

Records of Eclipses in Stone Inscriptions found in and around the regions of Karnāṭaka in India

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Abstract: Stone inscriptions are one of the main sources of construction of History. In India they are found all across the landscape. Considering them as sources of astronomical events yields dates that help in coming to several important conclusions regarding the observational practices of astronomy in India. The state of Karnāṭaka has thousands of inscriptions with descriptions of dates, which go back to more than two thousand years. The dates discussed here indicate the importance of meticulous study of stone inscriptions as sources of astronomical records.

Keywords: Stone inscription, eclipse, solstice, equinox, epigraphical volumes, vyatīpāta, astronomical observations.

1. Introduction:

Stone inscriptions are found all over India in the remotest of villages. Finding them and understanding them involves understanding of several languages. The main languages that one should have an understanding of are Sanskrit, Prakrit and regional language of the place in which the stone inscription is found. In the state of Karnāṭaka the regional, official language is Kannaḍa.

India is a home to hundreds of spoken and written languages. In the southern states of India each state has its own official language, spoken by millions of people. Each of these major languages has its own rich history. Some of them go back as far as two thousand years or more. Meticulous study of inscriptions belonging to each of these states involves the study of regional language and its unique script. Kannaḍa is one of the major Dravidian languages of south India. As a language with its own unique script, it has evolved in the past two thousand years.

The epigraphical experts have been compiling volumes of epigraphy for more than a century since the beginning of such work in India. With new discoveries of inscriptions the number of epigraphical volumes has grown. Each volume with hundreds of inscriptions is available for researchers for reference and study. These epigraphical compilations are the main source of study of stone inscriptions in India. The geographical vastness of India makes it very challenging to go through all the inscriptions in all the various languages.

The latest softwares which are used to prepare catalogue or canons of ancient eclipses can be used to prove the authenticity of astronomical events mentioned in inscriptions and vice versa. Such authentication indicates important facts regarding the practical observational practices of Indian astronomy.

The observations of celestial events found in stone inscriptions are found to be authentic because, all inscriptional records were written after the events; sometimes the next day, which indicates observation. There are cases of multiple records mentioning the same date of eclipse. These inscriptions are

found in different geographical locations, which make them very useful for calculations.

2. **Understanding the details mentioned regarding time and astronomical events:**
Stone inscriptions can be categorized based on the reasons for which they were carved and made. The majority of inscriptions found are about gifts and grants made on auspicious occasions. They are referred to as *Dāna Śāsana* (Dāna = Gift or Donation, Śāsana = Inscription). The auspicious occasions include astronomically significant events of eclipses, solstices, equinoxes, planetary conjunctions and a special occasion termed as Vyatīpāta. Vyatīpāta is a unique term found to be used only in Indian astronomy and is not seen to be used in any other astronomical practices of the world¹.

The main purpose of carving out an inscription was to make the public or people seeing that inscription, become aware of the details in that inscription. For example, in case of inscriptions termed, *Vīragallu* (Vīra = Hero, Kallu = Stone), it is made in the memory of a hero who fought and died protecting something or someone. It is a memorial stone, celebrating heroism and bravery of fallen hero. They were carved and established for the public to know and remember that hero.

In case of *Dāna Śāsana* the main purpose is to publicize a grant made to an individual or a temple. Most gifts or grants were made on auspicious occasions. The auspicious occasions include several of the astronomically important events mentioned in the introduction.

The mentioning of the date on which the grant was made is an important detail, though it is of a secondary priority in the inscription. The primary priority is to the details of the gifts made and the names of the people giving and receiving the gift or grant.

The *Dāna Śāsana* were summarized copies of a document of a grant. The original copy of the grant would have been given to the receiver of the grant on a copper plate. The available original copper plates are very less in number compared to the number of stone inscriptions. Most copper plates which are the original documents of grant are lost either because they were recycled or held in private custodies.

The details of the text on the stone inscriptions were written by a scholar who would have been an expert in several fields of study. But the person who carved the inscription on the stone would have been a sculptor who specialized in sculpting words on stones. Such a person need not have been a scholarly expert. Keeping this in mind one needs to be careful while looking at details in an inscription. The expert opinion of the compilers of inscriptions is most important in this regard.

The part of an inscription describing time, can have the following details.

