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On the story of supposed Indian superstitions contrary to what is told by illiterate historians. .based on al Biruni.

experimentally refuted, and a theory (Stokes) seen as having been mathematically proved to be incorrect! There was little doubt of what physicists would choose, for they regarded mathematical proof as clearly superior to experimental refutation. Thus Planck suggested that the problem could be avoided by making the aether compressible, but Lorentz suggested that the Stokes theory should be abandoned altogether. Hence, he sought to explain the outcome of the experiment by proposing the length contraction, first that the spaces between the molecules got compressed in the direction of motion, and then that the molecules themselves got shortened in the direction of motion. It was left to the subtle Poincaré to clear up the mess with his elegant proposal of the special theory of relativity, and to Einstein to grab the credit for it, although Einstein never fully understood the theory of relativity, and never abandoned the notion of aether or its origin in the related notion of action by contact.

## 5.4 Refutation of the popular beliefs

In Indian tradition, definitely from the time of the *Sūrya Siddhānta* and Aryabhata, and probably from long before that, the earth was regarded as a sphere. As Aryabhata describes it (*Āryabhaṭīya*, *Gola* 6-7):

The globe of the Earth stands supportless in space. . . Just as the [spherical] bulb of a Kadamba flower is covered all around by blossoms, just so is the globe of the Earth surrounded by all creatures, terrestrial as well as aquatic.

While Aryabhata does not feel the need to defend the idea of a round earth, later writers like Lalla (748 CE) do. Lalla, in the twentieth chapter of his *Sishyadhivrdhida*<sup>38</sup> examines various false notions, and states that some people have the following false notions about the earth.

(20.6) Some think that the earth is infinite; others that it is plane like a mirror. Again, others say that it extends to many yojanas and floats on water like a boat.

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<sup>38</sup>Lalla, "False Notions", chp. 20 of *Sisyadhivrdhida Tantra of Lalla*, with the commentary of Mallikarjuna Suri, ed. and trans. Bina Chatterjee, INSA, New Delhi, Part II, p. 269.

(20.7) Some say that the earth is supported by a tortoise, a serpent, a boar, an elephant or by mountain ranges. . .

He then refutes the belief that the earth is plane through a variety of arguments, some of which are the following.<sup>39</sup>

(20.31) The eclipse, the conjunction and rising of planets, the cusps of the Moon, and the length of the shadow (of the gnomon) at any time—the calculation of all these five depends upon the measurement of the earth, and agrees with the observed result.

(20.35) Mathematicians say that one hundredth of the circumference of the earth appears to be plane.

(20.36) If the earth is level, why cannot tall trees like the date palm, alas, be seen by man, though at a very great distance from the observer.

He separately refutes the belief that the earth is supported:<sup>40</sup>

(20.39) Clay is destroyed by water, so it is not possible for the earth [made of clay] to remain in water or to float on it like a boat.

(20.40) If the heavy sphere of the earth can remain on water, which water stands supportless in space, why can the earth not remain in space?

(20.41) If the earth is supported by a tortoise or other things, by whom are *they* supported in space? If they can remain in space [unsupported] what prevents the earth from remaining thus [unsupported]?

This idea is elaborated by Vaṭeṣvara in his book also called *Gola* (meaning round or spherical, since this too deals with the same subject of spherics).<sup>41</sup>

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<sup>39</sup>Lalla, cited above, p. 274–75.

<sup>40</sup>Lalla, cited above, p. 276.

<sup>41</sup>*Vaṭeṣvara Siddhānta, and Gola of Vaṭeṣvara*, ed. and trans. K. S. Shukla, pt. II, English translation and commentary, Indian National Science Academy, New Delhi, 1985, pp. 638–639. Emphasis added. Vaṭeṣvara was well known as a critic of Brahmagupta. Vaṭeṣvara's book (*Siddhānta*) was written in 904 CE, and is referred to by subsequent scholars like al Bīrūnī (b. 973 CE) and Sripati (1039 CE).

(V.2) Just as an iron ball surrounded by pieces of magnet does not fall through standing (supportless) in the sky, in the same way this Earth though supportless does not fall. . .

(V.5) If the earth is supported by Sesa [serpent], tortoise, mountains, and elephants etc. how do *they* stand supportless (in space)? If they are believed to be endowed with some power [to stand supportless], why is not the same power assigned to the Earth?

He also refutes the idea that the earth would fall down, on the grounds that “up” and “down” are decided by reference to the centre of the earth.

(V.3) If you are inclined to believe that it falls down, say what is up and down for an object standing in space. The globe of the Earth. . . in what direction should it then fall?

