

IISc as the Fountainhead of Indian Science and Technology

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Educational Institutions are known by the eminence of their faculty, the quality of their alumni, the impact of their research publications and in recent times by the number of patents. Judged by these criteria the Indian Institute of Science is unrivalled in the Indian academia. A more fascinating aspect is the number of institutions that have come out of IISc or had their gestation and early nurturing within its campus. It has few rivals in this, as it has been extremely influential with its hundred year history spanning the growth of modern science and technology in India in a concurrent fashion. In this brief essay the symbiotic relationship is described. The chronological order has been abandoned in favour of describing arenas of influence. The Higher Technical Education Sector including the Indian Institutes of Technology (IITs), Council for Scientific and Industrial Research (CSIR), the Strategic Sector and in particular atomic energy and aerospace, modern waves of information technology (IT) and biotechnology (BT) and the industrial sector are described as IISc spheres of influence.

The vesting order of 1909 was emphatic in the establishment of chairs and lectureships in science and arts especially with a view to the promotion of original investigations in all branches of knowledge and their utilization for the benefit of India. The first quarter century saw the Institute addressing the local needs, especially those of the erstwhile Mysore State. It played a pioneering role in the establishment of several industries. The Founder combined in himself industrial entrepreneurship with a passion for higher education. The pendulum has swung through this century of existence from applied research to basic research to applied research with a harmonious balance in its current phase.

According to Kim Sebaly, the source of the social and intellectual capital that led to the establishment of the IITs after Independence is IISc, Bangalore. However important foreign technical assistance was to the establishment of the IITs, it was the early influence of IISc that was critical. In June 1944, the Viceroy, Lord Wavell, invited Ardeshir Dalal (who had association with IISc) to join the Executive Council as Member-in-Charge of Planning and Development. Dalal was one of the architects of the Government of India's plan formulated in 1945. It called for establishment of technological education patterned after Massachusetts Institute of Technology (MIT), USA. This eventually led to starting a string of the Indian Institutes of Technology. J.C. Ghosh, a chemist by training and a student of P C Ray, had succeeded C.V. Raman as Director. Simultaneously, M. Visvesvaraya became the President of the Court. Together they established during the forties a string of engineering departments including aeronautical engineering, metallurgy and internal combustion engineering. Ghosh was appointed as the first Director of IIT, Kharagpur. The high profile of the IITs is in no small measure due to the formative influence of IISc. Several faculty members were drawn from IISc, as the IITs got established.

There is no doubt of the intangible influence of IISc in the founding in 1948 of Raman Research Institute by CV. Raman from his own private resources. Nearly forty years later, in 1988, Jawaharlal Nehru Centre for Advanced Scientific Research came to be established to commemorate the Birth Centenary of Pandit Jawaharlal Nehru. Its founder president C.NR. Rao was concurrently the Director of IISc at that time. JNCASR and IISc work together in many areas.

At the same time as JNCASR was established, the National Institute of Advanced Studies (NIAS) came into existence at the edge of IISc campus as a separate institution. NIAS encompasses Natural and Social Sciences and Humanities and is the realization of the original vision of J.N. Tata. He wanted a University covering Science, Medicine and Arts. Sir William Ramsay felt that what India needed was essentially chemical sciences to be applied to nascent industries and truncated the vision from a University covering all aspects of knowledge to an Institute dedicated to a few chosen domains. This was

vigorously fought by B.J. Padshah. Much of the trouble faced by Morris Travers was on account of this difference. Later John Matthai and J.R.D. Tata, both Presidents of the Court, took up the cause to include humanities in IISc. This was most poignantly expressed by J.R.D. Tata in his Platinum Jubilee address in 1984. NIAS came into being in June 1998. It is noteworthy that all the three Directors of NIAS, Raja Ramanna, Roddam Narasimha and K. Kasturirangan had strong IISc connections.

The idea of the establishment of Science & Technology laboratories under the Board of Scientific and Industrial Research was born in April 1940. Subsequently the Board metamorphosed into the Council of Scientific and Industrial Research (CSIR). In the Board, the then Director J.C. Ghosh and Ardeshir Dalal played significant roles. Some of the earliest projects of CSIR were at IISc. Several CSIR laboratories have active IISc links in their formative years.

The most romantic story of an institution coming out of IISc is that of the Tata Institute of Fundamental Research, in turn the torch bearer of the atomic energy programme. Homi Bhabha, a nephew of Dorab Tata, had returned from Cambridge, where he became acquainted with the promise of modern physics. His letter to J.R.D. Tata requesting for a grant to establish TIFR is a remarkable visionary outline. TIFR started functioning in IISc campus and subsequently moved to Mumbai and the Atomic Research Centre itself came up in Trombay. This was the original site preferred by J.N. Tata himself for IISc! In subsequent years TIFR established its mathematics, radio astronomy and biological sciences at the IISc campus, evidently a fertile ground. In due course, they moved out, as they grew to become formidable centres in their own right, often rivals to IISc prowess in these areas. In 1957 Brahm Prakash moved from IISc after laying the foundation for research into nuclear metals at IISc and took with him a number of students including C.V. Sundaram, K. Balaramamoorthy, P. Rodriguez and Baldev Raj. In turn, they played a key role in ensuring the nuclear renaissance we are currently witnessing.

