Progress of Bio-Sciences in Independent India

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Abstract -

India is trying to become a contender in the race of researches in life sciences. powered by its economic growth and a desire to add biotechnology and other upcoming fields of bio-sciences to its portfolio. In this article, the history, current status, and expected future growth of biological research in India is discussed. In India science education Is given in schools colleges, and science institutions.To achievethe aspirations, India's greatest challenge will be in educating, recruiting, and supporting its next generation of scientists. These challenges are faced by many countries, but are particularly acute in developing countries that are racing to achieve scientific excellence, perhaps faster than their present basic educational and faculty support systems ispermitting.

Key Words - Bio-Science, Biotechnology, Research , Institute.

Introduction -

"It is science alone that can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening of custom and tradition, of vast resources running to waste, or a rich country inhabited by starving poor... Who indeed could afford to ignore science today? At every turn we have to seek its aid... The future belongs to science and those who make friends with science."

-Jawaharlal Nehru (Independent India's first Prime Minister)

India's indentations in the biological sciences is relatively small, especially considering its population. Much of India's high-level biology research is pursued at about 15 Institutes and a few Universities with good biology departments, each of which houses 10-80 faculty) for an overview of the Institute, University, and College systems). The relatively small size of India's life science enterprise is hardly surprising given that the country began much of its own national scientific agenda after achieving independence in 1947, with more pressing needs occupying the nation at the start. In addition, physics, math, and engineering in India have been considered as higher scientific endeavors than biology and have produced more internationally recognized scientists. Thus, it is useful to look at how biology in India developed in the last century, to provide a historical backdrop for its current situation and a perspective for how it might develop in the future.

History -

The British East India Company established Universities in the middle of the 19th century in the three Presidency towns of Calcutta, Madras, and Bombay (now known as Kolkata, Chennai, and Mumbai) with the objective of teaching, native Indians in various subjects of arts and sciences, medicine, law, and engineering. Just before Independence, India had 20 Central and State run Universities, in addition to the original Presidency Universities. These Universities provided a solid basic education, but did not conduct any significant amount of research. The first Institute with a mandate to pursue scientific research was the Indian Association for the Cultivation of Science (IACS), which was established in Calcutta in 1876 and focused on chemistry and physics (as a note for newcomers, a daunting aspect to the Indian scientific scene is the lettered acronyms by which indians refer to their numerous research Institutes, Universities, and funding agencies. The IACS spawned a number of intellectual giants, including Sir CV Raman who conducted his Nobel Prize-winning research there. A second prominent research Institute was the Indian Institute of Science (IISc) in Bangalore, which was conceived of in 1896 and launched in 1909. These two Institutes continued to dominate basic scientific research in the physical sciences for the first half of the 20th century.

A committee was madeat the end of World War II, to establish higher technical institutes for the industrial development of an independent India.This committee envisioned these institutes as engaging in world-class engineering training and research, following Western examples such as the Massachusetts Institute of Technology. The first Indian Institute of Technology (IIT), as these schools came to be known, was inaugurated near Kolkata in 1951. Jawaharlal Nehru, the first Prime Minister of India, was a key force in establishing four additional IITs in other regions of the country in the ensuing decade. Currently, India has seven highly regarded IITs that attract top students in a highly competitive admissions process. The IITs and other research institutes such as the IISc and the Bose Institute were focused primarily on mathematics, physics, and engineering. The legacy of this early investment carries through to the present; India now trains over 400,000 engineers per year and has a strong international reputation in physics, math, and engineering.

Post independence Scenario -

Until the 1960s, biological research was largely directed toward pragmatic applications in agriculture, nutrition, and public health. For example, the IISc in Bangalore started laboratory groups involved in fermentation, pharmacology, and silkworm biology in 1941.Modern biological research came into being much later in India. The first truly modern "molecular biology research unit" began in 1962 as a branch of the Tata Institute of Fundamental Research (TIFR) in Mumbai, an institute originally devoted solely to physics and mathematics. (As an aside, TIFR's current Department of Biological Sciences faculty is still small, in comparison to mathematics and physical sciences. Similarly, new biological research units formed within traditional physical science institutes in other locations. G.N. Ramachandran (trained as physicist and inventor of the "Ramachandran plot" widely used in protein structural studies) founded the Molecular Biophysics Unit at the IISc in 1970. The Centre for Cellular and Molecular Biology (CCMB) in Hyderabad also began as a semi-autonomous branch of a regional Indian Institute of Chemical Technology in 1977 and became a National Laboratory in 1981. Other biology institutes started with very pragmatic goals and then broadened their scope. The National Institute of Immunology (NII) began in 1986 with the focused goal of developing vaccines but broadened several years later and is now conducting a wide range of basic biological research. The Centre for Biochemical Technology began as a producer of biochemical reagents for India in 1977 but changed its name (Institute of Genomics and Integrative Biology) and mission (basic scientific research) in 2002. In a somewhat analogous path, the National Centre for Cell Science (NCCS) started in 1988 as a repository and

