

## Historical Notes

### Cause of Sunrise, Sunset from *Jñāneśvarī* and its comparison to *Āryabhaṭīya*

Anand Dabak

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#### Abstract:

We discuss here the cause of sunrise/sunset as referred to in Jñāneśvara's *Jñāneśvarī*, a 13<sup>th</sup> Century translation of *Bhagavadgītā* into Marathi accompanied with his own explanations. The explanations involve a number of similes which can be used to glean the prevalent views of the society of his time.

Āryabhaṭa I in his *Āryabhaṭīya* in the 5<sup>th</sup> century of course held a proposition of earth's rotation as the cause of sunrise/sunset which was criticized and rejected by celebrated mathematicians-astronomers like Varāhamihira and Brahmagupta etc. The concept of Earth's rotation possibly went into oblivion after 6<sup>th</sup>-7<sup>th</sup> century CE. An attempt has been made how the concept was developed by Āryabhaṭa and nature of its survival among the common people in Maharashtra, apart from learned scholars.

**Key words:** Āryabhaṭa, *Āryabhaṭīya*, *Bhagavadgītā*, Brahmagupta, Cause for sunrise/sunset Jñāneśvara, *Jñāneśvarī*, *Karma Yoga*, Relative motion.

#### 1. INTRODUCTION

The topic of the cause for sunrise and sunset is somewhat related to the concept of Geo-centrism & Helio-centrism. This also involves the question of the understanding of whether the earth revolves around the sun or vice versa over a year. Rather than getting into this additional issue, we limit the discussion of this paper only to the topic of cause of sunrise/sunset as understood during Jñāneśvara's time.

The 5<sup>th</sup> Century mathematician/astronomer Āryabhaṭa (476-550 CE) in *Āryabhaṭīya* does refer to the rotation of earth being the cause of the (apparent) motion of asterisms. This was rejected by Brahmagupta (598-670 CE) (Ikeyama, 2003, p.20) and also Varāhamihira (505-587 CE). As a result of this, it is propounded (Clark, 1930, p. 65; Naralika, 1998, pp. 2, 39) that Āryabhaṭa's

theory of rotation of earth was not in prevalence in India after Brahmagupta's time and hence Indians believed that sunrise/sunset occurred due to diurnal motion of Sun around the Earth (Naralika, 1998, p. 2) as in Medieval Europe.

Jñāneśvara (1275-1296 CE) translated *Bhagavadgītā* into Marathi. His primary objective was for common people in Maharashtra to get an understanding of the *Bhagavadgītā* in Marathi. Jñāneśvara uses a number of similes from everyday lives/examples, to explain the concepts in the *Bhagavadgītā* so that a common person can understand it better in an easier fashion. He was not a mathematician or an astronomer per say, but the similes he used can give us an understanding of the prevalent views of the then society of Maharashtra on different topics. In this regards there are a couple of interesting similes from

\* 8625 Kendall Drive, Plano, TX 75025, USA; Email: dabakanand@yahoo.com

*Jñāneśvarī* that we give below that point to the prevalent view about the cause of sunrise/sunset in 13<sup>th</sup> Century Maharashtra.

## 2. JÑĀNEŚVARĀ'S VERSES FROM *JÑĀNEŚVARĪ*

The verses 93-102 in Chapter 4 in *Jñāneśvarī* (*Jñāneśvarī*, Marathi, chap. 4, p.6) are explanation of the verse 18 from chapter 4 of *Bhagavadgītā*. We consider the three verses 97-99 from Chapter 4 of *Jñāneśvarī* as below that are most relevant to the discussion in this paper (*Jñāneśvarī*, Marathi, chap 4, p.6).

अथवा नावें हन जो रिगे। तो थडियेचें रुख जातां देखे वेगें।  
तेचि साचोकारों जो पाहों लागे। तव रूख म्हण अचळ ॥97॥  
तैसें सर्व कर्मी असणें। ते फुडें मानूनि वायाणें। मग आपणया  
जो जाणे। नैष्कर्म्यु ऐसा ॥98॥  
आणि उदोअस्तुचेनि प्रमाणें। जैसें न चालतां सूर्याचें चालणें।  
तैसें नैष्कर्म्यत्व जाणें। कर्मीचि असतां ॥99॥

The verbatim English translation of these stanzas is given below (*Jñāneśvarī*, chap. 4, p.5, lines 14-18).

just as a person moving in a boat sees the trees on the bank moving swiftly, but on close inspection knows that they are stationary, (97)

so even when he is performing actions without desiring their fruits, he knows that he is not the agent of those actions. (98)

And even as the motionless sun seems to go round the world, because of the sunrise and sunset, so a person knows himself to be inactive even while working (99)

