

India's SciTech Powerhouse

Srinivasa Ranganathan

Applying and advancing modern science in the nation's rich and complex cultural, intellectual, and physical environment, the Indian Institute of Science in Bangalore has emerged as one of the world's great centers of research, application, and instruction.

Bangalore in South India was famed for its salubrious climate for most of its history. Today it is better known as the science capital of India and it bids fair to become one of the ten major technopolises of the world according to a recent survey by Newsweek. This transformation has been mainly due to the location of the Indian Institute of Science (IISC) the premier research institute of India in Bangalore. Founded in 1909 this institution has grown steadily over the past nine decades to become a formidable center for research in all aspects of science and technology. It is quite instructive to look at the origin, growth and the future directions of this institution in India, where many wonderful institutions grow for some time and then wither away.

The beginnings of this institute can be traced to several improbable encounters and coalitions. One was between Swami Vivekananda, a Hindu ascetic and Mr Jamsetji Nusserwanji Tata the foremost industrialist of India in the twilight years of the nineteenth century. They met on a boat sailing from Japan to the U S A. Swamiji was on his way to address the Parliament of Religions. His address beginning with Brothers and Sisters of America cast a hypnotic spell on his audience and propelled him into international fame. Vivekananda and Tata discussed Tata's scheme for creating a research institute of science in India. Tata was convinced that it should be a modern monastery imbued with a scientific, yet ascetic spirit. He was also inspired by the model of John Hopkins University in the U S A.

Mr. Tata is described in the memorial to the founder of the Institute, as a "Parsi Citizen of Bombay" and a "Captain of Industry." He was in many respects the most remarkable Indian of his times. In 1886 he conceived the idea of setting up an Indian institute of science devoted to higher learning and research. In September 1898, he offered property then worth two hundred thousand pounds as an endowment for establishing an Institute, where the best intellects of the country should come into close touch with Western science and find new careers in industry. When he passed away in 1904 he had laid the foundations for the Institute, which came into existence in 1909. He had broken the barriers of his own lifetime, as his heirs and associates toiled hard to turn his dreams and plans into reality. In fact he had divided his property three ways: among his two sons and the Institute.

The next improbable coalition was among the Tata family, the viceroy of India and the maharaja of Mysore. Lord Curzon took over as Viceroy of India on December 30, 1898. The very next day he turned his attention to the proposal of Tata. He had it examined from various angles. The choice of the location of the institute saw many cities vying for it-. Bombay, Calcutta, Poona, Nasik, Nagpur. Some preferred cooler climates. Thus Nainital, Coonoor, and Bangalore came on to the list. Roorkee, where the first engineering college in India had been established was a strong contender. William Ramsay, the discoverer of the noble gases and a Nobel Laureate, was asked to give his advice on the location. Finally, the Kolar Gold Fields and other mineral deposits of the State of Mysore tilted the balance in favor of Bangalore. In addition an imaginative dewan of Mysore, Sir K. Seshadri Iyer persuaded the maharajah of Mysore to offer 372 acres of land. This clinched the issue in favor of Bangalore.

First light

The Institute started functioning in 1911, with two departments—general and applied chemistry, and electrical technology—and the library. It will be seen that the two departments exuded an industrial bias. The library was gifted journals by the British Government so that the first issues of such journals as *Nature* and *Proceedings of the Royal Society* are among its prized possessions.

The Institute has an extraordinary record of distinguished leadership, starting with its first director M.W. Travers, a student of William Ramsay. He was followed by A.G. Bourne and M.O. Forster. These early directors had come from far away Britain not as traders, soldiers or missionaries as the original tide from England to India was. Rather, they were distinguished scientists in their own right who tried to give shape to modern science and technology in India. It must be remembered that India had a rich tradition in science, most notably in astronomy, mathematics, medicine, and technology, most assuredly in metallurgy. Yet these traditions had vanished under the Mughal and the succeeding British regimes. The Institute was also different from other institutions set up by the British under the drive of Thomas Babington Macaulay. He wanted Indians to be educated and trained to serve the

cause of the British Empire. He envisioned educated Indians brown in color but British in taste. The universities at Madras, Bombay, and Calcutta were founded on this basis, though in time they evolved to serve different purposes. One lonely national voice was that of Pandit Madan Mohan Malaviya, who set up the Banaras Hindu University as a national university. But this was after IISc. In many ways IISc was the torch bearer for Indian science, even though it had mixed Indian and British parentage.

The first Indian to serve as the director of the Institute was C.V. Raman, the lone Nobel Laureate that India has produced in science. His “journey into light” is most admirably captured in a biography with the same title. As a young man, he was working as an accountant but his passion for science led him to work on scientific problems and gravitate to the academic world in Calcutta. Here with nothing more than string and wax he observed a remarkable effect in light scattering, which has come to be eponymously called the Raman effect. Raman set up the department of physics at the Institute in 1933 and truly laid the foundations for a foremost department. Towering and powerful personality that he was, he soon encountered problems with the members of the governing council of the Institute. Even the powerful intervention of Lord Rutherford from Cambridge, U K with Lord Linlithgow, the viceroy of India did not help. Raman resigned and after retirement went on to found the Raman Research Institute, the first of many offsprings that the Institute was to produce.