(V.7) As here in our locality a flame of fire goes aloft in the sky and a heavy mass falls towards the Earth, so is the case in every locality around the Earth. As there does not exist a lower surface (for the Earth to fall upon), where should it fall?

He goes on to comfort people who are afraid they might fall off the earth.

(V.8) Just as a house lizard runs about on the surface of a pitcher [pot] lying in open space, so do the human beings move about comfortably all around the Earth.

Writers who precede Lalla and Vaṭeṣvara, e.g. writers like Aryabhata, or Bhaskara, or Brahmagupta, all invariably state that the earth is spherical, they state its dimensions etc., but they do not refute any such beliefs in a flat earth. This suggests that the view was not seriously contested in their time.

## 5.5 Refutation of the demonic theory of eclipses

The demonic theory of eclipses has often been used to demonise Indian traditions. The following refutation of the demonic theory within Indian tradition also serves to refute the demonisation of Indian tradition.

First the background. Western historians have often quoted al Biruni on India, particularly famous is his “pearls and dung quote”, and this is especially favoured with those historians who want to write about Indian mathematics and astronomy, but are unfamiliar with the original sources, and are misguided by Western authorities like Pingree. The context of the quote is a comparison between Greek and Indian science, especially mathematics and astronomy

The Greeks...had philosophers who...discovered and worked out from them the elements of science, not of superstition. . . .

Think of Socrates when he opposed the crowd of his nation as to their idolatry and did not want to call the stars gods. At once eleven of the twelve judges of the Athenians agreed on a sentence of death, and Socrates died faithful to the truth.

The Hindus had no men of this stamp both capable and willing to bring sciences to a classical perfection.<sup>42</sup>

So far as al Biruni’s political formula for conquering and ruling India is concerned, if all he wanted to do was to make a general observation to the effect that the Indian intelligentsia by-and-large lacks a spine, he was perhaps right, and this probably remains true today. But as a peice of history this is all muddled: Socrates was a martyr all right, but proposing him as a martyr against idolatry is a bit thick, and a matter fit for consumption only by ignorant and cruel kings like Mahmood of Ghazni.

First of all, Socrates was not at all concerned about the physical or mathematical sciences. Plato’s Socrates, at any rate, emphatically denied during his trial that he had anything to do with sciences: “. . . the simple truth is, O Athenians, that I have nothing to do with physical speculations”.<sup>43</sup> He went on to say that his accusers, believing the audience to be illiterate (like al Beruni, or perhaps Sachau), had mixed him up with Anaxagoras.

[Socrates:] Do you [Meletus] mean that I do not believe in the godhead of the sun or moon, like other men?

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<sup>42</sup>Al Bīrūnī, *Kitāb al Hind*, trans. E. C. Sachau, Alberuni’s India, reprint, Munshiram Manoharlal, New Delhi, 1992, vol 1, p. 25

<sup>43</sup>Plato, *Apology*, trans. Benjamin Jowett, Encyclopaedia Britannica, Chicago, 1990. 201

[Meletus:] I assure you, judges, that he does not: for he says that the sun is stone, and the moon earth.

[Socrates:] Friend Meletus, you think that you are accusing Anaxagoras, and you have but a bad opinion of the judges, if you fancy them illiterate to such a degree. . . .<sup>44</sup>

Confounding Socrates with Anaxagoras is, of course, fatal to al Biruni's argument, since Anaxagoras (like Aristotle) did not die a martyr, but ran away instead! This is similar to the case of Galileo vs Giordano Bruno: Galileo apologised to the church, Bruno chose to be burned at the stake. Scientists do not die for their beliefs, religious people do.

At any rate, at his trial, Socrates went on to swear by Zeus, thereby denying that he is an atheist, and he argues that since he is accused of believing in demi-gods, he must, therefore, also believe in the existence of gods:

But this is what I call a facetious riddle invented by you...you say first that I do not believe in gods, and then again that I do believe in gods that is, if I believe in demigods. For if the demigods are the illegitimate sons of gods...what human being will believe that there are no gods if there are the sons of gods? You might as well assert the existence of mules, and deny that of horses and asses.<sup>45</sup>

The fact that a death penalty could be demanded for such Socrates' alleged belief about the moon shows that Athenian society was terribly superstitious. There is corroborated by the extensive Greek belief in oracles.

There are other details that do not gel. The number of jurors, at several hundred, was lot more than the twelve jurors mentioned in Sachau's translation: the figure twelve for the number of jurors was arrived at after much statistical research into the Poisson probability distribution. Also, Socrates expresses surprise that the juror's votes were "so nearly equally divided"<sup>46</sup>, so 11 out of 12 cannot even be taken as a valid metaphor, especially coming from one, like al Biruni, who is himself a mathematician. All this goes to show how inaccurate is the account provided the current text.

