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A Glimpes of Science and Technology Development in India

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Abstract

Science and Technological advances in India have been much greater in the past 50 years than in the previous 2,000 years. In ancient India we had a well developed system of science though it largely depended on observation and contemplation. During the mediaeval period there was considerable scientific activity in India. In that period architecture engineering and textile industry were highly developed. Recent advances in the fields of Biotechnology, nuclear energy, health, lasers, electronics and instrumentation, Oceanography, Solar energy, agriculture, mining, rural technology have been made in a large scale. Today India has vast scientific infrastructure and strong technology base & science and technology have played a vital role in modernising India

Keywords: Science and technology development, Research Institutes, National Laboratories, Natural resources, Organisation.

Introduction

Science basically means a search for truth. Our sages and seers were great seekers of truth. In their search they not only accomplished remarkable feats in the field of Philosophy, religion, ethics, art and culture but they also contributed significantly to the development of science.

Science, is the product of thinking and man is a thinking animal. The primitive man made use of a stone to hunt. This use of a stone for killing was not a simple process. He observed that a stone was hard and if hunted at an animal it would either killed or in capacitate enough to facilitate the killing. He repeated the experiment and the results were encouraging. This was perhaps the first encounter of the primitive man with science.

In ancient India

We had a well-developed system of science though it largely depended on observation and contemplation. When we think of the early periods of Indian history. What immediately comes to our minds is the lofty tradition of science which was the product of outstanding contribution of men like Kanad, Aryabhata, Varahmihira, Charaka, Susruta, Vagabhatta and Bhaskara, In the field of Mathematics it was India who gave the zero to the world.

In the field of astronomy, India remarkable achievements to her credit, People in ancient India were known to have computed the exact timing of the solar and lunar eclipse. They had calculated very fine and accurate calendars.

During the mediaeval period

Also there was considerable scientific activity in India. Architecture, engineering and industry particularly the textile industry were highly developed. One example of the quality and the popularity of Indian goods in the western market is that, Britain even after the industrial revolution, had to pass legislation to protect her own nascent industries against the spread of Indian goods in her market. The wearing of wrought silk and printed and dyed calico from India, Persia and China was prohibited by an Act of Parliament and a penalty of 200 Dollar was imposed on anyone having or selling them. Britain knew very well that British goods could not compete with the creative crafts of India. British goods were thrust upon India with no duty being paid on them. As a result of this protection British Industry flourished. Britain was also competing with other european countries that wanted to capture the Indian market for their goods.

Due to mass production technology they were producing more than what was required for their use and they were keen to find markets for their goods outside their own countries. So they thought India being a rich country would provide a good market for their goods. It was this search

for a market by the European world which ultimately led Britain to colonise India.

Objective of the Study

1. This paper explains the India's achievements in the field of science and technology.
2. The main focus of the study is science and technology development in the ancient time, mediaeval period, during the British age and after the independence.
3. Different organisations of science and technology in India give an account of the knowledge of different departments.
4. For science and technology to be effectively applied, there is need to complete the total innovation chain consisting of basic research, applied research, design and development, extension, production and service.

Science & Technology In British Age

The growth of science of India under the British, however was not systematic. Institution were established mainly to furnish data that was required by the British from time to time for various operations facilitating colonial exploitation. For this purpose they established scientific department like the -

1. Botanical survey of India in (1899)
2. Geological survey of India in (1851)
3. Indian marine survey department in (1874)
4. Indian coastal survey in (1875)

They also set up observations at Madras (Chennai), Calcutta (Kolkata) and Bombay (Mumbai)

1. The first meteorological observatory was founded in Madras in 1792.
2. Asiatic society founded by William Jones came in to being in 1784.

Although all these surveys and the data collection work were done mainly to promote British colonial interests, they also promoted unintentionally, western science in India and the progress of science in the western world did influence the mind of sum of Indians.

1. Sir Mahendra Lal sircar founded the Indian Association for the cultivation of Science in 1876.
2. Great scientists like J.C. Bose, P.C. Ray, C.V. Raman and K.S. Krishnan were associated with this organisation.
3. This organisation aimed at attracting talented youth to conduct advance research and enhance the status of science in India.
4. The Indian science congress was inaugurated in 1914.
5. The Indian academy of science in 1934.
6. National Institute of science in 1935.

