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## Development of science and technology in India

**Dr. Sangita Katiyar**

*M.Sc.(Chemistry), Ph.D., Dr. Bhimrao Ambedkar, University, Agra (U.P.).*

### Abstract-

Before understanding the development process of science and technology in India during colonial rule, it is necessary to understand what science is. Science is a way of gaining knowledge which leads us to such beliefs. Which can be verified on the basis of logic and experiments. In English it is called Justified True Beliefs. In short, the foundation of science is based on direct evidence i.e. Positivist MPricipm. The science that was coming with the new technology had no existing roots in India. In modern science, theory and experiment go together. It was so in Europe but such scientific vision had not emerged in India. It is often said very strongly that modern science was present in ancient Indian thought and that India had a very old tradition of science and technology. It is true that India before the arrival of the Europeans was not an intellectual void, but there is no special justification for this when we see that even at that time only a limited and exclusive class had the right to acquire knowledge. At the beginning of the colonial period, nothing was happening in terms of science and technology in India. A fundamental difference between the ancient and modern scientific traditions is that in the ancient Indian tradition, there was progress in various fields of science but no significant achievements were made at the mechanical level. Whereas the biggest achievement of the modern scientific tradition has been the development of mechanics in it. The development of mechanics promoted new research in the field of science.

**Key Words-** Science & Technology; Mechanics; Scientific Research; Investigation

### Introduction-

After the Renaissance in the 19th century, Indians started realizing that the

main reason for the progress of western countries was their strong eagerness for research and exploration and the advancement of science. Therefore, he also resolved to take steps towards this direction in his country. With the progress of education, my government also paid attention towards the study-teaching of science and its progress. Not only was the education of astrology and mathematics promoted in the country, arrangements were also made for the study of western style medicine and engineering. Medical colleges were established in Calcutta and Bombay and engineering colleges in Roorkee. In 1916, Mahendralal government established the “Indian Council of Scientific Studies” and it started the work of scientific education and research. Although till 1907 there was no system and facility for study and teaching of various branches of science in schools and universities, still Sir Jagadish Chandra Bose made special discoveries in the field of physics in 1897.

Before the establishment of colonial rule in India, the state did not play a special role in providing formal education to the people till the end of the 18th century. The objective of the British was to get economic benefits by exploiting India more and more, but the British Company had well understood the role and importance of science in empire building and hence its focus remained on geographical, geological and botanical areas.

Jagadish Chandra Bose created many instruments and through them he proved that plants also eat, drink, sleep and breathe. On one hand, Bose had made a very important invention. He discovered wireless wire. Although in Europe in those days Marconi was also doing research on “message transmission” through electrical waves, but Marconi used long electrical waves in radio message transmission. On the contrary, Shri Bose invented and used short electric waves and later the “short waves” invented by Bose started being used in radar, television etc. Due to the scientific research of Shri Bose, in 1896, the University of London honored him with the title of “Doctor of Science”.

Taking inspiration from Jagadish Chandra Bose, scholars born in India also showed their scientific abilities. In 1902, Prabhutla Chandra Roy wrote “History of Hindu Chemistry” in which the western countries got the introduction of our chemical progress. In this festival, facilities and arrangements were made for the education of B.Sc. for science in Calcutta University and in 1908 for M.Sc. In the year 1914, Poochak College of Science was established in this university. In the year 1911, with the generous grants of industrialist Tata, “Indian University” was established in Bangalore in South India for investigation and research work in physics and chemistry. Institute of Science was established. In the same year, “Indian Research Fund Association” was formed to provide financial assistance in carrying out experiments and research work in the field of science. To promote the progress of science in India, to encourage research activities and to make the general public aware of it, to have mutual contact with scientists. In order to generate more cooperation and increase the interest of the general public in science, “Indian Science Congress” was established in 1914. That organization organizes its conferences every year. Through these annual conferences and other systems, this organization does commendable work in the field of science. It is encouraging young scientists. The result of all this is that Indians showcased their scientific talent and gained immense fame in the world. Srinivasa Ramanujan in 1918 praised the mathematicians for their extraordinary intelligence and the unique nature of

mathematics. As mentioned above, Jagadish Chandra Bose in the field of plant science in 1920, Chandrashekhar Venkatraman in physics in 1930 and Meghnad Shah in 1931 gained immense fame for their original discoveries.

