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Three Purāṇic Statements on the Shape of the Earth

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INTRODUCTION

THE PRESENT ARTICLE is part of an investigation into how authors of Sanskrit astronomical treatises thought about, critiqued, and used cosmographical material from the Purāṇas, a corpus of Hindu religious texts. The focus is on an argument on the Purāṇic conception of the shape of the earth presented by the astronomer Jñānarāja (fl. 1500) in the *Siddhāntasundara* at the dawn of the Early Modern period in Indian history.¹ In the argument, Jñānarāja cites and interprets three Purāṇic statements about the shape of the earth. The argument offers insights into how cosmographical material from the Purāṇas was understood and used at the time of Jñānarāja.

1 SIDDHĀNTAS AND PURĀṆAS

SINCE AT LEAST THE TIME of the astronomer Varāhamihira (fl. sixth century), Indian astronomers composing Siddhāntas were aware of and reacted to cosmographical ideas from other traditions, including both Buddhism and Jainism.² However, since the Siddhāntic astronomers belonged to the religious tradition we today call Hinduism, the most important tradition of cosmography that they engaged with was perhaps that of the Purāṇas.

¹ In the following, the term “India” will refer to South Asia in general.

² Varāhamihira lived in Ujjain in the sixth century CE (Pingree 1970–94: 5.563–595; 1976; Plofker and Knudsen 2008b). A Siddhānta is a comprehensive Sanskrit

treatise on astronomy and cosmography. As an example of the rejection of a Jain opinion, in *Pañcasiddhāntikā* 13.8 (Neugebauer and Pingree 1970–1: 1.110), Varāhamihira rejects the Jain idea that there are two suns and two moons.



THE PURĀṆAS

A corpus of texts belonging to the Hindu tradition of India, the Purāṇas were composed over a long period of time, from the middle of the first millennium CE to the middle of the second millennium CE. The corpus is far from monolithic. Additions and other changes were regularly made to existing Purāṇas, and new Purāṇas would continue to be composed according to various sectarian and regional standpoints. As a consequence, it is difficult to date individual Purāṇas, and even sections of Purāṇas.³

As a corpus, the Purāṇas are often considered to be primarily religious texts. More broadly, the Purāṇas are encyclopedic in nature, covering a vast range of subjects. Over time, the Purāṇic corpus grew into a large repository of Brahmanic learning. As part of that process, the cosmographical material in the Purāṇas was expanded and developed. The composite nature of the Purāṇic texts is illustrated by the traditional view that a Purāṇa should possess five components (*pañcalakṣaṇa*): (1) the creation of the universe; (2) the destruction of the universe; (3) the genealogy of gods and sages; (4) the reigns of the Manus; and (5) the history of the solar and lunar races.⁴

Two Purāṇas, the *Bhāgavatapurāṇa* and the *Viṣṇupurāṇa*, each of which contains large sections on cosmography, will be important in the following. Rocher considers both texts to be among the “better established and more coherent” Purāṇas.⁵ In terms of relative chronology, the *Viṣṇupurāṇa* is considered older than the *Bhāgavatapurāṇa*.

THE COSMOGRAPHY OF THE PURĀṆAS

Purāṇic cosmography consists of and preserves an intermingling of many different ideas from different periods of time. In particular, it contains ideas contrary to the science of astronomy as practised in ancient and medieval India. For example, it is stated in some Purāṇas that the sun is closer to the earth than the moon is.⁶

The Purāṇas conceive of the universe as the *brahmāṇḍa*, a word meaning “Brahmā’s egg.” As such, the word *brahmāṇḍa* itself offers a clue to the shape of the universe, namely, oval, or perhaps even spherical. Inside the *brahmāṇḍa* is the earth as well as multiple regions not accessible to human beings, including Svarga, the heavenly realm, and the Pātālas, the seven subterranean regions.

3 On the dating of the Purāṇas, see Rocher 1986: 100–103.

4 For a discussion of the five characteristics of a Purāṇa, see Rocher 1986: 24–30. For a discussion of the Purāṇas as religious docu-

ments, see Rocher 1986: 104–115.

5 See Rocher 1986: 103.

6 See, for example, *Viṣṇupurāṇa* 2.7.5 (Śarmā 1985: 92v) and *Bhāgavatapurāṇa* 5.22.8 (K. Sāstrī 1966: 495).

The earth is frequently described by the Sanskrit word *bhūmaṇḍala* in the Purāṇas. The word is a compound word formed by combining two words, *bhū*, “the earth,” and *maṇḍala*, “circular, round; circle.” The literal meaning of *bhūmaṇḍala* is therefore “earth-circle.” As such, there is no doubt that the idea of a round earth is present in the Purāṇas. However, the word “round” is ambiguous in Sanskrit, just as it is in English, where a plate, a bracelet, and a ball can be described as “round” despite having different geometrical shapes.

The Purāṇas describe the *bhūmaṇḍala* as covered by continents or landmasses (*dvīpa*) and oceans. At the *bhūmaṇḍala*'s center is a round continent known as Jambūdvīpa, which is subdivided into regions (*varṣa*) separated from each other by mountain ranges. Meru, the world-mountain, is located at the center of Jambūdvīpa. It is in Jambūdvīpa that human beings live, and the region Bhāratavarṣa corresponds to India. Surrounding Jambūdvīpa is an alternating series of seven oceans⁷ and seven continents. The oceans and continents are annular in shape (ring-shaped), and the further they are from Jambūdvīpa, the larger they are. Beyond the continents and oceans, the circular Lokāloka mountains mark the boundary for reach of the sun's light.

Overall, the *bhūmaṇḍala*, as described in the Purāṇas, is enormous in size, vastly larger than the earth described in the Siddhāntas. It is clear, therefore, that the Purāṇic concept of the *bhūmaṇḍala* is different from “the earth” as we think of it today.⁸

THE SHAPE OF THE EARTH IN THE PURĀṆAS

One interpretation of the Purāṇic *bhūmaṇḍala* is that it represents the earth as a flat disk. As we will see in the following, some astronomers from the Siddhāntic tradition believed that the cosmography of the Purāṇas operates with a flat earth. Some modern scholars likewise hold that the earth is flat in Purāṇic cosmography.⁹ In this interpretation, the *bhūmaṇḍala* exists as a large circle inside the *brahmāṇḍa*. More specifically, it is the Great Circle that divides the *brahmāṇḍa* into two equal halves.

There is evidence that indigenous traditions saw the *bhūmaṇḍala* as a flat disk. One example is a model of the universe found in the Hanūmāṇḍhokā palace in Kathmandu, Nepal. The model, which dates from 1656 CE and is “likely based on Purāṇic concepts”,¹⁰ depicts the earth precisely as a flat disk.¹¹ However, there are no known Purāṇic passages that explicitly state that the earth is flat.

⁷ Each ocean consists of a different liquid. An ocean of saltwater surrounds Jambūdvīpa.

⁸ For an account of the cosmography of the Purāṇas, see Kirfel 1920: 54–173.

⁹ See, for example, Pingree 1990: 274 and Plofker 2005: 65.

¹⁰ See Bühnemann 2020: 2.

¹¹ See Bühnemann 2020 for a detailed discussion of the model.

Besides flatness, there are other possible interpretations of the shape of the *bhūmaṇḍala*, including the earth having the shape of an inverted bowl. For example, some Purāṇas describe the earth as resembling a turtle shell, that is, having a convex shape, after a destruction has burned away trees and grass.¹² Without a clear and unambiguous Purāṇic statement on the earth's shape, there is no certain answer to the question of what the shape of the earth is according to the Purāṇas. Furthermore, given how the Purāṇas have evolved over time and place, even if such a statement was available in some Purāṇa, there is no way to be sure that it would apply consistently across the numerous and different Purāṇic texts (even different parts of the same Purāṇa) and their traditional commentaries.

THE COSMOGRAPHY OF THE *BHĀGAVATAPURĀṆA*

The cosmographical sections of the *Bhāgavatapurāṇa* warrant an additional comment. Like much of Sanskrit literature, the Purāṇas are composed in verse. But the chapters on cosmography in the *Bhāgavatapurāṇa*, which are found in the fifth section (*skandha*) of the text, are in prose rather than in verse.

It is not clear why the *Bhāgavatapurāṇa* contains material written in prose, but perhaps the reason is that Purāṇic cosmography involves both a technical vocabulary and huge numbers. Plofker notes that,

Since Sanskrit (like other languages) generally has only one standard number word for each number, it can be difficult to fit such words into the metrical structure of verses so as to convey a desired mathematical meaning without ruining the scansion of the verse.¹³

In the Siddhāntas, which are composed in verse, the problem is solved by employing systems that allow numbers to be expressed in a different way than the corresponding number words. One example is the object-number (*bhūtasai-khyā*) system, which provides synonyms for standard number words.¹⁴ But such systems are not followed in the Purāṇas, in which the standard number words are consistently used. As a result, the *Viṣṇupurāṇa* sacrifices clarity in its cosmographical parts in order to present the material in versified form. In contrast, the prose account in the *Bhāgavatapurāṇa* has more clarity and detail.¹⁵ It is possible, therefore, that a desire for clarity and ease of expression is behind the decision to use prose in the *Bhāgavatapurāṇa*'s cosmographical chapters.

Whatever the reason is for the use of prose in the *Bhāgavatapurāṇa*'s cosmographical chapters, these chapters stand out in the voluminous Purāṇa, and have attracted significant attention in the commentarial tradition.

¹² See, for example, *Brahmāṇḍapurāṇa* 3.1.147 (Sharma 2000: 239v) and *Kūrmapurāṇa* 2.43.23 (Gupta 1971: 665).

¹³ Plofker 2009: 47.

¹⁴ See Sarma 2003.

¹⁵ This is not to say that the cosmography in the *Bhāgavatapurāṇa* is always clear.

PURĀṆIC MATERIAL IN CLASSICAL INDIAN ASTRONOMY

The approach to Purāṇic cosmography taken by many prominent Siddhāntic astronomers is to incorporate compatible elements into their own model while rejecting incompatible elements. An example of the incorporation of a compatible element is the astronomers' placing of Meru, the world mountain, at the earth's North Pole. An example of the rejection of an incompatible element is the astronomers' refutation of the Purāṇic idea that the sun is closer to us than the moon is.¹⁶ Minkowski refers to this approach as the "standard accommodation," and describes it as "substantially standardized, if not quite a stable and uniform one".¹⁷ First articulated in Lalla's *Śiṣyadhītorḍdhidatantra* in the eight or early ninth century CE, the standard accommodation was followed for many centuries, propagated by prominent astronomers like Śrīpati (fl. 11 cent.) and Bhāskara II (b. 1114).¹⁸

JÑĀNARĀJA

In contrast to the standard accommodation is the approach taken by the scholar-astronomer Jñānarāja in the treatise *Siddhāntasundara*, composed around 1500 CE.

Jñānarāja belonged to a Brahman family with a long history of study and scholarship. He lived in Pārthapura, which has been identified as the modern Pathri in Maharashtra. At the time, Pārthapura was a center for astronomy, and Jñānarāja's family was just one of the families of astronomers residing there.¹⁹ Jñānarāja had two sons, who both contributed to the field of astronomy: Cintāmaṇi, who composed an extensive commentary on his father's *Siddhāntasundara* called the *Grahagaṇitacintāmaṇi*, and Sūryadāsa, a polymath who wrote on a vast range of subjects.²⁰

The key difference between Jñānarāja's approach to Purāṇic cosmography and that of his predecessors is his concern with the authority of the Purāṇas. Contrary to Lalla, Śrīpati, Bhāskara II, and others, Jñānarāja never rejects cosmographical ideas from the Purāṇas. Moreover, he does not hesitate to reject

16 For a detailed account, see Plofker 2005: 66–70.

17 Minkowski 2004: 352–354.

18 The astronomer Lalla lived in Gujarat in the eight or early ninth century CE (Pingree 1981: 22; 1970–94: 5.545). The astronomer Śrīpati lived in Maharashtra in the 11th century CE (Pingree 1981: 25). The astronomer Bhāskara II, a towering figure in the Siddhāntic tradition, was born in 1114 CE and lived in what is now Karnataka state (Pingree 1970–94: 4.299–300).

19 See Minkowski 2004: 354.

20 For more information on Jñānarāja, see Minkowski 2004 and Knudsen 2014. The *Grahagaṇitacintāmaṇi* has not been published. All references to this commentary in the following are to MS Ujjain, Scindia Oriental Institute 9401. This MS supports both the main text of Jñānarāja's *Siddhāntasundara* and Cintāmaṇi's commentary on it, *Grahagaṇitacintāmaṇi*. A copy of this manuscript was kindly made available to me by Professor Christopher Minkowski of the University of Oxford.

tenets from the Siddhāntas in order to preserve the validity of statements from the Purāṇas.

The Siddhāntic tradition holds that the earth does not require external support to remain motionless in space, specifically rejecting the claim that such support is needed. Jñānarāja, however, endorses the Purāṇic position that the earth needs the support of divine beings for its position to remain fixed in space, and explicitly rejects the argument against external support given in the *Siddhānta-śiromaṇi* of Bhāskara II.²¹ Jñānarāja even redefines the meaning of the word “up” in order to preserve the validity of a Purāṇic description.²²

It is noteworthy that Jñānarāja is silent on the Purāṇic claim that the sun is closer to the earth than the moon is. If this idea were accepted, however, the Siddhāntas’ cosmological model would break down. For example, the model would no longer be able to scientifically account for eclipses, an important topic in astronomy. For this reason, Jñānarāja’s silence is not surprising. Rather than engaging with a problem that would expose a rift between the Purāṇas and the Siddhāntas, he omits a discussion of it in order to avoid calling the authority of the Purāṇas into question.

