

Pradeep Kumar Gautam*

Science and India

Abstract

This paper enquires in to the deliberations of why India has been overtaken by the West in science and technology, despite its earlier successes with the same. A number of both social and philosophical factors need to be considered. The paper revisits several debates and arguments of the Indian scientific community and of contemporary Indian scientists. Some entrenched and unchanging attitudes of the past as well as contemporary times are also analyzed. To avoid stagnation of scientific thinking, there is a need to have a scientific temper, critical thinking, and an enquiring mind. These attributes can definitely propel India forward, back into the realm of science and technology.

Introduction

Joseph Needham – the ‘Sinologist’ of the early 20th Century, posed the grand question: “Why had China and India been overtaken by the West in science and technology, despite their earlier successes?” I carry forward and supplement this puzzling question with debates of the Indian scientific community, on the period of decay and neglect that started in the 15th century and is continuing to the present. I will then discuss the debates over it in the early 20th century including the arguments on knowledge as well as the present situation.

To begin with, an interesting observation that can be made is that though rational and scientific thinking may have been slightly neglected in India during some stages of history, there is also evidence to show a high standard of scientific applications. Michel Danino explains the Indian knowledge-centred civilizations’ contributions to astronomy, mathematics, medicine *Shulba Sutra* (the text of geometry), metallurgy and even textiles as well as transport.¹ B.M. Udgaonkar invites attention to the scholarship of Jawaharlal Nehru, Claudi Alvares and Dharampal, where it is shown that a rich tradition of shipbuilding and naval

* The author is a consultant with IDSA (New Delhi) in the Indigenous Historical Knowledge Project.

architecture existed at Lothal as far back as in 2000 BC and how During the 17th and 18th centuries, the English borrowed and adapted many improvements in their shipping from Indians.² Dharampal's work also clearly shows that a great deal of interest was shown by scientists in England, in the 18th century, in finding out information on Indian achievements in science and technology—from all contemporary accounts; viz. astronomy, observatories, mathematics, inoculation against smallpox, agriculture, use of drill ploughs, processes of making iron and steel.³ Further, Zaheer Baber, gives finer details on the world class quality of Indian steel ('Wootz') and metallurgy, from which Damascus swords were made, the fifteenth century canons manufactured (as noted by the historian Irfan Habib), and rockets were constructed as early as 1398, by Marathas, and later by the armies of Haidar Ali and Tipu Sutan. Much of the technology of the British 'Congreve rockets' was based on Tipu Sultan's rockets captured by them.⁴

B.M. Udgaonkar recognizes that "China and India could not have become such great civilizations without a fair amount of science and technology—and that science is as much a part of Indian heritage as the greatly extolled mystical tradition".⁵ Udgaonkar goes on to argue that his task was made very difficult in the absence of a "comprehensive work on the history of Indian science."⁶ Absence of history of Indian science was also mentioned by Professor Dhruv Raina from the Zakir Husain Centre for Educational Studies, School of Social Sciences, JNU, in his keynote.⁷ However, some idea can be obtained from other secondary sources, which this article has attempted to elaborate in the following pages.

So the burning question at hand is that in spite of India's rich scientific heritage, what transpired to cause an almost complete lack of a broad based scientific thinking in the later periods of 15th to 17th centuries in India—a period which incidentally, coincided with the flowering of scientific thinking in Europe, and can be used here for comparative purposes. The Sinologist Joseph Needham has some answers.

Needham's Explanation

Joseph Needham had studied a similar problem on scientific thinking in China. Needham, basing his judgment, on his seminal, multi-volume work on China,⁸ in a foreword, in a book by Debiprasad Chattopadhyaya, *History of Science and Technology in Ancient India: The Beginnings*, wonders as to "why in spite of so many wonderful discoveries and inventions during sixteenth or seventeenth centuries before the Scientific Revolution did modern science not develop in China but only in Europe?" He then explains that,

The answer can only be stated in social and economic terms. Only when we know that China was characterized by bureaucratic feudalism, while Europe had military-aristocratic feudalism, seemingly stronger but in fact much weaker, and so exposed to overthrow when the time came for the rise of the bourgeoisie; then only can one begin to see why modern science, along with capitalism and the Reformation, originated in Europe and Europe alone.⁹

