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## Introduction

### A Life in the History of Science: Profile and Publications of Dr B.V. Subbarayappa

India has a rich classical scientific tradition that developed over millennia. However, no organized inter-disciplinary studies such as the history and philosophy of Indian sciences evolved even well after Independence. In such a challenging situation Dr B.V. Subbarayappa, quite out of his own inclinations, began a study of the history of Indian sciences informed by the history and philosophy of science in the West. In fact, he spent a considerable amount of time familiarizing himself with the methodologies and concerns of this latter discipline before embarking fully on the Indian counterpart, about which he held both some hunches and healthy scepticism. But it was to be a matter of investigation, close reading of ancient and classical texts, and discoveries in the field, rather than one of armchair speculation or dismissal as many Western-trained Indian scientists were prone to do. Some three decades of this painstaking research led to numerous ground-breaking publications and major lectures.

This work on the growth of knowledge and critical appraisal of traditional sciences in India earned the recognition of the world community of historians of science. And the deserved recognition in part culminated in his election as the General President of the Science Division of the UNESCO related International Union of the History and Philosophy of Science, by its general assembly at Liege, Belgium on July 25, 1997. But more than such institutional and bestowed laurels, the man himself is rather more intriguing, or something of a living institution in his own right, particularly with his astute philosophic perceptiveness and a gentle intellectual disposition, as well as his deep spiritual openness from his own Brahmanic scholarly pedigree. These qualities make any subject he writes or speaks on quite more interesting than one might have otherwise thought possible: it is as though the subject-matter itself comes fully endowed, though not yet manifest, with a depth, a fascination of its own, and an elevating smile! With his singular effort in the field, the scene had become quite different and something to be celebrated, as it indeed was, on the eve of the golden jubilee of the birth and freedom of the modern Indian nation. This volume in part recalls that moment of celebration through the studious contribution of Dr Subbarayappa who, on the margins of the nascent nationalist movement, both stimulated the retrieval of the glories of ancient India and

nurtured its embrace of the modern sciences. True to his quasi-Gandhian spirit, Subbarayappa has written on science's grand phases and, more importantly, attempted to forge a conduit, a bridge, a continuum between traditional and modern sciences. He has always emphasised that in the Indian context, traditional astronomy, medicine and technology coexisted with their modern counterparts, which is an observation of considerable significance. Several essays in this commemorative volume attest to the lotus-like steps he chalk-marked quietly to demonstrate this observation from, and in his own long-ranging studies. Had Galileo lived in India, for instance, he would not have suffered as much as he did under the Catholic church of Europe: he would have been celebrated for his advancements into heliocentric theories (which had heuristic counterparts in navigational calculus) and for the impact his early discoveries had on astrology. Classical Indian astronomers were not only supported in such pursuits, their "odd" endeavours were never quite abandoned in India.

As a science historian of both the ancient and Raj periods in India, and a veritable witness to the development of science in the postcolonial era, Dr Subbarayappa posits that the socio-political environment that marked the pre-independence freedom struggle was a key source of inspiration to Indian scientists. Indeed, it was a primary force behind scientific pioneers such as J.C. Bose and P.C. Roy. Post-independence a socio-political climate favouring a public/institutional focus has veered more towards technological developments – from nuclear capability to the industrious IT revolution. Nevertheless, pure research continues to be supported and encouraged in large measure by private institutes and collective, and is carried out by Indian scientists working abroad, such as Chandrasekhar and Ramanujan.

Bidare Venkatasubbaiah Subbarayappa was born in 1925 in the town of Bidare in the erstwhile princely state of Mysore. His early High School education was at Madhugiri, after which he attended Intermediate College at Tumkur. The youthful Subbu, as he was popularly known, then entered Central College, a constituent of Mysore University, where he majored in chemistry with physics as a subsidiary and was subsequently awarded a subject scholarship for chemistry during his honours year. In the year of India's Independence and soon after his graduation in 1947, Dr Subbarayappa began his career as a lecturer in chemistry in Vijaya College, Bangalore. In 1955 he joined the Central Foundation Technological Research Institute in Mysore and it was through his association with the Oriental Research Institute there that he developed a keen interest in the scientific manuscripts, and other primary and secondary sources, that he discovered as he scoured the library shelves. In 1962, his paper on "Indian Atomism" was specially noticed in the British journal *Nature*. Two years later Subbarayappa obtained his doctorate degree from Mysore University for his thesis titled *Studies in Indian Concepts in Physical Sciences*.

