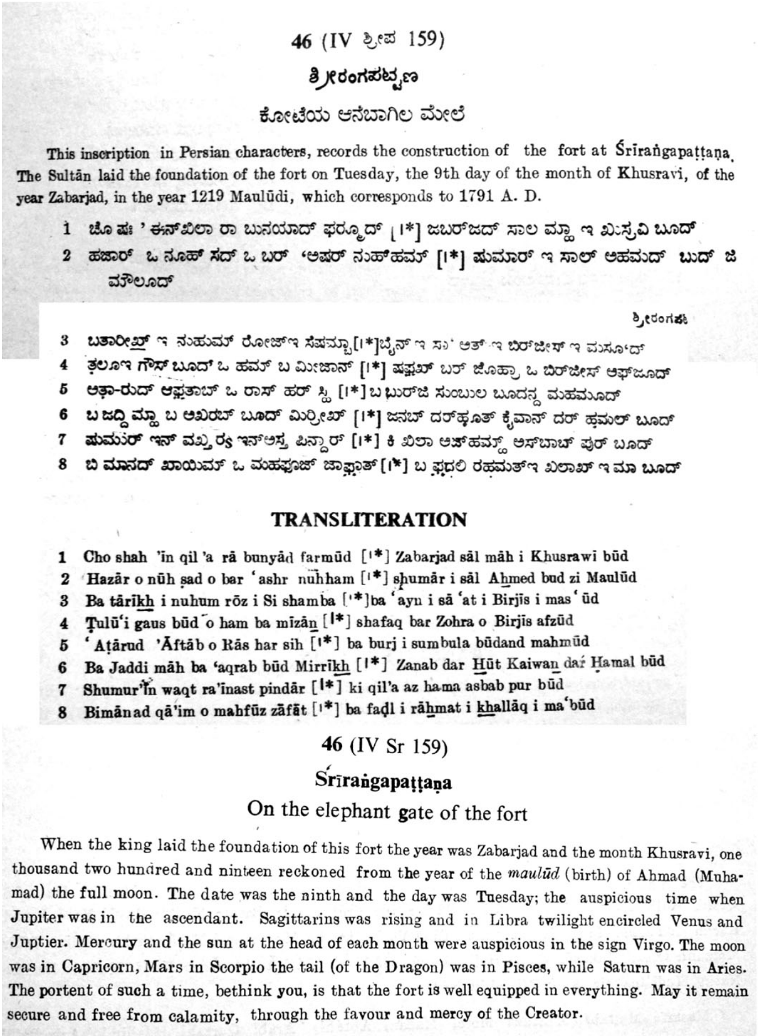
Inscription in Srirangapattana, near Mysore

The small island of Srirangapattana near Mysore, encircled by the two branches of River Kaveri played an important role in the history of Mysore. It served as the capital town in the reign of Tipu Sultan till his death in AD 1799. Many stone inscriptions are available in the town and surrounding villages pertaining to his regime. The languages used are Kannada and Persian. Most of them refer to the grants released to temples.

One inscription on the elephant gate of a mosque has an inscription in Persian language (Figure 1).

It reads (as translated by Rice[2], who pioneered the systematic documentation of stone inscriptions during the 20th century).

'The elephant gate way bears an inscription in Persian, stating that the foundation of the fort was laid in the year 1219 from the birth of Mohammad, that is Tipu's Mauludi era (AD 1791) when Jupiter was in the ascendant, Sagittarius was rising, Venus and Jupiter in Libra, Mercury and sun in Virgo, moon in Capricorn,



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ಶ್ರೀರಂಗಪಟ್ಟಣ

ಕೋಟೆಯ ಆನೆಬಾಗಿಲ ಮೇಲೆ

This inscription in Persian characters, records the construction of the fort at Śrīraṅgapaṭṭaṇa. The Sultān laid the foundation of the fort on Tuesday, the 9th day of the month of Khusravi, of the year Zabarjad, in the year 1219 Maulūdi, which corresponds to 1791 A. D.

