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Review Report

A NATIONAL REPORT ON STUDIES IN HISTORY OF SCIENCE IN INDIA (1990-93)

(Based on the report presented in the 19th International Congress of History of Science at Zaragoza, Spain on August 22-29, 1993)*

INTRODUCTION

The origin of investigations in History of Sciences in India (hereafter HS) may be traced back to the 18th century, when the Asiatic Society was established in 1784 with Sir William Jones, the famous orientalist and linguist, as its first President. The main objective of the Society was "to enquire into the history and antiquities, arts and sciences and literature of Asia". The Society began its first serial publication, the *Asiatick Researches* in 1788, which ran into 20 volumes by 1839. Thereafter, it was replaced by the *Journal of the Asiatic Society of Bengal*, (instituted in 1832), which continues till today.

The early historical researches on Indian Sciences (published in the journals mentioned above) were carried out by the European scientists and orientalists. Among them Joseph Tieffentaler and W.W. Hunter, H.T. Colebrooke, G. Thibaut, G.R. Kaye, E. Burgess, Jean Filliozat, A.B Keith, M. Winternitz, A. Weber, C.M. Whish, L. Wilkinson and others are well known. Their interaction with the Indian orientalists inspired many Indian scholars of classical languages to take interest in studies of Indian scientific source-materials. The Indian historians of sciences like Bapudeva Sastri, Sudhakara Dvivedi, Brajendra Nath Seal, Bhau Daji, B.G. Tilak, P.C. Ray, P.K. Acharya, G.N. Mukhopadhyaya, G.P. Majumdar, Gananath Sen, B.K. Sarkar, P. Neogi, S.N. Das Gupta, H.D. Sankalia, P.C. Sen Gupta, B.B Datta are particularly noteworthy for their contributions to History of Science in India, since the first quarter of the nineteenth century.

A symposium on History of Sciences in South Asia, which was organised in collaboration with UNESCO in November 1950 at the University of Delhi, laid the first emphasis on the importance for a co-ordinated and sustained effort in the study of the genre. The Indian National Science Academy recognised that a compilation of history of sciences in India would be of great value to the study and growth of civilization and culture in the sub-continent. In 1955 the Council of the Academy initiated a plan in collaboration with the Asiatic Society; and the History of Science

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* For details, see the 'National Report of Indian National Committee for IUHPS for 1993 on Studies in History of Science in India'.

Board was established in 1960 with eminent Scientists, Indologists and Historians as members. Later, a Commission was set up by the Indian National Science Academy for the purpose.

1. *The Indian National Commission for History of Science*

The Indian National Commission for History of Science (hereafter, just Commission) plays a major role in sponsoring studies in History of Sciences. The President of the Academy is the *ex-officio* Chairman of the Commission.

Originally the Commission was set up for promoting studies in HS in India. However, after taking stock of its work during the 25 years of its existence, the Commission, in 1989 decided to "extend its scope for studies in HS from international perspective".

The Commission also publishes a well-established quarterly the *Indian Journal of History of Science (IJHS)* since 1966.

The Commission operates through its three Advisory Committees, namely, for *ancient, medieval* and *modern* periods. The members are nominated from various Indian universities and research institutes. The Commission offers both academic and financial support for all branches of History of Science on advice of these advisory committees.

The Commission approved 30 project in 1990-91, 24 in 1991-92 and 28 projects in 1992-93, respectively. These research projects cover the areas like that of exact sciences, architecture, technology, Indian medicine etc. A selective list of titles of projects for 1990-93 is given in *Appendix I.*

In granting research projects, the Commission lays importance on textual research of primary source-material in classical languages like Sanskrit, Arabic and Indo-Persian and also in modern Indian languages. A number of studies based on these projects are published in the form of monographs. A list of monographs published for the period 1990-93 by the Commission is displayed in *Appendix II.* The Commission has sponsored more than 30 monographs since its foundation.