Although Needham had not researched on India in a detailed manner, he had a working knowledge in comparative perspective, which can be gathered from his introduction to the work by Debiprasad Chattopadhyaya. In the foreword, Needham brings out a number of themes on which Debiprasad Chattopadhyaya had written about, like the struggle with religious scruples and reason for being one. Needham introduces upfront to the reader the absence of materialistic and practical thinking which led to the neglect of science:

Debiprasad Chattopadhyaya made his name in the world of learning some thirty years ago, with his book “Lokayata” in which he showed how much theoretical materialism there had been in ancient India, and how it had been systematically obscured and vilified by the theologians of all Indian religions. He has never ceased to uphold the banner of the naturalists of India, and some twenty years later, in his book on “Science and Society” he showed in detail how the medical men had to struggle against religious theorists. The former were searching for the naturalistic cause of disease – a point of view entirely justified by modern medical science—but the theologians always wanted to attribute disease to the bad *karma* incurred in previous existence.¹⁰

In India’s case, Needham argued, “apart from wars and colonialism, some concrete social and economic factors will in the end account for the fact that, in spite of wonderful past achievements, modern science did not originate there either.”¹¹ Later, in 1971 Needham wrote in an essay: “the failure of China and India to give rise to distinctively modern science *while being ahead of Europe for fourteen previous centuries* is going to take some explaining.”¹²

Roddam Narasimha further qualified the quote by Needham with this important observation: “But there is the other side of this Needham question: whether, and if so why, China and India were ahead for fourteen previous centuries. If the Needham clause is true, (as I believe it is) the trajectory of science has certainly not been linear.”¹³ So another puzzle that has been inserted to this question is why China and India led for such a long time. May be other civilisations and societies caught up late but surely they could not have overtaken. The priority here then becomes: ‘to see the state of science in the last few centuries’.

Needham has not listed any of the social and economic factors. It was nearly half a century ago that he made this observation. In fact, no one has provided a satisfactory and comprehensive answer. Udgaonkar, however is one of the few scientists, who has made at least a list of factors but without reaching any firm conclusion or suggestions for more research, inquiry and ‘a fresh look’ on the subject which lies between decay and stagnation. Some of the contributory factors towards answering the question of why India lagged behind in recent centuries, was listed as being: other-worldliness of Indian culture, influence of Buddhism, impact of Sufism and *Bhakti-Marg*, rigidity of the caste system, belief that all knowledge is in the Vedas, suppression of scientific spirit for political reasons, conflict between science and religion, tendency to accommodate conflicting opposites, ban on foreign travel, complacency when India attained a high level of colonization (as noted by Fa Hien, AD 400 and later Alberuni) including in Akbar’s time, oral tradition, effect of invasion, etc. Without allowing either Hindu or Muslim chauvinism to distort the view of the happenings, other contributory factors were inability of the education system to change with the times, non-emergence of the culture of R&D to improve old technologies and master new technologies, lack of interest in printing and other inventions seen with Europeans, and too big a load from the past, where he ponders:

Was the continuity in Indian civilization a handicap? Europe lost its Graeco-Roman knowledge and tradition in the dark ages, and then recovered these a thousand years later through the Arabs, along with the knowledge, which the Arabs brought from India. When this happened, the Europeans had a chance to have a fresh critical look at the old heritage. Such a critical look started already in the 13th-14th centuries with the scholastics, and was an important factor leading to Renaissance. Was the absence of discontinuity a disadvantage for the Chinese and the Indians?¹⁴

The questions so posed need to be further examined by scholars. One monolithic view is unlikely to emerge, but the research itself demands that the researcher has an open mind.

Current Views of Some Indian Scientists

M.G.K. Menon, a former scientific advisor to the Indian prime minister argues that, in the period from 12th to 18th century, over 10,000 books (manuscripts) were written in India on science and technology. Then he wonders what happened to this tempo thereafter? One key sociological explanation, he hypothesizes is the same as that Prafulla Chandra Ray had cited, that it was the “dominance of fundamentalism leading to development in society that did not encourage free thinking and enterprise.”¹⁵

The importance of mass education is now well known. No society can progress without it. One explanation for decay and stagnation may be the absence of mass education. The nationalist, Indologist, A.S. Altekar, in '*Education in Ancient India*' gives the date as AD 800 when primary education was restricted to only the higher strata of society and the majority of the artisan class became illiterate and knew "only the traditional processes of their profession."¹⁶