There is no doubt that within the Siddhāntic tradition, Jñānarāja acts as an apologist for the Purāṇas. An important question arises from this observation: Does Jñānarāja’s emphasis on Purāṇic authority mean that he follows the traditional interpretation of the Purāṇas? In other words, is Jñānarāja’s interpretation of the Purāṇas (or at least of the relevant passages of the Purāṇas) in agreement with the traditional understanding of the texts given in the many commentaries on the Purāṇas? This question will be explored later in the article.

THE SHAPE OF THE EARTH

It is well known that a central tenet of Siddhāntic cosmology is that the earth is small in size and spherical in shape. However, parallel to this Siddhāntic conception of the earth as a small sphere, other traditions had their own ideas about the size and shape of the earth.

In the *Siddhāntasundara*, Jñānarāja enters into a discussion of how the Purāṇas describe the shape of the earth. He presents an argument based on three statements, which he claims are Purāṇic, to refute the idea, held by his predecessors in the Siddhāntic tradition, that the Purāṇas describe the earth as flat.

The standard accommodation of the Siddhāntic tradition contains different arguments against a flat earth. More specifically, these arguments refute the idea,

²¹ See *Siddhāntasundara* 1.1.29–31 (Knudsen 2008: 263–264).

²² See *Siddhāntasundara* 1.1.33–38 (Knudsen 2008: 264–266).

generally said to be held by an unspecified “some,” that the earth resembles the surface (*tala*) or belly (*udara*) of a mirror.²³

The first astronomer to mention the mirror simile is Bhāskara I. In his commentary on Āryabhaṭa’s *Āryabhaṭīya* from 629 CE, we find the following statement:²⁴

भुवं तावदन्ये शकटाकारं दर्पणवृत्ताकारं च मन्यन्ते

For one thing, other people believe that the earth is shaped like a cart or has the shape of a round mirror.

The idea of a cart-shaped earth does not seem to be Purāṇic,²⁵ and later astronomers do not mention it. But the mirror simile is subsequently cited by Lalla, Caturveda Pṛthūdakasvāmin, Śrīpati, Bhāskara II, and Jñānarāja.²⁶

23 The use of one of the words *udara* or *tala* with a word for “mirror” indicates the reflective surface of the mirror (“belly” indicating the front as opposed to the back), if it at all changes the meaning of “mirror.” The astronomers use *udara* and *tala* synonymously. For example, Śrīpati uses *udara* in *Siddhāntaśekhara* 15.8 and *tala* in 15.9 (Miśra 1932–47: 2.138–139). Pingree (1983: 356) translates *darpaṇodara* as “concave mirror,” but there is no evidence that the Siddhāntic astronomers understood the simile to imply concavity. In fact, they use “mirror,” “belly of a mirror,” and “surface of a mirror” synonymously in the simile, the *tertium comparationis* of which they understand to be flatness.

24 Shukla 1976: 250. Note that *śakaṭākārā* in the printed edition has been corrected to *śakaṭākārām*. The astronomer Āryabhaṭa was born in 476 CE, and he completed the *Āryabhaṭīya* in 499 CE. See Pingree 1970–94: 1.50–53, 2.15, 3.16, 4.27–28, 5.16–17 and Plofker and Knudsen 2008a. The astronomer Bhāskara I wrote the *Āryabhaṭīyabhāṣya* on the *Āryabhaṭīya* in 629 CE. See Pingree 1970–94: 4.297–299, 5.254.

25 In the Indian tradition, “cart-shaped” (*śakaṭākāra*) refers to an isosceles trapezoid or triangle, but it is not immediately clear how the earth could have such a shape. However, Bhāskara I is likely critiquing a Buddhist idea. In the *Abhidharmakośa*

of Vasubandhu (3.53) (Shastri 1998: 1.404), Jambūdvīpa is said to have the shape of a cart. In Hindu cosmography, Jambūdvīpa is the central circular continent of the *bhūmaṇḍala*. But in pre-Mahāyāna Buddhist cosmography, Jambūdvīpa refers to the Indian subcontinent only (see Sadakata 1997: 31). In this Buddhist context, Jambūdvīpa “is a trapezoid, the short side facing outward. In fact, it is virtually a triangle. It has three sides of 2,000 *yojanas* each; the short side is 3.5 *yojanas*” (Sadakata 1997: 30–31 and 33, fig. 11). In other words, the Buddhist Jambūdvīpa is shaped like a trapezoidal cart. Perhaps Bhāskara I confused the Buddhist notion of Jambūdvīpa with that of the Purāṇas, and thought the *bhūmaṇḍala* is cart-shaped in Buddhist thought.

26 See *Śiṣyadhīvṛddhidatantra* 20.6 and 20.34 (B. Chatterjee 1981: 1.232, 1.237); Caturveda Pṛthūdakasvāmin’s *Vāsanābhāṣya* on Brahmagupta’s *Brāhmasphuṭasiddhānta* 21.1 (Ikeyama 2002: 17, 18); *Siddhāntaśekhara* 15.8–9 (Miśra 1932–47: 2.138–139); *Siddhāntaśiromaṇi* 2.3.11 (D. Apte 1943–52: 1.40); and *Siddhāntasundara* 1.1.27–28 (Knudsen 2008: 262–263). The astronomer Caturveda Pṛthūdakasvāmin lived around 864 CE (Pingree 1970–94: 4.221–222). The astronomer Brahmagupta composed the *Brāhmasphuṭasiddhānta* in 628 CE at the age of 30 (Pingree 1970–94: 4.254–257, 5.239–240).

It is clear from the texts that the Siddhāntic astronomers understood the simile (comparing the earth to a mirror) to mean that the earth is flat. For example, Lalla writes the following in the *Śiṣyadhīṣṭhīdatantra*:²⁷

अमितामवनीं प्रचक्षते
सुसमां केचन दर्पणोपमाम्

Some say that the earth is immense; others that it is perfectly flat like a mirror.

The first of the Siddhāntic astronomers to identify the source of the mirror simile is Bhāskara II, who cites the simile in the *Siddhāntaśiromaṇi*:²⁸

यदि समा मुकुरोदरसन्निभा
भगवती धरणी तरणिः क्षितेः
उपरि दूरगतोऽपि परिभ्रमन्
किमु नरैरमरैरिव नेक्ष्यते

If the glorious earth is flat like the belly of a mirror, why is the sun, which is revolving far above the earth, not [always] visible to humans like it is to the gods?

In the *Vāsanābhāṣya*, Bhāskara II's own commentary on the *Siddhāntaśiromaṇi*, the following comment is made on the verse:²⁹

पुराणे भूः समादर्शोदरसन्निभा कथ्यते

It is described in the Purāṇas that the earth is flat like the belly of a mirror.³⁰

Unfortunately, Bhāskara II does not reveal where in the Purāṇas the mirror simile is found.

Besides Bhāskara II, the only other astronomer to identify the source of the mirror simile is Jñānarāja, who also points to the Purāṇas. A detailed discussion of Jñānarāja's treatment of the mirror simile is found in the next section.

Additionally, in his compendium on India, the Muslim scholar Al-Bīrūnī (born 973 CE) writes that some people in India hold that the earth is flat like a mirror. He further notes that sayings about the shape of the earth are especially common among the followers of the Purāṇas.³¹

27 See *Śiṣyadhīṣṭhīdatantra* 20.6 (B. Chatterjee 1981: 1.232). Lalla presents arguments against the earth being flat in *Śiṣyadhīṣṭhīdatantra* 20.34–37 (B. Chatterjee 1981: 1.237).

28 *Siddhāntaśiromaṇi* 2.3.11 (D. Apte 1943–52: 1.40).

29 See the *Vāsanābhāṣya* on *Siddhāntaśiromaṇi* 2.3.11–12 (D. Apte 1943–52: 1.40). This work is not to be confused with Caturveda Pṛthūdakasvāmin's commentary of the

same name on the *Brāhmasphuṭasiddhānta*.

30 The word *purāṇe* is here interpreted as a singular standing for the whole category.

31 Sachau 1910: 267–268. Al-Bīrūnī cites Brahmagupta as his source. However, as noted by Pingree (1983: 356), the information given by Al-Bīrūnī is not from Brahmagupta, but appears to be from Caturveda Pṛthūdakasvāmin's commentary on Brahmagupta's *Brāhmasphuṭasiddhānta*.

JÑĀNARĀJA ON THE PURĀṆAS AND THE SHAPE OF THE EARTH

As one would expect from a member of the Siddhāntic tradition, Jñānarāja maintains that the earth is spherical in shape. Not only does he state that the earth is a sphere, he gives a number of scientific arguments for the sphericity of the earth.³²

However, unlike his predecessors, Jñānarāja does not attempt to refute the supposedly Purāṇic belief that the earth flat like a mirror. He argues instead that the mirror simile has been misinterpreted and that a spherical earth is consistent with the cosmographical statements in the Purāṇas. In other words, Jñānarāja makes the point that a spherical earth is supported not only by scientific demonstrations, but also by Purāṇic authority.³³

JÑĀNARĀJA'S ARGUMENT

Jñānarāja presents his argument on the Purāṇas and the shape of the earth in two Sanskrit verses in the *Siddhāntasundara's* first chapter, the chapter on cosmography (*bhuvanakośa*):³⁴

सद्भूगोलपदं पुराणपठितं दृष्ट्वा तथा सर्वतो
मेरुः सौम्यदिशीति चाग्रहरता जल्पन्ति ये मानवाः
भूरादर्शतलोपमेति सकला तेऽर्थं पुराणोदितं
नो जानन्ति च सूपपत्तिविदितां सत्कन्दुकाकारताम्
मुकुरतलनिभत्वं यत्पुराणप्रदिष्टं
तदवनिशतभागस्यैव नो भूगोले
परिधिशतविभागो दण्डवद्दृश्यतेऽतः
सम इव मनुजानां भाति गोलो धरित्र्याः

[Even] after seeing the straightforward word *bhūgola* used in the Purāṇas, as well as the statement “Meru is north of everywhere,” obstinate people say that the statement “resembling the surface of a mirror” [applies to] the entire earth. But they do not know the

32 See *Siddhāntasundara* 1.21–26 (Knudsen 2008: 260–262).

33 Even though he argues that a spherical earth is consistent with Purāṇic cosmography, Jñānarāja concedes that some cosmographical descriptions given by the followers of the Purāṇas differ from the descriptions given in the Siddhāntas. While such descriptions are deemed true by Jñānarāja, he argues that they can be explained by “epoch-difference” (*kalpabheda*). That is,

they are descriptions of the universe during a different epoch (*kalpa*) (in a previous creation). Jñānarāja holds that in the present epoch (the current creation), the texts of the Siddhāntic tradition should be consulted for cosmographical knowledge. See *Siddhāntasundara* 1.1.76 (Knudsen 2008: 280).

34 See *Siddhāntasundara* 1.1.27–28 (Knudsen 2008: 262–263). Note that 1.1.27 in Knudsen’s edition incorrectly has *mānavah* instead of the correct reading *mānavāḥ*.

meaning of the Purāṇas, nor [do they know] that the spherical nature of the earth is established by excellent demonstrations.

The resemblance to the surface of a mirror, which is mentioned in the Purāṇas, [applies] only to a one-hundredth part of the earth, not to the [entire] sphere of the earth. A one-hundredth part of the circumference [of the earth] is perceived [to be straight] like a stick. Therefore the sphere of the earth appears to human beings as if it is flat.

Jñānarāja does not reveal the identity of the obstinate people that he reprimands, nor does his son Cintāmaṇi in his commentary on the above two verses. Minkowski refers to them as “offstage voices”.³⁵ The most obvious candidates are:

1. The traditional guardians and interpreters of Purāṇic lore.
2. The astronomers of the Siddhāntic tradition.

We know that the Siddhāntic astronomers ascribe the mirror simile to another tradition (identified as the Purāṇic tradition by Bhāskara II and Jñānarāja), and that they interpret the simile to mean that the earth is flat. However, it would be odd for Jñānarāja to state that the astronomers are ignorant about arguments for and demonstrations of the spherical shape of the earth. On the other hand, Jñānarāja assumes that his antagonists know specific, perhaps obscure, Purāṇic passages, which points to the first possibility. This group is also not likely to know the Siddhāntas’ arguments that the earth is a sphere. As things stand, though, it is not clear exactly who Jñānarāja has in mind.

The question of Jñānarāja’s antagonists aside, the two verses introduce three separate statements, all of which are attributed to the Purāṇas:

1. *bhūgola*, “earth-sphere.”
2. *sarvato meruḥ saumyaśi*, “Meru is north of everywhere.”
3. *ādarśatalopamā* or *mukuratalanibhatvam*, “resembling the surface of a mirror” or “resemblance to the surface of a mirror.”

The argument can be broken down as follows: Jñānarāja claims that the word *bhūgola* and the statement *sarvato meruḥ saumyaśi* are (1) found in the Purāṇas, and (2) indicate that the earth is a sphere. According to Jñānarāja, even though his antagonists are aware of these two statements (and presumably know how they should be interpreted), they nonetheless proceed to cite a third Purāṇic statement, *ādarśatalopamā*, as evidence that the earth is described as flat in the Purāṇas. However, according to Jñānarāja, his antagonists are misinterpreting

³⁵ Minkowski 2004: 356.

the third statement, which he argues means only that the earth locally appears to be flat.³⁶

In the following, each of the three statements in Jñānarāja's argument will be carefully analyzed. Attention will be given to the context of the statements in the Purāṇas, as well as to how the statements have been interpreted by the traditional commentators—and whether Jñānarāja's interpretation of the statements deviates from this context and traditional interpretation.³⁷

2 THE WORD *BHŪGOLA*

THE FIRST STATEMENT in Jñānarāja's argument is a single Sanskrit word, *bhūgola*. More specifically, it is a compound word formed as a combination of the word *bhū*, which means "the earth," and the word *gola*. In Jñānarāja's verse, it occurs as part of a larger compound, *sadbhūgolapadam*, translated as "the straightforward (*sat*) word (*pada*) *bhūgola*" above.³⁸

SCHOLARLY DICTIONARIES ON *GOLA* AND *BHŪGOLA*

Before Jñānarāja's argument can be properly critiqued, it is essential to have a full understanding of the meaning(s) of the Sanskrit word *gola*. The most commonly used scholarly dictionaries all have an entry for *gola*.