These stanzas have been written by *Jñāneśvara* to elaborate the concept of *Karma Yoga of Bhagavadgītā*. *Jñāneśvara* here is using the simile of the perceived motion of the Sun during Sunrise/Sunset, similar to the non-involvement of the deeds of a Karma Yogī. The motionlessness of the Sun referred to by *Jñāneśvara* and the (apparent) motion of the sun due to sunrise/sunset (in stanza 99 above) in conjunction with the simile of the apparent motion of the trees on a river bank for a person sitting in a boat (in stanza

97) clearly implies that *Jñāneśvara* is referring to the rotation of earth being the cause of sunrise/sunset. This concept of relative motion that *Jñāneśvara* talks about in *ślokās* 97, 99 above was probably influenced by *Āryabhaṭīya* by *Āryabhaṭa* about eight centuries before, so we will consider the relevant *ślokas* from *Āryabhaṭīya* below. As also, *Jñāneśvara* refers to the commentary on *Bhagavadgīta* of *Adi Shankaracharya* (commonly considered to be ~788-820 CE) for writing *Jñāneśvarī* (chap.18, p. 61, line 7). We will hence also consider *Shankaracharya's* commentary on the relevant *ślokas* from *Bhagavadgītā*.

Note that *Jñāneśvara* wrote *Jñāneśvarī* for ordinary people, so this may indicate that the view of the ordinary people (at least in that particular part of India/Maharashtra) also could have been that the cause of sunrise/sunset was earth's rotation with the Sun being motionless (as given verbatim in stanza 99 above).

### 2.1 Relevant *ślokās* from *Āryabhaṭīya*

Consider the following two stanzas and their translation from *Āryabhaṭīya* (Clark, 1930, p.64; Naralīkar, 1998, p.2) for comparison to *Jñāneśvarī's ślokās* given above:

अनुलोमगतिर्नौस्थः पश्यच्चलं विलोमगं यद्वत् ॥ 4.9.1  
अचलानि भानि तदनत्समपश्चिमगानि लङ्कायाम् ॥ 4.9.2

The verbatim translation of above *śloka* from (Clark, 1930, p.64; Naralīkar, 1998, p. 2] is given below:

Just as a man in a boat going forward sees a stationary object (on either side of the river) moving backward, just so at Lanka a man sees the stationary asterisms moving backward (Westward) in a straight line. (4.9)

The similarity of the concept of relativity of a man sitting in a boat expounded by *Āryabhaṭa* and as used by *Jñāneśvara* (section (2), stanza 97) is clear. It is also clear that *Āryabhaṭa* is referring to the rotation of earth and it being responsible for the apparent motion of asterisms. Interestingly,

Jñāneśvara particularizes the concept of distant bodies from earth (that is asterisms in case of Āryabhaṭa) to that of Sun and clearly implies earth's rotation being the cause of sunrise and sunset (as given in section (2) above).

Both (Clark, 1930; Naralīkar, 1998) give credit to Āryabhaṭa for proposing that earth rotates around its axis with an implication that sunrise and sunset occur due to this phenomenon. However, both references (Clark, 1930; Naralīkar, 1998) also mention that the Indian scientists that followed Āryabhaṭa namely Varāhamihira, Brahmagupta in 6<sup>th</sup> Century rejected Āryabhaṭa's theory of rotation of earth and proposed that earth is stationary. For a translation of Brahmagupta's rejection of Āryabhaṭa's proposition, see (Ikeyama, 2003, p.20). As stated in (Naralīkar, 1998, pp. 2, 39), after Āryabhaṭa's thought of earth's rotation was rejected by Brahmagupta, non-rotation of earth was the prevalent view in India after Brahmagupta. However, based on the stanzas given in *Jñāneśvarī* in section (2) above, it is very interesting to see that Āryabhaṭa's thought of earth's rotation and it being the cause of sunrise and sunset seems to have remained in at least some parts of India all the way to Jñāneśvara's time in 13<sup>th</sup> century. Also, not only could this theory have been prevalent in the learned people but also in the common people, because Jñāneśvara basically targeted common people in *Jñāneśvarī*. If the common man did not accept the notion of rotation of earth, there is no utility in employing the simile in stanza 99 (section (2) above). This prevalent view of earth's rotation during Jñāneśvara's times seems to be in contradiction with the claim in (Naralīkar, 1998), that Āryabhaṭa's thought of earth's rotation did not remain prevalent in India after Brahmagupta.

## 2.2 Relevant ślokās from Ādi Śankarācārya's Commentary on *Bhagavadgītā*

Jñāneśvara refers (*Jñāneśvarī* chap. 18, p. 61, line 7) to ādi Śankarācārya's commentary on *Bhagavadgītā* for his translation of *Bhagavadgītā*

into Marathi. We hence consider the commentary of Ādi Śankarācārya to Chapter 4, verse 18 of *Bhagavadgītā* (Sastri, 1901, pp.113-115).

