Progress of Science in Colonial India

- From the sixteenth century onwards, Europe began to outdistance India in scientific and material advancement. The rise of modem science in Europe strengthened European economic domination over the colonies where education, science and research were kept backward.
- After the establishment of the British supremacy over the Indian sub-continent. This was a very exciting time for the British rulers; a new empire was in the making and in the process of consolidation. The colonisers were out to collect the maximum possible information about India, its people and resources.
    - They faithfully reported what was best in India's technological traditions, what was best in India's natural resources, and what could be the most advantageous for their employers.
    - The rulers were also quick to realise that knowledge of the geography, geology and botany of the areas being conquered was essential. They fully recognised **the role and importance of science in empire-building**.
- **Feature in the early phase** of this period:
    - colonial scientists would try their hand at **several fields simultaneously** and each scientist was, in fact, a botanist, geologist, geographer and educator-all rolled into one.
    - As **data-gatherers**, the individual scientists were efficient. However, for analysis and drawing conclusions, they had to depend upon the scientific institutions in Britain, which received such data from many colonies.
    - The British made investment in botanical, geological and geographical surveys from which they hoped to get direct and substantial **economic and military advantages**.
    - **Medical and zoological sciences** did not hold such promise and, thus, they were neglected.
    - Research in physics or chemistry was simply out of question because these subjects were related to industrial development which the British did not want to encourage.
        - India was considered to be only a source of raw materials and a wonderful market for all sorts of articles manufactured in Britain, from needles, nibs and pencils to shoes, textiles and medicines.
    - However, **the setting up of some scientific bodies and museums** was a positive step.
        - Pre-British India had a weak scientific base and, therefore, neither scientific institutions existed nor were there any journals to spread scientific information.
        - **William Jones**, a judge of the Supreme Court of Calcutta and some other European intellectuals in the city realised this and founded **the Asiatic Society in Calcutta in 1784**. This society soon became the focal point of all scientific activity in India.
        - It was followed by **Agricultural-Horticultural Society of India** (1817), **Calcutta Medical & Physical Society** (1823), **Madras Literary and Scientific Society** (1818), and **the Bombay Branch of the Asiatic Society** (1829).
        - These societies rendered invaluable service, particularly through their journals which compared very favourably with the European ones.

- When the Crown formally took over the Indian administration in 1858, activities for exploring the natural resources in the country had already passed their formative stage.
    - The problem was more of consolidating the gains which individual efforts had made possible.
    - For this, many institutions were set up and the government expanded the **survey organisations**.
        - In 1878, the **three survey branches**-the **trigonometrical**, **topographical** and the **revenue** which had upto that time been separate departments, **were amalgamated**. Naturally, Revenue Survey got the upper hand.
    - Similarly, geological explorations were patronised because of their direct economic benefit.
        - The **Geological Survey of India** was created in 1851.
        - Unlike the Geological Survey or Survey of India, an organisation for carrying out botanical explorations did not come up.
- The establishment and development of various scientific departments and institutions called for a **different cadre**.
    - The biggest and the oldest was the **Indian Medical Service** which was raised and maintained basically to serve the army.
    - The most dis-organised sector was that of agriculture.
        - Though the maximum revenue came from agriculture, the problems of its improvement were too complex and the government left it in the hands of private agricultural societies.
        - Much later, in 1906, an **Indian Agricultural Service** was organised. However, it did not grow into a well-knit and integrated scientific department because of financial and administrative constraints.
    - A few branches which were of military or instant economic significance could manage to develop. But, on the whole, the efforts remained adhoc, sporadic and local in nature. The government wanted practical results rather than research papers.
    - An **excessive administrative control**, exercised at different levels, ensured that the colonial scientists would always dance to the official tune.
- In the educational scheme, science was never given a high priority.
    - **The charter of 1813** called for 'the introduction and promotion of knowledge of science among the inhabitants of British India'.
        - But it remained a pious wish, at least partly because the indigenous educational system was also not sympathetic to the idea.
    - In 1835, **Macaulay** succeeded in making a foreign language English the medium of instruction. Also, his personal distaste for science led to a curriculum which was purely literary.
    - The entry of science in schools was, thus, delayed.
    - A few medical and engineering institutions were opened but they were meant largely to supply assistants to British trained doctors and engineers.
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Ancient universities in India were leading centres of learning in their time and attracted scholars from other countries. So were the famous centres of Islamic learning in the medieval period in India. But these traditions did not survive.
    - It was in 1857 that the Universities of Calcutta, Bombay and Madras were set up more or less on the pattern of London University.
- However, it was only in 1870 that the Indian universities began to show some interest in science education.
    - In 1875, Madras University decided to examine its matriculation candidates in geography and elementary physics in place of British history.
    - Bombay was the first to grant degrees in science.
    - Calcutta University divided its B.A. into two branches- 'A' course, i.e. literary, 'B' course, i.e. science.
- A fact of great significance, however, was that the entire direction of colonial education was not towards opening up the minds of students or developing a questioning attitude. Rather it encouraged passive acceptance of what was taught or written in the books.
    - The books were in English and were mostly written and printed abroad. They depicted the British culture. Education so imparted, by and large, tended to alienate the educated people from their own culture.
    - Further, the educational milieu ensured lack of enterprise, and readiness to take orders from above, which was indeed the intention of the rulers.
    - Institutions and teachers looked at the British educational model as the ideal and, by and large, they tried to copy it even though they were in a very different social and economic situation.
- Thus, the British were primarily interested in strengthening their political and economic domination over India. They exploited India's resources to the full and developed a nominal scientific infrastructure for this purpose. However, in all other areas, like physics, chemistry and agriculture, in which scientific development was not imperative, no attention was paid.
    - In this period of colonisation, India's cultural heritage, scientific tradition and educational system got destroyed. In its place came a tradition of servility and an education that was designed to produce subservience rather than inculcate a spirit of free and creative inquiry.