Böhtlingk and Roth's *Sanskrit-Wörterbuch*, an extensive Sanskrit-German dictionary published between 1855 and 1875, gives *Kugel*, that is, "ball, globe," as the primary meaning of both *gola* and the related word *golaka*.³⁹ Besides references to Sanskrit-Sanskrit lexicons, the dictionary states that this meaning of *gola* is attested in *Bhāgavatapurāṇa* 3.23.43, 5.16.4,⁴⁰ 5.20.38, 5.20.43, and 5.25.12, as well as *Gītāgovinda* 1.16.⁴¹ In these examples, *gola* and *golaka* occur with *bhū*, either in

³⁶ This is an old Siddhāntic argument. See, for example, *Śiṣyadhīvoṛddhidatantra* 20.35 (B. Chatterjee 1981: 1.237).

³⁷ Due to its popularity, the *Bhāgavatapurāṇa* has attracted more commentaries than any other Purāṇa. We often do not know much about the individuals who wrote the commentaries. A brief note on the commentators on the *Bhāgavatapurāṇa* is given by Tagare (1986: lxvi–lxix).

³⁸ The adjective *sat*, used by Jñānarāja in the larger compound, is difficult to translate. Cintāmaṇi understands it to indicate that the word *bhūgola* is used in its basic, literal sense. See MS Ujjain, Scindia Oriental Institute 9401 f. 20r. For that reason, the word is

translated as "straightforward."

³⁹ Böhtlingk and Roth 1855–75: 2.813–814.

⁴⁰ Note that *Bhāgavatapurāṇa* 5.16.4 is cited under the entry *golaka*.

⁴¹ Each of the *Bhāgavatapurāṇa* passages will be carefully discussed in the following. For the *Gītāgovinda*, see Telang 1937: 17, but note that the verse is numbered differently in Telang's edition of the text. The *Gītāgovinda*, a famous poem, falls outside of the Purāṇic context and will not be considered here. However, it can be noted that a quick survey shows that the available commentaries on the *Gītāgovinda* mainly gloss *gola* as *maṇḍala*, "circle."

one of the compound forms *bhūgola* and *bhūgolaka*, or, in the case of *Bhāgavatapurāṇa* 3.23.43, in the form *bhuvo golaṃ*.

Monier-Williams' *A Sanskrit-English Dictionary* from 1899 and Apte's *The Practical Sanskrit-English Dictionary* from 1890 similarly both give "ball, globe" as the primary meaning of *gola* and *golaka*.⁴²

Mayrhofer's *Kurzgefasstes etymologisches Wörterbuch des Altindischen = A Concise Etymological Sanskrit Dictionary* lists only "globe, ball, jar in the form of a ball" as the meanings of *gola*.⁴³

For the compound word *bhūgola*, Böhtlingk and Roth give the meaning *Erdkugel*, "earth-ball," and Monier-Williams gives "earth-ball, the terrestrial globe, earth." Böhtlingk and Roth have no entry for *bhūgolaka*, but Monier-Williams has "the terrestrial globe." Apte and Mayrhofer have no entries for *bhūgola* and *bhūgolaka*.⁴⁴

It is important to note that while the dictionaries of Böhtlingk and Roth, Monier-Williams, and Apte give "ball, globe" as the primary meaning of *gola*, they also give a secondary meaning, namely, "circle." Taken in this secondary sense, the word *gola* can be understood as a synonym of the word *maṇḍala*, "circular, round; circle." As we have seen, the Purāṇas commonly use the word *bhūmaṇḍala*, "earth-circle," to describe the earth. Using the secondary meaning of *gola*, it is possible to interpret the word *bhūgola* as a synonym of the word *bhūmaṇḍala*. However, the scholarly dictionaries do not give any examples from Sanskrit literature of *gola* used in the sense of "circle," but only refer to Sanskrit-Sanskrit lexicons.

SANSKRIT-SANSKRIT LEXICONS ON GOLA AND BHŪGOLA

Though a careful study of the history of the words *gola* and *golaka* in the traditional Sanskrit-Sanskrit lexicons (*kośas*) will not be undertaken here, a quick survey shows that the early lexicons mostly do not provide relevant information. However, the following is worth noting:

The *Śāśvatakośa* has *golaka* as *guḍa*, "ball".⁴⁵ The *Medinīkośa*, which Vogel places between 1200 and 1275 CE,⁴⁶ is the earliest lexicon to give *maṇḍala*, "circle,"

42 Monier-Williams 1899: 368; V. S. Apte 1890: 469–470.

43 Mayrhofer 1956–80: 1.349.

44 Böhtlingk and Roth 1855–75: 5.334 and Monier-Williams 1899: 761. Böhtlingk and Roth cite *Bhāgavatapurāṇa* 5.20.38 and 5.25.12, *Gītāgovinda* 1.16, and *Nāradapañcarātra* 4.8.37 (Banerjea 1865: 281) as attestations of the meaning *Erdkugel* for *bhūgola*. In non-technical literature, the

earliest known occurrence of *bhūgola* is found in the *Mālatīmādhava* (verse 5.22 (Telang 1936: 126)), a celebrated play by Bhavabhūti (8th century CE). However, the context does not provide valuable insight into the precise meaning of the word.

45 See *Śāśvatakośa* 383 (Kulkarni 1929: 34). The lexicon also has "son of a widow" for *golaka*, but that meaning is not relevant

46 Vogel 1979: 347.

as a synonym of *gola*.⁴⁷ Contrary to Böhlingk and Roth, the 19th-century Sanskrit-Sanskrit lexicon *Śabdakalpadruma* gives *Bhāgavatapurāṇa* 3.23.43 as an example of the use of *gola* in the sense of *maṇḍala*, citing the *Medinīkośa* as an authority for this sense of the term. The *Śabdakalpadruma* furthermore cites Hemacandra (born 1088 CE) as an authority for the definition *sarvavartula*, “round everywhere,” that is, “spherical,” of *gola*.⁴⁸

THE WORD *BHŪGOLA* IN THE *SIDDHĀNTAS*

Before proceeding to a discussion of the occurrences and meaning of the word *bhūgola* in the Purāṇas, it is necessary to discuss its meaning in the Sanskrit treatises on astronomy.

The word *gola* is a technical term in the Siddhāntic tradition. In the context of astronomy, the word *gola* and the equivalent word *golaka* mean either “sphere” or “hemisphere.”

Neither *gola* nor *golaka* are found in the *Vedāṅgajyotiṣa*, the earliest text on astronomy in India,⁴⁹ and *golaka* is used only as the name of a certain conjunction of planets in the *Yavanajātaka* of Sphujidhvaja.⁵⁰ The earliest attestation of the word *golaka* meaning “hemisphere” is the *Paitāmahasiddhānta*, which Pingree dates to the first half of the 5th century CE.⁵¹ Āryabhaṭa uses *gola* both as “sphere” and as “hemisphere” in the *Āryabhaṭīya*, composed in 499 CE. Subsequent astronomers, including Brahmagupta, Varāhamihira, Lalla, Bhāskara I, and Bhāskara II, use *gola* as both “sphere” and as “hemisphere” as well.

In other words, the Indian astronomical tradition has consistently used the word *gola* (and its equivalent *golaka*) to denote a sphere or a hemisphere since at least the time of Āryabhaṭa.

When it comes to the word *bhūgola*, all Indian astronomers, including Āryabhaṭa, Varāhamihira,⁵² Brahmagupta, Lalla, Bhāskara I, Bhāskara II, and, as we have seen, Jñānarāja, use it in the sense of “earth-sphere.” That is, the earth is a sphere. The Siddhāntic tradition accepts as a basic tenet that the earth is spherical in shape. The compound word *bhūgola* (or an equivalent thereof) is the tradition’s standard nomenclature for the spherical earth of its model.

47 See first half of verse 15 in Hośiṅga 1968: 146.

48 See Rādhākāntadeva 2002: 2.363. For Hemacandra’s date and life, see Vogel 1979: 335–336.

49 Pingree (1981: 9–10) dates the *Vedāṅgajyotiṣa* to around 400 BCE.

50 See *Yavanajātaka* 36.45 (Pingree 1978: 1.291).

51 For the dating of the *Paitāmahasiddhānta*, which is part of the *Viṣṇudharmottarapurāṇa*, see Pingree 1967–8: 473. For the occurrence of *gola* in the sense of “hemisphere,” see the *Viṣṇudharmottarapurāṇa* 2.171 (Śrīkrṣṇadāsa 1912: 298v).

52 Varāhamihira uses the equivalent word *mahīgola* in *Pañcasiddhāntikā* 13.1 (Neugebauer and Pingree 1970–1: 1.108).

THE WORD *BHŪGOLA* IN THE PURĀṆAS

As we have seen, Jñānarāja tells his readers that the word *bhūgola* is used in the Purāṇas.⁵³ However, he does not tell us where in the Purāṇic corpus it occurs. Cintāmaṇi's commentary is likewise silent in this regard, but Sūryadāsa, Jñānarāja's other son, cites *Bhāgavatapurāṇa* 10.8.37, where the word is indeed found.⁵⁴

In the extant Purāṇas, the word *bhūgola* (or the variant *mahīgola*) is known to occur five times in the *Bhāgavatapurāṇa*, once in the *Brahmāṇḍapurāṇa*, twice in the *Narasimhapurāṇa*, and once in the *Padmapurāṇa*:

- *Bhāgavatapurāṇa* 3.23.43 (*bhuvo golaṃ*); 5.16.4 (*bhūgolaka-*); 5.20.38 (*bhūgolasya*); 5.25.12 (*-bhūgolaṃ*); and 10.8.37 (*bhūgolaṃ*).
- *Brahmāṇḍapurāṇa* 3.22.76 (*mahīgolaṃ*).⁵⁵
- *Narasimhapurāṇa* 30.1 (*bhūgolaṃ*) and 31.119 (*bhūgolasya*).⁵⁶
- *Padmapurāṇa* 6.221.5 (*bhūgolaṃ*).⁵⁷

In the following, we will carefully go through each occurrence of the word in the *Bhāgavatapurāṇa*, a text we know from Sūryadāsa that Jñānarāja was familiar with, to try to ascertain whether the word *bhūgola* can be taken to indicate a spherical earth. However, we will not enter into a discussion of the occurrences in the other three Purāṇas. It is not certain that Jñānarāja used these texts, and the occurrences of *bhūgola* in them do not add anything substantial to the discussion.

Bhāgavatapurāṇa 3.23.43

The first occurrence of the word *bhūgola* (in this case written as *bhuvo golaṃ*) in the *Bhāgavatapurāṇa* is verse 3.23.43:⁵⁸

प्रेक्षयित्वा भुवो गोलं
पत्न्यै यावान्स्वसंस्थया
बह्वश्चर्यं महायोगी
स्वाश्रमाय न्यवर्तत

After showing his wife the *gola* of the earth as far as [it extends] by its arrangement, which is abundant with wonders, the great sage returned to his hermitage.

The context is the sage Kardama traveling with his wife Devahūti in an airborne vessel (*vimāna*). Their journey brings them to various locations known from Purāṇic cosmography, including the mountain Meru and the lake Mānasa.

⁵³ See *Siddhāntasundara* 1.1.27–28, cited above.

⁵⁴ See Minkowski 2004: 367, n. 64.

⁵⁵ Sharma 2000: 282v.

⁵⁶ Joshi and Trivedi 2003: 96, 112.

⁵⁷ C. Śāstrī 1984: 3.218r–218v.

⁵⁸ K. Śāstrī 1965: 859.

Can the word *gola* in the verse be taken as evidence that the earth is considered a sphere in the *Bhāgavatapurāṇa*? As noted previously, Böhtlingk and Roth's *Sanskrit-Wörterbuch* cites this verse as an example of the word *gola* used in the sense of *Kugel*, that is, "ball." However, the commentators do not see the text's use of the word as warranting any special discussion. Śrīdharasvāmin, Vijayadhvaja Tīrtha, Visvanātha Cakravartin, Śukadeva, Giridhara, and Gaṅgāsahāya all gloss *gola* as *maṇḍala*, "circle".⁵⁹ No commentator takes the discussion beyond this gloss, and some commentators do not even comment on the word. In other words, *bhūvo golaṃ* is seen by the traditional commentators as having the same meaning as *bhūmaṇḍala*. As we have noted, in support of this interpretation, the Śabdakalpadruma cites this verse as an example of the use of the word *gola* in the sense of *maṇḍala*, "circle."

Bhāgavatapurāṇa 5.16.4

The second occurrence of *bhūgola* in the *Bhāgavatapurāṇa* is 5.16.4.⁶⁰

न वै महाराज भगवतो मायागुणविभूतेः काष्ठां मनसा वचसा वाधिगन्तुमलं विबुधायुषापि पुरुषस्तस्मात्प्राधान्येनैव भूगोलकविशेषं नामरूपमानलक्षणतो व्याख्यास्यामः।

O great king, no human being, not even one with a lifespan like that of the gods, can adequately understand by the mind or [express] by speech, the extent of the Lord's mighty manifestation through *māyā* and the *guṇas*. Therefore, we will mainly describe the characteristics of the *bhūgolaka* from its names, form, extent, and qualities.

Bhāgavatapurāṇa 5.16 opens with King Parīkṣit asking the sage Śuka for detailed information about the earth. The present passage is the beginning of Śuka's reply.