The Commission has also been active in organising National and International Seminars/Symposia and workshops not only to promote HS activities in the Indian institutions but also to bring together Indian historians of science to interact with one another. The planning and publication of special monographs is another important activity. Three monographs on *History of Technology in India* – one for ancient; one for modern period; and a *Hand Book on System of Dating in India* have been planned and prepared in which a large number of experts have contributed – are being finalized for publication.

II. *The Centre for History and Philosophy of Science (CHPS), Bangalore*

The Indian Institute of World Culture (Bangalore) established a Centre for History and Philosophy of Science in the middle of eighties as an academic wing

of the Institute. The moving spirit behind the establishment is Dr B.V. Subbarayappa, the first Honorary Director of CHPS.

A number of HS studies undertaken at the CHPS were sponsored and financed by the National Commission. These are projects on 'Indian Food' by K.T. Achaya, 'Source Book on Indian Chemical Practices', compiled by B.V. Subbarayappa, Mira Roy and B.S.R. Rao; *Rasahydra Tantra*: A Critical Edition of Eleventh Century Chemical Sanskrit text by B.V. Subbarayappa, M.M. Shastry and B.S.R. Rao and S.R.N. Murthy; *Source-Book on Indigenous Traditions in Indian Navigation*, Vol.I. Navigational Aspects; Vol. 2, Boat-building Aspect, (a joint project of universities of Bombay, Thanjavur and Bhubaneshwar). The project which is based on Indian literary sources was sponsored by the Council of Scientific and Industrial Research.

Dr B.V. Subbarayappa has recently completed a study : *In Pursuit of Excellence : A History of the Indian Institute of Science*. This institute was established by the Indian industrialist, J.N. Tata, in 1909. Based on records and other source-material, he deals in detail "the story of the obstacles encountered in its institutionalisation process in colonial India and the pivotal role which is being played by the Institute in the pre-Independence period as well as the broad spectrum of its research activities after Independence and accomplishments."

An International Summer School of History and Philosophy of Science was organised in July 1990 at Bangalore and a Regional Seminar on Sources for History of Science in South Asia was organised in January 1992 in Bangalore.

III. *The National Institute of Science, Technology and Development Studies* (NISTADS)

The NISTADS was established by the Indian Council of Scientific and Industrial Research at New Delhi, in 1981 with A. Rahman as the Founder Director. This Institute, with Dr. Ashok Jain as the present Director, is engaged in multi-disciplinary studies; and has made a significant contribution to the following areas of activities :

(a) *Science and technology in ancient India.*

Late Prof. Debi Prasad Chattopadhyaya edited two volumes on the same title on the basis of historical, philosophical and technological orientations.

(b) *Foundation and methodology of theoretical sciences,* like (Logic, linguistics, mathematics and cognitive sciences).

Navjyoti Singh is working on these problems from an Indian perspective.

(c) *The structure and dynamics of scientific theories.*

R.K.M. Nair has focussed his attention on the contemporary history of science and technology with special reference to foundations of quantum mechanics.

(d) *Science & the Raj.*

Dr Deepak Kumar has been analysing the nature and character of science and technology in India with reference to colonial period.

The History and Philosophy of Science (HPS) division has organised two international seminars, one on *Quantum Mechanics*, (February 1991); and another on *Environmental History in South Asia*, (February 1992). The Division has brought out some notable publications as well.

IV. *The Department of History of Science and Medicine, Hamdard University , New Delhi*

A Department of History of Science and Medicine (hereafter, DHSM) was established by Hakeem Abdul Hameed (presently Chancellor of Jamia Hamdard, University in New Delhi) in 1984 as one of the constituents of the Institute of History of Medicine and Medical Research. The DHSM is now actively engaged in the studies of primary sources in Arabic and Persian manuscripts available in the Indian libraries. Presently, the thrust of research is on history of exact sciences and history of Unani (Graeco-Arab) medicine in Medieval India. The Department has also organised a couple of national seminars in the fields of its specialization.