The status of Scientific Research in Colonial India:

- In the absence of higher scientific education, scientific research remained an exclusive governmental exercise for a long time. It was, therefore, linked to the economic policies pursued by the imperial power.
    - A scientist serving the colonial power was supposed to not only discover new economic resources, but also to help in their exploitation.
    - In **agriculture**, it was basically plantation research with emphasis on experimental farms, the introduction of new varieties, and the various problems related to cash crops. These were basically cotton, indigo, tobacco and tea, which were all to be exported to Britain.
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Next came surveys in **geology** to exploit mineral resources, again for export as raw material.
    - Another major area of concern was **health**. The survival of the army, the planters and other colonisers depended on it.
- In spite of difficult conditions and the government's lukewarm attitude, quite a **few scientific works** were came out in this period.
    - Ronald Ross did original work on the relation between malaria and the mosquito.
    - Macnamara worked on cholera, Haffkine on plague and Rogers on kalazar. The famous medical scientist, Robert Koch visited Calcutta to work on cholera.
    - Bacteriological laboratories were set up in Bombay, Madras, Coonoor, Kasauli and Mukteswar. This shift towards bacteriological research had one significant result. It led to the growth of clinical treatment, private practice and a booming drug industry.
        - However, preventive measures like sanitary reforms, or even supply of drinking water to villages and towns remained neglected.
    - In other fields too significant developments took place through the effort of foreign and Indian scientists working in institutions here.
- **Response of the Local populace**:
    - The British activities did evoke some response from the local populace, particularly the educated section, who were looking for jobs in the colonial administration and economy.
    - A few Indians participated in the officially patronised scientific associations or institutions. However, they often searched for a distinct identity and established institutions, scholarships and facilities of their own.
    - **Ram Mohun Roy's** petition to Amherst asking for a proper science education became well known.
    - Bal Gangadhar Shastri and Hari Keshavji Pathare in Bombay, Master Ramchander in Delhi, Shubhaji Bapu and Onkar Bhatt Joshi in Central Provinces, and Aukhoy Dutt in Calcutta worked for the popularisation of modem science in Indian languages.
    - Geography and astronomy were the areas chosen first because, in these fields, the Pauranic myths were considered the strongest. Vyas, the author of Srimad Bhagwat, for example, had talked about oceans of milk and nectar.
        - This is part of popular myth even now, and this was attacked by these persons. For instance, Onkar Bhatt explained that Vyas was only a poet, not a scientist, and his interest was merely to recount the glories of God, so he wrote whatever he fancied.
        - Even Urdu poets, devoted mainly to the romances of life, took notice of the western science and technology. Hali and Ghalib, for example, talked about the achievements of western civilisation based upon steam and coal power.
    - The next logical step from these individual efforts was to give some organisational shape to the growing yearning for modem science.
    - In 1864, **Syed Ahmed Khan** founded **the Aligarh Scientific Society** and called for introduction of technology in industrial and agricultural production. Four years later, **Syed Imdad Ali** founded the **Bihar Scientific Society**.

