

# Commentaries and the history of science in India

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# COMMENTARIES AND THE HISTORY OF SCIENCE IN INDIA

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## *Abstract*

The question studied in this article is whether and to what extent the commentatorial manner of presentation, there where it is used, can have an effect on the contents of the science concerned. Is it conceivable that the clothes in which the baby is dressed end up changing the baby herself? Could it be that the history of science is to some extent determined by the form of expression chosen by its representatives? The first part of the article discusses, in the light of the Indian evidence, a recent proposal as to the exact way in which such influence might have taken place. The second part raises a new question, once again on the basis of the Indian evidence.

## I.

Developments in the history of science often find expression in commentaries on texts that are considered classical in one way or another. Such commentaries may go beyond the fundamental texts they comment upon, but often under the pretense that they don't. The fundamental text, it is claimed, contains in condensed form what the commentaries bring out.<sup>1</sup>

The question to be considered is whether and to what extent this manner of presentation, there where it is used, can have an effect on the contents of the science concerned. Is it conceivable that the clothes in which the baby is dressed end up changing the baby herself? Could it be that the history of science is to some extent determined by the form of expression used by its representatives? According to at least one theory this can happen, and has actually happened in literate old-world societies. It claims that the methods

1 Note the verse that occurs in Kumāriḷa's Tantravārttika on Mīmāṃsāsūtra 2.16 (Mīmāṃsādarśana, Anandashrama edn. vol. 2:180): *sūtreṣv eva hi tat sarvaṃ yad vṛttau yac ca vārttike / sūtraṃ yonir ihārthānāṃ sarvaṃ sūtre pratiṣṭhitam* // "whatever is found in the commentaries and in the Vārttikas is already (inherent) in the Sūtras. The Sūtra is the origin of all meanings, and therefore everything is founded on the Sūtra" (tr. DESHPANDE, 1998:22).

used by premodern commentators show a certain invariance. A small number of hermeneutic techniques is presumably used repeatedly in successive layers of tradition, resulting in the growth of religious and philosophical systems that are similar to each other across cultural boundaries, in spite of the fact that the classical texts on which the commentaries are ultimately based can be very different from each other. These systems, according to this theory, stay in place until their final collapse under their own weight, so to say, having approached maximum levels of complexity and systematic integrity. This happened in Europe in the early modern scientific era; in China something similar was on its way.

This theory, if correct, might have consequences for our understanding of the history of science in different cultural areas. It finds expression in a number of publications from the hand of Steve Farmer: one – a book on the European Renaissance author Pico (Giovanni Pico della Mirandola) – by him alone, another one an article written in collaboration with the Sinologist John B. Henderson, and two further articles by these two and the Indologist Michael Witzel.<sup>2</sup> These publications base themselves on materials from a variety of cultures, but primarily from premodern western Europe, from China, and, to a lesser extent, from India and other cultures.<sup>3</sup> The first part of this paper is meant to critically reflect on the applicability of this theory to the Indian situation.

In order to do so, we have to get some more clarity as to its exact content. What, according to this theory, do commentators do? And what exactly is the presumed outcome of this commentatorial activity?

Commentators, according to the theory under consideration, were confronted with the task of reconciling or “syncretizing” traditions, especially so during epochs in which pressures to harmonize traditions were intense (FHR p. 2). They had to free authoritative traditions from internal contradictions or to harmonize them with foreign traditions. One way to attain this goal is the introduction of “scholastic distinctions”, for example levels in heaven and hell (FHR p. 3). This process repeated itself numerous times, since the outcome of a preceding “layer” of commentatorial activity is the basis for the next one. Each new layer of tradition, whether embodied in canonical texts

2 The contribution of the fourth author, Peter Robinson, appears to have been the creation of computer simulations meant to check the model.

3 FHR p. 1: “The model originally arose out of textual studies of European and Chinese cosmological traditions, but its ideas are supported as well by data from premodern India, Southeast Asia, the Middle East, and pre- and early-colonial Mesoamerica.”

or later commentaries, tended to transform the products of earlier strata in predictable ways (FHR p. 5). We can therefore speak of the repetitive application to sacred and semisacred traditions of a relatively small, and largely culturally invariant, series of commentatorial techniques. The commentators were obliged, not only to syncretize opposing or foreign traditions, but also to harmonize conflicting layers of canonical texts (FHR p. 6).