Śaka year (*Śālivāhana* or *ChālukyaVikrama Śaka* year number), name of *Samvatsara* (60 year cycle of the Sun), name of the lunar month, *Pakṣa* (name of the either of the two fortnights in a lunar month), *Tithi* (name of the day indicating lunar phase) or number of the day indicating lunar phase for

that day and *Vāra* (name of the weekday). Sometimes the name of the star or *Nakṣatra* (the 27 stars used to indicate moon's position) for that particular day is also mentioned. There are very few inscriptions which mention time precisely with words *Ghaḷige* and *Vighaḷige* (subdivisions of time indicating hours and minutes). Along with these details, if there was an astronomical event on that day, that may or may not be mentioned. All these details are converted using the tables of conversion into Julian calendar date.

When time is not mentioned, the other details, such as, the language and its script, along with historical details are used to determine approximate date of the inscription.

Islamic calendar system and many other systems were also followed. But, these inscriptions are very less in number compared to the Hindu calendrical system described above.

2.1 Astronomical details in Stone Inscriptions:

Not all inscriptions mention astronomically significant details. And those that do are very few in number compared to the total number of available inscriptions. Common words which directly mean astronomical events are, *Grahaṇa* or *Uparāga* (Eclipse), *Sankrānti* (Solstice), *Viṣu Sankramaṇa* (Equinox). Planets are mentioned by their names directly without any ambiguity. Most of these are Sanskrit words which are commonly found in old and famous Indian astronomical texts. These terms are used even today in spoken and written languages, making them common terms of description of such events.

2.2 Solar and lunar eclipses in stone inscriptions:

Solar eclipse is commonly referred to by words such as *Sūrya Grahaṇa*, *Sūryōparāga* and lunar eclipses by *Chandra Grahaṇa*, *Sōma Grahaṇa* and *Chandrōparaga*. There are other unusual ways of descriptions of eclipses which are not common and which need special attention while deciding the authenticity of records and astronomical observation. Some of those special records have been discussed ahead in this paper.

In case of solar eclipse, there are three possible observations that can be easily made and described. They are partial, total and annular solar eclipses. Out of many interesting eclipse descriptions, very few describe totality and annularity without any ambiguity.

In case of lunar eclipses, it is almost impossible to observe a penumbral eclipse with naked eyes. Therefore any record which mentions lunar eclipse is safely assumed to be an umbral eclipse. If totality was not observed then the possibility of observation of partial eclipse, exists. In the context of available data from stone inscriptions, this is yet to be studied in detail. Depending on the time and place of visibility an umbral eclipse can be registered as partial eclipse.

For both solar and lunar eclipses, the inscriptions do not mention the magnitude of the eclipse. Therefore, whenever there is a description of

partiality, it can be anywhere from 1% to 99%, keeping in mind that it is very difficult to observe the first and the last contact in an eclipse.

Although time of the eclipse observation has not been found, there is hope for finding records of eclipses with precise time of observation.

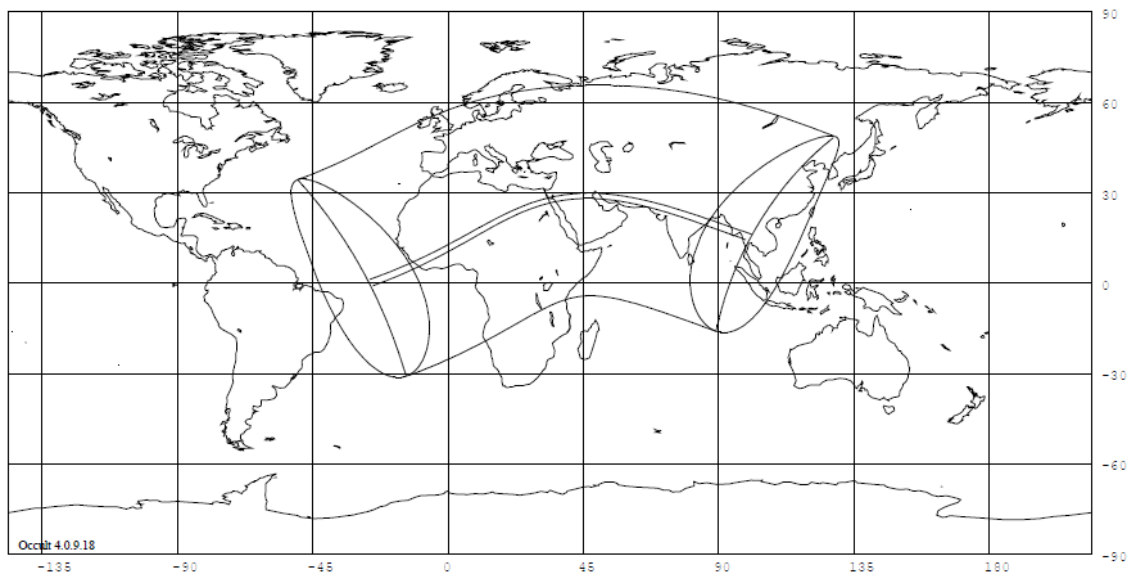
3. Some important interesting cases:

3.1 Date: May 11th, 1119 AD

An inscription belonging to a place called Kuḍitini in Baḷḷāri Tāluk of Baḷḷāri district, gives the details as, *Chālukya Vikrama year 44, Vikāri Samvatsara, Vaiśākha masa, Sūrya grahaṇa*. This converts to the date May 11th, 1119 AD.

The same date and details have been mentioned in another inscription found in Miryālagūḍa Tāluk, Nalgonda district of the state of Āndhra Pradesh. These details get converted to the annular eclipse of the same date, though the annularity was not visible from these two regions, which agrees with the theoretical model of eclipse prediction.

May 11th, 1119 AD - Annular eclipse

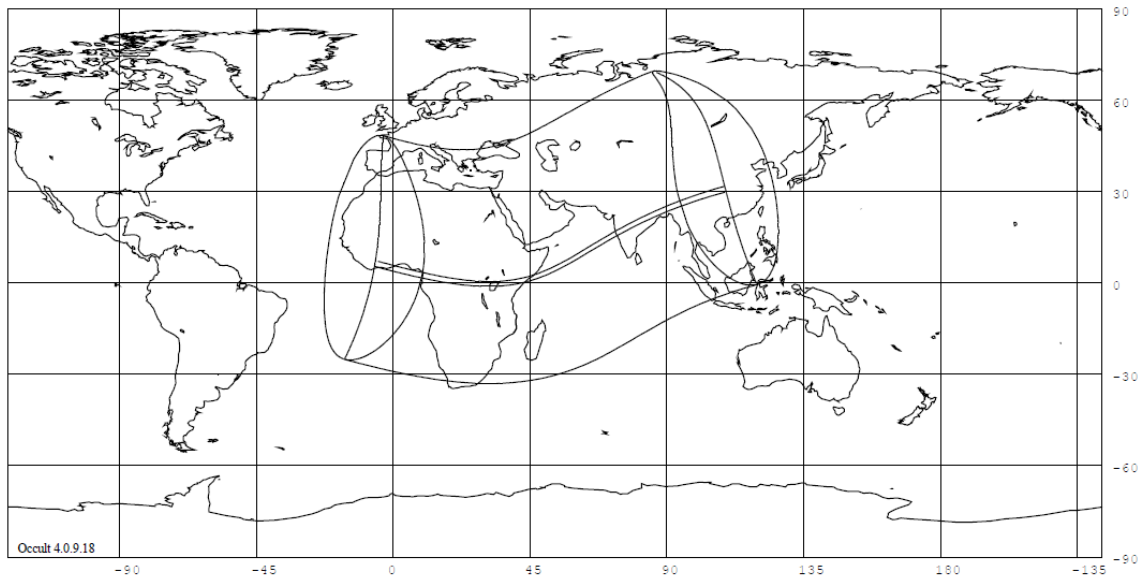


3.2 Date: February 3rd, 938 AD

An inscription from Śivamogga District, Soraba taluk⁵ mentions

“861 viḷambi samvatsara, Chaitra masa, 1st day after new moon, Vaḷaya Grahaṇa”. Vaḷaya means a zone, ring or a peripheral indicator. Therefore it is understood as annular eclipse since the sun is visible like a ring on the periphery. Co-ordinates of the place of the inscription are 14.37°N and 75.09°E. It is clearly seen that the eclipse was indeed annular and it passed through India, even though the region falls slightly outside the path of annularity. Since the record clearly mentions annularity this provides a test case for other softwares which predict ancient eclipses and look for differences in theoretical models of eclipse predictions.