Dr Subbarayappa's interest in the history of Indian sciences was further stimulated when the Union Education Ministry established a National Commission for the History of Science in India in 1967, within the Indian National Science Academy (INSA). He was at first appointed the Project Coordinator and later Member-Secretary of the Commission and in 1971 was instrumental in co-editing (with D.M. Bose and S.N. Sen) and writing the major chapters for the widely used cyclopaedic work, *A Concise History of Science in*

*India.* He also worked as the Executive Secretary of the INSA and later, from 1978-83, as Director of the Nehru Centre in Bombay. By 1977, Dr Subbarayappa was a Visiting Professor at the Birla Institute of Technology and Sciences in Pilani (Rajasthan) teaching the History of Science, an area that was beginning to be recognized and developed in India. To reinforce this arduous task, he had convened a number of signpost meetings and exploratory seminars in the various institutes he had been associated with. For example, in 1969 he organized the First National Seminar on Indian Scientific Heritage at the INSA in New Delhi; in 1973 a major International Seminar on Alberuni was convened; and this was followed by another on Aryabhata, the classical Indian astronomer and mathematician. His participation in several International Congresses on the History of Science also enhanced the importance of the Indian scientific tradition among the international community of science historians.

Given his landmark accomplishments, it would not be an exaggeration to suggest that Dr Subbarayappa is truly the pioneer of the history of science in the Indian context, as understood and practised in the modern academy: a *Bharatiya Vijnana* indeed. As a result of his dedicated work, honours and awards came in search of this distinguished scholar. Several awards and emblems of recognitions have been conferred upon him nationally and internationally and attest to this profile in the making. Here follows some highlights from his curriculum vitae.

In 1974 Dr Subbarayappa was awarded the Copernicus Medal by the Polish Academy of Sciences, an occasion that, not insignificantly, marked the 500th anniversary of the birth of Copernicus that was being celebrated in New Delhi. He was the first Indian to be elected a full-member of the Executive Committee of the International Union of the History and Philosophy of Science (IU-HPS) for two terms (Bucharest in 1981, and Berkeley in 1985), and the first Indian to be elected a full member of the prestigious International Academy of the History of Science at its 1987 meeting in Paris. He was also the Chairman of the National Committee for IU-HPS and led Indian Delegations to the International Congresses of History of Science in Berkeley (1985), Hamburg (1989), Liege (1997) and Mexico (2001). In 1997, Dr Subbarayappa was elected to a four-year term as General President of the Science Division of the International Union of History and Philosophy of Science. He was the first scholar-member outside the Western academies to be elected to this position in the Union's fifty-five-year history.

The year 1999 was a busy and prestigious one for Dr Subbarayappa. In July he was invited by UNESCO to chair a session on Science and Traditional Knowledge systems at the World Conference on Science held in Budapest. In October he was an invited speaker at a symposium on Cultural Bases of Science organized by the International Institute of Advanced Studies, Kyoto (Japan) and his lecture on "The Cultural Bases of Indian Science" was extolled as a mark of profound scholarship. Then in December 1999, Dr Subbarayappa was conferred the *Dottore ad Honorem Storia* (Honorary Doctorate in the History of Science) by the University of Bologna at a ceremony there, which also marked the conclusion of the bicentenary celebrations of Luigi Galvani, a great name in history of science. Dr Subbarayappa is the first Indian to be so honoured in the field of history of science.

