

Development of Indigenous Modern Science and Technology in Colonial India

Arka Acharjee

Assistant Professor of History, A.B.N.Seal College, Cooch Behar, W.B.

Colonialism is a very important process and its consequences are deep-rooted, huge and also in far remote level. In a colonial country like India the direct influence of colonialist hegemony falls upon its society, economy, politics, education etc. But the field of science and technology is also not an exceptional field. Britain very effectively and cleverly used the tool 'science and technology' to penetrate into the interior region in India by constructing Schools, text books about modern science, Railways, Modern Postal System, Telegraph etc. By using these tools the British succeeded to create an astonishing admiration into the mind of the common people of India about the field of western science and technology. But the educated Indians received this modern concept with various thrusting stage. In Indian Historiography there is a general tendency of highlighting the political, social and economic field of India under colonial rule but the practice of indigenous science and technology and its development in colonial rule is not so much highlighted issue. So through this article one attempt has been made to ventilate the views about the origin and development of indigenous modern science and technology in colonial India.

Debate regarding the emergence of modern science in India:

There is a serious question arises here regarding the actual time of the emergence of modern science in India. In search of the answer from this question we found two important concepts in this much related issue- I. Colonialist Concept/Thought, ii. Nationalistic Concept/Thought. The founder of Colonialist Concept was renowned historian '**George Basalla**'. In his famous work "**The Spread of Western Science**" he confirmed very clearly that before the arrival of the Europeans in India there was inexistence of modern science. In its counter act there is another viewpoints arises here- The Nationalistic Concept. The originator of this concept firmly states that India had a strong and rich heritage of the cultivation of science before the arrival of the Europeans especially British. But after the arrival of the British the development of the practice of science becomes faster and richer. But according to the nationalistic thinkers we should not forget that there is a specific reason for the introduction and development of the cultivation of modern science and technology by the colonial imperial British Govt. in India. They wanted to establish hegemony firmly in this field like society, economy, politics etc. They introduced various modern technology like Railways, Telegraph and Modern Postal System etc. on the basis of totally own interest and profit not for the up gradation of the lifestyle of Indians. But on the other hand in its counterpart another trend emerged out which we discussed previously i.e. Nationalistic Thought. This thought mainly established by some important figures of that time like Raja Rammohan Roy, Dr. Mahendralal Sarkar, Acharya P.C.Roy etc. who clearly believed and perceived that the practice and cultivation of modern science and technology must be based and exercised on the basis of the necessity and interest of the Indians.

Recent Researches regarding Cultivation of Modern Science and Technology in Colonial India in Contemporary Historiography:

In Contemporary period there are some important writings by some remarkable historians published on this topic like 1. "**Domesticating Modern Science**" by **Irfan Habib**, 2. "**Science and the Raj: 1857-1905**" by **Deepak Kumar** and 3. "**Western Science in Modern India**" by **Pratik Chakraborty**. The main content of these writings are- how far the modern science was applied in the colonial India, how far this modern science was the bearer and holder of economic development in colonial India, Special emphasis upon the science policy of Colonial Imperial Gov. and its consequences. Deepak Kumar in his book addressed modern science as a "**Dependent Science**"¹. Because according to him in colonial India