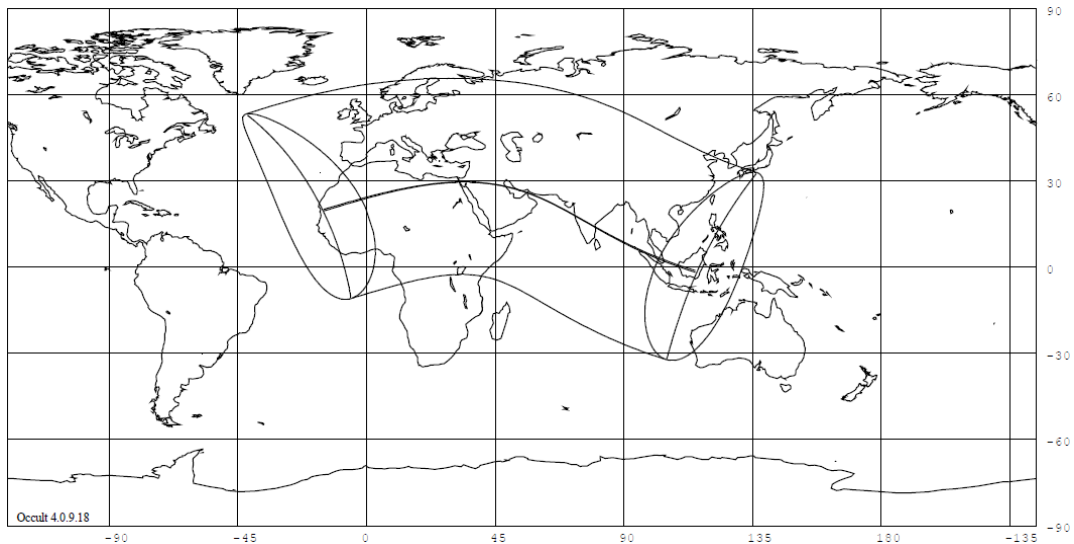
February 3rd, 938 AD - Annular eclipse



3.3 Date: August 1st, 1087 AD

There are seven records³ of this eclipse over a small geographical spread. Only one (co-ordinates of the place of inscription 15.76°N, 75.12°E) mentions totality and it agrees with the theoretical predictions. This is a Hybrid (Annular – Total) eclipse.

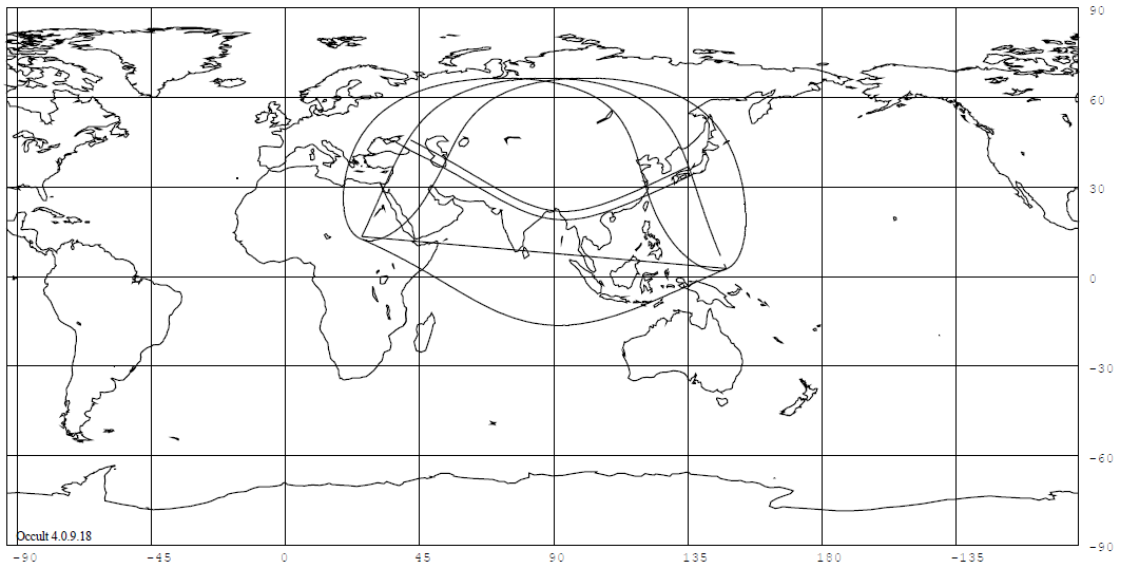
August 1st, 1087 AD - Hybrid eclipse



3.4 Date: December 16th, 1107 AD

Eight records mention the same date of solar eclipse³. One of them describes the annularity as '*Chūdāmaṇigrahaṇa*' (meaning eclipse that looked like a bracelet or bangle). The coordinates of the place of the inscription 18.05°N, 76.5°E, falls just outside of the path of totality.