Importantly, the *Bhāgavatapurāṇa* uses the word *bhūmaṇḍala*, "earth-circle," when King Parīkṣit makes his request for knowledge.⁶¹ Furthermore, as Śuka continues his reply, he uses the word *kuvalaya* twice.⁶² The word *ku* means "the earth" and the basic meaning of the word *valaya* is "bracelet," hence "circle." As such, the word *kuvalaya* is synonymous with *bhūmaṇḍala*. There is no indication that the *bhūmaṇḍala* in Parīkṣit's question is any different from the *bhūgolaka* and *kuvalaya* in Śuka's reply. In other words, the three words denote the same thing and are used interchangeably in this section of the *Bhāgavatapurāṇa*.

The commentators do not engage with the word *bhūgolaka*. This is not surprising since it is clear from the text itself that *bhūgola* is used as a synonym of *bhūmaṇḍala*. As such, we should be careful with arguments that infuse the word *gola* with special significance in this context.

59 K. Śāstrī 1965: 859, 861, 862, 863 and K. Śāstrī 1968: 167.

60 K. Śāstrī 1966: 327.

61 See *Bhāgavatapurāṇa* 5.16.1 (K. Śāstrī

1966: 327).

62 See *Bhāgavatapurāṇa* 5.16.5 and 5.16.7 (K. Śāstrī 1966: 327).

Bhāgavatapurāṇa 5.20.38

The third occurrence of *bhūgola* in the *Bhāgavatapurāṇa* is 5.20.38:⁶³

एतावाल्लोकविन्यासो मानलक्षणसंस्थाभिर्विचिन्तितः कविभिः स तु पञ्चाशत्कोटिगणितस्य
भूगोलस्य तुरीयभागोऽयं लोकालोकाचलः ।

So far [that is, up to the Lokāloka mountains], the arrangement of the world with respect to its dimensions, characteristics, and manifestations has been considered by the sages. The Lokāloka mountain range [has a measurement of] a quarter of the *bhūgola*, which is calculated to be five hundred million *yojanas*.

According to Böhtlingk and Roth's *Sanskrit-Wörterbuch*, the word *bhūgola* means *Kugel*, that is, "ball," in this passage. But that is not reflected in the commentaries, the majority of which are silent on the word *bhūgola*. However, one commentator, Viśvanātha Cakravartin, whose commentary on the *Bhāgavatapurāṇa* was completed in January 1705, presents an explanation:⁶⁴

स तु लोकालोकस्तु भूगोलकस्य भूसम्बन्धाण्डगोलकस्येत्यर्थः । सूर्यस्येव भुवो
ऽप्यण्डगोलकयोर्मध्यवर्त्तित्वात्खगोलमिव भूगोलमपि पञ्चाशत्कोटियोजनप्रमाणं तस्य
तुरीयभागः सार्द्धद्वादशकोटियोजनविस्तारोच्छ्राय इत्यर्थः ।

"It" (*saḥ*) means the Lokāloka [mountains] and "of the *bhūgolaka*" means "of the hemisphere (*gola*) of the [universal] egg joined to the earth (*bhū*)."

This is the meaning: Like the sun, the earth (*bhū*) is also [located] between the two hemispheres (*golaka*) of the [universal] egg. For that reason, the *bhūgola*, like the *khagola*, measures five hundred million *yojanas*. [The Lokāloka mountain range] has a distance and height of one hundred twenty-five million *yojanas*, which is a quarter of that.

Viśvanātha Cakravartin's interpretation of the word *bhūgola* refers to the Purāṇic conception of the universal egg (the *brahmāṇḍa*). There are two *golakas* in the cosmography of Viśvanātha Cakravartin. One, the *bhūgola*, is the lower half of the universal egg (the lower hemisphere, if the egg is understood as being spherical), and the other, the *khagola*, is the upper half. As such, Viśvanātha Cakravartin is

63 K. Śāstrī 1966: 457. Note that the word *tu* is omitted in K. Śāstrī 1966.

64 K. Śāstrī 1966: 462. At the end of his commentary on the *Bhāgavatapurāṇa*, Viśvanātha Cakravartin writes that the commentary was completed on the sixth *tithi* in the

bright half of the month of *māgha* in the year *śaka* 1626 (ऋत्वक्षिपद्भूमिमिते शाके राधाकृष्णसरस्तटे । शुक्लषष्ठ्यां सिते माघे टीकेयं पूर्णतामगात्), which corresponds to Saturday, January 31, 1705, in the Gregorian calendar. See K. Śāstrī 1975: 351.

telling us that *bhūgola* does not mean that the earth is a sphere or a hemisphere. Rather, the earth exists within a sphere (the *brahmāṇḍa*).⁶⁵

It is noteworthy that *gola* and *golaka* mean “hemisphere” in Viśvanātha Cakravartin’s commentary, a meaning used in the Siddhāntic tradition, but not attested in earlier commentaries on the *Bhāgavatapurāṇa*. Not only that, the commentary also uses the word *khagola*, “sphere of the heavens,” which is a technical term in the Siddhāntas. However, Viśvanātha Cakravartin does not interpret *bhūgola* to mean that the earth is a sphere, but follows a traditional understanding of the shape of the earth.

It appears that Viśvanātha Cakravartin is engaging with words and concepts coming from the Siddhāntic tradition. Unlike Jñānarāja, Viśvanātha Cakravartin is not attempting to reconcile the inconsistencies between the cosmographies of the Siddhāntas and the Purāṇas. However, another follower of the Purāṇas, Nīlakaṇṭha Caturdhara, who flourished in the second half of the 17th century, attempted such a reconciliation.⁶⁶ Later commentators on the *Bhāgavatapurāṇa* likewise engaged in an attempt to reconcile the two cosmographies.⁶⁷ It is possible that Jñānarāja’s engagement with Purāṇic cosmography led to this development.

To summarize, according to Viśvanātha Cakravartin’s interpretation, the word *bhūgola* means “the earth within a sphere,” not “the earth that is a sphere.” While *gola* and *golaka* have the sense of “hemisphere,” a spherical shape is not attributed to the earth.

Bhāgavatapurāṇa 5.25.12

The fourth occurrence of *bhūgola* in the *Bhāgavatapurāṇa* is verse 5.20.38:⁶⁸

मूर्धन्यर्पितमणुवत् सहस्रमूर्ध्नो
भूगोलं सगिरिसरित्समुद्रसत्त्वम्
आनन्त्यादनिमितविक्रमस्य भूम्नः
को वीर्याण्यधिगणयेत्सहस्रजिह्वः

Just like an atom, the earth, with its mountains, rivers, oceans, and living beings, is resting on one of the heads of the thousand-headed [serpent Śeṣa]. Because of his limitlessness, who can count the heroic

65 This interpretation ignores that the *Bhāgavatapurāṇa* itself parses *bhūgola* as *bhuvogolaṃ* in 3.23.43.

66 Nīlakaṇṭha Caturdhara, a scholar who is famous for his commentary on the *Mahābhārata*, wrote the *Saurapaurāṇīkamatā-samarthana*, a treatise on reconciling the Purāṇic and Siddhāntic cosmographies. See Gangadhara 1997 and Minkowski 2000.

67 Two late commentators, Vaṃśīdhara and Gaṅgāśahāya, cite from Viśvanātha Cakravartin’s commentary on *Bhāgavatapurāṇa* 5.20.38 in their own commentaries. See K. Śāstrī 1966: 458–459 and K. Śāstrī 1968: 346. Note that *Bhāgavatapurāṇa* 5.20.38 is numbered 5.20.59–60 in Gaṅgāśahāya’s edition of the text.

68 K. Śāstrī 1966: 545.

deeds of the Lord whose power is immeasurable, [even if they had] a thousand tongues?

Once again, Böhtlingk and Roth's *Sanskrit-Wörterbuch* states that this verse uses *bhūgola* in the sense of "Kugel," that is, "ball." None of the commentators engage in a discussion of the word. However, Vīrarāghava and Jīva Gosvāmin use the word *bhūmaṇḍala* in their commentaries instead of *bhūgola*, as does Vaṁśīdhara, who is quoting Jīva Gosvāmin.⁶⁹ In other words, there is no indication that the word *bhūgola* in 5.25.12 is used in a different sense than *bhūmaṇḍala*.

Bhāgavatapurāṇa 10.8.37

Perhaps the most important occurrence of *bhūgola* in the *Bhāgavatapurāṇa* is verse 10.8.37. The verse is part of the story of the god Kṛṣṇa, the most popular episode of the *Bhāgavatapurāṇa*. As such, the verse has attracted much more attention than the other four occurrences of *bhūgola* in the text. It is precisely this verse that Jñānarāja's son Sūryadāsa cites as an example of an occurrence of *bhūgola* in the Purāṇas. Note that this occurrence of *bhūgola* is not cited in Böhtlingk and Roth's *Sanskrit-Wörterbuch*.

In the story, which takes place during Kṛṣṇa's childhood, Kṛṣṇa's friends inform Kṛṣṇa's mother Yaśodā that Kṛṣṇa has eaten dirt. When Yaśodā looks into Kṛṣṇa's mouth, she sees the entire universe:⁷⁰

सा तत्र ददृशे विश्वं
जगत्स्थासु च खं दिशः
साद्रिद्वीपाब्धिभूगोलं
सवाय्वग्नीन्दुतारकम्

There [in Kṛṣṇa's mouth], she [Yaśodā] saw the entire universe, moving and unmoving; space; the directions; the *bhūgola* with its mountains, landmasses, and oceans; [the celestial sphere] with wind and fire, the moon, and the stars; ...

Śrīdharasvāmin, Vīrarāghava, Giridhara Lāla, and Bhagavatprasādācārya gloss *bhūgola* as *bhūrloka*, "earthly world," and Vijayadhvaja and Satyadharma gloss *bhūgola* as *bhūmaṇḍala*.⁷¹ The late commentator Gaṅgāsaḥāya glosses *bhūgola* as *bhūloka*, "earthly world".⁷² In other words, the traditional commentators do not see anything unusual about the use of the word *bhūgola* in the verse.

69 K. Śāstrī 1966: 546, 547.

70 *Bhāgavatapurāṇa* 10.8.37 (K. Śāstrī 1985: 1054).

71 K. Śāstrī 1985: 1054, 1055, 1057, 1059, 1060.

72 K. Śāstrī 1985: 1060.

SUMMARY AND CONCLUSIONS ON THE WORD *BHŪGOLA* IN THE
BHĀGAVATAPURĀṆA

Given the evidence from Sanskrit texts and modern scholarly dictionaries, we see that the earliest attestations of the word *gola* in the sense of “sphere” come from the Indian astronomical tradition. The scholarly dictionaries give the non-technical attestations of the word in this sense as the *Bhāgavatapurāṇa*, the poem *Gītāgovinda*, and the *Nāradapañcarātra*. However, as we have seen, it is not clear at all that the word means “sphere” in the *Bhāgavatapurāṇa* like it does in the Siddhāntic tradition. In fact, it appears that the *Bhāgavatapurāṇa* uses the word *gola* to mean “round” in a general sense, and as a synonym of *maṇḍala*, ‘circular, round; circle.’

An example in support of this interpretation is provided by the model of the universe in the Hanūmāndhokā palace in Kathmandu, Nepal, which was mentioned earlier. The earth, represented as a flat disk in the model, has the word *bhūgola*, glossed as *pr̥thvī*, “the earth,” inscribed on it.⁷³

If there were different opinions about the shape of the earth among the followers of the Purāṇas, as there surely was, the word “round” would apply to them all: the earth as a flat disk, the earth as an inverted bowl, and the earth as a sphere. In other words, the meaning “round” in a vague sense, as conveyed also by the English word “round,” would fit the context well.

In Kāvya (Sanskrit high poetry), it is considered a fault when a word is repeated in the same verse.⁷⁴ In Sanskrit literature in general, there is similarly a tendency to avoid repetition of a word in a verse. To avoid such repetitions, a synonym is used when a word is needed a second time in the same verse. It is natural, therefore, that the authors of the Purāṇas would need synonyms of the word *maṇḍala*.

To summarize, it seems unlikely that the word *gola* is used in the sense of “sphere” in the Purāṇas. Rather, the word is used in the general sense of “round,” serving as a synonym to the word *maṇḍala*.

3 NORTHNESS OF MERU

THE SECOND OF THE THREE STATEMENTS attributed to the Purāṇas by Jñānarāja deals with the mythological mountain Meru and its relationship to the rest of the earth:

सर्वतो मेरुः सौम्यदिशि

Meru is north of everywhere.

⁷³ See Bühnemann 2020: 2.

⁷⁴ When a repetition of a word occurs in

the same verse, the fault is referred to as *kathitapada*. See Jha 1967: 217.

In the cosmography of the Siddhāntas, the mountain Meru is located at the earth's North Pole, and is therefore north of any given place on the earth. An explicit statement to this effect is given by Bhāskara II in the *Siddhāntaśiromaṇi*:⁷⁵

यत्रोदितोऽर्कः किल तत्र पूर्वा
तत्रापरा यत्र गतः प्रतिष्ठाम्
तन्मत्स्यतोऽन्ये च ततोऽखिलानाम्
उदक्स्थितो मेरुरिति प्रसिद्धम्

East is where the sun rises, west is where it sets. The other two [cardinal directions, that is, north and south] are [determined] from [a figure shaped like] a fish [derived from] them [that is, the east and west points]. Therefore it is well known that Meru is located north of everything.

Bhāskara II starts by defining the cardinal directions east and west to be the directions of the rising and setting sun, respectively. With the east and west points thus determined, he proceeds to use them to determine the north and south points.

The method is outlined in Figure 1, where *E* and *W* denote the east and west points, respectively. Two circles with the same radius are drawn, one centered at *E* and the other at *W*. The common radius is chosen so that the two circles intersect at two distinct points, denoted *N* and *S* in the figure. The “fish figure” mentioned in the verse is formed by the two thick arcs. It is this figure that determines the points *N* and *S* in Bhāskara II's construction.