Jamia Hamdard is also publishing a journal entitled *Studies in History of Medicine and Science* (*SHMS*). Some of the notable papers published therein are: *Yantraprakāra* – a Sanskrit text on Arabian astronomical instruments with text, translation and commentary by S.R Sarma; *History of Astronomical Instruments* of *Delhi Sultanate and Mughal India by Y. Ohashi*; *Tibb-i Firoz Shahi*, a Persian manuscript of the Sultanate period on Unani medicine with text and introduction; *Ibn Sina's Arabic Treatise Cardiology*, edited with introduction by S. Zillur Rahman; *Āryabhaṭa, the Paitāmaha Siddhānta and Greek Astronomy; Health Science in Al-Andalus, Tunisia and Egypt* by Sami Hamerneh.

V. *The Indian Society for History of Mathematics, Delhi*

This *Society* was founded by the late Professor U.N. Singh, Department of Mathematics, University of Delhi in 1977. Since then it has been committed to the studies in history of mathematics, particularly in ancient and medieval India. The *Society* has been organising biannual national conferences. Since 1979, the *Society* has been publishing the bulletin : *Gaṇita Bhāratī* (GB), a quarterly journal under the active editorship of Professor R.C. Gupta (Birla Institute of Technology, Mesra, Ranchi). Fourteen volumes were published by 1992. It is no exaggeration to say that GB has caught the attention of world historians of mathematics. Besides original contributions in history of mathematics, GB also carries book reviews and reports of conferences/symposia, particularly, which are held in India. A special feature of GB is "Notices of Selected Publications", which in fact is a documentation on

periodical literature in the history of exact sciences. This section is very useful for Indian historians of sciences. Its compilation is based on Professor R.C. Gupta's own personal library and efforts.

VI. *Project on History of Indian Science, Philosophy and Culture, New Delhi*

Professor D.P. Chattopadhyaya, the Chairman of Indian Council of Philosophical Research (ICPR) in 1981 initiated discussion with many nodal agencies, institutes and experts to undertake a comprehensive research project of interdisciplinary study of History of Indian Science, Philosophy and Culture (PHISPC). The project was approved by ICPR during the period of the eighth Five year Plan with overall emphasis on collection of source materials, their study and analyses through debates, seminars, and workshops from Indian perspective for eventual preparation of large number of volumes on the subject. A few volumes on Geography and Ethnography, Mathematics and Astronomy, Physical Science, Chemistry, Life Science and Medical Science, Natural Resources and Technology of Resource Utilisation, Agriculture and allied Modes of Production, Life in village and towns and Civil Engineering, Machines and Mechanical Engineering, Social and Political Institutions etc. have already been planned. Some seminars were also organised during 1990-93 to initiate discussions among Philosophers, Scientists, Historians, Indologists and others. Eleven volumes on such topics were published.

VII. *B.M Birla Science Centre, Hyderabad*

The Centre which also runs a planetarium, has been functioning in Hyderabad for quite some time under Dr. B.G. Siddharth. This Centre has also developed interest in history of astronomy and has organised a number of seminars/symposia on Indian Astronomy and Jai Singh. [For a report of this Seminar see S.M.R. Ansari, *Gaṇita Bhāratī*, 12 (1990; pp. 113-116)]. An International symposium on Indian Astronomy and other Asiatic Astronomy was held in December 1991, at Hyderabad and at Jaipur in which a number of historians of science participated. The Proceedings of this Symposium are being edited by Dr. B.G Siddharth and Professor S.M.R. Ansari.

VIII *PPST Foundation, Madras*

The Foundation with headquarters at Madras is a body of Indian academies "belonging particularly to the sphere of the sciences and technologies". Its main objective is to promote studies concerning "the basis for science and technology having its roots in the Indian scientific and technological traditions and oriented towards meeting the needs of the Indian people". The President of the *Foundation* is Mr. Dharampal. The *Foundation* publishes *The PPST Bulletin* which carries original papers and survey articles dealing with history of exact sciences.

