

## BALAJI PRABHAKAR MODAK — A NINETEENTH CENTURY SCIENCE PROPAGATOR IN MAHARASHTRA

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Balaji Prabhakar Modak (1847-1906) was a product of 19<sup>th</sup> century Maharashtrian renaissance. He shifted his interest from social and political movements to the area of science movements through translations of science literature available during his time. Modak being a hard core propagator enriched Marathi literature by his translations and original writings on almost all branches of natural and social science, then taught in schools and colleges. His public lectures on physics and chemistry in Kolhapur in 1870s coincided with K L Chhatre's astronomy lectures in Poona and Sakharam Arjun's lectures on gynaecology and general science in Bombay. Modak made great efforts to revolutionize the hitherto theoretical, urban and elitist movement for spread of science by extending it to the princes and masses of the southern Maratha region, with the help of his innovative science exhibitions. The demonstrative character of exhibits added a new dimension to the movement for spread of science in Maharashtra. In a sense, he extended Vishnushastri Chiplunkar's movement of de-anglicisation to science literature and may be taken as the first active science propagator from Maharashtra (spreading science at grass root level through his science exhibitions) and the predecessor to Marathi Vijnān Parisad and like-minded organizations. He introduced electric lamps in south Maharashtra and created scientific ambience in Kolhapur. He awakened the princes of south Maharashtra to play their due role for spread of science movement. He was one of the few Maharashtrian intellectuals who emphasized on the importance of scientific context of the *swadeshi* movement. Besides being a committed nationalist, Modak maintained universal view of the world science through out his life.

**Key words:** Balaji Prabhakar Modak, Books, Dying & Calico printing, Education, Industrial Exhibition, Science education, Science exhibition, Science Propagator.

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## Introduction

Science education was started in western India during the tenure of Mount Stuart Elphinstone (1819-1829), the first Governor of the Bombay Presidency. In 1823, the Engineering institute was established by George Resto Jervis to train surveyors and builders for public works department in Indian languages. In 1845, the Grant Medical College was developed, out of the medical school which started its work. At the initial phases, the College got enthusiastic support to western education in general, but did not receive much support from the vegetarian Chitapawan and Karhada Brahmins because of their disapproval of dissection. Mr. Jagannath Shankarseth appealed to Indians to study medicine in order to free Indians from high fee of English doctors whereas Mr. Bhau Mahajan asked them to join the engineering institute by giving up their caste prejudice.

In 1820, the native school book and school committee set up by Lord Elphinstone awarded rewards of Rs. 1000/- to Rs. 5000/- for the best Marathi and Gujarathi book. This contributed greatly to the publication of Marathi science literature on natural sciences. According to G. N. Sahastrabuddhe, the periodical of the Upayukta Jñān Prasārak Sabhā, (the Marathi wing of the students literary and scientific society of the Elphinstone College), led to the foundation of original Marathi Science literature<sup>1</sup>. The period between 1820 and 1860 witnessed many individual efforts in this direction. Balashastri Jambhekar, a scholar of mathematics, languages and modern sciences and a member of the Geographical Society, wrote Marathi text books on mathematics, astronomy, history and geography. He published regularly a glossary of scientific terms in his monthly *Digdarsan*. Hari Keshavji Pathare, a member of the Native Education Society, and the Vice President of Marathi Jñān Prasārak Sabhā, translated physics and chemistry books in 1833 and 1835, respectively in the form of couplets in simple scholarly Marathi. His Sanskrit based Marathi science terminology was adopted by later Marathi science writers. Bhau alias Govind Mahajan acquainted Marathi readers with modern science, psychology and European history through his periodical *Jñān Darsan* from July 1854 to April 1856.

The period after 1860 witnessed growth of original Marathi writing as well as research by Indian initiative on astronomy, medicine and botany. Kero

alias Vinayak Lakshman Chhatre (1824-1884), a second assistant at the Government observatory at Bombay in 1840 and later an Assistant Professor of Mathematics at the Engineering College, Poona and Elphinstone College, Bombay wrote Marathi text books on physics and mathematics and read papers on science to the Students' Literary and Scientific Society. He observed eclipses with the help of telescope and delivered public lectures on astronomy and water supply. He put forth the theory that solar spots (through the heat they generate) determine the amount of rainfall in a particular place. With the help of rainfall records of observatories, he devised formulae to calculate the years of excessive rainfall and famine. His book, *Graha Sādhanañci Koṣṭake* (1860) contained astronomical formulae (studies of ancient Indian and modern western methods), helped in determining date of the Mahābhārata War and started the movement for reforming Hindu calendar in Maharashtra.

Dr. Bhau Daji Lad (1822-1874), an eminent allopathic doctor and indologist, was associated with the foundation of the Victoria and Albert Museum and the Victoria Gardens in Bombay. Out of his thorough knowledge of ancient Indian medicine and pharmacological research in his private botanical garden (with a large collection of botanical specimen from the western coast) and with the assistance of his brother Dr. Narayan Daji Lad, he devised a leprosy cure from a plant *Hydnocarpus wightiana* known as *Tugarak* in *Suśruta Saṃhitā*. Dr. Narayan Daji Lad (1828-1875), a professor of chemistry and pharmacology in Grant Medical College, was one of the leading botanists from Bombay. He published research papers on botany in the journal of the Grant Medical College and the Medical and Physical Society. His Marathi books on chemistry in 1862 and pharmacology in 1865 were popular in Grant Medical College. Dr. Anant Chandroba Dukle (1829-1884), a vaccination superintendent of the Bombay Presidency, popularized small pox vaccination in Bombay.

Sakharam Arjun Raut (1839-1885), a professor of botany and surgery in Grant Medical College, Bombay, the first Indian assistant surgeon in the J. J. Hospital and vaccination superintendent for Bombay Presidency, was a leading Marathi writer on gynaecology, child-care, child psychology, and public health between 1865-1880. He wrote Marathi text books on principles and practices of medicine and obstetrics for the Marathi classes of Grant Medical College and distributed a Marathi pamphlet on prevention and cure of small pox free of

cost. He published a detailed account of the drugs in the Bombay Bazaar to identify fake drugs and contributed research papers on Botany and Medicine to the journals of the Medical and Physical Society and Theosophical Society. He discovered a plant called *Dressina furgussaina*. As one of the founders of the Bombay Natural History Society, he proposed a plan for development of Victoria Gardens. He lectured on science to the women wing of the Bombay Prārthanā Samāj and educated his step-daughter Rakhsmabai in medicine.