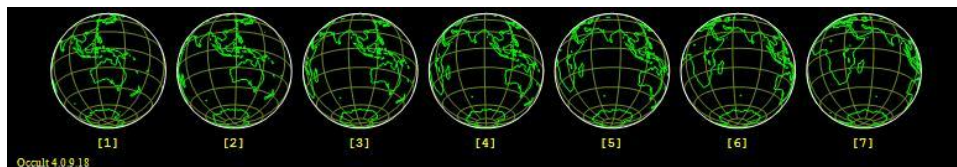
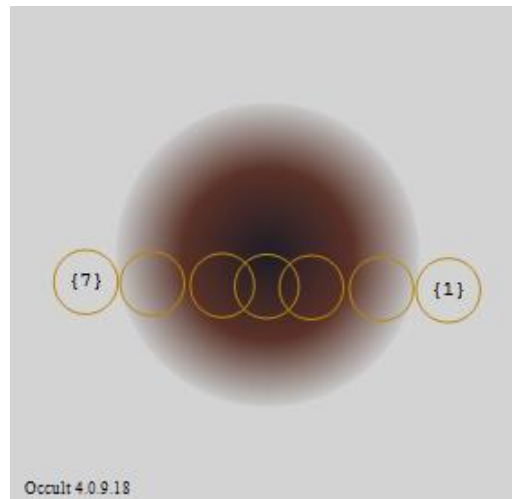
December 16th, 1107 AD - Annular eclipse



3.5 Date: June 5th, 1099 AD

In an inscription belonging to a place called Kuruvatti in Haḍagali Tāluk of Baḷḷāri district, gives the detail as, “*Chālukya Vikrama 24, Pramāthi, Jyēṣṭha, Suddha, Sōma Grahana*”. This gets converted to June 5th, 1099AD. It was an umbral eclipse of the moon, visible from India.

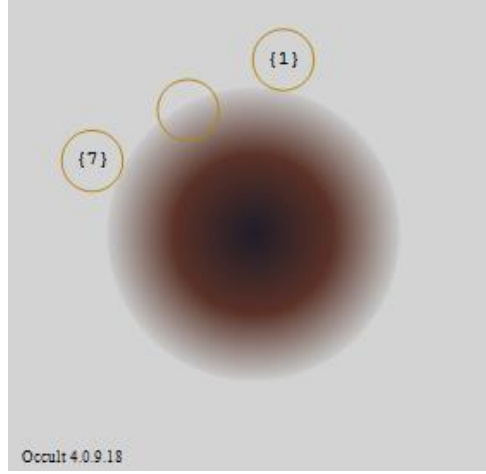
June 5th, 1099 AD - Umbral eclipse visible from India



3.6 Date: August 17th, 1076 AD

The inscription¹ says, “*Naḷa, Āṣāḍa, lunar eclipse*”. The date gets converted to August 17th, 1076 AD. According to the theoretical model, this was a penumbral eclipse visible from India. Penumbral eclipses are very difficult to observe, hence this could have been an umbral eclipse which was observed from India. Such cases help with the development of theoretical models.

