



The Contribution Of Ancient Indians To The World Of Science And Technology

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Abstract:

This research paper explores the remarkable scientific contributions made by ancient Indians, spanning a period of several millennia. From the earliest Vedic period to the Gupta Empire, Indian civilization demonstrated remarkable advancements in diverse fields of science, including mathematics, astronomy, medicine, and metallurgy. This paper highlights the key achievements of ancient Indian scientists, the enduring impact of their work, and the rich intellectual heritage they left for future generations. Our nation's rich heritage encompasses a wealth of ancient scientific knowledge that has majorly shaped the world. From astronomy and mathematics to medicine and metallurgy, scientists who lived ages ago, made ground breaking discoveries and devised remarkable theories. Their wisdom and insights continue to inspire and influence our understanding of the world.

Key Words

Ancient India, Scientific contributions, Mathematics, Astronomy, Medicine, Metallurgy, Indian philosophy, Scientific method, Aryabhata, Ayurveda, Sushruta, Vedic period, Indian mathematicians, Ancient Indian scientists, Decimal numbering system, Heliocentric model, Zero (shunya), Wootz steel, Indian metallurgy, Non-European roots of science, History of Indian science, Pramana, Sanskrit texts, Indian philosophy and science, Influence on modern science.

Introduction:

Indian civilization is one of the oldest civilizations in the world and has a strong tradition of science and technology. Our culture has a long history of producing brilliant minds, from ancient seers and philosophers to modern scientists. Research shows that India made important contributions to science and technology hundreds of years before modern laboratories were built. Numerous ideas and methods developed by ancient Indians have helped build and strengthen the foundations of modern science and technology. Many of the advances in the sciences that we consider today to have been made in Europe were made in India centuries ago.

The history of science is replete with the achievements of ancient Indian scientists who made significant contributions to the world's scientific knowledge. While much of this knowledge was developed within the context of ancient Indian philosophy and culture, it has had a lasting influence on both the Eastern and Western scientific traditions.

Mathematics:

Ancient Indians made pioneering contributions to the field of mathematics. The concept of zero (shunya) was introduced in India around the 5th century CE, and it revolutionized mathematics. Aryabhata's "Aryabhatiya" (499 CE) laid the foundation for algebra and trigonometry, while the "Sulba Sutras" contained geometric principles, including the famous Pythagorean theorem. Additionally, the decimal numbering system, which is used worldwide today, was developed in India.

Value of Pi and Negative Numbers

The value of pi was first calculated by Indian mathematician Baudhayan which is useful in calculating the area and circumference of a circle. Also the theorem which is known as Pythagoras theorem today can be found in Baudhayan's Sulva Sutra, which was published several years before the age of Pythagoras. Brahmagupta pioneered the use of negative integers and operation of zero as a number in mathematics. He worked a lot with geometry and trigonometry and found new theorems. He also showed how to find cubes, cube roots, squares, and square roots. He wrote 'Brahm Sputa Siddantika,' which introduced the Arabs to our mathematical theory.

Chemistry in Ancient India

Ayurveda, which utilised a variety of minerals in ancient India, played a vital influence in the development of chemistry. In ancient and mediaeval India, science and technology encompassed all major areas of human knowledge and activity. In any early culture, metallurgy has remained a central activity to all subsequent civilizations, from the Bronze Age to the Iron Age. India has proficiency in metallurgy since ancient times. The level of expertise that India possessed in the field of metallurgy was of the highest order.

Astronomy:

Astronomy was a subject of immense interest in ancient India. Indian astronomers made substantial contributions, including the accurate calculation of planetary orbits, the concept of the heliocentric model, and the measurement of the Earth's circumference. Aryabhata's "Aryabhatiya" and Brahmagupta's "Brahmasphutasiddhanta" are notable works in this field.

Medicine:

The ancient Indian medical system, Ayurveda, dates back to the Vedic period. It encompasses a wide range of medical knowledge, including anatomy, surgery, and herbal medicine. Sushruta, often regarded as the "Father of Surgery," authored the "Sushruta Samhita," which detailed surgical techniques that were highly advanced for its time. Charaka's "Charaka Samhita" provided comprehensive insights into internal medicine.

Philosophy and Scientific Method:

Ancient Indian philosophy was closely intertwined with scientific thought. The concept of "Pramana" (valid means of knowledge) was developed in Indian philosophy, providing a basis for scientific inquiry. The process of observation (Anumana) and inference (Upamana) were instrumental in advancing scientific understanding.