Atmaram S Jayakar translated into English a medical lexicon from Arabic. Dr. Kanhoba R. Kirtikar, a specialist of mental diseases and a botanist wrote Marathi books on botany and was the only Indian contributing research papers to the journal of the *Bombay Natural History Society* in the 19<sup>th</sup> century. Dr. Sir Bhalchandra Krishna Bhatavadekar was from a family of Ayurvedic practitioners, and believed in marrying ayurveda with allopathy. Women's medical education started in Maharashtra in the late 19<sup>th</sup> Century with Dr. Anandibai Joshi, the first lady doctor of India <sup>2</sup>.

In spite of these elite achievements mass education in natural sciences remained neglected till 1870s. Science was excluded from the curriculum of vernacular primary schools. Scientific instruction in High Schools was on par with European Primary Schools. Science being an optional subject, attracted few students in colleges. Bombay Presidency fell short of specialized science schools, and colleges and science professors. Little was done by the British Government and Private institutions to promote scientific research. Peile, DPI, Bombay, introduced physics and physical geography in class VI of vernacular primary schools and in training colleges but failed to include geology due to absence of Marathi books on the subject.

However in late 1870s and during 1880s, Bombay Presidency witnessed a systematic growth of science education with government initiative. Grey, DPI, Bombay, proposed a chair for science in Bombay University. Poona Engineering College (opened in 1868) was renamed as Poona Science College in 1879 by adding to it classes in agriculture, zoology and physics during Governorship of Sir Richard Temple. B. Sc. Degree, the first of its kind all over India, was introduced in the Bombay University in 1880. The Bombay Veterinary College and the Victoria Jubilee Technical Institute were started in 1888 and

1889 respectively. However, these professional institutions, being upper-cast dominated, did little to bring about technological improvements in these professions as the students tended to prefer Government jobs to professional work.

Except small annual grants for apparatus and chemicals, the Government did not spend adequately on science education. Grants were cornered by city colleges, adversely affecting science education in Mofussil. Further, with increase in fees in medical, engineering and technical courses and the growing predominance of history, geography and english in the curriculum after Richard Temple's Governorship, science education suffered a serious setback in Bombay Presidency.

Science courses were handicapped by want of scholarships and laboratory facilities, leaving students untrained for industrial employment. Due to high fees, in professional courses students preferred to join only those courses with scholarships and guaranteed employment. English as the medium of scientific instruction deprived Indian languages of science literature and terminology and encouraged rote learning of natural sciences among Indian students. Therefore, Indian scholars advocated application of Indian languages in science education with science terminology in modern Indian languages.

British emphasis on liberal instead of scientific and technical education led to proliferation of legal and teaching professions. Their neglect of original research and encouragement only to need-based technical education, produced clerks, overseers, and mechanics rather than research scientists. The individuals and the private societies who wrote and translated science books in Indian languages for primary and secondary schools faced financial difficulties in the absence of state patronage and readership. Neglect of scientific education in training colleges led to a low level of scientific instruction in the vernacular schools, generating low demand for science books which affected growth of original science literature in Marathi.

Minor Marathi literature on geology, agriculture, home industry and natural products was published in the last half of the 19<sup>th</sup> century. However, the university graduates in general doubted potential of modern Indian languages for scientific expression. DPI Bombay got translated a series of children's primer

on science. However, with the exception of K.L. Chhatre and B. P. Modak, translators owing to their lack of expertise in the subject failed to do justice to 7 out of 11 books of the series.

1880s saw emergence of specialized Marathi Journals on medicine, agriculture and pure science in Bombay, Poona, and Sholapur. The work of coining Marathi terminology commenced by Balshastri Jambhekar and Hari Keshavji Pathare gathered momentum after 1880 leading to the dictionary of Marathi Science Terminology by Marathi Sāhitya Pariṣad in 1901. However, religious and romantic literature along with history (popularized by the nationalist movement) had more readership. The period also witnessed rapid expansion in transport and communications, mainly in the efficient postal and telegraphic service, railway network and steam engine, slowly challenging the old order in big cities like Bombay and Poona<sup>3</sup>. However small towns like Kolhapur and Miraj remained feudal where Balaji Prabhakar Modak spread emerging scientific culture of Bombay and Poona.

### **BALAJI PRABHAKAR MODAK**

Balaji Prabhakar Modak was born on 22 March 1847, in a Chitpavan Brahmin family (village Achre, Taluka Malvan), of Ratnagiri district of Bombay Presidency and expired on 2 December 1906 (Fig. 1). A scholarship from the ruler of Sangli enabled Modak to complete matriculation from Sardar High School, Belgaum, and pursue higher education in Deccan College, Poona. Unable to appear for B. A. examination due to illness, Modak joined Rajaram High School, Kolhapur, as a first Assistant Teacher in July 1869. Modak was also a tutor to prince Shivaji of Kolhapur and Superintendent of the Rajkumar High School at Kolhapur founded exclusively for the children of Maratha nobility.<sup>4</sup>

Modak's training in theoretical and practical chemistry under Dr. Samuel Cooke (Principal of the Poona Science College), under a Government project distributing science apparatus to the schools of Bombay Presidency, proved a turning point in his life. The practical experience in laboratory gained here generated in him a passion for science. His appointment as a Professor of Physical



Fig.1 Balaji Prabhakar Modak (1847-1906)

Sciences in 1880 in the newly opened Rajaram College paved the way for his science exhibitions resulting out of his public lectures on science. To keep himself abreast of latest developments in science, Modak visited Bombay and Poona regularly.

Modak had developed interest in history. His pioneering books on the History of Kolhapur (from 1<sup>st</sup> century AD to the 1<sup>st</sup> decade of 20<sup>th</sup> century) served to revive interest in Shivaji's descendents ruling in Kolhapur but forgotten after Peshwa hegemony in eighteenth century.

Modak's first Marathi history of Bahamani rulers (1891) inspired Justice M. G. Ranade to seek his co-operation in his writing on 'The Rise of Maratha Power'. Modak's chronological table with corresponding dates of the Śaka era, the Raja Śaka (Shivaji Calender), Hizri, Fasli and Gregorian calenders from 1728 AD to 1894 AD was extremely useful to historians as well as lawyers. By the orders of Kolhapur Government, he translated into Marathi 24th Volume (on Kolhapur) of the Bombay Gazette, 1892.