The straight lines *EW* and *NS* are perpendicular to each other. Since *E* and *W* are the east and west points, it follows that *N* and *S* are the north and south points, respectively. Moreover, the line *NS* coincides with the local meridian, for which reason it will reach the North Pole if extended toward the north. It follows that Meru, which the Siddhāntas say is located at the North Pole, is due north of any given location on the earth.

Furthermore, in his refutation of the the earth being flat with Meru at its center, Bhāskara II mentions the Purāṇic view that Meru lies to the north:⁷⁶

यदि निशाजनकः कनकाचलः
किमु तदन्तरगः स न दृश्यते
उदगयं ननु मेरुरथांशुमान्
कथम् उदेति च दक्षिणभागके

⁷⁵ *Siddhāntaśiromaṇi* 2.3.45 (D. Apte 1943–52: 1.70).

⁷⁶ See *Siddhāntaśiromaṇi* 2.3.12 D. Apte 1943–52: 1.40.

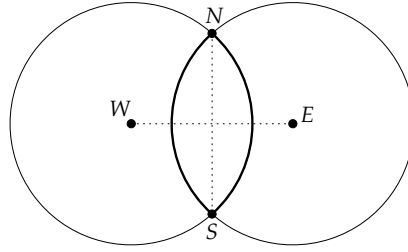


Figure 1: Bhāskara II's construction of the cardinal directions.

If the Golden Mountain [that is, Meru] is the cause of night, why is it not seen when it is between them [that is, when Meru is between the observer's position and the sun⁷⁷]?

If Meru is to the north, why does the sun rise to the south?

In the last half-verse, Bhāskara II essentially states that Meru lies to the north by the Purāṇas' own admission.⁷⁸

It is clear that the statement *sarvato meruḥ saumyadīśi* is consistent with a spherical earth. However, it is not clear that the statement contradicts the earth having another shape. Jñānarāja does not present any arguments for why the statement implies a spherical shape of the earth, and, in fact, it does not. There are shapes other than a sphere that are consistent with the statement, such as an inverted bowl.

DIRECTIONS AT MERU

More broadly, the statement *sarvato meruḥ saumyadīśi* is connected to the question of whether there are directions at Meru. In the cosmography of the Siddhāntas, it is not meaningful to speak of directions at Meru; there is only one direction at Meru, namely, south. However, the astronomer Lalla mentions the belief that

⁷⁷ Bhāskara II's *Vāsanābhāṣya* on *Siddhānta-sīromaṇi* 2.3.11–12 (D. Apte 1943–52: 1.40) has this explanation: यदि मेरुणान्तर्हितो रविस्तर्हि मेरुः कथं न दृश्यते, "If the sun is covered by Meru, then why is Meru not seen?"

⁷⁸ While the Purāṇas are not mentioned in the verse, it immediately follows *Siddhānta-sīromaṇi* 2.3.11 (D. Apte 1943–52: 1.40). As

seen earlier, the latter verse cites the mirror simile, which Bhāskara II attributes to the Purāṇas. Since the two verses and the arguments presented in them contextually belong together, it is reasonable to assume that Purāṇic material is being critiqued throughout them.

there are directions at Meru.⁷⁹ While Lalla does not identify who in ancient India believed that there are directions at Meru, it is likely that he had the followers of the Purāṇas in mind. For example, the *Viṣṇupurāṇa* states that the region Harivarṣa is south of Meru while the region Ramyakavarṣa is north of Meru.⁸⁰ Bhadrāśvavarṣa and Ketumālarṣa are similarly said to be east and west of Meru, respectively.⁸¹ The *Bhāgavatapurāṇa* and other Purāṇas have similar descriptions.⁸²

If such Purāṇic passages are what Lalla had in mind, the critique is largely unjustified. While the Purāṇas speak of places east, west, north, and south of Meru, such passages define the cardinal directions “in relation to the centre of the world, which is occupied by Meru.”⁸³ The descriptions are therefore based on a bird’s-eye view of Jambūdvīpa, where east, west, north, and south are absolute directions defined with respect to Meru.

Bhāratavarṣa (India) is considered to be the southern part of Jambūdvīpa. The region on the other side of Meru from Bhāratavarṣa is similarly considered to be the northern part of Jambūdvīpa, and therefore described as being north of Meru. Regions east and west of Meru are determined similarly.⁸⁴

In daily and religious life, however, east is understood in precisely the same way as Bhāskara II defines it in the *Siddhāntaśiromaṇi*, namely, as the direction of the rising sun. The *Viṣṇupurāṇa* says:⁸⁵

उदयास्तमनाभ्यां च
स्मृते पूर्वापरे दिशौ

The east and west cardinal points are defined by [the sun’s] rising and setting.

PURĀṆIC SOURCES

As noted previously, Jñānarāja does not reveal where in the Purāṇic corpus the statement *sarvato meruḥ saumyadiśi* can be found. However, without mentioning

79 See *Śiṣyadhīvṛddhidatantra* 20.5 (B. Chatterjee 1981: 1.232).

80 See *Viṣṇupurāṇa* 2.2.13–14 (Śarmā 1985: 59v).

81 See *Viṣṇupurāṇa* 2.2.24 (Śarmā 1985: 60r).

82 See, for example, *Bhāgavatapurāṇa* 5.16.27 (K. Śāstrī 1966: 342).

83 See Kintaert 2011–2: 95, n. 46.

84 An example from our modern world can be used as an illustration: Utqiagvik

(Alaska, USA) and Longyearbyen (Svalbard, Norway) are close to being on opposite sides of the North Pole. If a resident of Utqiagvik casually says that Longyearbyen is to the north, the statement makes sense.

85 See *Viṣṇupurāṇa* 2.8.18 (Śarmā 1985: 98r). The identification of the cardinal direction east with the direction of the rising sun is found as early as the *Ṛgveda*. See Jurewicz 2016: 268.

a source, his son Cintāmaṇi cites half of a verse that closely resembles the last half of *Viṣṇupurāṇa* 2.8.20:⁸⁶

सर्वेषां द्वीपवर्षाणां
मेरुरुत्तरतः स्थितः

Meru lies to the north of all *dvīpas* and *varṣas*.

The half-verse is also found in the *Devībhāgavatapurāṇa*:⁸⁷

सर्वेषां द्वीपवर्षाणां
मेरुरुत्तरतो स्थितः
यैर्यत्र दृश्यते भानुः
सैव प्राचीति चोच्यते

तद्वामभागतो मेरुर्
वर्ततेति विनिर्णयः

Meru lies to the north of all *dvīpas* and *varṣas*. East is said to be where people see the sun [rising], [at which time] Meru is known to be on their left side.

In other words, Meru is always to the north because it is on the left side of a person facing the rising sun, that is, who is facing east.

The *Devībhāgavatapurāṇa* is less likely to be Jñānarāja's source than the *Viṣṇupurāṇa*, which is why we will focus on the latter Purāṇa in the following.⁸⁸

⁸⁶ See the *Grahaṅāṇitacintāmaṇi* on *Siddhāntasundara* 1.1.27 (MS Ujjain, Scindia Oriental Institute 9401, f. 20r). Minkowski notes that Sūryadāsa cites the same half-verse in the *Siddhāntasaṃhitāsārasamuccaya*, though he errs when he states that Cintāmaṇi does not cite it. See Minkowski 2004: 367, n. 64. The *Marīci*, a commentary by Munīśvara on the *Siddhāntaśiromaṇi*, cites the half-verse as well. See D. Apte 1943–52: 1.43. The astronomer Munīśvara was born in 1603 CE. See Pingree 1970–94: 4.436–441, 5.314. The half-verse is also cited outside of the Purāṇic context, for example by Hemādri (13th century) in his commentary *Āyurvedarasāyana* on Vāgbhaṭa's *Aṣṭāṅgahṛdaya* Kuṃṭe et al. 1939: 2.

⁸⁷ *Devībhāgavatapurāṇa* 8.15.26, cited here with the first half of 8.15.27 (Khemakā et al. 2010: 2.257).

⁸⁸ Other than the *Viṣṇupurāṇa* and the *Devībhāgavatapurāṇa*, three other Purāṇas—the *Brahmāṇḍapurāṇa*, the *Matsyapurāṇa*, and the *Vāyupurāṇa*—state that Meru is north of everywhere. See *Brahmāṇḍapurāṇa* 1.21.51 (Sharma 2000: 45r), *Matsyapurāṇa* 124.38 (Ānandāśrama Pandits 1981: 223), and *Vāyupurāṇa* 50.108 (Ānandāśrama Pandits 1983: 258). Each of these three passages deal with why the sun cannot be seen at night. Since the phrasings of the statement differ from the half-verse cited by Cintāmaṇi, we omit a discussion of the passages.

VIṢṆUPURĀṆA 2.8.20

Cited in full, *Viṣṇupurāṇa* 2.8.20 reads:⁸⁹

तस्माद्दिश्युत्तरस्यां वै
दिवा रात्रिः सदैव हि
सर्वेषां द्वीपवर्षाणां
मेरुरुत्तरतो यतः

Note that the *Viṣṇupurāṇa* has *yataḥ* as the last word of the verse whereas Cintāmaṇi's citation has *sthitaḥ*, a reading not attested in the critical edition of the *Viṣṇupurāṇa*.⁹⁰ If we accept the reading *sthitaḥ* given by Cintāmaṇi, the half-verse is a simple sentence:

Meru lies to the north of all *dvīpas* and *varṣas*.

However, as given in the *Viṣṇupurāṇa*, it forms part of a compound sentence: "Therefore (*tasmād*) ..., since (*yataḥ*) ..."

Wilson notes that *Viṣṇupurāṇa* 2.8.20 is an obscure verse.⁹¹ In order to interpret it correctly, it is necessary to consider the preceding verses as well:⁹²

उदयास्तमनाभ्यां च
स्मृते पूर्वापरे दिशौ
यावत्पुरस्तात्तपति
तावत्पृष्ठे च पार्श्वयोः (18)
ऋतेऽमरगिरेर्मरोर्
उपरि ब्रह्मणः सभाम्
ये ये मरीचयोऽर्कस्य
प्रयान्ति ब्रह्मणः सभाम्
ते ते निरस्तास्तद्भासा
प्रतीपमुपयान्ति वै (19)
तस्माद्दिश्युत्तरस्यां वै
दिवा रात्रिः सदैव हि
सर्वेषां द्वीपवर्षाणां
मेरुरुत्तरतो यतः (20)

The east and west cardinal points are defined by [the sun's] rising and setting. As far as [the sun] sends out light⁹³ in front, so far [it

89 Śarmā 1985: 98r. Both Śarmā 1985: 98r and Pathak 1997–9: 1.215 read *divārātriḥ* in the second quarter of 2.8.20. Following Wilson (1865: 2.243), the better reading *divārātriḥ* is used here.

90 Pathak 1997–9: 1.215.

91 Wilson 1865: 2.243, n. 1.

92 *Viṣṇupurāṇa* 2.8.18–20 (Śarmā

1985: 98r).

93 The Sanskrit root *tap* means "to give out heat" but can also mean "to shine." Both meanings are probably intended here, but given the exception that will be mentioned subsequently, the emphasis in the translation is on the sun emitting light.

likewise sends out light] behind and on either side, with the exception of Brahmā's court on top of Meru, the mountain of the gods. The rays of the sun that reach Brahmā's court are repelled by the palace's luster and reverse course. Therefore, in the northern quarter it is always night during the day [here, in our location], since Meru is north of all *dvīpas* and *varṣas*.

According to the passage, the sun emits an equal amount of heat and light in all directions. There is an exception to the reach of the sun's light, however. The city of the god Brahmā lies on the top of Meru,⁹⁴ and the luster of Brahmā's court in the city drives away any sunlight that reaches it.

Since Meru is north of all *dvīpas* and *varṣas*, it follows that by "northern quarter" (*diśy uttarasyāṃ*), the *Viṣṇupurāṇa* means the region of Jambūdvīpa on the other side of Meru from the observer. It is left unexplained by the text itself why Meru is north of everywhere, but two commentators offer interpretations.

Viṣṇucitti explains the northness of Meru in this way:⁹⁵

उदयेन पूर्वदिक्स्तमयेनापरादिक्। अत एवोद्यन्तं भास्वन्तं पश्यतां वामदक्षिणभागे
स्थितत्वात्सर्वेषामुत्तरतो मेरोर्लोकालोकाचलश्च दक्षिणः स्यात्।

The direction of east is [determined] by [the place of the sun's] rising and the direction of west is [determined] by [the place of its] setting. Therefore, because they lie on the left and the right side [respectively] of those watching the sun rise, Meru is to the north of everyone and the Lokāloka mountain range is to the south.

Śrīdharasvāmin offers the following explanation:⁹⁶

अयं भावः। मेरुं प्रदक्षिणीकुर्वन्तं सूर्यं ये यत्र पश्यन्ति सैव तेषां प्राची। तेषां च वामभागे एव
मेरुः। अतः सर्वेषां सर्वदा मेरुरुत्तरत एव दक्षिणभागे च लोकालोकाचलः। तस्मादुत्तरस्यां
दिशि सदा रात्रिः। दक्षिणस्यां च दिनमिति।

This is the gist: Wherever they see [the rising of] the sun, which is circling Meru to the right, that is east for them. And Meru is on their left side. Therefore, Meru is always north of everyone and the Lokāloka mountain range is to the south. Consequently it is always night in the northern quarter and day in the southern.

⁹⁴ See *Viṣṇupurāṇa* 2.2.31–33 (Śarmā 1985:80v) and *Bhāgavatapurāṇa* 5.16.28–29 (K. Śāstrī 1966:342) for a description of the city.

⁹⁵ See Viṣṇucitti's commentary on *Viṣṇupurāṇa* 2.8.18–19 (Śarmā 1985:98r).