1 ಚೊ ಷಃ ’ ಈನ್‌ಖಿಲಾ ರಾ ಬುನಯಾದ್ ಫರ್ಮೂದ್ [।*] ಜಬರ್‌ಜದ್ ಸಾಲ ಮ್ಹಾ ಇ ಖುಸ್ರವಿ ಬೂದ್
2 ಹಜಾರ್ ಒ ನೂಹ್ ಸದ್ ಒ ಬರ್ ‘ಅಷರ್ ನುಹ್‌ಹಮ್ [।*] ಷುಮಾರ್ ಇ ಸಾಲ್ ಅಹಮದ್ ಬುದ್ ಜಿ ಮೌಲೂದ್

ಶ್ರೀರಂಗಪ

3 ಬತಾರೀಖ್ ಇ ನುಹುಮ್ ರೋಜ್ ಇ ಸೆಷಮ್ಬಾ[।*]ಬೈನ್ ಇ ಸಾ‘ ಅತ್ ಇ ಬಿರ್‌ಜೀಸ್ ಇ ಮಸೂ‘ದ್
4 ತ಼ಲೂಇ ಗೌಸ್ ಬೂದ್ ಒ ಹಮ್ ಬ ಮೀಜಾನ್ [।*] ಷಫಖ್ ಬರ್ ಜೊಹ್ರಾ ಒ ಬಿರ್‌ಜೀಸ್ ಅಫ್‌ಜೂದ್
5 ಅತಾ-ರುದ್ ಆಫ್ತಾಬ್ ಒ ರಾಸ್ ಹರ್ ಸ್ಹಿ [।*] ಬ ಬುರ್‌ಜಿ ಸುಂಬುಲ ಬೂದನ್ದ ಮಹಮೂದ್
6 ಬ ಜದ್ದಿ ಮ್ಹಾ ಬ ಅಖರಬ್ ಬೂದ್ ಮಿರ್ರೀಖ್ [।*] ಜನಬ್ ದರ್‌ಹೂತ್ ಕೈವಾನ್ ದರ್ ಹಮಲ್ ಬೂದ್
7 ಷುಮುರ್ ಇನ್ ವಖ್ತ ರಇ ಇನ್‌ಅಸ್ತ ಪಿನ್ದಾರ್ [।*] ಕಿ ಖಿಲಾ ಅಜ್‌ಹಮ್ಹ ಅಸ್‌ಬಾಬ್ ಪುರ್ ಬೂದ್
8 ಬಿ ಮಾನದ್ ಖಾಯಿಮ್ ಒ ಮಹಫೂಜ್ ಜಾಫ್ಹಾತ್[।*] ಬ ಫಧಲಿ ರಹಮತ್ ಇ ಖಲಾಖ್ ಇ ಮಾ ಬೂದ್

TRANSLITERATION

1 Cho shah 'īn qil 'a râ bunyâd farmūd [।*] Zabarjad sāl māh i Khusrawi būd
2 Hazār o nūh ṣad o bar ʻashr nuhham [।*] shumār i sāl Ahmed bud zi Maulūd
3 Ba tārīkh i nuhum rōz i Si shamba [।*]ba ʻayn i sā ʻat i Birjīs i masʻūd
4 Ṭulūʻi gaus būd o ham ba mīzān [।*] shafaq bar Zohra o Birjīs afzūd
5 ʻAṭārud 'Āftāb o Rās har sih [।*] ba burj i sumbula būdand mahmūd
6 Ba Jaddi māh ba ʻaqrab būd Mirrīkh [।*] Zanab dar Hūt Kaiwan dar Ḥamal būd
7 Shumur'īn waqt ra'īnast pindār [।*] ki qil'a az hama asbab pur būd
8 Bimānad qā'im o mahfūz zāfāt [।*] ba faḍl i rāhmat i khallāq i maʻbūd

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Śrīraṅgapaṭṭaṇa

On the elephant gate of the fort

When the king laid the foundation of this fort the year was Zabarjad and the month Khusravi, one thousand two hundred and ninteen reckoned from the year of the *maulūd* (birth) of Ahmad (Muhamad) the full moon. The date was the ninth and the day was Tuesday; the auspicious time when Jupiter was in the ascendant. Sagittarins was rising and in Libra twilight encircled Venus and Juptier. Mercury and the sun at the head of each month were auspicious in the sign Virgo. The moon was in Capricorn, Mars in Scorpio the tail (of the Dragon) was in Pisces, while Saturn was in Aries. The portent of such a time, bethink you, is that the fort is well equipped in everything. May it remain secure and free from calamity, through the favour and mercy of the Creator.

Figure 1. Extract from the *Epigraphia Carnatica* giving the inscription in three languages.

> Mars in Scorpio, the tail of the dragon in Pisces, and Saturn in Aries....'