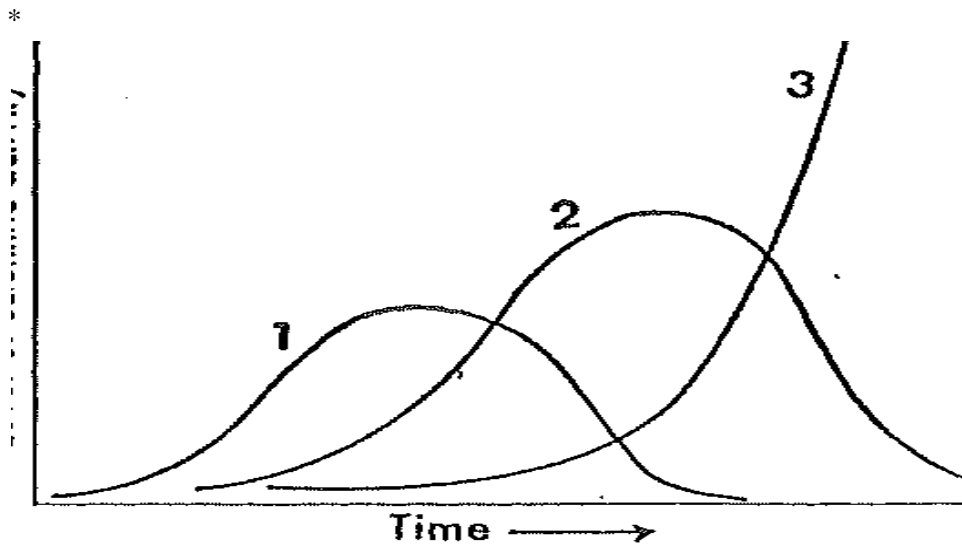
there was a very limited scope for the independent practice of science. This field was totally controlled by the Colonial British Gov. In this connection George Basalla gave a very important statement in his monumental work “The Spread of Western Science”. In this book he categorically divided the development and spread of modern science in colonial India into 3 stages²:

1. **Non-scientific society or nation provides a source for European science:**

In the initial stage the Colonial Govt. mainly focussing for collecting information about natural resources of India. They tried earnestly to extend their knowledge about Botany, Zoology and about the Geographical condition of India. The development of modern science was totally controlled around of this topic at first stage.

2. **A period of colonial science:** In 2nd stage Basalla points out the fact that some Indigenous scientists of Colonial India had started the commencement of the cultivation of modern science by western influence but they failed to develop this field of education due to lack of various modern association, modern laboratory and also lack of patronization of Indigenous Noble class etc.

3. **Completes the process of transplantation with a struggle to achieve an independent scientific tradition (or culture):** The 3rd stage is totally the consequence of previous stage. Due to lack of various important things the development of Indigenous practice of modern science was interrupted. Because of this the indigenous scientists perceived that political independency was so much necessary for the development of this field of study. So they tried to self-dependent in the practice of modern science which set the background of the emergence of “Peripheral Native Stage” of the cultivation of modern science. **David Arnold** in his monumental work “**Science, Technology and Medicine in Colonial India**” strictly criticised³ Basalla’s point of view but it can’t be ignored that from Basalla’s statement we gained the basic ideas of spread and development of modern science in Colonial India by Colonial Imperial British Govt.



g. 1. Sequence of phases in the diffusion of Western science.

*[source: George Basalla, The Spread of Western Science, Science (Magazine), Vol.156, 1956, pp. 612]

Beginning and Development of Modern Science in India:

The beginning of the modern science in India was connected with the arrival of the Portuguese in India on the eve of the 16th century. We know the fact from various records that in 1510 a Portuguese Doctor and Botanist came in India together with some merchants and later permanently settled in this country from the same year. He had created “Botanical Garden” in Goa mainly for the purpose of scientific research. But the development of modern science suddenly fastened with the establishment of 1st modern observatory by the initiative of ‘Charles Ochle’, an employ of the English Govt. of Madras Presidency in 1792. Astronomy, Naval Science, Aerospace were the subjects which were continuously researched in this observatory. On the eve of the 19th century by the interest of the Colonial British Govt. smoothen the way for the establishment of 1st modern type weather department in Ujjain. This establishment was full of modern equipment’s like Barometer, Thermometer etc. which were brought from Europe.

In the 1st half of the 19th century a group of talented European Scientists came in India and appointed in various professions. Most of them continued their work as a geologist in south and middle India. For example, Surgeon ‘P.N.Benza’ engaged in the geological search in Nilgiri valley of South India; Doctor ‘J.Finis’ in Nagpur and Doctor ‘Homfray’ in Raniganj region mainly for to collect information about its rich coal wealth. The main reason behind those researches inevitably connected with the colonial interest. In 1835 for the necessity of the traffic of boats or vessels specially searching for coal wealth “Geological Survey of the Coal formation in India” was established. This institution later transformed into G.S.I. (1851) which was located in Calcutta. So it was clearly visible that Colonial Gov. perceived the importance of the introduction and development of modern science and technology in Colonial India. So, in this respect Geology included in the syllabus of the Presidency College in 1851 on the basis of purely colonial interest.