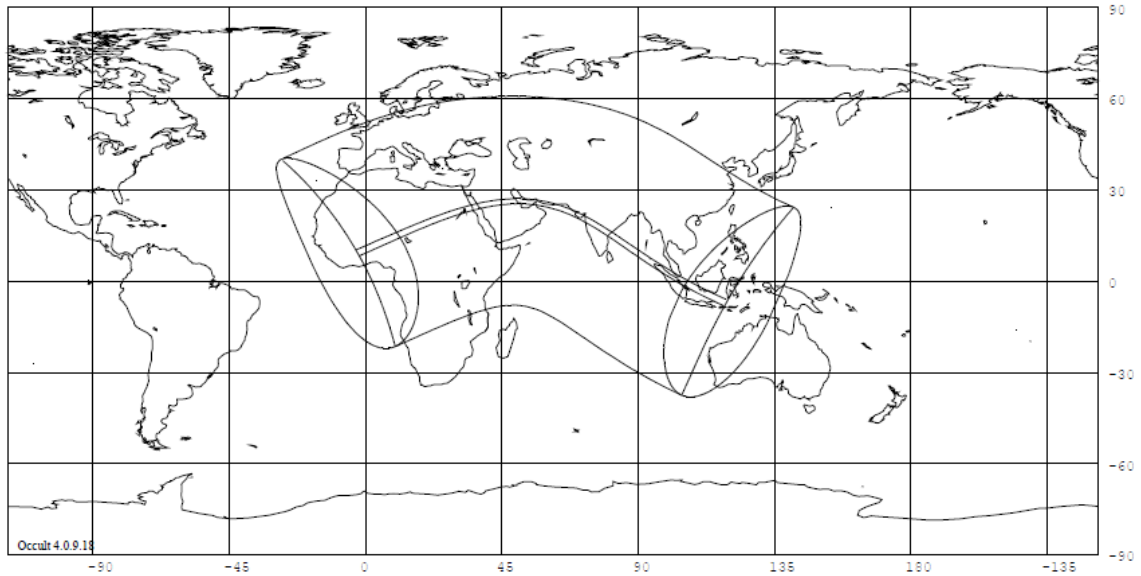
August 17th, 1076 AD - Penumbral eclipse eclipse



3.7 Date: June 26th, 819 AD

In a copper plate inscription⁷ belonging to a place called Sāligrāma (coordinates of the place of inscription, 12.56° N, 76.26°E), Kriṣṇarājanagara taluk, Mysūru district, the solar eclipse has been described as, “.....*Sakalakalikaḷuṣapaṭalāpāṭanapatiyasi sūryagrahaṇē*.....”. Since the words are in Sanskrit, it implies more than one meaning along with the actual literal meaning. One such interpretation is - *the solar eclipse that cuts down the dirt or defect (the colour of darkness) caused by the sins of Kali, which engulfs everything*. This is a description of the solar eclipse just after totality, when the sunlight shines through, after total darkness. From the co-ordinates of the place, the eclipse viewed was partial.

June 26th, 819 AD - Total solar eclipse

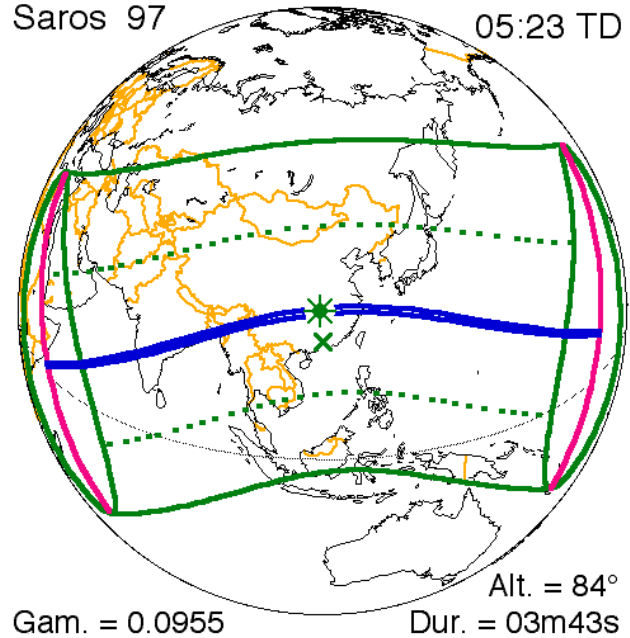


3.8 Date: 754 AD June 25

An inscription in the premises of Mallikārjuna temple Bādāmi Tāluk, Pattadakallu village (co-ordinates: 15.94°N, 75.81°E), mentions, *Śrāvaṇamāsē Amāvāsyāyām Sarvvagrāsē Sūryyagrahaṇē*. Based on the genealogy of the king mentioned in the inscription, experts have decided the Śaka to be 677. This corresponds to 755 AD. Considering that the total solar eclipse has been mentioned in inscription, we can establish the date to be June 25th, 754 AD.

This is a very rare inscription which directly mentions totality of the solar eclipse, which precisely agrees with theoretical predictions.