Bangalore is the aerospace capital, as both the Hindustan Aeronautics Limited (HAL) and the Indian Space Research Organization (ISRO) have their headquarters here. HAL gave

as much to IISc as it received from IISc. It is interesting to note that aviation in India was started by a private entrepreneur. The factory set up in 1940 by Walchand Hirachand, primarily for automobiles, was transformed into HAL for assembly and repair of Airplanes. Its location in Bangalore and the World War II demands made M. Visvesvaraya to start a department of aeronautical engineering in 1942 by borrowing V.M. Ghatge, as its head. This department was the second department of engineering after the original foundation of electrical engineering. J.N. Tata may have seen the first manned flight but did not live long enough to see its importance nor the role that will be played by his successor, IR.D. Tata. In 1955-56 the emergence of the troika of P. Nilakantan, V.M. Ghatage and Satish Dhawan which worked together on dozens of national aeronautical committees proposed the establishment of the National Aeronautical laboratory under the aegis of CSIR in Bangalore. S.R. Valluri and Roddam Narasimha served as Directors of National Aerospace Laboratories (NAL) and with their strong affinity for IISc ensured dynamic interactions between IISc and NAL.

The forties are a decade of miraculous years impacted in an intriguing way by the World War -II. Homi Bhabha got his inspiration at IISc for a future of nuclear energy. Following him, Vikram Sarabhai had joined IISc to work under C.V. Raman. It is possible that his vision for the Indian Space Programme got nucleated here. When Satish Dhawan was offered the chairmanship of 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, started by Roddam Narasimha, a graduate of Caltech. These developments naturally led to a further alliance with the Defense Research and Development Organization. It is interesting to record that Brahm Prakash moved to Trivandrum to oversee the Space programme in 1972. The pervasive influence of Vikram Sarabhai, Satish Dhawan and Brahm Prakash for the evolution and success of the programme as it reaches out to the moon in Chandrayaan-I is best captured in the words of AP.J. Abdul Kalam, who had acknowledged these three as his gurus.

The idea that TIFR should start a Centre for Biological Research was mooted in 1982, following a suggestion by S. Ramaseshan, then Director of IISc, that a joint TIFR-IISc Centre could be located on the IISc campus. This move did not materialize but, in 1984, the Planning Commission of the Government of India agreed to fund a centre for fundamental research in biological sciences at Bangalore. This has matured into the National Centre for Biological Sciences (NCBS), which was initially located on the IISc campus.

V Subrahmanyam, Professor of Biochemistry, became the founder Director of the Central Food Technological Research Institute (CFTRI) of CSIR at Mysore- a major contribution of biochemistry at IISc. G. Padmanaban, as Director, IISc gave a strong fillip to the area of biotechnology 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 including medicine 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 Centre for Human Genetics, Bangalore was started by H Sharat Chandra from IISc. IISc has provided the base from which major R&D centres and smaller biotech start-up companies have emerged.

As mentioned earlier several companies had their genesis in IISc. It is noteworthy that within the first decade of its existence six units came into production. These are Government Acetone factory in Nasik, Sandalwood Oil Factories in Bangalore and Mysore, Thymol Factory in Hyderabad-Sind, Soap Factory in Bangalore and Bamboo Boards in Bangalore. Later examples include Lac in Ranchi and a Rubber company in Coonoor. While India began to industrialize and major plants came up, it is inevitable that the role of IISc should also change. Thus we see in the nineties Jindal Steel Works at Toranagallu locating their R & D for their Corex process with A K Lahiri at the Department of Metallurgy.

Indian Universities have evolved from mere examining bodies patterned after the University of London to teaching institutions to research universities after the German model. In the latter half of the twentieth century they became engaged with industries not just by way of consultancies but by innovations. Nowhere else is this transformation more dramatic than in the information, communication and computer technologies. If Bangalore is hailed as the Silicon Valley of India, part of the credit is due to the scientific ambience radiating out of IISc. The Department of Computer Science and Automation has led this revolution. Wipro Technologies had its modest beginnings in one of the research laboratories of the department. The Texas Instruments, which was the first significant MNC to set up R & D operations in India, began their operations from the portals of the department. In yet another bold departure IISc permitted its faculty to become venture capitalists. Picopeta Simputers and Strand Life Sciences were initiated by four of the departmental faculty. The Simputer led to the vision of a laptop for every child. There are numerous examples of IT companies started by the alumni both in India and abroad.

The development of Science and Technology is also nourished by scientific journals and academies. IISc catalyzed the starting in July 1932 of Current Science, patterned after the journal Nature. It was due to a major initiative of the third director, Martin Forster, with the help of colleagues from IISc and the Central College, Bangalore. The flowering of this journal due to the efforts of C V Raman, S Ramasesahan and P Balaram has contributed in a significant fashion to the growth of Indian science itself. The Indian Academy of Sciences was founded by C V Raman on July 1934. IISc has given support to the functioning of the Academy in numerous ways over the past twenty five years..

The above is meant to be illustrative. It is hoped that in the near future a more complete compilation will bring to light the stellar role played by IISc in the material welfare of India. J N Tata did not seek titles and fame. He was adamant in not naming the Institute after himself. A grateful Council of IISc erected a bronze monument for him in 1916. But the true monument is IISc. As has been written for Christopher Wren, LECTOR, SI MONUMENTUM REQUIRIS, CIRCUMSPICE (Reader, if you seek his memorial ,look around

you). More than a century after the dream, IISc continues its pursuit of excellence and as the fountainhead for Indian science and technology- true to the vision of its founder.