Practice and Cultivation of Modern Science by Indigenous Scientists in Colonial India:

In Colonial India like other fields such as society, economy, politics etc. cultivation science and technology also controlled and manipulated by British Imperial Govt. By successfully using western science, technology and rationalism British ruling class trying to establish the righteousness of their position as a ruler. They had used this tool (i.e. modern science and technology) to establish their superior position against Indians. So this is the fact that those Indians who engaged with the practice of science failed to gain respect from the British. This critical situation helped to create the background for the emergence of so called “**Hindu Science**” which mainly presented by the Indian scientist cum nationalist as a competitor of western science. They wanted the “Hindu Science” actively connected with European Modern Western Science. This type of activity intensely prevalent in Bengal than any other region in India. So it is clearly noticed that practice and cultivation of modern science by Indigenous Scientists mainly divided into two categories: I. In Bengal & ii. Outside Bengal.

Practice and Cultivation of Modern Science in Bengal:

The 1st important step for the practice of modern science in Bengal was conducted by the followers of famous teacher in Hindu College Henry Luois Vivian Derozio (1809-1831). By publishing bilingual journal “**Vigyan Sarsangraha**” (Digest of Science) in 1833 the Derozian’s (followers of Derozio) successfully created and also extended scientific consciousness among the common people in India. Next important step for the cultivation of modern science in Bengal was centred on by the institution named “**Indian Association for Cultivation of Science**” (IACS) established by Doctor Mahendralal Sarkar (1833-1904) in 1876. In case of the development of the cultivation of modern science in Bengal we cannot

forget those important persons specially Acharya Prafulla Chandra Ray, Upendranath BrahmaChari, Acharya Jagadish Chandra Bose and many more.

Prafulla Chandra Ray (1861-1944) was one of the leading personalities in the practice of modern science in Bengal. His greatest achievement lies in creating independent group of researcher in Chemistry. He successfully presented India's rich heritage of science by his monumental writing "**A History of Hindu Chemistry**". In this book he had explained very efficiently the practice of the Chemistry in India from Vedic age to 1550 and it worked as a cardinal point for future researchers in this discipline. He had written 107 papers in all branches of Chemistry by 1920.

Next important figure in this field was Upendranath Brahmachari (1873-1946), one of the eminent scholars of medical science. He was famous for his epoch making invention- the antidote of black fever (**'Kala-Azar'**). His another important contribution in this field was the establishment of "**Brahmachari Research Institute**" in Kolkata around 1924. In the later years this institute had done quite well both in the field of research and manufacture of medicine. It is a most unknown fact to us that he was selected as a nominee for the Noble prize in 1929 in the category of Physiology and Medicine.

Another important person in this field was the world famous scientist and the pride of Bengal Acharya Jagadish Chandra Bose (1858-1937). Although he was the first who invented "Wireless Telecommunications" (**'Coherer'**) but this credit went to another person (Italian scientist 'Merchani'). He also invented the machine named "**Cresco graph**" which proved that the tree also has life. But his glorious contribution in the cultivation of modern science in India by the establishment of research centre named "**Basu Vigyan Mandir**" in 1917.

There was also an important contribution in the cultivation and practice of modern science in Bengal by famous "**Dawn Society**". This institution by the able leadership of Satish Chandra Mukherjee induced them in the search for India's rich cultural heritage. Another important aim of this society was their effort to establish close contact between the qualitative features of traditional science with new approach and features of modern science. But their greatest contribution was in criticising the so called "Downward Filtration Theory" of Colonial Govt. and presenting a new thought for the spread of modern science which mentioned as "Downward to Upward Theory". Among active members of the "Dawn" were Sister Nibedita, Bagha Jatin (Jatin Mukherjee), Rajendra Prasad (first President of India), Haran Chakladar, Radhakumud Mukherjee, Kishorimohan Gupta (principal, Daulatpur College), Atulya Chatterjee, Rabindra Narayan Ghosh, Benoy Kumar Sarkar, all future celebrities.