These scientific institution and societies were definitely the product of new thinking and they aimed at promoting science in India. These efforts, however small they appeared in the beginning, did influence the future growth of Science in India.

1. In 1904 the university Act came into being. It allowed the existing Indian universities to organise teaching and research.
2. In 1909 provision was made post graduated teaching and research at the Calcutta University.
3. In 1917 an engineering college was set up at Banaras Hindu University. This college undoubtedly, was the product of the upsurge for national education.

Indian scientists with the single determination of purpose dedicated themselves to the field of science. Although most of their contribution lie in the field of fundamental research, by their work they laid the foundation of modern science in India with their commendable work they brought India into the scientific map of the world.

1. J.C. Bose studied the molecular phenomenon produced by electricity on living and non-living substances.
2. P.C.Ray analysed a number of rare Indian minerals to discover in them some of the missing elements in mendeleef's periodic table.
3. C.V. Raman's research on the scattering of light led to the discovery of what is known Raman's effects, for which he was awarded the Nobel Prize in 1930.
4. K.S. Krishnan experimented on the magnetic susceptibility work function of metals.
5. Meghna Saha contributed to the field of astrophysics.
6. S.N. Bose collaboration to with Einstein led to what is known as the Bose Einstein Equation.
7. D.N. Wadia worked in the field of geology.
8. Birbal Sahni in paleobotany.
9. S.S. Bhatnagar in Chemistry.
10. Homi J. Bhabha later became the chief architect of independent India's nuclear programme.
11. Vikram Sarabhai contributed to the development of the space research programme.
12. The Indian institute of science was founded in Bangalore in 1911 by the funds provided by J.N. Tata.
13. J.C. Bose founded the Bose Research Institute at Calcutta in 1917.

The outbreak of the second world war in 1939 brought about a radical change in the pattern of scientific and technological research in India. The colonial government in India had her links served from Britain due to war. This made it essential for them to develop local resources, meet the demands of war and strive to become industrially self-sufficient to meat the challenges posed by war conditions. 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 (CSIR) in 1942 as an autonomous society.

Prof. A.V. Hill of Royal Society prepared a report and following professor Hill's recommendations the govt. created a department of Planning and Development and CSIR was transferred to this department.

Two National Laboratories

National physical laboratories and the national chemical laboratories as well as nine specialised institute in such fields as food technology, metallurgy, fuel, leather and glass research are proposed by the committee.

Science and Development In Independent India

The marvellous growth of science in India witnessed after independence was largely due to the efforts of Jawahar Lal Nehru, the first Prime minister of India, has felt a great need of promoting scientific research and scientific work in the country and for that purpose he was associated with various important organisation dedicated to the development of science. In 1947 he appointed Maulana Abul Kalam Azad, a man with progressive vision and out look, as the education Minister Maulana Azad apart from being the Education Minister, also held the science port folio from 1952. In 1951 India became the first country in the world to have created a ministry on Natural Resources and scientific research.

The government also appointed a scientific man power committee in 1947 under the chairmanship of S.S. Bhatnagar. Some important recommendations of the committee were -

1. Introduction of specialised or post-graduate courses of study and research in science and technology.
2. Expansion of training and research facilities in existing institutions.
3. Re-organisation of some of the existing polytechnics or technical institutions.
4. Establishment of new medical colleges for increasing the outturn of doctors.
5. Provision of facilities for training in production, engineering, design engineering etc.

The main achievement of the Nehru era is that during this period he chalked out the path. He believed that India could only progress through planned development. In 1950 with the appointment of the planning commission India ushered in an era of planned development and obviously science and technology became important components of the whole process. Planning was essential for development and for attaining self-reliance and self-reliance was not possible unless science and technology were closely merged with the whole strategy of planning.

In 1951 the first five plan was launched. This plan gave importance to the setting up of the scientific infrastructure. It aimed at the setting up of new national laboratories and research institutes. Second and third five year plans were primarily aimed to strengthen the existing research institutes and expand facilities for research and this process is continue till the present 12th five year plan.