Modak believed that history of a period was incomplete without details of trade, defense system, foreign contacts, transport and communication, average expenditure of a family, rainfall, crops, popular support to rulers, power politics of various classes, conflicts, if any, among various religious groups. Modak viewed history as a source of cultivating nationalism among youth during British colonial rule. He appealed to Indians to set up historical societies, launch historical journals and publish books out of historical articles from journals. He advised Shastris to study Sanskrit literature with modern analytical methods, modern Indian scholars to collect Persian books in order to study medieval history and British Government to fund scholarly pursuits.<sup>5</sup>

Modak, the Director of Industrial Museum (started in 1873 by Kolhapur Government on his suggestion) held an industrial exhibition in 1891 at Kolhapur.

Prompted by this exhibition, the Dewan of Kolhapur Meherjibhai Kuwar asked Modak to conduct an industrial survey between 1892 to 1895. On the orders of Kolhapur Government, he conducted research on the problem of limited employment opportunities for teachers in Kolhapur, with Sethna (the temporary Principal of the Rajaram College) and Kirtikar (Deputy Education Inspector, Kolhapur) in 1894-1895. He contributed to the development of the 'Native General Library', present<sup>d</sup> 'Karvir Nagar Vachanalaya', as its secretary and president. He wrote a book on banking when he was entrusted with reorganization of Southern Maratha Bank by Kolhapur government. Although not a member of any political organization, he was associated with the popular Maharashtrian leaders of late 19<sup>th</sup> century and strongly condemned British colonial practices in the fields of science and education.

Modak worked as temporary Vice-Principal of Rajaram College between 1894-1895 and retired as its Vice-Principal in 1900. He was offered membership of Royal Chemical Society and Principalship of Kalābhavan, Baroda. As Chairman of the annual gathering of Bombay Marathi Grantha Saṅgrahālaya in 1904 he emphasized the need to use Marathi in higher education. There were unsuccessful attempts to appoint him as the Chairman of Kolhapur Representative Council in 1906. Modak spent his retired life studying the *Bhāgavad Gītā* and writing science books till his death on 2 December 1906<sup>6</sup>.

### ROLE IN SCIENCE EDUCATION

Modak strongly advocated inclusion of natural sciences in the curriculum on equal (if not higher) footing with social sciences right from the primary level, in order to inculcate scientific temper and to accelerate Indian Industrialization. He argued that, the study of physical science was imperatively needed in India as Physical Arts were extremely backward. People devoid of scientific knowledge and untrained in scientific experiments ascribed everything to supernatural causes. Religion seconded by superstition divided people into several castes and produced intellectual stagnation by discouraging the spirit of inquiry due to unbounded reverence for old institutions. Science based on empirical knowledge could alone dispel the darkness of ignorance by proving that the nature is governed by some fixed and invariable law.



Thus science would further the ultimate aim of education i.e. intellectual advancement of the regenerated Indian mind and the development of Physical Arts. No branch of knowledge other than natural science had exerted so much decisive and beneficial influence on the progress of civilization in a very short period. If the claim of science was readily allowed in the 'Civilized European Continent', it must be allowed with still greater force in a country like India, which could not claim the credit of having made a single discovery in physical sciences and had yet a lot to learn from the western nations in that field.

Modak urged the government, voluntary organizations and the Indian princes to lend active patronage to science education and scientific research. He advised DPI, Bombay and the Mumbai Marathi Grantha Sangrahalaya to reward the best Marathi Science book on the model of DPI, Bengal. In order to produce scientific literature in Indian languages, Modak appealed to Indians to emulate Russia and Japan by inviting foreign professors to teach science through languages for the first five years and to teach and write books on science in Indian languages for the next five years. He favoured the moves of sending Indian artisans abroad for learning modern techniques of industrial crafts and urged Indian Princes to follow the footsteps of Abasaheb Kagalkar, Balasaheb Mirajkar and Sayajirao Gaikwad in patronizing the movement for spread of science, as they alone had resources to finance expensive science equipment and research ventures yielding no immediate financial returns.<sup>7</sup>

In order to disseminate scientific information among laymen and to facilitate Marathi science textbooks for future Marathi schools and colleges, Modak wrote and translated science books in Marathi. Out of his 38 published books (original writings and translations) 24 were on various branches of science such as physics, chemistry, mechanics, health and hygiene and zoology. His son and biographer, Ganesh B. Modak, credited him with an unpublished book on agriculture.

Modak's first science book, *Rasāyan Śāstra, Pūrvārdha* was on inorganic chemistry, and dedicated to Dr. Samuel Cooke. The book was well received by readers, Marathi Press and the Department of Public Instruction. This detailed Marathi book on chemistry was a milestone, as the information on Chemistry in Kero Lakshman Chhatre's book *Siddha Padārth Vijñān* (Physics) was meager and Dr Narayan Daji's book *Rasāyan Śāstra* (Chemistry) was used essentially by the students of Grant Medical College.

Modak's book was reviewed in *Nibandhamālā* of Vishnushastri Chiplunkar (a champion of Marathi language in late 19<sup>th</sup> century) and in *Vividha Jñān Vistār* (a leading Marathi journal of the period). The editor of the *Vividha Jñān Vistār*, Bhausahab Gupte, compared Modak's task of introducing western science in Indian languages, without leaving any trace of its foreign origin, to that of Varāhamihira in ancient India. Vishnushastri Chiplunkar credited him with pioneering the movement to liberate Marathi from English domination, through original scientific in Marathi. Chiplunkar appreciated Modak's simple style of scientific writing developed out of his experience as a science teacher and public demonstration of science experiments in Kolhapur. Chiplunkar appreciated Modak's book with numerous illustrations, since experiments and scientific explanations of natural phenomena in daily life would be greatly useful in science education of students and the masses and its popularity in well equipped museums.