Fibonacci Numbers & Binary Numbers

The Fibonacci numbers and their sequence first appear in Indian mathematics as mātrāmeru, mentioned by Pingala in connection with the Sanskrit tradition of prosody. Later on, the methods for the formation of these numbers were given by mathematicians Virahanka, Gopala and Hemacandra, much before the Italian mathematician Fibonacci introduced the fascinating sequence to Western European mathematics. Binary numbers are the basic language in which computer programs are written. Binary basically refers to a

set of two numbers, 1 and 0, the combinations of which are called bits and bytes. The binary number system was first described by the Vedic scholar Pingala, in his book Chandahśāstra, which is the earliest known Sanskrit treatise on prosody (the study of poetic metres and verse)

A Theory of Atom

One of the notable scientists of the ancient India was Kanad who is said to have devised the atomic theory centuries before John Dalton was born. He speculated the existence of anu or small indestructible particles, much like an atom. He also stated that any can have two states absolute rest and a state of motion. He further held that atoms of same substance combined with each other in a specific and synchronized manner to produce dvyanuka (diatomic molecules) and tryanuka (triatomic molecules).

The Heliocentric Theory

Mathematicians of ancient India often applied their mathematical knowledge to make accurate astronomical predictions. The most significant among them was Aryabhatta whose book, Aryabhatiya, represented the pinnacle of astronomical knowledge at the time. He correctly propounded that the Earth is round, rotates on its own axis and revolves around the Sun i.e. the heliocentric theory. He also made predictions about the solar and lunar eclipses, duration of the day as well as the distance between the Earth and the Moon.

Plastic Surgery

Written by Sushruta in 6th Century BC, Sushruta Samhita is considered to be one of the most comprehensive textbooks on ancient surgery. The text mentions various illnesses, plants, preparations and cures along with complex techniques of plastic surgery. The Sushruta Samhita 's most well-known contribution to plastic surgery is the reconstruction of the nose, known also as rhinoplasty.

Ayurveda

Long before the birth of Hippocrates, Charaka authored a foundational text, Charakasamhita, on the ancient science of Ayurveda. Referred to as the Father of Indian Medicine, Charaka was the first physician to present the concept of digestion, metabolism and immunity in his book. Charaka's ancient manual on preventive medicine remained a standard work on the subject for two millennia and was translated into many foreign languages, including Arabic and Latin.

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Chakravala method of Algorithms

The chakravala method is a cyclic algorithm to solve indeterminate quadratic equations, including the Pell's equation. This method for obtaining integer solutions was developed by Brahmagupta, one of the well-known mathematicians of the 7th century CE. Another mathematician, Jayadeva later generalized this method for a wider range of equations, which was further refined by Bhāskara II in his Bijaganita treatise.

Cataract Surgery

The first cataract surgery is said to have been performed by the ancient Indian physician Sushruta, way back in 6th century BCE. To remove the cataract from the eyes, he used a curved needle, Jabamukhi Salaka, to loosen the lens and push the cataract out of the field of vision. The eye would then be bandaged for a few days till it healed completely. Sushruta's surgical works were later translated to Arabic language and through the Arabs, his works were introduced to the West.

Astronomy

One would expect that the development of early Indian mathematics and astronomy went through several phases but we don't have sufficient data to reconstruct these phases. Certain astronomy has been inferred from the Vedic books, but there existed additional sources which have not survived. For example, there were early astronomical siddhantas of which we know now only from late commentaries written during the Gupta period (320-600); this period provided a long period of stability and prosperity that saw a great flowering of art, literature, and the sciences. Of the eighteen early siddhantas the summaries of only five are available now. Perhaps one reason that the earlier texts were lost is because their theories were superseded by the more accurate later works. In addition to these siddhantas, practical manuals, astronomical tables, description of instruments, and other miscellaneous writings have also come down to us. The Puranas also have some material on astronomy.

Concepts of space, time, and matter

Yoga-Vasishtha (YV) is an ancient Indian text, over 29,000 verses long, traditionally attributed to Valmiki, author of the epic Ramayana which is over two thousand years old. But the internal evidence of the text indicates that it was authored or compiled later. It has been dated variously as early as the sixth century AD or as late as the 13th or the 14th century dated it about the sixth century AD on the basis that one of its verses appears to be copied from one of Kalidasa's plays considering Kalidasa to have lived around the fifth century.