The results of this multi-layered commentatorial activity could generate, among other things, abstract pantheons of gods, monotheistic deities, or abstract ethical or cosmological principles. In later traditions, our authors maintain, typical products included dualistic or trinitarian concepts of deity, broad systems of correspondences, multileveled pictures of heaven or hell, elaborate emanational systems, and other diagnostic features of scholastic traditions. They add: “Over many centuries, higher-level integrations of structures like these gave birth to elaborate multilayered correlative systems – Neo-Platonic, Neo-Confucian, Buddhist, Hindu, Islamic, or Christian cosmologies, etc. – whose levels of self-similarity tended to increase whenever those traditions inbred and grew in complexity.” (FHR p. 6).

In order to test this theory against the Indian evidence, we first have to make some choices. In this paper I will confine myself to philosophical and scientific traditions linked to Brahmanism. Developments in “popular” Hinduism will not be considered, and indeed, one wonders whether the theory covers these developments, which were not always accompanied by commentatorial traditions and certainly not created by them. Buddhism, too, will be left out, to the extent possible; we will see below that it is not possible to ignore Buddhism altogether.

With regard to the theory itself, too, we will introduce some limitations. Farmer c.s. mention among the byproducts of iterated exegetical processes the appearance of correlative cosmologies, “high-correlative thought” as they sometimes call it. This effect is, as far as I can see, not at all applicable to the Indian situation, where high-correlative thought is most prominent in the Vedic texts, and much less important in later developments.<sup>4</sup>

4 WITZEL (2004) proposes – while referring to FARMER *et al.*, 2000 – to look upon the “Ṛgvedic religious system” as the result of “attempts at changing and ‘updating’ an older pre-Vedic system in accordance with local religious, social and political developments that eventually led to the post-Ṛgvedic continuation of speculation, and even more significantly, to the classification in the post-RV period of the Śrauta system with its stress on a rather restricted ‘access to heaven’” (p. 626). But does he seriously be-

Which are the sacred texts of Brahmanism? No doubt the Veda, a corpus that was obtaining canonical status near the beginning of the Common Era, constitutes a major part of them. All “orthodox” authors claim adherence to this corpus (or are believed to do so implicitly). The question we have to address is: can subsequent developments in philosophy be looked upon as due to the iterated activity of commentators on the Vedic corpus? The answer is simple: no, it cannot. In spite of its exalted status, the Vedic corpus was very little studied for its contents. Commentaries on some of its parts exist, but they are few in number and have not exerted much, if any, influence on other areas of reflection.<sup>5</sup> Most of the philosophical schools of Brahmanism pay lip-service to its superior position. The school of hermeneutics called Mīmāṃsā whose only reason of existence was the analysis of the Vedic texts was only interested in the ritual prescriptions it could find in them. All other Vedic statements were not taken literally. The ideas which it accepted were not even in theory derived from the Vedic texts.

There is one partial exception to the above. Roughly from the second half of the first millennium C. E. onward another school of Vedic hermeneutics arose which *was* interested in the factual contents of at least some parts of the Veda. This is the one known by the name Vedānta (better perhaps, Vedāntism), which argued that some factual Vedic statements *are* to be taken literally. These are the sentences found in the Vedic Upaniṣads that speak about *brahman*, the highest principle, and the nature of the soul. These sentences are made the basis of a philosophy which is claimed to be derived from the Veda. Vedānta became important in the second millennium of the Common Era, and split into a number of schools. The most famous early representative of the school called Advaita Vedānta is Śaṅkara (around the year 700 C. E.), nowadays probably the best-known thinker of classical India. Farmer c.s. refer to Śaṅkara as a confirmation of their theory from India. They do so, for example, where they wish to emphasize the links between exegetical processes and the evolution of religious and philosophical systems.<sup>6</sup> The value of this example is however dubious. Śaṅkara’s school of

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lieve that there is here question of the iterated activity of commentators, of a small number of hermeneutic techniques used repeatedly in successive layers of tradition? Where Farmer and Henderson appear to be speaking specifically of commentatorial traditions, Witzel here seems to widen the theory so as to cover all religious developments, with or without commentaries.