The year 2000 was no less a landmark year for Dr Subbarayappa as an internationally renowned historian of science. In April, UNESCO and Interdisciplinary University in Paris invited him to deliver a lecture on Indian Metaphysical Concepts and Practices at an International Seminar on Metaphysical Implications of Science. A Study Group on Science and Traditional Knowledge was subsequently set up by the International Council of Science (October 2001 to January 2002) as a follow up of the Action Plan of UNESCO's World Conference on Science and Dr Subbarayappa was a member of this group. In 2000 he was also invited by the Chinese Academy of Sciences and the Chinese Society for History of Science to participate in their International Conference in Beijing in August 2000 where he delivered talks on "Needham's Perspective on Indian Science and Promoting Science and Humanism: New Role of Science Historians."

Dr Subbarayappa was invited to be a Founder-Member of the International Society for Science and Religion held in Granada, Spain, in August 2002. In October that year he was awarded the R.C. Gupta Endowment Medal and Prize for History of Science, by the National Academy of Sciences, Allahabad. He was invited to organize a major symposium on the Science-Religion Dialogue, Past and Present at the International Congress of IU-HPS to be held in Beijing in July 2005 and played a pivotal role in the SSRI (Science and Spirituality Research in India) Life and Universe: Cosmology, Biology and Consciousness International Symposium in Bangalore, Karnataka, in August 2005.

Back-tracking a little, after his retirement as the Executive Secretary of the Indian National Academic of Science, Professor Subbarayappa returned to Bangalore where he has been serving as Honorary Director of the Centre for History and Philosophy of Science of the Indian Institute of World Culture (IIWC). The IIWC was founded in the 1940s by Sofia and W.P. Wadia, Parsi philanthropists and purveyors of intellectual wisdom in the nascent nation-state. The Centre for History and Philosophy of Science has also forged strong links with the National Institute of Advanced Studies, in the campus of the well-known Indian Institute of Science, where Dr Subbarayappa is an Honorary Professor. Several projects have been undertaken under the aegis of the Centre; most have been successfully completed, or are in the process of being completed, even as the scholar-investigator in his very early eighties. For three years (1996-99) he was the National Academic Coordinator of the *Encyclopaedia of Hinduism* project. Currently as Honorary Chairman of the Indological Research Foundation, he is guiding the multifarious academic and research activities. He is the Co-Investigator and Executive Director of the SSRI, an organisation supported by the Sir John Templeton Foundation (in collaboration with the editors of the present volume). In 2001 and again in 2002 he helped bring an international conference on Science and Metaphysics co-sponsored by the Science and Spirituality Quest (SSQ) II Programme within the ambit of the Sir John Templeton Foundation to the National Institute of Advanced Studies, in Bangalore.

However, for Dr Subbarayappa, a disavowal is called for: expressed in his utter self-effacing humility and disarming smile among the best of men and women in any tradition of learning. All this is really a recognition of the achievements of the Indian traditions of science, which is only just beginning

to be understood and appreciated for its vast encompass and magnificent history.

In continuing the dedicated task to which he has given his life, Dr Subbarayappa was engaged in the preparation of four comprehensive volumes on the History and Philosophy of Science in India, under the Project of the History of Indian Science, Philosophy and Culture: (in which three published from Munshiram Manoharlal Publishers): *Chemistry and Chemical Techniques in India* 1999, *Medicine and Life Sciences in India* (2001); and *Indian Perspectives on the Physical World* (2004).

Dr Subbarayappa takes pride in the several dimensions of India's scientific heritage and its achievements, such as the discovery of the Indian decimal place-value system utilising nine digits and zero; the accurate estimation of the duration of Earth's rotation on its own axis by Aryabhata, the value of  $\pi$ ; developments in geometry and trigonometry; and equally in the practical sciences, such as in metallurgy of iron, steel and zinc. His own textual-archival excavations add to the importance of these discoveries, and he encourages younger researchers to continue to interpret and probe deeper into the buried treasures of the ancient Indian scientific heritage – for it belongs to the people of the Republic and complements their civilizational heritage. While some areas remain somewhat speculative, good science always begins with conjectures and hypotheses which – in the traditions of Mimamsa and Popper alike – stand to be falsified, empirically and mathematically demonstrated to be unassailable, or otherwise corroborated if hard evidence is at hand.