YV may be viewed as a book of philosophy or as a philosophical novel. It describes the instruction given by Vasishtha to Rama, the hero of the epic Ramayana. Its premise may be termed radical idealism and it is couched in a fashion that has many parallels with the notion of a participatory universe argued by modern philosophers. It's most interesting passages from the scientific point of view relate to the description of the nature of space, time, matter, and consciousness. It should be emphasized that the YV ideas do not stand in isolation. Similar ideas are to be found in the Vedic texts. At its deepest level the Vedic conception is to view reality in a monist manner; at the next level one may speak of the dichotomy of mind and matter. Ideas similar to those found in YV are also encountered in Puranas and Tantric literature.

Yoga

The science of Yoga was developed in ancient India as an allied science of Ayurveda for healing without medicine at the physical and mental level. The term Yoga has been derived from the Sanskrit work Yoktra. Its literal meaning is "yoking the mind to the inner self after detaching it from the outer subjects of senses". Like all other sciences, it has its roots in the Vedas. It defines chitta i.e. dissolving thoughts, emotions and desires of a person's consciousness and achieving a state of equilibrium. It sets in to motion the force that purifies and uplifts the consciousness to divine realization. Yoga is physical as well as mental. Physical yoga is called Hathyoga. Generally, it aims at removing a disease and restoring healthy condition to the body. Rajayoga is mental yoga. Its goal is self-realization and liberation from bondage by achieving physical mental, emotional and spiritual balance. Yoga was passed on by word of mouth from one sage to another. The credit of systematically presenting this great science goes to Patanjali. In the Yoga Sutras of Patanjali, Aum is spoken of as the symbol of God. He refers to Aum as a cosmic sound, continuously flowing through the ether,

fully known only to the illuminated. Besides Yoga Sutras, Patanjali also wrote a work on medicine and worked on Panini's grammar known as Mahabhasaya.

Cosmology

We have seen how the logical apparatus that was brought to bear on the outer world was applied to the analysis of the mind. But the question remains: How does inanimate matter come to have awareness? This metaphysical question was answered by postulating entities for smell, taste, form, touch, and sound. In the Sankhya system, a total of twenty-four such categories are assumed. These categories are supposed to emerge at the end of a long chain of evolution and they may be considered to be material. The breath of life into the instruments of sight, touch, and hearing and so on is provided by the twenty fifth category, which is purusha, the soul. The recursive Vedic world-view requires that the universe itself go through cycles of creation and destruction. This view became a part of the astronomical framework and ultimately very long cycles of billions of years were assumed. The Sankhya evolution takes the life forms to evolve into an increasingly complex system until the end of the cycle. The categories of Sankhya operate at the level of the individual as well. Life mirrors the entire creation cycle and cognition mirrors a life-history. Surprisingly similar are the modern slogan: ontogeny is phylogeny, and microgeny (the cognitive process) is a speeded-up ontogeny.

Grammar

Panini's grammar (6th century B.C.E. or earlier) provides 4,000 rules that describe the Sanskrit of his day completely. This grammar is acknowledged to be one of the greatest intellectual achievements of all time. The great variety of language mirrors, in many ways, the complexity of nature. What is remarkable is that Panini set out to describe the entire grammar in terms of a finite number of rules. Frits Staal has shown that the grammar of Panini represents a universal grammatical and computing system. From this perspective it anticipates the logical framework of modern computers.

Vedic cognitive science

The Rigveda speaks of cosmic order. It is assumed that there exist equivalences of various kinds between the outer and the inner worlds. It is these connections that make it possible for our minds to comprehend the universe. It is noteworthy that the analytical methods are used both in the examination of the outer world as well as the inner world. This allowed the Vedic rishis to place in sharp focus paradoxical aspects of analytical knowledge. Such paradoxes have become only too familiar to the contemporary scientist in all branches of inquiry. In the Vedic view, the complementary nature of the mind and the outer world is of fundamental significance. Knowledge is classified in two ways: the lower or dual; and the higher or unified. What this means is that knowledge is superficially dual and paradoxical but at a deeper level it has a unity. The Vedic view claims that the material and the conscious are aspects of the same transcendental reality. The idea of complementarity was at the basis of the systematization of Indian philosophic traditions as well, so that complementary approaches were paired together. We have the groups of: logic (nyaya) and physics (vaisheshika), cosmology (sankhya) and psychology (yoga), and language (mimamsa) and reality (vedanta). Although these philosophical schools were formalized in the post-Vedic age, we find an echo of these ideas in the Vedic texts. In the Rigveda there is reference to the yoking of the horses to the chariot of Indra, Ashvins, or Agni; and we are told elsewhere that these gods represent the essential mind. The same metaphor of the chariot for a person is encountered in Katha Upanishad and the Bhagavad Gita; this chariot is pulled in different directions by the horses, representing senses, which are yoked to it. The mind is the driver who holds the reins to these horses; but next to the mind sits the true observer, the self, who represents a universal unity. Without this self no coherent behaviour is possible.