In his critical appraisal of the book, Bhausahab Gupte disapproved Modak's definition of atom and molecule to explain chemical combination and his Marathi terminology for oxygen bromide gas and Davy's safety lamp and adulterated Marathi expressions like guru carborated hydrogen, which Vishnushastri Chiplunkar pardoned as Marathi science terminology was in the making. *Vividha Jñān Vistār* pointed out faults in Modak's footnotes, experiments illustrations and a few explanations. It also opposed Modak's arguments about Hindus not being credited with any discovery in natural sciences.<sup>8</sup>

Modak discussed non-metallic elements and their compound in his second and third volumes on organic chemistry, the latter mainly based on Rascoe's book prescribed for Matriculation. Modak wrote three original books on organic chemistry (one unpublished) and translated Dr. Samuel Cooke's book on inorganic chemistry prescribed for Matriculation.

Modak's first book on physics, '*Sr̥ṣṭi Sāstraci Mūlatatve*', published in 1877 was a collection of his lectures delivered in Rajaram College. Modak translated *Elements of Natural Philosophy* by Theodore Cook and the book of Ganot and Lordon on heat prescribed in English Schools, on the initiative of the Department of Public Instruction, Bombay Presidency. Modak translated the ninth volume (on physics), *Aneka Vidyā-viṣayak Bālas'ikṣā Granthamālā*

On the request of Prof. T. K. Gajjar, Modak translated volumes on electricity, magnetism, sound and light from Ganot's book, 'Popular Natural Philosophy,' for Gajjar's series '*Śrī Sāyaji Jñānamāñjuṣā*'. The original work he published in Marathi on sound and light by adding information from English books which proved a landmark in the history of Marathi science literature for being the first Marathi book explaining in detail all the theories on the subject.

Modak translated Hathorn Thwe's book on mathematics prescribed for High School and published separately mathematical and statistical problems from the same book. Modak wrote an original book on mechanics for college students. He published a translation of *Way to Health* prescribed in English schools as *Ārogya Mārg* and the book of sanitary science as *Ārogya Śāstra*, covering elementary information on human anatomy, primary healthcare measures for public and private health. The chapters on childcare, obstetrics and first aid for accident victims were translated with the help of Dr. Vishnu Gopal Apte, the Assistant Court Surgeon of Kolhapur. These books emphasized the need to observe cleanliness, provide ventilation and drainage facilities to implement Government legislation conducive to public health and criticized superstitious dissuading Indians to avail of modern medicine. In order to acquaint Indian readers with health consciousness of an average European, Modak retained the information on European ideas about housing, clothing and food, in the translation.

On the suggestion of the DPI, Bombay, Modak wrote two volumes of *Padārtha Varnan* with information on metals, minerals, precious stones and useful products derived from trees and animals having industrial and medicinal values not covered in textbooks. Modak's book on elementary zoology published posthumously by his son, Vishwanath B. Modak was greatly appreciated by V. B. Sohoni, Principal of the Poona Training College for its method of classification of animals.

Modak's books with illustrations and guidelines for scientific experiments spread up-to-date scientific information on gases, water, electricity, magnetism, gravitation, laws of buoyancy, sound, light, wind, clouds, atmospheric pressure, metal and metal compounds, Dalton's atomic theory, hydrogen, oxygen, alkalis, crystals, public and individual health and hygiene, chemical products, medical properties of trees and animals, photosynthesis,

pollination and the principles underlying the working of scientific instruments, like calorimeter, barometer, kaleidoscope, spectroscope, prisms, concave and convex mirrors, camera and magic lantern. No other Marathi writer had written earlier in detail on such a variety of subjects.

Owing to Modak's path breaking contribution, G. N. Sahasrabudhe and G. D. Khanolkar called Modak the 'Standard Bearer' of Marathi Science literature in the 19<sup>th</sup> century. According to them, Modak was convinced about the dire necessity to spread science, in view of the numerous problems encountered due to low level of scientific knowledge among students and the public, when G. V. Joshi had launched the movement for industrialization of Maharashtra. Noting Modak's contribution in disseminating scientific knowledge, the editor of the *Rajaraman* (house journal of Rajaram College) had rightly observed that although not a research scientist, Modak's contribution in spreading science cannot be undervalued as he played a significant role in the history of science education in Kolhapur.

Modak's science books containing information a little more than present high school text books might appear elementary to the present generation. However, his voluminous writing on almost all branches of science was a step ahead of scientific articles of Balashastri Jambhekar and Bhau Mahajan and generalized science books of Hari Keshavji Pathare. It was indeed a Herculean Task in view of low scientific literacy in India, absence of scientific terminology and apathy of the average educated Indian.

In his work, Modak readily accepted suggestions from experts like Dr. Bhalchandra Bhatavadekar – an eminent medical practitioner in Bombay and the right hand of Sir Phirozeshah Mehta, and V. B. Sohoni, Principal, Poona Training college as well as criticism even from a matriculate like Bhaisaheb Gupte of *Vividha Jñān Visfār*. Modak was helped and encouraged by Chatfield, DPI, Bombay, who instructed all libraries through a circular to buy Modak's translation of the *Popular Natural Philosophy*, Vol. I, *Electricity and Magnetism* by Ganot. Modak's permission was sought to translate his books in Gujarati and Kannada.

Dissemination of scientific information among Indian masses being main thrust of his writing Modak sold his books at subsidized price, in spite of large

expenditure incurred in printing stenciled figures. While serving his mission, Modak had to struggle often with discouragement from a section of educated people, who doubted utility, readership and circulation of scientific literature in Indian languages. However, Modak continued to publish science books, with a missionary zeal, in spite of waning support from the DPI, Bombay and reduced chances of financial help from the Princes of Kolhapur and Miraj during famine.

As Modak considered diffusion of knowledge, a solemn duty of educated people, he tried to persuade his scholarly friends to write on subjects of their interest in Marathi. When they harped on the financial problems involved in the work, Modak sighted examples of the medieval poets like Moropant, Waman Pandit, Mukteshwar and Tukaram, who composed poetry out of pure personal interest, and as a religious service. Modak was convinced that his books owing to their social utility like those of medieval marathi poets (whose poetry survived even in the absence of printing technology) would stand the test of time. Comparing his work of stemming the tide of anglicization of Maharashtra in the field of science to the similar work undertaken by Vishnu Shastri Chiplunkar in the field of literature, G. N. Sahasrabudde attributed Modak's failure (against Vishnu Shastri's success) to the numerous difficulties destined in the path of championing an unpopular cause and observed that his failure in this effort not only frustrated him but also discouraged all those who tried to emulate his example.<sup>9</sup>

Modak believed that science literature in Indian languages ought to spread the most modern scientific knowledge with its practical application. For faster diffusion for scientific knowledge, Modak recommended Indian scientific terminology. According to him, science terminology coined in Indian languages should be simple, lucid and indicative and should be uniform to all Indian languages. It should be derived from Sanskrit roots (having the system of prefixes and suffixes) with regional variations, like modern European languages adopting Greek and Latin oriented terminology with national variations. Modak did not hesitate to use even Pali and Persian words and retained English terms whenever he could not coin Marathi equivalents. He used the word 'Sṛṣṭi śāstra for Physics' instead of the popular word *Siddha Padārtha Vijñān*'. Although an advocate of Sanskrit –based Indian terminology, he highly disapproved complicated, lengthy incomprehensive terms. He welcomed Ranade's moves to incorporate scientific terminology in his English Marathi General Dictionary.