In his recent monograph, *Decipherment of the Indus Script*, Dr Subbarayappa has advanced the hypothesis that the Indus script represents a numeral system which is decimal-additional-multiplicate in nature. With this, he has also tried to interpret the majority of seals from the Indus heritage, suggesting that they encode records of agricultural production and distribution. This new approach, although it has raised the eyebrows of a number of critics, has received support from several scholars and archaeologists, both in India and abroad. For instance, if Dr Subbarayappa's interpretation of the numerical nature of the Indus forms becomes widely accepted, it should bring to life the oral tradition of the Harappans in a similar vein to that of the Vedic people, supplementary to the aniconic tradition of both. This would suggest that there was a historical continuity between the two civilizations in the ancient period. But the thesis, informative and challenging as it is, awaits further empirical and archaeological investigation. Dr Subbarayappa and some of his ardent followers in the field are hopeful.

He has always maintained that modern-day Indians should feel proud of their scientific heritage as much as their religio-philosophy, fine arts and architecture. For, as he has pointed out, it is due to its centuries of scientific tradition, that when the British introduced Western science in colonial India in the nineteenth century, Indians did not find these concepts alien. Rather, science was welcomed and substantial progress continues to be made into its new frontiers into the twentieth and twenty-first centuries.

After recently coming away after a visit to Dr Subbarayappa's humble and unassuming apartment-home in a middle class suburb of Bangalore, we were touched by the friendly and gentle manner he also extends to all in his private

world. The professor is often seen fielding the curiosities of his resident (just over five old) grandson, Aditya, who brings out the compassionate and attentive character of a grandpa. Surrounded by his books, heirloom icons and writing-desk, he takes coffee breaks, conversing in Kannada with members of the extended family, assistants, and visitors who come and go. To each he offers a warm reception – as a new guest (*atithi*), a god, a messenger from regions transcendental, sacred, or the profanely secular – all in this humble space. With these remarks we conclude personal glimpse into Dr Subbarayappa's life, which complements his considerable professional achievements in both the Indian and international realms of the history of science.

#### MAJOR PUBLICATIONS DR B.V. SUBBARAYAPPA

- (i) *A Concise History of Science in India*: D.M. Bose, S.N. Sen and B.V. Subbarayappa, (eds.), Indian National Science Academy, New Delhi, 1971. Besides planning and editing, Dr Subbarayappa has contributed five chapters (see below).  
This publication has received generous appreciation from the community of historians of science.
- (ii) *Rasārṇavakalpa* (an iatro-chemical text in Sanskrit) translation into English and Introduction (with Mira Roy), Indian National Science Academy, New Delhi, 1974.
- (iii) *Indian Astronomy: A Source-Book* (with K.V. Sarma) about 3000 Sanskrit verses, translation in English with Introduction, Nehru Centre, Bombay, 1985.
- (iv) *In Pursuit of Excellence: A History of the Indian Institute of Science*, Tata-MacGraw Hill, New Delhi, 1973. This received appreciative reviews in foreign Journals like *Nature* and *Science*.
- (v) *Indus Script: Its Nature and Structure*, New Era Publications, Madras, 1996. This is regarded as an original scientific approach to the enigmatic problem.
- (vi) *Science in the West and India: Some Historical Aspects* (Summer School Lectures): Edited with N. Mukunda, Himalaya Publishing House, Bombay, 1995 (contributed to this volume two chapters on Astronomy and Chemical Practices).
- (vii) *Scientific and Technological Exchanges between India and Central Asia*: (Edited), Indian National Science Academy, New Delhi.
- (viii) *Science in India: A Changing Profile* (with S.K. Mukherjee), Indian National Science Academy, New Delhi, 1985.
- (ix) *Scientific Heritage of India*, (with S.R.N Murthy, ed.), The Mythic Society, Bangalore, 1988.
- (x) *Chemistry and Chemical Techniques*, Project of History of Indian Science, Philosophy and Culture, New Delhi, Center of Studies in Civilisations, under the Ministry of HRD, New Delhi, 1999. Contributed three chapters besides editing and planning.
- (xi) *Medicine and Life Sciences*: Project of History of Indian Science, Philosophy and Culture. Planned, edited and contributed two chapters besides editing.