The Foundation organised the Congress on Traditional Sciences and Technologies in India in NovemberDecember 1993 in collaboration with I.I.T. Bombay. The Congress draw the encinent experts of the respective fields from all over the world. Professor H.S. Shankar, of I.I.T. Bombay are Professor Ashok Jhunjhun Wala of I.I.T. Moderns and Navjyoti Singh of NISTADS were the chief organisers.

The Scientists from NISTADS under the guidance of Dr Ashok Jain brought out the daily *News Bulletins* covering every main theme of every lecture and activity in the Congress.

IX. *Department of Ilmul Advia*

The Department of Ilmul Advia (Unani Pharmacology) is a constituent of Hakeem Ajmal Khan Tibbiya College (Aligarh Muslim University, Aligarh). It was established in 1972 as the first post-graduate department in any Tibbiya College in India. Under the Chairmanship of Professor Hakim S. Zillur Rahman, the Department (hereafter, DIA) has done a good work in history of Unani pharmacology and Unani medicine. During the last three years the Department organised a few seminars on Unani medicine, in Allahabad in October 1989; in Aligarh in 1980 and 1990; and in Azamgarh, in April 1993. These seminars have contributed to history of Unani medicine in India. The department has produced a number of publications like *Risalab Atrital* by Imamududdin Mohmud Shiraji.

Teaching in History of Science

One of the objectives of the Indian National Commission for History of Science has been to appoint whole-time Professors and Readers to conduct research as well as to supervise the work of research scholars and technical assistants to form a cadre of science historians who might be able to recruit staff for the history of science departments. However, this objective has not yet been realised.

By organising national seminars and international symposia, the Commission tries to support and promote history of science studies in the Indian Universities. Yet, only a hardful of the Indian universities have departments of HS, though some, like the universities of Delhi, Aligarh, Jaipur, Calcutta, Kharagpur, Pilani etc. do teach HS to their undergraduate students. Some universities also have Ph.D programmes. A list of doctoral theses, based on the available information, is given in *Appendix III.*

Other activities

Some individuals and groups are working in various Indian universities and institutes in the field of HS. Here, a brief exposition of the work may be given.

Professor S.M.R. Ansari is busy with preparation of a Persian text of Raja Jai Singh's astronomical tables (*Zij-i Muhammad Shahi*) with a detailed introduction in

English. This project has been supported by Indian National Science Academy (New Delhi).

Dr. A.K. Bag (NISTADS) has been analysing a few mathematical and astronomical concepts from international perspective. Presently, he has been analysing the *Surya Siddhānta and Gaṇita Sārasaṅgraha* of Mahāvīra in addition to accomplishment of various programmes of the Indian National Commission for History of Science.

Dr R.K. Kochhar (Indian Institute of Astrophysics, Bangalore) has made some important studies on the introduction of modern European observational astronomy in India.

Dr S.R. Sarma (Dept. of Sanskrit, Aligarh Muslim University, Aligarh) is involved with the researches in history of astronomical instruments in India.

Dr Kameswara Rao (Indian Institute of Astrophysics, Bangalore) has initiated the studies in archaeo-astronomy in India. He has tried to show that "the Buddhist stupas in Sanchi, including the Great stupa built by the Suṅga kings around second century B.C. are oriented towards the moon rise and sunset on the day of the *Buddha purnima* (birthday)."

Professor R.C. Gupta has made important appraisal of ancient Indian Mathematics including the Jain a mathematics.

Professor S.N. Sen (the Ramakrishna Mission Institute of Culture, Calcutta, recently expired) has made a considerable contribution to studies in history of science in India. His account of Science and technological Education during 19th century India is an important document. He has compiled a detailed bibliography of publications in Physics, Astrophysics, and Magnetism during the 19th and 20th century alongwith S. Chatterjee and a group of young documentation specialists. Their bibliographies will not only help to assess the progress but also indicate the nature of quantum of growth in different areas in modern period.