Modak was in favour of gradual introduction of Indian terminology; century-old learning of ayurveda in India simplified the task of coining medical terminology, however a lot of time and great amount of efforts would be required to coin Indian terminology for physics and chemistry (especially chemical compounds like bromide, sulphate) which developed mainly in Europe. Secondly, the scientific world required a universal language for faster exchange of scientific information. Thirdly, since chemical industries in India were in the hands of British, English chemical terms were in vogue in the market. Modak favoured provisional co-existence of English terms in literature, till science education was imparted in Indian languages and Indian industries were run by Indians themselves. He refrained from using the newly coined, simple and indicative terminology of Deshmukh and Gajjar.

Most of the terms (e.g. *Sūrya Lekhan* for Heliograph) coined by Modak were indicative of the function of the object and were understandable to a Marathi High School student, with Sanskrit as the second language. These types of terms have been incorporated in the present Marathi science text books with a few exceptions. He coined new Marathi terminology for physics, mechanics, health and biological sciences, and also listed them at the end of his books in order to evoke public discussion to finalize the right Marathi terms and appealed to other science writers to follow the same practice. He refrained from coining Marathi words for chemical elements, (including hydro-carbon) compounds and formulae, a practice still followed in Marathi text books. In his Marathi biography of Raghuvēer, Shridhar Dattatraya Limaye, an eminent chemist, in the Post-Independence Maharashtra credited Modak for his unparalleled voluminous Marathi science literature as well as pioneering thinking on coining Marathi Science terminology.<sup>10</sup>

## SCIENCE EXHIBITIONS AND THE INDUSTRIAL SURVEY

Encouraged by Abasaheb Kagalkar and Krishnaji Bhikaji Gokhale in the early stages and financed by Kolhapur Government throughout, Modak held annual science exhibitions in the Christmas vacation in Rajaram College from 1883 to 1896, in order to acquaint the public with the latest scientific inventions. With growing public response, their scope was widened by adding

new equipment from time to time. *Śilpa Kalā Vijñān*' a science journal edited by Mahadeo Ballal Namjoshi (the right hand of Bal Gangadhar Tilak) reported in 1888, Modak's science exhibition of 1887 and an anonymous visitor described in January 1897 in *Karmānuk* (a Poona based monthly) Modak's grandest exhibition of 1896.

In organizing the science exhibitions, Modak was helped by his colleagues, Kelkar and Dhurandhar. His exhibitions were widely advertised and public force was stationed to maintain law and order. Free but mandatory daily entry tickets were distributed to visitors. The first day of exhibitions was reserved for honourable guests, nobles and organizers, the second and third day for students and rest of the days for the public. According to the report published in '*Śilpa Kalā Vijñān*', the number of visitors of the exhibition of 1887, ranged between ten to twelve thousand per day. The smart students of Rajaram College including Narasimha Chintaman Kelkar (later associate of Bal Gangadhar Tilak) and Govind S. Tembe (later famous Harmonium player) with their experienced teachers, demonstrated scientific experiments to visitors with the help of instruments used in diverse branches of science placed in separate rooms on elevated platforms. N. C. Kelkar noted that a special room was allotted to physics and the experiments connected with electricity enjoyed precedence over those with chemistry.

In these exhibitions, Modak displayed the latest machinery like X-ray machine, camera, surgical instruments, telescope, and microscope, coil illustrating Faraday's law, Morse's telegraph, Edison's phonogram, water mills, automobiles and fire engines. Volunteers disseminated scientific information with practical demonstration on electricity, sound and light, manufacture of dyes from trees, flying of toy guns using hydraulic pressure, magnetization and demagnetization and law of gravitation (by dropping a coin and a paper simultaneously from same distance). Various types of snakes, crocodiles, and birds stuffed with straw and coins from diverse periods of history were brought from the Industrial Museum especially for science exhibition. The anonymous visitor was delighted to see through microscope enlarged portraits of the English Royal family, Bengal grams looking like pomegranates, eggs of caterpillars, and the system of blood circulation of frogs. The science exhibition convinced him about potentiality of science to master the five elements of nature.

N. C. Kelkar noted in his memoirs that spreading of Dynamo wires in verandah and lighting of colourful lamps chandeliers and hanging lamps of clay with the help of electricity at night reminded the students of the Rajaram College of a marriage ceremony or a Diwali celebration. They were terrified at the strong burning power of the arc light in the experiments connected with electricity. They were delighted to see artificial rainbow appearing in the vacuum tubes. Girls standing in the circle shrieked and gesticulated when they received electric shocks. Inspired by Modak's exhibitions, his semi-literate students too spread science in other villages by demonstrating experiments.<sup>11</sup>

Modak's activities in spreading science were encouraged and financed by the Princes of Kolhapur and Miraj. In fact, without the sponsorship of Kolhapur Government, his science exhibitions would not have materialized. Abasaheb Kagalkar, the natural father of Shahu Maharaj, the Regent of Kolhapur and a student of Modak in the Rajkumar School Kolhapur, solely sponsored Modak's science exhibitions till 1884. Influenced by Modak, Abasaheb conducted science experiments. He furnished the common laboratory of Rajaram High School and Rajaram College with scientific instruments purchased during his annual Bombay visits with Modak, and a binocular worth Rs. 1000/- from England. Modak attributed continuing his scientific pursuits to the financial assistance and encouragement of Abasaheb Kagalkar. The princes of Kolhapur entrusted to Modak, the common laboratory of Rajaram High School and Rajaram College during his teaching career from 1870 to 1900 and permitted him to work there after retirement.