5 Cf. GONDA, 1975:39ff.; DANDEKAR, 1990.

6 E. g. FHR p. 19.

thought, Advaita Vedānta, considered itself, and presented itself as, an improved version of the Mīmāṃsā already mentioned. Vedānta, too, is a form of Mīmāṃsā, sometimes calling itself Brahma-Mīmāṃsā. In principle it accepted the ideas of the old ritual Mīmāṃsā which, as we have already seen, were not even in theory derived from the Veda. To this it merely added some elements, most important among them the conviction that there are after all a few factual statements in the Veda – viz., the Upaniṣadic statements about *brahman* – that should be taken literally.<sup>7</sup> The world view that arises from this mixture is largely determined by exegetical considerations, yet it is not the byproduct of the iterated application of exegetical techniques. The connection between world view and hermeneutics in this case exists, but does not correspond to the model of layered texts and iterated exegetical techniques.

Farmer c.s. also make much of the “double-truth” sponsored by Śaṅkara and his commentators. The double-truth, they point out, is a useful exegetical device in syncretic systems which allows the absorption of contradictory features. Now it may indeed be argued – even though Farmer c.s. do not do so explicitly – that Śaṅkara’s system is syncretic. Other Sanskrit commentators accused him of being a pseudo-Buddhist, and it is clear that many elements of his thought have Buddhist roots. This does not however mean that Śaṅkara accepted the Buddhist canonical texts. He was not a commentator who accepted the classical Buddhist texts in the repertoire he commented upon, or who wished to reconcile the ideas of Buddhists and Brahmins. Quite on the contrary, Śaṅkara was a fierce critic of Buddhism, who had no respect whatsoever for their canonical texts.<sup>8</sup> If he used some of their ideas, he did so without any acknowledgment. He did not need double-truth in order to find place for Buddhist thought. As a matter of fact, he had borrowed the idea of double-truth itself from the Buddhists. The Buddhists had introduced it, probably already during the centuries preceding the Common Era, but not in order to make place for two different world views which they wished to reconcile. They had introduced it to make sense of their first attempts at systematizing, which had provided them with a coherent world view which however had few points of resemblance with the common sense view of the world. They had resolved this by stipulating that the common sense world view is not quite as true as the theoretical one they

7 BRONKHORST, 2006.

8 ALSTON, 1989:251–313.

had developed. This double-truth had accompanied Buddhist thought until the time of Śaṅkara and beyond. It was *not* the result of exegetical processes trying to reconcile different traditions.

It may be clear from the above that the history of Vedic exegesis does not easily fit the model presented by Farmer and others. However, the Vedic corpus was not the only corpus which was invested with canonical status within the Brahmanical tradition. A subsequent stage of this tradition found expression in the Purāṇas, a large number of texts of great length. Contrary to the Veda the texts in this corpus *were* read by numerous Hindus. For our present purposes it is particularly interesting to note that these Purāṇas presented a view of the universe that was completely different from the one advocated by the practitioners of astronomy during the same period who followed the astronomical Siddhāntas. It is not necessary to go into details, but the inconsistencies between the Purāṇic and Siddhāntic cosmologies strike the eye: in the former the earth is flat, while in the latter it is a globe; in the first it has a huge size, in the second it has a manageably small size.<sup>9</sup> One might expect that these inconsistencies provide us with the situation in which commentators are under pressure to reconcile the two different views, thus acting in the way envisaged in the model of Farmer c.s. What really happened does not however fit the model all that easily.