        - These societies gradually became defunct.
    - In 1876, **M.L. Sarkar** established **the Indian Association for the Cultivation of Science**.
        - This was completely under Indian management and without any government aid or patronage. Sarkar's scheme was fairly ambitious. It aimed at original investigations as well as science popularisation.
        - It gradually developed into an important centre for research in optics, acoustics, scattering of light, magnetism etc.
    - In Bombay, **Jamshedji Tata** drew up a similar scheme for higher scientific education and research. This led to the establishment of the **Indian Institute of Science at Bangalore** in 1909. \
    - There was, thus, greater awareness about science in India by the turn of the century. This was especially so, as a movement to gain freedom from colonial rule emerged.

Impact of the Freedom Movement:

- By the early twentieth century, the Indian society had started witnessing the first stirrings for freedom from colonial rule. While their political aspirations led to a demand for self-rule, the frustration resulting from economic stranglehold found expression in their insistence on using only goods made in India.
- Swadeshi Movement provided further impetus for:
    - promotion of education along national lines and under national control with special reference to science and technology,
    - industrialisation of the country.
- In 1904, an **Association for the Advancement of Scientific and Industrial Education of Indians** was formed.
    - The objective was to send qualified students to Europe, America and Japan for studying science-based industries.
- As mentioned earlier, in colonial India the environment was not conducive to higher studies, much less to research. Indians were allowed only subordinate posts and even those who had distinguished themselves abroad were given less salary than the Europeans of the same grade and rank. This '**apartheid' in science** made the Indians react strongly.
    - **J.C. Bose**, the first noted Indian physicist, refused to accept this reduced salary for three years. Not only this, till the Royal Society recognised Bose, the college authorities refused him any research facility and considered his work as purely private.
        - J.C. Bose was unorthodox in one more sense. He was one of the first among the modem scientists to take to interdisciplinary research. He started as a physicist but his interest in electrical responses took him to plant physiology.
            - He invented crescograph, a device for measuring the growth in plants.
        - To fight for a place and recognition in the scientific circles in Britain was no less difficult than fighting against the administrative absurdities of a colonial government. Bose persisted and won.
    - Another noted Indian scientist, **P.C. Ray** had also suffered similarly.

        - On his return from England in 1888 with a doctorate in chemistry, he had to hang around for a year and was finally offered a temporary assistant professorship.
        - All through he had to remain in Provincial Service.
    - **P.N. Bose**, preferred to resign, when in 1903 he was superseded for the directorship of the Geological Survey by T. Holland who was 10 years junior to him.
- These problems were reflected on the political platform of the country.
    - In its **third session** (1887), the Indian National Congress took up the question of technical education and has since then passed resolutions on it every year.
    - K.T. Telang and B.N. Seal pointed out how, in the name of technical education, the government was merely imparting lower forms of practical training.
    - **The Indian Medical Service** was also severely criticised.
    - In 1893, the Congress passed a resolution asking the government "to raise a scientific medical profession in India by throwing open fields for medical and scientific work to the best talent available and indigenous talent in particular."
    - Whether it be education, agriculture or mining, the Congress touched several problems under its wide sweep.
- We find that the activities of this era had **two important features**.
    - One was that almost all the exponents of Swadeshi looked to **Japan as a major source of inspiration**.
        - Japan's emergence as a viable Asian industrial power and its subsequent military victory over Russia in 1904-05 caught the imagination of Indians.
    - Another characteristic was that quite often they showed **revivalist tendencies**.
        - This may have been because the distant past comes in handy for the recovery of a lost self or reassertion of one's identity.
        - This search for moorings made **P.N. Bose**, a geologist, mention about whom has been made above, write '***A History of Hindu Civilisation***' in three volumes.
        - **J.C. Bose** gave **Sanskrit names to the instruments** he had fabricated, like Kunchanagraph and Shoshangraph.
        - Many science popularisers had a tendency to show that whatever was good in western science existed in ancient India also. For example,
            - Ramendrasundar Trivedi's discussion on Darwin ends with comparing his theory with what is written in Gita.
            - Later, B.K. Sarkar wrote on the Hindu Achievements in Exact Science.
        - All these scientists were for the industrial application of modern science but failed to overcome certain cultural constraints, which was necessary for this effort. All they tried to do was to demonstrate that the Indian ethos and the values of modem science were congruent and not poles apart.
        - In such a situation, it was not easy to evolve a correct understanding of our intellectual and cultural heritage. This was all the more difficult because of the total colonial domination both in education and in social life.
- These efforts had, nonetheless, a **galvanising effect**.