Total **0754 Jun 25**
Saros 97 05:23 TD



Five Millennium Canon of Solar Eclipses
(Espenak & Meeus)

4. Vyatīpāta:

The definition of Vyatīpāta that is often found in inscriptions is, *“the instant of time when the magnitude of the declination of the sun is equal to the magnitude of the declination of the moon”*.

$$|\delta_S| = |\delta_M|$$

A table of records of Vyatīpāta observed over a long period of time helps in accurately measuring and observing upcoming solar and lunar eclipses. Vyatīpāta was used to predict and to help in the calculations pertaining to eclipses, so that the next eclipse can be anticipated and observed.

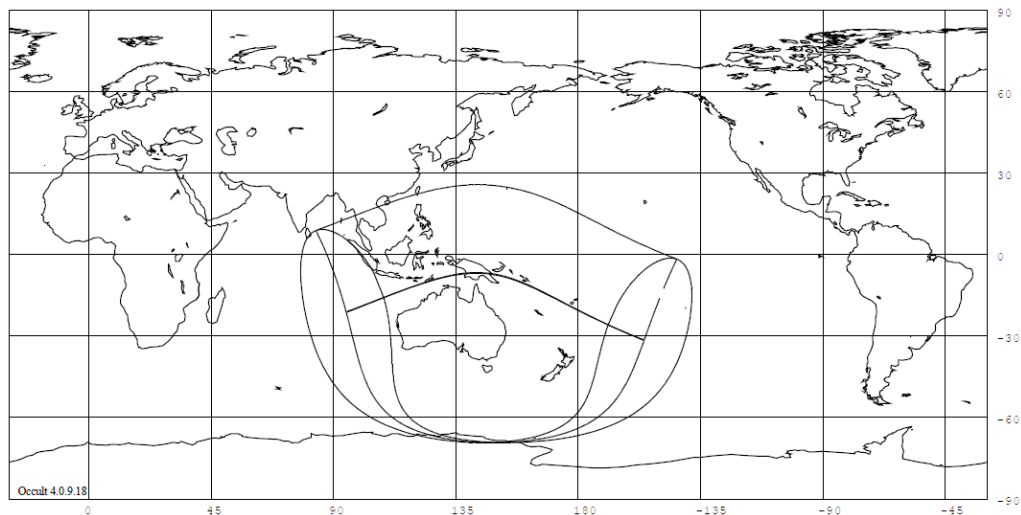
Records of Vyatīpāta in inscriptions are honest reports of meticulous observations. Therefore a compilation of such records is really helpful in determining the authenticity of an eclipse.

For example: There are cases in which, the inscription mentions the word Vyatīpāta. On that date there would have been an eclipse which was visible from another part of the world and not from India. It is obvious that the condition for Vyatīpāta is satisfied for that place in India, from where the eclipse was not visible².

4.1 Date: July 14th, 1162 AD

An inscription⁸ belonging to Gubbi taluk, Tumakūru district mentions *“.....Sūrya grahaṇa Vyatīpāta.....”*. The solar eclipse was not visible from India. But the word Vyatīpāta indicates the position of the moon and the sun ².

July 14th, 1162 AD - Total - annular eclipse



5. Conclusions:

The most important part of doing research in this particular study is, understanding and extracting relevant data from thousands of lengthy inscriptions. Only after having compiled that data in a chronological order can they be used for calculations.

This whole study relies upon the previous work of epigraphical experts and their compilations of hundreds of volumes of inscriptions. Even now, new

inscriptional volumes with previously unknown inscriptions are being published. Without the ground work of those epigraphical experts, doing this research would be almost impossible.

A large collection of data base of these observed records can help in verifying long term variation parameters involved in the prediction of eclipses. Extending this study to other regions in India and abroad will broaden the database, which can be used to improve the ΔT (the difference between the time measured using the rotation of the Earth and a standard clock) variation analysis⁴.

Compared to the number of inscriptions that have been meticulously studied so far, about 10% of them have been found to have astronomically significant details. Amongst these, few have turned out to be crucial and of great importance as far as calculations are concerned. These include records mentioning eclipses with totality and annularity without any ambiguity. Although few in number, studying these inscriptions is a continued process of revisiting already studied inscriptions. With the understanding of new ideas, it becomes crucial to re-look at inscriptions again and again. The cases discussed in this paper, give hope of finding records of rare and important astronomical events in unconventional sources.

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7. Acknowledgements:

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The software Occult and NASA's five millennium catalogue of solar eclipses have been used to produce the map of eclipses.