Minkowski (2001:82) gives the following brief résumé of what happened (with a reference to Pingree 1990:279):

As far as we know, [the] mutual inconsistency [between the Purāṇic and Siddhāntic cosmologies] passed largely undiscussed until the mid-9th century, when the astronomer Lalla turned to a critique of the Purāṇic model in his Siddhānta, the Śiṣyadhīvr̥ddhidatantra. Lalla did attempt to accommodate some elements of the Purāṇic model to the globular earth of the Siddhāntas: Mt. Meru is made the axis inside the earth on which the earth revolves; all the other oceans and continents of the Purāṇic model are assumed to be south of the equator; and the power that drives the interesting spheres is still the Pravaha wind, which is the force that makes the planets and stars revolve around Meru in the Purāṇic model.

Nevertheless Lalla explicitly rejected the improbable Purāṇic assertions that eclipses are caused by Rāhu; that night is caused by Meru blocking the Sun; that the Moon wanes because the gods are drinking the Soma in the moon; that the Moon is higher in the heavens than the Sun is; and that the earth is flat and rests on a support.

9 MINKOWSKI, 2001:82.

These criticisms are repeated in later Siddhāntas, especially in Bhāskara II's very influential work, the Siddhāntaśiromaṇi, of the 12th century [...].

It is clear from this résumé that, far from completely reconciling the two traditions, Lalla and his successors did not shy away from straightout rejecting certain aspects of Purāṇic cosmology. Attempts at reconciliation at any cost do make their appearance later on, apparently from the sixteenth century onward. These attempts, however, never gave rise to the process of iterated application of exegetical techniques<sup>10</sup> which underlies the model of Farmer c.s., for the battle for reconciliation was far from won. The nineteenth century in particular saw a vivid exchange of treatises in Sanskrit and other languages about the question whether and to what extent the two cosmologies were compatible.<sup>11</sup>

This example from astronomy raises the question to what extent Indian commentators in the Brahmanical tradition saw it as their task to reconcile contradictions and inconsistencies. The astronomical example suggests that this tendency became stronger during the last few centuries, perhaps from the middle of the second millennium onward. Before this time commentators may have been comfortable with unresolvable inconsistencies between different schools of thought. This, if true, would exclude the literary traditions of South Asia from the regularities which presumably characterize such traditions elsewhere. And the effects that commentaries might have had on the contents of the sciences would not take the form we would expect on the basis of the theory of Farmer, Henderson and Witzel.

10 Concerning the exegetical techniques themselves, MINKOWSKI (2004:351) describes them in the following manner: "removal of contradiction can conceivably be done in a variety of ways. Some of our authors simply refute one or the other of the contradictory views as untruth or illogic, hence leaving the field to the other view and in that way removing any contradiction. Others accord different levels of truth to the two positions, saying that one describes practical, the other, ultimate reality. A related removal of inconsistency is done by putting the two positions on different planes of reality by appeal to their purpose, one being for timings of mundane affairs, the other for soteriological aims. Some adopt an exegetical strategy, according one of the two views a higher truth, but reading its texts so that they only confirm what the other view already maintains. Others assume that both views have the same subject and purpose on the same plane, and actually adjust and revise doctrines so that they conform to each other. Some of our authors resort to combining several of these theoretical approaches."

11 See especially MINKOWSKI, 2000; 2001; 2002; 2003; 2004.



## II.

Are there other ways in which the use of commentaries might have affected the contents of the sciences in India? I suspect there may be one, but in order to appreciate it we have to concentrate on some of the peculiarities of the South Asian situation and keep universalistic ambitions for the time being in check. Of the South Asian sciences linguistics is the one that came to occupy a central position in literate culture. The study of grammar in particular, preferably the grammar of Pāṇini, became part of the educational curriculum of all those who aspired for higher knowledge. The early commentaries on this grammar were looked upon as examples and prototypes of what commentaries should look like.