    - Taking advantage of the **University Act of 1904**, which allowed the existing Indian universities to organise teaching and research instead of merely affiliating colleges, Sir Asutosh Mookherjee took the initiative of establishing a **University College of Science in Calcutta**. Eminent scientists such as P.C. Ray, C.V. Rarnan, S.N. Bose and K.S. Krishnan taught there.
        - This very college, although starved financially all through, produced a group of physicists and chemists who received international recognition.
        - By contrast, the contributions of many government scientific organisations staffed by highly paid Europeans were rather poor.
- Those who put India on the scientific map of the world were many.
    - **J.C. Bose** showed that animal and plant tissues display electric responses under different kind of stimuli, like pricking, heat etc. We have referred to his work earlier also.
    - **S. Ramanujan**, an intuitive mathematical genius contributed a lot to number theory.
    - **P.C. Ray** analysed a number of rare Indian minerals and started the Bengal Chemical and Pharmaceutical Works, a pioneering and pace setting organisation in the field of indigenous chemical and pharmaceutical industry.
    - **C.V. Raman's** research on the scattering of light later won him the Nobel Prize in 1930.
    - **K.S. Krishnan** did theoretical work on the electric resistance of metals.
    - **S.N. Bose's** collaboration with Einstein on the study of elementary particles led to what is known as **the Bose-Einstein Statistics**.
    - **D.N. Wadia** worked in the field of geology, **Birbal Sahni** in palambotany, **P.C. Mahalanobis** in statistics, and **S.S. Bhatnagar** in chemistry.
    - Apart from the individual contributions of these scientists, their greatest contribution was in the field of teaching and guiding research.
    - Many institutes were set up. For example, **the Bose Institute** (1917), **Sheila Dhar Institute** of Soil Science (1936), **Birbal Sahni Institute** of Palambotany etc. This gave further impetus to scientific activity in India.
- The need for an annual scientific meeting had been felt all along, so that different scientific workers throughout the country might be brought into touch with one another more closely. So far it had been possible only in the purely official and irregular conferences such as the Sanitary Conference or the Agricultural Conference. Thus, was born the **Indian Science Congress Association** (ISCA) in 1914 with the following objectives:
    - to give a stronger impulse and a more systematic direction to scientific enquiry,
    - to promote the interaction of societies and individuals interested in science in different parts of the country,
    - to obtain a more general attention to the cause of pure and applied sciences.
    - The objectives have not changed much since then and the ISCA has now grown into the largest organisation of Indian scientists and technologists representing all disciplines of science and technology.
- In the wake of **the first World War** (1914-18), the Government realised that India must become more self-reliant scientifically and industrially.