Chandrashekhar Venkata Raman became famous in the science world due to his first research paper on the unsymmetrical diffraction band due to a rectangular aperture published in London's *Philosophia-Kal Begazine* in 1906. He became a member of the Indian Science Council and got involved in research work. In 1914, a science college was established in Calcutta and Shri Raman was appointed the principal there. As a result of his research and explorations, Calcutta University gave him the title of 'Doctor of Science' in 1921. In 1930, the Government of India gave him the title of 'Sir'. He received the 'Nobel Prize' in 1930 for his scientific research and 'Raman Lines'. Physics Through his research, he obtained new lines which were called "Raman Lines" and this new effect was named "Raman Effect". Due to this burden of Sir C.B. Raman, the industrial system of the world Received unprecedented assistance in the development of physics. The government of independent India honored Shri Raman with "Bharat Ratna". He died in Bangalore on 21 November 1970. Shri Raman encouraged the work of research and exploration in physics. For this, Raman Institute of Science was established in Bangalore.

Other famous scientists of this era were Meghnad Shah. He was born in East Bengal (modern Bangladesh) in 1893. After completing his primary education in Dhaka, he came to the capital Calcutta for higher education and completed his M.Sc. from the famous Presidency College. Has received the title of. After this he became a professor of physics and also continued his research work. Impressed by the success of his research, he was given the post of professor at the Imperial College of Science in London. After this he was appointed professor in Germany. In 1922, he was appointed Professor of Physics in Allahabad University. Impressed by his scientific achievements, he was elected a Fellow of the Royal Society of London in 1927. It was a great honour. In 1919, he propounded the famous Theory of thermal ionization. He did special research in various fields of physics.

### **Encouragement of scientific research-**

During the Second World War, scientific research in India got a big boost to meet the wartime needs and a lot of progress was made in it. In 1940, the Government of India established the 'Council of Scientific and Industrial Research'. For the needs of war time, many research committees got involved in research work in various universities and scientific institutions in relation to science and industry. These committees started research on chemical dyes. Did satisfactory work in the field of plastics business, radio and other industries. During these days, research was also done in chemistry and physics. As a result, Shri Krishnan, a disciple of Chandrashekhar Raman, was appointed in 1940 for research in physics, in 1943, Shri Shantiswarup Bhatnagar got international fame for making fundamental discoveries in chemistry and similarly, Bhabha and Chandrashekhar got international fame for their research work. And all of them were elected members of the world famous "Royal Society" of London. After independence, A separate department for scientific research was established by the Government of India in 1948 and a Scientific Advisory Council was also established for it. Gradually, passion and interest in scientific research increased and both the public and the national

government Move forward rapidly in this area. As a result, in 1948, the government established a special commission "Atomic Energy Commission" for the discovery of nuclear power and appointed Dr. Homi Jahangir Bhabha as its chairman.

Prafulla Chandra Roy and Shantiswaroop Bhatnagar in Chemistry, Meghnad Saha, Satyendra Nath Bose in Physics, D.N. in Geology. Wadia, Birbal Sahni in Botany, Mahalanobis in Statistics contributed in scientific research and direction. Many institutions were established which encouraged scientific activities. Most of the scientists were nationalists and the contribution they made led to the creation of scientific consciousness in the country. The government postponed the commission's recommendations citing lack of financial resources. In most cases there was a conflict between the interests of the colonial administration and the nationalists. J.C. in Kolkata in 1917 Bose Institute and 'Agricultural Research Station and Experimental Farm' were established. In 1924, an institution called Indian Academy of Sciences came into existence. There were differences of opinion among nationalist scientists as to whether scientific progress should be achieved by general development through primary education and traditional industries or by the establishment of large-scale industries.