The earliest surviving commentary on Pāṇini's grammar is the Great Commentary (Mahābhāṣya) of Patañjali.<sup>12</sup> This Great Commentary dates from the second century before the Common Era, which is exceptionally early for an Indian commentary. It is also exceptional for another reason. This is not just a simple commentary that explains the words and direct meaning of the aphorisms that make up Pāṇini's grammar; this knowledge is somehow taken for granted. No, it discusses the implications of certain rules, the consequences of applying them, their need in the grammar as a whole, etc. Occasionally it rejects a rule, or proposes emendations. For most of its history Pāṇini's grammar was studied along with Patañjali's Great Commentary. The latter became the example of a certain type of commentary which was imitated in other fields of knowledge.<sup>13</sup>

The Great Commentary was not however the type of first-level commentary one needs to understand the rules. It presupposes such an understanding, which indicates that traditional explanations of the rules existed already before its time. Whether these early traditional explanations existed in the form of complete commentaries we do not know for certain. We do know that the Great Commentary had some clear ideas as to what such a commentary should contain. An explanation, it states, is not just the words of the rule repeated, this time separated from each other; it also includes one or more examples, counterexamples, and the completion of the utterance by

12 I do not here discuss the *vārttikas* of Kātyāyana and others that are contained in the Mahābhāṣya; their character was not fully understood for some time; cf. BRONKHORST, 1990.

13 BRONKHORST, 1990; 1991.

supplying words.<sup>14</sup> Later commentators, both inside and outside the grammatical tradition, took these remarks to heart and composed commentaries of this kind, sometimes with an admixture of elements taken from Patañjali's Great Commentary.

An explanation of the kind proposed by Patañjali fulfills the basic needs of a user of Pāṇini's grammar. Separating the words of the rule concerned is required because the way words are joined in Sanskrit might easily give rise to ambiguities in rules as condensed as those that constitute this grammar. Supplying words, too, is a requirement that results from the condensed way the rule has been presented to begin with. But an explanation should do more than only disambiguating the wording of the rules. By giving one or more examples it illustrates what the rule is for; counterexamples make clear which are its limits of applicability. Armed with the understanding thus provided it is possible to proceed to other issues, like those discussed in Patañjali's Great Commentary.

Suppose now that one were to follow Patañjali's suggestions in explaining a rule of geometry, say, the theorem of Pythagoras (for a rectangular triangle the lengths of the sides  $a$ ,  $b$  and  $c$  obey the rule  $a^2 + b^2 = c^2$ ). The verbal presentation of the theorem should first be made clear by separating the words and supplying further words that may be required for a full understanding. Next it will be useful to give some concrete examples of triangles to which the theorem is applicable, such as a triangle with sides 3, 4 and 5. Counterexamples may similarly illustrate where the theorem is not applicable.

A commentary of this kind will no doubt be useful. However, it will not explain why we should accept the theorem of Pythagoras to begin with. There will be no proof of any kind. This is no problem in the case of a grammatical rule. Grammatical rules are not proven, whereas geometrical rules are. This, at any rate, is our view of the matter. But does it correspond to the way the early users of Sanskrit texts looked upon it?

Let us first look again at grammatical rules. They may not be in need of proof in the way a theorem of geometry is, but they are in need of justification. A grammatical rule that produces incorrect forms is incorrect, one that produces correct forms is correct. The kinds of justification we are looking

14 MAHĀ-BH I p. 11 l. 22–23; p. 12 l. 24–26: *na kevalāni carcāpadāni vyākhyānaṃ vṛddhiḥ āt aij iti / kiṃ tarhi / udāharaṇaṃ pratyudāharaṇaṃ vākyaḍhyāhāra ity etat samuditaṃ vyākhyānaṃ bhavati //*. Cf. JOSHI & ROODBERGEN, 1986:162–163.

for in the cases of grammar and geometry may be different, very different, but justification they need, both of them. The question is whether the early users of Pāṇini's grammar would agree with us in this respect. Did they too, like us, think that grammatical rules are in need of justification?