Professor K.V. Sarma has edited and translated a large number of astronomical texts. His edition of *Pañcasiddhāntika* alongwith T.S Kupannasastry is a unique contribution. Dr. George Abraham has been carrying out researches on Indian parameters and their parallelism with that of other cultural areas.

Dr M.S. Sriram, Dr. M. Srinivasan and their group (of Theoretical Physics, Madras University) has a research project on Indian mathematical astronomy sponsored by Science & Technology of Government of India. This group of scholars have worked out the algorithms for calculation of planetary positions in several classical astronomical Sanskrit texts. However, a very significant contribution of this group has been the finding of a *heliocentric model* in the Kerala school of Indian astronomy.

A.K. Biswas (Indian Institute of Technology, Kanpur), Dr Mira Roy (the Department of Sanskrit, University of Calcutta) and Dr Vijay Deshpande (Bhandarkar Oriental Research Institute, Pune) have been working on Indian metals, metallurgy and alchemical texts. The thrust of their researches is on critical studies of texts and

on diffusion of alchemical knowledge between India and China. Some of their contributions have already been published in the *Indian Journal of History of Science.*

Victor Rajamanickam (Tamil Nadu University, Thanjavur), B. Arunachalam (Dept. of Geography, Bombay University) and Dr Lotika Varadarajan (New Delhi) have been working for several years on the research project – 'Indigenous Traditions of Navigation in the Indian Ocean'. The project was sponsored originally by the Indian Council of Scientific and Industrial Research (CSIR), New Delhi. In this project Dr R.V. Manguin (École Française d'Extrême Orient, Branch Office at Pondicherry) has also been collaborating. The following areas are covered under this project : (a) boat building practices; (b) navigational techniques; (c) cross-cultural aspects. Part (c) belongs to a bigger project on Maritime History of India, on which work is being done by Dr Lotika Varadarajan.

Dr A. Vasantha of the Department of Life Sciences, Jawaharlal Nehru University has compiled a *Dictionary of Biographies of Indian scientists.*

Mr Shabbir A Khan Ghori (Aligarh) and M.S. Khan (Calcutta) have been working for the last several years on various topics on history of sciences in Islamic civilization and in Medieval India.

APPENDIX I

RESEARCH PROJECTS APPROVED BY THE COMMISSION DURING 1990-93

a. *Ancient Period*

(i) Scientific Information in the Sanskrit Pali and Prakrit Inscriptions by Sibdas Chaudhuri, Calcutta.
(ii) Prastar Ratnāvalī of Muni Ratnachandra (English translation with notes) by L C Jain, Jabalpur.
(iii) The Technique of Architecture as revealed in the Purāṇas by M. Banerjee, Calcutta.
(iv) Mathematical Contents in the Digambara Jaina Texts of the Karananuyoga group by L. C. Jain, Jabalpur.
(v) Numismatics and Technology by Amal Kumar Jha, Nasik.
(vi) History of Textile and Weaving Technology in Ancient India by Mamata Chaudhuri, Calcutta.
(vii) Technical Terms related to Ecology, Geomorphology, Climatology, Agriculture, Mineralogy, Metallurgy and Allied Sciences, Industries and Crafts in North Indian inscriptions (AD 600-1250) by A. Chakraborty, Calcutta.
(viii) Suśruta's Contribution to Surgery by A.N. Sharma, Varanasi.

(ix) History of Agricultural Science in Ancient India by Lallanji Gopal, Varanasi.
(x) Study of Scientific Concepts in Brahmanical, Buddhist and Jaina Literature in Ancient India by S N Sen, Calcutta.
(xi) A Critical Study of *Kaśyapa Saṃhitā (Vṛdha-Jīvaka-Tantra)* by P.V. Tewari, Varanasi.
(xii) *Vṛkśāyurveda of Parāsara* with English Translation and Notes by N N Sircar, Calcutta.
(xiii) English Translation of *Cakradatta* by P.V. Sharma, Varanasi.
(xiv) Śaka Kuṣān a Age by B.N. Mukherjee, Calcutta.
(xv) Astronomical Parameters by George Abraham, Madras.
(xvi) Restoration of *Amṛta Aṣṭāṅga Hṛdaya Guhyopdeśa Tantra* – A lost Ayurvedic Text in Sanskrit by Bhagwan Dash, Delhi.
(xvii) Mathematical Models in Bījgaṇita of Bhāṣkarācārya by Mahadev Dutta, Calcutta.