Apart from above mentioned personalities there were also a bunch of important persons who were memorable for their contributions in the practice and cultivation of modern science like **Sisir Kumar Mitra** (1890-1963), **Debendra Mohan Bose** (1885-1975) in Physics and **Nilratan Dhar** (1892-1986), **Jnan Chandra Ghosh** (1894-1959) in Chemistry. Undoubtedly their researches made an important impact in the development of modern science in Colonial India.

Practice and Cultivation of Modern Science outside Bengal:

Development of the cultivation of modern science also extended so far outside Bengal in different parts in India. In south India the man who contributed so much for the development of the modern science was famous scientist **Kariamanickam Srinivasan Krishnan** (1898-1961). He mainly famous for his comprehensive research on magnetic nature of crystal, the most definitive scientific studies on the

structure and tendencies of small crystals. He got huge popularity for his unique, distinctive and research paper on “**pleochroism in crystals and its relation to photo-dissociation**”. He played a significant role in the discovery of the ‘Raman Effect’.

In Punjab the credit for the development of the practice of modern science went to two famous scientist- I. **Sir Shanti Swarup Bhatnagar** (1894-1955) and ii. **Birbal Sahani** (1891-1949). Bhatnagar’s practice on science mainly centred on his subject Chemistry. He had worked in various institutions like Banaras Hindu University as a Professor of Chemistry, Director of University Chemical Laboratories of the University of the Punjab, Lahore University as a Professor of Physical Chemistry. His major innovation was improving the procedure for drilling crude oil. He added an Indian gum, which had the remarkable property of lowering the viscosity of the mud suspension and of increasing at the same time its stability against the flocculating action of electrolytes. But his greatest contribution in this field was the establishment of five national laboratories — the National Chemical Laboratory, the National Physical Laboratory, the Fuel Research Station, and the Glass and Ceramics Research Institute. This was the beginning of scientific laboratories in India⁴. On the other hand Dr. Sahani got huge respect by his innovative researcher in Pale botany. He founded the Birbal Sahni Institute of Palaeobotany at Luck now. His major contributions were in the study of the fossil plants of India and in plant evolution⁵. He was also involved in the establishment of Indian science education and served as the President of the National Academy of Sciences, India and as an Honorary President of the International Botanical Congress, Stockholm.

In Gujarat the man who responsible for the independent practice of Geology and made an epoch making work on this subject in Colonial India was **Darashaw Noshawan Wadia**(1883-1969). He was a pioneering geologist in India and among the first Indian scientists to work in the ‘Geological Survey of India’. He is remembered for his work on the stratigraphy of the Himalayas. He helped establish geological studies and investigations in India, specifically at the Institute of Himalayan Geology, which was renamed in 1976 after him as the **Wadia Institute of Himalayan Geology**⁶. His textbook on the **Geology of India**, first published in 1919, continues to be in use⁷. Undoubtedly Geology received a new impetus of development and extensive cultivation in India by his innate effort.

Development of Modern Science and Technology in India by Various Indigenous Institutions:

The history of the development of modern science and technology in Colonial India is closely connected with the establishment of various indigenous institutions. Actually these institutions acted as a medium for the widespread extension of modern science and technology.

Industrial Art Society: The first institution which started the process of development in this field was founded by **Rajendralal Mitra** (1829-1891) who later become the 1st Indian president of the ‘Asiatic Society’. In 1854 he had established ‘Industrial Art Society’ where the Indians could learn practical skills. It was an attempt to create an Indian infrastructure of science parallel to that of British infrastructure of western science. But this attempt ultimately failed due to inexperience, lack of infrastructure and money and addressed as an ineffectual and half-hearted attempt.