In the period 15th to 17th century, scientific thinking advanced rapidly leading to the age of reason, and industrial revolution in Europe. B.V. Subbarayappa tries to answer the 'intriguing question' as to why 'a scientific renaissance', a new way of looking at Nature, a new methodology of experimentation, observation and inference, that occurred in Europe between the fifteenth and seventeenth centuries, did not happen in India, too, despite the history of just such a strong scientific tradition. He agrees that the question is a difficult one, with no precise answers.' He further argues:

The caste-ridden social organization, or the political upheavals from time to time, or the absence of the medieval universities of the type that came up in Europe, or the emphasis on preceptor-disciple relationship, or the importance given to spiritual pursuits and the life-sustaining values as well as a general mind-set towards being in *harmony* with nature in contradistinction to the *exploitation* of nature—all of these would have led India to choose or prefer the already determined pathways of traditional scientific thinking.¹⁷

Of the many reasons that led to a stagnation of the scientific way of thinking, the main are the social factors. Let us debate the matter with examples from the 20th century.

The Struggle of Prafulla Chandra Ray and Meghnad Saha

Illustrating the work of the makers of modern science in India, Chattopadhyaya mentions Prafulla Chandra Ray (1861-1944) or P.C. Ray. It is clarified that "Ray was furthest from any communal understanding of the word "Hindu" and his book *History of Hindu Chemistry* never had a communal angle."¹⁸ Chattopadhyaya then further goes on to explain how Ray addresses two central or key questions. The first was- "what it was that infused real vitality to the scientific activities in ancient India." The second-, "what it was that inhibited their growth and eventual decline."¹⁹ For the first question in a lecture delivered in 1918, PC Ray argued, "Experiments and observations constitute the fundamental bases of Sciences." He gave examples of work on chemistry and an emphasis on the methodology of science in ancient times:

Rasendra-Chintamani by Ramacandra and *Rasa-Prakash-Sudhakara* by Yasodhara, both of the 13th and 14th century A.D.... The former says: ‘That which I have heard of learned men and have read in the Shastras but have not been able to verify by experiment I have discarded. On the other hand those operations which I have according to the directions of my sage teachers, been able to perform with my own hands – those alone I am committing to writing.... Yashodhara, the author of the latter observes: ‘All the chemical operations described in my book have been performed with my own hands – I am not writing from mere hearsay. Everything related is based upon my own conviction and observations’²⁰

To address the question on what it was that inhibited the growth and eventual decline of this scientific discipline, Chattopadhyaya agrees with P.C. Ray’s hypothesis, viz., “The main cause of the decline of the scientific spirit in India was the entrenchment of the caste society, with its disastrous degradation of the social status of the technicians, craftsmen and other menial workers”. This P.C. Ray felt, took place “when the Brahmins reasserted their supremacy on the decline and expulsion of Buddhism.”²¹ To complete this debate Chattopadhyaya also challenged the notion that “Indian sages had discovered the secret of some mysterious supra-scientific knowledge”. He takes on S Radhkrishana, who “for example, goes to the extent of regretting the modern fascination for science and rationalism.”²²

In more recent times, the scientist cum Sanskrit scholar, Roddam Narasimha argues that: “P.C. Ray blamed ‘*advaitic*’ philosophy and the concept of ‘*maya*’, as also the caste system, for lack of scientific progress in India.”²³ There is however, much truth in this complex variable.

Another modern Indian scientist who also challenged the old orthodox ways was none other than P.C. Ray’s student, the scientist Meghnad Saha. Chattopadhyaya clearly demonstrates how Saha in his writings had blamed the caste system that was the root cause, which had “completely snapped the connection between the hand and the brain and that is why the material culture of India is lagging far behind that of Europe and America”²⁴ But, Saha’s biggest contribution was to challenge religious orthodoxy and caste doctrines. Saha, as a result had to:

...confront literally, a barrage of attacks from the champions of Vedic orthodoxy. He was accused of showing only slavish mentality in defending modern science flourishing in Europe, over-looking the fact that everything worthwhile in modern science is already to be found in Veda-centric culture of ancient India, which in many ways was alleged to have been far ahead of

modern “European” science since for example, in developing the caste system which was supposed to impart a kind of stability to society and hence enabled the Indians to evade the social turmoil of capitalist Europe. Saha had to waste much of his valuable time to clean up such rubbish.²⁵

All Knowledge is in the Vedas?