b. *Medieval Period*

(i) A Critical Study of *Yogaratnākara* by Nirmal Saxena, Bareilly.
(ii) A Critical Study of Sanskrit Alchemical Text *Rasopaniṣad* by V.J. Deshpande, Pune.
(iii) Evolution of Kashmiri Shawl Craft and Design based on Persian Sources by K.N. Pandita, Kashmir.
(iv) The Temple of Orissa – Historical Documentation of its Structural Engineering aspects by S.K. Misra, Bhavnagar.
(v) Minerals and Metals in Pre-Modern India (1200-1900 AD) by A.K. Biswas, Kanpur.
(vi) Shipping and Ship Building in India – Medieval Period by Baldev Sahai, Delhi.
(vii) The Process of Modernization of Indian Science (17th and 18th cent) by M.A. Alvi, Aligarh.
(viii) Physical Sciences in Medieval India by S. Jafar Mahmud, Delhi.
(ix) Eclipses and occulation in Indian Astronomy K.S. Shukla, Lucknow.
(x) Science Atlas by A. Rahman, Delhi.
(xi) Edition and Translation of *Sadaratnamālā* by M.S. Rangachari, Madras.
(xii) Critical and Scientific English commentary of *Bhav Prakāśa* by L.V. Guru, Varanasi.
(xiii) Ali bin Rabban at Tabri-9th century Arab Physician by M.S. Khan, Calcutta.
(xiv) Unani Medicine in India – Pre Mughal Period by R.L. Verma, Delhi.
(xv) A Critical Study of *Ziz-i-Muhammad Shāhi* by S.M.R. Ansari and S.A. Khanghoni, Aligarh.

(xvi) *Tantrasaṅgraha* of Nīlkaṇṭha Somayaji by S. Hariharan, Bangalore.
(xvii) Arabic Source Materials for the History of Science in India by M.S. Khan.
(xviii) Analysis of selected Astro-Mathematical Manuscripts in Persian at Salarjang Museum – Hyderabad by R.K. Kochhar, Bangalore.
(xix) Development of Agricultural Science in Medieval Period by M. Mazumdar, Calcutta.

c. *Modern Period*

(i) History of Botany in India in Modern Times by B.M. Johri, Delhi.
(ii) Biography of Scientists in India Part I by A. Vasantha, Delhi.
(iii) History of Magnetic Studies (1850-1980) by S.N. Sen, Calcutta.
(iv) History of Past Major Cyclones in India by A.K. Sensarma, Madras.
(v) Food Technology Development in India (1800-1947) by K.T. Achaya, Bangalore.
(vi) Origins and Development of Nuclear Physics in India by B.B. Baliga, Calcutta.
(vii) History of Cultivation of Sandal wood Tree and its Prospects for promotion by S.P. Raychaudhuri, Delhi.
(viii) History of Pharmaceutical Development in India during last two centuries by Harkishan Singh, Chandigarh.
(ix) Modern Astronomy in Bengal during Company's Time by A.K. Chakraborty, Calcutta.
(x) On the Development of Physics, Astrophysics, Astronomy and Geophysics during the period (1800-1950) by S.N. Sen and Santimoy Chatterjee, Calcutta.
(xi) Calendar Reform in India in Modern Times by S.K. Chatterjee, Delhi.
(xii) Investigation of Commetary Records in Indian Traditions by S.D. Sharma, Patiala.
(xiii) Role of Intellectuals and Scientific Societies in the 19th Century Bengal by Durga Prasad Bhattacharya, Calcutta.
(xiv) Man's Quest for Knowledge of Materials, A Decisive Factor in Development of Western Scientific Thought by T. Ray, Delhi.
(xv) Some Aspects of Ramanujan's Mathematical Works by K.G. Ramanathan, Bombay.
(xvi) Meghnad Saha and His Time – A Short History of Physics, Astronomy and Allied Science in India (1900-1946) by Santimoy Chatterjee, Calcutta.