- (xii) *Indian Perspectives on the Physical World.*
- (xiii) *The Tradition of Astronomy in India*(under publication).
- (xiv) *Science in India: Past and Present* (ed.), Nehru Centre, Mumbai, 2006.

#### *In Kannada*

- (xv) *Lives of Ten Eminent Scientists (Vikhyāta Vijnānigalu)*, Eastern Press, Bangalore, 1954.
- (xvi) *Great Indian Scientists (Bharatiya Vijnānigalu)*, Geetha Publishing House, Mysore, 1958.
- (xvii) *The Story of Alchemy (Bangarada Kathe)*, Adult Education Department, Mysore, 1959
- (xviii) Besides, translated into Kannada the book *Mr Tompkins in Wonderland* by G. Gamow (Vichitralokadalli Vidyalankara) and *Origin of Earth and Planets* by Boris Levin (*Bhumi mattu itara Grahalagala Huttu*), Peoples' Publishing House, Mysore, 1958.

#### *Articles*

About eighty articles have been published in journals and other publications.

These include:

1. Chemistry and Alchemy (76 pp.)
2. The Physical World: Views and Concepts (51 pp.)
3. Western Science in India (83 pp.)
4. Agriculture (with two other collaborators) 31 pp.
5. Resumé(48 pp.)

Published in *A Concise History of Science in India* [see (i) above]

6. Indian Astronomy: some Reflections (26 pp.)
7. Chemical Practices in India (22 pp.)

Published in *Science in the West and India* [ see (vi) above]

8. Indian Alchemy: Its Origin and Ramifications ( 32 pp.)
9. The Tradition of Cosmetics and Perfumery (22 pp.)
10. An Overview of Indian Chemical Practices (24 pp.)

Published in *Chemistry and Chemical Practices* [see (x) above]

11. Siddha Medicine (26 pp.)
12. A Perspective on Indian Medicine (39 pp.)

Published in *Medicine and Life Sciences* [ see (xi) above]

13. "On Indian Atomism," *Bulletin of the National Institute of Science of India*, New Delhi, 21, pp. 118-29, 1961.
14. "Production of Bar Iron in South India (Salem region)," *IJHS*, 1, no. 2, pp. 156-60, 1966.
15. "Indian doctrine of Pañcabhūtas," *Indian Journal of History of Science (IJHS)*, 1, No. 1, pp. 60-67, 1966.
16. "An Estimate of the Vaiśeṣika Sūtras in the History of Science," *IJHS*, 2, no. 1, pp. 21-34, 1967.
17. "Matrkābheda tantram and its alchemical ideas," (with Mira Roy) *IJHS*, 3, no. 1, pp. 42-49, 1968.
18. "Some Aspects of Technology and Society in the Classical Age of India" in *Technology and Its Impact on Society*, Tekniska Museet, Stockholm, 1979, pp. 37-44.