Indian Association for Cultivation of Science: Next important institution was founded by eminent doctor **Mahendralal Sarkar** (1833-1904) with the idea ‘of a national institution for the cultivation of science by the natives of India’ which resulted to the foundation of “Indian Association for Cultivation of

Science' in January, 1876. This institution acted as a forum for popular and college level lecture. Two eminent scientists Sir J.C. Bose (1858-1904) and Sir P.C. Ray (1861-1944) had given lecture at IACS.

Bombay Astrophysical Observatory:

Another striking example of far-developing Indian acquaintance with science is provided by **Kavasji Dada Bhai Naegamvala** (1857-1938), a physics teacher at Gov. College of Science (Now Engineering College), Pune. By his strong and keen interest resulted by the foundation of 'Bombay Astrophysical Observatory' in 1888. Naegamvala successfully completed his observation and showed Lockyer's (Eminent British Solar Physicist) perception was wrong compared to his hypothesis regarding 'nebular lines in Orion'.

Indian Institute of Science, Bangalore:

Indian initiative for technical education came from **Jamsedji Nauservanji Tata** (1839-1904), a product of English education and made a successful transition from trading to manufacture. The Tata group set up a Technical University at Bangalore named 'Indian Institute of Science'. This institution from its very beginning acted as a most successful technical institution in Colonial India and undoubtedly increase the dignity of India towards the world.

University College of Science and Technology:

'Pride of Bengal' **Sir Asutosh Mukherjee** (1864-1924) who was the honorary Vice Chancellor of Calcutta University during 1906-1914 and 1921-1923 make endowments to the University for setting up this institution in 1914 where the Professorship will be held by Indian themselves. He succeeded when C.V. Raman (world famous scientist who awarded Nobel Prize for his path finding research in Physics) resigned his Gov. Job to become a Professor at this study center.

Council of Scientific and Industrial Relation (CSIR):

CSIR was established on 26th September, 1942 funded mainly by the Indian Ministry of Science and Technology and it is one of the world's largest publicly funded organizations. Dr. **Shanti Swarup Bhatnagar** (1894-1955), one of the brightest luminaries of Science in India was the 1st director of CSIR. The wide range of the areas of CSIR included Aerospace, Biology and Biotechnology, Chemical Science and Technology, Coal, Minerals, Mining etc. This institution by its wide range of activity and as a medium of the development of modern science and technology become the National Pride of India.

Development of Space Research in Colonial India:-

Establishment of Observatory⁸:

Nungambakkam Observatory- The proud chapter of India's Space Research was opened between 1780 and 1790 when the Nungambakkam Observatory in Madras initiated a new phase of study in the field of Climatology associated with Meteorology, Weather Prediction and related subjects. This observatory acted as a medium for further development of the field of astronomy, geography, and navigation in India by systematic meteorological observations.

Colaba Observatory: It was established in 1823 in Bombay for astronomical and magnetic studies.

Trivandrum observatory: The inauguration of Trivandrum Observatory in 1836 expanded the scope for astronomical and meteorological studies in Colonial India.

Additional Observatory: An Additional Observatory was established in 1852 on the peak of Agasthyamalai near Trivandrum at an altitude of 6,200 ft. above sea level. This observatory fostered the study of the effect of altitude on magnetic and meteorological elements.

The **Agra** (1862) and **Nagpur Observatory** (1869) further extended the scope of studies of meteorological cum climatologically subjects in the country.

Indian Meteorological Department (IMD): In 1875 the Indian Meteorological Department (IMD) assumed the responsibility of coordinating the meteorological studies reported from various center. This study received a new energy after the establishment of a **Solar Physical Observatory** at Kodaikanal in 1899. This institution mainly set up for promoting the study of astrophysics. The study of atmosphere made rapid development due to the efforts of IMD. It introduced many of the latest methods for weather studies using balloons and similar instruments.

Tata Institute of Fundamental Research (TIFR): In 1932-33 India participated in the radio research programme of the 2nd International Polar Year. Ionosphere studies were started in 1933 at Bangalore and the experiments of cosmic-rays associated with high value of terrestrial magnetism leading to the establishment of this institution- 'Tata Institute of Fundamental Research' (TIFR) at Bombay. Research in the field of Cosmic-Ray also extended to the various parts of this country especially at **Bose Institute** (Calcutta), **Aligarh University** (Aligarh). The most remarkable progress happened in this field when **Physical Research Laboratory (PRL)** was established at Ahmadabad. PRL specialized in the field of cosmic rays and astronomy and took a leading role in forming 'the cradle of space research in India'.