    - It appointed an **Indian Industrial Commission in 1916** to examine steps that might be taken to lessen India's scientific and industrial dependence on Britain.
        - The scope of the resulting recommendations was broad, covering many aspects of industrial development. But few of the Commission's recommendations were actually implemented.
    - Similar was the fate of numerous other Conferences and Committees. Whenever requests were made by India for starting new institutions or expanding existing ones, the government pleaded insufficiency of funds or inadequacy of demand.
    - The interests of the colonial administration and those of the nationalists in most instances often clashed.
- If we look at the events during the first quarter of the twentieth century, we find that this period was characterised by debate about further development.
    - When **Gandhiji** started his campaign for cottage industries, varying notes were heard at the annual session of the Indian Science Congress.
        - **P.C. Ray**, for example, held that general progress through elementary education and traditional industries, is a necessary precondition for scientific progress.
        - But many differed with him. **M.N. Saha** and his Science & Culture group opposed the Gandhian path of economic development and supported setting up of big industries.
    - The socialist experiments in Russia had unveiled the immense potentialities of science for man in terms of economy and material progress. The national leadership was veering towards heavy industrialisation and sucialism, both of which stood on the foundations of modern science and technology.
- On Saha's persuasion, the then Congress President Subhas Chandra Bose agreed to accept national planning and industrialisation as the top item on the Congress agenda. The result was the formation of the **National Planning Committee** in 1938 under the chairmanship of Jawaharlal Nehru.
    - This Committee appointed 29 subcommittees, many of which dealt with such technical subjects as irrigation, industries, public health and education.
    - The subcommittee on Technical Education worked under the Chairmanship of M.N. Saha. Other members were Birbal Sahni, J.C. Ghose, J.N. Mukherjee, N.R. Dhar, Nazir Ahmed, S.S. Bhatnagar and A.H. Pandya. The subcommittee reviewed the activities of the existing institutions to find out how far the infrastructure of men and apparatus was sufficient in turning out technical personnel.
- The outbreak of the **Second World War** (1939-45) and the interruption of the direct sea route between India and England made it necessary for the colonial government to allow greater industrial capability to develop in India.
    - It was, therefore, felt necessary to establish a Central Research Organisation and this was eventually followed by the establishment of the **Council of Scientific and Industrial Research in 1942**.
    - As part of the post-war reconstruction plan, the government invited A.V. Hill, President of the Royal Society. In 1944, he prepared a report that identified various problems

confronting research in India.
    - These developments offered greater opportunities to Indian scientists in policy-making and management of scientific affairs.
    - In fact, the origins of the science policy of free India and of the whole national reconstruction can be traced to these activities.

Q. How English education led to rise of scientific rationalist mentality in India which in turn translated into social reform agenda?

Ans:

English education was introduced in India by British to serve their colonial purpose. But the educated Indians selectively adopted the knowledge and deployed it to interrogate colonial rule itself. It is also argued that English education brought the native youth in contact with a body of thought which openly questioned many of the fundamental assumptions upon which the fabric of traditional values rested.

- They began to look at their own society through a prism ideologically constructed by such concepts as reason, utility, progress and justice. This gave rise of a civil societies, though very limited it was, but articulate in defending its rights, while locating its identity in an Indian tradition. But this tradition, it was also felt, needed reform, Existing social practices and religious notions appeared to be signs of a decadent feudal society that had to be remodelled.
- For this new elite "science" became "a universal sign of modernity and progress" and came to constitute an authoritative "language of reform".
- Although the colonial state would not provide scientific education for the Indian masses, intellectuals like Rammohan Roy proposed for his countrymen an education system that would focus on Western sciences.
- In Calcutta, in 1825, a Society for Translating European Sciences was set up, followed by the establishment of the Society for the Acquisition of General Knowledge in 1838.
- This movement, which saw the development of scientific education as the key to national improvement, reached a major milestone when the Bengali intellectual Mahendra Lal Sircar established in 1876 the Indian Association for the Cultivation of Science.
- And if this discourse was first started by a small circle of enlightened Calcutta elite, it was soon universalised, as it spread to other provinces through the development of a new print culture.
- In north India, for example, the Banaras Debating Club founded in 1861, the Aligarh Scientific Society founded in 1864 by Sayyid Ahmed Khan and the Bihar Scientific Society started in 1868, contributed to this discourse on the power of science, which then began to pervade the new territories of Hindi literary movements and Hindu revivalist campaigns.
- Later this scientific rationalist mentality of an elite translated into an effective social reform agenda affecting and involving the larger public.

This new Rationalist mentality provided legitimacy of reform agenda:

- To search reason and science in their own civilisation, and to reposition the modernisation project within a cultural space defined by Indian tradition. These new rationalist mentalities that did not reject Indian tradition, but sought to change certain ‘unreasonable’ aspects of Hindu society, which did not conform to their new ‘rationalist’ image of a glorious Indian past.
- This provided legitimacy to the reform agenda of the Utilitarian reformers like William Bentinck.

But since this mentality was still confined to a small circle of English educated elite, the reform programme could hardly be expected to succeed. Indeed, in the early nineteenth century a series of social reforms followed, being mainly reform from above through government fiat. And as expected, these reforms remained on paper in most cases, as there was never any attempt to develop a modern social consciousness from below.