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<sup>44</sup>Plato, *Apology*, p. 204

<sup>45</sup>Plato, *Apology*, p. 205

<sup>46</sup>Plato *Apology*, p. 209

As a representation of Indian tradition, al Biruni is equally incorrect. India admittedly had very few martyrs like Carvaka (about whom al Biruni evidently had never heard), but this was rather because criticism was freely permitted and practised: people attacked each others theories, not the persons holding those theories. Carvaka was a special case, who criticised a victorious king for lack of ethics immediately after a major and painful war. Having said that, it nevertheless seems to me, further, that martyrdom and truth are unrelated, except as an aspect of Christian and perhaps Islamic belief. The fact that Bruno died, and Galileo did not can hardly be taken as an indication that Bruno was right and Galileo was wrong.

Similar cultural presuppositions are reflected in al Biruni's further observations as follows:

Therefore you find that even the so-called scientific theorems [sic] of the Hindus are in a state of utter confusion, devoid of any logical order, and in the last instance always mixed up with the silly notions of the crowd, e.g. immense numbers, enormous spaces of time, and all kinds of religious dogmas, which the vulgar belief does not admit of being called into question. Therefore, it is a prevailing practice among the Hindus jurare in verba magistri. . . .<sup>47</sup>

The accusations of lack of logical order merely reflect the cultural presuppositions. One can understand al Biruni's frustration: the *Āryabhaṭīya* is not the *Elements*—it is neither a religious, nor a pedagogic, nor an elementary text. The *Ārabṭīya* is a specialist text, written purely from the viewpoint of practical applications, which is bound to present difficulties to those who lack the requisite background, such as some present-day historians.

Unlike a pedagogical text, a specialist text assumes the reader to be knowledgeable, and does not bother to develop the subject step by step. So there was a clash of cultural expectations between the writer of the book who expected the reader to be knowledgeable, and the reader (in this case al Biruni) who expected the writer to explain himself in the step-by-step hand-holding manner to which he (al Biruni) was accustomed. Under these circumstance, to blame the writers of the books in one cultural setting for not living up to the expectations of a person from another cultural milieu is an unfair political act of blamesmanship. There is a perfectly well-defined

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<sup>47</sup>al Beruni, I.25. This continues into the “pearls and dung” quote.

order in the *Āryabhaṭīya*, but this is not a pedagogical order, nor is it the order of the *Elements*.

The large numbers are obviously due to the requirements of higher precision. To refer to the requirements of higher precision as unscientific only reflects on al Biruni's own lack of scientific knowledge.

Against this background, let us consider the oft-quoted claim that Indian tradition was unscientific because of the belief that Rahu and Ketu are the causes of eclipses.

This is what Lalla has to say about it in his chapter on “False Notions”:

18. ...when a demon, an enemy of the gods, was drinking the nectar, his head was chopped off by his enemy Hari. But the head did not die. Some say this is Rahu. The Sun (and the Moon) are devoured by it.

22. If you are of the opinion that an artful demon is always the cause of an eclipse by swallowing (the Sun or Moon), then how is it that an eclipse can be determined by means of calculation? Moreover, why is there not an eclipse on a day other than the day of New or Full Moon.

25. An eclipse cannot be cause by Rahu, because the sides of the discs of the Sun and Moon, which are first to be eclipsed, are not the same; nor are the portions eclipsed the same; and nor even are the durations the same.

26. In a solar eclipse, people at different part (of the earth) see different portions of the Sun eclipsed. Some do not see (the eclipse) at all. Knowing this, who can maintain that an eclipse is caused by Rahu?

27. Because of the great authority of Brahmā, at the time of eclipse, the Sun is near Rahu. So in the Vedas, Smrtis, and Samhitas is has come to be known that Rahu is the cause of the eclipses.<sup>48</sup>

Note that the Rahu in the last stanza is an astronomical term, a reference to the ascending node of the Moon, and has nothing to do with the legendary demon who tried to steal the nectar from the gods! Thus, quite possibly

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<sup>48</sup>Lalla, cited above, pp. 272–273

al Biruni confused the two meanings, just as Vasco da Gama confused the Malayalam *kau* (meaning pole star) to mean *kau* (meaning teeth), since the celestial navigator (“pilot”) who navigated him from Africa to India held his instrument between his teeth, and accordingly recorded in his diary that the pilot was telling the distance by his teeth.