APPENDIX II

PUBLICATIONS OF NATIONAL COMMISSION, INSA

A Critical Study of Laghumānasa of Mañujla (AD 932) K.S. Shukla, Indian National Science Academy. New Delhi : 1990.

Interaction between Indian and Central Asian Science and Technology in Medieval Times, 2 Vols. Indian National Science Academy. New Delhi : 1990.

Vol. I : *General Ideas and Methodology, Astronomy, Mathematics and Physical Concepts.*

Vol. II : *Medicine, Technology, Arts & Crafts, Architecture and Music.*

Scientific and Technical Education in India-1781-1900. S.N. Sen. Indian National Science Academy. New Delhi : 1991.

Rasa Ratna Samuccaya by Sri Vagbhata Edited with English Translation Notes and Appendices – (two parts). Damodar Joshi. Indian National Science Academy. New Delhi : 1992.

History of Medicine in India. P.V. Sharma (ed). Indian National Science Academy. New Delhi : 1992.

Cakradatta – Ratna Prabhā with English Translation and Notes. P.V. Sharma. Chaukhamba Orientalis. Delhi : 1993.

History of Technology in India (Antiquity to 1200 AD). A.K. Bag. Indian National Science Academy. New Delhi. (Under print).

History of Technology in India (1801-1947). Jai Krishna (ed). Indian National Science Academy. New Delhi. (Under print).

Indian Journal of History of Science (Quarterly). (Editor : S. Sriramachari).

APPENDIX III

LIST OF INDIAN DOCTORAL THESES ON HISTORY OF SCIENCE

Ramesh Chand. *A Study of Siddhānta Śiromaṇi.* Gurukul Kangri University. Hardwar : 1991-92.

Babban Chaubey. *Mathematics in Ancient Indian Astronomy.* Ranchi University : 1989.

B.N. Chaudhary. *A Critical Study of Mathematical Contributions of Bhaskaracarya.* L.N. Mithila University, Darbhanga : 1989.

Amit Ranjan Das. *Brahmagupta and his Contributions to Mathematics.* Bhagalpur University : 1992.

Anupam Jain. *Contributions of Jain Scholars to the Development of Mathematics.* (in Hindi). Meerut University : 1990-1992.

Mritunjay Jha. *A Critical Study of the Contribution of Ancient Hindu (including*

Jain) Mathematicians from Ancient to Medieval Period to Algebra and Geometry. Bhagalpur University : 1989-90.

Vedanand Jha. *Aryabhaṭa II and his Contributions to Mathematics.* Bhagalpur University : 1992.

Sant Kumar Kapoor. *Mathematical Basis of Vedic Literature.* Kurukshetra University : 1990.

Yukio Ohashi. *A History of Astronomical Instruments in India.* Lucknow University : 1990-92.

Jai Narain Prasad. *Investigations into the Sūtras of Vedic Mathematics and Contributions of Indian Mathematicians.* Bihar University, Muzaffarpur : 1991.

Ramashish Prasad. *Indeterminate Analysis in Ancient and Medieval India.* Bihar University, Muzaffarpur : 1989.

J.N. Sah. *Algebra of Umar Khayyam and Bhaskaracarya : A Comparative Study.* L.N. Mithila University, Darbhanga : 1990.

Baleshwar Singh. *Patisara of Munišvara.* Bihar University, Muzaffarpur : 1992.

Udain Narayan Singh. *A Scientometric Analysis of High-Tech Physics in India, Australia, Canada and Israel.* Birla Institute of Technology. 1991-93.

Syam Shankar Thakur. *Hindu Mathematicians and Indeterminate Equations.* Bhagalpur University, 1991-92.