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distribution centre for tissue culture cell lines (then known as the National Facility for Animal Tissue and Cell Culture) but became a broad, basic biological science institute and was rechristened with its current name in 1995.

More recently, research Institutes have seeded many new Institutes. A molecular biology unit at TIFR, Mumbai,,and the National Centre for Biological Sciences (NCBS) in Bangalore in 1992 were established, which have developed into India's premier biological institute. NCBS's and Stem Cell Institute have also been established recenly . In recent years, the government has invested heavily in the infrastructure of its research institutes, and some of their facilities are on par with those in the US and Europe (e.g., state-of-the-art microscope and fluorescence-activated cell sorter facilities).

Prior to the formation of biology research Institutes, the top Universities were home to much of India's best biology research. However, since the 1990s the research Institutes have been heavily favoured in research funding and faculty recruitment, which has contributed to a two-decade decline in the stature of the Universities. Currently, there are more than 350 Indian Universities, a spectacular rise since Independence. Most are operated by State governments along with a smaller number of Central, and, more recently, private Universities. The Universities are primarily dedicated to graduate training (master's, PhD, and postgraduate training after a medical college degree). They also serve as official degree-granting entities for the graduate students at most research Institutes. Universities also oversee the curricula, textbooks, and exams of the vast majority of India's >18,000 + undergraduate colleges; >100 colleges are often affiliated with a single University, thus creating a complex administrative system. Most of the Colleges are physically separated from the Universities, a trend that was initiated at least four decades ago (a few exceptions exist such as Benares Hindu University, which has retained undergraduate colleges on its campus). A few medical schools also have basic science departments, most notably the All-Indian Institute of Medical Sciences (AIIMS) in New Delhi. While there are examples of fine biologists at the Universities, financial constraints and substantial demands on faculty for teaching and administrative duties have made it difficult for biological research to thrive in the current University system.

At the recenttime, many new initiatives have begun or are in the planning stage for the studies and researches at different institutions. Several of the premier research institutes (e.g., NCBS, CCMB, and TIFR [Dept. of Biological Sciences]) are constructing new buildings on their campuses, which will result in a doubling of their faculty. Several new research Institutes also are being planned. Notably, a new Stem Cell Institute has been approved recently by the Central government. Located adjacent to the NCBS in Bangalore, this new research facility is expected to hire 40 faculty and will interface in clinical translation projects with the Christian Medical College in nearby Vellore. The Stem Cell Institute is the first of what may become a very exciting and collaborative campus of several adjacent research institutes. The other institutes, which are in an early planning phase, include (1) a centre for platform technologies (e.g., imaging, mass spectrometry, etc.), which is provisionally called the Bangalore BioCluster; (2) an institute focused on problems at the interface of biology and material sciences; and (3) a plant genomics centre. In the national capital territory around New Delhi, a new Translational Health Science Technology Institute (THSTI) has been planned, as well as a UNESCO centre for biotechnology research and education, which together might add over a hundred faculty. The National Institute of Immunology also has long-range plans to expand its activities adjacent to the THSTI/UNESCO campus. A National Centre for Translational Science is being planned in Pune, which will have three units that study different complex diseases and will emphasize stem cell and regenerative biology. Each unit will have ?20 translational faculty, an associated hospital, and a training program for MD/PhD students. In Kolkata, an Institute for Human Genetics and Medicine is in the proposal stage. Biology also has come to the Indian Institutes of Technology. The IITs at Kanpur and Mumbai have started biotechnology departments, and several new IITs are being established, some of which are likely to have biotechnology/bioengineering departments. The Indian government also has launched five Indian Institutes for Science Education and Research (called IISERs), which are new campuses devoted to undergraduate/master's science education and research. Each IISER is expected to hire ?30 biology faculty, with additional physical science faculty working on problems that interface with biology. In addition, theINSA,New Delhi, and IASC Bengaluru. have recommended establishing 10

Universities as premier internationally recognized centres for research as well as higher education. Other proposals have called for the building of >1,000 new Universities.