19. "Science and Technology in India," *Endeavour* (at the time of Festival of India in London), 1981.
20. "Dimensions of Scientific Tradition in India" in *Proceedings of International Congress of Human Sciences*: ed. Yamamoto Tatsuro, Tokyo, 1984.
21. "Indus Seals: The Womb of Numbers," *Quarterly Journal of Mythic Society*, Bangalore, 1988.
22. "Impact of European Science in Colonial India" in *Revolutions in Science: Their Meaning and Relevance*: ed. William R. Shea, Science History Publications, Canton, USA, 1988, pp. 226-83.
23. "Indian Astronomy: An Historical Perspective" in *Cosmic Perspectives*: S.K. Biswas et al., eds. Cambridge University Press, Cambridge, 1989, pp. 25-40.
24. "Indus Seals: The Case of the Unicorn" in *Essays on Science: Joseph Needham Felicitation Volume*: ed. Hakim Mohammed Said, Hamdard Foundation, Karachi, 1990, pp. 246-59.
25. "Science in India and China" (trans. into Italian) in *Le Scienze fisiche e astronomiche*: William R. Shea (ed.), Milano, 1991, pp. 26-37.
26. "Siddha medicine: An Overview," *Lancet*, vol. 35, Dec 20/27, pp. 1841-44, 1997
27. "Past in the Present" in *India 1000-2000 AD*, Indian Express Publication, Bangalore, 2000.
- 28-30. Three Articles on: Indian Astronomy, Cosmetics and Perfumery, and Technology (trans. into Italian) published in *Storia Della Scienza, Estrato Dal*, vol. II, Insituto Della Enciclopedia Italiana, Roma, 2001.
31. "Joseph Needham's Perspectives on Indian Science: Some Reflections," *Studies in the History of Natural Sciences*, vol. 10, no. 3, 2000, Beijing, pp. 218-25.
32. "Hinduism: Concepts and Practices" (trans. into Italian), published in *Treccani Il Libra Dell'anno*, Istituto della Enciclopedia Italiana, Roma, 2001, pp. 321-54.
33. "Some Thoughts on Science in the nineteenth century India," Raja Ram-Mohan Roy Foundation Lecture, Kolkata, 2002.
34. "Our Heritage" in *Pursuit and Promotion of Science: Indian Experience*, Indian National Science Academy, New Delhi, 2001.
- 35-59. A series of 25 articles (bi-weekly) on History of Science in *Science Magazine* of a leading newspaper (during 1985-89) for the general readers with a view to popularising the history of Indian Science in the ancient and medieval periods.
- 60-81. Twenty-two articles/write-ups on different aspects of Science in India including a perspective one on Ancient and Medieval Science for publication in the proposed *Encyclopedia of Hinduism of India Heritage Research Foundation*, Rishikesh.
82. "Origin of Alchemy in India: Some Reflections" in *The Human Body at the Crossroads of Multiple Indian Ways of Knowing*: ed. Oscar Botto et al. Universit  de Bucarest, Bucarest, 2004, pp. 331-37.
83. "Indian Scientific and Technological Achievements" in *Self, Society and Science: Theoretical and Historical Perspectives*: ed. D.P. Chattopadhyaya, Centre for Studies in Civilizations, New Delhi, 2005, pp. 115-26.

84. "Indian Atomism" in *Philosophical Consciousness and Scientific Knowledge: Conceptual Linkages and Civilizational Background*: ed. D.P. Chattopadhyaya, Centre for Studies in Civilizations, New Delhi, 2004, pp. 212-19.
85. "Traditional Science, Spiritual Quest and Modernity: Some Reflections on Indian Ethos" in *Science and Tradition: Roots and Wings for Development*, Royal Academy of Overseas Sciences and UNESCO, Brussels, 2001, pp. 54-61.
86. "The Roots of Ancient Medicine: An Historical Outline," *Journal of Biosciences*, Bangalore, **26**, 2, June 2001, pp. 135-44.
87. "Spirituality and Low-Entropy Culture: A Synergic Vista of the twenty-first Century," *Actas do Forum Internacional Ciencia, Religiao e Consciencia*, ed. Joaquim Fernandes and Nelson Lima Santos, Centro Transdisciplinar de Estudos da Consciencia, Porto, Portugal, 2004, pp. 103-16.
88. "The Hinduism and Science" in *Why the Science and Religion Dialogue Matters*, ed. Fraser Watts and Kevin Dutton, Templeton Press, Philadelphia, 2006, pp. 91-101.
89. "The Vital Tripod: Science, Religion and Humanism" under publication in Frankfurt (ed. Vladimir Burdyuza).
90. "Science in India: Past and Present" an Overview in *Science in India: Past and Present*, Nehru Centre, Mumbai, 2007, pp. vii-xxxvii.
91. "Indian Astronomy: Some Facets" in *Science in India: Past and Present*, Nehru Centre, Mumbai, 2007, pp. 49-79.