⁹⁶ See Śrīdharasvāmin's commentary on *Viṣṇupurāṇa* 2.8.20 (Śarmā 1985:98r).

In other words, Meru is located to the north because it is always on the left side of a person facing the rising sun. Similarly, Lokāloka is to the south because it is on their right side. The same reason is given in the *Devībhāgavatapurāṇa*, as we saw above.

When it is day for an observer, then, since Brahmā's court blocks sunlight, it is night in the northern quarter, that is, the region on the opposite side of Meru from the observer. This is essentially an explanation of why the sun cannot be seen at night. The reason, according to the *Viṣṇupurāṇa*, is that Meru blocks the sun's light.

MERU AS THE CAUSE OF NIGHT

The idea that Meru is the cause of night for the inhabitants of the earth is cited and refuted by some Siddhāntic astronomers. As summarized by the astronomers, the idea is that night occurs in a location when the sun is on the other side of Meru and therefore covered by the mountain. According to Lalla:⁹⁷

तमसा मेरुभुवा विभावरी

[Some say that] night is [caused] by the darkness produced by Meru.

Lalla refutes this idea by offering an objection: If night for the human beings on the earth is caused by Meru covering the sun, then how does night occur for the gods, who live on Meru?⁹⁸

As we have already seen, Bhāskara II objects to the notion that night is caused by Meru covering the sun by asking why in that case human beings cannot see Meru.⁹⁹ After all, Meru is said to be of immense size in the Purāṇas.

SUMMARY AND CONCLUSIONS ON THE SECOND STATEMENT

If taken at face value, the statement *sarvato meruḥ saumyadiśi* naturally makes us think of Meru as the North Pole, and thus of the earth as spherical in shape. However, a close examination of the context in the *Viṣṇupurāṇa* shows that the statement does not imply a spherical earth. The *Viṣṇupurāṇa* employs two distinct usages of the cardinal directions. Jñānarāja, however, interprets *sarvato meruḥ saumyadiśi* with reference to only one of them, the one used in the Siddhāntas. Additionally, the statement in the *Viṣṇupurāṇa* is based on a premise explicitly rejected by the Siddhāntic tradition, namely, that Meru is the cause of night. As such, Jñānarāja's interpretation of the statement as implying a spherical earth is not supported by the *Viṣṇupurāṇa* itself, nor by the traditional commentaries on

⁹⁷ See *Śiṣyadhīvrddhidatantra* 20.4 (B. Chatterjee 1981: 1.232).

⁹⁸ See *Śiṣyadhīvrddhidatantra* 20.11 (B. Chatterjee 1981: 1.233).

⁹⁹ See *Siddhāntaśiromaṇi* 2.3.12 (D. Apte 1943–52: 1.40).

the text. Jñānarāja presents a novel interpretation of the statement *sarvato meruḥ saumyadiśi*. His interpretation serves his attempt to integrate the Siddhāntic and Purāṇic traditions, but it is not consistent with the Purāṇic material.

4 THE EARTH RESEMBLING A MIRROR

THE THIRD STATEMENT given by Jñānarāja is, like the first statement, a single Sanskrit compound word:

आदर्शतलोपमा

Resembling the surface of a mirror.

As discussed above, a line of Siddhāntic astronomers, starting with Bhāskara I, have cited this mirror simile, understanding it to mean that the earth is flat. Jñānarāja, who holds that the statement is Purāṇic, argues that this is a false understanding. Prior to Jñānarāja, the only astronomer to identify the Purāṇas as the source of the statement was Bhāskara II. However, the same identification is given by the Islamic scholar Al-Bīrūnī.

BHĀGAVATAPURĀṆA 5.20.35

Jñānarāja does not say where the statement *ādarśatalopamā* occurs in the Purāṇic texts, and Cintāmaṇi is similarly silent in his commentary. However, the statement is found in the *Bhāgavatapurāṇa*:¹⁰⁰

यावन्मानसोत्तरमेर्वोरन्तरं तावती भूमिः काञ्चन्यन्यादर्शतलोपमा यस्यां प्रहितः पदार्थो न
कथञ्चित्पुनः प्रत्युपलभ्यते तस्मात्सर्वसत्त्वपरिहृतासीत्

As great as the distance between [the] Mānasottara [mountain range] and [the mountain] Meru, so great is [the span of] another region, which is made of gold and resembles the surface of a mirror. Nothing whatsoever which is sent into it is recovered again. Therefore it is shunned by all living beings.

There are two interpretations of the passage. Some understand it to refer to two separate regions of the *bhūmaṇḍala*, while others understand it to refer to one region only.¹⁰¹ Regardless of which interpretation is followed, the passage asserts the existence of a region of the *bhūmaṇḍala* that is golden and resembles a mirror. We will refer to this region as the Golden Land. It is important to note that the

100 *Bhāgavatapurāṇa* 5.20.35 (K. Śāstrī 1966: 457).

101 For example, Śrīdharasvāmin follows the first interpretation and Viśvanātha

Cakravartin the second. See K. Śāstrī 1966: 458, 462. The translation above follows the second interpretation.

Golden Land is not the entire *bhūmaṇḍala*, but rather a region extremely far away from the area inhabited by human beings.

The *Bhāgavatapurāṇa* passage raises two difficulties:

1. The passage does not compare the earth to a mirror.
2. The point of the comparison to a mirror does not appear to be that the Golden Land is flat.

Regarding the first difficulty, it is hard to imagine why anyone would take *Bhāgavatapurāṇa* 5.20.35 as evidence of a flat earth in Purāṇic cosmography. However, there are some things to consider:

1. The antagonists in Jñānarāja's argument misinterpret *ādarśatalopamā* as *bhūr ādarśatalopamā sakalā*. In other words, they misunderstand, or worse, misrepresent, the statement to apply to the entire earth. The word *bhūmi*, translated above as "region," has the more common meaning of "the earth." The context makes it clear that *bhūmi* does not mean "the earth" in *Bhāgavatapurāṇa* 5.20.35. Though it seems unlikely, perhaps a careless reading of the passage could lead someone to think that the earth is compared to a mirror (*bhūmiḥ ādarśatalopamā*).¹⁰²
2. Even if the passage is Jñānarāja's source for the mirror simile in the Purāṇas, it is questionable whether it is also his predecessors' source. As we have seen, Bhāskara I's commentary on the *Āryabhaṭīya*, the first known attestation of the mirror simile in a Sanskrit astronomical text, predates Jñānarāja's *Siddhāntasundara* by close to nine centuries. It is entirely possible that Bhāskara I is referring to a different passage (or to an oral tradition rather than a literary passage).¹⁰³ Many of the astronomers who cite the mirror simile may have done so merely on the authority of their predecessors, without a specific passage in mind.
3. Bhāskara II identifies the Purāṇas as the source of the mirror simile. It is possible that Jñānarāja accepted the Purāṇic provenance on the authority of Bhāskara II, then looked for a Purāṇic reference, finding *Bhāgavatapurāṇa* 5.20.35.
4. The *Marīci* on *Siddhāntaśiromaṇi* 2.3.11, the verse in which Bhāskara II mentions the mirror simile, cites *Bhāgavatapurāṇa* 5.20.35.¹⁰⁴ As such,

¹⁰² Of course, Jñānarāja's own interpretation of the statement, that the earth locally appears to be flat (Jñānarāja simply repeats an old Siddhāntic argument against the earth being flat), makes no reference to the Golden Land. If *Bhāgavatapurāṇa* 5.20.35 was used to argue that the earth is flat in Purāṇic cosmography, the argument could

easily be refuted by referencing the proper context of the passage.

¹⁰³ While the date of the *Bhāgavatapurāṇa* is uncertain, the majority of the datings listed by Rocher (1986: 147–148) place the text after Bhāskara I.

¹⁰⁴ See the *Marīci* on *Siddhāntaśiromaṇi* 2.3.11 (D. Apte 1943–52: 1.41).

at least after Jñānarāja, the tradition accepted this *Bhāgavatapurāṇa* passage as the Purāṇic source of the mirror simile. It seems likely that *Bhāgavatapurāṇa* 5.20.35 indeed is Jñānarāja's source for the mirror simile.

When it comes to the second difficulty, we need to consider the *tertium comparationis* when a Sanskrit text compares something to a mirror. The mirrors of ancient and medieval India were made of metal.¹⁰⁵ Different alloys were used to achieve a mirror that would not easily break as well as have a surface with good reflective properties. The polishing process to achieve a reflective surface was extensive, and a mirror would subsequently need regular cleaning to retain its reflective properties.

The earliest known comparison of an object to a mirror is found in the *Kātyāyanaśrautasūtra* from about 300 BCE, where the point of comparison is roundness.¹⁰⁶ This is consistent with the archeological record, which shows that mirrors from ancient India were round or at least oval.¹⁰⁷ In later texts, such as the *Nāṭyaśāstra*, the comparison seems to indicate both flatness and smoothness/glossiness.¹⁰⁸ Considering that the metal mirrors used in ancient and medieval India had to be cleaned regularly to remain reflective, the comparison might also indicate that the object is spotlessly clean.

Neither roundness nor flatness seem to apply to the Golden Land. Since the Golden Land is made of gold, the point of its comparison to a mirror appears to be that it has reflective properties. Alternatively, it could indicate that the surface of the Golden Land is smooth and glossy.

The Golden Land has the peculiar property that objects placed in it are irretrievably lost, for which reason it is shunned by living beings.¹⁰⁹ Why things are lost in the Golden Land is not clear, but the commentator Vīrarāghava offers an explanation:¹¹⁰

... भूम्यां निहितः कश्चित्पदार्थः पुनर्नोपलभ्यते दर्पणोदरतुल्यत्वात्तस्या इति भावः। न हि दर्पणोदरे निहितमाषादिस्तिष्ठतीति।

The gist is that any object deposited in that region is not found again because of its [the region's] likeness to the belly of a mirror. For beans and such placed on a mirror's belly do not remain [there].

¹⁰⁵ The production of glass mirrors backed with lead dates only to about 1500 CE in western India. See Kock and Sode 2002: 84.

¹⁰⁶ See *Kātyāyanaśrautasūtra* 1.3.40–41 and the commentary thereon (Weber 1859: 63).

¹⁰⁷ See S. Chatterjee et al. 2015.

¹⁰⁸ See *Nāṭyaśāstra* 2.72–73 (Krishnamoorthy et al. 1992: 62).

¹⁰⁹ Śrīdharasvāmin and other commentators explain that the gods are an exception to this. See K. Śāstrī 1966: 458.

¹¹⁰ See K. Śāstrī 1966: 460.

Vīrarāghava's explanation implies that the "belly of a mirror" is convex, so that objects roll off it.¹¹¹ Whatever Vīrarāghava imagines the shape of the Golden Land to be, it is not flat. If we follow Vīrarāghava's explanation, flatness is not implied by the comparison of the Golden Land to a mirror.

RĀMĀYAṆA 4.45.12

Besides *Bhāgavatapurāṇa* 5.20.35, there are no known passages in the extant Purāṇas in which the earth, or a portion of the earth, is compared to a mirror. But there is such a verse in the *Rāmāyaṇa*.

The *Rāmāyaṇa* does not belong to the category of Purāṇa, but it is a text that was informative, and often authoritative, for the followers of the Purāṇas. As such, it is reasonable to consider evidence from the *Rāmāyaṇa* here, though it should be noted that there is no indication that Jñānarāja had the *Rāmāyaṇa* in mind when he composed *Siddhāntasundara* 1.1.27–28.

The context for the *Rāmāyaṇa* verse is a story in which Sugrīva is chased across the sky by his brother Vālin, the king of Kiṣkindhā. Flying high in the sky, Sugrīva describes the earth below him as follows:¹¹²

आदर्शतलसङ्काशा
ततो वै पृथिवी मया
अलातचक्रप्रतिमा
दृष्टा गोष्पदवत्तदा

Then I saw the earth, resembling the surface of a mirror and the circling of a torch, like [it was just] the hoof-print of a cow.

The verse uses two images to describe how the earth appears to Sugrīva:

1. *ādarśatalasaṅkāśā*, "resembling the surface of a mirror."
2. *alātacakrapratimā*, "resembling the circling of a torch".¹¹³

Lefebber notes that "[t]he images depend on the earth's being viewed as a flat disc".¹¹⁴ However, it is not clear from the verse or its context that that is the case. In fact, the two images need not mean more than that the earth is round in a general sense. The second image certainly indicates that Sugrīva perceives the

¹¹¹ In fact, ancient metal mirrors were often convex rather than flat. A convex mirror has less surface area, and therefore requires less metal to make. See Enoch 2006: 776; 2007: 1222. With a well-fed person in mind, the word "belly" (*udara*) might invoke the image of a round and bulging object. As Shakespeare put it in *As You Like It* (Act 2,

Scene 7, line 154): "In fair round belly with good capon lin'd" (Shakespeare 1919: 42).

¹¹² See *Rāmāyaṇa* 4.45.12 (Mankad 1965: 294).

¹¹³ The image refers to the circle of fire or light one sees when someone moves a lit torch fast in a circular motion.

¹¹⁴ Lefebber 2016: 319, n. 12.

earth as round. Since roundness is a quality associated with mirrors in ancient and medieval India, the two images could reinforce each other in expressing the roundness of the earth. The verse therefore does not rule out that the earth has the shape of, say, an inverted bowl.

Furthermore, Lefebvre's summary of the commentaries on the verse does not indicate that the commentators understood the earth to be a flat disk. The commentators explain that the image of a circling torch is used because the earth is encircled by a mountain range or to indicate the high speed at which Sugrīva is moving, and the image of a mirror's surface is used because Sugrīva can see clearly all of the objects on the earth below him.

In other words, the precise shape of the earth is not clear from the verse or from the commentators' exposition of it. That the earth is a flat disk is a possibility, but other shapes are not ruled out.