Gangadhar Patwardhan alias Balasaheb Mirajkar, the prince of Miraj, another student of Modak in Rajkumar High School Kolhapur was his sole assistant in the earlier science exhibitions. On Modak's inspiration, he wrote '*Mūtra Parikṣā* and *Rasāyan Śāstra* and delivered public lectures on science at Miraj. In the preface to *Rasāyan śāstra* dedicated to Modak, Balasaheb Mirajkar noted that he had full faith in pleasant and encouraging nature and empirical knowledge of his great teacher, Modak. Others could hardly imagine the extent to which he was benefited by Modak's perpetual love and selflessness and could master chemistry only because he tread upon the path shown by his great teacher. Balasaheb delivered public lectures on science and opened a well furnished laboratory at Miraj named '*Ganeśkalā Gṛha*' by employing US trained technicians.



He sponsored printing of 200 stencilled figures in Modak's translation of Ganot's volumes on Electricity and Magnetism, when Baroda Government discontinued 'Śrī Sāyaji Jñān Manjuṣā'. Balasaheb conducted experiments in the 'Gaṇeśkaḷā Gṛha' on Modak's articles on dyeing and calico printing published in '*Śilpa Kalā Vijñān*'. However, a book based on these articles could not be compiled due to Modak's sudden death. Thus, with the help of his associates Modak created scientific ambience in Kolhapur and its vicinity; so much so that his name became synonymous with science.<sup>12</sup>

After submitting his plan for Industrial survey of Kolhapur to the Industrial conference of Poona (1892) for further suggestions, Modak conducted Industrial Survey of Kolhapur with the help of questionnaire and his personal extensive tours of forests and the interior areas motivating illiterate people to co-operate with him in the investigation by explaining to them the purpose of the Survey. After analyzing the problems of Industries like cotton and blanket weaving, tanning, parched rice making, oil processing, sugar refining, dyeing, lacquer work and bangle making, Modak proposed to grant loans to artisans, capital at a low interest rate of 6% and incentives to promote settlement of Shahapur weavers in Kolhapur, in order to train Kolhapur weavers.

For marketing of the finished goods, he put forth the idea of central shops financed partly by Government and partly by people (in the form of shares) and managed by Mamletdars, at large centers where weavers and artisans could buy their raw material and sell finished goods. Profits earned by the state in this venture could be utilized wholly or partly, for training of weavers and purchase of expensive looms. In order to improve the lot of sugar industry (ruined by imposition of British tax on Indian sugar exports and the discovery of beet sugar in Europe) he suggested provision of better seeds and establishment of a large sugar factory in Kolhapur based on the English or the Mauritian model. His other suggestions were employment of trained potters from Calcutta and Jaipur, improvement in cattle breeding, cultivation of bark for colouring leather and that of bamboo, mulberry trees (for silk), coffee, tea, pepper and cardamom on the Mysore model. He proposed agro-based industries to generate rural employment, use of better agricultural implements, better irrigation and transport facilities and training of artisans. He advised the Kolhapur Government to export groundnut to Bombay, to use small hand presses for extracting linseed oil and castor oil, and to establish oil mills in Kolhapur.

Citing success stories of other countries, he strongly pleaded for adopting modern agricultural and industrial machines like manually operated vacuum pan and small centrifugal machines for easier crystallization of sugar. He supported Mahadeo Govind Ranade's proposal of a bank on European model for development of agriculture and industry, but did not wish to displace traditional creditors or Marwaris altogether. Modak opposed monopolies and favoured government support for development of industries. Bal Gangadhar Tilak, in his review of the Industrial Survey Report of Kolhapur in *Kesari* congratulated the Kolhapur Dewan for the Industrial Survey, a venture not attempted hitherto even by the British Government in India and appealed to him to honour Modak for his valuable contribution, in this regard.<sup>13</sup>

#### CONTRIBUTION TO SWADESHI MOVEMENT

In his report on the Industrial Survey of Kolhapur, Modak noted that the British administration, in spite of attempting manifold progress never aimed at assisting proper industrial development. On the contrary, many useful urban and rural industries, employing a large number of people, were allowed to dwindle away, without any counter balance in other industries. As a result, the bulk turned to agriculture. The iron melting furnaces of Kolhapur, turning annually 255 tons of iron worth Rs. 9000/- and employing 180 Dhavads (main suppliers of iron implements) in 1854, gradually declined by the end of the nineteenth century. Similarly, Kolhapur paper industry with 19 mills, with 666 employees suffered phenomenally, owing to competition from imported machine-made paper.

Modak was actively associated with the *swadeshi* shop at Kolhapur. For the revival of once flourishing dye-stuff manufacture and calico printing industry, with the help of modern techniques and ample Indian raw material, Modak wrote a series of articles entitled '*Raṅg Dene vā Chite Chāpāne*' in '*Śilpakalā Vijnān*', discussing in detail the modern western methods of manufacturing blue, yellow and red dye-stuffs from plants and bleaching techniques for cotton, jute, wool and silk, with guidelines for improving existing Indian techniques.

According to Modak, science education in Indian languages was indispensable for regeneration of Indian industry. In the 19<sup>th</sup> century, when the superior British finished goods, a product of European scientific inventions, resulting out of widespread scientific education in Modern European languages began to capture Indian markets, educated Indians, devoid of science education, precipitated ruin of Indian industry by favouring British finished goods instead of trying to improve Indian industrial techniques. Preponderance of history, economics and logic in education produced a plethora of lawyers and politicians capable only of ventilating political and economic grievances under colonial rule through political associations. However, even after half a century of establishment of the Bombay University, the Bombay Presidency lacked botanists, zoologists, mechanics and metallurgists, electricians researching in Indian flora and fauna, functioning and production of imported machines, application of electricity in daily life. Dearth of Indian metallurgists enable the British to exploit Indian metal deposits and forced Tata to invite experts from Japan.

Consistent attempts of *swadeshi* movement to regenerate Indian industries and create employment for ruined artisans by training them in manufacture of match sticks, soaps, paper, etc. and holding exhibitions of indigenous products failed drastically. Without general diffusion of scientific knowledge, a precondition to original research in industrial techniques, *swadeshi* movement could not and would not achieve success in its major objective of reviving Indian industries. “We regard the cloth manufactured in Indian mills as Indian cloth, however, all the machines used for its production are imported”. Regeneration of Indian industries was Modak’s major concern. According to him the instruction in physics and chemistry was more urgent than that of biology, agriculture, botany and zoology.