In 1983 Indira Gandhi announced to the nation as **"Technology Policy Statement"** the purpose of this is to give technological development of a clear directions as regard the growth of indigenous technology.

Technology

Knowledge applied to the production of goods or services or solving practical problems.

Different forms

1. Physical Machinery
2. Production Processes
3. Software
4. tacit knowledge

The principal aims of the technology policy statement are as,

1. To attain technological competence and self-reliance, to reduce vulnerability, making the maximum use of indigenous resources.
2. To use traditional skills and capabilities making them commercially competitive.
3. To ensure the correct mix between mass production technologies and production by the masses.
4. To ensure maximum development with minimum capital outlay.
5. To improve production speedily through greater efficiency.

India's Strides In The Field Of Science And Technology

Today India has vast scientific infrastructure and strong technological base. Science has played a vital role in modernising India, a brief account of the progress made by India in various fields, is as follows

Agriculture

As results of intensive R&D and extension programmes India has been able to achieve a high level of productions.

Rural Development

Rural uplifts is a priority area of national development. A large number of science and Technology programmes for rural development have been sponsored by various agencies. The area are as leather industry, including curing, preservation, tanning, pootery making, processing of cereals, pulses and oil industry, cottage industry, biogas and carpentry etc.

Nuclear Energy

India's declared aim is to utilise nuclear energy for peaceful purposes. Dhruva, an indigenously produced nuclear reactor was a major achievement in this direction. Fast breeder reactor at kalpakkam,Nuclear power station at tarapur, Kalpakkam, Kota and Narora have been established. As a result India is today one of few countries in the world which can indigenousley design, construct and operate nuclear reactor with out relying on extrnal inputs.

Space

The Indian space programme is directed to the goal of self relient use of space technology for national development over the years space programmes have established themselves with succession of achievements. They include the launching of the satellite starting from Aryabhata, Bhaskara, Rohini satellite on indigenous SLV-3 APPLE satellite and series of INSAT launched time to time. For protection purpose India has launched a series of Agni Missile. Recently India launched Agni-5 Ballestic Missile. In future India is prepared to launched Agni-6 Ballestic Missile with multiple independently targetable re-entry vehicle (MIRV).

India space scientist have been successful in developing launching system to put satellites in to orbit and put heavier satellites in geosynchronous position for regular service operations in the areas of telecommunications, broad casting and remote sensing.

Industrial Research

The council of scientific and industrial research (CSIR) and the defense research and development organisation (DRDO) cover between them a wide spectrum of science and technology research for civilian and defense purpose.

Medical and Health Sciences

In the field of medicine their have been many achievements. Research today is gearred to meet challenges as the stabilisation of population, control of communicable diseases such as malaria, hepatitis, leprosy and AIDS etc. Notable advances have also been made in the field of biological sciences relating genetic engineering, bio-technology etc. India has achieved a tremendous development in Medical and Health Sciences such as in kidney and liver transplantation and in the field of various heart surgeries such as angiography, angioplasty and by pass heart surgeries.

Environment

Plans and programmes in the fields of soil conservation, public health, forest and wild-life protection and industrial hygiene among others, have been in existence in India for many years. National Committee on Environmental Planning (NCEP) is established in 1972. The main areas of environmental concern include pollution monitoring and control, conservation of biological diversity, promoting of environmental education, training, sponsoring research and development studies etc.

Electronics

India has acquired the capability to produce a wide variety of electronic goods, broadcasting equipments telecommunication equipment, radars, earth stations, nuclear reactor control power electronics and so on.