C.V. Raman was followed by J.C. Ghosh as the director, even as the clouds of the second world war were gathering. At the time, the Institute had many science departments but not many in engineering. M. Visveswaraya, an engineer statesman, was the president of the governing council. Ghosh with the help of the governing council took bold initiatives to start departments of aeronautical engineering, internal combustion engineering, and metallurgy in the early forties. These and successive initiatives have led to the Institute’s flourishing mechanical sciences division, which today forms the largest component. In particular the aeronautical engineering department enjoyed a symbiotic relationship with Hindustan Aeronautics Ltd. Further growth took place under the direction of M.S. Thacker and S. Bhagavantam. With the establishment of the national level University Grants Commission in 1956, the Institute came under its purview as a deemed university. It is a postgraduate Institute providing quality education at the cutting edges of science and technology.

Explosive growth

A new phase of explosive growth was recorded in 1962, when Satish Dhawan took over as director. Benefitting from an improbable combination of education in English literature and aeronautical engineering Dhawan grew the Institute to new heights. When he was offered the chairmanship of the Indian Space Research Organization (ISRO), he took it but kept the directorship. In fact he moved the space program head quarters to Bangalore. Thus began a long synergistic link with ISRO. In turn this led to remarkable schools of research in fluid mechanics, starred by Roddam Narasimha, a graduate of Caltech. These developments naturally led to a further alliance with the Defense Research and Development Organization.

Dhawan was succeeded by S. Ramaseshan, a distinguished physicist and a nephew of Raman. Ramaseshan was no stranger to either high quality science or high level leadership. He brought many new themes such as supercomputing into the orbit of IISc.

In 1984 the Institute was to witness yet another star director, C.N.R. Rao, the most distinguished chemist of India. Rao, who had served earlier on the faculty of IISc, was invited to come over from the Indian Institute of Technology in Kanpur. He set up the solid state and structural chemistry unit as well as the Materials Research Centre. In time these have grown to extraordinary strength. Rao propelled the Institute into major heights of scientific excellence in every sphere. His own scientific research inspired the young faculty to strive hard for excellence. Under his guidance the Institute attracted research funding from several agencies and many of the departments came to be recognized as centers for advanced studies. To attract bright young students the Institute introduced an innovative integrated doctoral program for students with a bachelor's degree in science. In the decade from 1984 the Institute was transformed beyond recognition. It gained recognition as India’s mecca for basic research. Rao went on to establish the Jawaharlal Nehru Centre for Advanced Scientific Research with synergistic links with the Institute.

G. Padmanaban, a biochemist of international fame, succeeded Rao. By 1994 the winds of liberalization and globalization were beginning to blow across not only the nation but also academia. Padmanaban was sensitive to the importance of serving the needs of industry in a developing nation. He gave a strong fillip to this task and attracted support from Indian and multinational industries. Now, more than ever, the founder’s original vision of an institute with a balance of basic and applied research came into focus. One of several prime examples is the large grant offered by Dorab Tata Trust which directed support to the investigation of tropical diseases by the Institute’s talented biochemists.

The present director, Goverdhan Mehta, an internationally acclaimed organic chemist, has been at the helm

since 1998. He has given strong emphasis to international links, forging especially strong links with France, Norway and the USA. Noteworthy linkages with multinational companies cover a full range of technologies, including information (IBM, Microsoft, and Hewlett Packard for the USA), communication (Nokia from Finland), and manufacturing (General Motors, USA). These and other companies have endowed chairs, laboratories and projects. They help to support an unprecedented diversity and depth of research and development that characterizes the institute today.

Greatness in the ranks

An institution is not mere brick and mortar. An outstanding institution is made by men with ideals, vision and commitment. IISc has had the good fortune to have had not only a succession of preeminent leaders as its director, but also a succession of illustrious men of science and engineering who have studied at it and served it. Homi J. Bhabha went on to create the atomic energy program, while Vikram A. Sarabhai became the architect of the Indian space program. Brahm Prakash laid the foundations for advanced materials required by the strategic sector. G. N. Ramachandran was the discoverer of the triple helix in collagen. He was invited by the Institute to set up the molecular biophysics unit. This has been an important growth pattern for the Institute: attract extraordinary leaders in science, then support them in building new departments centered on their areas of research. Those mentioned represent but a few of the many examples that could be cited.

There are now over 40 departments and centers in the Institute, covering various branches of science and engineering. They are grouped under six divisions: the Biological, Chemical, and Physical & Mathematical Sciences Divisions constitute the Science Faculty, while the Mechanical, Electrical, and Information Sciences Divisions form the Engineering Faculty. The institute has close to 500 faculty, 1500 students and 1500 supporting staff. The ratio of students to faculty is an enviable one for India and may well be one of the more favorable ratios in any institution world wide.