कर्मण्यकर्म यः पश्येदकर्मणि च कर्म यः।  
स बुद्धिमान्मनुष्येषु स युक्तः कृत्स्नकर्मकृत्॥ 18॥

He who can see inaction in action, who can see action in inaction, he is wise among men, he is devout, he is the performer of all action.

Ādi Śankarācārya's explanation (Śāstri, 1901, p.115):

Objection: Action is ever action to all; it never appears to be anything else?

Answer: Not so. When a ship is in motion, the motion-less trees on the shore appear, to a man on board the ship, to move in the opposite direction; distant and moving bodies which are far away from the eye appear to be motionless. Similarly here (in the case of the Self) inaction is mistaken for action and action for inaction.

The original Sanskrit Bhāṣyam related to above can be found at (Śhankara-works, 4th *adhyāya*, p. 202) and is given below:

१ कर्मण्यकर्मण्यम् ।  
विपर्ययेण गृहीते प्राणिभिस्तद्विपर्ययग्रहणनिवृत्त्यर्थं भगवतो वचनं 'कर्मण्यकर्म यः' इत्यादि । न कर्माधिकरणमकर्मोस्ति कुण्डे यद्वराणीव । नाप्यकर्माधिकरणं कर्मोस्ति कर्माभावत्वात्कर्मणः । विपरीतकर्मगृहीते एव कर्माकर्मणी लौकिकैर्यथा मृगतृष्णिकायासुदकं शुक्तिकार्या वा रजतम् । कर्मव सर्वेषां न कश्चिद्विचरति । तत्र । नोस्थस्य नात्रि गच्छन्त्यां तदस्थेष्वगतिषु नमोषु प्रतिगतिदर्शनात् दूरेषु चक्षुषोऽसंनिकृष्येषु गच्छन्सु गत्यभावदर्शनात् । एवमिहाप्यकर्मण्यहं करोमं कर्मदर्शनं कर्मणि चाकर्मदर्शनं विपरीतदर्शनं येन तस्मिन्कारणार्थमुच्यते कर्मण्यकर्म यः पश्येत्यादि । तदेतदुक्तप्रतिवचनमप्यसकृदत्यन्त विपरीतदर्शनभाषिततया मोक्षुद्ग्रहमानो लोकः श्रुतमप्यव

There are two points to note:

- It is interesting that with respect to the 'inaction is mistaken for action' Śhankarācārya has the same analogy of ship in motion as has been used by Jñāneśvara given in section 2 above.
- For the 'action for inaction' Śhankarācārya employs the analogy of 'distant and moving bodies which are far away from the eye appear to be motionless'. Since this is in the context of action for inaction and Jñāneśvara's ślokās given in section 2 are only in the context of inaction is mistaken for action there is no contradiction here between Śhankarācārya's and Jñāneśvara's analogies.

So the interesting point to note is the similarity of the analogy of the ship in motion used by Śhankarācārya and its use by Jñāneśvara as given in section 2 above in the context of inaction mistaken for action.

### 3. CONCLUSIONS

In this paper we consider the topic of the cause for sunrise and sunset as prevalent during Jñāneśvara's time in 13<sup>th</sup> century Maharashtra. Sant Jñāneśvara refers to this in the context of the similes he uses to explain the concept of *karma yoga*. As shown in section 2 above, he clearly indicates that the Sun is motionless and its motion is only apparent due to sunrise/sunset, hence clearly implying that it is earth's rotation responsible for sunrise/sunset. The similes used by Jñāneśvara involve the idea of relative motion, both the similes are very similar to those given by Āryabhaṭa as shown in section 2.1.

Among other things, Āryabhaṭa is well-known to have proposed the rotation of earth being the cause for the apparent motion of distant stationary asterisms (see section 2.1 above). Varāhamihira, Brahmagupta, have also been known to have opposed/rejected this theory (5, p.20). However based on Jñāneśvara's *ślokas* given in section 2 above, we can infer that despite this rejection, Āryabhaṭa's theory of earth's rotation seems to have remained prevalent in some part of India/Maharashtra all the way to the 13<sup>th</sup> century. This is in contradiction to that proposed by current scientific community (Naralīkar, 1998, pp. 2, 39), that Āryabhaṭa's thought of earth's rotation did not remain prevalent in India after Brahmagupta.

Also, this idea of rotation of earth being responsible for sunrise/sunset during Jñāneśvara's time in 13<sup>th</sup> Century could also have been prevalent among the common people of that time, because Jñāneśvara basically targeted common people in *Jñāneśvarī*.

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