There is another strand in the debate on scientific thinking as well as the Vedas, akin to what Meghnad Saha had to confront. To the question of the reason for India lagging behind in science and technology in recent centuries, B.M. Udgaonkar had suggested one answer: the incorrect claim that refers to “all that is called knowledge is the Vedas”. Udgaonkar suggests, “It will be useful to know how old are these kind of beliefs in our culture/philosophical history. When and how did they get ascendancy? Such beliefs, if widely held, could lead to stagnation and then a decline in science, and could therefore be an important factor, inhibiting the growth of modern science in India. Such an attitude could also have inhibited the healthy development of philosophy”²⁶ It may be that this idea of all knowledge in the Vedas may have roots in a philosophical and a literary device found in the Mahabharata (which is also based on ‘Upanishadic’ and ‘Vedantic’ teachings). It is the famous statement of The Mahabharata as highlighted by S. Radhakrishnan: “what is here is elsewhere; what is not here is nowhere”.²⁷

From the encounters of P.C. Ray and Megnad Saha, just discussed, it seems that this type of thinking has emerged prominently, in the writings in the past few centuries. What follows in continuity is examined next.

Some Similar Debates of 21st Century

In the last century, Ray and Saha may have been the lone-warriors of the Indian scientific community, and there is a serious need to heed what scientists are now saying today. Nobel laureate, Venkataraman Ramkrishnan, in his lecture had stressed the need to become more rational and less superstitious.²⁸ Roddam Narasimha, from the Jawaharlal Nehru Centre for Advanced Scientific Research, in a guest editorial in *Current Science*, a flagship journal of the Indian Academy of Science, argues “It is high time we learn, once again, to distinguish science from mythology (both can be fun, but they are best when not mixed); evidence-based reasoning, from unthinking acceptance of authority or speculation, and the rational from the superstitious.”²⁹ Mayank Vahia from the Tata Institute of Fundamental Research builds up on Narasimha’s editorial to argue, “It is not that Indian achievements were not significant for their own period”. He gives the example of the work of Aryabhata, the Kerala School of Mathematics, secular

approach of a large fraction of literature in Sanskrit with its intricate arguments on the working of the world, exacting architecture from the Harappan towns to the Taj Mahal and rockets of Tipu Sultan. “Even the ‘*Sulba Sutra*’ possibly predates Pythagoras: there is no doubt that Indians already knew of the Pythagoras theorem before the Greeks learnt about it. But when such an assertion is also mixed with claims of invention of *vimanas* that could undertake interplanetary journey, both the earlier claims get discredited.”³⁰ Integrity and credibility of scientific work is a necessary condition. Jayant V. Narlikar an astrophysicist warns on the weak foundation of over-exaggeration of science in the Vedic era. “In our enthusiasm for our heritage (thermonuclear reaction in the sun as an example) we sometimes end up making statements that dilute our credibility”.³¹

Reality

Military capacity and capability is also a good indicator of science, its advancements and its follow-up, through design and technology. Let us set aside the debates and see the naked reality in one military test case. Let us begin with our ancient past. The historian, Jagadish Narayan Sarkar argues that one marked military weakness of Hindu power was that, early medieval India (11-13th centuries) was practically stagnant in the use of offensive and defensive weapons, which continued to be used in the same way as was used in the age of Vedas and the epics, early Smritis and the Guptas. In other words no new inventions were made; and bows and arrows, spears, maces, battle axes, noose, discs, etc., continued to be used as in the past.³²

Today India is the top importer of high-end defence equipment. This issue of possessing inferior weapons, equipment, and a lack of contemporary technology has left a deep impression on the military leadership. For example, in the debate of military defeats, a book on leadership published by the Army Training Command is making a very wide sweep. In this book, they seem to be the least interested in a glorious and now lost technological tradition. In a chapter on higher leadership, in the *longue durée* view, this book argues that from Alexander’s victory in 326 BCE till the Sino-India border war in 1962, one factor was constant: “constantly lagging behind in the weapons and equipment of contemporary technology.”³³ Surely no erudite scholarship can get rid of this impression. One needs to be truthful and accurate in measuring and recording reality. It needs to be admitted squarely that India needs to catch up.

As to the challenge and shame of the caste system today, Anaya Vajpeyi, a fellow at the Centre for the Study of Developing Societies, New Delhi, recalling her lecture tours to Canada said, “Sanskrit professors at leading universities were making absurd claims, for example, that caste is unrelated to birth; that

Hindu society is inherently gender blind; or that if the term “varna” does not occur, there is no discrimination.”³⁴ Theoretically, *The Sukraniti Sutras 75-76* say: “Not by birth are the Brahmana, Ksatriya, Vaisya, Sudra and Mlechchha separated, but by virtues and works.”³⁵ But the naked reality in actuality is still very different. This is one issue, which cannot be brushed aside just because it is given in an important text, though the bright side is to see its normative view – a job yet unfinished.