It should be noted that the Mauludi era was started by Tipu Sultan. Previous studies on this inscription were content with just fixing the date. Subsequent editions left out a couple of details on planetary positions[3], clearly indicating that a detailed verification on the veracity of the planetary positions was not attempted[4]. Now, this job is relatively easy with many softwares available providing precise planetary positions with the necessary corrections. It was found that the date does not agree well with all the planetary positions. Added to that, one edition has the phrase 'Sagittarius and Libra were rising'. The time of the day is 12:00 noon corresponding to rising of Sagittarius, or 7:00 am if Libra is rising for October 1792. The translation into Kannada offers a better solution[4]. It reads '*...on the day of laying the foundation stone for the fort, the year was Zabarjay, month was khusravi, Mauludi year 1219, 9th day, Tuesday, Jupiter (Guru) was ascending, Sagittarius was rising, Venus and Jupiter were glowing in twilight. Mercury and sun were in Virgo, Moon was in Capricorn, Mars in Scorpius, Tail was in Pisces, Saturn in Aries....*'

Mauludi year 1219 corresponds to AD 1791. However, the said planetary positions match for 25 September 1792, within the acceptable limits for *Ketu* – in Pisces (S. Balachandra Rao, private commun.). However the word *Zanab* creates some ambiguity, with the translated phrase 'tail in Pisces'. The word is used for both the descending node and comet.

The word tail immediately alerts us to look for a comet. Comets have generated immense curiosity from time immemorial and have been documented by various means in the literature, historical records and art works. Chinese and Japanese records have details on the position and brightness of comets as well[5–8]. Although such systematic records are not available from India for the historical comets, a word like *Ketu* (since a comet is named Dhoomaketu) may provide a clue.

Let us start with the location of a comet in the description. It is quite far away from the Sun (The Sun in Virgo and comet in Pisces). Usually comets are sighted when they are near the Sun, i.e. within one or two zodiacal signs. There were two bright comets[9] in 1792. One was discovered by Carolyn Herschel in December 1791. This was visible till mid-January 1792. The other one was visible in January 1793, after its perihelion in December 1792 by Gregory. This comet recorded as 1792II was identified as a possible source of meteors[10] in 1946. Another has been recorded by Chinese astronomers as visible during April–May 1792; therefore, it appears that no bright comet was sighted in the month of October of that year.

We now search for the location of the descending node by an alternate method for the year 1792. Since it is difficult to 'see' the node, we have to infer its location using eclipses. A solar eclipse on 16 September helps us decide the location. This happened at the ascending node, *Rahu*. In this case, we may safely assume that *Rahu* had the same longitude as the Sun on that day, since it was a total eclipse. A month after the eclipse, *Rahu* would not have greatly drifted from its position, but the Sun would have done so. The coordinates of *Rahu* works out to be 11 h 38 m (long. 175°) and declination + 20°21′. In fact, we can utilize the technique of 'vyatipatha' used by the Indian astronomers earlier to find the maximum declination of the Moon, which in turn is related to the longitude of the ascending node[11]

$$\sin(I) = \sqrt{\{(\sin i \sin \lambda)^2 + (\sin i \cos \lambda \cos \varepsilon + \cos i \sin \varepsilon)^2\}},$$

where I is the maximum declination of the Moon, ε the inclination of rotation axis, 23.5°, λ the longitude of the ascending node and i is the inclination of the Moon's orbit, 5°. We extend the formula for the year 1792 and derive that the ascending node was at long. 175° and Moon had a maximum declination of 18.5°. The descending node is then at 355°, exactly 180° away from *Rahu*. This puts it in Pisces or more precisely at the border of Pisces and Aries. This location also provides an opportunity for lunar eclipses. There were two penumbral eclipses on 30 September and 31 August. Only one of them was visible from India for a short while. It is difficult to identify penumbral eclipse from observations, justifying the absence of any record.

We can conclude that the 'tail' mentioned here corresponds to *Ketu*, the descending node. This can be revisited considering that the two lunar eclipses of previous months were penumbral. The node was perhaps at the limit of 18° from the full Moon (Table 1).

Therefore, the position of *Ketu* at long. 330° is different from long. 355° derived from the position of *Rahu*. This difference can be accounted for by the correction required for Ayanamsha (= 19° as provided by the referee).