The above discussion make us believe that the introduction and growth of modern science in India was with a view to serving the colonial interests. Thus the British-sponsored science, by the very reason of its existence, was field science. Geography, geology and geodesy, botany and zoology, archaeology, medicine and even astronomy—all these stemmed from the physical and cultural novelty of India. This science was colonial in the sense that its agenda was decided on grounds of political and commercial gain. But the studies made in India could not have been carried out any- where else. The European scientists at work in India felt and acted like pioneers in an exotic land, and were not always on the best of terms with their counterparts back home. The role assigned to the Indians in this State science was clear cut. They were to provide cheap labor which they did most conscientiously. The Superintendent of the Geological Survey had a very low opinion of the natives. He doubted whether the natives could ever prove competent for independent field work, which required 'the very quality which more than any other makes the western man differ from the eastern'.

In such atmosphere also, there were a few bright Indians who realized the importance of science and scientific investigations, and it is their zeal. They firmly believed that India had a strong heritage of science and technology before the arrival of the Europeans. So at first they were trained and hired to provide assistance to the government science machinery and later in the 'Indian-response stage', they took to scientific research on their own initiative.

From the above discussion we can know in a very limited scope how some Indigenous Scientists did a brilliant job which ultimately fostered the development of the modern science and technology in Colonial India. Actually the development of modern science and technology in Colonial India was indebted to both efforts- I. The British Sponsored Govt. Effort and II. The Indigenous Effort. Both contributed simultaneously for the worth-mentioning development of this field and remarkably this leads to Indians to prove themselves more than anybody else, that they as the inheritors of a great civilization and were capable of becoming full-fledged members of the world's science club.

References:

1. Kumar, Deepak- Science and the Raj (1857-1905), OUP, Delhi, 1995.
2. Basalla, George- The Spread of Western Science, Science (Magazine), Vol.156, 1956, pp. 612-613.
3. Arnold, David- Science, Technology and Medicine in Colonial India, CUP, Cambridge and New York, 2000.
4. Vigyan Prasar. "Shanti Swarup Bhatnagar". Vigyanprasar.gov.in Retrieved 2013-06-05.
5. R. Cuneo, S. Archangelsky (1986). "Ferugliocladaeae, a new conifer family from the Permian of Gondwana", *Review of Palaeobotany and Palynology*. 51 (1-3): 3-30. Doi: 10.1016/0034-6667(87)90016-9, Retrieved 14 February 2012.
6. "Wadia Institute of Himalayan Geology, Dehradun", Department of Science and Technology, Govt. of India. Retrieved 3 July 2014.
7. Stubblefield, C. James (1970). "Darashaw Noshawan Wadia. 1883-1969". *Biography. Memoirs Fell. R. Soc.* 16: pp.543-562. [Doi: 10.1098/rsbm.1970.0023](https://doi.org/10.1098/rsbm.1970.0023)].
8. Angelo, Josepha. The Dictionary of Space Technology. Frederick Muller Ltd., London, 1982.
9. Chakraborty, Pratik- Western Science in Modern India: Metropolitan Methods, Colonial Practices, Permanent Black, New Delhi, 2004.
10. Habib, Irfan & Raina, Dhruv (edited) - Domesticating Modern Science: A social History of Science and Culture in Colonial India, Tulika Books, New Delhi, 2004
11. Kumar, Deepak (edited)-Science and Empire, Anamika, New Delhi, 1991.
12. Sangwan, Satpal- Science, Technology and Colonization, Anamika, New Delhi, 1991.
13. Biswas, A. K. - Science in India, Firma KLM, Calcutta, 1969.
14. Krishnan, K.S. - The New Era of Science, Publication Division, Ministry of Information and Broadcasting, Govt. of India, New Delhi, 1957.