Wide-ranging influence

It is easy to perceive the far-reaching influence the Institute has had on developments in various disciplines such as physics, chemistry, biology, electronics, and metallurgy. National programs, such as atomic energy, aviation, biotechnology, space, and information technology, have radiated from the academic confines of the Institute outwards and contributed to technological developments in post-independence India.

What is most remarkable is the balance maintained by the Institute today in its various domains of influence: Education, Research, Development, International interactions, and Societal concerns. Again the creation of new knowledge is accompanied by application of that knowledge to create industrial wealth or alleviate the conditions in the villages.

The Institute offers advanced level courses leading to Master of Engineering (ME), Master of Technology (M Tech), Master of Science in engineering (MSc (Engg)) and Ph.D. degrees. The ME degree is a professional credential whereas the Msc (Engg) degree is on the track toward the PhD degree. An integrated PhD program in the Science Faculty attracts the cream of B.Sc. graduates of the country. In order to catch them young, the Institute has recently launched the Young Fellowship Program and Young Engineering Fellowships so that bright students can be exposed to the excitement of science and attracted to a career in scientific research. IISc's lush greenery and subdued architectural backdrop provide a tranquil and invigorating ambience to pursue academic life. More than 200 students are admitted annually to the Master's degree in Engineering.

Innovative programs in satellite technology and manufacturing engineering and design have been introduced in recent years. Besides formal education and research, the Institute has been playing an active role in offering short-term courses to working scientists and technologists through its Proficiency program. The Continuing Education Program covers a wide range of topics and over 1500 working scientists and engineers go through such courses every year.

The Institute publishes well over 1000 research papers and produces over 100 Ph.Ds in a year covering a wide range of areas. Many of the research papers have elicited laudatory reviews in international journals. The Institute has world renowned groups in several frontier areas in science and engineering of which materials technology, biotechnology, and information technology deserve special mention.

In keeping with its aims and objectives, the Institute has organized a multi-mode interaction with industry. <<<The know-how generated in the Institute percolates to industries via industry-sponsored projects organized through the Institute's Centre for Scientific and Industrial Consultancy (CSIC). One arm of CSIC, its Technology Development Mission, has made vital contributions in the areas of Genetic Engineering & Biotechnology, New Materials and Food Processing. An attractive feature of the projects organized through CSIC is that industry is an equal partner in this development work. An independent entity created by the Institute, the Society for Innovation

and Development, confers the operational flexibility required for taking up long term projects. Some major projects worthy of special mention are the Monsanto Program and the Indo-Norwegian Program on Aluminum Applications Technology.

The Institute has the largest computing facility of any academic institution in the country and is a hub of activity for both academic institutions and computer companies. Furthermore, the campus is wired for Internet connectivity.

The department of biotechnology has a major umbrella program at the Institute, which supports infrastructure in the form of centers and facilities for research and applications of biotechnology. The department of science and technology supports several individual projects and infrastructural facilities such as the NMR and X-ray units. The Institute has the largest library devoted to science and technology in the country. A digital library has been created in cooperation with IBM. In addition the National Centre for Science Information, supported by the university grants commission as an inter-university center, makes literature searches available to university teachers across the nation.

The Institute maintains an extraordinarily fruitful relationship with the Indian Space Research Organization and the Defense Research and Development Organization. The IISc-ISRO cell has already co-ordinated projects of vital importance to the nation's space program. Now its mandate is being expanded to include establishing a Satellite Applications Technology Centre. The Joint Advanced Technology Program established and handles several projects of relevance to defense establishments. Other centers for excellence are in solid state chemistry, computational fluid dynamics, condensed matter theory, and technical acoustics. The Centre for Electronics Design and Technology, a unique venture supported by the Swiss Government, provides training for potential entrepreneurs on projects of direct relevance to the electronic industry.

A different but important facet of the Institute's activities reflects the concern for societal needs. In this arena, the Centre for the Application of Science & Technology to Rural Areas has as its main focus the development of India's rural areas. The Institute has worked extensively on renewable energy technologies, alternate building technologies and community based rural utilities to provide electricity and drinking water. A new program, SUTRA (Sustainable Transformation of Rural Areas) has just been launched, where several appropriate technologies will be bundled together.

It has been said that one of the most characteristic features of excellence is its impermanence. Yet, the Institute is committed to disproving this statement. Conceived in the final years of the nineteenth century the Institute has maintained its excellence in every sphere of its activity throughout the twentieth century and it would be its endeavor to scale greater heights of accomplishments in scientific research and nation building in the twenty-first century. ✍

Srinivasa Ranganathan is professor of metallurgy at the Indian Institute of Science in Bangalore. The views expressed here are personal to the author.

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