There is a passage in Patañjali's Great Commentary which appears to show the opposite. A rule in Pāṇini's grammar (P. 6.3.109) refers to a list of irregularly formed words of which it only specifies the first one, the others being indicated with the help of a laconic "etcetera" (*°ādi*). Challenged to explain which the other words are, Patañjali answers that the usage of educated people (*śiṣṭa*) is to be followed. Who are those educated people? Patañjali's answer involves various elements: educated people are Brahmins who live in a certain region of the subcontinent, behave in certain ways, etc. But the for us most interesting part of this description is that they speak correct Sanskrit without having studied the Aṣṭādhyāyī, i.e., Pāṇini's grammar. This grammar allows us in this way to identify educated Brahmins.<sup>15</sup> Note that the educated Brahmins are not invoked to justify the rules of Pāṇini's grammar, but the other way round: Pāṇini's grammar, which is not in need of justification, allows us to identify educated Brahmins. Perhaps this is not surprising in view of the feeling of awe with which Patañjali refers to Pāṇini. Later authors in the grammatical tradition extend this feeling of awe so as to include Patañjali.<sup>16</sup>

Let us now return to geometry.<sup>17</sup> The earliest surviving commentary on a geometrical text is the one by Bhāskara I (completed at Valabhī in 629 C. E.). The text he comments upon is the Āryabhaṭīya, called after its author Āryabhaṭa (who was 23 years old in 499 C. E.). Its chapter entitled Gaṇitapāda deals with various mathematical topics, among them geometry. Bhāskara comments upon all of this. In the geometrical portions he provides

15 MAHĀ-BH III p. 174 l. 10–13: *yadi tarhi śiṣṭāḥ śabdeṣu pramāṇam kim aṣṭādhyāyī kriyate / śiṣṭajñānārthāṣṭādhyāyī / katham punar aṣṭādhyāyā śiṣṭāḥ śakyā vijñātum / aṣṭādhyāyīm adhīyāno 'nyam paśyaty anadhīyānam ye 'tra vihitāḥ śabdās tān prayuñjānam* / "If these śiṣṭas are the decisive standard for correctness of language, then what is the function of Pāṇini's Aṣṭādhyāyī? Pāṇini's grammar aims at helping one recognize these linguistic élites. How can the linguistic élites be recognized by means of Pāṇini's grammar? A student of Pāṇini's grammar observes another person who has never studied that grammar but who uses constructions taught in that grammar." (tr. DESHPANDE, 1993:97)

16 DESHPANDE, 1993; 1998.

17 Cp. BRONKHORST, 2001.

explanations, diagrams, exercises, and whatever may be required to understand Āryabhaṭa's text. He does not however provide proofs or justifications. And most interestingly, he attributes to Āryabhaṭa supernatural powers.<sup>18</sup> The parallelism with the commentatorial tradition on Pāṇini's grammar is therefore perfect.

This characterization of Bhāskara's commentary is all the more striking in view of the fact that one year before it another treatise had been composed (at Bhillamāla or Bhinmal, near Mt. Abu, Rajasthan, in 628 C. E.), viz. Brahmagupta's Brāhmasphuṭasiddhānta, which is not a commentary. Brahmagupta and Āryabhaṭa based their astronomical presentations on an earlier text, the Paitāmahasiddhānta. Of the two, Āryabhaṭa was less tradition-bound, for he revised several of its elements; he was severely criticized for this by Brahmagupta.<sup>19</sup> Obviously Brahmagupta did not attribute supernatural powers to Āryabhaṭa. What is more, Brahmagupta was the more traditional of the two.

The twelfth chapter of the Brāhmasphuṭasiddhānta is devoted to mathematics. Not being a commentary, this work is very condensed and, like the Āryabhaṭīya, it has no place for proofs. For the same reason it does not justify its geometrical theorems by taking recourse to an earlier authority, be it Āryabhaṭa or someone else. We may not know how exactly it arrived at the various theorems it proposes, but one thing is clear: it did not copy them from Āryabhaṭa. This is clear from a case where Āryabhaṭa had propounded an incorrect theorem, claiming that the volume of a pyramid is half the product of the height and the surface of the triangular base.<sup>20</sup> Brahmagupta's Brāhmasphuṭasiddhānta knows the correct formula: a third of this product.<sup>21</sup>

18 Āryabhaṭa "sees things that are beyond the reach of the senses" (*atīndriyārthadarśin*; ĀRYBH p. 189 ll. 14–15); he has composed this work having pleased Brahmā with great ascetic practices (ĀRYBH p. 11 l. 22–23: *atha katham asyātīndriyāṇām sphuṭagrahagatyarthānām prādurbhāvaḥ? brahmaṇaḥ prasādeneti / evam anuśrūyate: anenācārṇya mahadbhis tapobhir brahmārādhitāḥ /*).