SUMMARY AND CONCLUSIONS ON THE THIRD STATEMENT

The main problem with the third statement is that there is no extant Purāṇic passage that fits the argument in *Siddhāntasundara* 1.1.27–28. Jñānarāja's Purāṇic source is almost certainly *Bhāgavatapurāṇa* 5.20.35, but the passage supports neither the interpretation attributed to Jñānarāja's antagonists nor that of Jñānarāja himself. Jñānarāja understands the mirror simile to apply to only 1/100 of the earth's surface, that is, the earth appears flat locally though it is in fact a sphere. But this is just an old Siddhāntic argument, first articulated by Lalla as an argument against the idea that the earth is flat.¹¹⁵ It does not apply to the context of *Bhāgavatapurāṇa* 5.20.35.

It is not unreasonable to think that a passage comparing the earth to a mirror, similar to the verse we saw in the *Rāmāyaṇa*, was at some point part of one of the Purāṇas (or can still be found in a manuscript somewhere). If so, Jñānarāja must not have known about it. Furthermore, even if so, we must consider what the *tertium comparationis* would be. As we have seen, the *tertium comparationis* need not be flatness, but could easily be roundness.¹¹⁶ In other words, if the mirror simile is found in the Purāṇas, it could simply convey that the earth is round, an old Purāṇic idea.

5 CONCLUSION

AS A SCHOLAR, Jñānarāja was primarily an astronomer. The significance of the *Siddhāntasundara* is evidenced by Cintāmaṇi's extensive commentary on

¹¹⁵ See *Śiṣyadhīvr̥ddhidatantra* 20.35 (B. Chatterjee 1981: 237).

¹¹⁶ Smoothness/glossiness would not ap-

ply to the earth, with its mountains and valleys.

and later astronomers' engagement with the text.¹¹⁷ Though Jñānarāja engages with Purāṇic material in the *Siddhāntasundara*, there is no evidence that he otherwise wrote about or interpreted the Purāṇas. Sūryadāsa writes that Jñānarāja wrote three other works besides the *Siddhāntasundara*—on horoscopy (*jātaka*), rhetoric (*sāhitya*), and the art of singing (*gītaśāstra*).¹¹⁸ These works are no longer extant, but the topics do not indicate that they deal with the Purāṇas, at least not directly.

In general, Jñānarāja seems to have been a conservative and pious Hindu, who clearly was committed to the Purāṇas. We have seen that Jñānarāja acted as an apologist for the Purāṇas within the Siddhāntic tradition. He defended Purāṇic ideas to the point of rejecting tenets from the Siddhāntas, thereby asserting the relevance of the Purāṇas. He silently omitted ideas from the Purāṇas that would prove problematic in astronomy, such as the sun being closer to the earth than the moon is. More specifically, Jñānarāja sought an integration of two cosmographical systems—that of the Siddhāntas and that of the Purāṇas—which to educated observers at the time must have appeared to be mutually contradictory.

In our analysis of the three Purāṇic statements cited by Jñānarāja, we saw that Jñānarāja's interpretation of the first two amounts to imposing a Siddhāntic understanding on the passages. The word *bhūgola* is understood to mean that the earth is a sphere, a meaning taken from the Siddhāntas, and the northness of Meru is understood without reference to the ways in which the Purāṇas use the directions. Jñānarāja's interpretation of the third statement, where Purāṇic evidence is lacking for the interpretation given by the astronomers, is a repetition of an old Siddhāntic argument.

Jñānarāja's argument was effective. In today's scholarly dictionaries, the entries on *gola*, *golaka*, and *bhūgola* reflect his interpretation. The evidence from the *Bhāgavatapurāṇa* and its commentaries should be taken into account when the meaning of *bhūgola* is under discussion.

At the time of Jñānarāja, the *Bhāgavatapurāṇa* was growing in popularity, and the number of commentaries was increasing fast. Given the *Bhāgavatapurāṇa*'s popularity and reputation, it would not be surprising if the text, including its cosmography, caught the attention of some astronomers. If so, a plausible explanation for Jñānarāja's attempt at a synthesis of the two cosmographies is that the popularity and reputation of the *Bhāgavatapurāṇa* provided an impetus for reevaluating the Siddhāntic tradition's relationship to Purāṇic cosmography.

As we have seen, the commentaries on the *Bhāgavatapurāṇa* predating Jñānarāja agree on the interpretation of the word *bhūgola* in the text. But despite a consensus among the commentators, there is enough ambiguity in the Purāṇas' cosmographical accounts to allow for an intervention in the interpretation of the

¹¹⁷ See Minkowski 2004: 354–355.

¹¹⁸ See Knudsen 2014: 12.

texts. As such, the stage is set for Jñānarāja to argue that there are no contradictions between the two cosmographies.

Another possible explanation is that the Siddhāntic astronomers, like other groups, felt a need for unification among Hindus. Nicholson notes that Hindu scholars working on philosophy were concerned about Islam: “Philosophical authors writing in Sanskrit do not acknowledge Islam explicitly. But the perceived threat of Islam motivated them to create a strictly defined category of *āstika* philosophical systems, systems that professed belief in the authority of the Veda.”¹¹⁹ Jñānarāja does not mention Islam in the *Siddhāntasundara*, but he lived in an Islamic kingdom and must have been aware of Islam.¹²⁰ While the astronomers preceding Jñānarāja are not known to have engaged in the demonizing of Muslims that was done by other Hindu groups,¹²¹ they could have shared similar concerns. In other words, Jñānarāja could have been motivated by such concerns to integrate the Hindu tradition of astronomy closely with Hindu religion as expressed in the Purāṇas.

Whatever his reasons might have been, Jñānarāja’s attempt at a reconciliation between the cosmography of the Purāṇas and the cosmography of the Siddhāntas had a significant impact. His successors in the Siddhāntic tradition followed him and studied this cosmographical reconciliation. Later on, Purāṇic commentators did the same.

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¹¹⁹ See Nicholson 2010: 200–201.

¹²⁰ See Knudsen 2014: 1–12 for information about Jñānarāja and his native place. Regarding Jñānarāja’s knowledge of Islamic

astronomy, see Knudsen 2014: 31–35 and Knudsen 2009.

¹²¹ See Talbot 1995.

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Ujjain, Scindia Oriental Institute 9401: 132, 138, 150

REFERENCES

- Ānandāśrama Pandits (1981) (ed.), श्रीमद्वैपायनमुनिप्रणीतं मत्स्यपुराणम्। = [Mat-syapurāṇa] (Ānandāśrama Sanskrit Series, 54; Pune: Anandashrama Sanstha), <https://tinyurl.com/matsya1981>, (on 20 Apr. 2021).
- (1983) (ed.), महामुनिश्रीमद्व्यासप्रणीतं वायुपुराणम् = [Vāyupurāṇa] (Ānandāśrama Sanskrit Series, 49; Pune: Anandashrama Sanstha), <https://tinyurl.com/Apte1905>; First published in 1905.
- Apte, D. (1943–52) (ed.), वासनाभाष्य-मरीचिटीकाभ्यां सहितः श्रीभास्कराचार्यविरचितः (सिद्धान्तशिरोमणेः) गोलाध्यायः। = [The Golādhyāya of the Siddhāntaśiromani], 2 vols. (Ānandāśrama Sanskrit Series, 122; Poona: Ānandāśrama), <https://tinyurl.com/goladhyaya>.
- Apte, V. S. (1890), *The Practical Sanskrit-English Dictionary* (Poona: Shiralkar & co.), ARK: <ark:/13960/t9961gv8c>.
- Banerjea, K. M. (1865) (ed.), *The Nārada Pancha Rātra in the Original Sanscrit श्रीनारदं पञ्चरात्रं* || (Calcutta: Bishop's College Press), ARK: <ark:/13960/t82k3p307>; Bibliotheca Indica.
- Böhtlingk, O. and Roth, R. (1855–75), *Sanskrit-Wörterbuch* (St. Petersburg: Buchdruckerei der Kaiserlichen Akademie der Wissenschaften); Seven volumes.
- Bühnemann, G. (2020), 'A Model of the Universe in Kathmandu's Old Royal Palace', *History of Science in South Asia*, 8: 1–12. DOI: [10.18732/hssa.v8i0.59](https://doi.org/10.18732/hssa.v8i0.59).
- Chatterjee, B. (1981) (ed.), लल्लाचार्यविरचितं शिष्यधीवृद्धिदत्तन्त्रम् मल्लिकार्जुनसूरिविरचित-व्याख्योपेतम् = Śiṣyadhīvṛddhidatta Tantra of Lalla with the Commentary of Mallikārjuna Sūri, 2 vols. (New Delhi: Indian National Science Academy), ARK: <ark:/13960/t6933446r>.
- Chatterjee, S., Naher, S., and Chattopadhyay, P. K. (2015), 'Mirrors of Ancient India: From Harappa to Mahasthangarh', *Purātattva*, 45: 165–77; Plates 1–13 on pp. 18–19.
- Enoch, J. M. (2006), 'History of Mirrors Dating Back 8000 Years', *Optometry and Vision Science*, 83 (10): 775–81. DOI: [10.1097/01.opx.0000237925.65901.c0](https://doi.org/10.1097/01.opx.0000237925.65901.c0).
- (2007), 'Archeological Optics: The Very First Known Mirrors and Lenses', *Journal of Modern Optics*, 54 (9): 1221–39. DOI: [10.1080/09500340600855106](https://doi.org/10.1080/09500340600855106).

- Gangadhara, N. (1997), *Reconciliation of Siddhāntajyotiṣa and Paurāṇikajyotiṣa*, 20–3.
- Gupta, A. S. (1971) (ed.), *The Kūrma Purāṇa, Critically Edited* (Varanasi: All-India Kashiraj Trust), ARK: [ark:/13960/t0qs4bq9n](https://nopr.sri-cepr.res.in/ark:/13960/t0qs4bq9n).
- Hośiṅga, J. Ś. (1968) (ed.), नानार्थशब्दकोशापरपर्यायो मेदिनीकोशः श्रीमेदिनिकरनिर्मितः = *Nānārtha Śabda Kośa or Medinī Kośa of Śrī Medinikara* (Kashi Sanskrit Series, 41; Varanasi: The Chowkhamba Sanskrit Series Office), ARK: [ark:/13960/t70w3p59p](https://nopr.sri-cepr.res.in/ark:/13960/t70w3p59p).
- Ikeyama, S. (2002), 'The Brāhmasphuṭasiddhānta Chapter 21 with the Commentary of Pṛthūdakasvāmin', PhD thesis (Brown University).
- Jha, G. (1967), *Kāvayaprakāśha of Mammaṭa with English Translation (Revised) (chapters I to X)*, ed. S. Jha (2nd edn., Varanasi: Bharatiya Vidya Prakashan), ARK: [ark:/13960/t9766ns99](https://nopr.sri-cepr.res.in/ark:/13960/t9766ns99).
- Joshi, K. L. and Trivedi, B. (2003) (eds.), *Narasimha Purāṇa* (Delhi: Parimal Publications).
- Jurewicz, J. (2016), 'Etymologies in the Brāhmaṇas and the Ṛgveda: A Case Study of 'Fire's Precedence'', in A. Parpola and P. Koskikallio (eds.), *Vedic Investigations (Papers of the 12th World Sanskrit Conference, Vol. 1)* (Delhi: Motilal Banarsidass), 251–70.
- Khemakā, R. et al. (2010) (eds.), महर्षि वेदव्यासप्रणीत श्रीमद्देवीभागवतमहापुराण = *Devībhāgavatamahāpurāṇa [with Hindi translation]*, 2 vols. (Gorakhpur: Gita Press), <https://tinyurl.com/devibhagavata>.
- Kintaert, T. (2011–2), 'On the Role of the Lotus Leaf in South Asian Cosmography', *Wiener Zeitschrift für die Kunde Südasiens / Vienna Journal of South Asian Studies*, 54: 85–120. DOI: 10.1553/wzks2011-2012s85.
- Kirfel, W. (1920), *Die Kosmographie der Inder, nach den Quellen dargestellt* (Bonn and Leipzig: Kurt Schroeder), ARK: [ark:/13960/t15n50960](https://nopr.sri-cepr.res.in/ark:/13960/t15n50960).
- Knudsen, T. L. (2008), 'The Siddhāntasundara of Jñānarāja: A Critical Edition of Select Chapters with English Translation and Commentary', PhD thesis (Brown University), <https://repository.library.brown.edu/studio/item/bdr:274/>, (on 13 Apr. 2021).
- (2009), 'Crystalline Spheres in the Siddhāntasundara of Jñānarāja', in G. Gnoli and A. Panaino (eds.), *KAYD: Studies in History of Mathematics, Astronomy and Astrology in Memory of David Pingree* (Serie orientale Roma, 0102; Roma: Istituto Italiano per l'Africa et l'Oriente), 55–8, ISBN: 9788863232721.
- (2014), *The Siddhāntasundara of Jñānarāja: An English Translation with Commentary* (Baltimore: Johns Hopkins University Press).