Conclusion

It is clear that it is not possible to conclude what led to scientific stagnation in India in spite of an illustrious past with a lot of scientific discovery and traditions. There are many factors and reasons, as we can see. Even if a history of science were ever to be written for India, it would not be easy to select the methodology that would be needed to adopt. There is a total absence of political history from which social and scientific matters can be extracted. This also is a great intellectual challenge. What is continuity and what is change? All practices of the past need not be glorified, yet those that are relevant, need to be revived and reused. Satischandra Chatterjee and Dhirendramohan Datta have an important philosophical view:

If the openness of mind – the willingness to listen to what others have to say – has been one chief cause of the wealth and greatness of Indian philosophy in the past, it has a definitive moral for the future. If Indian philosophy is once more to revive and continue its great career, it can do so only by taking into consideration the new ideas of life and reality, which has been flowing into India from the West and the East, from Aryan, the Semitic, the Mongolian and other sources.³⁶

If the statements made by the elected political leaders and some constitutional leaders are analyzed, many claims are not based on any research or scientific enquiry but are mere opinions. With this sort of public utterances what is of real value does not get due attention as these are monologues and not healthy dialogues. Fiction gets mixed up with facts. Our reputed scientists at a national and international level, as we saw, have told us what is wrong with making false and unimaginable claims of our past. The astrophysicist, Jayant V. Narlikar makes an important observation on this lack of scientific temper. He warns against “pseudoscience that grows around superstition”. Claims of super weapons need to be explained with technical details like mathematical principles of flight, knowledge of nuclear physics and so on. He also questioned why there was no mention of the forces of electricity and magnetism, “knowledge of which would be necessary for understanding nuclear physics.”³⁷

Even the ancient “Kautilya” of the 4th century BCE, warns us to be wary of superstitions and religious rituals. In Book 9 (the activity of the King about to march) of Kautilya’s *Arthashastra* (9.4.26) there is a good deal of scientific temper: “The object slips away from the foolish person, who continuously consults the stars; for an object is the (auspicious) constellation for (achieving) an object; what will the star do?”

But, it is clear that this enquiry needs to be taken forward and all relevant past must be researched and the unsuitable or unscientific matters need to be systematically discarded. This is an intellectual problem, that needs much debate and deliberation (*vichara* or *tadvidyasambhasha* – friendly discussions of the cooperative variety) or *sandhyaya sambhasa* and not the aggressive and hostile known as ‘*vigraha*’. India has had a sophisticated tradition of debates and discussions in the past. Rather, I would put it as: “the Indian philosophical schools have attained their current richness and fullness only because of the criticism and opposition that they have faced.”³⁸ It is in this spirit that this desideratum-necessary prerequisite needs to be addressed.

Notes

1. Michel Danino, *Cultural Specificities in the History of Indian Science*, New Delhi: India International Centre, Occasional Publication 34, n.d, p.1.
2. B.M. Udgaonkar, “Why Did Early India Science Not Fulfill Its Promise?”, in Lalit K. Kothari and Ramesh K. Kothari (eds.), *Vision and Values – Science, Defence, Education, Ethics: Essays in Honour of Dr D.S. Kothari on His Birth Centenary*, New Delhi, 2007, p. 63.
3. For a five volume collected writings of Dharampal see *Essays on Tradition, Recovery and Freedom*, Aditya Prakashan paperback edition, 2007. Originally published by Other India Press and now available on the internet.
4. Zaheer Baber, *The Science of Empire: Scientific Knowledge, Civilization, and Colonial Rule in India*, Delhi: Oxford University Press, 1998, p. 64, p. 66, p. 68.
5. B.M. Udgaonkar, “Why Did Early India Science Not Fulfill Its Promise?”, note 2, p.60. The work on the heritage part quoted is D.M. Bose, S.N. Sen and B.V. Subbarayappa (eds.), *A Concise History of Science in India*, New Delhi: Indian National Science Academy, 1971.
6. Udgaonkar, n. 2, p. 67.
7. Dhruv Raina, Keynote Address, “Current Trends in the History of Science in India and China: The Relevance of the Needham Question”, *Juxtapose 2014*, Comparative Research, Creative Collaboration, Methodological Challenges in Contemporary China and India, Jawaharlal Nehru University, New Delhi, 25 September 2014 (unpublished).
8. Joseph Needham, *Science and Civilization in China* in five volumes and *The Grand Titration: Science and Society in East and West*, (First pub. 1969), 2nd impression, London: George Allen & Unwin Ltd., 1969.
9. Joseph Needham, “Foreword”, in Debiprasad Chattopadhyaya, *History of Science and Technology in Ancient India: The Beginnings*, Calcutta, Firma KLM Pvt. Ltd., 1986, pp. v-vi.