19 PINGREE, 1993.

20 Āry Gaṇitapāda 6cd: *ūrdhvabhujātatsaṃvargārdham sa ghaṇaḥ ṣaḍāśrir iti*. Cf. KELLER, 2006, I:30f.; II:27f.

21 Brāhmasphuṭasiddhānta 12.44ab (ed. Sharma): *kṣetraphalaṃ vedhaguṇaṃ samakhātaphalaṃ hr̥taṃ tribhiḥ sūcyāḥ /* "The volume of a pit of uniform depth is the area multiplied by the depth. This divided by three is the volume of a pyramid"; tr. SARASVATI AMMA, 1999:200, modified.

The commentator Bhāskara repeats Āryabhaṭa's error, apparently without being aware of it.<sup>22</sup>

What we have, then, is two authors – Bhāskara and Brahmagupta – who write at exactly the same time works that deal with the same subjects, among them geometry. One of these works contains a patent mistake, the other doesn't. The work with the mistake is a commentary, which repeats the mistake that it found in the work it comments upon. The other work, Brahmagupta's Brāhmasphuṭasiddhānta, is independent, i.e., no commentary. The question is inevitable: Is Bhāskara less critical, less acute as a mathematician, because he is a commentator? Is he, as a commentator, more or less obliged to raise the author of the text he comments on to superhuman heights, sacrificing his own critical spirit in the process? Does he have to do so in spite of the fact that he comments on the work of a rebel who himself felt free to deviate from tradition? It is difficult to answer these questions with confidence. It is of course possible that Bhāskara was quite simply less bright than Brahmagupta, that he was not as gifted in geometry. It is conceivable that Brahmagupta, if he had decided to write a commentary on the Āryabhaṭīya, would have drawn attention to the errors it contains, as he does, as a matter of fact, on several occasions. It is also possible that he did not write a full commentary on that work *because* he was too bright. Or again, perhaps brightness plays no role here. Perhaps a commentator, by virtue of becoming a commentator, had to adjust to this role and somehow manage to fit the model, which implied respect for the tradition and, above all, for the author whose work he was commenting upon.

One swallow does not make summer. One pair of scientists – of which one, the commentator Bhāskara, perpetuates an incorrect theorem, whereas the other, the independent author Brahmagupta, formulates the correct one – does not yet prove that writing commentaries has a dulling effect on the mind. It is however suggestive and, one hopes, it may encourage others to look for further evidence, both in India and elsewhere, that may bring clarity into this matter. The fact that Bhāskara and Brahmagupta were exact contemporaries who wrote about exactly the same things strongly suggests that their differences had little to do with the time in which they lived, or which the branch of knowledge in which they were active, but all the more with the genre of text they wrote. It creates the impression that writing a commentary

22 So does the commentator Nīlakaṇṭha, according to SARASVATI AMMA (1999:197ff.). This is all the more surprising in that Nīlakaṇṭha himself was innovative; cf. PINGREE, 2001.

implied more than choosing one out of a number of available literary genres.<sup>23</sup> Rather, it appears to have meant choosing a literary genre, and along with it a certain mind set. Once again, it would be fascinating to test this impression against evidence from different cultures.

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23 Cp. Kim PLOFKER's (1996) concern to "understand the thought processes of Indian mathematicians".

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### Abbreviations:

- ĀRY     Āryabhaṭīya of Āryabhaṭa, ed. Shukla.  
ĀRYBH   Āryabhaṭīya Bhāṣya of Bhāskara I, ed. Shukla.  
FHR     Farmer – Henderson – Robinson, 2002 (see the references, above).  
MAHĀ-BH   Patañjali, (Vyākaraṇa-)Mahābhāṣya, ed. F. Kielhorn, Bombay  
1880–1885.