Modak viewed *swadeshi* movement as a source of self-reliance and Indianisation of education through development of modern Indian languages. According to him, education imparted in Indian languages could alone be termed as national education. He called the 19<sup>th</sup> century Indian universities as foreign because they were a few in numbers and taught in a foreign language, English. He pleaded for treating ‘education in Indian languages as an issue of paramount importance on the agenda of the *swadeshi* movement’.

He was critical of the first generation of English educated Indians, the intellectual leaders, for tolerating in India the education system suited to white colonies like South Africa and the Indian National Congress for not raising the demand for higher education in Indian languages along with its political demands. It was foolish on the part of the British Government to expect the Indian educational institutions to attain, at the initial stage itself, a high level of progress which British educational institutions failed to achieve even after many years, in spite of the wealth and might of the British Empire. As the British were reluctant to diffuse higher level of science education in India, refrained from establishing research institutions and controlled universities through legal hurdles. Modak called for Indian initiative in national and science education. He appealed to Indians to strive to further the neglected cause of education in Indian languages and persuade British Government to remove foreign character of the Government educational institutions.

Modak taught chemistry voluntarily after retirement in Samarth Vidyalaya, a nationalist school at Kolhapur. Modak appealed to the Committee of National Education, Calcutta, to open a National Primary School, a National High School and a National University in each Presidency teaching in modern Indian Languages, with equal positions for science and mathematics in curriculum. National High Schools, with a curriculum of 4 to 5 years should teach elements of all branches of natural science along with '*Bhāgavad Gītā*' Hindi should be one of the subjects rather than a medium of instruction in the non-Hindi speaking regions of India. In higher scientific instructions, students needed to be provided with science equipments, and familiarized with science based industries and English scientific terminology to facilitate their higher education abroad.

Modak's advocacy of *swadeshi* movement had two distinguishing characteristics, promotion of Indian languages in Education and regeneration of Indian industries with the help of modern science. In the former, he had many parallels in Maharashtra. However, in his interpretation of *swadeshi* movement as an impetus to develop industrial infrastructure using modern technology against the popular notion of boycott of foreign goods, he epitomized the response of the tiny scientific community of Maharashtra.<sup>14</sup>

## HIS EMPHASIS ON CURRICULAR REFORMS

As a solution to the educational problems of the Bombay Presidency in the 19<sup>th</sup> century and for faster diffusion of knowledge at grass root level, Modak suggested following curricular reforms:-

1. Continuing the system of memorizing arithmetical tables, Marathi grammar, the writing of Devnagari and Modi characters along with story telling, drawing, craft and music at primary level.
2. Introduction of science, health and hygiene in higher standards of vernacular primary school. Closure of the Anglo vernacular schools by adding classes V, VI and VII to the vernacular primary school.
3. Opening high schools, teaching natural and social sciences in Indian languages with English as one of the subjects.
4. Conversion of English high schools and training colleges into vernacular colleges by 'instituting chairs in natural and social sciences', to promote growth of original science literature – a precondition to facilitate higher scientific instruction in modern Indian languages.
5. Establishment of a school per village, a high school per taluka and a college per district.

He appealed to the Kolhapur Government to raise its expenditure on education from 1/3 to 1/2 of the local cess, and promote compulsory primary education in Kolhapur, on the Baroda model 'for intellectual development and liberation of cultivators from various problems'. He proposed instruction in agriculture, drawing, carpentry and wood-work in the Kolhapur technical school; pottery, weaving, clay modeling and designing in the Kolhapur vernacular school and hosiery, sewing, dress making, weaving, household work, domestic hygiene and Indian cookery in the Kolhapur girls school.

In spite of recognizing the role played by English education in intellectual regeneration of India, Modak strongly advocated application of Indian languages in education on following grounds. Education in English, a foreign language, required more time, energy, money, and a good intellect, which could be fruitfully diverted to the study of other subjects, in Indian languages. English, a foreign

language being medium of instruction, backward communities like Shimpi, Sutar, Mali, Maratha and Muslim had to face tougher competition with Brahmins in education. Even the middle classes in the moffussil area could not afford expensive English high schools at district places. Education spread faster in advanced countries, where mother-tongue was the medium of instruction, whereas mass education suffered in India, because English was the medium of instruction.

Indian backwardness in education arrested growth of science education and scientific research. Poor quality of education in vernacular schools hindered original thinking among Indian masses, marginalized their political participation, discouraged serious discussions on politics and international affairs in the vernacular press and encouraged blind following of English-educated leaders. He pointed out that while the scholars educated in English would gain international reputation, those studying in Indian languages would be instrumental in wider and faster diffusion of knowledge. The major difficulty in imparting education in Marathi in 19<sup>th</sup> century was scarcity of Marathi books on natural and social sciences. According to Modak, in this respect 19<sup>th</sup> century Indian vernaculars resembled their European counterparts in 15<sup>th</sup> century. However the former could not progress as much as the latter because the class of *śāstris* was washed away by the tide of English education, with discontinuous instructions in modern science, history and geography in traditional *pāṭhśālas*, whereas European schoolmen themselves imbibed the spirit of Francis Bacon.

Replacement of Marathi by Sanskrit as second language at High school and college level in late 1860s affected proficiency of graduates in Marathi. Consequently, there were very few good Marathi writers after 1875. Moreover, British Government's sole patronage to English language prejudiced Indian scholars against potential of Marathi to express scientific concepts. The ventures of the vernacular college of science and *Kalābhavan* at Baroda imparting higher scientific instruction in Marathi and Gujarathi were successful but short lived. Citing European examples Modak argued that, application of Indian languages in higher education would be followed by a spurt of books on various subjects and not vice-a-versa. According to him, the last decade of 19<sup>th</sup> century was high time to introduce science education in Marathi, as graduates of the Bombay University were available as teachers.