Nationalist leaders were more inclined towards the establishment of heavy industries and socialism because it was based on science and technology. Meghnad Saha belonged to these thoughts. On his request, Subhash Chandra Bose gave the top position to industrialization in the Congress agenda in 1938. In 1938, the National Planning Committee was formed under the chairmanship of Jawaharlal Nehru. The chairman of its technical committee was Meghnad Saha. Birbal Sahni J. Eminent persons like N Mukhji, N R Ghar Nazir Ahmed, Shanti Swarup Bhatnagar were its members. The establishment of CSIR was an important step in the resolution passed in the Central Assembly in 1941 during the Second World War. In 1942 Sir A. Council of Scientific and Industrial Research was established in 1942 due to the efforts of Ramaswami Mudaliar and Dr. Shantiswaroop Bhatnagar. This provided an opportunity to find problems in the field of Indian research. All India Council for Technical Education was formed in November 1945. The work of this national level advisory body was to operate all the facilities for the coordinated development of technical education in the country.

The government established various laboratories for research in various fields of science. National Chemical Laboratory in Pune, National Physics Laboratory in Delhi, National Metal Refinery in Jamshedpur, National Fuel Research Laboratory in Dhanbad, and Central Glass and China Utensils Research Laboratory in Delhi were also established. Apart from physics and chemical science, experiments and progress are also being made in botanical science, zoology, geothermal science, human anatomy. Geological Survey of India, which was established in 1916, and Botanical Survey of India, which was established in 1916, are doing commendable work for geological progress. They have provided education to many scientists. Has prepared and presented valuable material for scientific study and economic utility and physical development of the country.

The result of the tireless efforts made by the governments in the field of science and technology has been that India is leading among the developing countries in the fields of medicine, nuclear energy, electronic communication, space transportation and defense science. The proof of how successfully Indian scientists

have completed the difficult journey from agriculture to space research despite the lack of facilities is the amazing discoveries and achievements made in every field, which have created a stir in the scientific fields of the entire world. Agriculture has been the main part of the Indian economy. As a result of the Green Revolution that took place in India due to the efforts of Dr. BP Pal, Dr. SM Swaminathan and Dr. Norman Borlaug, we are at the top position in the world in food grain production. Kurien has also taken India to the top position in milk production through White Revolution and we have become self-reliant in animal husbandry, fish farming and poultry farming. From the establishment of 'Imperial Precultural Research Institute' in Pusa Bihar in the year 1905 to the present 'Indian Council of Agricultural Research', we have covered a long distance and developed new varieties and sucker varieties which give higher yield in less time.

On August 10, 1948, Jananu Energy Commission was formed due to the efforts of Dr. Homi Jahangir Mama for the peaceful use of atomic energy. Since then, the developments that have taken place till date have resulted in fuel manufacturing for mineral research in India, energy production from waste materials, agriculture. Has achieved self-reliance in medical industry and research. The achievements of the Mama Atomic Research Center in Mumbai in the field of nuclear research under atomic energy are commendable. Due to the new research being done here, India has today come into the ranks of nuclear power countries of the world by successfully testing Pokhran-2.

Electronics, the world's fourth largest industry, has brought a revolution across India. In 1970, the government established the Department of Electronics which formulates policies for the sector development of electronics industry. The recent developments in technology, especially in the direction of computers and communication, have brought about revolutionary changes in the telecommunication and computer industry. The advent of mobile cellular radio paging Ethernet based on digital technology has revolutionized the field of information and communication.