Conclusion:

The scientific contributions of ancient Indians have left an indelible mark on the world's scientific heritage. Their innovations, particularly in mathematics, astronomy, medicine, and metallurgy, have transcended time and continue to influence modern scientific thought. The rigorous philosophical foundations of Indian thought and the scientific method introduced by ancient Indian scholars have enriched the global pursuit of knowledge. Recognizing and celebrating these contributions are not only a testament to the brilliance of ancient Indian civilization but also a reminder of the importance of acknowledging and preserving scientific heritage worldwide.

Reference:

1. AK Mandal, Origin of laws of motion (Newton's Law): An Introspective Study, American Journal of Engineering Research Vol.9, Issue 7, Pg 87-92.
2. AK Mandal, Physics in Ancient India: An Introspective Study, American Journal of Engineering Research Vol.9, Issue 9, Pg 1-6.
3. Ancient science.pdf, module VI, scientist of ancient India Ch-15.
4. Barrow, J. 1992. Pi in the Sky. Oxford: Oxford University Press.
5. Bhattacharyya, Dhruvakumar. "History of Metallurgy in India." Indian Institute of Advanced Study, 1991.
6. Chapple, C. 1984. Introduction and bibliography in Venkatesananda (1984).
7. Chavvi Purwar, Significant contribution of chemistry in ancient Indian science and technology, International Journal of Development Research Vol. 06, Issue, 12, pp.10784-10788.
8. Chopra, Ananda S. "Sushruta Samhita: An English Translation Based on Original Texts." Munshiram Manoharlal Publishers, 2001.
9. Dasgupta, S. 1975 (1932). A History of Indian Philosophy. Delhi: Motilal Banarsidass.
10. Dasgupta, Surendranath. "A History of Indian Philosophy." Vol. 1. Motilal Banarsidass, 1992.
11. Deshpande, P. B. "Ayurveda: A Historical Perspective." Bulletin of the Indian Institute of History of Medicine 27, no. 2 (1997): 109-118.
12. Filliozat, J. 1970. The expansion of Indian medicine abroad. In Lokesh Chandra (ed.)
13. Frawley, David. "The Yoga of the Bhagavad Gita." Lotus Press, 2014.
14. <https://pparihar.com/2017/05/22/modern-inventions-stolen-from-the-vedas/>
15. <https://subhashkak.medium.com/ka%E1%B9%87%C4%81da-the-great-physicist-and-sage-of-antiquity-5a2abd79b6f1>
16. <https://www.amarujala.com/spirituality/religion/hanuman-chalisa-facts-distance-between-earth-and-sun>
17. https://www.researchgate.net/publication/339850335_Human_Cloning_in_ancient_India_Is_it_a_reality
18. <https://www.thebetterindia.com/63119/ancient-india-science-technology/>
19. India's Contributions to World Thought and Culture. Madras: Vivekananda Memorial Committee. 67-70.
20. Iyengar, S. R. Ranganathan. "Aryabhata." Current Science 61, no. 3 (1991): 133-138.
21. Joseph, George Gheverghese. "The Crest of the Peacock: Non-European Roots of Mathematics." Princeton University Press, 2011.
22. Kak, Subhash. "The Wishing Tree: Presence and Promise of India." iUniverse, 2008.
23. Matilal, Bimal Krishna. "Epistemology, Logic, and Grammar in Indian Philosophical Analysis." Vol. 3. Oxford University Press, 2005.
24. Meulenbeld, Gerrit Jan. "A History of Indian Medical Literature." Motilal Banarsidass, 1999.
25. Sarma, K.V. 1985. A survey of source materials. Indian Journal of History of Science 20.1-20.

26. Selin, Helaine. "Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures." Springer, 1997.
27. Sen, S. N. "Ancient Indian History and Civilization." New Age International, 1999.
28. Sengupta, P.C. 1947. Ancient Indian Chronology. Calcutta: University of Calcutta Press.
29. Shastri, Ajay Mitra. "Land of the Seven Rivers: A Brief History of India's Geography." Penguin UK, 2012.
30. Venkatesananda, S. (tr.), 1984. The Concise Yoga Vasistha. Albany: State University of New York Press.