The stone inscription in Angkor Wat

Another example involving the word *Ketu* is from the Angkor Wat temple in Cambodia. French archaeologist Henri Mouhot found a 'stele' with the Sanskrit inscription which reads as follows

> '*In the year 1217 (of the Saka era – corresponding to* AD *1295) on the 12th day of the first half of the month of Vaishakha, on a Thursday, under Chitra... the king erected these two statues. Sun and Saturn were in Taurus, Mars and Rahu in Gemini; Moon in Libra; Jupiter in Scorpio; Mercury, Venus and Ketu in Aries. The ascendant being in the sign of Cancer....*'

Details of the planetary positions have been studied thoroughly by various authors. Beer[12] summarizes the discrepancies as discussed by various authors which arose basically because of the use of extrapolated calendars. In this description both *Rahu* and *Ketu* have been specified, again, as an unusual feature. We may now check the planetary positions with accuracy far better than just the names of the constellations. It has been possible to fix the date as 28 April 1295 with a software specially written

Table 1. Coordinates of *Ketu* as derived from eclipses in the year 1792

	Right Ascension (1792)	Longitude	Declination (1792)
Full Moon on 31 August	21:10	318°	–11°07′
30 September	00:07	1.1°	–0°:07′
Ketu	22:53	330°	–5°30′

for Indian nomenclature agreeable to all planetary positions, except *Ketu* (S. Balachandra Rao, private commun.). Beer[12] had also encountered the same problem, and explored the possibility of *Ketu* being 'Keid', the invisible planet, cited by Arab astronomers.

We now use the same technique as was done earlier for fixing the longitude of *Rahu*. The solar eclipse of 15 May 1295 at the ascending node can be used to get the position of *Rahu*.

$03^h57^m + 20°28'$ were the Right Ascension and Declination of *Rahu*.
The maximum declination of Moon was 25°.
Therefore, the Right Ascension of *Ketu* is at 15^h57^m and the cited position in Aries is obviously incorrect.

The position at Aries is quite close to the Sun. We may understand that *Ketu* possibly refers to a comet rather than the descending node. However, no comet has been recorded in this region in any of the available historical records. The apparitions of established periodic comets also do not correspond to this location in the sky at the said time.

Discussion

The two inscriptions from geographically isolated locations are distinct with the mention of the word *Ketu.* In both cases, the location seems to point to a phenomenon occurring at the border of Pisces and Aries.

We may consider an alternate source as a record of an eruptive variable in this region. A Chinese record[13] reports an interesting case of two eruptions in the same month, but this is dated 9–18 September, AD 1297. Within an interval of a month the 'strange star' appeared twice. Its location is specified as 'between Pisces and Andromeda'. The constellation of Andromeda has not been identified in Indian astronomical texts; but it may be in proximity to Aries. Therefore we need to explore other possibilities, for example a long period variable or explosive star.

Our search yielded one possible candidate as NGC 7662, which is an extensively studied planetary nebula. Guerrero *et al.*[14] identified two ellipsoidal shells in this nebula and the kinematic ages were derived as ($700 \times d/800$) years and ($1050 \times d/800$) years, where *d* is the distance 800pc (ref. 15). On the other hand, an upper limit to the age has been given as 8000 years[16]. If this is the candidate, we have the history of its pre-planetary nebula eruptions recorded as appearance of new bright stars.

Chinese records[13] cite the eruption of a star in 1297, seen as two successive eruptions. There was probably another noticed two years earlier. In this case, it falls in place with the previous argument in favour of the planetary nebula NGC 7662. The possibility of yet another explosion in 1792, mistaken as a comet and recorded in the 1792 inscription cannot be ruled out, although the position of *Ketu*, matches with the position approximately.

Conclusion

The stone inscriptions of AD 1295 and AD 1792 point to objects referred to by the word *Ketu* generally used for the descending node of the Moon's orbit. Since the positions, as derived from eclipses in the corresponding years, do not match for the one dated AD 1295, other alternatives are explored. The second one points to approximately the same location in the sky. Calculated position of *Ketu* matches approximately; but the word *Zanab* used in the inscription refers to a comet as well. Search for comets recorded in history yielded negative results. The record may therefore hint at an eruptive star. Recent results of planetary nebulae suggest episodes of the brightening of a star associated with the formation of a planetary nebula, NGC 7662.

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ACKNOWLEDGEMENTS. We thank INSA, New Delhi for providing funds. We also thank Prof. S. Balachandra Rao for checking the planetary positions using the computer program specially written for the purpose. Discussions with Prof. K. Ramasubramanian and Prof. S. M. R. Ansari were helpful. We thank the anonymous reviewers for their valuable suggestions.

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Edited by R. Srinivasan, and printed & published by G. Madhavan for Current Science Association, Bangalore 560 080.
Typeset by WINTECS Typesetters (Ph: 2332 7311), Bangalore and Printed at Printek Printers, Bangalore (Ph: 2328 7763)