- Kock, J. and Sode, T. (2002), 'Medieval Glass Mirrors in Southern Scandinavia and Their Technique, as Still Practiced in India', *Journal of Glass Studies*, 44: 79–94, <https://www.jstor.org/stable/24190873>.
- Krishnamoorthy, K. et al. (1992) (eds.), नाट्यशास्त्रम् श्रीमदभिनवगुप्ताचार्यविरचितविवृति समेतम् *The Nāṭyaśāstra of Bharatamuni with the Commentary Abhinavabhāratī by Abhinavaguptācārya. Volume 1 (chapters 1–7)* (Gaekwad Oriental Series, 36; 4th revised ed, Vadodara: Oriental Institute).
- Kulkarni, N. N. (1929) (ed.), शाश्वतकोशः, *The Anekārtasamuchchaya of Śāśvata, a Lexicon of Sanskrit Words* (Poona: Oriental Book Agency), ARK: [ark:/13960/t6b30w550](https://nbn-resolving.org/urn:nbn:in:cc0:13960-t6b30w550).
- Kuṃṭe, A. M., Navare, K., and Parādkar, H. (1939) (eds.), श्रीमद्वाग्भटविरचितम् अष्टाङ्गहृदयम्, श्रीमदरुणदत्तविरचितया “सर्वाङ्गसुन्दर्याख्या” व्याख्यया हेमाद्रिप्रणीतया “आयुर्वेदरसायनाहया” टीकया च समुल्लसितम् = *the Astāngahṛidaya. a Compendium of the Ayurvedic System Composed by Vāgḥbhaṭa with the Commentaries (sarvāngasundarā) of Arunadatta and (āyurvedarasāyana) of Hemādri* (6th edn., Bombay: Nirnaya Sagara Press), ARK: [ark:13960/t3tt6967d](https://nbn-resolving.org/urn:nbn:in:cc0:13960-t3tt6967d), (on 4 June 2017).
- Lefebvre, R. (2016), *The Rāmāyaṇa of Vālmīki: An Epic of Ancient India* (Princeton: Princeton University Press); Volume IV: Kiṣkindhākāṇḍa.
- Mankad, D. R. (1965) (ed.), *The Kiṣkindhākāṇḍa: The Fourth Book of the Vālmīki Rāmāyaṇa* (Volume 4 of the critical, Baroda: Oriental Institute), ARK: [ark:/13960/t5r85gx2h](https://nbn-resolving.org/urn:nbn:in:cc0:13960-t5r85gx2h).
- Mayrhofer, M. (1956–80), *Kurzgefaßtes etymologisches Wörterbuch des Altindischen = A Concise Etymological Sanskrit Dictionary*, 4 vols. (Heidelberg: Carl Winter), ARK: [ark:/13960/t0gv25j36](https://nbn-resolving.org/urn:nbn:in:cc0:13960-t0gv25j36).
- Minkowski, C. Z. (2000), 'Nīlakaṇṭha's Cosmographical Comments in the Bhīṣmaparvan', *Purāṇa*, 42/1: 24–40.
- (2004), 'Competing Cosmologies in Early Modern Indian Astronomy', in C. Burnett, J. P. Hogendijk, K. Plofker, and M. Yano (eds.), *Studies in the History of the Exact Sciences in Honour of David Pingree* (Leiden and Boston: Brill), 349–85.
- Miśra, B. (1932–47) (ed.), श्रीपतिप्रणीतः सिद्धान्तशेखरः. *The Siddhāntaśekhara of Śrīpati: A Sanskrit Astronomical Work of the 11th Century*, 2 vols. (Calcutta: Calcutta University Press), <https://tinyurl.com/misra1932>, (on 23 Apr. 2021).
- Monier-Williams, M. (1899), *A Sanskrit-English Dictionary* (Oxford: Clarendon Press).

- Neugebauer, O. and Pingree, D. (1970–1) (eds.), *The Pañcasiddhāntikā of Varāhamihira*, 2 vols. (København: Det Kongelige Danske Videnskaberne Selskab), ARK: [ark:/13960/t26b5tx8f](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-3960-t26b5tx8f).
- Nicholson, A. J. (2010), *Unifying Hinduism: Philosophy and Identity in Indian Intellectual History* (New York: Columbia University Press).
- Pathak, M. M. (1997–9) (ed.), *The Critical Edition of the Viṣṇupurāṇam*, 2 vols. (Vadodara: Oriental Institute).
- Pingree, D. (1967–8), 'The Paitāmahasiddhānta of the Viṣṇudharmottarapurāṇa', *Adyar Library Bulletin*, 31–32: 472–510.
- (1970–94), *Census of the Exact Sciences in Sanskrit*, 5 vols. (Philadelphia: American Philosophical Society), ARK: [ark:/13960/t4dp0cq1z](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-3960-t4dp0cq1z); Series A.
- (1976), 'Varāhamihira', in C. C. Gillespie (ed.), *Dictionary of Scientific Biography*, xiii (New York: Charles Scribner's Sons), 581–3.
- (1978) (ed.), *The Yavanajātaka of Sphujidhvaḥja*, 2 vols. (Cambridge and London: Harvard University Press), ARK: [ark:/13960/t6p059h5d](https://nbn-resolving.org/urn:nbn:de:hbz:5:1-3960-t6p059h5d).
- (1981), *Jyotiḥśāstra: Astral and Mathematical Literature* (A History of Indian Literature; Wiesbaden: Otto Harrassowitz).
- (1983), 'Brahmagupta, Balabhadra, Pṛthūdaka and Al-Bīrūnī', *Journal of the American Oriental Society*, 103/2: 353–60. DOI: [10.2307/601457](https://doi.org/10.2307/601457).
- (1990), 'The Purāṇas and Jyotiḥśāstra: Astronomy', *Journal of the American Oriental Society*, 110/2: 274–80. DOI: [10.2307/604530](https://doi.org/10.2307/604530).
- Plofker, K. (2005), 'Derivation and Revelation: The Legitimacy of Mathematical Models in Indian Cosmology', in T. Koetsier and L. Bergmans (eds.), *Mathematics and the Divine: A Historical Study* (Elsevier), 61–76. DOI: [10.1016/b978-0-44450328-2/50004-7](https://doi.org/10.1016/b978-0-44450328-2/50004-7).
- (2009), *Mathematics in India* (Princeton and Oxford: Princeton University Press), ISBN: 9780691120676.
- Plofker, K. and Knudsen, T. L. (2008a), 'Āryabhaṭa (ca 500 CE)', in P. T. Keyser and G. L. Irby-Massie (eds.), *Encyclopedia of Ancient Natural Scientists: The Greek Tradition and Its Many Heirs* (London and New York: Routledge).
- (2008b), 'Varāhamihira (ca 550 CE)', in P. T. Keyser and G. L. Irby-Massie (eds.), *Encyclopedia of Ancient Natural Scientists: The Greek Tradition and Its Many Heirs* (London and New York: Routledge), ISBN: 9780415692632.
- Rādhākāntadeva (2002), शब्दकल्पद्रुमः। ... स्यार्-राजा-राधाकान्तदेव-बाहादुरेण विरचितः = [*The Śabdakalpadruma*], 5 vols. (repr. Delhi: Nag Publishers), <https://tinyurl.com/sabdakalpadruma>, (on 20 Apr. 2021).

- Rocher, L. (1986), *The Purāṇas* (A History of Indian Literature; Wiesbaden: Otto Harrassowitz).
- Sachau, E. (1910), *Alberuni's India: An Account of the Religion, Philosophy, Literature, Geography, Chronology, Astronomy, Customs, Laws and Astrology of India about A.D. 1030*, i, 2 vols. (London: Kegan Paul, Trench, Trübner & Co.), ARK: ark:/13960/t3jw8pf34.
- Sadakata, A. (1997), *Buddhist Cosmology: Philosophy and Origins*, trans. from the Japanese G. Sekimori (Tokyo: Kōsei Publishing Co.).
- Sarma, K. V. (2003), 'Word and Alphabetic Numerical Systems in India', in A. K. Bag and S. R. Sarma (eds.), *The Concept of Śūnya* (New Delhi: Indira Gandhi National Centre for the Arts, Indian National Science Academy, and Aryan Books International), 37–71.
- Śarmā, R. (1985) (ed.), अथ श्री विष्णुमहापुराणं विष्णुचित्त्यात्मप्रकाशाख्यश्रीधरीय व्याख्याद्वयोपेतं प्रारभ्यते = [*The Viṣṇumahāpurāṇam*] (Delhi: Nag Publishers), ARK: ark:/13960/t42s3sv85; Reprint of Bombay: Venkatesvara Steam Press, 1910.
- Śāstrī, C. (1984) (ed.), *The Padmamahāpurāṇam*, 4 vols. (Delhi: Nag Publishers).
- Śāstrī, K. (1965) (ed.), श्रीमद्भागवतम् अनेकव्याख्यासमलङ्कृतम् तृतीयः स्कन्धः = [*Śrīmadbhāgavatamahāpurāṇam, Third Skanda*] (Ahmedabad: Kṛṣṇaśaṅkara Śāstrī), ARK: ark:/13960/t2c83f75k; With multiple commentaries.
- (1966) (ed.), महर्षिवेदव्यासप्रणीतं श्रीमद्भागवतमहापुराणम् पञ्चमः स्कन्धः = [*Śrīmadbhāgavatamahāpurāṇam, Fifth Skanda*] (Ahmedabad: Kṛṣṇaśaṅkara Śāstrī), ARK: ark:/13960/t1cj9jb7w; With multiple commentaries.
- (1975) (ed.), महर्षिवेदव्यासप्रणीतं श्रीमद्भागवतमहापुराणम् द्वादशस्कन्धः = [*Śrīmadbhāgavatamahāpurāṇam, Twelfth Skanda*] (Ahmedabad: Kṛṣṇaśaṅkara Śāstrī), ARK: ark:/13960/t55f00n16; With multiple commentaries.
- (1985) (ed.), श्रीकृष्णद्वैपायन-वेदव्यास-महर्षिप्रणीतम् ... श्रीमद्भागवतमहापुराणम् सात्वतसंहिता = [*Śrīmadbhāgavatamahāpurāṇam, Tenth Skanda*], 2 vols. (Ahmedabad: Bhāgavatavidyāpīṭhaḥ), ARK: ark:/13960/t7cr70n78; With multiple commentaries.
- Śāstrī, K. (1968) (ed.), श्रीमद्भागवत-अन्वितार्थप्रकाशिका (श्रीगंगासहायविरचिता) = [*Śrīmadbhāgavata-anvitārthaprakāśikā*] (Kṛṣṇaśaṅkara Śāstrī), ARK: ark:/13960/t7kq2sb4x.
- Shakespeare, W. (1919), *As You Like It*, ed. J. R. Crawford (New Haven: Yale University Press), <https://catalog.hathitrust.org/Record/001398183>.
- Sharma, K. V. (2000) (ed.), ब्रह्माण्ड-महापुराणम् = *The Brahmāṇḍa Mahāpurāṇa with English Introduction, Verse-Index and Textual Correction* (Krishnadas Sanskrit Series; Varanasi: Krishnadas Academy), ARK: ark:/13960/t0jt6232f.

- Shastri, D. (1998) (ed.), आचार्य-यशोमित्र-कृत-स्फुटार्था-व्याख्योपेतम् आचार्य-वसुबन्धु-विरचितम् स्वोपज्ञ-भाष्य-सहितम् अभिधर्मकोशम् = *The Abhidharmakosa & Bhāṣya of Acārya Vasubandhu with Sphutārthā Commentary of Ācārya Yaśomitrā* [sic], 2 vols. (Bauddha-Bhāratī-Granthamālā, 5–6; 1st edn., Varanasi: Bauddhabhāratī).
- Shukla, K. S. (1976) (ed.), *Āryabhaṭīya of Āryabhaṭa with the Commentary of Bhāskara I and Someśvara* (New Delhi: Indian National Science Academy).
- Śrīkrṣṇadāsa, K. (1912) (ed.), अथ विष्णुधर्मोत्तरमहापुराणप्रारंभः = [*Viṣṇudharmottaramahāpurāṇam*] (Bombay: Veṅkaṭeśvara Press), ARK: [ark:/13960/t6qz6fr23](https://nbn-resolving.org/urn:nbn:in:cc0:t6qz6fr23).
- Tagare, G. V. (1986), *The Bhāgavata-Purāṇa, Part 1* (Ancient Indian Tradition and Mythology; Reprint, Delhi: Motilal Banarsidass), ARK: [ark:/13960/t15n4qf25](https://nbn-resolving.org/urn:nbn:in:cc0:t15n4qf25); First published in 1976.
- Talbot, C. (1995), 'Inscribing the Other, Inscribing the Self: Hindu-Muslim Identities in Pre-Colonial India', *Comparative Studies in Society and History*, 37/4: 692–722. DOI: [10.1017/s0010417500019927](https://doi.org/10.1017/s0010417500019927).
- Telang, M. R. (1937) (ed.), महाकविश्रीजयदेवविरचितं गीतगोविन्दकाव्यम् = *The Gīta-govind of Jayadeva with the Commentaries Rasikapriyā of King Kumbha and Rasamañjarī of Mahāmahopādhyāya Śankara Miśra* (8th edn., Bombay: Nirṇaya Sāgar Press), ARK: [ark:/13960/t5cc5ts5x](https://nbn-resolving.org/urn:nbn:in:cc0:t5cc5ts5x).
- (1936) (ed.), महाकविश्रीभवभूतिप्रणीतं मालतीमाधवम् = *The Mālatīmādhava of Bhavabhūti with Commentaries of Tripurāri and Jaḡaddhara* (6th edn., Bombay: Nirṇaya Sāgar Press), ARK: [ark:/13960/t3810fv3g](https://nbn-resolving.org/urn:nbn:in:cc0:t3810fv3g).
- Vogel, C. (1979), *Indian Lexicography* (A History of Indian Literature; Wiesbaden: Otto Harrassowitz).
- Weber, A. (1859) (ed.), *The Çrautaûtra of Kâtyâyana with Extracts from the Commentaries of Karka and Yâjñikadeva* (Berlin and London: F. Dümmler, Williams, and Norgate), ARK: [ark:/13960/t5v78d38j](https://nbn-resolving.org/urn:nbn:in:cc0:t5v78d38j).
- Wilson, H. H. (1865), *The Vishṇu Purāna: A System of Hindu Mythology and Tradition*, ii, 2 vols. (London: Trübner & Co.), ARK: [ark:/13960/t9285r18z](https://nbn-resolving.org/urn:nbn:in:cc0:t9285r18z).

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