Extensive progress in the field of transportation has reduced the sufferings of rural areas located in almost remote areas. Although there has been rapid development in the fields of rail, road, water and air transport, a lot of work still needs to be done in this field to reach the world's leading edge. India's achievements in the field of computers are commendable. Today India is one of the few leading countries in the world producing computer software. Computer is such an achievement of the modern world which has revolutionized every sector of the society. On the basis of information, new avenues of experiments are also opening up every day. Kent scanner in the field of medicine, missiles, radar and nuclear weapons in the field of defense science, satellites in the world of space, motor cars and airplanes in the field of transportation and development of chemical fertilizers and agricultural equipment in the field of agriculture are also mixed scientific achievements. India is a participant in all these areas.

While teaching, Homi Jahangir Bhabha made fundamental discoveries regarding electricity, magnet, quantum theory and cosmic rays. Received the "Adam" Prize of Cambridge University in 1942. At the young age of 32, he was elected a Fellow of the Royal Society of London. On this, he strongly advocated banning the spread of nuclear power and declaring nuclear bombs illegal. With his efforts, the country's

first nuclear research center was established in Trombay near Bombay and in 1956, India's first nuclear reactor "Apsara" was commissioned. From 1945-1961, he worked hard for the development of India's nuclear power. In 1945, he established the Tata Institute of Fundamental Research.

India has made unprecedented progress in various other fields of science. of ancient studies in astronomy It is on this base that Indian scientists are engaged in space research work. Today, India's space scientists are capable of making satellites on their own and placing them in space with their own powerful rockets. The completely indigenous launch i.e. PSLVC-2 successfully launched from Sriharikota on 26 May 1999 at 11:52 am and placed one Indian satellite and two foreign satellites in the designated orbit in space. India has reached far ahead in space programmes. With this, 634 planets have been included in India's remote sensing network. This remote sensing network of ours is the largest remote sensing network in the world. The development of space programs has proved very useful in communication media and defense related matters. Today India is capable of making missiles that can hit different ranges.

India has also made amazing progress in the field of nuclear energy. Nuclear energy is mainly being used for peaceful purposes like agriculture and medicine. Electronics is a subject related to nuclear and space. India has made amazing progress in the field of information technology. By creating Param 10000 supercomputer, we have come into the line of leading countries in this field. We are now exporting information technology related equipment to developed countries also. India's information technology trained engineers are in huge demand in developed countries like America, Britain, Germany and Japan. The present era is called the technological era. Education technology is related to both hardware and software. Distance education is an example of modern education technology. The practical aspect is more active in educational technology, hence it is also called educational engineering.

Recently, the Prime Minister of India, Narendra Modi, while delivering the inaugural address at the 103rd Indian Science Congress, assured that, "We will facilitate science research in India. We will improve science administration and expand the scope of supply and science education and research in India. Will improve the quality." He said, "Innovation should not be the only goal of our science. Innovation will also accelerate the scientific process." He also mentioned Startup India and Digital Network.

### **Conclusion-**

From a review of the development of science and technology under British rule, it becomes clear that the development of science was related to commercial profit. Scientists coming from outside conducted research keeping in mind the economic needs. Due to this, fundamental research was not possible and science did not spread among the Indian people. Despite this, students were attracted towards science courses in universities. Indians did not get admission in colonial scientific institutions, hence the enlightened middle class of India started research work by establishing scientific societies at their own level. Indian scientists got the opportunity to conduct scientific activities independently. This was the background of the science policy of independent India and the reconstruction of the nation. After independence, the following departments were established for the progress

of science - Department of Atomic Energy, Department of Science and Technology, Department of Space, Department of Electronics, Ocean Development, Department of Non-Conventional Energy Sources, Council of Scientific and Industrial Research, Defense Research and Development. Organization, Indian Council of Agricultural Research, Indian Council of Medical Research, Indian Space Research Organization, Space Commission, Vikram Sarabhai Space Center etc. The programs and schemes of these departments and institutions and the exploration, research and active activities of our scientists will pave the way for the multifaceted development and prosperity of our country and will help in maintaining world peace.

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