10. *Ibid.*, p. v.
11. *Ibid.*, p. vi.
12. As quoted (with his italics), by Roddam Narasimha, "The Chequered Histories of Epistemology and Science", Jawaharlal Nehru Centre for Advanced Scientific Research and National Institute of Advanced Studies, Bangalore, p. 2.
13. *Ibid.*
14. Udgaonkar, n. 2, p. 87.
15. M.G. K. Menon, "Science in India: Past and Present: A Sociological Perspective", in B.V. Subbarayappa (ed.), *Science in India: Past and Present*, Mumbai, Popular Prakashan Pvt Ltd/Nehru Centre, 2007, p. 5.
16. Udgaonkar, n. 2, p. 74.
17. B.V. Subbarayappa, "Pioneers of Science and Nationalism in India", in B.V. Subbarayappa (ed.), *Science in India: Past and Present*, Mumbai, Popular Prakashan Pvt. Ltd. / Nehru Centre, 2007, pp. 285-286.
18. Debiprasad Chattopadhyaya, 'Introduction', in Debiprasad Chattopadhyaya, *History of Science and Technology in Ancient India: The Beginnings*, Calcutta: Firma KLM Pvt. Ltd., 1986, p. 6.
19. *Ibid.*, p. 7.
20. *Ibid.*, p. 8
21. *Ibid.*, p. 9.
22. *Ibid.*, p. 46.
23. Roddam Narasimha, 'The Chequered Histories of Epistemology and Science', n.d, p. 4.
24. Chattopadhyaya, n. 18, p. 132.
25. *Ibid.*, pp. 17-18. Quotes omitted from reference quoted above.
26. Udgaonkar, n. 2, pp. 74-75. A brief snapshot of some of these issues was included as an Appendix B - 'All Knowledge of Science and Technology is in the Vedas?' in P.K. Gautam, "One Year of *Arthashastra*: Response, Pedagogy and Research" in Pradeep Kumar Gautam, Saurabh Mishra and Arvind Gupta (eds.), *Indigenous Historical Knowledge: Kautilya and His Vocabulary*, Volumes II, 2015, pp.124-125.
27. *Ibid.*
28. R. Krishan Kumar, "India needs to become more rational and less superstitious: Nobel laureate", *The Hindu*, 12 December 2015.
29. Roddam Narasimha, "The "historic" storm at the Mumbai Science Congress", Guest Editorial, *Current Science*, Vol. 108, No. 4, 25 February 2015, pp. 471-472.
30. Mayank Vahia, "Evaluating the claims of ancient Indian achievements in science", *Current Science*, Vol. Even 108, No. 12, 25 June 2015, pp. 2145-2148.
31. Jayant V. Narlikar, "Where's science in the bombast?", *The Asian Age*, 11 March 2015.
32. Jagadish Narayan Sarkar, *The Art of War in Medieval India*, Munshiram Manoharlal Publishers, New Delhi, 1984, p.111.
33. Army Training Command, *Leadership*, Revised edition, Shimla, 2004, pp. 195-196.
34. Anaya Vajpeyi, "How to move a mountain", *The Hindu*, 14 August 2018.
35. *The Sukraniti* by Benoy Kumar Sarkar, First published in 1914, New Delhi, Oriental Books Reprint Corporation, second edition 1973, distributed by Munshiram Manohar Lal publishers, New Delhi, p. 8.
36. Satischandra Chatterjee and Dhirendramohan Datta, *An Introduction to Indian Philosophy*, New Delhi: Rupa, 2015, p. 5.

37. Jayant V. Narlikar, “Science should have the last word”, *The Hindu*, 17 February 2018.
38. T.R.V. Murti, “Rise of the Philosophical Schools”, in Haridas Bhattacharya (ed.), *The Philosophies: The Cultural Heritage of India*, Volume III, Ramakrishna Mission, Belur Math, 2013, p. 33.