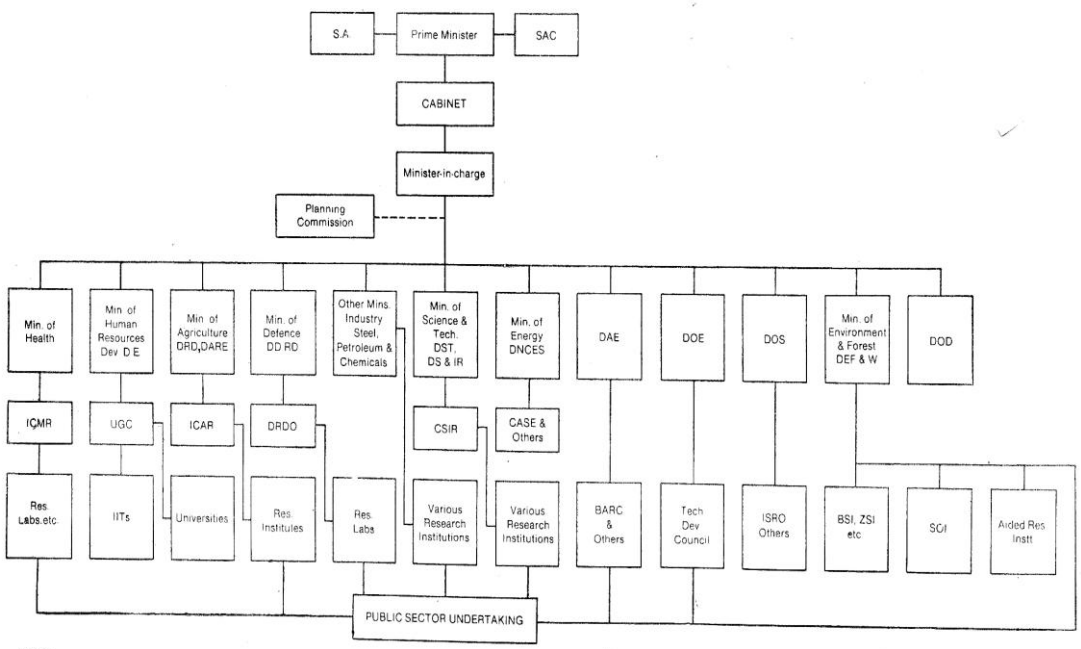
Oceanography

India has many interests in the filed of oceanography such as off shore hydrocarbons, fishery resources under standing the weather, mining the resources and pollution. A major thrust is being given to R & D in this field.

Energy

Energy in India is derived from a wide variety of sources both of commercial and non-commercial nature. India has made significant progress in the field of energy production since independence.

ORGANISATION CHART OF SCIENCE AND TECHNOLOGY, INDIA



KEY:

ICMR	—Indian Council of Medical Research	DSIR	—Deptt. of Scientific and Industrial Research	DOE	—Deptt. of Electronics
SAC	—Science Advisory Council to the P.M.	DST	—Deptt. of Science & Technology	CSIR	—Council of Scientific and Industrial Research
ICAR	—Indian Council of Agricultural Research	DRSE	—Deptt. of Renewable Sources Energy	BARC	—Bhabha Atomic Research Centre
UGC	—University Grants Commission			DOS	—Deptt. of Space
DAE	—Deptt. of Atomic Energy	BSI	—Botanical Survey of India	ISRO	—Indian Space Research Organisation
DS & IR	—Deptt. of Scientific and Industrial Research	ZSI	—Zoological Survey of India	DOD	—Deptt. of Ocean Development
S.A.	—Science Advisor	SOI	—Survey of India	DEF & W	—Deptt. of Environment, Forests and Wild Life
DARE	—Deptt. of Agricultural Research and Education	DNCES	—Deptt. of Non-conventional Energy Sources		
DRD	—Deptt. of Rural Development	CASE	—Commission for Additional Source of Energy		
DDRD	—Deptt. of Defence Research Development				

Conclusion

Looking at the progress of science in Indian, over can certainly say that science in India has come to age. Developing countries which are on the threshold of economic progress can now safely share India's scientific knowledge and depend upon her technical know-how because it is suited to their own conditions. As a matter of fact over the years, India has been playing a major role in establishing technical co-operation among developing countries by way of technology transfer.

Last but not least, a sound infrastructure for pursuing science at its frontiers has been built up in the country. At the same time, India has succeeded, to some extent in using the benefits of indigenous technology for solving the development problems.

As the celebrated Indian scientist C.V. Raman said: "Unless the real importance of pure science and its fundamental influence in the advancement of knowledge are realised and acted upon, India cannot make headway in any direction and attain her place among the nations of the world this is only one solution for India's economic problems and that is science, and more science and still more sience."

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