Modak's ideas on education evolved over a period of time. In 1876, he stressed the need to bring natural sciences on par with social sciences in curriculum. He championed the cause of education in Indian languages in 1888, for the first time. He recommended compulsory primary education and professional education in the Industrial Survey Report 1895. He proposed closure of Anglo vernacular schools and his scheme for middle level education in Indian languages, after research on the issue of limited employment opportunities for teachers in Kolhapur, in 1894-95. He spoke for the first time about his concept of the Marathi University in 1904 during his presidential address to the annual gathering of the Mumbai Marathi Grantha Saṅgrahālaya and about National Education in 1906 during the *swadeshi* movement launched in the wake of partition of Bengal.<sup>15</sup>

### **HIS PLACE IN THE HISTORY OF MODERN MAHARASHTRA AND INDIA**

Modak enjoys a significant place in the history of modern Maharashtra for being an 'avant garde' in many respects. He expounded technical and scientific education in Indian languages, when primary education was not free and compulsory even in British India. He envisaged Marathi University (half a century before establishment of Poona and Shivaji University, Kolhapur) when the sharpest Marathi intellectuals were agitating to introduce Marathi language as only an optional subject in university curriculum. Using holistic approach, he took into account socio-economic factors while interpreting history, more than seventy-five years before Marxian interpretation of history gained currency in India. He was the first Indian to conduct an industrial survey. By his preference for manufacture of capital goods with modern technology over the popular advocacy of production of consumer goods, Modak raised the fundamental issues in the process of Indian industrialization in nineteenth century. By his penetrating grasp of an issue and application of scientific method, Modak broke new ground even in history and economics, the subjects not of his regular pursuit.

However, out of his diverse activities Modak's most remarkable contribution to mass education was his work of spreading science undertaken as a life mission, with the conviction that India would lag behind other countries in the struggle for survival, in the absence of her progress in physical science.

Himself a product of the nineteenth century Maharashtrian renaissance, he tried to shift its exclusive emphasis from social and political movements to spread of science. In fact, he was the major exponent of the translation movement of science literature in Maharashtra in the nineteenth century. In this sense, he extended Vishnushastri Chiplunkar's movement of de-anglicisation of science literature. Devoid of research accomplishments in a particular branch of natural science unlike Bhau Daji, Sakharam Arjun, and K. L. Chhatre, Modak, a hard core science propagator, greatly enriched Marathi literature by his translations and original writings on almost all branches of natural and social sciences then taught in schools and colleges. His public lectures on physics and chemistry in Kolhapur in 1870s coincided with K. L. Chhatre's astronomy lectures in Poona and Sakharam Arjun's lectures on gynaecology and general science in Bombay. However Modak's attempts to revolutionize the hitherto theoretical, urban and elitist movement for spread of science by extending it to the princes and masses of the southern Maratha country. His innovative science exhibitions carried demonstrative effects and added a new dimension to the movement for spread of science in Maharashtra. In this sense he was the first active science propagator from Maharashtra (spreading science at grass root level through his science exhibitions) and the predecessor to Marathi Vijnān Pariṣad and like-minded organizations. He introduced electric lamps in south Maharashtra and created scientific ambience in Kolhapur. He awakened the princes of south Maharashtra to play their due part in the movement for spread of science. He was one of the few Maharashtra intellectuals who emphasized upon the scientific context of the *swadeshi* movement. Although a committed nationalist, Modak had a universal view of the world of science as testified by his views on scientific terminology. Although no evidence is available so far, to trace Modak's direct contacts with non-Maharashtrian science propagators except T. K. Gajjar of Baroda, the striking similarities between his ideas and work with his counterparts in Bengal and elsewhere present him as an active Maharashtrian representative of the wider all-India scientific community of the period. He resembled Mahendralal Sarkar in championing the cause of science for self-reliance by exposing British reluctance to promote science education and research in India and stressing the need for Indian initiative in this respect. However, unlike Sarkar, who tried to bring together scientific community of Bengal through his Indian Association for Cultivation of Science (IACS), Modak's individual efforts



in Kolhapur and the vicinity evoked hardly any repercussions in the scientific circles of Bombay and Poona. He was a loner, without followers to perpetuate his movement.

In translating science books in Marathi, he continued the work of his Maharashtrian predecessors as well as science propagators from Bengal, Baroda and the United Province. Although Modak's well organized annual science exhibition attracting more than 10,000 visitors per day had no parallel in nineteenth century India, he resembled Sir Syed Ahmed Khan in holding public lectures cum demonstrations. Whereas Syed Ahmed Khan got financial support from the landlords of NWP, Modak drew patronage from the princely states of Kolhapur and Miraj. In his advocacy of Indian languages as medium of instruction, the Baroda school of T. K. Gajjar directly inspired him. Modak was however, opposed to the Benaras School, which favoured Hindi as medium of instruction throughout the country.

Like his Bengali counterparts, the trend of revivalist nationalism of late nineteenth century had also influenced Modak. The shift of Modak's emphasis, in championing the cause of science education, from rationalist point of view (i.e. for fostering scientific attitude) in 1876 to nationalist point of view (i.e. for strengthening *swadeshi* movement) in 1906 was to a great extent a reflection of changing politico-intellectual climate in India. Like Pramath Nath Bose, a geologist, [who wrote *A History of Hindu Civilisation*] and Prafulla Chandra Ray, a chemist, [who wrote *History of Hindu Chemistry*], Modak, a science teacher, compiled *History of Kolhapur* to educate young generation about past Maratha glory. Like Pramath Nath Bose, Modak analysed the causes for general degeneration of Hindus. Like P. N. Bose, Modak desired marriage of modern science with Indian cultural values. Like the Bengali supporters of *swadeshi* movement, Modak looked to Japan as a role model for modernization and believed in Indian industrialization through application of modern science and technology evolving out of wide spread scientific education and higher scientific training of Indians abroad.

In spite of his penetrating vision and outstanding contribution to the renaissance in Maharashtra, Modak is unknown to the present scholars of modern Maharashtra for several reasons. He played no active part in the social and

political movement, the major concern of the historical research on modern Maharashtra. The main field of his activities was Kolhapur, the capital of a princely state, away from Bombay and Poona, the centers of modernization in the Marathi speaking region in the nineteenth century. More of a science propagator than a research scientist, Modak was forgotten even by the scientific community. Bereft of any scientific inventions to his credit and a group of dedicated followers, Modak failed to leave a long-lasting movement after him. The movement for science education through Indian languages, the mission of Modak's life received a blow, with the failure of the translation movement and its sole purpose in equipping Indian languages with the most modern scientific knowledge. This is mainly due to absence of general literacy and industrialization as well as, the preference given to liberal education over scientific and technical education at Government and private level.<sup>16</sup>

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