One must keep this in mind how far the life sciences in India have come in the past three decades. Many scientists have demonstrated their determination, resourcefulness, and intellect under less-than-optimal circumstances for scientific research. Thus, India's journey in biology has involved courage and initiative as well as increased funding. Now, India must look to a new generation of pioneers-a successful postdoctoral fellow who turns down a job at Harvard to take a faculty position in India; a senior scientist who invests time to teach undergraduates, mentor young faculty members, or assume an important administrative responsibility and not just focus on his/her own research; a bright high school student who turns down an IIT to train in biological research at an IISER; a graduate student who takes time off from his/her thesis work to teach college undergraduates; or an American or European who comes to an Indian laboratory for their postdoctoral training. India's future biology enterprise shall be built, brick by brick, from such rewarding individual success stories

In March 1995, the Department of Indian Systems of Medicine and Homoeopathy (ISM&H) was created by the Government of India. Later, in November 2003, this Department was renamed as the Department of AYUSH (Ayurveda, Yoga, Unani, Siddha, Homoeopathy) under the Ministry of Health and Family Welfare, Government of India. the introduction of Green Revolution is supposed to have saved the lives of one-third of the world's population. The man who is credited with it is Dr Norman Borlaug. In 1963, he introduced high-yielding varieties of wheat in India. That was the turning point for our agriculture and we have been moving ahead from there. Several measures were introduced to improve agricultural production along with the use of high-yielding crop varieties. In this task, the group of indigenous scientists led by Dr M.S. Swaminathan played a major roleSimultaneously, the government also invested in opening agricultural universities and research laboratories to develop indigenous technologies. This led to developing wheat and paddy crop varieties that are typically suited to our climate and the vagaries of monsoon-flooding or droughts-are pest resistant and have better yield, thereby lowering the risks for farmers

There has been considerable hope put on biotechnology and nanotechnology. Biotechnology deals with applications of living organism to improve human initiatives. When we talk of biotechnology in India, we tend to talk primarily of its use in health and agricultural sectors. In medicine, it would mean better and cheaper medicines, new therapies to deal with age-old adversaries like cancer, vaccinations and diagnostics. In agriculture, the expectations are in terms of developing higher yielding seeds by manipulating the very genes of plants, bio pesticides and bio-fertilizers, and food preservation and processing. Food preservation is essential as we still lose almost 30% of our food grain production a year due to poor storage facilities. Nanotechnology, on the other hand, is a relatively unexplored area with only government-funded research so far. But the hopes associated with it are great.

Without doubt, life science researches in India will change dramatically in future, but what will it look like? Indians themselves debate the outcome, some being optimistic and others pessimistically projecting that India cannot rise above mediocrity in the life sciences. The critical mass in biology will certainly increase, conditions for conducting research will improve, the life sciences will assume a more equal stature to physics, and even the launching of a few new programs for life science faculty will make a world of difference. But India's success will not be measured solely by the money that it invests, the number of life scientists that it employs, and the number of papers that it publishes. It also must take advantage of this unique period of growth to find opportunities for innovation. Will India try new experiments in academic research/biotechnology or continue to adopt Western models? Will India develop closer collaborations between biology and its extensive physical science enterprise (something that has been lacking in the past)? Will it formulate new models for translational research involving a strong connection between research institutes and medical centres (underdeveloped at present)? Will it develop a new culture for collaborations between academic centres and industry (currently minimal in the life sciences)? And will it tackle biological questions and diseases that are understudied in the West (particularly those that affect India)? While developing basic infrastructure for research and education is still of paramount concern, India also must think about these grander challenges. However, interesting new initiatives are sprouting in India, an example being a recently launched "Open-Source drug discovery model" for tuberculosis. This initiative, launched by the Council for Scientific and Industrial Research (CSIR), will promote collaboration and open access/Internet sharing of data from drug screening, bioinformatics, and early-phase clinical trials.

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